Vol. 33 No. 2, July, 2009 ISSN 0378-813 X

PKV RESEARCH JOURNAL

DR. PANJABRAO DESHMUKH
KRISHI VIDYAPEETH
(AGRICULTURAL UNIVERSITY)
AKOLA (Maharashtra) INDIA

DR. PANJABRAO DESHMUKH KRISHI VIDYAPEETH, AKOLA

RESEARCH JOURNAL

1. PKV Research Journal is published twice a year in January and July by Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.
2. The contribution of paper is open only to active members and subscribers.
3. Annual membership of Journal subscription (with effect from 1-1-2006)

i) Active member	Rs. 200/- per annum
ii) Students	Rs. 100/- per annum
iii) Libraries/Institutes	Rs. 200/- per annum
iv) Other subscribers	Rs. 500/- per annum (for overseas)
v) Life members/Donors	Rs. 1000/- (Rs. 3000/- for overseas)
vi) Patrons	Rs. 5000/-
vii) Sustaining Associates	Rs. 10,000/-

4. A limited space will be provided for the advertisement pertaining to various branches of Agriculture and Veterinary Science.
5. **Correspondence :** All correspondence regarding subscription and business matter may please be address to the Secretary, PKV Research Journal, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Krishi Nagar, Akola - 444 104 Maharashtra State (India).

This publication is included in the abstracting and indexing coverage of Biosciences Information Service of Biological Abstracts and Field Crop Abstracts.

PKV Res. J. Vol. 33 (2) : 2009

Genetic Study to Identify Parents Suitable to Develop Salt Stress Tolerant Hybrids in Sunflower

P. Amala Balu[1], P. Sumathi[2], T. Kalaimagal[3] and S. M. Ibrahim[4]

ABSTRACT

The present study was conducted to study the combining ability of the parents so as to develop hybrids suitable for salt affected areas. The experimental materials consisted of four CMS lines and fifteen testers. The line x tester model (Kempthorne, 1957) of mating design was adapted to effect 60 crosses. These 60 hybrids and 19 parents were evaluated in salt affected area to assess the combing ability of the parents so as to give suitable hybrids for salt stress condition. The present study revealed that the parents 821A, CO 4, 6D-1 and RHA299 were found to express both high per se and significant gca for yield and yield contributing characters and the hybrids 351A x 6D-1, 821A x RHA299, 852A x Morden, 821A x RHA856, 351A x RHA273, 821A x RHA297 and 821A x 6D-1 expressed high *per se*, significant *sca* and standard heterosis for yield and yield contributing characters. They can be exploited for the development of hybrids suitable for salt stressed condition.

Sunflower is an important oil seed crop next to groundnut. To meet out the increasing demand for this oil, the area of cultivation should be increased. To bring out the salt affected areas under sunflower a suitable hybrids with salt tolerance is a mandatory. To initiate heterosis breeding programme, in sunflower the evaluation of inbred lines for their combining ability is important. The information obtained on the relative magnitude of variance component from combining ability studies can be usefully exploited in the development of suitable breeding methodology for improvement of different characters. Heterotic performance of a hybrid combination depends upon combining abilities of its parents (Kadkol *et al.*, 1984). The present study was carried out to identify suitable parents for the development of salt tolerant hybrids.

MATERIAL AND METHODS

The experimental materials used as parents in the present study consisted of four cytoplasmic genic male sterile lines (CMS lines) *viz.*, 351A, 821A, 852A and 234A and fifteen testers cum restorers *viz.*, RHA265, RHA274, RHA278, RHA273, RHA857, RHA297, RHA298, RHA299, RHA586, 6D-1, RRI, RHA859, RHA856, CO 4 and Morden. The parents were raised in crossing block. The restorers were raised in three staggered sowings at an interval of one week. This ensured ample supply of pollen for the male sterile lines to get sufficient seed set. The line x tester model (Kempthorne, 1957) of mating design was adapted to effect 60 crosses. The hybrids and parents were raised in RBD with two replications in salt affected area of Anbil Dharmalingam Agrl. College & Research Institute, Trichy (Calcareous sodic soil). The soil had pH – 8.6, EC – 0.39 dsm^{-1}, ESP – 19 and CEC – 20 c mol kg^{-1} of soil and irrigation water had pH – 9.2 and EC – 1.84 dsm^{-1} The mean data on five plants in each replication for each genotype were utilized for statistical analysis. Data obtained were subjected to analysis of variance for ten important characters *viz.*, days to 50 per cent flowering, plant height, number of leaves $plant^{-1}$, diameter of stem, diameter of head, number of seeds $plant^{-1}$, hundred seed weight, hulling percentage, oil content and single plant yield.

RESULTS AND DISCUSSION

Analysis of variance for combining ability of line x tester mating design inferred that the parents (Lines and Testers) taken for the study were significantly different. The estimates of mean squares for lines, testers, hybrids and line x tester interaction were significant for all characters.

Study on the gene action involved for the trait and nature of gene effects controlling the characters guides the breeders to formulate the breeding programmes suitable to improve the

1,2, & 3 Associate Prof., Centre for Plant Breeding and Genetics, TNAU, Coimbatore.4. Professor, Agriculture College and Research Institute, Madurai, Tamil Nadu.

Table 1. *Per se* performance and General Combining ability effects of parents in salt stress condition

Parents	Days to 50% Flowering	Plant height	Number of leaves	Diameter of stem	Diameter of head	number of seed plant^{-1}	Hundred seed weight	Hulling %	Oil Content	Single Plant Yield
351 A	0.05	-1.66**	-2.65**	-0.05**	0.51**	74.68**	0.61**	2.15**	-1.91**	5.68**
	56.00	132.2	26.97	1.30	7.39	247.5	2.09	12.32	27.35	12.00
821 A	0.88**	-8.09**	0.40**	-0.04**	-0.21**	12.24**	0.04	1.33**	0.79**	2.60**
	50.00	122.3	26.16	1.05	9.10	295.5	3.88	17.42	33.64	16.69
852 A	-0.28	-4.72**	0.36**	0.01**	0.36**	-4.93	0.22**	-0.77**	0.26*	0.82*
	55.5	120.9	25.81	1.54	11.75	283.5	4.59	23.08	29.01	18.08
234 A	-0.65**	14.48**	1.88**	0.00	-0.66**	-81.99**	-0.87**	-2.70**	0.86**	-9.10**
	29.5	115.2	21.60	1.36	10.00	342.00	3.28	13.17	30.6	17.00
SE	0.06	0.55	0.09	0.01	0.06	342.00	0.02	0.09	0.10	0.40
RHA265	1.10**	9.03**	-1.27**	-0.17**	-4.23**	-135.20**	-1.31**	0.11	3.23**	-10.83**
	60.5	106.1	14.76	1.23	7.20	332.5	2.90	9.89	32.67	14.45
RHA274	-1.53**	10.09**	-2.66**	-0.28**	-2.66**	-94.08**	0.68**	3.97**	-0.93**	-6.11**
	52.5	105.6	21.80	1.27	5.88	250	2.13	9.06	37.61	10.51
RHA278	-0.65**	0.74	-0.90**	-0.08**	-0.37**	-65.20**	0.18**	-2.16**	-1.05**	-2.10**
	55.5	89.28	17.65	0.95	6.36	380	3.20	11.34	22.72	17.88
RHA273	-0.53**	0.63	1.50**	-0.13**	-0.73**	-22.33**	-0.81**	4.58**	-2.18**	-5.77**
	54.5	98.67	20.23	1.14	5.21	400.5	2.82	9.88	21.01	16.4
RHA857	-0.90**	5.55**	0.09	-0.07	0.87**	78.17**	0.79**	-3.19**	-0.08	7.25**
	50.5	102.1	14.94	1.25	6.39	450.5	2.89	10.85	28.85	18.78
RHA297	-2.15**	0.04	-0.08	-0.02	1.42**	105.55**	0.48**	1.11**	-0.32	8.03**
	55.00	80.18	17.17	1.29	7.39	420	2.93	10.14	38.38	19.01
RHA298	0.10	0.99	-1.68**	-0.05**	-1.58**	13.55	0.49**	4.01**	-2.88**	2.94**
	53.5	125.9	21.78	1.25	6.02	563.50	2.77	9.93	35.11	22.08
RHA299	2.35**	12.86**	1.82**	0.22**	3.38**	92.07**	-0.09	-2.74**	-0.79**	2.77**
	62.00	99.45	24.9	1.28	8.75	553.00	3.53	15.86	38.95	23.90
RHA586	1.85**	5.66**	-0.57**	-0.06**	-1.04**	12.00	-0.05	0.69**	-0.15	0.74
	52.50	108.1	17.00	1.32	7.85	452.50	4.68	20.41	23.61	28.11
6D-1	-0.78**	-4.11**	1.66**	0.15**	3.32**	172.12**	0.59**	-4.48**	0.37	15.90**
	55.50	108	16.06	1.42	9.90	439.00	3.52	15.04	19.99	21.06
RRI	2.72**	5.05**	0.04	0.03	1.25**	-92.08**	-0.76**	1.24**	0.17	-6.44**
	56.50	102.7	18.13	1.68	5.70	266.00	3.76	16.2	27.43	15.89
RHA 859	0.47**	-1.27	0.65**	-0.05**	-1.85**	-3.20	-0.55**	-0.04	-0.87**	-5.43**
	52.00	88.55	14.96	1.29	7.22	288.50	3.91	10.97	23.32	12.91
RHA 856	0.10	2.80*	0.31	0.16**	0.48**	-46.58**	0.04	3.09**	3.81**	1.34
	58.00	107.4	18.51	1.12	4.76	215.60	2.57	10.91	33.61	11.12
CO4	-0.15	1.44	-0.26	0.16**	-0.13	-55.20**	1.04**	-2.57**	1.82**	2.62**
	53.5	114.4	23.6	1.48	13.44	415.8	5.83	27.45	33.12	30.05
Morden	-2.03**	-6.52**	1.35**	0.20**	1.87**	40.42**	-0.72**	-3.61**	-0.13	-4.90**
	52.00	92.89	22.7	1.56	14.61	358.50	4.64	22.68	27.75	23.24
SE (m)±	0.13	1.19	0.20	0.01	0.12	7.87	0.05	0.19	0.23	0.87

quantitative traits (Panse, 1942). In this present study, the σ^2D values were higher than σ^2A values for all characters except plant height (Table 2). The nine characters except plant height were under the influence of non additive gene action. This is in accordance with the reports of Limbore *et al.* (1997), Castiglioni *et al.*(1999), and Nirmala *et al.* (2000) . The plant height that was governed by additive gene action can be improved through simple selection procedure and recombination breeding. But for the improvement of all other characters, heterosis breeding or hybridization, followed by selection in later generation or reciprocal recurrent selection can be used to exploit non additive gene action. Generally reciprocal recurrent selection is recommended to exploit non additive genetic components.

The lines 821A, 852A and the testers CO 4, RHA298, RHA299, 6D-1 and Morden high per se performance. The hybrids 351A x 6D-1, 821A x RHA299, 351A x RHA859, 852A x Morden, 351A x RHA273, 821A x RHA856, 852A x 6D-1, 351A x RHA586, 821A x RHA297, 821A x 6D-1, 852A x RHA298 and 852A x RHA299 registered high *per se* for important characters including single plant yield. In this study the parents 821A, CO 4, 6D-1 and RHA299 were found to express both per se and significant desirable gca for yield and yield contributing characters (Table 1). The hybrids 351A x 6D-1 and 852A x Morden, 821A x RHA299 and 821A x RHA856, 852A x RHA299, 351A x RHA586 and 821A x 6D-1, 351A x RHA273 and 852A x CO 4, 351A x RHA859, 821A x CO 4, 852Ax 6D-1 and 821A x RHA297 expressed more than 20 per cent standard heterosis yield and other yield contributing characters.

Sprague and Tatum (1942) defined general combining ability as the average performance of a genotype in a series of cross combinations and specific combining ability as deviation in performance of a cross combination from that predicted on the basis of general combining abilities of the parents involved in the cross. The breeders should have sufficient knowledge about the combining ability of parents, type of gene action and components of genetic variance of traits so as to decide the breeding methods for crop improvement. Singh and Harisingh (1985) had also suggested that parents having high *gca* effects could produce transgressive segregation in F_2 or later generations. In this study the line 852A adjudged as good combiner for days to 50 per cent flowering, number of leaves per plant, diameter of stem, diameter of head, hundred seed weight, hulling percentage, oil content and single plant yield. It was followed by 821A, for the characters number of leaves per plant, number of seeds plant^{-1}, hulling percentage, oil content and single plant yield. Among testers 6D-1 expressed itself as the best combiner for all eight characters except plant height and oil content. This was followed by RHA857, for days to 50 per cent flowering, plant height, diameter of head, number of seeds plant^{-1}, hundred seed weight and single plant yield, RHA297 for days to 50 per cent flowering, diameter of head, number of seeds plant^{-1}, hulling percentage and single plant yield and RHA299 for days to 50 per cent flowering, number of leaves plant^{-1}, diameter of stem, diameter of head, number of seeds plant^{-1}, hulling percentage and single plant yield.

The 821A x RHA299 registered significant *sca* for eight characters except days to 50 per cent flowering and oil content, followed by 351A x 6D-1 for seven characters except days to 50 per cent flowering, plant height and number of seeds plant^{-1}, 852A x Morden for seven characters except days to 50 per cent flowering, plant height and oil content. The hybrids 821A x RHA856 (diameter of stem, diameter of head, hundred seed weight, hulling percentage, oil content and single plant yield), 821A x RHA297 (days to 50 per cent flowering, diameter of stem, diameter of head, number of seeds plant^{-1}, hulling percentage and single plant yield), 852A x 6D-1 (days to 50 per cent flowering, diameter of head, number of seeds plant^{-1}, hundred seed weight, hulling percentage and single plant yield) and 234A x Morden (days to 50 % flowering, number of leaves plant^{-1}, diameter of stem, diameter of head, hulling percentage and single plant yield) expressed significant *sca* for six characters including single plant yield. In salt stress condition 351A x 6D-1, 821A x RHA299, 852A x Morden, 821A x RHA856, 351A x RHA273, 821A x RHA297 and 821A x 6D-1 expressed high *per se*, significant *sca* and standard heterosis for yield and yield contributing characters. (Table 2)

The study of combining ability revealed that, 821A, RHA299, 6D-1 and CO 4 as best parents

Table 2. Specific Combining ability, *Per se* performance and heterosis effects of hybrids in salt stress

Hybrids	Days to 50% flowering	Plant height	No. of leaves plant^{-1}	Diameter of Stem	Diameter of head	No. of of seeds	Hundred seed wt	Hulling %	Oil content	Single plant Yield
351A x 6D-1	-1.92**	3.57	5.64**	0.36**	2.70**	66.16**	0.71**	-0.82*	5.89**	11.50**
	58.50	*106.60*	*29.36*	*2.09*	*19.90*	*824.80*	*6.79*	*19.95*	*34.10*	*64.21*
	4.90**	-15.70**	31.98**	51.81**	41.69**	65.46**	33.27**	-28.47**	-8.08**	112.97**
351A x CO 4	0.95**	-11.26**	-1.02**	-0.17**	-0.93**	-0.81	-0.83**	-8.06**	7.38**	-2.39**
	57.00	*97.30*	*20.78*	*1.57*	*12.82*	*530.50*	*5.69*	*14.63*	*37.04*	*37.04*
	11.76**	-23.04**	-6.61	13.77**	-8.72**	6.42	11.77**	-47.54**	-0.18	22.82**
351A x RHA 859	-3.17**	1.58	1.90**	0.11**	1.76**	155.19**	1.54**	-1.16**	4.73**	6.41**
	53.50	*107.45*	*24.60*	*1.63*	*13.79*	*738.50*	*6.47*	*24.06*	*31.70*	*37.79*
	4.90**	-15.03**	10.59**	18.48**	-1.82	48.14**	27.08**	-13.75**	-14.57**	25.34**
351A x RHA273	-1.67**	2.99	-3.75**	0.03	1.93**	2.32	1.86**	-9.60**	-0.90*	8.56**
	54.00	*109.50*	*19.80*	*1.49*	*15.07*	*566.50*	*6.53*	*20.24*	*24.76*	*39.61*
	5.88**	-13.40**	-10.99**	7.61**	7.33*	13.64**	28.26**	-27.43**	-33.27**	31.37**
351A x RHA278	1.45**	5.51*	-0.65	0.17**	0.44*	73.69**	0.33**	-5.67**	-0.18	5.16**
	57.00	*111.92*	*20.50*	*1.33*	*13.95*	*595.00*	*6.01*	*17.43*	*26.61*	*39.88*
	11.76**	-11.49**	-7.84*	-3.62	-0.68	19.56**	17.86**	-37.51**	-28.28**	32.27**
351A x RHA297	-1.05**	-0.08	-1.37**	0.08**	-0.32	161.94**	-1.44**	0.67*	-0.10	-4.92**
	53.00	*107.10*	*20.60*	*1.48*	*14.98*	*854.00*	*4.53*	*27.03*	*27.42*	*39.92*
	3.92**	-15.30**	-7.39*	6.88*	6.62*	71.31**	-10.99**	-3.08	-26.11**	32.27**
351A x RHA586	3.45**	6.10**	-1.59**	0.16**	-3.08**	-211.06**	-2.13**	8.46**	-4.53**	13.56**
	61.50	*119.90*	*19.90*	*1.68*	*14.50*	*876.30*	*5.07*	*17.84*	*23.16*	*51.11*
	20.59**	-5.97*	-10.56**	21.74**	3.24	75.79**	-0.39	-36.04**	-37.58**	69.52**
351A x RHA857	1.70**	-10.92**	-2.35**	0.21**	-1.41**	-218.49**	-0.24**	-4.89**	-0.25	10.09**
	53.00	*101.76*	*19.80*	*1.30*	*14.99*	*748.50*	*6.39*	*26.09*	*27.51*	*54.15*
	3.92**	-19.52**	-10.99**	-5.80*	6.76*	50.15**	25.32**	-6.45**	-25.85**	79.58**
821A x 6D-1	4.74**	4.70*	-2.20**	-0.12**	-0.47*	126.81**	-0.13	-5.97**	-1.58**	3.25*
	61.00	*101.30*	*24.57*	*1.70*	*16.01*	*823.00*	*5.39*	*13.98*	*26.76*	*52.88*
	19.61**	-19.89**	10.45**	22.83**	13.96**	65.10**	5.69	-49.87**	-20.93**	75.37**
821A x CO 4	-2.38**	-7.40**	-1.21**	0.36**	0.22	-71.86**	1.41**	5.87**	2.11**	-0.09
	54.50	*94.75*	*23.64*	*2.18*	*13.25*	*397.00*	*7.37*	*27.74*	*27.09*	*36.25*
	5.86**	-25.07**	6.25	58.33**	-5.66	-20.36**	44.65**	-0.53	-7.09**	20.25*
821A x RHA 856	-3.13**	-0.61	-1.21**	0.27**	5.01**	389.01**	0.93**	-5.88**	-0.24	21.02**
	54.00	*102.90*	*22.92*	*2.09*	*18.65*	*866.50*	*5.89*	*21.64*	*29.34*	*56.09*
	5.88**	-18.62**	3.06	51.81**	32.75**	73.62**	15.71**	-22.41**	-8.05**	86.04**
821A x RHA297	-1.88**	10.25**	-1.34**	-0.18**	0.83**	153.89**	-0.71**	0.61	-0.36	1.76
	53.00	*111.00*	*23.68*	*11.90*	*15.40*	*783.50*	*4.69*	*17.92*	*28.12*	*53.56*
	3.92**	-12.22**	6.47	38.04**	9.65**	51.17**	-7.85*	-35.75**	-19.16**	77.63**
821A x RHA298	0.87**	-9.63**	-2.92**	0.25**	-1.62**	-15.61	2.06**	-15.87**	-0.82	6.16**
	58.00	*90.10*	*20.51*	*1.33*	*9.96*	*522.00*	*7.48*	*40.69*	*25.90*	*45.26*
	13.73**	-28.75**	-7.80*	-3.99	-29.09**	4.71	46.72**	45.89**	-27.89**	50.11**
821A x RHA299	2.12**	19.08**	4.57**	-0.06**	0.71**	64.36**	0.88**	9.75**	-0.09	2.61
	61.50	*132.65*	*31.50*	*2.24*	*17.25*	*680.50*	*5.71*	*17.40*	*24.42*	*43.26*
	20.59**	4.90	-41.60**	62.32**	22.82**	36.51**	12.07**	-37.61**	-24.02**	43.47**
852A x 6D-1	-1.09**	-5.94**	2.27**	-0.17**	-0.30	104.48**	-0.04	3.22**	-0.81*	5.87**
	54.00	*94.30*	*24.47*	*1.62*	*16.76*	*783.50*	*5.66*	*21.07*	*26.31*	*53.72*
	5.88**	-25.64**	9.98**	17.39**	19.30**	57.17**	11.08**	-24.45**	-27.56**	78.17**
852A x CO 4	2.28**	3.08	0.26	-0.14**	-1.45**	62.30**	0.36**	1.96**	-3.62**	4.80**
	58.00	*108.60*	*25.08*	*1.65*	*12.16*	*514.00*	*6.51*	*21.73*	*31.56*	*39.38*
	13.73**	-14.11**	12.72**	19.57**	-13.39**	3.11	27.67**	-22.08**	-30.00**	30.59**
852A x Morden	2.16**	2.49	2.63**	0.37**	4.72**	296.18**	2.01**	-3.01**	-8.22**	19.99**
	56.00	*100.05*	*29.05*	*2.21*	*20.33*	*843.50*	*6.40*	*15.72*	*30.10*	*47.05*
	9.80**	-20.88**	30.59**	60.14**	44.78**	69.21**	25.62**	-43.64**	-20.76**	56.05**
852A x RHA297	3.28**	4.98*	3.36**	-0.01	0.35	-221.88**	0.50**	6.35**	0.69	-8.63**
	57.00	*109.10*	*24.33*	*1.44*	*15.50*	*518.50*	*7.24*	*24.05*	*27.58*	*41.75*
	11.76**	-13.72**	9.37**	16.30**	-5.45	4.01	42.10**	-13.77**	-20.93**	38.47**
852A x RHA298	2.03**	-2.77	-0.08	-0.05*	3.59**	154.62**	-0.42**	-4.83**	2.40**	4.75**
	58.00	*100.32*	*26.06*	*1.84*	*15.75*	*592.50*	*6.09*	*10.47*	*26.87*	*41.06*
	13.73**	-20.66**	17.17**	11.23**	-12.78**	18.86**	19.43**	-62.46**	-29.08**	36.17**
234 A x Morden	-0.87*	-2.65*	-0.03	0.07**	1.06**	118.55**	0.17	3.00**	-6.22**	1.59**
	57.50	*132.65*	*25.42*	*2.10*	*16.73*	*795.20*	*4.62*	*24.25*	*23.81*	*38.09*
	5.88**	-12.53**	22.50**	42.39**	17.30**	42.91**	-21.39**	-22.67**	-40.02**	-26.15**

for producing superior segregants with favourable genes for yield and different yield contributing characters and among hybrids 821A x RHA273, 821A x RHA297, 821A x RHA299, 821A x RHA856, 821A x 6D-1, 852A x RHA298, 852A x 6D-1 and 852A x Morden, 234A x Morden expressed themselves as good specific combiners for most of the yield and yield components. In conclusion, the parents 821A, CO 4, 6D-1 and RHA299 were found to express both per se and significant desirable gca for yield and yield contributing characters and the hybrids 351A x 6D-1, 821A x RHA299, 852A x Morden, 821A x RHA856, 351A x RHA273, 821A x RHA297 and 821A x 6D-1 expressed high *per se*, significant *sca* and standard heterosis for yield and yield contributing characters. They can be exploited for the development of hybrids suitable for salt stressed condition.

LITERATURE CITED

Castiglioni, V.B.R., M.F. Oliveric and C.A.A. Arias, 1999. Combining ability analysis among inbred lines of sunflower, Pesquisa Agropecuria Brasileira., 34(6) : 981-988.

Kadkol, G.P., I.J. Anand and R.P. Sharma, 1984. Combining ability and heterosis in sunflower, Indian J. Genet., 44: 447-451.

Kemphthorne, O., 1957. An Introduction to genetic statistics. John Wiley and Sons, Inc., New York.

Limbore, A.R., D.G. Weginwar, B.D. Gita and R.B. Ghorade, 1997. Combining ability in sunflower (*Helianthus annuus* L.), J. Soil and Crops, 7(1) : 39 - 42.

Nirmala. V.S., A. Gopalan and D. Sassikumar, 2000. *Per se* performance and combining ability in sunflower (*Helianthus annuus* L.), Madras Agric. J., 86 (4-6): 221-224.

Panse, V.G., 1942. Genetics of quantitative characters in relation to plant breeding, Indian J. Genet., 2 : 318-327.

Singh, D.P. and Hairsingh, 1985. Combining ability and heterosis for seed yield, its component characteristic in Indian mustard sown early and late, Indian J. Agric. Sci., 55(5): 309-315.

Sprague, G.F. and L.A. Tatum, 1942. General Vs specific combining ability in single crosses of corn, J. American Soc. Agron., 3 : 923-932.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

PKV Ashwini: A Sweet-Grained Parching Type *Kharif* Sorghum Variety

R.B. Ghorade[1], P.P. Bhopale[2], P.A. Kahate[3], A.M. Dethe[4] and J.P. Deshmukh[5]

ABSTRACT

'PKV Ashwini' (Wani 11/6) is a sweet-grained parching type (*Hurda* purpose) *Kharif* sorghum variety derived through hybridization followed by pedigree selection method from a cross of (Malkapur Wani x SPV 462). It has early mid-tall growth habit and drooping leaves with high green dough stage *Hurda* grain yield within 82 days after sowing. The variety has shown tolerance to major pests and diseases. Based on the performance in various trials over five years, the PKV Ashwini consistently recorded 54.6 and 65.4 per cent increase in green *Hurda* yield over checks, Malkapur Wani and Parbhani Wani, respectively. It has also shown 55.4 and 20.9 per cent higher grain yield than the checks mentioned above. PKV Ashwini also performed well under various multilocation and adaptive trials by producing *Hurda* grains of excellent quality in respect of aroma, taste, sugar content and easy threshability. Therefore, the variety is released under the name 'PKV Ashwini' for commercial cultivation in Vidarbha region of Maharashtra in June 2006.

Among the food grain crops, sorghum [*Sorghum bicolor* (L.) Moench] (2n=20) occupies an important place, being a staple food for very large population of semi-arid and arid tropics countries. In India, sorghum ranks third in area and production after rice and wheat; which is a major dual purpose cereal constituting important source of food as well as fodder. Green grains of sorghum at dough stage are used for consumption as 'roasted grains'; this locally called as '*Hurda*'. These special scented sweet-grained type sorghums posses pleasant fragrance and sweetness, which makes them popular.

In research contribution regarding development of sweet-grained (*Hurda*) type varieties was, however, meagre. Such *Hurda* sorghum fetches better price in market because of the high demand from rural as well as urban consumers. Traditional local types are very tall, late and susceptible to pest and diseases causing lower yield with poor quality.

Keeping these facts in view, it was, therefore felt necessary to identify and develop high yielding and early types of *Kharif hurda* sorghum with better organoleptic properties.

MATERIAL AND METHODS

A single cross, 'Malkapur Wani x SPV 462' was effected at Sorghum Research Unit, Dr. PDKV, Akola during the year 1991-92. The selections were made in F_2 as well as advanced populations till 1994-95. When homozygous population stage was achieved. Among the several selections made in segregating populations, a strain 'Wani 11/6' appeared to be one of the most promising. It was, therefore, tested in a small-scale yield trials alongwith other promising cultures and a local check (Malkapur Wani) during 1995-1997 at Akola.

On account of the promising performance in comparison with the checks *viz.*, Malkapur Wani and Parbhani Wani, this strain was promoted to University level multilocation varietal trials at Akola, Yavatmal, Achalpur and Buldana during 2004-2006. Each genotype was sown at 45 x 15 cm in randomized block design with three replications. Recommended plant protection measures and fertilizers were applied to raise normal crop.

Chemical properties such as, reducing, non-reducing and total sugars (%) were estimated coupled with organoleptic testing for sensory properties by the pre-trained team of evaluators as per the defined rating scale shown in Table 1.

The genotype was also screened for reactions to major pests and diseases. The data from agronomical evaluation was recorded for response to different fertility levels. Thus the performance of this genotype was tested alongwith the checks across various experimental trials as well

1. Senior Research Scientist, 2. Assistant Prof. and 3. Senior Res. Asstt., 4. Senior Res. Asstt. and 5. Sorghum Agronomist, Sorghum Research Unit, Dr.PDKV, Akola.

as on Farmers' fields in adaptive trials. The statistical analysis was carried out according to Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Screening of the sweet-grained sorghum genotypes at Sorghum Research Unit, Dr.P.D.K.V., Akola revealed the scope of improvement in this type. After crossing Malkapur Wani, the only landrace prevailing in Central Vidarbha region with an advanced dual purpose variety SPV 462, selections were made from F_2 and successive generations populations to reveal promising genotypes like Wani 11/6 and Wani 8/5, which were further tested in various station and multilocation trials.

Performance of PKV Ashwini across different trials:

In University trials conducted during the year 1995-1997 at Akola the yield differences due to genotypes were found significant. The culture 'Wani 11/6' gave average green *Hurda* yield of 43.52 q ha^{-1}, which was 54.57 and 65.44 per cent higher than the checks, Malkapur Wani (28.15 q ha^{-1}) and Parbhani Wani (25.52 q ha^{-1}), respectively; while in case of pooled mean analysis the mean at 40.79 q ha^{-1} of PKV Ashwini (Wani 11/6) was at 86.4 and 19.9 per cent higher than the checks, Malkapur Wani (21.80 q ha^{-1}) and Parbhani Wani (27.79 q ha^{-1}), respectively (Table 2) (Anonymous, 1998).

For green fodder yield, average performance of 214 q ha^{-1} was recorded by PKV Ashwini with 14.43 per cent decrease and 46.59 per cent increase over Malkapur Wani (250 q ha^{-1}) and Parbhani Wani (146 q ha^{-1}), respectively. Similarly, the pooled mean of 156 q ha^{-1} green fodder exhibited 9.61 per cent decrease and 4.52 per cent increase over the checks, Malkapur Wani and Parbhani Wani, respectively.

The location wise grain yield data (Table 3) revealed 15.04 q ha^{-1} average, where increase of 55.37 and 20.99 per cent over the checks, Malkapur Wani (9.68 q ha^{-1}) and Parbhani Wani (12.43 q ha^{-1}) was recorded in University level multilocation trials conducted during the year 2005 (Anonymous, 2006). Also, this variety required only 62.62 days to 50 per cent flowering, which showed 3.09 and 20.5 per cent earliness than the respective checks, Malkapur Wani (78.7 days) and Parbhani Wani (64.0 days). As this variety flowers in 62-64 days, thereby it escapes from midge fly attack. It thus matures earlier than Malkapur Wani by 10 to 12 days.

The genotype, Wani 11/6 was evaluated alongwith check on Farmers' field in adaptive trials for green *hurda* and fodder yield in various districts of Vidarbha region. The data of 15 trials indicated that, the Wani 11/6 yielded higher green *hurda* (38.49 q ha^{-1}) than check Malkapur Wani (28.84 q ha^{-1}) which was higher by 33.49 per cent (Table 4). Whereas, the green fodder yield was found to be slightly decreased by 4.69 per cent than the check, that is due to early and mid-tall growth habit of improved genotype, Wani 11/6.

In agronomic trials (Table 5), three varieties were compared for their yield performance. The wani 11/6 was given significantly higher grain yield at soft dough stage (49 %) over the check Malkapur Wani across all the locations, where more response was obtained at increasing levels of N and P_2O_5 kg ha^{-1}. Economics calculated over 40:20 kg N and P_2O_5 ha^{-1} clearly indicated that higher input : output ratio was recorded with Wani 11/6 at all increasing fertilizer levels tried than that of Malkapur Wani (Table 6).

Table 1. Rating scale for organoleptic properties of *hurda* sorghum

Threshability	1	Free	1.5	Medium	2	Hard
Colour	1	Attractive	2	Inferior	-	
Size	1	Bold	2	Medium	3	Small
Shape	1	Round	2	Flat	3	Turtle
Taste	1	Very sweet	2	Medium sweet	3	Slightly sweet
Fragrance (Aroma)	1	Good	2	Fair	3	No aroma

Table 2. Summary yield data of 'PKV Ashwini' (Wani 11/6) in University trials conducted during 1995 - 1997 and 2004 -2005 for green *Hurda* yield and green fodder yield

Name of variety	Year of testing	Locations	Green *hurda* (q ha^{-1})	Green fodder (q ha^{-1})
Wani 11/6	1995	1	62.24	—
(PKV Ashwini)	1996	1	50.61	—
	1997	1	42.30	—
	2004	3	46.78	296.00
	2005	3	32.08	131.67
Average		9	43.52	214.00
Pooled mean			40.70	156.60
Wani 8/5	1995	1	28.40	—
	1996	1	40.29	—
	1997	1	39.90	—
	2004	3	38.45	247.00
	2005	3	28.46	125.00
Average		9	34.37	186.00
Pooled mean			35.70	137.30
Malkapur Wani	1995	1	41.15	—
	1996	1	37.69	—
	1997	1	36.30	—
	2004	3	27.13	352.00
	2005	3	18.96	148.00
Average		9	28.15	250.00
Pooled mean			21.80	173.31
Parbhani Wani	2005	3	25.53	146.00
Average		3	25.53	146.00
Pooled mean			27.79	199.00
% Increase over Wani 8/5			26.63	14.86
% Increase over Malakapur Wani			54.57	(-) 14.43
% Increase over Parbhani Wani			65.44	46.59
% Pooled Increase over Wani 8/5			14.1	14.0
% Pooled Increase over Malakapur Wani			86.4	(-) 9.61
% Pooled Increase over Parbhani Wani			19.9	4.52

Table 3. Locationwise grain yield (q ha^{-1}) of Wani 11/6 (PKV Ashwini) during the year 2005

Genotypes	Akola	Achalpur	Buldhana	Average	% Increase
Wani 11/6	14.03	14.80	16.30	15.04	—
Wani 8/5	13.12	12.30	14.70	13.37	12.49
Malkapur Wani (C)	10.86	9.80	8.40	9.68	55.37
Parbhani Wani (C)	9.71	14.80	12.80	12.43	20.99
CD at 5%	NS	NS	2.68		

Table 4. Adaptive trials of sorghum variety Wani 11/6 (PKV Ashwini) during *Kharif*, 2005

S.N.	Locations	No. of trials	Average performance (q ha^{-1})			
			Green hurda yield		Green fodder yield	
			Wani 11/6	M'pur Wani (C)	Wani 11/6	M'pur Wani (C)
1.	Akola	1	40.30	28.30	190.0	-
2.	Amaravati	5	36.96	26.87	187.6	210.0
3.	Buldhana	7	39.08	29.81	197.1	198.8
4.	Washim	2	37.85	30.59	197.5	205.1
Average			38.49	28.84	193.5	203.1
% increase or decrease over			—	33.49	—	(-) 4.69

Table 5. Green *hurda*, grain and fodder yields as influenced by different treatments

Treatments	Green *Hurda* yield (q ha^{-1})				Grain yield (q ha^{-1})			Fodder yield (q ha^{-1})		
	Akola	Washim	Buldana	Pooled over location	Akola	Washim	Mean	Akola	Washim	Mean
Wani genotypes:										
Wani 8-5	**33.37**	**44.61**	**35.72**	**37.90**	**17.56**	**19.31**	**18.44**	**114.13**	**119.13**	**116.63**
Wani 11-6	42.69	57.83	38.01	46.18	17.79	20.69	19.24	116.17	155.78	135.92
M'pur Wani	30.60	41.03	21.48	31.04	17.26	16.55	16.90	124.97	200.15	162.56
SE(m)±	1.72	2.77	0.57	1.68	0.81	0.67	-	2.89	5.00	-
CD	5.05	8.12	1.67	4.94	NS	1.98	-	8.47	14.68	-
Fertilizer levels:										
40:20:00	20.12	34.11	12.69	22.30	11.60	12.68	12.14	95.70	120.42	108.06
60:30:00	27.12	38.42	22.69	29.41	14.70	17.39	16.04	111.55	153.27	132.41
80:40:00	40.06	52.35	45.34	45.92	18.94	21.61	20.27	119.78	171.33	145.53
100:50:00	54.92	66.42	46.24	55.86	24.91	23.73	24.32	146.66	188.38	167.51
SE(m)+	1.99	3.20	0.66	1.94	0.93	0.78	-	3.34	5.78	-
CD	5.83	9.38	1.93	5.70	2.73	2.28	-	9.78	16.95	-
Interaction G x F:										
SE(m)+	3.44	5.54	1.14	3.37	1.61	1.35	-	5.77	10.01	-
CD	NS	NS	3.34	NS	NS	NS	-	NS	NS	-
CV%	16.78	20.06	6.22	15.21	15.93	12.38	-	8.45	10.95	-

Reaction to major pests and diseases:

Wani 11/6 recorded less susceptibility to shoot fly and stem borer by 31.6 and 40.9 per cent, respectively, than that of Malkapur Wani in the trials during 2004 and 2005. The screening in field and controlled conditions revealed the Wani 11/6 as tolerant to grain mold as well as foliar diseases like rust, anthracnose and leaf spots. (Table 7).

Performance of PKV Ashwini for chemical and organoleptic parameters:

In chemical assessment studies, PKV Ashwini (Wani 11/6) recorded highest percentage

Table 6. Economic analysis: Input-output ratio of different treatment combination

Genotypes	Fertilizer levels (kg $N:P_2O_5$ ha^{-1})	Yield (q ha^{-1})	Additional yield over (40:20 kg $N:P_2O_5$ ha^{-1})	Cost of additional yield @Rs10 kg^{-1}	Expenditure incurred on fert. levels	Additional returns (Rs ha^{-1})	Input-output ratio
Wani 8/5	F_1 40:20	19.99	-	-	818	-	-
	F_2 60:30	27.65	7.66	7660	1226	6434	6.25
	F_3 80:40	47.08	27.09	27090	1635	25455	16.57
	F_4 100:50	56.88	36.89	36890	2044	34846	18.04
Wani 11/6	F_1 40:20	28.76	-	-	818	-	-
	F_2 60:30	35.32	6.56	6560	1226	5334	5.35
	F_3 80:40	55.69	26.93	26930	1635	25295	16.47
	F_4 100:50	64.95	36.19	36190	2044	34146	17.70
Malkapur Wani	F_1 40:20	18.17	-	-	818	-	-
	F_2 60:30	25.26	7.09	7090	1226	5864	5.78
	F_3 80:40	34.98	16.81	16810	1635	15175	10.28
	F_4 100:50	45.74	27.57	27570	2044	25526	13.49

Table 7. Reaction to major pest and diseases

Infestation by	Wani 11/6	Wani 8/5	Malakapur Wani
Shootfly	9.5	10.5 (-9.52)	11.0 (-113.6)
Stemborer	6.5	9.50 (-31.57)	11.0 (-40.9)
% increase over		31.6	40.9
Grain mold (1-5)	2.25	2.25	2.25
Rust	1	1	3
Anthracnose	1	1	1
Sooty stripe	1	1	1
Leaf spots(zonate, rough, gray)	1	1	1

Figures in parentheses are the per cent increase over the Wani 11/6.

of non-reducing sugar (12.8 %) and total sugar (11.08 %) than the checks involved due to which the *hurda* of Wani 11/6 has more sweetness than the prevailing landraces. The organoleptic testing of sensory properties attempted as per defined rating scale revealed easy threshability, attractive lustrous colour, medium size, flat round shape, sweeter *hurda* grains with good aroma (Table 8).

Kharif sorghum breeding is a success story in India. However, area under *Kharif* sorghum is reducing mainly due to low profitability and grain mold problem. Under such circumferences such kind of alternate uses from low input production can be one of the better options to the sorghum growers. Thus, being early maturity duration, mid-tall in growth habit, high yield potential, tolerant to major

Table 8. Chemical and organoleptic assessment of different *hurda* genotypes.

	Wani 11/6	Wani 8/5	Malakapur Wani	Parbhani Wani
Chemical parameters:				
Reducing sugar (%)	0.03	0.93	0.50	0.52
Non-reducing sugar(%)	12.80	7.04	7.44	12.09
Total sugar (%)	12.83	7.47	7.94	12.61
Sensory properties:				
Threshability	1.6	1.4	1.7	1.8
Colour	1.3	1.6	1.4	1.5
Size	2.4	2.1	1.9	1.9
Shape	2.3	2.1	2.4	2.1
Taste	1.3	1.9	1.8	2.4
Aroma	1.7	1.9	1.8	2.4

pests and diseases, responsive to recommended fertilizer dose with easy threshability, better taste and aroma; Wani 11/6 has been recommended for release under the name 'PKV Ashwini' during the year 2006 to replace prevailing old landraces, where this is the first improved variety of its kind developed and identified in Vidarbha region for *kharif* season (Anonymous, 2007). This variety has been assigned by National Bureau of Plant Genetic Resources, New Delhi with national identity number IC 553708.

LITERATURE CITED

Anonymous, 1998. Annual Progress Report on Sorghum Research for the year 1997-98 submitted to Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola-

Anonymous, 2006. Annual Progress Report on Sorghum Research for the year 2005-06 submitted to Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola

Anonymous, 2007. Release Proposal of Sorghum Variety Wani 11/6 (PKV Ashwini) submitted to State Seed Sub-Committee, Maharashtra State, India.

Panse, V.G. and P.V. Sukhatme, 1967. Statistical Methods for Agricultural Workers. 6th Edn. Indian Council of Agriculture Research Pub., New Delhi, India:117-186.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Tolerance of Advanced *Capsularis* Jute Cultivars Against Their Insect Pests

U. S. Yadav[1] and Adbhut Yadav[2]

ABSTRACT

The field experiments with 4 advanced *Capsularis* jute cultivars along with JRC-321 and JRC- 698 varieties as standard check were conducted during two consecutive *Kharif* seasons 2005 and 2006 to screen resistant/ multiple resistant cultivars against stem weevil *(Apion corchori)*, semilooper *(Anomis, sabulifera)* and yellow mite (*Polyphagotarsonemus latus)*. The infestation of stem weevil, semilooper and yellow mite varied from 1.24-28.56per cent, 3.33-17.49per cent and 1.67-7.49 per cent, during 2005 and 2006, respectively. The results revealed that the advanced *Capsularis* cultivar C-532 was found significantly superior and the most promising against stem weevil, semilooper and yellow mite with an average infestation of 9.00, 6.87per cent and 1.67per cent, respectively. Thus it is inferred that the *Capsularis* jute cultivars C-532 was significantly superior to standard check varieties, JRC- 321 and JRC- 698 and may be considered as multiple resistant to stem weevil, semilooper and yellow mite.

Jute is an important fibre crop only next to cotton and is extensively cultivated in eastern part of India and Bangladesh. The *capsularis* jute (*Corchorus capsularis* Linn.) is severely infested and damaged by stem weevil (*Apion corchori* Marshall), semilooper (*Anomis sabulifera* Guen) and yellow mite (*Polyphagotarsonemus latus* Banks). Several workers have conducted studies on evaluation of *capsularis* jute germplasm/ varieties against these pests (Dixit *et al.*, 1989, Mohapatra and Patnaik, 1995, Das and Pathak, 1999; Prasad *et. al.*, 2004 and Yadav *et al.*, 2008 and 2008). However, in changing scenario of pest management programme, there is need to evolve resistant varieties/ cultivars against their respective pests. Keeping in view the above facts, an attempt has been made to evaluate certain newly developed *capsularis* jute cultivars against stem weevil, semilooper and yellow mite under field conditions.

MATERIAL AND METHODS

The field experiments were conducted at Crop Research Station, Bahraich, (U.P) during the *Kharif* seasons 2005 and 2006 with 4 advanced *Capsularis* cultivars along with two standard check varieties in randomized block design with 4 replications. The seeds of 4 advanced *Capsularis* jute cultivars, viz C-531, C-532, C-533, and JBC-2004 along with standard check varieties JRC-321 and JRC-698 were sown in plot of size 6x4.5 m. with line to line spacing of 30cm during 3rd week of April. The crop was raised adopting a standard package of practices except plant protection measures. After germination, the plant to plant spacing was maintained at 5-7cm. Data on different pests, viz., stem weevil, semilooper and yellow mite were recorded at peak infestation during 3rd week of August. The infested plants were counted in a square metre per plot and presented as per cent plant infestation. For plant infestation, over 3 punctures plant^{-1} were considered as stem weevil infested plant, whereas over 3 damaged top leaves plant^{-1} have been considered as semilooper and yellow mite infested plant. The infestation of yellow mite was negligible during Kharif season 2006, hence not reported. The data have been statistically analyzed after transforming it by square root transformation formula, $\mathbf{a = \sqrt{p+0.5}}$, where **'a'** is transformed value and **'p'** is per cent infestation.

RESULTS AND DISCUSSION

Screening against stem weevil : The infestation of Stem weevil (*Apion corchori*) varied from 1.24 to 28.56per cent during kharif seasons 2005 and 2006 and its infestation was higher during 2006 in comparison to 2005 (Table1). The results revealed that the cultivar C- 532 recorded lowest infestation of stem weevil 1.24 and 16.76per cent during the year 2005 and 2006 respectively, It was significantly

1. Associate Prof., CRS Ghaghraghat-Jarwal (U. P.) and 2. Ph.D Scholar, S. V. B. Patel University of Agriculture & Tech., Modipuram, Meerut.

Table 1. Screening of advanced *capsularis* jute cultivars against stem weevil, semilooper and yellow mite during *kharif* seasons 2005-06 and 2006-07.

Advanced *Capsularis* Cultivars	Incidence of stem weevil (%)			Incidence of semilooper (%)			Incidence of yellow Mite (%)
	2005-06	2006-07	Average	2005-06	2006-07	Average	2005-06
C-531	3.33 (1.83)	24.57 (5.00)	13.95	17.49 (4.23)	4.17 (2.12)	10.83	7.49 (2.80)
C-532	1.24 (1.21)	16.76 (4.15)	9.00	10.41 (3.29)	3.33 (1.93)	6.87	1.67 (1.47)
C-533	2.91 (1.71)	26.59 (5.20)	14.75	13.33 (3.71)	7.08 (2.75)	10.20	3.33 (1.95)
JBC-2004	2.91 (1.82)	21.87 (4.73)	12.39	11.24 (3.42)	3.75 (2.05)	7.49	2.49 (1.68)
JRC-698	2.91 (1.80)	28.56 (5.39)	15.73	14.58 (3.87)	5.84 (2.51)	10.21	4.16 (2.14)
JRC-321	4.16 (2.09)	27.89 (5.32)	16.02	12.07 (3.54)	8.75 (3.03)	10.41	5.83 (2.48)
CD at 5%	0.39	0.27	-	0.19	0.42	-	0.58
CV(per cent)	14.86	3.60	-	4.94	11.60	-	14.96

Figures in parentheses are transformed values.

different to JBC- 2004 with 2.91 and 21.87per cent infestation during 2005 and 2006, respectively. Thus, on an average, the cultivar C- 532 was the most promising with an average stem weevil infestation of 9.00per cent and significantly superior to standard check varieties JRC-321and JRC-698 with average infestation of 16.02per cent and 15.73per cent, respectively. Earlier, Dixit *et al.* (1989), Prasad *et.al.*, (2004) and Yadav *et al.* (2008) have reported that the *capsularis* jute germplasm/ cultivars with 1-10per cent stem weevil infestation are resistant, where as Mohpatra and Patnaik, (1995) have rated the *capsularis* genotypes with 10.5 to 19.30per cent stem weevil infestation as moderately resistant. Hence, the *capsularis* jute cultivars C-532 may be considered resistant against stem weevil.

Screening against semilooper: The infestation of semilooper (*Anomis sabulifera* Guen) varied from 3.33 to 17.49per cent during *Kharif* seasons 2005 and 2006, respectively and its infestation was comparatively more during the year 2005 (Table 1). The infestation of semilooper was significantly low on cultivar C-532 with 10.41 and 3.33per cent infestation during the year 2005 and 2006, respectively. It was non-significantly followed by the cultivar JBC- 2004 with 11.24per cent & 3.75per cent infestation during 2005 and 2006, respectively. Thus, on an average, the cultivar C-532 and JBC-2004 were most promising with 6.87 and 7.49 per cent semi-looper average semilooper infestation, respectively. These cultivars were significantly superior to standard check varieties JRC-321 and JRC-698 with 10.41per cent and 10.21per cent average semilooper infestation, respectively. Earlier Das and Pathak, (1999), Prasad *et. al.*, (2004) and Yadav *et al.*, (2008) have reported that *capsularis* jute cultivar with less than 10.00 per cent semilooper infestation are resistant. Hence, the *capsularis* jute cultivar C-532 and JBC-2004 may be considered resistant against semilooper.

Screening against Yellow mites: The infestation of yellow mite, varied from 1.67 to 7.49per cent during the year 2005. The results indicated that the culture C-532 with 1.67per cent infestation was most promising against yellow mite. It was followed by the cultivar JBC- 2004 with 2.49per cent yellow mite infestation, respectively. It is clear from the results that the *Capsularis* jute cultivars C-532 and JBC-2004 were significantly superior to standard national varieties JRC-321 and JRC-698 with 5.83 and 4.16per cent yellow mite infestation respectively during the year 2005. Earlier Prasad *et. al.*, (2004) and Yadav *et. al.*, (2008 and 2008) have reported that *capsularis* jute cultivars with lass than 10.00per cent yellow mite infestation are resistant. Hence the advanced *capsularis* cultivars C-532 and JBC- 2004 may be considered highly resistant against yellow mite.

CONCLUSION

On the basis of over all results, the advanced *Capsularis* jute cultivars C-532 with average infestation of 9.00per cent stem weevil, 6.87per cent semilooper and 1.67per cent yellow mite have been recognized as multiple resistant against stem weevil, semilooper and yellow mite, and may be recommended for field use. However, the *capsularis* jute cultivar JBC-2004 may be recognized as resistant to semi looper and yellow mite with 7.49 and 2.49per cent infestation, respectively.

LITERATURE CITED

Das, L .K. and S. Pathak ,1999. Resistance behavior of some jute varieties against their pests, Environment and Ecology., 17: 456-457.

Dixit, U. N., A. N. Das and B. Mishra ,1989. Evaluation studies on jute germplasm for field resistance to stem weevil, *Apion corchori* Marshall (Apionidae: Coleoptera), Indian J. Genetics and Plant Breeding, 49: 191-194.

Mohapatra, L .N. and N. C. Patnaik, 1995. Screening of jute (*Corchorus capsularis* Linn.) germplasm for resistance to stem weevil, *Apion corchori* Marshall (Coleoptera: Curculionidae), Current Agricultural Research, 8: 39-40.

Prasad, S. S., U. S. Yadav, R. K. Srivastava, N. Prakash and B. P. Pandey, 2004. Performance of certain *capsularis* jute cultivars against jute pests, Proceedings of the National Academy of Sciences India, 74 B : 189-193.

Yadav, U. S., S. S. Prasad and N. Prakash, 2008. Evaluation of advanced Capsularis jute cultivars against insect and mite pests in eastern U. P. Res. on Crop., 9:478-480

Yadav, U.S., S. S. Prasad, N. and R. B. Singh, 2008. Reaction of advanced *Capsularis* jute cultures against insect and mite pests in eastern Uttar Pradesh, J. Plant Prot. Environ, 5 : 6 - 8.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Studies on Host Range, Physical Property and Seed Transmission in Chilli Mosaic Virus

T. K. Narute[1], D. M. Sawant[2] and G. P. Deshmukh[3]

ABSTRACT

Trasmitting through mechanical sap inoculation was found suitable from tender leaves containing highest concentration of the virus than stem, fruits and root. Various isolates of chilli mosaic virus were identified on the basis of host range, physical property and seed transmission. Based on host range, five isolates *viz.*, isolate I (Cucumber mosaic virus), isolate II Potato virus Y, isolate III Tobacco mosaic virus (TMV), isolate IV Cucumber mosaic virus + Potato virus Y (CMV + PVY) and isolate V Cucumber mosaic virus + Tobacco mosaic virus (CMV + TMV). These isolates have different physical property. Thermal inactivation point for five isolates in between 55-90 °C, dilution end point in between 10^{-4} - 10^{-6} and longevity *In-vitro* 42 h to 95 days. The 3-4 per cent infection of seed transmission was noticed in isolate III i.e. Tobacco mosaic virus and in isolate V i.e. mixture of CMV (Tobacco mosaic virus + Cucumber mosaic virus), respectively.

Chilli (*Capsicum annuum* Linn) is vulnerable to several biotic stresses caused by viruses and phytoplasmas (Green and Kim, 1991; Singh, 1993; Singh and Singh, 2000; Satya Prakash *et al.* ; 2001). Among all these, viral diseases have been recognized as a serious threat in successful cultivation of capsicum. Chilli mosaic virus was first time reported by Kulkarni (1924) from India. Details studies were undertaken on transmission of virus through seed, presence of virus in different plant parts, physical properties of various isolates of chilli mosaic virus and host range to identifiy different strains of virus.

MATERIAL AND METHODS

1. Mechanical transmission :

The virus infected capsicum leaves showing different types of symptoms were collected from different polyhouse grown capsicum field's *viz.*, Pune, Satara, Kolhapur, Sangli and Ahmednagar district of Maharashtra. The cultures of various isolates of chilli mosaic virus were maintained on California Wonder by mechanical sap transmission.

Determination of virus concentration :

Samples of leaves, fruits, stem and roots of virus infected capsicum plants of all the isolates were separately collected for determination of virus concentration. The crude sap was separately extracted from leaves, fruits, stem and roots and inoculated to five leaves of local lesion host i.e. *Chenopodium amaranticolor* for each isolate. Inoculated plants were labeled properly and maintained in an insect proof glasshouse. Observations were recorded for number of local lesions developed on leaves of local lesion host i.e. *Chenopodium amaranticolor.*

Host range :

The different virus isolates were maintained on capsicum cv. California Wonder in an insect proof glasshouse. Six plant species belonging to *Solanaceae, Cucurbitaceae, Chenopodiaceae, Leguminoaceae, Compositae* and *Cruciferae* were tested to find out the possible natural reservoirs.

Seed transmission :

In order to find the possibility of transmission of virus through seeds, two hundred seeds collected from infected plants of respective isolates of polyhouse grown capsicum of three verieties *Viz.*, Orbello, Bombay and California Wonder were sown separately in earthen pots and kept in an insect proof glasshouse. Observations on germination per cent and developments of symptoms were recorded. The levels of per cent seed transmission were calculated by counting infected plants from total plant populations.

1. Professor of Plant Pathology, College of Agril., Pune. 2. Associate Dean, College of Agril., Kolhapur. and 3. Scientist (Plant Pathology), Pulses Improvement Project, M.P.K.V., Rahuri.

Physical properties :

The standard methods (Noordam, 1973) were employed for studying the physical properties viz., (i) Thermal inactivation point (TIP), (ii) Dilution end point (DEP) and (iii) Longevity *In vitro* (LIV) of various isolates of capsicum.

RESULTS AND DISCUSSION

Determination of capsicum virus titre in leaf, stem, fruit and root

Infectivity of inocula prepared from different plant parts (*viz.*, leaves, stem, fruits and roots) of infected test plants of various isolates under study were carried out to estimate the concentration of virus in different plant parts.

The data given in the Table-1 showed that the extract prepared from leaves of chilli mosaic virus of all isolates proved to be the most infectious containing the highest concentration of virus (57.0, 52.0, 50.0, 39.2 and 34.2), followed by stem (28.2, 27.0, 23.0, 22.8 and 19.6) and fruits (39.0, 35.0, 30.4, 27.4 and 24.4). Low concentration was noticed in roots of plants infected with isolate IV. The average local lesions produced on *C. amaranticolor* ranged between 34.2 and 57.0. Maximum local lesions were observed on local lesion host inoculated with isolate IV, followed by Isolate V, III, II and I. The local lesion host inoculated with sap of fruit produced local lesions within the limit of 24.4 to 39.0, followed by stem in which 19.6 to 28.2.

Table 1 : Determination of capsicum virus titre in leaf, stem, fruit and root tissues in different isolates.

S. N.	Extract from	No. Local lesions A
1. Isolate I	Leaves	34.2
	Stem	19.6
	Fruits	24.4
	Root	4.8
2. Isolate II	Leaves	39.2
	Stem	22.8
	Fruits	30.4
	Root	4.2
3. Isolate III	Leaves	50.0
	Stem	27.0
	Fruits	39.0
	Root	6.4
4. Isolate IV	Leaves	57.0
	Stem	23.0
	Fruits	27.4
	Root	4.0
5. Isolate V	Leaves	52.0
	Stem	28.2
	Fruits	35.0
	Root	4.2

Similarly, Kiranmai *et al.*, (1997) reported extract prepared from virus infected tender leaves could transmit the virus by meachnical sap inoculation to a greater extent.

Host range :

The isolate I expressed the symptoms on family *Solanaceae, Cucurbitaceae, Chenopodiaceae* and *Leguminoaceae,* while host plants from compositae remained free. Symptoms observed are perfectly matched with earlier reports. (Kiramani *et. al.*, 1997 and Basavarajappa 1997). The virus Isolate II i.e. Potato Yirus Y could infect the *solanaceae,* but, *Datura stramonium* remained free. The plants from family *Cucurbitaceae, Leguminoaceae* and *compositae* had not expressed any kind of symptoms. However, host plants of chenopodiaceae *viz.*, Chenopodium album, Chenopodium, amaranticolor and Chenopodium quinoa developed symptoms (Table 2). These results are in agreement with the earlier reports of Elsanusio *et al.*, (1991).

The Isolate III i.e. Tobacco mosaic virus expressed the symptoms on family *Solanaceae*. Three host plants from cucurbitaceae family *viz.*, cucumis melo, C. sativus and C. pepo expressed the symptoms while others remained free. The host plant from family chenopodiaceae and compositae showed the symptoms while *Cajanus cajan* from leguminoaceae expressed the susceptibility for isolate III and other hosts remained free. In Isolate IV i.e. in the mixture of cucumber mosaic virus and potato virus Y, combined symptoms of Isoate I and II were observed in which the host plants from solanaceae, cucurbitaceae, chenopodiaceae and leguminoaceae expressed the symptoms. However, Zinnia elegans from family compositae remained free.

Isolate V i.e. a mixture of CMV + TMV expressed mixed types of symptoms on solanaceae,

Table 2 : Host range of present virus

S.N.		CMV Isolate I	PVY Isolate II	TMV Isolate III	CMV+PVY Isolate IV	CMV+TMV Isolate V
I. Solanaceae						
1.	*Capsicum annuum* L.	+	+	+	+	+
2	*C. frutescens* L. cv. Orbello	+	+	+	+	+
3.	*C. frutescens* L. cv. California Wonder	+	+	+	+	+
4.	*Nicotiana tabacum* L.	+	+	+	+	+
5.	*N. tabacum* L. cv. Xanthi	+	+	+	+	+
6.	*N. glutinosa* L.	+	+	+	+	+
7.	*N. robusta*	+	+	+	+	+
8.	*Datura Stramonium* L.	+	-	+	+	+
9.	*Datura metel* L.	+	+	+	+	+
10.	*Physalis floridana* Rydb.	+	+	+	+	+
11.	*Petunia hybrida* Vilm.	+	+	+	+	+
12.	*Lycopersicum esculentum* Mill.	+	+	+	+	+
II. Cucurbitaceae						
1.	*Cucumis melo* L.	+	-	+	+	+
2.	*C. sativus* L.	+	-	+	+	+
3.	*Cucurbita pepo* L.	+	-	+	+	+
4.	*Cucurbita maxima* Duch.; C.	+	-	-	+	+
5.	*Cucurbita moschata* Duch.	+	-	-	+	+
6.	*Luffa acutangula* Roxb.	+	-	-	+	+
7.	*Luffa cylindrical* (L) Roam	+	-	-	+	+
8.	*Memordica balsamina*	+	-	-	+	+
III. Chenopodiaceae						
1.	*Chenopodium album* L.	+	+	+	+	+
2.	*Chenopodium amaranticolor* Coste and Reyn	+	+	+	+	+
3.	*Chenopodium quinoa* Wild	+	+	+	+	+
4.	*Beta Velgaris* L.	+	-	+	+	+
IV. Leguminoaceae						
1.	*Phaseolus. Mungo*	+	-	-	+	+
2.	*Cajanus cajan* (L) Millsp.	+	-	+	+	+
3.	*Vigna unguicylata* (L.) Walp.	+	-	-	+	+
4.	*V. sinensis Savi.*	+	-	-	+	+
V. Compositae						
1.	*Zinnia elegans* Jacq.	-	-	+	-	+

Table 3 : Transmission of capsicum virus of different isolates through infected seeds of respective isolates.

Cultivars	No. of seeds sown	Seed Germination percentage	No. of plants showing symptoms	Per cent Seed transmission
Isolate I				
1. Orbello	200	83.5	00	00
2. Bombay	200	85.0	00	00
3. C.W.	200	81.5	00	00
Isolate II				
1. Orbello	200	80.0	00	00
2. Bombay	200	86.5	00	00
3. C.W.	200	83.5	00	00
Isolate III				
1. Orbello	200	81.0	06	3.7
2. Bombay	200	83.5	08	4.8
3. C.W.	200	84.0	08	4.8
Isolate IV				
1. Orbello	200	85.5	00	00
2. Bombay	200	86.5	00	00
3. C.W.	200	84.0	00	00
Isolate V				
1. Orbello	200	81.0	08	4.9
2. Bombay	200	81.5	06	3.6
3. C.W.	200	83.5	08	4.8

bitaceae, chenopodiaceae leguminoaceae and compositae. Similiarly Basavarajappa (1997) differentiated viruses' *viz.,* Toabcco mosaic virus (TMV), Potato virus Y (PVY), Cucumber mosaic virus (CMV) and mixture of these viruses on the basis of host range also indicator plants. The present findings are in conformity with those of Basavarajappa (1997).

Transmission through seeds :

The germination percentage of different cultivars found variable in the range of 81.0 to 86.5 and seedlings raised with seeds collected from virus infected plants of isolate I, II, and IV were found free. However, only 3-4 per cent infection was noticed in the remaining isolates of III and V in which tobacco mosaic was observed in singly and in mixture with CMV, respectively. Similar types of results have been reported by Singh (1993) and Satya Prakash (2001). To confirm the infection, representative samples of disease free isolates *viz.,* I, II and IV were back indexed on local lesion host *Chenopodium amaranticolor* but none of the test plant was found infected. This study indicated that the capsicum virus was not transmitted from the seeds collected from diseased plants of Isolates I, II and IV.

Table : 4 Physical properties of various isolates of chilli mosaic virus.

S. N.	Present study	Host	Cucumber mosaic virus (CMV)		
			Thermalinactivation point	Dilution end point	Longevity *In-vitro*
1	Isolate I	Pepper	60-65 °C	10^{-5}	48-60 hr
Potato virus Y (PVY)					
2	Isolate II	Pepper	55-60 °C	10^{-4}	42-48 hr
Tobacco mosaic virus (TMV)					
3	Isolate III	Pepper	85-90 °C	10^{-6}	90-95 days
4	Isolate IV	Pepper	Cucumber mosaic virus + Potato virus Y		
5	Isolate V	Pepper	Cucumber mosaic virus + Tabacco mosaic virus Y		

1. Thermal inactivation point :

Cucumber mosaic virus (CMV) was observed singly in Isolate I and in combination with PVY in Isolate IV and also with TMV in Isolate V. The thermal inactivation point of this virus was observed in between 60 to 65°C. Similar results in respect of CMV in pepper were reported by Kiranmai *et al.* (1997). Another virus *viz.*, PVY was observed singly in Isolate II and in combination with in Isolate IV. These two isolates containing PVY were infective up to 55°C and lost infectivity at 60°C. The results are in agreement with the earlier findings of Sherf and MacNab (1997). The tobacco mosaic virus disease was noticed singly in Isolate III and in combination with in Isolate V. The thermal inactivation point of TMV ranged between 85 and 90°C in both these isolates i.e. III and V. Similiarly, Bidari and Reddy (1990) and Rishi and Dhawan (1989) studied thermal inactivation point of TMV which was in the range of 85 to 90 °C.

2. Dilution end point :

In the present studies (Table 4), the cucumber mosaic virus reported from Isolate I and in mixture with Isolate IV remained infective up to 10^{-4} dilution and lost their at 10^{-5}. These results are in agreement with results of lost their infectivity at 10^{-5}. Kiranmai *et, al.*, (1997). In isolate II, potato virus Y was observed singly while in IV it was in combination with virus CMV. When it was reported singly in isolate it remained infective up to 10^{-3} and lost its infectivity at 10^{-4}. Similar results were also reported by Bidari and Reddy (1990) Sherf and MacNab (1997). Maximum dilution end point 10^{-6} was recorded in Isolate III in which TMV was observed singly and in Isolate V where it was in combination with CMV. The results are in agreement with the previous findings of Sherf and MacNab (1997).

3. Longevity *In-vitro* :

A minimum longevity range of 42 to 48 hrs was observed in Isolate II in which potato virus was investigated. These results are in agreement with the earlier reports of Sherf and MacNab (1997).

In Isolate I (i.e. CMV) and in Isolate IV (CMV in combination with PVY) the virus CMV remained infective up to 48 h and lost their infectivity after 60 h Similar results was reported by Bidari and Reddy (1990).

Isolate III containing TMV alone and in Isolate V, TMV in combination with CMV, maximum longevity of 2160 h (90) days were observed. These results are in agreement with the results of and Bidari and Reddy (1990).

LITERATURE CITED

Basavarajappa, M. P., 1997. Further studies on mosaic of chilli (*C. annuum* L.) M. Sc. Thesis (Unpub) U. A. S. Dharwad Karnataka, India.

Bidari, V.B. and H.R. Reddy, 1990. Identification of Naturally occurring viruses on commercial cultivars of chill, Mysore J. Agri.Sci., 24 : 45-51.

Elsanusio, S., M. Shagrum, and J. Khalli, 1991. Isolation and Identification of potato virus Y from pepper plants in Libya, Arab. J. Plant Prot., 9 : 47-51.

Green, S.K and J.S. Kim, 1991. Characterization and control of viruses infecting pepper:A literature Review, Technical Bulletin No.18, AVRDC : 60.

Kiranmai, G., P Sreenirasulu and M.V. Nayudu, 1997. Characterization of cucumber mosaic cucumovirus isolates naturally infecting three solanaceous vegetable crops in Andhra Pradesh, Indian Phytopathol, 50 (3) : 416-425.

Kulkarni, G. S., 1924. Mosaic and other related diseases of crops in Bombay presidency. Poona Agric. Coll. Mag., 16 : 6-12.

Noordam, D., 1973. Identification of plant viruses, Methods and Experiments. Oxford and IBH Publish Co., New Delhi, 250.

Rishi, N. and P. Dhawan, 1989. Characterization and identification of viruses causing mosaic diseases of Capsicum in nature, Indian Phytopathol, 42 (2) : 221-226.

Satya Prakash, S. J. Singh and R. K. Upadhyaya, 2001. Distribution, incidence and detector of potyvirus on chilli from eastern Utter Pradesh, Indian Phytopathol, 55 (3) : 294-298.

Sherf, A. F. and A. A. MacNab, 1997. Vegetables Diseases and their control. Second Edison. A Wiley-Inter science Pub., New York 728.

Singh, D. and S. J. Singh, 2000. Chilli little leaf-a new phytoplasma disease in India, Indian Phytopathol, 53 : 281-282.

Singh, S. J., 1993. Viral and Mycoplasmal Diseases of Vegetable Crops, Indian Institute of Horticultural Research, Banglore : 1-162.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Genetic Variability Studies for Yield Attributes in Jatropha

A.R. Bhuyar[1], V.K. Gour[2] and S.R. Patil[3]

ABSTRACT

Over the past few years, biofuels in general and biodiesel in particular have attracted an increasing interest as potential solutions to pressing challenges including global warming as well as depletion of conventional crude oil reserves, Jatropha being a possible example. The ninety-two plants over fifty-nine accessions of *Jatropha curcas* were selected from J.N.K.V.V., Jabalpur during the year 2008-2009 for the studies. The accessions represent different geographical location of Madhya Pradesh from Jhabua district was recorded on important characters *viz.*, number of branches (primary, secondary and tertiary), number of fruit bearing branches, number of fruiting inflorescence (inflorescence and co-florescence), number of capsules (developed and underdeveloped capsules), weight of capsules, hull (%) and seed yield. To study genetic variability from the recorded observations for yield attributing traits was estimated by range, mean ± standard error and standard deviation over the accessions. The economic characters *viz.*, number of branches, number of fruit bearing, number of developed capsules and weight of capsule recorded highest value in accession number 343 (175), 9 (80), 411-1 (481) and 411-1 (1160.56 g) as a desirable trait.

Jatropha curcas L. is commonly known as Physic nut, Purging nut or Ratanjyot belongs to the family Euphorbiaceae. India ranks sixth in the world in energy demand accounting for 3.5 per cent of world commercial energy consumption. India's import of crude oil was expected to go up from 85 million tonnes to 147 million tonnes in 2007.

Jatropha is a drought tolerant perennial plant that received extensive attention for its seed oil as a commercial source of fuel (Takeda, 1982; Banerji *et al.*, 1985; Martin and Mayeux, 1985). It grows in tropical and subtropical regions of the world and can be grown in areas of low rainfall and problematical sites, being drought tolerant. It can be used to reclaim eroded areas and as fence or live hedge.

Freshly harvested Jatropha dried fruit contains about 35-40 per cent shell and 60-65 per cent seed (by weight). The fruits are 2.5 cm long, ovoid, black and have 2-3 halves. The shells are available after de-shelling of the fruit while seed husks are available after decortications of seed for oil extraction. Seed contains about 40-42 per cent husk hull^{-1} and 58-60 per cent kernels (Singh *et al.*, 2008).

Over the past few years, biofuels in general and biodiesel in particular have attracted an increasing interest as potential solutions to pressing challenges including global warming as well as depletion of conventional crude oil reserves, Jatropha being a possible example (Polastro and Tulcinsky, 2008).

Therefore, investigation has been planned to conduct study on variability for yield attributes to explain the possibility of large quantity of feed stock (seed) for effective oil extraction high recovery and to establish inter-relationship amongst fruit and seed characteristics.

MATERIAL AND METHODS

The germplasm of *J. curcas* raised under the Jatropha Improvement Project at Breeder's seed farm, Department of Plant Breeding and Genetics, JNKVV, Jabalpur (MP) during the year 2008-2009 was utilized for the experiment. Jabalpur is situated at 23.9° N latitude and 79.58° E longitudes at an altitude of 411.87 m above the mean sea level. It is a subtropical zone as a part of Satpura Plateau and Kymore Hills region of the agro climatic zones of India with extremes of summer and winter season (Sehgal *et. al.*, 1990). The climate of Jabalpur is described as semi-humid, subtropical with hot dry summer, medium rainfall and cold winter with occasional showers. The average rainfall is about 1400 mm, mostly received during July to September.

1. and 3. M.Sc. Student and 2. Professor and Senior Scientist, Deptt. of Plant Breeding and Genetics, JNKVV, Jabalpur (MP)

1. Thermal inactivation point :

Cucumber mosaic virus (CMV) was observed singly in Isolate I and in combination with PVY in Isolate IV and also with TMV in Isolate V. The thermal inactivation point of this virus was observed in between 60 to 65° C. Similar results in respect of CMV in pepper were reported by Kiranmai *et al.* (1997). Another virus *viz.,* PVY was observed singly in Isolate II and in combination with in Isolate IV. These two isolates containing PVY were infective up to 55° C and lost infectivity at 60°C. The results are in agreement with the earlier findings of Sherf and MacNab (1997). The tobacco mosaic virus disease was noticed singly in Isolate III and in combination with in Isolate V. The thermal inactivation point of TMV ranged between 85 and 90°C in both these isolates i.e. III and V. Similiarly, Bidari and Reddy (1990) and Rishi and Dhawan (1989) studied thermal inactivation point of TMV which was in the range of 85 to 90 °C.

2. Dilution end point :

In the present studies (Table 4), the cucumber mosaic virus reported from Isolate I and in mixture with Isolate IV remained infective up to 10^{-4} dilution and lost their at 10^{-5}. These results are in agreement with results of lost their infectivity at 10^{-5}. Kiranmai *et, al.,* (1997). In isolate II, potato virus Y was observed singly while in IV it was in combination with virus CMV. When it was reported singly in isolate it remained infective up to 10^{-3} and lost its infectivity at 10^{-4}. Similar results were also reported by Bidari and Reddy (1990) Sherf and MacNab (1997). Maximum dilution end point 10^{-6} was recorded in Isolate III in which TMV was observed singly and in Isolate V where it was in combination with CMV. The results are in agreement with the previous findings of Sherf and MacNab (1997).

3. Longevity *In-vitro* :

A minimum longevity range of 42 to 48 hrs was observed in Isolate II in which potato virus was investigated. These results are in agreement with the earlier reports of Sherf and MacNab (1997).

In Isolate I (i.e. CMV) and in Isolate IV (CMV in combination with PVY) the virus CMV remained infective up to 48 h and lost their infectivity after 60 h Similar results was reported by Bidari and Reddy (1990).

Isolate III containing TMV alone and in Isolate V, TMV in combination with CMV, maximum longevity of 2160 h (90) days were observed. These results are in agreement with the results of and Bidari and Reddy (1990).

LITERATURE CITED

Basavarajappa, M. P., 1997. Further studies on mosaic of chilli (*C. annuum* L.) M. Sc. Thesis (Unpub) U. A. S. Dharwad Karnataka, India.

Bidari, V.B. and H.R. Reddy, 1990. Identification of Naturally occurring viruses on commercial cultivars of chill; Mysore J. Agri.Sci., 24 : 45-51.

Elsanusio, S., M. Shagrum, and J. Khalli, 1991. Isolation and Identification of potato virus Y from pepper plants in Libya, Arab. J. Plant Prot., 9 : 47-51.

Green, S.K and J.S. Kim, 1991. Characterization and control of viruses infecting pepper:A literature Review, Technical Bulletin No.18, AVRDC : 60.

Kiranmai, G., P Sreenirasulu and M.V. Nayudu, 1997. Characterization of cucumber mosaic cucumovirus isolates naturally infecting three solanaceous vegetable crops in Andhra Pradesh, Indian Phytopathol, 50 (3) : 416-425.

Kulkarni, G. S., 1924. Mosaic and other related diseases of crops in Bombay presidency. Poona Agric. Coll. Mag., 16 : 6-12.

Noordam, D., 1973. Identification of plant viruses, Methods and Experiments. Oxford and IBH Publish Co., New Delhi, 250.

Rishi, N. and P. Dhawan, 1989. Characterization and identification of viruses causing mosaic diseases of Capsicum in nature, Indian Phytopathol, 42 (2) : 221-226.

Satya Prakash, S. J. Singh and R. K. Upadhyaya, 2001. Distribution, incidence and detector of potyvirus on chilli from eastern Utter Pradesh, Indian Phytopathol, 55 (3) : 294-298.

Sherf, A. F. and A. A. MacNab, 1997. Vegetables Diseases and their control. Second Edison. A Wiley-Inter science Pub., New York 728.

Singh, D. and S. J. Singh, 2000. Chilli little leaf-a new phytoplasma disease in India, Indian Phytopathol, 53 : 281-282.

Singh, S. J., 1993. Viral and Mycoplasmal Diseases of Vegetable Crops, Indian Institute of Horticultural Research, Banglore : 1-162.

❖ ❖ ❖

The 92 plants over 59 accessions of *J. curcas* comprised the experimental material and those represents different geographical location (village/block) of Madhya Pradesh from Jhabua district. The accessions were selected on the basis of yield attributing characters *viz.*, number of branches (primary, secondary and tertiary), number of fruit bearing branches, number of fruiting inflorescence (inflorescence and co-florescence), number of capsules (developed and underdeveloped capsules), weight of capsules, hull (%) and seed yield.

To study genetic variability from the recorded observations for yield attributing traits was estimated by range, mean ± standard error and standard deviation for above mentioned characters over the accessions of *Jatropha curcas*.

RESULTS AND DISCUSSION

The study conducted on ninety-two plants over fifty-nine accessions from germplasm have been evaluated in four years old plantation is still in developmental phase. The important characteristics such as number of fruit bearing branches, number of fruiting inflorescence and underdeveloped capsules have been recorded for the first time is given in table 1. Hence, the inherent potential expressed and finally assessed on the basis of yielding ability in largely lacking and would need validation in successive generations until yield stabilizer.

The variation for number of branches ranged from 32 to 175 over all the accessions with the mean value of 74.72 and highest number observed in accession number 343 (175). The detail analyses of branching based on primary, secondary and tertiary were undertaken. The variation for primary branches ranged from 2 to 19 with the mean value of 4.38 and highest number in accession number 402–2 (19); secondary branches varied from 8 to 87 with a mean value of 26.03 and recorded highest number of (87) in accession 402–2 and tertiary branches ranged form 4 to 117 across all the accession with a mean value of 44.30 and highest number in accession 343 (117) (Table 2).

The branch number is highly variable in *J. curcas* due to allegaman nature. The result of Heller (1992) and Anonymous (2005) reveal less variation in unpruned population, whereas slight variation have been seen in the study by Pant *et al.* (2006) from conditions of plantation *viz.*, arable (T_1) and non-arable (T_2) at different altitudinal ranges. The present study reveal that the topography even with no pruning of four years of age exhibit high degree of variation but much higher number against the repairs. Anonymous (2007) observed the mean value for the number of primary branches (5.6) was observed highest in unpruned population (October 2006) of accession no. 51, whereas, in unpruned population and pruned population (August, 2007) pruned at the height of 1.5 m in plantation aging three years. There were no subsequent changes in number of primary branches. Most of the plants exhibited number of primary branches above one and as high as nineteen across accession. Anonymous (2007) recorded the mean value for highest number of secondary branches (37.4) observed in unpruned population (October, 2006) of accession no. 132; whereas, in unpruned population (August, 2007) and pruned population (August, 2007) there were no marked changes for number of secondary branches. Most of the plants exhibited number of secondary branches as low as 3 to 31 and as high as 11 to 48 branches as apparent from range across all the forty five accessions. Anonymous (2007) recorded value for highest number of tertiary branches (41.6) observed in unpruned population (October 2006) of accession no. 403 whereas, in unpruned population (August, 2007) the highest mean value (55.00) was observed in accession no. 132 followed by accession no. 131 (53.5) with higher number of tertiary branches with higher standard deviation. The pruned population (August, 2007) exhibited highest mean value (35.16) in accession no. 400.

No such data is available in literature for comparison of tertiary branches. However, the present study with unpruned plants revel that with age the natural branching occurring, the central stem disappeared due to repeated forking and form a large spreading crown is conformity with the concept of Dwivedi (1993). However, the highest attained (not recorded) and crown shape directs the need for pruning at proper stage to control highest to fulfill management needs, increases number of branches and facilitates harvesting.

The number of fruit bearing branches ranged from 0 to 80 with a mean value of 26.34 and

33.	90	Bekelda	Petlavad	5	31	43	79	Oct.–Nov.	16	16	0	43	4	88.26	55.00	33.26	37.68
34.	91	Madli	Petlavad	5	15	63	83	Oct.–Nov.	36	36	2	163	10	314.89	178.26	136.63	43.39
35.	92–1	Rambhapur	Meghanagar	2	16	48	66	Oct.–Nov.	26	26	0	112	4	217.70	119.20	98.50	45.25
36.	92–2	Rambhapur	Meghanagar	4	16	37	57	Oct.–Nov.	34	34	1	137	6	285.27	160.27	125.00	43.82
37.	93	Rambhapur	Meghanagar	3	36	34	73	Oct.–Nov.	78	78	0	224	22	423.89	219.89	204.00	48.13
38.	94	Sajlee	Meghanagar	4	17	59	80	Oct.–Nov.	62	62	1	276	10	668.50	389.68	278.82	41.71
39.	97–1	Sajlee	Meghanagar	2	13	71	86	Oct.–Nov.	53	53	0	260	11	531.40	299.00	232.40	43.73
40.	97–2	Sajlee	Meghanagar	2	15	54	71	Oct.–Nov.	42	42	1	208	6	455.55	255.15	200.40	43.99
41.	100	Madrani	Meghanagar	3	15	55	73	Oct.–Nov.	23	23	0	90	4	192.18	106.93	85.25	44.36
42.	103	Pipalkhump	Meghanagar	3	37	61	101	Oct.–Nov.	32	32	0	174	4	407.05	229.26	177.79	43.68
43.	105	Badlipada	Meghanagar	2	17	78	97	Oct.–Nov.	54	54	0	229	4	500.21	292.78	207.43	41.47
44.	106–1	Meghanagar	Meghanagar	5	31	56	92	Oct.–Nov.	58	58	0	190	19	319.89	173.14	146.75	45.88
45.	106–2	Meghanagar	Meghanagar	2	20	51	73	Oct.–Nov.	34	34	0	106	9	179.91	86.16	93.75	52.11
46.	107	Meghanagar	Meghanagar	3	34	53	90	Oct.–Nov.	46	46	0	197	5	391.68	217.48	174.20	44.48
47.	112–1	Pervliya	Dhandla	3	13	32	48	Oct.–Nov.	12	12	0	44	4	87.68	49.21	38.47	43.87
48.	112–2	Pervliya	Dhandla	2	14	28	44	Oct.–Nov.	4	4	0	5	0	8.54	5.05	3.49	40.87
49.	116	Dhandla	Dhandla	4	23	40	67	Oct.–Nov.	28	28	1	109	2	242.28	156.49	85.79	35.41
50.	117	Alirajpur	Alirajpur	3	21	42	66	Oct.–Nov.	29	29	0	148	3	331.00	222.60	108.40	32.75
51.	120–1	Borkua	Alirajpur	3	27	22	52	Oct.–Nov.	12	12	0	33	4	61.30	35.79	25.51	41.62
52.	120–2	Borkua	Alirajpur	5	45	37	87	Oct.–Nov.	22	22	1	103	1	242.93	158.35	84.57	34.81
53.	121	Mahendra	Bhabhra	4	23	51	78	Oct.–Nov.	14	14	0	51	2	112.08	66.27	45.81	40.87
54.	122	Bhabhra	Bhabhra	3	21	38	62	Oct.–Nov.	8	8	0	36	0	80.07	46.31	33.76	42.16
55.	126–1	Mordha	Bhabhra	2	16	28	46	Oct.–Nov.	18	18	0	59	2	140.23	81.60	58.63	41.81
56.	126–2	Mordha	Bhabhra	3	20	46	69	Oct.–Nov.	17	17	0	57	7	123.85	65.42	58.43	47.18
57.	130	Devlee	Bhabhra	8	25	19	52	Oct.–Nov.	8	8	0	27	0	45.80	32.00	13.80	30.13
58.	131	Devlee	Bhabhra	2	34	11	47	Oct.–Nov.	10	10	0	35	2	75.35	41.00	34.35	45.59
59.	132	Kadwal	Kaddiwada	7	42	4	53	Oct.–Nov.	1	1	0	0	0	0.00	0.00	0.00	0.00
60	136–1	Gadwara	Jhabua	4	24	21	49	Oct.–Nov.	1	1	0	10	0	19.11	13.77	5.34	27.94
61.	136–2	Gadwara	Jhabua	9	18	23	50	Oct.–Nov.	22	22	0	92	5	223.11	137.47	85.64	38.38
62.	137	Pithumpur	Jhabua	2	12	55	69	Oct.–Nov.	19	19	0	85	6	148.74	82.94	65.80	44.24
63.	138–1	Sarolipada	Jhabua	9	34	14	57	Oct.–Nov.	20	20	0	118	3	259.10	153.90	105.20	40.60
64.	138–2	Sarolipada	Jhabua	3	20	53	76	Oct.–Nov.	53	53	1	228	1	446.24	249.90	196.34	44.00
65.	139–1	Sarolipada	Jhabua	3	25	13	41	Oct.–Nov.	0	0	0	0	6	6.24	0.00	6.24	100.00
66.	139–2	Sarolipada	Jhabua	7	52	20	79	Oct.–Nov.	16	16	0	68	5	127.26	70.08	57.18	44.93

67.	140	Padalva	Ranapur	2	16	23	41	Oct.–Nov.	21	21	0	105	1	240.28	152.81	87.47	36.40
68.	146–1	Khardubadi	Rama	2	8	7	17	Oct.–Nov.	0	0	0	0	0	0.00	0.00	0.00	0.00
69.	146–2	Khardubadi	Rama	2	18	40	60	Oct.–Nov.	27	27	0	182	4	444.81	265.35	179.26	40.30
70.	149–1	Kharduchotti	Rama	3	15	42	60	Oct.–Nov.	28	28	0	151	0	343.84	203.40	140.44	40.84
71.	149–2	Kharduchotti	Rama	2	15	49	66	Oct.–Nov.	13	13	0	56	0	121.73	68.83	52.90	43.46
72.	154–1	Para	Rama	3	10	33	46	Oct.–Nov.	5	5	0	24	0	42.82	30.82	12.00	28.02
73.	154–2	Para	Rama	6	33	75	114	Oct.–Nov.	34	34	0	96	3	184.34	103.65	80.69	43.77
74.	155	Para	Rama	3	15	57	75	Oct.–Nov.	7	7	0	35	0	62.39	32.66	29.73	47.65
75.	156	Bhakankudi	Jhabua	4	14	31	49	Oct.–Nov.	47	47	1	183	2	445.56	288.00	157.56	35.36
76.	159–1	Navapada	Rama	3	14	59	76	Oct.–Nov.	31	31	2	165	9	380.26	242.69	137.57	36.18
77.	159–2	Navapada	Rama	2	14	49	65	Oct.–Nov.	14	14	0	93	0	191.31	118.64	72.67	37.99
78.	159–3	Navapada	Rama	5	29	58	92	Oct.–Nov.	22	22	0	140	3	296.43	159.55	136.88	46.18
79.	163	Semliya	Jhabua	7	42	20	69	Oct.–Nov.	2	2	0	5	0	6.86	4.27	2.59	37.76
80.	164	Bansemliya	Jhabua	2	17	18	37	Oct.–Nov.	2	2	0	6	0	11.57	6.27	5.30	45.81
81.	343	Mahumandli	Khargone	12	46	117	175	Oct.–Nov.	74	74	4	299	4	695.62	424.44	271.18	38.98
82.	401	Alirajpur	Alirajpur	2	28	47	77	Oct.–Nov.	8	8	0	38	0	77.19	46.00	31.19	40.41
83.	402–1	Sokha	Alirajpur	3	29	69	101	Oct.–Nov.	44	44	0	204	0	353.92	199.21	154.71	43.71
84.	402–2	Sokha	Alirajpur	19	87	30	136	Oct.–Nov.	47	47	0	250	6	534.33	325.50	208.83	39.08
85.	403–1	Attah	Mathwad	4	34	86	124	Oct.–Nov.	72	72	0	288	6	349.14	97.80	251.34	71.99
86.	403–2	Attah	Mathwad	12	72	30	114	Oct.–Nov.	26	26	0	176	18	135.18	71.66	63.52	46.99
87.	403–3	Attah	Mathwad	3	36	76	115	Oct.–Nov.	60	60	3	326	11	462.66	149.77	312.89	67.63
88.	406–1	–	KVK	6	61	76	143	Oct.–Nov.	58	58	0	377	15	608.23	251.23	357.00	58.69
89.	406–2	–	KVK	3	15	78	96	Oct.–Nov.	9	9	0	45	1	82.44	46.75	35.69	43.29
90.	406–3	–	KVK	8	58	36	102	Oct.–Nov.	24	24	0	117	5	258.93	150.93	108.00	41.71
91.	411–1	–	KVK	4	57	70	131	Oct.–Nov.	72	72	2	481	13	1160.56	714.26	446.30	38.46
92.	411–2	–	KVK	11	38	19	68	Oct.–Nov.	5	5	0	17	0	31.95	17.17	14.78	46.26

Table 2: Range, mean, standard deviation and error of yield and its attributes in accessions of *J. curcas*

	Number of branches				Number of fruit bearing branches	Number of fruiting inflorescence		Number of capsules		Weight of capsules (g)	Seed yield (g)	Weightof hull(g)	Hull (%)
	Primary branches	Secondary branches	Tertiary branches	Total		Inflorescence	Co-florescence	Developed	Underdeveloped				
Range	2 – 19	8 – 87	4 – 117	32 – 175	0 – 80	0 – 80	0 – 4	0 – 481	0 – 22	0.00–1160.56	0.00–714.26	0.00–446.30	0 – 100
Mean	4.38	26.03	44.30	74.72	26.34	26.34	0.38	120.28	4.25	251.15	145.79	106.01	41.62
STDEV	2.92	14.45	21.16	26.57	20.06	20.06	0.80	95.05	4.59	203.05	121.33	87.36	10.91
SE (m) ±	0.30	1.51	2.21	2.77	2.09	2.09	0.08	9.91	0.48	21.17	12.65	9.11	1.14

highest number in accession number 9 (80). Number of fruiting inflorescence varied from 0 to 80 with the mean value of 26.34 and highest value in accession 9 (80). The occurrence of co–florescence was also recorded. It ranged from 0 to 4 with the mean value of 0.38 and highest number (4) in accession 343 (Table 2). There is no published record for this trait. However, few plants in accession 38–2, 39, 44, 45, 68–3, 71–1, 87–2, 112–2, 122, 130, 132, 136–1, 146–1, 149–1, 149–2, 154–1, 155, 159–2, 163, 164, 401, 402–1 and 411–2 have shown non bearing in few plants across the seasons, reveal that it could be due to genetic causes coupled with some effect of environment (Table 1).

The observation on non fruit bearing plants across accession under study exhibited variation for this trait. This variation in capsule bearing is subjected to genetic and environmental causes which may be due to female sterility or sensitivity of plants within and across accessions could be due to high moisture condition. However, few plants in accession 132, 139–1 and 146–1 have shown non bearing during the seasons under experiment; reveal that it could be due to genetic causes coupled with some effect of environment. The shy bearing in most of the accessions in field gene bank expressed similarly due to hypoxia.

The observation need to be recorded year after year to ascertain that whether the old branches bear fruit or juvenile is a requisite for fruiting or branches alternatively bear fruits. This trait has a very high bearing on number of branches per plant.

It also reveals that maximum fruiting inflorescence per plant would contribute for yield and is again factored by high number of branches. Anonymous (2005) recorded the number of co-florescence varied from 3.02 to 4.25 with a mean performance of 3.68. The maximum number (4) of co-florescence per cyme was exhibited by accession no. 128, 180 and 403. However the limited variation for this trait directs the need to search plants with high number of co–florescence to achieve yield target.

The number of capsules (developed and underdeveloped) was recorded. The developed capsule number varied from 0 to 481 with a mean value of 120.28 and the highest number in accession 411–1 (481). The weight of capsule was recorded highest in accession number 411–1 (1160.56 g). The hull per cent was recorded (100%) in accession number 139–1 with a mean value more than 30 per cent (Table 2). The capsule set plant^{-1} is a factor of male : female flower ratio, effective pollination and successful fertilization.

Pant *et al.* (2006) reported the highest capsules plant^{-1} were recorded in T_2 (167.10) and E_2 (216.40) and minimum in T_1 (150.40) and E_1 (113.70). The mean value for highest number of capsule plant^{-1} (32.8) was recorded by Anonymous (2007) in unpruned population (October 2006) of accession no. 132. In unpruned population (August 2007) the highest mean value (34.6) was observed in accession no. 23, whereas, in pruned population (August 2008) the highest mean value (21.4) was observed in accession no. 22. The area (arable/non-arable) of plantation and altitudes have shown variation in yield (Pant *et al.*, 2006) in non-arable land (T_2) altitude ranging from 800–1000 m exhibited higher yield as against 400 to 800 m.

The highest capsule weight (244.12 g) was recorded by Anonymous (2008) in three split capsules and the lowest one in non split capsules (102.73 g) across the plants. Increase in capsule weight has direct relation to yield and oil content. The increase in weight shall contribute to high seed yield and high oil unit^{-1} area. Anonymous (2007) recorded minimum hulling per cent (6.84%) for unpruned population (October 2006) of accession no. 195. The minimum hulling per cent (35.74%) was recorded for zero split capsules (Anonymous, 2008). All of the capsules exhibited hulling more than 30 per cent. The search for plants/accessions with lower hulling value coupled with higher seed yield could be advantageous.

A perusal of the data revealed that the maximum (714.26 g) seed yield plant^{-1} with a mean value of 145.79 g observed in accession no. 411–1, followed by accession number 9 (435.3 g) which is nearly less than half of the highest value. Anonymous (2007) recorded maximum (61.17 g) seed yield plant^{-1}. Anonymous (2005) observed maximum seed yield of 19.14 g. Heller (1992) reported weight of seeds/shrub in the range of 2.4 to 9.60 g with a mean value of 6.72 g; 7.9 MAP and 0.32 to 9.22 g with a mean value of 3.48 g; 25.3 MAP. The variation

in seed yield subjected to genetic and environmental variations. The seed yield in the present study is higher than reported by Anonymous (2005) and (2007). The wide variations in trait of economic importance need through scrutiny to screen and identify plants with higher yielding ability in subsequent years.

An attempt has been made to study *Jatropha curcas* to determine the extent of variation for quantitative traits as yield attributing traits, understand its morphological architecture, develop suitable management procedure and schedule to maximize productivity of feed stock.

LITERATURE CITED

Anonymous, 2005. Studies on floral biology, yield and yield attributed in wild cultivated species of Jatropha. M.Sc. Thesis (unpublished), JNKVV, Jabalpur, M.P., India.

Anonymous, 2007. Studies on yield attributes in early accessions of *J. curcas* L. M.Sc. Thesis (unpublished). JNKVV, Jabalpur, M.P., India.

Anonymous, 2008. Genetic Variability for oil content and Fruit Characteristics in Selected Accessions of *J. curcas* L. M.Sc. Thesis (unpublished). JNKVV, Jabalpur, M.P., India.

Banerji, R., A.R. Chowdhury, G. Misra, G. Sudarsanam, S.C. Verma and G.S. Srivastava, 1985. Jatropha seed oils for energy. Biomass, 8: 277-282.

Dwivedi, A.P., 1993. Form and Life of trees and crops in a text book of Siliviculture, Pub. Int. Book Distributor, Dehradun–248001, India, : 159-169.

Heller, J., 1992. Studies on genotypic characteristics and propagation and cultivation methods for physic nuts (*Jatropha curcas* L.)

Martin, G. and A. Mayeux, 1985. Curcas oil (*Jatropha curcas* L.) a possible fuel. Agri. Trop., 9: 73-75.

Pant, K.S., V. Khosla, D. Kumar and S. Gairola, 2006. Seed oil content variation in *Jatropha curcas* Lnn. In different altitudinal ranges and site conditions in H.P., India. A Journal of ecology and application, 11(2): 31-34.

Polastro, E.T. and S.Tulcinsky, 2008. Will biodiesel be ever competitive as a fuel, Pharma Chem., 7(6): 8-12.

Sehgal, J.C., D.K. Mandal, C. Mandal and S. Vadi, 1990. Agro-ecological regions of India, NBSS Tech. Bull. No., 24. NBSS and IUP, Nagpur, 73.

Singh, R.N., D.K. Vyas., N.S.L. Srivastava and Madhuri Narra 2008. SPRERI experience on holistic approach to utilize all parts of Jatropha curcas fruit for energy, Renewable Energy; 33(8): 1868-1873.

Takeda, Y., 1982. Development study on *Jatropha curcas* L. (Sabudam) oil as a substitute for diesel engine oil in Thailand, J. Agric. Assoc. China, 120: 1-8.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Management of Dieback, Fruit Rot and Powdery Mildew of Chilli

S. W. Khodke[1], R. S. Wankhade[2] and R. S. Ghawade[3]

ABSTRACT

A field experiment was conducted for consequative two years i.e. 2002-2003 and 2003-2004 to study the efficacy of fungicides, bioagents and plant product against die-back, fruit rot and powdery mildew of chilli. Among the treatments, chlorthalonil (0.2%), copper-oxychloride (0.25 %), mancozeb (0.2%), wettable sulphur (0.3%) and tricure (0.4 %) were found efficient in reducing dieback infection. Three sprays of copper-oxychloride, mancozeb, chlorthalonil, wettable sulphur and *Tricoderma* (0.25 %) were found most superior in reduction of fruit rot. While in the management of powdery mildew, wettable sulphur and mancozeb were found significantly superior over other treatments. Maximum yield of dry chilli fruit i.e.10.17 q ha^{-1} was obtained in mancozeb (0.2 %) treatment, followed by wettable sulphur (9.81q ha^{-1}).

Chilli (*Capsium annuum* L.) is an indispensable condiment in Indian cuisine and is cultivated as one of the important cash crops in India. Its pungency "Capsaicin" and colouring matter "Capsinoids" are gaining importance in processed foods. The colouring matter and oleresin content are important for Food and Spice industries. The green as well as red (dry) chilli fruit are valuable on account of their richness in ascorbic acid, protein, carotene, carbohydrates, mineral matter, etc. (Anonymous, 1950).

Most of the commercial varieties of chilli under cultivation suffer from many devastating diseases like dieback (*Colletotrichum dematium*, (Fr.) Groove, fruit rot (*Collectotrichum dematium*, *Colletotrichum* spp), Powdery mildew (*Leveillula taurica* (Lev.) Arn., Bacterial blight (*Xanthomonas axenopodis* pv. *vasicatoria* (Doidge) Dowson and Churda-murda (Virus and/ or mites and thrips infestations) which result in considerable losses in yield and quality of green as well as red chillies. Among diseases, dieback, fruit rot and powdery mildew are important and more destructive diseases causing heavy losses in yield and quality of product since last so many years in Maharashtra. Peshne and Deshmukh (1991) reported that 1per cent disease intensity of fruit rot of chilli was found responsible for 0.88 per cent loss in yield of fruits at 20.53 per cent of plant infection whereas 1per cent of powdery mildew PDI was responsible for 0.62 per cent loss in yield. Reduction of ascorbic acid, sugar and capsaicin content in chilli due to fruit rot have been reported (Azad,1991; Khodke and Wankhede,2000). In the present studies, management of dieback, fruit rot and powdery mildew by using chemicals, plants product and bioagents were evaluated.

MATERIAL AND METHODS

Chilli disease namely dieback, fruit rot and powdery mildew are restricted to the aerial part of the plant. The application of effective fungicide, bio-agent and botanicals were found suitable for reduction of diseases. Efficacy of different fungicides, neem product and bio-agent was assessed under field condition for two years i.e. 2002-03 and 2003-04. The chilli was raised by adopting all the recommended agronomical practices required for normal growth of the plant.

The trials were conducted in field of Zonal Agril. Research Station Yavatmal and replicated thrice in Randomised Block Design with chilli cv. Jayanti. The crop was planted in 4.2 m x 3.6 m plots, net plot size was 3.6m x 3.0m with 60x60 cm. spacing. Nine treatements viz., Tricure 4 ml l^{-1}, *Ampelomyces* culture filtrate 50 ml l^{-1}, *Tricoderma* 2.5 g l^{-1}, Chlorthalonil 2g l^{-1} , Wettable sulphur 3 g l^{-1}, Mancozeb 2g l^{-1} , Copper- oxychloride 2.5 g l^{-1}, and Kasumin 3ml l^{-1} were evaluated as foliar sprays. The first spray of fungicides/ bioagent was applied at the initiation of disease i.e. either die-back, fruit rot and powdery mildew. Subsequently two sprays were given at 15 days intervals. For recording disease intensity of die-back, fruit rot and powdery mildew, six plants were randomly selected from each

1. Assistant.Prof., ZARC, Yavatmal, 2. Junior Res. Asstt. and 3. Senior .Res. Asstt., Department of Plant Pathology, Dr.PDKV,Akola

Table 1 : Efficacy of fungicides, plant product and antagonist against die back, fruit rot and powdery mildew of Chilli.

Treatments (Conc")		PDI (Dieback)				PDI (fruit rot)				PDI (powdery mildew)			
		2002-03	2003-04	Pooled means	% Dis control	2002-03	2003-04	Pooled means	% Dis control	2002-03	2003-04	Pooled means	% Dis control
T_1	Tricure 4 ml lit^{-1}	5.08 (2.25)**	10.75 (3.27)**	7.57 (2.75)**	31.37	8.75 (2.95)**	10.12 (3.18)**	9.44 (3.07)**	30.33	20.74 (27.03)*	28.02 (31.96)*	24.38 (29.50)*	39.05
T_2	*Ampelomyeces* culture filtrate 5%	5.48 (2.34)	10.65 (3.26)	8.07 (2.84)	26.84	10.74 (3.28)	11.14 (3.34)	10.94 (3.31)	19.26	24.94 (29.94)	29.01 (32.55)	26.98 (31.25)	32.55
T_3	*Trichoderma* (25g +10 lit water)	5.26 (2.29)	9.87 (3.14)	7.92 (2.81)	28.20	8.86 (2.97)	9.38 (3.06)	9.12 (3.02)	32.69	22.10 (27.89)	23.21 (28.81)	22.67 (28.35)	43.33
T_4	Chlorthalonil 0.2%	3.61 (1.90)	8.14 (2.85)	5.88 (2.42)	46.69	5.70 (2.39)	7.36 (2.70)	7.00 (2.63)	49.96	21.48 (27.54)	22.10 (28.03)	21.79 (27.79)	45.55
T_5	Wett. sulphur 0.3%	4.87 (2.20)	9.95 (3.15)	7.41 (2.72)	32.82	7.91 (2.81)	9.45 (3.05)	8.68 (2.95)	35.94	14.20 (21.93)	17.90 (25.04)	16.05 (23.49)	59.88
T_6	Mancozeb 0.2%	3.50 (1.89)	9.17 (3.03)	6.34 (2.52)	42.52	6.15 (2.48)	7.84 (2.78)	6.53 (2.56)	51.81	18.89 (25.71)	21.11 (27.10)	20.00 (26.41)	50.00
T_7	Copper Oxy chloride 0.3%	3.75 (1.93)	8.32 (2.88)	6.04 (2.46)	45.24	6.04 (2.46)	6.98 (2.64)	6.51 (2.55)	51.95	22.10 (27.97)	24.32 (29.49)	23.21 (28.73)	41.98
T_8	Kasumin 3ml lit^{-1}	5.43 (2.33)	10.92 (3.30)	8.18 (2.86)	25.84	9.16 (3.01)	11.11 (3.33)	10.14 (3.18)	25.17	22.84 (28.49)	27.28 (31.49)	25.06 (29.99)	37.35
T_9	Control	9.40 (3.06)	12.65 (3.57)	11.03 (3.32)	—	13.66 (3.69)	13.43 (3.66)	13.55 (3.68)	—	36.54 (37.79)	43.46 (41.25)	40.00 (39.52)	—
	'F' test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	
	SE (m) ±	0.08	0.07	0.12	—	0.11	0.09	0.09	—	1.22	0.70	1.01	
	CD at 5%	0.25	0.20	0.38	—	0.34	0.29	0.28	—	3.67	2.10	3.26	

** Square root value * Arcsin Values

treatments and lebelled. For powdery mildew, six leaves, two each from upper, middle and lower of each plant were obversed. Per cent disease intensity of die-back, fruit rot was worked out as per the method suggested by Peshney and Deshmukh (1991). Intensity of powdery mildew was worked out by using 0-9 scale, as per score card (Mayee and Datar, 1986). Two years data on disease intensity and yields were calculated. Yields from net plot were taken into account for computing the average yield of dry chilli in q ha^{-1}

RESULTS AND DISCUSSION

All the fungicides, plant product and bioagents were found significantly superior in reducing die-back intensity during both the years (Table 1). Pooled results reveals that chlorthalonil 2g l^{-1} was found efficient in minimizing die-back infection with 46.69 per cent disease control, followed by copper oxy-chloride 2.5 g l^{-1}, mancozeb 2g l^{-1}, wettable sulphur 3g l^{-1} and tricure @ 4ml l^{-1} and were at par with others. Per cent disease intensity in these treatment were 6.04, 6.34, 7.41 and 7.57 per cent, respectively. Maximum i.e. 11.03 per cent intensity was noticed in control. Mistry *et.al.*, (2008) reported that three sprays of carbendazim (0.05%), chlorthalonil (0.2%) and foltaf (0.2%) were most effective against *Colletotrichum capsici*, a causal agent of die-back of chilli.

Maximum reduction of fruit rot caused by *Colletotrichum dematium* was achieved in three sprays of copper oxy-chloride, mancozeb and chlorthalonil with disease intensity of 6.51, 6.53 and 7.00 per cent, respectively. In control plot 13.55 per cent fruit rot was recorded. Eswaramurthy *et.al.*, (1988) recorded efficient control of die-back and fruit rot of chilli with two sprays of foltaf (0.2%) and fytolan (0.25 %). Ekbote (2005) reported the efficacy of copper oxychloride @ 0.25 per cent against die-back of chilli and copper oxychloride (0.25 %) and mancozeb (0.25 %) against fruit rot of chilli. These findings correlates the present studies. Efficacy of neem oil in reducing dieback and fruit rot of chilli caused by *Colletotrichum capsici* have been reported (Jayalakshmi and Setheraman, 1998) while tricure was moderate in efficiency for reducing the diseases under present investigation. *Trichoderma* 2.5 g l^{-1} was found effective in reducing foliar diseases. Jaylakshmi and Setheraman (1998) also reported the biological control fruit rot and dieback of chilli. Mistry *et. al.*, (2008). Proved efficacy of *Trichoderma viride* and *T. harzianum* against die-back of chilli.

All the treatments were significant over control in reducing powdery mildew incidence. Wettable sulphur and mancozeb were proved most effective in reducing the disease by 59.88 and 50.00 per cent, respectively. Similar results were also recorded by Mathur *et.al.*, (1970) and Joi and Sonone, (1980). Three sprays of wettable sulphur @ 0.25 per cent proved an effective for maximum reduction of powdery mildew (Anonymous,2006).

Table 2 : Efficacy of fungicides, plant product and antagonist on dry Chilli fruit yield

Treatments (Conc^n)	Yield q ha^{-1}		
	2002-03	2003-04	Pooled means
T_1 Tricure 4 ml lit^{-1}	8.92	7.40	8.35
T_2 *Ampelomyeces* culture filtrate 5%	8.58	7.25	7.94
T_3 *Trichoderma (25g +10 lit water)*	8.84	7.85	8.17
T_4 Chlorthalonil 0.2%	9.87	9.00	9.6
T_5 Wett. sulphur 0.3%	10.53	9.10	9.81
T_6 Mancozeb 0.2%	9.84	9.35	10.17
T_7 Copper Oxy chloride 0.3%	10.74	9.60	9.44
T_8 Kasumin 3ml lit^{-1}	8.87	7.80	8.34
T_9 Control	7.28	6.55	6.93
'F' test	Sig	Sig	Sig
SE (m) $\pm$	0.26	0.33	0.24
CD at 5%	0.80	1.00	0.76

Maximum yield of dry chilli fruits (10.17 q ha^{-1}) was obtained in mancozeb 2g l^{-1} , followed by wettable sulphur, chlorthalonil and copper oxychloride. Yield with 9.81, 9.60, 9.44q ha^{-1}, respectively (Table 2.).In control plot 6.93 q ha^{-1} yield was recorded. Hadden and Black (1989) studied anthracnose of pepper caused by *Colletotrichum* spp. and reported that application of chlorthalonil or maneb at 7 and 14 days interval reduced anthracnose severity and increased the yield of marketable fruits. Mistry *et. al.*, (2008). obtained effective control of die-back of chilli with three sprays of carbendazim, chlorthalonil and foltaf with increasing yield of green fruit. Three sprays of triazoles and wettable sulphur were found effective in controlling powdery mildew and increasing dry chilli fruit yield have been reported (Ashtaputre *et. al.*,2007) These findings corroborate present results.

LITERATURE CITED

Anonymous,1950.The Wealth of India –Raw Materials II 69-72.

Anonymous,2006.Report on joint Agresco of Plant Pathology Maharashtra Agril. Universities : 21.

Ashtaputre, Sudheendra, A., Shrikant Kulkarni, M.S.L. Rao and M.Shivprasad. 2007. Management of powdery mildew of chilli using Triazoles. J.Pl. Dis. Sci., 2(2) : 132-134.

Azad, P.1991.Fate and role of chemical constituents of chilli fruits during infection with *Collototrichum capsici,* Indian Phytopath, 44 (1) : 129-131.

Ekbote, S.D.2005. Management of Bio-rational fungicide Emcop SC (Shield) against die-back and fruit rot of chilli. J. Mycol. Pl. Pathol., 35 (1): 177-183.

Ekbote, S.D., 2005. Evaluation of chilli fruit rot caused by *Colletotrichum capsici*, J. Mycol, Pl. Path. 35 (2) :

Eswarmurthy, S., C.M. Pappiah, M. Muthusamy, S. Muthusamy, V. Mariappan, R.Jeyasekar, S. Natrajan, P. M. M. David and P. Gomathinayagam, 1988. Chemical control of die back and fruit rot of chillies. *Pesticides*, 22(3):40

Hadden,J.F. and L.L. Black, 1989. Anthracnose of Pepper caused by Colletotrichum spp. Tomato and Pepper Prod. in the tropics : 189-199.

Jayalakshmi, C and K. Setherman, 1998.Biological control of Fruit rot and Die back of Chilli with Plant product and Antagonics Micro organisms. Plant Dis. Res. 13(1) :46-48.

Joi, M.B. and H.N. Sonone, 1980. Chemical control of leaf curl, fruit rot and powdery mildew of chilli. J. Maharashtra Agril. Uni, 5(3): 219- 222.

Khodke, S.W. and S.G. Wankhede, 2000. Biochemical changes in rotted chilli fruits, PKV Res. J., 24 (2) : 124-125.

Mathur,R.L.,G. Singh and R.B.L. Gupta, 1970. Chemical control of powdery mildew of chilli (*Capsicum annuum*)caused by *Leveillula taurica*. Paper presented in First Seminar on Plant Disease Problems of Rajasthan in Dec.16-17, 1970. Udaipur.

Mayee,C.D. and V.V. Datar,1986.Phytopathometry, Tech. Bulletin – 1 Marathwada Agril. University, Parbhani .

Mistry, D.S., I.P. Sharma and S.T. Patel, 2008. Evaluation of fungicides, phytoextracts, and bio-pesticides against die back of chilli, J. Pl. Dis. Sci. 3(1) : 53-55.

Peshney, N. L. and B. S. Deshmukh, 1991. Determination of effective and economic plant protection schedule for chilli. III. Estimation of Losses due to dieback and powdery mildew and scheduling of application interval. PKV Res. J. 15(1) : 18-22.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Identification of Mungbean Genotypes Against Diseases and Pests Under Field Conditions

G. P. Deshmukh[1], S.K. Patil[2], D.D. Dudhade[3] and J.V. Patil[4]

ABSTRACT

Twenty two mungbean germplasm accessions were screened against powdery mildew (*Erysiphe polygoni* DC) and yellow mosaic under epiphytotic conditions. Of these only three genotypes *viz.*, Vaibhav Phule Mung-2 and BPMR-145 showed resistant reaction for powdery mildew. Ten other genotypes showed moderate resistant for yellow mosaic. While seven entries *viz.*, Phule M-2003-03, Phule M-2005, Phule M-2, BM-4, AKM-8802, AKM-99110 and AKM-9911 were found to be combined significantly less susceptible against sucking pests i.e. white fly (*Bemisia tabaci)* and jassids (*Empoasca* spp.) over check Vaibhav. None of the entries recorded less pod damage caused by different pod borer in mungbean over check Vaibhav (7.95 %). The resistant lines found in the screeing may be utilized in breeding programme for developing high yielding varieties with multiple disease resistance.

Mungbean (*Vigna radiata* (L.) Wilczek) is an important grain legume grown in tropical and subtropical countries. It is grown in *Summer* and in *Kharif* seasons. One of the major constraints limiting the potential yield is the damage caused by various diseases and insect pests.Powdery mildew (*Erysiphe polygoni* DC) and yellow mosaic are the most destructive and widely distributed foliar disease of mungbean affecting *Kharif* and *Rabi* sown crop. (Singh *et. al.*, 2007).

The yield losses to the extent of 20 to 40 per cent have been reported from different parts of the world. (Quebral and Lantican,1969, Legaspi *et al.*, 1978, Ayub Dey *et al.*, 1996). Losses are much higher when the infection takes place prior to flowering. However, infections at seedling stage result in complete loss of the crop. Mungbean crop is attacked by 64 species of insects (Lal, 1985). Much damage to *Kharif* season crop is caused at vegetative stage mostly the sucking pests like white flies (*Bemisia tabaci* Genn.), jassids (*Empoasca* spp.), aphids (*Aphis craccivora* Koch), leaf eating caterpillars and pod borers like Bihar leaf eating caterpillar, Red hairy caterpillar , tobacco leaf eating caterpillar (*Spodoptera litura)*, gram pod borer (*Helicoverpa armigera)*, legume pod borer (*Maruca testulalis*). Among them, whitefly is the most serious pest causing damage by sucking the sap from the leaves and also acts as the vector of mungbean yellow mosaic virus (MYMV) (Chhabra and Kooner 1981, Chhabra *et al.*, 1988, Lal, 1985 and Nariani, 1960).

Growing resistant varieties is the only economical and eco-friendly approach to combat these diseases and pests. Very few sources having combined resistant to Mungbean yellow mosaic virus and powdery mildew are available in mungbean. Therefore, efforts were made to identify new sources of resistance for use in breeding multiple disease resistant varieties.

MATERIAL AND METHODS

Twenty two mungbean germplasms were screened against powdery mildew and yellow mosaic at Pulses Improvement Project, MPKV, Rahuri, during *Kharif* 2005-06 to 2006-07. Each test entry was sown in a plot of two rows of 5 meter length with powdery mildew infector-cum-spreader row of highly susceptible check 'Kopergaon-1' after every two test entries and replicated twice in RBD design. In addition, two rows of infector were planted around the experimental plot. Dusting of spore mass with severely infected plants was also done in screening nursery to create epiphytotic conditions. The same germplas were evaluated against pests like white fly, jassid and pod damage, in RBD design with two

1. Scientist (Plant Pathology) 2.Scientist (Entomology), 3.Scientist (Agronomy) and 4. Principal Scientist, Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri

replication having plot size 5.0 x 0.60 m. i.e. two rows of each germplasms. Recommended cultural practices were followed to raise the crop. Genotype differences in the severity of infection were observed. Based on above parameters, a rating scale of 0-9 was used for powdery mildew reaction as described by Mayee and Datar 1985. The same genotypes were evaluated for yellow mosaic at the pod formation stage. The Kopergaon-1 is highly susceptible for yellow mosaic and was used as infector-cum-spreader row. Disease reactions were observed when the incidence was more than 90 per cent in susceptible check. The disease incidence was calculated as per the formula given by Mayee and Datar, (1985).

Similarly, observations on pests *viz*., white fly, Jassids and pod borer were taken. The observations on the incidence of white fly and jassids were recorded on five randomly sampled plants at 30 days after sowing, when the pest population was at its peak. Population count of white fly were taken with the help of split cylindrical cone (60 cm height and 45 cm diameter) which was made of wooden/ aluminum angle frame and covered with black cloth on all sides except one which was fitted with rectangular glass pane (285 cm x 585 cm) with bottom open. While taking observation, the glass pane side was kept facing the sun, so that the flies could migrate to the screen. Simultaneously, the number of jassids, nymphs and adults were also recorded on the glass screen. The observations on pod damage due to pod borers were recorded at harvest on five randomly sampled plants by counting the total number of healthy and damaged pods. From which per cent pod damage was calculated.

RESULTS AND DISCUSSION

Powdery mildew and yellow mosaic

Among twenty two germplasm, only three accessions *viz.*, Vaibhav, Phule Mung-2 and BPMR-145 showed resistant reaction for powdery mildew. Similarly, Phule Mung-2003-3, AKM-9801, AKM-9910, PM-2003-5, Vaibhav, PM-2, AKM-8802, TARM-18, BM-4 and J-781 showed moderately resistant reaction (0.1-10.00 %) for yellow mosaic. None of the entries was found to be combined resistant against both diseases i.e. powdery mildew and yellow mosaic disease. Some reports *viz.*, Singh *et. al.*, (2007), Agarwal and Nema (1998), Venu *et al.*, (1997) for identification of resistant sources of powdery mildew and yellow mosaic are available in literature. In present, resistant accessions for powdery mildew and moderately resistant genotypes for yellow mosaic can be utilized as donor parents in breeding programme.

White fly

The white flies mean population fluctuated from 3.25 pests population 5 plants^{-1} on BM-2004 to 10.00 pests population 5 plants^{-1} on Kopergaon-1 with the mean pest population of 5.64 $\pm$ 2.77. All the entries recorded minimum white flies population than check Vaibhav (8.00 pest population 5 plants^{-1}) except kopergaon-1. Out of 22 entries, 11 entries *viz*., Phule M-2003-3, BM-2004, AKM-9901, AKM-9911, AKM-9912, TAM-99-58, AKM-9910, PM-2003-5, AKM-8802, BM-4 and J-781 were found to be significantly promising against white flies over check Vaibhav.

Jassids

The data on surviving pest population of jassids showed that the mean jassids population among the test entries in between from 10.00 jassids 5 plants^{-1} on TARM-18 to 25.05 jassids 5 plants^{-1} on BM-2002-1 with the mean pest population of 16.73 $\pm$ 5.30. Only one entry TARM-18 found to be significantly minimum jassids population (10.00 jassids 5 plants^{-1}) than check Vaibhav (15.75 jassids 5 plants^{-1}). Among the test entries, nine entries *viz*., Phule M-2003-1, PM-2003-3, BM-2004, AKM-9911, AKM-9910, PM-2003-5, PM-2, AKM-8802 and TARM-18 recorded significantly less jassids population than the check Vaibhav (15.75 jassids 5 plants^{-1}) and which was at par with it.

Pod borers damage

The pod damage due to different pod borers among the test entries was between 7.95 per cent in Vaibhav to 22.12 per cent in TAM-99-58 with the mean pod damage of 11.08 $\pm$ 6.08 per cent. None of the entries found to be significantly less susceptible over check. However, the entries *viz*; AKM-9801, AKM-9906, AKM-9910, Kopergaon-1, BSMR-145 recorded minimum pod damage caused by pod borer in mungbean against check Vaibhav and at par with it.

Table 1 : Field reaction of mungbean genotypes against diseases and insect pests.

S.N.	Name of genotypes	Disease reaction (%)						Sucking pests population 5 plants^{-1}						Pod damage (%)		
		Powdery mildew			Yellow mosaic			Whiteflies			Jassids					
		2005-06	2006-07	Mean	2005-06	2006-07	Mean	2005-06	2006-07	Mean	2005-06	2006-07	Mean	2005-06	2006-07	Mean
1	Phule M-2003-1	25.11	41.25	33.18	25.12	36.66	30.89	9.50	6.00	7.75	20.00	4.00	12.00	13.20	26.73	19.97
2	Phule M-2003-3	33.98	28.00	30.99	3.12	7.48	5.30	6.00	4.00	5.00	14.50	16.5	15.50	13.20	21.66	17.43
3	BM-2002-1	33.84	40.00	36.92	14.12	13.93	14.03	6.50	7.50	7.00	34.50	15.60	25.05	11.47	28.12	19.80
4	BM-2003-2	33.43	35.50	34.47	70.80	36.49	53.65	7.00	9.00	8.00	23.50	14.00	18.75	14.43	21.33	17.88
5	BM-2004	26.66	38.00	32.33	15.85	13.85	14.85	3.50	3.00	3.25	12.00	18.50	15.25	10.00	27.43	18.72
6	AKM-9801	30.66	27.50	29.08	6.70	3.85	5.28	9.50	8.00	8.75	17.00	25.50	21.25	7.96	13.03	10.50
7	AKM-9901	25.00	26.25	25.63	18.00	2.27	10.14	5.00	2.50	3.75	19.00	14.00	16.50	15.93	20.48	18.21
8	AKM-9911	22.50	30.00	26.25	30.40	18.74	24.57	8.00	2.00	5.00	9.00	17.50	13.25	14.03	26.05	20.04
9	AKM-9912	33.61	36.25	34.93	15.00	9.92	12.46	4.50	3.50	4.00	19.50	17.00	18.25	13.98	27.76	20.87
10	TAM-98-37	29.54	64.00	46.77	40.80	20.83	30.82	9.00	8.50	8.75	25.00	22.00	23.50	11.26	26.14	18.70
11	TAM-99-58	33.43	56.25	44.84	19.00	5.00	12.00	8.00	2.50	5.25	20.50	23.00	21.75	22.91	21.32	22.12
12	AKM-9906	35.65	27.50	31.58	40.72	14.06	27.39	10.50	6.00	8.25	32.50	7.00	19.75	8.52	19.05	13.79
13	AKM-9910	31.11	31.25	31.18	8.00	5.71	6.86	5.50	2.00	3.75	14.00	17.50	15.75	13.54	12.88	13.21
14	PM-2003-5	27.12	29.25	28.19	3.12	6.25	4.69	6.00	3.00	4.50	15.00	12.50	13.75	11.06	21.15	16.11
15	PM-2	8.88	3.75	6.32	6.12	4.17	5.15	9.00	5.00	7.00	11.50	17.00	14.25	15.80	15.52	15.66
16	BSMR-145	8.32	6.00	7.16	40.72	27.62	34.17	6.00	6.50	6.25	30.00	17.50	23.75	17.42	10.49	13.96
17	AKM-8802	25.45	30.00	27.73	5.15	3.13	4.14	4.5	3.50	4.00	16.50	12.00	14.25	7.52	24.02	15.77
18	TARM-18	16.66	15.00	15.83	7.12	6.23	6.68	5.00	8.00	6.50	7.50	12.50	10.00	8.89	26.44	17.67
19	BM-4	36.66	38.00	37.33	6.85	3.85	5.35	8.00	3.00	5.50	14.50	18.50	16.50	7.49	27.43	17.46
20	J-781	35.65	32.25	33.95	8.14	7.14	7.64	6.50	2.50	4.50	16.50	18.50	17.50	12.36	19.71	16.04
21	Vaibhav (C)	7.66	7.50	7.58	7.20	10.00	8.60	6.00	10.00	8.00	14.50	17.00	15.75	9.51	6.38	7.95
22	Kopergaon-1 (C)	58.78	92.00	75.39	78.80	89.90	84.35	9.50	10.50	10.00	24.60	20.50	22.55	12.22	14.16	13.19
							Mean	13.71	11.65	5.86	17.89	17.10	16.73	11.80	14.33	11.08
							SD ±	7.25	7.39	2.27	7.87	10.58	5.30	6.82	7.78	6.05

LITERATURE CITED

Agarwal, S.C. and S. Nema, 1998. Resistance in mungbean and urdbean against powdery mildew, Indian J. Pulses Res., 2 : 76-77.

Ayub Dey T.K., M. Johan and M.Z. Rahman, 1996. Assessment of yield loss due to powdery mildew of blackgram, Bangladesh. J. Plant Pathol, 12:9-10.

Chhabra, K.S. and B.S. Kooner, 1981. Field resistance in black gram, *Vigan mungo* L. against insect - pests complex and yellow mosaic virus, Indian J. Entomology, 43 (3): 288-293.

Chhabra, K.S., B.S Kooner, A.K Sharma and A.K. Saxena, 1988. Sources of resistance in mungbean (Vigna) radiate) to insect pests and mungbean yellow mosaic virus. Proccding of the second International Symposium, Bangkok, Thioland.16-20 November, 1987: 308-314.

Lal, S.S., 1985. A review of insect pests of mungbean and their control in India. Tropical Pest Manage, 31 (2): 105-114.

Legaspi, B,M,, E.M. Catipon and J.N. Hubell, 1978. AVRDC Philippines Outreach Program, Mungbean Studies. In : Proceedings of First International Mungbean Symposium, Asian Vegetable Research and Development Centre, Shanhua, Taiwan. 220-223.

Mayee, C.D. and V.V. Datar,1985. Phytopathometry. Tech. Bull., 1, Marathwada Agric. Univ., Parbhani : 146.

Nariani, T.K., 1960. Yellow mosaic of mung (*Phaseolus aureus* L.) Indian Phytopathol., 13 : 24 - 29.

Quebral, F.C. and R.M. Lantican, 1969. Effects of benlate on powdery mildew and yield of mungbean, Agriculture at Los Banos, 9: 13-14.

Singh, R.A. Shivkumar, Sanjeev Gupta and B.B.Singh, 2007. Powdery mildew resistant sources in mungbean and their reaction to yellow mosaic disease, J. Food Legumes, 20 (1) 98-99.

Venu, C., C. Cheralu, S. Ali and A. Sadanandam, 1997. Screening for resistance to powdery mildew disease of mungbean (*Vigna radiate* (L.) Wilczek), Microbio Biotechnol,: 178-179.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Nutritional and Physiological Factors Responsible for Growth and Sclerotial Development of *Rhizoctonia bataticola*

Vanita N. Salunkhe[1], Sarika V. Armarkar[2] and R.W. Ingle[3]

ABSTRACT

Experiment was carried out to see the effect of nutritional and physiological factors on growth and sclerotial development of *Rhizoctonia bataticola* isolates. Out of six media tested, PDA supported the growth and sclerotial formation of *Rhizoctonia bataticola*, followed by Czapek's dox, Richard's, Oat meal and peptone agar media. Sclerotial formation on malt extract medium was moderate with poor mycelial growth whereas, peptone agar medium induced rare or no sclerotial formation. Among six carbon sources, highest growth was obtained in dextorse, followed by sucrose, mannitol, starch, maltose and cellulose. Sclerotial production in cellulose was maximum, followed by dextrose, sucrose, maltose, starch while, it was minimum in mannitol. Sodium nitrate proved better nitrogen source for growth and sclerotial formation than ammonium nitrate. All isolates gave maximum mycelial growth and sclerotial development at 35°C and minimum or rare at 20° and 40°C. There was no significant difference in radial growth at pH range 5 to 9, while pH 7.0 was suitable for the growth of pathogen.

A sclerotial fungus *Rhizoctonia bataticola* (Taub.) Butler (Pycnidial stage - *Macrophomina phaseolina* (Tassi) Goid) is an important pathogen on several crops distributed in many parts of the world. It causes complex disease syndromes like charcoal rot, collar rot, root rot, fruit rot, seed rot, dry rot, pod rot, stem blight, foliage blight, seedling blight, tuber decay, etc. Moisture stress and nutritional deficiency help the pathogen for developing symptoms in host plant.

The pathogen is seed as well as soil borne, causes severe losses mainly due to moisture stress (Arya *et al.*, 2004). The fungus has distinct vegetative (*Rhizoctonia bataticola*) and reproductive (*Macrophomina phaseolina*) stages. It was also observed that some isolates of *R. bataticola* (*M. phaseolina*) produce pycnidia on hosts but not in ordinary culture media. Others produce vegetative (sclerotial) stage only, both on hosts and in ordinary media. Some isolates were forming single celled, hyaline pycnidiospores.

Temperature and pH regimes have a major effect on cellular activities and growth of fungus. Different carbon and nitrogen sources were also responsible for morphological variations among isolates. Nutritional requirements provide better understanding of the host-parasite relationship. In present investigation *R. bataticola* isolates from four different hosts were studied for cultural, morphological, nutritional and physiological variability

MATERIAL AND METHODS

The samples of sorghum showing charcoal rot symptoms were collected from Sorghum Research Station. Sesamum (*Sesamum indicum*), sunflower (*Helianthus annus*) collar rot samples were collected from Oil Seed Research Station and cotton (*Gossypium* Spp.) root rot from Agronomy field of Dr. PDKV, Akola. These four isolates were used for nutritional and physiological study.

Nutritional study

Effect of different media

Potato dextrose agar, Czapek's dox, Richard's, Oat meal, Peptone agar, Malt extract media were tested for the growth and sclerotial development. Twenty ml of sterilized medium was poured in each sterilized petri plate and five mm discs of fungus were cut and one disc of the culture was placed in inverted position in the center of each Petri- plate. Three replications were made for each isolate. Inoculated plates were incubated at room temperature (27 ± 2°C).

1.M.Sc. Student , 2. Ph.D.Scholar, 3. Assistant Prof., Department of Plant Pathology, Dr. PDKV, Akola

Table 1. Response of *Rhizoctonia bataticola* isolates to different media for radial growth (mm) and sclerotial development

Isolates from Media	Sorghum			Sesamum			Sunflower			Cotton		
	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI
	16	17	18	19	20	21	22	23	24	1	2	3
Potato Dextrose Agar	52.00 (+++)	82.00 (+++)	90.00 (+++)	57.00 (+++)	87.00 (+++)	90.00 (+++)	55.00 (+++)	75.00 (+++)	90.00 (+++)	52.67 (+++)	90.00 (+++)	90.00 (+++)
Czapeck's Dox	38.00 (N)	77.00 (+)	90.00 (++)	44.00 (N)	74.00 (++)	90.00 (++)	33.00 (N)	70.00 (++)	83.67 (++)	39.33 (N)	75.67 (++)	90.00 (++)
Richard's	43.67 (++)	76.00 (+++)	90.00 (+++)	35.00 (++)	68.80 (+++)	90.00 (+++)	30.00 (++)	57.33 (+++)	90.00 (+++)	34.00 (++)	64.00 (+++)	90.00 (+++)
Peptone agar	19.00 (N)	38.67 (++)	58.67 (+++)	30.50 (N)	60.00 (++)	71.00 (++)	24.00 (N)	71.00 (++)	74.33 (++)	26.17 (N)	54.00 (++)	74.00 (++)
Oat meal	28.67 (N)	70.17 (++)	90.00 (++)	43.00 (N)	81.00 (+++)	90.00 (+++)	33.00 (+)	47.00 (+++)	90.00 (+++)	30.17 (+)	64.00 (+++)	90.00 (+++)
Malt extract	28.50 (+)	54.00 (++)	76.00 (+++)	27.00 (+++)	60.00 (+++)	81.00 (+++)	20.00 (+++)	53.00 (+++)	82.00 (+++)	18.17 (++)	39.67 (+++)	66.33 (+++)
SE (m) ±	0.73	1.24	1.01	0.67	0.71	0.33	0.71	11.67	1.28	1.07	1.08	0.54
CD P=0.01	3.15	5.38	4.33	2.87	3.05	1.44	3.05	50.40	5.52	4.64	4.65	2.32

Sclerotia formation

N : No formation

\+ : Rare (10-20 sclerotia per microscopic field)

++ : Medium (21-30 sclerotia per microscopic field)

+++ : Abundant (Above 30 sclerotia per microscopic field)

Table 2. Response of different *Rhizoctonia bataticola* isolates to carbon sources for radial growth (mm) and sclerotial development

Isolates from Carbon sources	Sorghum			Sesamum			Sunflower			Cotton		
	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI
	16	17	18	19	20	21	22	23	24	1	2	3
Sucrose	46.33 (+)	83.00 (++)	90.00 (+++)	44.83 (N)	78.65 (++)	90.00 (+++)	39.83 (N)	71.00 (++)	90.00 (+++)	37.67 (N)	72.00 (++)	90.00 (+++)
Dextrose	55.33 (++)	90.00 (+++)	90.00 (+++)	50.00 (+)	83.67 (++)	90.00 (+++)	44.63 (+)	73.00 (++)	90.00 (+++)	43.00 (+)	78.67 (++)	90.00 (+++)
Maltose	6.00 (+)	13.00 (++)	23.00 (++)	38.33 (+)	74.62 (++)	90.00 (++)	4.00 (+)	13.00 (++)	33.00 (++)	31.67 (+)	64.33 (++)	90.00 (++)
Starch	31.67 (+)	67.33 (++)	90.00 (+++)	38.60 (+)	77.33 (++)	90.00 (+++)	34.17 (+)	65.00 (++)	85.00 (+++)	33.00 (+)	67.33 (++)	90.00 (+++)
Mannitol	37.33 (N)	70.67 (+)	90.00 (++)	42.67 (N)	77.83 (+)	90.00 (++)	37.33 (N)	68.00 (+)	90.00 (++)	37.33 (N)	70.67 (+)	90.00 (++)
Cellulose	23.00 (++)	52.00 (+++)	72.00 (+++)	29.00 (++)	69.00 (+++)	82.00 (+++)	20.17 (++)	54.00 (+++)	84.00 (+++)	23.33 (++)	62.00 (+++)	84.00 (+++)
SE (m) ±	0.93	1.04	0.85	1.26	1.66	0.47	1.22	0.94	0.82	0.88	0.79	0.24
CD P=0.01	3.96	4.48	3.66	5.42	7.13	2.01	5.24	4.05	3.59	3.75	3.42	1.01

Sclerotia formation

N : No formation

\+ : Rare (10-20 sclerotia per microscopic field)

++ : Medium (21-30 sclerotia per microscopic field)

+++ : Abundant (Above 30 sclerotia per microscopic field)

The mycelial growth was measured after 3rd, 5th and 7th days after inoculation. The observations on redial mycelial growth and the time required for the initiation of scelrotia were recorded in all the aspects studied. The number of sclerotia microscopic^{-1} field was counted and categorized (Das, 1988).

Effect of different carbon sources

Czapek's dox was used as basic medium for nutritional study. Sucrose as carbon source was substituted by different sources *viz.*, dextrose, maltose, mannitol, starch, cellulose, on the basis of molecular weight. For each isolate three replications were maintained. The inoculated plates were incubated at room temperature up to 7 days.

Effect of nitrogen sources

Sodium nitrate, a source of nitrogen of Czapek's dox medium was substituted by ammonium nitrate on the basis of molecular weight.

Physiological study

Effect of temperature

Sterilized Petri-plates poured with autoclaved PDA were placed at 20, 25, 30, 35and 40°C in an incubator to get medium acclimatized to that particular temperature prior to inoculation. After 24 hrs, poured Petri-plates were inoculated centrally each with 5 mm disc of the different *R. bataticola* isolates. Inoculated plates were re-incubated at the respective temperature with three replications for each isolate.

Effect of pH

The initial pH of potato dextrose agar was adjusted at 5, 6, 7, 8, 9 with the help of 0.1 N HCl or 0.1 N NaOH prior to autoclaving. Sterilized Petri-plates were poured with this media and inoculated with 5 mm disc of mycelial culture of *R. bataticola* isolates separately. For each isolate three replications were made. Inoculated plates were incubated at 27 ± 2°C temperature.

RESULTS AND DISCUSSION

Six culture media were tested and the results are presented in Table 1.Growth of fungus on all the six media was found significantly different from each other. PDA was found best medium for growth and sclerotial formation of *R. bataticola* isolates over other media. All isolates showed maximum mycelial growth on PDA (82.00, 87.00, 75.00 and 90.00 mm in isolates of sorghum, sesamum, sunflower and cotton at 5 DAI, respectively), followed by Czapek's dox, Richard's, oat meal and peptone agar while poor on malt extract with medium sclerotial formation. Suriachandraselvan and Seetharaman (2003) and Sharma *et. al.*, (2004) also reported that, PDA was the best medium for growth and sclerotial formation of *R. bataticola*. El-Wakil *et al.*, (1985) stated that dextrose probably supported the growth of pathogen. However, other media *viz.*, Czapek's dox agar and Richard's medium were known to supported good growth of *M. phaseolina* (Mishra and Sinha, 1982).

Among six carbon sources tested, significantly highest growth of all isolates was supported by dextrose (90.00, 83.67, 73.00 and 78.67 mm in isolates of sorghum, sesamum, sunflower and cotton at 5 DAI, respectively), followed by sucrose, mannitol, starch, maltose and cellulose. Mycelial growth in cellulose was poor while sclerotial formation was maximum followed by dextrose, sucrose, maltose,

Table 3. Effect of nitrogen sources on radial growth (mm) and sclerotial formation of isolates of *R. bataticola*

Nitrogen sources	Sodium nitrate			Ammonium nitrate		
Isolates from	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI
Sorghum	46.33	83.00	90.00	35.11	62.33	90.00
	(N)	(+)	(++)	(N)	(N)	(+)
Sesamum	44.25	78.67	90.00	34.27	55.67	88.67
	(N)	(++)	(++)	(N)	(N)	(+)
Sunflower	39.67	67.00	90.00	29.33	50.67	82.33
	(N)	(++)	(++)	(N)	(N)	(+)
Cotton	37.67	72.00	90.00	21.43	46.67	74.33
	(N)	(++)	(++)	(N)	(N)	(+)

Table 2. Response of different *Rhizoctonia bataticola* isolates to carbon sources for radial growth (mm) and sclerotial development

Isolates from Carbon sources	Sorghum			Sesamum			Sunflower			Cotton		
	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI
	16	17	18	19	20	21	22	23	24	1	2	3
Sucrose	46.33 (+)	83.00 (+ +)	90.00 (+ + +)	44.83 (N)	78.65 (+ +)	90.00 (+ + +)	39.83 (N)	71.00 (+ +)	90.00 (+ + +)	37.67 (N)	72.00 (+ +)	90.00 (+ + +)
Dextrose	55.33 (+ +)	90.00 (+ + +)	90.00 (+ + +)	50.00 (+)	83.67 (+ +)	90.00 (+ + +)	44.63 (+)	73.00 (+ +)	90.00 (+ + +)	43.00 (+)	78.67 (+ +)	90.00 (+ + +)
Maltose	6.00 (+)	13.00 (+ +)	23.00 (+ +)	38.33 (+)	74.62 (+ +)	90.00 (+ +)	4.00 (+)	13.00 (+ +)	33.00 (+ +)	31.67 (+)	64.33 (+ +)	90.00 (+ +)
Starch	31.67 (+)	67.33 (+ +)	90.00 (+ + +)	38.60 (+)	77.33 (+ +)	90.00 (+ + +)	34.17 (+)	65.00 (+ +)	85.00 (+ + +)	33.00 (+)	67.33 (+ +)	90.00 (+ + +)
Mannitol	37.33 (N)	70.67 (+)	90.00 (+ +)	42.67 (N)	77.83 (+)	90.00 (+ +)	37.33 (N)	68.00 (+)	90.00 (+ +)	37.33 (N)	70.67 (+)	90.00 (+ +)
Cellulose	23.00 (+ +)	52.00 (+ + +)	72.00 (+ + +)	29.00 (+ +)	69.00 (+ + +)	82.00 (+ + +)	20.17 (+ +)	54.00 (+ + +)	84.00 (+ + +)	23.33 (+ +)	62.00 (+ + +)	84.00 (+ + +)
SE (m) ±	0.93	1.04	0.85	1.26	1.66	0.47	1.22	0.94	0.82	0.88	0.79	0.24
CD P=0.01	3.96	4.48	3.66	5.42	7.13	2.01	5.24	4.05	3.59	3.75	3.42	1.01

Sclerotia formation

N : No formation

\+ : Rare (10-20 sclerotia per microscopic field)

++ : Medium (21-30 sclerotia per microscopic field)

+ + + : Abundant (Above 30 sclerotia per microscopic field)

The mycelial growth was measured after 3rd, 5th and 7th days after inoculation. The observations on redial mycelial growth and the time required for the initiation of scelrotia were recorded in all the aspects studied. The number of sclerotia microscopic^{-1} field was counted and categorized (Das, 1988).

Effect of different carbon sources

Czapek's dox was used as basic medium for nutritional study. Sucrose as carbon source was substituted by different sources *viz.*, dextrose, maltose, mannitol, starch, cellulose, on the basis of molecular weight. For each isolate three replications were maintained. The inoculated plates were incubated at room temperature up to 7 days.

Effect of nitrogen sources

Sodium nitrate, a source of nitrogen of Czapek's dox medium was substituted by ammonium nitrate on the basis of molecular weight.

Physiological study

Effect of temperature

Sterilized Petri-plates poured with autoclaved PDA were placed at 20, 25, 30, 35and 40°C in an incubator to get medium acclimatized to that particular temperature prior to inoculation. After 24 hrs, poured Petri-plates were inoculated centrally each with 5 mm disc of the different *R. bataticola* isolates. Inoculated plates were re-incubated at the respective temperature with three replications for each isolate.

Effect of pH

The initial pH of potato dextrose agar was adjusted at 5, 6, 7, 8, 9 with the help of 0.1 N HCl or 0.1 N NaOH prior to autoclaving. Sterilized Petri-plates were poured with this media and inoculated with 5 mm disc of mycelial culture of *R. bataticola* isolates separately. For each isolate three replications were made. Inoculated plates were incubated at 27 ± 2°C temperature.

RESULTS AND DISCUSSION

Six culture media were tested and the results are presented in Table 1.Growth of fungus on all the six media was found significantly different from each other. PDA was found best medium for growth and sclerotial formation of *R. bataticola* isolates over other media. All isolates showed maximum mycelial growth on PDA (82.00, 87.00, 75.00 and 90.00 mm in isolates of sorghum, sesamum, sunflower and cotton at 5 DAI, respectively), followed by Czapek's dox, Richard's, oat meal and peptone agar while poor on malt extract with medium sclerotial formation. Suriachandraselvan and Seetharaman (2003) and Sharma *et. al.*, (2004) also reported that, PDA was the best medium for growth and sclerotial formation of *R. bataticola*. El-Wakil *et al.*, (1985) stated that dextrose probably supported the growth of pathogen. However, other media *viz.*, Czapek's dox agar and Richard's medium were known to supported good growth of *M. phaseolina* (Mishra and Sinha, 1982).

Among six carbon sources tested, significantly highest growth of all isolates was supported by dextrose (90.00, 83.67, 73.00 and 78.67 mm in isolates of sorghum, sesamum, sunflower and cotton at 5 DAI, respectively), followed by sucrose, mannitol, starch, maltose and cellulose. Mycelial growth in cellulose was poor while sclerotial formation was maximum followed by dextrose, sucrose, maltose,

Table 3. Effect of nitrogen sources on radial growth (mm) and sclerotial formation of isolates of *R. bataticola*

Nitrogen sources	Sodium nitrate			Ammonium nitrate		
Isolates from	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI
Sorghum	46.33	83.00	90.00	35.11	62.33	90.00
	(N)	(+)	(++)	(N)	(N)	(+)
Sesamum	44.25	78.67	90.00	34.27	55.67	88.67
	(N)	(++)	(++)	(N)	(N)	(+)
Sunflower	39.67	67.00	90.00	29.33	50.67	82.33
	(N)	(++)	(++)	(N)	(N)	(+)
Cotton	37.67	72.00	90.00	21.43	46.67	74.33
	(N)	(++)	(++)	(N)	(N)	(+)

Table 4. Effect of temperature levels on radial growth (mm) and sclerotial formation of isolates of *Rhizoctonia bataticola*

Isolates from Temp °C	Sorghum			Sesamum			Sunflower			Cotton		
	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI
	16	17	18	19	20	21	22	23	24	1	2	3
20	22.67 (N)	62.72 (+)	82.07 (+)	30.00 (N)	43.00 (+)	63.00 (+)	33.00 (N)	53.33 (+)	73.20 (+)	28.00 (N)	56.00 (+)	86.00 (+)
25	32.00 (+)	72.50 (+ +)	90.00 (+ + +)	35.67 (+)	67.00 (+ +)	90.00 (+ + +)	43.00 (+)	63.30 (+ +)	83.25 (+ + +)	36.67 (+)	76.67 (+ +)	90.00 (+ + +)
30	47.00 (+ +)	78.62 (+ +)	90.00 (+ + +)	53.00 (+ +)	83.00 (+ + +)	90.00 (+ + +)	51.67 (+ +)	80.60 (+ + +)	90.00 (+ + +)	45.00 (+ +)	90.00 (+ + +)	90.00 (+ + +)
35	57.17 (+ + +)	90.00 (+ + +)	90.00 (+ + +)	59.00 (+ + +)	90.00 (+ + +)	90.00 (+ + +)	55.83 (+ + +)	90.00 (+ + +)	90.00 (+ + +)	52.00 (+ + +)	90.00 (+ + +)	90.00 (+ + +)
40	52.07 (N)	84.00 (N)	90.00 (+)	54.60 (N)	77.33 (N)	90.00 (+)	50.30 (N)	80.03 (N)	90.00 (+)	42.00 (N)	86.00 (N)	90.00 (+)
SE (m) ±	1.47	1.03	0.65	0.88	1.11	0.52	0.92	0.94	0.56	0.65	0.54	0.26
CD P=0.01	6.56	4.63	2.91	3.93	4.94	2.31	4.12	4.21	2.50	2.92	2.41	1.14

Table 5. Effect of pH levels on radial growth (mm) of isolates of *Rhizoctonia bataticola*

Isolates from pH	Sorghum			Sesamum			Sunflower			Cotton		
	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI
	16	17	18	19	20	21	22	23	24	1	2	3
5	43.17	65.67	88.83	45.83	68.50	88.17	40.17	63.50	88.50	44.00	69.17	87.50
6	47.00	67.10	89.50	47.67	69.80	89.50	41.00	64.33	89.00	49.33	70.33	90.00
7	47.60	68.27	90.00	51.00	71.33	90.00	42.33	64.80	90.00	52.50	71.30	90.00
8	46.83	67.50	89.25	48.60	70.50	90.00	41.30	63.25	90.00	49.00	70.50	90.00
9	45.35	66.55	88.17	47.00	69.67	89.33	40.83	63.00	89.00	42.00	69.83	88.50
SE (m) ±	0.57	0.72	0.38	0.93	0.56	0.21	0.65	0.45	0.45	0.79	0.53	0.18
CD P=0.01	2.57	3.23	1.71	4.15	2.50	0.95	2.92	1.99	1.99	3.53	2.41	0.82

starch (Table 2). In mannitol, sclerotia development was reduced. El-Wakil *et al.* (1985) and Lakpale *et al.* (1995) reported dextrose as a best source of carbon, followed by mannitol and starch for mycelial growth and sclerotial production. However, Das (1988) reported highest sclerotial production in sucrose and moderate in dextrose.

Sodium nitrate was the best source of nitrogen as compared to ammonium nitrate (Table 3). Mycelial growth was faster in sodium nitrate (83.00, 78.67, 67.00 and 72.00 mm in isolates of sorghum, sesamum, sunflower and cotton at 5 DAI, respectively) than ammonium nitrate. All isolates were unable to induce the formation of sclerotia till third day of incubation. In ammonium nitrate rate of sclerotial formation was low as compared to sodium nitrate. Results of present investigation are in conformity with Lakpale *et. al.*, (1995) reported asparagine as a best nitrogen source for growth and sclerotial production of *R. solani,* followed by potassium nitrate, sodium nitrate and ammonium nitrate.

R. bataticola isolates were able to grow between the temperature range of 20°C to 40°C. Maximum growth was observed at 35°C (57.17, 59.00, 55.83 and 52.00 mm in isolates of sorghum, sesamum, sunflower and cotton at 3 DAI, respectively) and minimum at 20°C. Mycelial growth rate increased as temperature extended from 20°C to 35°C. The maximum sclerotial production in most of the isolates was recorded at 35°C and almost no sclerotial formation at 20°C and 40°C (Table 4). Ratnoo and Bhatnagar (1991), Sahi *et al.* (1992), Sharma *et al.* (2004) and Jha and Sharma (2005) reported the optimum temperature i,e. 30-35°C for the growth and sclerotial production of *R.. bataticola* with decreased mycelial growth at 40°C. These observations correlate the present findings.

There were no significant differences in radial mycelial growth in isolates at pH range of 5 to 9 (Table 5). But at pH 7.0 growths of all isolates was comparatively superior (68.27, 71.33, 64.80 and 71.30 mm in isolates of sorghum, sesamum, sunflower and cotton at 5 DAI, respectively). These results are in agreement with those of Sharma *et al.* (2004), and Jha and Sharma (2005) who reported pH 7 as optimum for good growth and sclerotial formation of *R. bataticola.*

LITERATURE CITED

Arya, V. K., K. Vishunavat and H. Negi, 2004. Detection, location and transmission of seed borne inoculum of *Macrophomina phaseolina* in charcoal rot of soybean, J. Mycol. Pl. Pathol., 34(2) : 233-237.

Das, N. D., 1988. Effect of different sources of carbon, nitrogen and temperature on the growth and sclerotial production of *Macrophomina phaseolina* (Tassi.) Goid, causing root rot/ charcoal rot of castor, Indian J. Mycol. Pl. Pathol. 6 : 97-98.

El-Wakil, A. A., I. A. Radwan, M. A. Zayed and M. M. Satour, 1985. Morphological and cultural characteristics of some isolates of *Sclerotium bataticola* (Taub.), Agric. Res. Rev., 63 : 71-88.

Jha, K. M. and N. D. Sharma, 2005. Influence of temperature and pH affecting *Rhizoctonia bataticola* (Taub.) Butler, JNKVV Res. J., 39(1) : 69-73.

Lakpale, N., V. S. Thrimurty and K. C. Agarwal, 1995. *In vitro* response of paddy isolate of *Rhizoctonia solani* to different carbon and nitrogen sources, J. Mycol. Pl. Pathol., 25(3) : 291.

Mishra, B. and S. K. Sinha, 1982. Studies of wilt of linseed caused by *Rhizoctonia bataticola*. Indian Phytopathol., 35(4) : 555-557.

Ratnoo, R. S. and M. K. Bhatnager, 1991. Growth requirements of *Macrophomina phaseolina*, ashy grey stem blight of cowpea, Indian J. Mycol. Pl. Pathol., 21 : 110.

Sahi, S. T., A. S. Shakir; M. N. Bajawa and Intizar-ul-Hassan, M., 1992. Physiological studies on *Macrophomina phaseolina* (Tassi.) Goid causing dry rot of mungbean, J. Agric. Res. (Pakistan)., 30(3) : 40-43.

Sharma, Y. K., R. B. Gaur and H. R. Bisnoi, 2004. Cultural, morphological and physiological variability in *Macrophomina phaseolina*, J. Mycol. Pl. Pathol., 34(2) : 532-533.

Suriachandraselvan, M. and K. Seetharaman, 2003. Effect of culture media on growth and sclerotial production of different isolates of *Macrophomina* infecting sunflower, J. Mycol. Pl. Pathol., 33(2) : 226-229.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

In Vitro Clonal Propagation of Kagzi Lime

Ekta D. Shinde[1], N. D. Jogdande[2], D. B. Dhumale[3] and H. V. Ingle[4]

ABSTRACT

The present experiment was undertaken to develop an *In vitro* technique for rapid multiplication of Kagzi lime citrus aurantifolia, Osbeck cv. PDKV lime using axillary buds of mature trees. Nodal segments of 1-1.5 cm size with one axillary bud, after surface sterilization were established on MS media supplemented with BAP ranging from 0.25 to 1.0 mgl^{-1} with an increment of 0.25 mgl^{-1} and NAA 0.1 mgl^{-1} for shoot proliferation. Maximum number of multiple shoots with longest shoots and optimum number of leaves were obtained with BAP 1.0 mgl^{-1}. The maximum number of roots $shoot^{-1}$ were produced *In vitro* regenerated shoots on MS medium supplemented with NAA and IBA each at 1.0 mgl^{-1}. Rooted plants were transferred to soilrite for hardening and further establishment.

Citrus trees are propagated by seeds and vegetative means. Vegetative propagation is preferred because it ensures true to type plants, uniform quality, regular bearing, etc. Not withstanding its merits, seed propagation is still in vogue in case of certain citrus species like acid limes, wherein the intensity of polyembryony is more (Rajput and Hari Babu, 1985) and large percentage of seedlings are nucellar in origin (Frost and Soost, 1968). But nucellar seedlings possess long juvenility excessive vigour, thorniness, etc. Moreover, they are difficult to identify from zygotic plants morphologically at early growth stages. The methods available for their identification are not sufficiently reliable and are laborious (Singh *et. al.*, 1994). The application of *In vitro* micropropagation, hastens the timely increase and availability of planting material of newly evolved variety as well as quicker spread. *Kagzi* lime cv. PDKV lime is a recommended variety of Dr. PDKV, Akola, for its high yield and superior quality fruit production. However, the *in vitro* technique for the propagation of PDKV lime has not been developed so far. Moreover, in past, whatever reports have been made in general, seedlings have been used as the explant material. With most heterozygous woody species, approach using explant material from adult trees would be of dubious value for clonal propagation. Hence, the present study was undertaken to develop an *in vitro* technique for rapid multiplication of *Kagzi* lime cv. PDKV lime using explants of mature trees.

MATERIAL AND METHODS

In vitro clonal propagation of *Kagzi* lime was undertaken at Tissue Culture Laboratory, Dr. PDKV, Akola, during 2003-04 and 2004-05. Nodal segments of 1-1.5 cm with one axillary bud were excised from the mature field grown trees. Axillary buds were thoroughly washed with tap water and detergent for 10 min. and then surface sterilized with $HgCl_2$ 0.1 per cent for 10 min. After washing with sterile distilled water, they were cultured on basal MS medium for establishment. MS medium supplemented with BAP ranging from 0.25 to 1.0 mgl^{-1} with an increment of 0.25 mgl^{-1} and NAA 0.1 mgl^{-1} was used for proliferation of shoots. The pH of the medium was 5.8 prior to autoclaving at 15 $Lbin^{-2}$ for 20 min. The media contained 0.8 per cent agar and 3 per cent sucrose. Each treatment consisted of eight glass bottle cultures were maintained at 25 ± 1°C with 16 h light. Observations on shoot number, shoot length and number of leaves on longest shoot were recorded, after six weeks of inoculation. Multiple shoots were separated and individually transferred to rooting media, consisting of different combination of auxins. Observations regarding number of days required for root initiation, number of roots per shoot, length of longest root, were also recorded. The rooted shoots were transferred on soilrite and kept for hardening. The data were analyzed by completely randomized block design.

RESULTS AND DISCUSSION

The results presented in Table 1, revealed that, maximum number of multiple shoots per explant was obtained in MS + BAP 1.0 mgl^{-1}. Similar results have been reported by Kumar *et al.* (2001 a,b), who found maximum shoot proliferation with BAP 1.0 m gl^{-1}.

As regards the length of longest shoot, maximum length was noticed in MS + BAP 1.0 mgl^{-1}

1. Assistant Prof. , Shri Shivaji College of Horticulture, Amravati, 2. Sr. Horticulturist, 3. Professor, and 4. Rtd. Associate Prof., Department of Horticulture, Dr. PDKV, Akola.

Table 1 : Effect of BAP alone or in combination with NAA on proliferation of shoots from axillary buds of mature trees in *Kagzi* lime cv. PDKV lime*

Treatments no.	Media composition	Mean no. of multiple shoots/explant	Mean length of longest shoots (cm)	Mean no. of leaves on longest shoots
PM_1	MS+BAP 0.25 mg l^{-1}	7.00	1.28	8.25
PM_2	MS+BAP 0.25 mg l^{-1} + NAA 0.10 mg l^{-1}	6.62	0.95	6.87
PM_3	MS+BAP 0.50 mg l^{-1}	8.12	1.08	8.00
PM_4	MS+BAP 0.50 mg l^{-1} + NAA 0.10 mg l^{-1}	8.37	1.33	10.62
PM_5	MS+BAP 0.75 mg l^{-1}	8.62	1.07	8.75
PM_6	MS+BAP 0.75 mg l^{-1} + NAA 0.10 mg l^{-1}	7.12	1.11	8.87
PM_7	MS+BAP 1.0 mg l^{-1}	11.50	1.56	8.50
PM_8	MS+BAP 1.0 mg l^{-1} + NAA 0.10 mg l^{-1}	11.12	1.50	9.00
S. E. (m) ±		0.29	0.05	0.30
C. D. at 5%		0.89	0.16	0.89

*Observations recorded 6 weeks after inoculation.

Table 2 : *In vitro* response of shoots derived from axillary buds of mature trees to different media compositions for rooting in *Kagzi* lime cv. PDKV lime#.

Treatments no.	Media composition	% rooting*	Mean no. of days required for root induction	Mean no. of roots/ shoot	Mean length of longest roots (cm)	Root growth
RM_1	¼ MS + NAA 0.1 mg l^{-1}	11.66	25.25	1.75	1.27	++
RM_2	¼ MS + NAA 0.5 mg l^{-1}	25.00	26.25	1.75	2.17	++
RM_3	¼ MS + IBA 0.2 mg l^{-1}	10.83	24.25	1.25	2.02	++
RM_4	¼ MS + IBA 0.5 mg l^{-1}	13.60	23.25	1.50	3.27	++
RM_5	½ MS + NAA 0.2 mg l^{-1}	23.74	19.00	3.25	1.67	+++
RM_6	½ MS + NAA 2.0 mg l^{-1}	52.50	22.75	2.50	1.15	+++
RM_7	MS + NAA 1.0 mg l^{-1} + IBA 1.0 mg l^{-1}	63.33	25.00	7.25	1.72	++++
RM_8	MS + NAA 5.0 mg l^{-1}	54.16	27.00	3.00	2.92	+++
RM_9	MS + NAA 10.0 mg l^{-1}	41.66	33.50	2.00	4.82	+++
RM_{10}	MS + IBA 2.0 mg l^{-1}	14.16	28.50	2.75	1.22	+++
RM_{11}	MS + IBA 3.0 mg l^{-1}	18.33	29.75	5.75	1.45	++++
S. E. (m) ±		0.46	0.29	0.07		
C. D. at 5%		1.37	0.86	0.22		

* Unreplicated data

Observations recorded 10 weeks after inoculation.

++ Fair (One or two healthy roots)

+++ Good (Few, thick and healthy roots)

++++ Very good (Thick, healthy and profused roots)

. This is in agreement with the findings reported by Bhat *et al.* (1992). They reported that, inclusion of BAP upto 1.0 mg l^{-1} in the medium enhanced shoot elongation. Kumar *et. al.*, (2001[b]) also obtained maximum shoot length of Kinnow mandarin in MS + BAP 1.0 mgl^{-1}. Thus, it was observed in the present study that, MS + BAP 1.0 mg l^{-1} was best proliferation media giving highest number of multiples with longest shoots and optimum number of leaves. Similar observations were recorded by Kumar *et. al.*, (2001[a,b]) and Almeida *et. al.*, (2002). Further, it was observed that NAA in combination with different concentrations of BAP either increased or decreased number of multiple shoots, length of longest shoots and number of leaves. Similar kind of results were also reported by Al – Bahrany (2002).

It is evident from Table 2 that, earliest root induction occurred in ½ MS + NAA 0.2 mgl^{-1}. Whereas, maximum length of longest roots was recorded in MS + NAA 10.0 mgl^{-1}. This is in agreement with Duran – Vila *et. al.* (1989).

Highest rooting percentage with maximum number of roots $shoot^{-1}$ was noticed in MS + NAA 1.0 mg l^{-1} + IBA 1.0 mg l^{-1}. Similar response was also reported by Can *et. al.*, (1992) in Sour orange. The same media was responsible for the production of profused and very good growth of thick and healthy roots.

The *In vitro* technique developed through this study could be used for the faster multiplication of PDKV lime plants using the axillary buds from mature trees.

LITERATURE CITED

Al-Bahrany, A. M., 2002. Effect of phytohormones on *in vitro* shoot multiplication and rooting of lime *Citrus aurantifolia* (Christm), Swing. Scientia Hortic., 95(4):285-295.

Almeida, W.A. B.de, A. A. F. de-Mourao-Filho, B.M.J. Mender and A.P.M. Rodriguez, 2002, *In vitro* organogenesis optimization and plantlet regeneration in *Citrus sinensis* and *C. limonia,* Scienntia – Agricola. 59(1):35-40.

Bhat, S. R., P. Chitralekha and K.P.S. Chandel, 1992. Regeneration of plants from long-term root culture of lime, *Citrus aurantifolia* (Christm.) Swing. Plant Cell Tis. Org. Cult. 29(1) : 19-25.

Can, C., N. K. Koc and A. Cinar, 1992. *In vitro* clonal propagation of Sour orange (*Citrus aurantium* var. Brezilia) by using epicotyl segments. Doga Turk Tarim Ve Ormancilik Dergisi. 16(1) : 132-139.

Duran – Vila, N., M. Chambra, V. Medina, C. Ortega and L. Navarrao, 1989. Growth and morphogenesis of citrus tissue cultures infected with citrus tristeza virus and citrus infectious variegation virus, Phytopathol. 79 : 820 – 826.

Frost, H. B. and R. K. Soost, 1968. Seed reproduction : Development of gametes land embryos. In : Reuther, W.; L.D. Batchelor and H. J. Webber (eds.) The Citrus Industry, Vol. II. Berkley. University California Press : 290-324.

Kumar, K., A. S. Dhatt and M.I.S. Gill, 2001[a]. *In vitro* plant regeneration in Sweet orange (*Citrus sinensis* L. Osbeck) cv. Mosambi and Jaffa., Indian J. Hortic. 58(3) : 208-211.

Kumar, K., A. S. Dhatt and M.I.S. Gill, 2001[b]. *In vitro* plant regeneration in Kinnow mandarin (*Citrus nobilis* Lour. X *C. deliciosa* Tenora), Indian J. Hortic. 58(4) : 299-302.

Rajput, C.B.S. and R. Sri Hari Babu,1985. Propagation. In : Citriculture, Kalyani Pub., Ludhiana : 89.

Singh, S., B. K. Ray, S. Bhattacharya and P. C. Deka, 1994. *In vitro* propagation of *Citrus reticulata* Blanco and *Citrus limon* Burm F, Hortsci., 29 : 214-216.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Effect of Nitrogen and Phosphorous on Garlic Yield

S. P. Wakale[1], S. M. Ghawade[2] and S. W. Jahagirdar[3]

ABSTRACT

The experiment was conducted during the year 2007-08 on Agrifound white variety of garlic to find out the optimum dose of nitrogen and phosphorous. The yield and yield contributing characters like bulb weight, size of bulb, clove index and cloves per bulb were found maximum with application of 150 kg nitrogen and 75 kg phosphorous ha^{-1}. While in present investigation, an application of 129.10 kg nitrogen and 75 kg phosphorous ha^{-1} was considered as economically optimum. The maximum benefit cost ratio was 2.28 and 1.72 with an application of 100 kg nitrogen and 50 kg phosphorous ha^{-1}, respectively.

Garlic *(Allium satiuum* L.) belongs to family Alliaceae. It is most important spice crop used for flavouring and seasoning of vegetable dishes throughout the world and in preparing *chutneys*, pickles, curry powder, tomato ketchup, etc. It has higher nutritive value than other bulb crops. Nutrient plays an important role in improving productivity and quality of garlic bulbs. Nitrogen increases vigour of the plant, assimilating area, size of bulb and clove. Phosphorous is an equally essential nutrient as a constituent of nucleoproteins, enzymes and high energy bonds. The judicious use of chemical fertilizers is one of the well known tools for the maximization of bulb yield through their proper, rational and optimum doses (Naidu *et al,* 2000). The present investigation was, therefore, conducted to find out the optimum dose of nitrogen and phosphorous for obtaining better yield of garlic.

MATERIAL AND METHODS

The present investigation was conducted at Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experiment was laid out in a Factorial Randomized Block Design with four replications. Four levels of nitrogen (0, 50, 100 and 150 kg ha^{-1}) and phosphorous (0, 25, 50, 75 kg ha^{-1}) were tested with potassium 50 kg ha^{-1} as common dose. The garlic variety Agrifound White (G-41) was used. The garlic cloves were planted at 10 x 10 cm spacing in flat bed of plot size 3x1 m dimension on 18th October, 2007.

FYM @ 25 t ha^{-1}, half dose of nitrogen in the form of urea, full dose of phosphorous in the form of single super phosphate and full dose of potassium in the form of murate of potash (as per treatment), to each plot were applied as basal dose at the time of planting. Remaining half dose of nitrogen was applied as a top dressing, after one month from the date of planting.

The observations on yield and yield attributing parameters were recorded at harvest.

Estimation of physical optimum dose

The physical optimum dose of nitrogen and phosphorous was worked out with following quadratic equation as suggested by Gomez and Gomez(1984).

$Y = a + b1N + b2 P + b3 N2 + b4P2 + b5 NP$

Where, Y = Yield (q ha^{-1})

a= Intercept,

bl ..... b5 are coefficients

Estimation of economic optimum dose

The economic optimum dose of nitrogen and phosphorous was worked out with the following equation.

$$X = \frac{q - pb}{2\,PC}$$

Where,

X = Economic optimum dose of nitrogen and phosphorous

q = Price of output i.e. garlic bulb @ Rs.q^{-1}

p = Price of input i.e. nitrogen @ Rs. q^{-1} or phosphorous @ Rs.q^{-1}

For nitrogen b = bi, c = b3

For phosphorous b = b2, c = b4

1. M.Sc. Student, Department of Horticulture. 2. Assistant Prof. of Horticulture 3. Associate Prof. of Statistics, Dr. PDKV, akola

Estimation of predicted yield

The maximum predicted yield at physical and economic optimum dose calculated by substituting coefficient of optimum values of N & P.

RESULTS AND DISCUSSION

Effect of nitrogen

The data presented in Table 1 revealed that, an application of 150 kg nitrogen ha^{-1} produced the maximum fresh (111.04 q ha^{-1}) and cured (100.62 q ha^{-1}) bulb yield, bulb weight (18.24 q), diameter of bulb (3.16 cm), length of bulb (4.11 cm) and cloves per bulb (21.28). Whereas an application of 100 kg nitrogen ha^{-1} produced 110.42 q ha^{-1} fresh and 100.20 q ha^{-1} cured bulb yield, which were at par with 150 kg nitrogen ha^{-1} (N3). The yield and yield attributes increased with each incremental level of nitrogen. This might be due to the supply of optimum dose of nitrogen, which helped in assimilation of more carbohydrates due to higher photosynthetic activities. These results are in agreement with Kunwar and Pandey (1992), Reddy *et al.*, (2000), Kumar *et. al.*, (2002) and Singh and Singh (2006) in garlic.

Effect of phosphorous

The data presented in Table 1 indicated that, an application of 75 kg phosphorous ha^{-1} produced the maximum fresh (91.70 q ha^{-1}) and cured (83.60 q ha^{-1}) bulb yield, bulb weight (17.88 q), diameter (3.06 cm) and length (4.02 cm) of bulb and cloves per bulb (20.47). While application of 50 kg phosphorous ha^{-1} produced 91.15 q ha^{-1} fresh and 83.19 q ha^{-1} cured bulb yield which were at par with 50 kg phosphorous ha^{-1}(P2).

This increasing trend of yield, length, diameter and bulb weight might be due to increase in uptake of phosphorous and other nutrients which favoured the better nutrition for optimum growth and development. Application of phosphorous along with nitrogen enhanced the root initiation that improved better utilization of moisture and food material and translocation of these material towards bulb during its formation. Similar results have also been reported by Wankhade *et. al.*, (1996), Reddy *et. al.*, (2000) and Kumar *et. al.*, (2002) in garlic.

Quadratic equation

It is fitted by the method of orthogonal polynomials by using following formula.

$Y = a + b1N + b2P + b3N2 + b4P2 + b5NP$

By computing the figures, the fitted quadratic equation is as under.

$Y = 48.80 + 0.5310N + 0.1172P - 0.001266N2 - 0.0003542P2 - 0.00007846NP$

It can be perused from the Table 2 that, regression coefficient b1 and b3 represent nitrogen levels which were found to be significant i.e. economic optimum level was viable. However, the

Table 1. Effect of nitrogen and phosphorous on yield and yield attributes of garlic

Treatments	Fresh bulb yield (q ha^{-1})	Cured bulb yield (q ha^{-1})	Bulb wt. (g)	Diameter of bulb (cm)	Length of bulb (cm)	Cloves $bulb^{-1}$	B:C ratio
Nitrogen (kg ha^{-1})							
No (0 kg ha^{-1})	60.26	54.97	16.34	2.62	3.55	18.44	0.93
N1 (50 kg ha^{-1})	73.76	68.04	17.21	2.76	3.74	19.28	1.25
N2 (100 kg ha^{-1})	110.42	100.20	18.07	2.99	3.98	20.50	2.28
N3(150 kg ha^{-1})	111.04	100.62	18.24	3.16	4.11	21.28	2.25
CD at 5%	0.63	0.44	0.065	0.017	0.025	0.13	
Phosphorous (kg ha^{-1})							
Po (0 kg ha^{-1})	85.44	77.87	17.05	2.69	3.66	19.23	1.59
Pi (25 kg ha^{-1})	87.19	79.17	17.21	2.81	3.77	19.64	1.61
P2 (50 kg ha^{-1})	91.15	83.19	17.72	2.97	3.94	20.15	1.72
P3 (75 kg ha^{-1})	91.70	83.60	17.88	3.06	4.02	20.47	1.70
CD at 5%	0.63	0.44	0.065	0.017	0.025	0.13	

Table 2. Multiple linear regression analysis of cured bulb yield of garlic

Co-efficient	Regression coefficient	SE(b)	't' Value
a	48.80		
b_1	0.5310	-0.05084	10.44**
b2	0.1172	0.1016	1.15
b3	-0.001266	-0.003033	4.17**
b4	-0.0003542	-0.001213	0.29
b5	-0.00007846	-0.0004853	0.16
R2	0.917		

**** Significant at 1% level of probability**

regression coefficients b2 and b4 represent the phosphorous levels which were found to be non-significant i.e. economic optimum level in the present study was non viable. The regression coefficient b5 stands for the values of interaction which were found to be non-significant.

Estimation of physical optimum

Physical optimum dose of nitrogen and phosphorous was worked out by differentiating quadratic equation w.r.t. N and P. The estimated values of physical optimum dose of nitrogen and phosphorous was 205.28 kg ha^{-1} and 142.85 kg ha^{-1}, respectively.

Estimation of predicted yield at physical optimum

Substituting the values of physical optimum dose of nitrogen (xn) and phoshporus (xp) in response equation. The predicted values of cured bulb yield of garlic at physical optimum dose of nitrogen and phosphorous was 375.69 q ha^{-1} and 117.42 q ha^{-1}, respectively.

Estimation of economic optimum

The economic optimum dose of nitrogen and phosphorous was worked out as 129.10 kg ha^{-1} and 98.05 kg ha^{-1} for N and P, respectively.

Estimation of predicted yield at economic optimum

The estimated values of predicted cured bulb yield at economic optimum dose of nitrogen and phosphorous was 96.25 q ha^{-1} and 56.90 q ha^{-1}, respectively.

Optimum dose of nitrogen and phosphorous

The maximum predicted cured bulb yield 375.69 q ha^{-1} was obtained at physical optimum dose of nitrogen (205 kg ha^{-1}), whereas economically viable cured bulb yield of 96.25 q ha^{-1} was produced at 129.1 kg ha^{-1} nitrogen application. In case of phosphorous, the economically viable cured bulb yield 56.90 q ha^{-1} was recorded at 98.05 kg ha^{-1} phosphorous application

LITERATURE CITED

Gomez, K.A. and A.A. Gomez, 1984. Statistical procedure for agricultural research, Wiley Interscience Publication, Singapore, 2:20-29.

Kumar, R.; S.S. Singh and V.K. Rao, 2002. Response of garlic *(Allium satiuum* L.) to various levels of nitrogen, phosphorus and potassium, Prog. Hort., 34(2):218-222.

Kunwar, R. and C.B. Pandey, 1992. Response of garlic *(Allium satiuum L.)* to N and P fertilizers in Garhwal Hill conditions of Uttar Pradesh, Prog. Hort., 24(3-4):241-246.

Naidu, A.K.; J.P. Tiwari; S.K. Dwivedi and S.K. Saxena, 2000. Effect of various levels of N, P, K on physiological growth determinants of productivity in garlic, Veg. Sci., 27(2): 165-167.

Reddy, G.S.; K. Suryanarayana; K.M. Reddy and K.C. Reddy, 2000. Effect of different levels of nitrogen and phosphorus on yield and yield components in garlic, J. Res. ANGRAU. 28(3):56-59.

Singh, A.K. and S.P. Singh, 2006. Effect of levels of nitrogen and phosphorus in conjunction with varying plant densities on some important bulb characters and yield of garlic *(Allium satiuum* L.), International J. Agric. Sci., 2(2):490-492.

Wankhade, R.S.; M.H. Chaudhari and B.J. Jadhao, 1996. Effect of graded doses of phosphorus and potash fertilizers on growth and yield of garlic *(Allium satiuum* L.), J. Soils and Crops, 6(1):36-91.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Correlation Coefficients Between Wood and Oleoresin Characteristics of High Resin Yielders and Check Trees in Chirpine

A. U. Nimkar[1], K. R. Sharma[2] and Soniya A. Nimkar[3]

ABSTRACT

Chirpine is the most important species being tapped for the commercial production of resin. Resin is an important forest product obtained from pine forest in the world. The physico-chemical properties of wood are also important parameters for the preliminary characterization of cellulose raw material and its potentiality for pulp and paper, fuelwood, timber and for certain other non-timber products for their related use. This species becomes a material of paramount importance to be worked upon especially for its future benefits owing to its diverse uses. For this, the different high resin yielders were required to be identified and evaluated for different parameters. In the present investigation, relationship of wood i.e. physico-chemical, anatomical and oleoresin characteristics of different high resin yielders and check trees in Chirpine (*Pinus roxburghii*) were quantitatively measured for correlation studies. The correlation studies revealed that there was strong positive correlation between specific gravity and relative flow rate of turpentine. Strong negative relationship was recorded between turpentine and rosin percentage.

Resin is an important forest produce of pine forest in the world. *Pinus* is one of the most widely distributed tree genera extending from polar region to the tropics in the Northern hemisphere. In India, four species are found in the Himalayas and the hills of Assam. *Pinus roxburghii* is the most important species for production of resin but the resin of *Pinus kesia* and *Pinus wallichiana* is far superior in quality. *Pinus gerardiana* has very restricted distribution having no value to the turpentine- resin industry.

The expression of a particular character is an aggregate of complex contribution of so many other characters. In tree improvement programme, a clear understanding of the nature and degree of association among different traits is of great importance because the choice of one character can favour the appearance or disappearance of the other. Correlation, an important statistical tool, helps in determining such associations among different factors under consideration.

In the present investigations, the relationship of wood and oleoresin characteristics were attempted which have not been reported so far in Chirpine (*Pinus roxburghii*). Hence the attempt was made to know the correlations of this economically important tree species in order to utilize the findings and developing future strategies for enhancing the production of resin in the country.

MATERIAL AND METHODS

The study was conducted on twenty six high resin yielders and ten check trees of Chirpine (*Pinus roxburghii*) marked at different location in Himachal Pradesh during the year 1999-2001. Observations of the physical parameters namely oleoresin yield, height, diameter, grain angle and bark percentage of wood were recorded at site. Wood and oleoresin samples were taken from these marked trees and evaluated for different wood and oleoresin traits in the departmental laboratory of Forest Products, College of Forestry, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni-Solan (HP). The data for eighteen parameters namely, oleoresin yield (Kg season^{-1}), height (m), diameter (cm), grain angle (degrees), bark percentage of wood, specific gravity of wood, tracheid length (mm), cold water soluble extractives (%), hot water soluble extractives (%), alcohol-benzene extractives (%), lignin percentage of wood, holocellulose percentage of wood, number of resin ducts per mm^2, diameter of resin ducts (mm), needle length (cm), needle thickness (mm), turpentine percentage, specific gravity of turpentine, relative flow rate of turpentine, rosin

1. Assistant Prof., College of Forestry, Dr. PDKV., Akola, 2. Associate Prof., College of Forestry, Dr. Y.S. P. U. H. F., Nauni, Solan (HP). and 3. Assistant Prof., S.V.G.I. College of Agriculture, Jalgaon Jamod

percentage, specific gravity of rosin and ash percentage of rosin were studied to work out the correlations.

Grain angle of the trees were measured by drawing straight line perpendicular to the base of the tree trunk and the deviation of the grain was measured with the help of protractor after shaving the bark. The bark thickness of the trees was measured in centimeters at breast height with the help of Swedish bark gauge. The recorded bark thickness was expressed as percentage. The specific gravity of wood was determined by the maximum moisture method (Smith, 1954). Tracheid length was determined by macerating the shavings of wood in Jeffery's fluid i.e. 10 per cent chromic acid and 10 per cent nitric acid for 48 hours (Pandey *et al.*, 1968). The cold and hot water soluble extractives were determined by employing the T_1m 59 method (Anonymous, 1959a). Alcohol-benezene extractives, klason-lignin content and holocellulose were determined by using T_6m 59 (Anonymous, 1959b), T_{12}m 59c (Anonymous, 1959c) and T_9m 54 (Anonymous, 1954) methods, respectively. The turpentine and rosin contents were determined by distillation process using Clevenger's apparatus. The specific gravity of turpentine and rosin were determined with the help of sinkers using standard method. The relative flow rate of turpentine was taken using Ostwald (U-tube) viscometer (Gould, 1978). The ash content of rosin was determined by burning in muffle furnace.

The data obtained for these traits were statistically analyzed by using randomized block design and completely randomized design in three replicates for each treatment as described by Panse and Sukhatme (1967) and Chandel (1984) and subjected for correlation coefficient analysis as per the method suggested by Panse and Sukhatme (1978) and Gupta (1984). The significances at 5 and 1 per cent level of significance were tested as per the formula given by Gosset (1908).

RESULTS AND DISCUSSION

The values for correlation coefficients between wood and oleoresin characteristics of high resin yielders and check trees in Chirpine (*Pinus roxburghii*) are presented in Table 1. Out of 153 combinations of simple correlation, 16 combinations were found to be positive and significant and 16 combinations were negative and significant. Out of these 16 positive and significant correlations, 11 combinations were significant at 1 per cent level of significance and 5 combinations were observed to be significant at 5 per cent level of significance. Whereas, in 16 combinations of negative and significant, 12 combinations were recorded to be significant at 1 per cent level of significance and 4 combinations were significant at 5 per cent level of significance. Rest of the correlation coefficients was found to be non-significant. Highly significant and positive correlation coefficients were obtained between specific gravity of turpentine Vs relative flow rate of turpentine (0.9623), rosin percentage Vs ash percentage of rosin (0.9520), cold water soluble extractives Vs hot water soluble extractives (0.9007), needle length Vs needle thickness (0.8796), number of resin ducts Vs diameter of resin ducts (0.6363), number of resin ducts Vs needle thickness (0.6110), number of resin ducts Vs needle length (0.5576), diameter of resin ducts Vs needle thickness (0.5205), specific gravity of turpentine Vs rosin percentage (0.4532), relative flow rate of turpentine Vs rosin percentage (0.4445), diameter of resin ducts Vs needle length (0.4370), specific gravity of turpentine Vs ash percentage of rosin (0.3918), relative flow rate of turpentine Vs ash percentage of rosin (0.3823), bark percentage of wood Vs rosin percentage (0.3629), bark percentage of wood Vs ash percentage of rosin (0.3532), tracheid length Vs holocellulose percentage of wood (0.3438). In the present findings, cold water soluble extractives were strongly correlated with hot water soluble extractives, which was similar to the reports of Sharma (2000) in *Dendrocalmus strictus*.

The highly significant and negative relationship was found between turpentine percentage Vs rosin percentage (-0.8879), turpentine percentage Vs ash percentage of rosin (-0.8219), specific gravity of wood Vs number of resin ducts (-0.6698), lignin percentage of wood Vs holocellulose percentage of wood (-0.6566), specific gravity of wood Vs diameter of resin ducts (-0.6167), cold water soluble extractives Vs needle length (-0.5486), hot water soluble extractives Vs needle length (-0.5435), turpentine percentage Vs specific gravity of turpentine (-0.4964), turpentine percentage Vs relative flow rate of turpentine (-0.4840), specific

Table 1. Simple correlation coefficients between wood and oleoresin characteristics of HRYs and check trees in Chirpine (*Pinus roxburghii*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	1.0000																	
2.	0.0881	1.0000																
3.	0.1097	-0.0264	1.0000															
4.	0.0162	-0.0065	-0.3624*	1.0000														
5.	-0.0632	-0.0574	-0.2822	0.9007**	1.0000													
6.	0.2644	0.0992	-0.2888	0.0459	-0.0534	1.0000												
7.	-0.0093	0.1934	-0.2106	0.1669	0.0118	-0.1128	1.0000											
8.	0.0602	-0.0669	0.3438*	-0.0445	0.0750	-0.0390	-0.6566**	1.0000										
9.	-0.0402	-0.6698**	0.1404	-0.3045	-0.1705	-0.1454	-0.2221	0.0244	1.0000									
10.	-0.1010	-0.6167**	0.1833	-0.2986	-0.2888	0.0475	-0.0323	-0.1429	0.6363**	1.0000								
11.	-0.0894	-0.2261	0.2458	-0.5486**	-0.5435**	-0.0009	-0.0637	-0.3446*	0.5576**	0.4370**	1.0000							
12.	-0.1224	-0.4196*	0.2086	-0.4843**	-0.4326**	0.0241	-0.2001	-0.1890	0.6110**	0.5205**	0.8796**	1.0000						
13.	-0.3306*	-0.4821**	-0.1874	0.0330	0.0529	-0.1644	0.0546	0.1195	0.2640	0.1892	-0.0965	0.0152	1.0000					
14.	0.3257	0.2761	-0.0116	0.2592	0.2890	0.1421	-0.1841	0.2269	-0.2910	-0.2479	-0.3066	-0.3006	-0.4964**	1.0000				
15.	0.3288	0.2606	-0.0289	0.2477	0.2737	0.1639	-0.1686	0.1998	-0.3090	-0.2459	-0.3064	-0.2785	-0.4840**	0.9623**	1.0000			
16.	0.3629*	0.2897	0.1756	-0.1396	-0.1492	0.2738	-0.0354	-0.1622	-0.0605	-0.0073	0.2276	0.1474	-0.8879**	0.4532**	0.4445*	1.0000		
17.	0.0832	0.0232	0.0357	-0.0183	-0.0196	0.1074	-0.0152	-0.0449	-0.0296	0.0113	0.0750	0.0200	-0.2125	0.0780	0.0976	0.2428	1.0000	
18.	0.3532*	0.2336	0.1668	-0.1077	-0.1233	0.2351	-0.0242	-0.1584	0.0063	-0.0167	0.2337	0.1666	-0.8219**	0.3918*	0.3823**	0.9520**	0.1976	1.0000

Parameters

1. Bark percentage of wood
2. Specific gravity of wood
3. Tracheid length
4. Cold water soluble extractives
5. Hot water soluble extractives
6. Alcohol-benzene extractives
7. Lignin percentage of wood
8. Holocellulose percentage of wood
9. Number of resin ducts
10. Diameter of resin ducts
11. Needle length
12. Needle thickness
13. Turpentine percentage
14. Specific gravity of turpentine
15. Relative flow rate of turpentine
16. Rosin percentage
17. Specific gravity of rosin
18. Ash percentage of rosin

* Significant at 5% level of significance (r=0.3295)

** Significant at 1% level of significance (r=0.4243)

gravity of wood Vs. turpentine percentage (-0.4821), cold water soluble extractives Vs needle thickness (-0.4843) and hot water soluble extractives Vs needle thickness (-0.4326). It is obvious from the figures in the Table 1, that increase in turpentine percentage will result in decrease in rosin percentage and vice-versa. The similar type of relationship was also existed in all of the above parameters.

LITERATURE CITED

Anonymous, 1954. Holocellulose of wood. Official standard. T9m-54. Tech. Assoc. Pulp and Pap. Ind., New York : 43-45.

Anonymous, 1959a. Water solubility of wood. Official standard. T1m-59 Tech. Assoc. Pulp and Pap. Ind., New York: 22-28.

Anonymous, 1959b. Alcohol-benzene solubility in wood. Official standard. T6m-59 Tech. Assoc. Pulp and Pap. Ind., New York, New York. 29-30.

Anonymous, 1959c. Lignin in wood. Official standard T12m-59. Tech. Assoc. Pulp and Pap. Ind., New York. 36-37.

Chandel, S.R.S., 1984. A Handbook of Agricultural Statistics. Achal Prakashan Mandir, Kanpur, 565.

Gosset, W.S., 1908. Test of statistics. Gupta, S.C. and Kapoor, V.K. (eds.). Fundamental of Mathematical Statistics. 9th Rev. ed. Sultan Chand and Sons., New Delhi, 12-38.

Gould, W.A., 1978. Food quality assurance AVI Publishing Company, INC. Westport, Conn. 234.

Gupta, S.P., 1984. Statistical methods. XV Ed. Sultan Chand and Sons., Daryaganj, New Delhi.

Pandey, S.C., G.S. Puri and J.S. Singh, 1968. Research methods in plant ecology. Asia Pub. House, Bombay : 44-46.

Panse, V.G. and P.V. Sukhatme, 1967. Statistical methods for agricultural workers, 2nd ed. New Delhi, ICAR : 99-116.

Panse, V.G. and P.V. Sukhatme, 1978. Statistical methods for Agricultural Workers. ICAR, New Delhi. 610.

Sharma, D.K., 2000. Studies on physico-chemical attributes of *Dendrocalamus strictus* (Roxb.) from different sites of Himachal Pradesh and Punjab. Ph.D. Thesis, submitted to Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni-Solan (HP) : 78.

Smith, D.M., 1954. Maximum moisture content for determining specific gravity of small wood samples. Forest Products Lab. U.S.D.A. Forest Service Rep. : 2014.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Characteristics and Classification of Some Black Soils

P. R. Damre[1], O. Challa[2], T. K. Sen[3] and S. N. Goswami[4]

ABSTRACT

Five typical pedons of soils all developed from weathered basalt but supporting different land use systems in Yavatmal district of Maharashtra were studied to characterize and classify the soils. The soils, in general, are deep, well to moderately well drained, clay to sandy clay loam in texture, alkaline in reaction, low to moderately high in organic carbon content with calcium as the dominant cation among the major exchangeable cations. These soils were classified as Typic Haplustepts and Typic Halusterts based on the variation in their morphological and physico-chemical properties as per the guidelines in Keys to Soil Taxonomy.

Yavatmal district is situated in north Deccan (Maharashtra) plateau. This is characterized by semi-arid ecosystem with deep, medium and shallow black soils belonging to Ustorthents, Haplusterts, Haplustepts (Challa *et al.* 1995; Challa *et al.* 1999).

The soils which are derived from Deccan trap, vary in their characteristics as per their location in different catchments. The deep black soils occupy low-lying areas and the brownish soils, comparatively coarse in texture occur on the higher plains. The soils in the district are slightly alkaline in reaction, clay-loamy in texture and calcareous with calcium carbonate to an appreciable extent.

Yavatmal district is surrounded by Amravati and Wardha districts in north, Chandrapur district in the east, Andhra Pradesh state and Nanded district in the south and Akola and Parbhani districts in the west. The main rivers of the district are the Wardha and Penganga both of which flow along the north-east and southern district boundaries. Material, shale and limestones are mainly drained by the Penganga river. Yavatmal district is located in the south-eastern part of Maharashtra. The soils are black developed from basaltic alluvium as well as weathering of basalt and saprolite. Keeping this in view, the study was undertaken to characterize and classify the soils in Yavatmal district.

MATERIAL AND METHODS

Study area:

The study area lies between 20°28' 25" to 20°3' 36" N latitudes and 77°45' 19" to 78°12'45" E longitudes of Babulgaon and Ner tahsil of Yavatmal district. In Babulgaon tahsil samples were collected from Mandni, Krishnapur, Naygaon and Vyhali in Ner tahsil of Yavatmal district. The mean annual temperature is 25.4°C with mean maximum of 45.5°C in summer and mean minimum of 11. 2°C in winter season. This district is agro-climatically placed under hot moist to semi-arid eco-sub-region. The temperature regime is hyperthermic. The natural vegetation of the area comprises of dry deciduous mixed tree and grass species. It is dominated by the species, which are *Acacia arabica* (*Babool*), *Azdirachta indica* (*Neem*), *Butea frondosa* (*Palas*), *Leucana leucocephala* (*Subabool*), *Zizyphus jujuba* (*Ber*). The grass species are *Cynadon dactylon* (Doob), *Cyperus rotundus* (Nut sedge), *Scchanum spontaneum* (*Kans*) and the dominant crops grown are cotton, sorghum, pigeonpea, etc. A large percentage of cultivated land is mainly under *Kharif* cotton intercropped with pigeonpea, soybean, turmeric, oranges are grown under irrigated conditions.

Based on the physiographic units and land use of the area five representative pedons were collected from different locations of Yavatmal district of Maharashtra. These soils occurred at an elevation of 270 to 360 m above MSL supporting different types of vegetation. Out of these five, the pedons collected from Mandni (P1), Krishnapur (P2) and Naygaon (P3) in Babulgaon tahsil and other two pedons collected from Vyhali (P4 and P5) in Ner tahsil of Yavatmal district represent different land use systems.

The site characteristics of the pedons comprising location, landform, parent material and land use are presented in Table 1.

1Ph.D. Scholar 2. Principal Scientist, 3,4. Senior Scientist, NBSS&LUP, Amravati Road, Nagpur.

Table 1. Site characteristics of soils

Psdon	Village and Tahsil	Location	Eleva-tion (m)	Slope(%)	Drainage	Land forms	Erosion	Parent material	Land use
P1	Mandni (Babulgaon)	20°28'25" N 78°11'11 E	320	1-3	Mod-well drained	Lower piedmont	Mode rate	Weathered basalt	Cotton - soybean-pigeonpea (3 yrs, Rotation)
P2	Krishnapur (Babulgaon)	20°29'48" N 78° 12'04" E	291	0-1	Well drained	Lower piedmont	Mode-rate	Weathered basalt	Cotton-pigeonpea soybean
P3	Naygaon (Babulgaon)	20°31'36" N 78°12'45" E	270	0-1	Well drained	Lower piedmont	Very slight	Weathered basalt	Cotton-pigeonpea-soybean Blackgram/green gram (4 years rotation)
P4	Vyhali (Ner)	20°30'40" N 78°45'19" E	360	3-8	Mod. well drained	Lower piedmont	Mode-rate	Weathered basalt	Sugarcane-onion-chickpea
P5	Vyhali (Ner)	20°30'40" N 78°45'19 E e	360	1-3	Mod. well drained	Lower piedmont	Mode-rate	Weathered basalt	Tunneric-cotton- green gram

The morphological properties of soils were studied as per the procedure outlined in Soil Survey Manual (Soil Survey Staff, 1995) and the physical and chemical characteristics of the soil samples (<2 mm) were determined for particle size analysis, pH, organic carbon, CEC, exchangeable bases and base saturation following standard procedure (Black, 1965). The soils were classified as per Keys to Soil Taxonomy (Soil Survey Staff, 1998).

RESULTS AND DISCUSSION

Morphological properties:

The morphological properties of these soils are presented in Table 2. The colour of the surface layer of profile varies from dark grayish brown (10YR 4/2) to very dark grayish brown (10YR 3/2) and the subsurface soil colour varies from very dark gray (10YR 3/1) to dark yellowish brown (10YR 4/4) due

Table 2. Morphological characteristics of soils

Horizon	Depth (cm)	Colour	Textture	Structure			Consistency			Effervescence
				S	G	T	D	M	W	
P1: Fine, smectitic, hyperthermic (cal.) family of Typic Haplustepts										
Ap	0-18	10YR4/2	c	m	1	sbk	sh	fr	ssps	es
Bwl	18-40	10YR 3/2	c	m	2	sbk	sh	fr	sp	es
Bw2	40-72	10YR3/2	c	m	2	sbk	h	fi	sp	es
Bw3	72-106	10YR 3/2	c	m	2	sbk	h	fi	sp	es
BC	106-160	10YR 4/3	c	m	1	sbk	sh	vfi	sopo	es
P2 : Fine, smectitic, hyperthermic family of Calcic Haplustepts										
Ap	0-17	10YR3/2	c	m	1	sbk	sh	fr	sp	ev
Bwl	17-55	10YR 3/2	c	m	1	sbk	h	fi	sp	ev
Bw2	55-87	10YR4/2	scl	m	1	sbk	sh	fr	svpv	es
BCK	87-118	10YR 4/4	scl	m	1	sbk	sh	fr	sopo	es
BCK	118-140	10YR 4/4	scl	m	1	sbk	sh	fr	sspo	es
P3 : Very-fine, smectitic, hyperthermic (cal.) family of Typic Haplusterts										
Ap	0-19	10YR4/2	c	m	2	sbk	h	fi	sp	es
'Bw	19-51	10YR 3/1	c	m	2	sbk	vh	vfi	vsvp	es
Bssi	51-86	10YR 3/1	c	m	3	abk	vh	vfi	vsvp	es
Bss2	86-130	10YR 3/1	c	m	3	abk	vh	vfi	vsvp	es
BC	130-150	10YR 3/3	c	m	3	abk	vh	fi	sp	ev
P4 : Very-fine, smectitic, hyperthermic (cal.) family of Typic Haplusterts										
Ap	0-16	10YR3/2	c	m	1	sbk	sh	fr	sp	es
Bw	16-50	10YR 3/2	c	m	1	sbk	h	fi	sp	es
Bssi	50-79	10YR 3/1	c	m	2	sbk	vh	vfi	vsvp	es
Bss2	79-117	10YR 3/1	c	m	2	sbk	vh	vfi	vsvp	es
BCK	117-150	10YR 3/1	c	m	2	sbk	vh	vfi	vsvp	ev
P5 : Very-fine, smectitic, hyperthermic (cal.) family of Typic Haplusterts										
Ap	0-15	10YR4/2	c	m	2	sbk	sh	fr	sp	e
Bw	15-45	10YR 3/2	c	m	2	sbk	h	fi	vsvp	e
Bssi	45-70	10YR 3/1	c	m	3	abk	vh	vfi	vsvp	e
Bss2	70-105	10YR 3/1	c	m	3	abk	vh	vfi	vsvp	es
BCK	105-145	10YR 3/2	c	m	2	sbk	vh	vfi	vsvp	ev

to the composition of parent materials. The soils representing Pedon 1, 3, 4 and 5 are clay texture where as the pedon 2 is clay to sandy clay loam textured. The structure of surface soils of most of the pedons is sub-angular blocky in all pedons. However, the structure of the subsurface soils of pedon 3 and 5 are angular blocky structure in sub-surface horizons.

Physical characteristics: The characteristics of the soils (Table 3) show that most of the soils were clay in texture, with clay content ranging from 40.7 to 68.3 per cent and it usually increases in subsoils, which decreases again in lower horizons in most of the soils. Similar trend at gradual increase in clay content with depth was also observed by Puranik *et. al.,* (1972). The silt content ranging from 18.0 to 35.7 per cent and the highest value was observed in pedon 4 whereas the lowest value was noticed in pedon 2. The sand content ranging from 3.5 to 33.1 per cent. The bulk density of soils ranged from 1.5 to 1.9 Mg m^{-3}. Lower bulk density was observed in the surface soils which might be due lesser compaction

Table 3. Physical characteristics of soils

Horizon	Depth (cm)	Sand	Silt	Clay	BD	Water retention		AWC(%)
		(%)			(Mgm^{-3})	33kPa	1500kPa	
P1: Fine, smectitic, hyperthermic (cal.) family of Typic Haplustepts								
Ap	0-18	26.7	28.7	44.6	1.6	38.7	22.5	16.2
Bw1	18-40	26.1	27.5	46.4	1.7	31.0	18.5	12.5
Bw2	40-72	21.9	25.7	52.4	1.7	33.7	23.7	10.0
Bw3	72-106	24.4	26.7	48.9	1.7	33.5	23.6	09.9
BC	106-160	28.4	30.9	40.7	1.7	39.9	19.6	20.3
P2 : Fine, smectitic, hyperthermic family of Calcic Haplustepts								
Ap	0-17	23.4	21.3	55.3	1.7	31.3	22.0	9.3
Bw1	17-55	23.6	18.7	57.7	1.7	34.2	25.0	9.2
Bw2	55-87	31.1	22.6	46.3	1.7	26.8	17.3	9.5
BCK	87-118	32.2	22.1	45.7	1.5	23.3	15.2	8.1
BCK	118-140	33.1	18.0	48.9	1.5	21.3	14.6	6.7
P3: Very-fine, smectitic, hyperthermic (cal.) family of Typic Haplusterts								
Ap	0-19	4.6	31.2	64.2	1.8	42.8	22.5	20.3
Bw	19-51	4.5	31.1	64.4	1.9	47.9	26.6	21.3
Bssi	51-86	4.6	30.9	64.5	1.9	46.9	25.5	21.4
Bss2	86-130	3.5	28.2	68.3	1.9	48.5	26.2	22.3
BC	130-150	5.8	34.1	60.1	1.9	42.2	22.0	20.2
P4: Very-fine, smectitic, hyperthermic, (cal.) family of Typic Haplusterts								
Ap	0-16	9.3	26.3	63.4	1.8	41.1	21.7	19.4
Bw	16-50	9.4	28.3	62.3	1.8	43.4	22.8	20.6
Bssi	50-79	8.3	28.4	63.3	1.8	48.1	25.8	22.3
Bss2	79-117	8.9	27.1	64.0	1.8	46.9	24.8	22.1
BCK	117-150	14.6	35.7	49.7	1.8	40.0	20.7	19.3
P5: Very-fine, smectitic, hyperthermic, (cal.) family of Typic Haplusterts								
Ap	0-15	9.0	24.3	66.7	1.7	40.5	22.6	17.9
Bw	15-45	9.4	27.9	62.7	1.7	41.0	21.1	19.9
Bssi	45-70	9.3	26.6	64.1	1.7	44.1	22.5	21.6
Bss2	70-105	9.3	26.5	64.2	1.7	52.0	25.0	27.0
BCK	105-145	12.5	26.7	60.8	1.7	40.3	19.4	20.9

and exposure to anthropogenic activities. Earlier Padole *et al.* (1998) attributed the lower bulk density at surface to the addition of relatively high amount of organic input like FYM and other manures in the soils (Badanur *et al.* 1990). The moisture content varies from 21.3 to 52.0 per cent at 33 kPa and 14.6 to 26.56 per cent at 1500 kPa and the available moisture content in soils ranged from 6.7 to 27.0 per cent. No regular trend of available water capacity was observed. In general, the moisture content was higher in subsurface horizon as compared to the surface horizon.

Chemical characteristics: The chemical characteristics of the soils (Table 4) show that all the soils were alkaline in reaction and the pH of these soils varied from 7.8 to 8.5. The electrical conductivity (EC) of soils ranged from 0.16 to 0.40 dSm^{-1}. The organic carbon content in surface soils ranged from 0.76 to 0.99 per cent and it decreased abruptly with depth. The calcium carbonate content of the soils ranged from 3.1 to 23.0 per cent and it increased with depth. This could possibly be due to the accumulation of displaced calcium from exchange complex from the upper layer or due to precipitation of $CaCO_3$.

Table 4. Chemical characteristics of soils

Hori-zon	Depth (cm)	pH (1:2.5)	EC (dSm^{-1})	O.C. (%)	$CaCO_3$ (%)	Exchangeable cations Ca	Mg	Na	K	CEC	B.S. (%)	ESP
						cmol (p+) kg^{-1}						
P1 : Fine, smectitic, hyperthermic (cal) family of Typic Haplustepts												
ApfAp	0-18	8.1	9.20	0.79	7.2	26.0	10.4	0.7	1.0	40.9	93	1.7
Bwl	18-40	8.2	0.19	0.64	9.5	32.5	8.5	0.7	1.0	45.2	94	1.5
Bw2	40-72	8.2	0.18	0.58	10.3	37.0	9.4	0.6	0.7	50.3	95	1.2
Bw3	72-106	8.3	0.20	0.58	11.7	31.5	8.5	0.5	0.6	46.9	87	1.0
BC	106-160	8.3	0.25	0.50	12.8	22.5	11.4	0.4	0.6	39.5	88	1.0
P2 : Fine, smectitic, hyperthermic family of Calcic Haplustepts												
Ap	0-17	8.3	0.17	0.76	8.6	32.3	15.1	0.6	1.0	51.8	94	1.1
Bwl	17-55	8.0	0.34	0.52	7.7	37.4	14.4	0.5	0.9	56.3	94	0.0
Bw2	55-87	81	0.27	0.28	22.9	28.6	13.4	0.4	0.7	45.1	95	0.9
BCK	87-118	8.3	0.31	0.20	22.9	23.5	9.5	0.3	0.6	36.8	95	0.8
BCK	118-140	8.5	0.17	0.16	23.0	22.4	28.5	0.5	0.5	55.1	94	0.9
P3 : Very-fine, smectitic, hyperthermic (cal) family of Typic Haplustepts												
Ap	0-19	8.0	0.28	0.99	7.8	45.5	14.1	0.6	1.0	63.4	96	0.9
Bw	19-51	8.1	0.26	0.83	7.6	44.0	15.4	0.5	0.9	63.5	95	0.8
Bssi	51-86	7.8	0.32	0.64	6.1	47.0	12.4	0.5	0.7	62.2	97	0.8
Bss2	86-130	8.0	0.35	0.67	7.0	40.5	19.9	0.5	0.6	65.1	95	0.7
BC	130-150	8.1	0.28	0.32	3.1	31.0	18.6	0.4	0.6	55.1	91	0.7
P4 : Very-fine, smectitic, hyperthennic (cal.) family of Typic Haplusterts												
Ap	0-16	8.2	0.16	0.81	11.3	38.6	22.0	0.9	0.8	63.2	98	1.4
Bw	16-50	8.2	0.19	0.76	11.7	34.9	21.0	0.8	0.7	60.5	94	1.3
Bssi	50-79	8.2	0.40	0.59	12.3	31.9	25.6	0.8	0.6	61.9	95	1.2
Bss2	79-117	8.3	0.39	0.46	17.5	32.1	28.9	0.6	0.5	63.4	97	1.0
BCK	117-150	8.3	0.26	0.35	22.0	16.6	24.2	0.5	0.5	46.5	90	1.0
P5 : Very-fine, smectitic, hyperthennic (cal.) family of Typic Haplusterts												
Ap	0-15	8.1	0.25	0.86	5.4	42.2	19.6	0.8	0.8	65.4	96	1.2
Bw	15-45	8.1	0.18	0.80	7.0	42.8	17.7	0.7	0.6	64.0	96	1.0
Bssi	45-70	8.1	0.32	0.76	9.4	39.9	23.3	0.6	0.6	65.8	97	0.9
Bss2	70-105	8.2	0.24	0.69	14.5	38.2	25.5	0.6	0.5	68.1	95	0.9
BCK	105-145	8.2	0.21	0.59	16.8	27.1	29.2	0.6	0.5	62.7	92	1.0

The exchangeable calcium varied from 16.6 to 47 cmol (p+) kg^{-1} and exchangeable magnesium 8.5 to 29.2 cmol (p+) kg^{-1}. The exchangeable sodium and potassium ranged from 0.4 to 0,9 and 0,5 to 1.0 cmol (p+) kg^{-1}. The CEC of the surface soils varied from 40.9 to 65.4 cmol (p+) kg^{-1} and the higher CEC value in the surface layers of pedon 3, 4 and 5. The minimum value was observed in pedon 1 and higher value in pedon 5. The high CEC of these soils is attributed to its smectitic clay mineralogy (Pal and Deshpande, 1987). The base saturation of these soils varied from 87 to 98 per cent (Table 4).

Nutrient status of soils: The micronutrients (Cu, Fe, Zn and Mn) were determined (Table 5). The content of copper varied from 1.6 to 6.1 mg/kg. The content of Fe ranged from 5.5 to 12.9 mg/kg. The content of Mn ranges from 2.3 to 14.0 mg/g and zinc content 0.17 to 0.86 mg kg^{-1}. Available N content of soils, in general, ranges from 5 to 95 mg kg^{-1} (Table 5). Available P content of soils ranges from 3 to 19 mg kg^{-1} and available K content of soils ranges from 75 to 354 mg kg^{-1}. The content of the nutrients decreased down the profile.

The surface Ap horizon contain 2.3 to 3.7 ppm Cu which is sufficient to critical limit < 1.0 to >2.0, 9.0 to 12.7 ppm Fe which is sufficient to critical limit <5.0 to >10.0, 0.44 to 0.66 ppm Zn which is deficient to 0.5 to >1.5, 8.5 to 14.0 ppm Mn which is sufficient to critical limit <7.5 to >12.0.

Table 5. Nutrient status of soils

Depth (cm)	Micronutrients (mg kg^{-1})				Available (mg kg^{-1})		
	Cu	Fe	Zn	Mn	N	P	K
P1: Fine, smectitic, hyperthermic (cal.) family of Typic Haplustepts							
0-18	3.0	9.0	0.66	9.2	73	11	354
18-40	3.3	7.5	0.38	4.2	56	10	262
40-72	3.3	7.5	0.38	3.2	39	9	210
72-106	3.3	7.5	0.28	2.7	39	8	147
106-160	2.3	6.8	0.27	2.7	11	4	101
P2 : Fine, smectitic, hyperthermic family of Calcic Haplustepts							
0-17	3.7	11.7	0.44	14.0	45	12	197
17-55	3-4	5.3	0.40	2.3	39	10	91
55-87	3.2	7.1	0.82	4.9	28	8	84
87-118	1.8	7.1	0.64	4.6	5	7	78
118-140	1.6	5.0	0.54	2.4	5	3	75
P3: Very-fine, smectitic, hyperthermic (cal.) family of Typic Haplusterts							
0-19	2.3	12.1	0.49	8.5	95	12	343
19-51	2.2	12.0	0.38	6.5	78	12	224
51-86	2.2	11,8	0.24	4.7	67	11	184
86-130	2.1	10.6	0.19	3.7	62	6	179
130-150	1.7	9.5	0.17	3.5	39	3	179
P4 : Very-fine, smectitic, hyperthermic (cal.) family of Typic Haplusterts							
0-16	3.0	127	0.47	8.7	62	11	280
16-50	4.2	12.9	0.46	9.4	33	11	225
50-79	4.3	12.4	0.46	7.6	22	10	105
79-117	5.1	9.1	0.38	5.4	17	5	101
117-150	3.2	5.5	0.30	3.2	11	3	99
P5: Very-fine, smectitic, hyperthermic (cal.) family of Typic Haplusterts							
0-15	3.1	10.9	0.60	10.0	62	13	189
15-45	5.1	10.2	0.86	8.7	46	13	96
45-70	5.4	10,1	0.70	7.9	39	11	92
70-105	6.1	9.1	0.66	7.2	39	5	95
105-145	5.6	9.0	0.56	3.8	22	4	84

Soils representing pedon 1 and 2 have textural and/or structural development indicating the formation of horizon. Hence the soils are classified in the order Inceptisols and pedon 3, 4 and 5 are classified in the order Vertisols. The pedon 2 get keyed out a Calcic Haplustepts as it has a calcic horizon with its upper boundary within 100 cm of the universal soil surface and its calcareousness.

The temperature regime of the soils is hyperthermic. The soils (pedon 1 to 5) are classified at the family level as follows.

Pedon 1 : Fine, smectitic, hyperthermic (cal.) family of Typic Haplustepts

Pedon 2 : Fine, smectitic, hyperthermic (cal.) family of Calcic Haplustepts

Pedon 3 : Very-fine, smectitic, hyperthermic (cal.) family of Typic Haplusterts

Pedon 4 : Very-fine, smectitic, hyperthermic (cal.) family of Typic Haplusterts

Pedon 5 : Very-fine, smectitic, hyperthermic (cal.) family of Typic Haplusterts

LITERATURE CITED

Badanur, V.P., C.M., Poleshi and Balachandra K. Naik, 1990. Effect of organic matter on crop yield and physical and chemical properties of Vertisols, J. Indian Soc. Soil Sci. 38(3): 426-429.

Black, C.A., 1965. Methods of soil analysis. Part 1 & 2. American Soc. Agron., Madison, Wisconsin, USA, 770.

Challa, O., S. Vadivelu and J. Sehgal, 1995. Soils of Maharashtra for optimizing land use. NBSS Publ.54b, NBSS&LUP (ICAR), Nagpur : 16.

Challa, O., K.S. Gaibhiye and M. Velayutham, 1999. Soil Series of Maharashtra, NBSS Publ.79. NBSS&LUP, Nagpur, : 410.

Padole, V.R., P.W. Deshmukh, R.J. Nikesar and N.V. Bansode,1998. Effect of organics and inorganics on yield and quality of cotton grown on Vertisols, PKV Res. J., 22(1): 6-8.

Pal, D.K. and S.B. Deshpande, 1987. Characteristics and genesis of minerals in some benchmark Vertisols of India, Agropedol. 37(3): 259-275.

Puranik, R.B., N.K. Barde and D.K. Ballal, 1972. Studies on some saline alkali soils of Akola district, Maharashtra state, PKV Res. J., 51-58.

Soil Survey Staff, 1995. Soil survey manual. Agric. Handbook 18, US Dept. Agric., USA, 18.

Soil Survey Staff, 1998. Keys to soil taxonomy, 8th Edition, SMSS Tech. Monograph No. 19, Virginia, USA.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Effect of Phosphorous and Potassium Levels on Seed Yield and Quality Isabgol

S.G.Wankhade[1], A.G.Waghmare[2], S.V.Gholap[3], S.S.Wanjari[4] and S.S.Narkhede[5]

ABSTRACT

The present study was undertaken during 2005-2006 at Nagarjun Medicinal Plants Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. There were four levels of phosphorous *viz.*, 0 kg (Po), 15 kg (P-i), 30 kg (P2) and 45 kg (Pa) and four levels of potassium *viz.*, 0 kg (K_0), 15 kg (Ki), 30 kg (K_2) and 45 kg (K_3) per hectare tried in split plot design with three replications. The application of 30 kg P_2O_5 and 30 kg K_2O ha^{-1} to Isabgol significantly increased the dry matter, number of tillers, number of spikes and spike length $plant^{-1}$. The seed and straw yields of Isabgol were recorded significantly highest with the application of 30 kg P_2O_5 ha^{-1}, however the seed yield was not significantly influenced by the potassium application. The application of phosphorus and potassium had significant effect on quality aspects of seeds; particularly test weight, husk percent and swelling factor.

Isabgol is one of the crops having high export potential because of its utility in the western countries. For further export promotion, there is need to increase the productivity and extend its cultivation to new areas, where Isabgol cultivation is very limited owing to its poor production (Lal *et. al..*, 1999). However, the use of inorganic fertilizers in appropriate quantity, form and stage of growth could upgrade yield remarkably (Gupta and Pareek, 1981).

The research work carried out under "All India coordinated Research Project (AICRP) on medicinal and aromatic plants" at Akola Centre revealed that Isabgol crop can be very well grown under Vidarbha agro-climatic conditions (Paturde *et. al.*, 1998) with optimum nutrient levels. The research work carried out is very megre on nutritional requirement of this crop grown on Vertisol, therefore the present investigation to study the effect of phosphorous and potassium levels on seed yield & quality of Isabgol was carried out during 2005-06.

MATERIAL AND METHODS

The present study was undertaken during 2005-2006 at Nagarjun Medicinal Plants Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, with four levels of phosphorous viz., 0 kg (P_0), 15 kg (P_1), 30 kg (P_2) and 45 kg (P_3) and four levels of potassium viz., 0 kg (Ko), 15 kg (K_1), 30 kg (K_2) and 45 kg (K_3) ha^{-1} tried in split plot design with three replications.

The soil of the experimental site was slightly alkaline (pH 7.7), medium black, uniform in texture with good drainage. The Isabgol seeds were sown on flat bed with a seed rate of 4 kg ha^{-1} keeping the spacing at 30 cm row to row. The protective irrigations were given at timely interval as and when required. The field was kept free from weeds by adopting hand weeding from time to time. Urea was used as a source of nitrogen. Nitrogen was applied @ 50 kg N ha^{-1} in two split doses. The first dose of nitrogen was applied just before sowing. Remaining half dose of nitrogen was applied as top dressing at 30 days after sowing. Phosphorous and potassium were applied as per the treatments in a single dose at the time of sowing through single super phosphate and muriate of potash. Harvesting was done at maturity by cutting the plants at ground level. After drying the plants, threshing was done and seeds were separated. The observations on yield contributing parameters such as number of tillers and spikes per plant , spike length ,seed and straw yield were recorded. The content of N,P,K in plants were estimated by Kjeldhal's method, Vanadomolybdate phosphoric acid yellow colour method v in diacid extract and Flame photometrically (Piper, 1966) .respectively. Uptake of nutrients (N, P and K) were calculated by multiplying the per cent composition (N, P and K) by dry matter yield at harvest.

The quality parameters viz, husk percentage of seed by chemical method and swelling factor of the seeds were estimated by the procedures described in Biannual Report (1978-80) of AICRP on Medicinal and Aromatic plants (Anonymous, 1980)

1. Associate Professor, 2. M.Sc. Student, 3. Junior Res. Asstt. 4. Associate Prof. and 5.Associate Prof., AINRP on Medicinal and Aromatic Plants, Dr. PDKV, Akola

RESULTS AND DISCUSSION

Growth Parameters

The application of phosphorous and potassium levels to Isabgol crop resulted in favourable effect on number of tillers, number of spikes and spike length plant^{-1} (Table 1). Significantly highest number of tillers, number of spikes and spike length plant^{-1} was observed due to the application of 45 kg P_2O_5 ha^{-1}, however it was at par with 30 kg P_2O_5 ha^{-1}. Similarly, application of 45 kg K_2O ha^{-1} recorded significantly highest number of tillers, number of spikes and spike length per plant, however, it was also at par with 30 kg K_2O ha^{-1}. These results are supported by the findings of Ramesh *et. al.*, (1989), Singh and Chouhan(1994), Swarupa Utgikar (2001). The reports revealed that the application of 25-30 kg P_2O_5 ha^{-1} resulted into increased number of spikes plant^{-1}.

Seed and Straw yield

The seed and straw yields of Isabgol were recorded significantly highest with the application of 30 kg P_2O_5 ha^{-1}, however, it was at par with 45 kg P_2O_5 ha^{-1} level. The potassium application at various levels had also favourable effect on the seed and straw yield (Table 1). However, no significant differences in the seed yield levels were noticed due to application of 15 to 45 kg K_2O ha^{-1}. On the contrary significantly highest straw yield was recorded with 45 kg K_2O ha^{-1}, however, it was at par with 30 kg K_2O ha^{-1}. These results are in agreement with the findings of Ramesh *et. al.* (1989), Singh and Chouhan (1994) and Wankhade *et.al.* (2005).

Uptake of Nutrients

The phosphorous application had favourable effect on uptake of nutrients (N, P and K). The significantly highest nutrient uptake was recorded due to the application of 30 kg P_2O_5 ha^{-1} which was at par with 45 kg P_2O_5 ha^{-1}. The potassium application at various levels had favourable effect on nutrient uptake. Significantly highest nutrient uptake was also recorded due to application of 45 kg K_2O ha^{-1}; however it was at par with 30 kg K_2O ha^{-1} and 15 kg K_2O ha^{-1} (Table 2).

Quality of Seed

The application of phosphorous had significant effect on quality aspects of seeds; particularly test weight, husk pencent and swelling factor (Table 2). Significantly highest test weight, husk pen ent and swelling factor of seed was noticed due to the application of 30 kg P_2O_5 ha^{-1}, however, the levels 15 kg P_2Os ha^{-1} and 45 kg P_2O_5 ha^{-1} were statistically at par with 30 kg P_2O_5 ha^{-1}. Whereas, application of potassium at 45 kg K_2O ha^{-1} recorded significantly highest test weight, husk percent and swelling factor which was statistically at par with 15 kg K_2O ha^{-1} and 30 kg K_2O ha^{-1}). These results are supported by the findings of Ramesh *et. al.*, (1989), Singh and Chouhan (1994), Swarupa Utgikar (2001).

The application of 30 kg P_2Os and 30 kg K_2O ha^{-1} to Isabgol significantly increased the dry matter, number of tillers, number of spikes and spike length plant^{-1}. The seed and straw yields of Isabgol were recorded significantly highest with the application of 30 kg P_2O_5 ha^{-1}, however the seed yield was not significantly influenced by the potassium application. The application of phosphorous and potassium had significant effect on quality aspects of seeds; particularly test weight, husk peifcent and swelling factor.

LITERATURE CITED

Anonymous, 1980. Long term manurial trials on Isabgol, Biannual Report of AICRP on Medicinal and Aromatic Plants, Anand : 4.

Gupta, Rajendra and S. K. Pareek 1981. Status of fertilizer use in medicinal plants in India, Fertilizer News : 8-9.

Lal, R. K., J. R. Sharma; Sushilkumar, S. Sharma; P. O. Mishra and Neelakshi Singh, 1999. Stability for economic traits in Isabgol. (Plantago ovata), J. Medicinal and Aromatic Plant Sciences, 21 : 1064-1068

Paturde, J. T., S. G. Wankhade; P. P. Khode and A. H. Khan, 1998[a]. To study the effect of nitrogen and phosphorous levels on, yield of seed., 12[th] Workshop of AICRP on Medicinal and Aromatic Plants held at Hissar: 130-131.

Piper, C. S., 1966. Soil and Plant Analysis, 4[th] Edn Inc. Pub., New York.

Ramesh, M. N., A. A. Farooqui and Thilak Subbaiah, 1989. Influence of sowing date and nutrients on growth and yield of Isabgol (Plantago Ovata Forsk), Crop Res., 2(2): 169-174.

Singh, Ishwar and G. S. Chouhan, 1994. Effect of mixtalol and different combinations of nitrogen and phosphorus fertilizer on growth and yield of blond psyllium (Plantago ovata), Indian J. Agron. 39(4): 711-712

Table 1: Growth parameters and seed and straw yield of Isabgol as influenced by P and K levels

Treatments	Growth Parameters			Yield (q ha^{-1})	
	Tillers plant^{-1}	No. of Spikes plant^{-1}	Length of Spikes (cm)	Seed	Straw
Phosphorus levels (kg P_2O_5 ha^{-1})					
Po -0	7.10	13.79	2.97	8.79	36.95
P^ -15	7.30	13.58	3.55	10.27	44.36
P_2 -30	7.65	16.74	3.70	11.25	50.47
P_3 -45	7.40	16.85	3.75	10.72	49.85
SE (m) ±	0.27	0.47	0.13	0.20	0.52
C.D. at 5%	-	1.64	0.44	0.69	1.82
Potassium levels (kg K_2O ha^{-1})					
Ko -0	6.79	12.76	3.19	9.66	38.05
K_1 -15	7.40	15.05	3.49	10.20	44.29
K_2 -30	7.63	16.45	3.64	10.53	48.74
K_3 -45	7.63	16.68	3.65	10.63	50.55
SE(m)±	0.13	0.38	0.09	0.26	1.09
C.D. at 5%	0.40	1.12	0.28	0.78	3.19
Interaction (P x K)					
SE (m) ±	0.27	0.76	0.19	0.52	2.19
C.D. at 5%	-	-	-	-	-

Table2: Uptake of nutrients and quality of Isabgol seed as influenced by P and K levels

Treatments	Uptake of Nutrients (kg ha^{-1})			Quality parameters		
	Nitrogen	Phosphorous	Potassium	Test Wt. (g)	Husk %	Swelling factor (cc g^{-1})
Phosphorus levels (kg P_2O_5 ha^{-1})						
P_0 -0	15.74	7.82	14.03	1.57	25.48	10.22
P_1 -15	28.28	11.03	17.54	1.78	27.67	10.29
P_2 -30	32.01	14.01	21.54	1.81	28.69	10.38
P_3 -45	29.42	14.17	17.17	1.79	28.29	10.36
SE (m) ±	0.74	0.20	0.31	0.009	0.490	0.020
C.D. at 5%	2.56	0.69	1.08	0.031	1.70	0.071
Potassium levels (kg K_2O ha^{-1})						
K_0 -0	19.49	9.36	13.35	1.67	25.17	10.23
K_1 -15	26.19	11.74.	17.00	1.73	27.40	10.31
K_2 -30	29.41	12.84	20.21	1.76	28.71	10.34
K_3 -45	30.09	13.20	19.70	1.77	28.85	10.38
SE (m) ±	0.91	0.31	0.41	0.015	0.620	0.028
C.D. at 5%	2.73	0.93	1.19	0.045	1.81	0.084
Interaction (P x K)						
S. E. (m) ±	1.82	0.62	0.83	0.031	1.24	0.057
C.D. at 5%	-	-	-	-	-	-

Swarupa, S. Utgikar, 2001. Studies on various levels of nitrogen and phosphorous on growth and yield of Isabgol (Plantago ovata Forsk). M. Sc. Thesis (Unpub), Dr. PDKV, Akola.

Wankhade, S. G., P. P. Khode, S. S. Wanjari, J. T. Paturde and M. R. Kale, 2005. Response of Isabgol (Plantago ovata Forsk) to nitrogen and phosphorous, Agric. Sci. Digest. 25(2): 121-123.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Effect of Cropping Systems and Nutrient Management on C and N Mineralization

Ritu Thakare

ABSTRACT

Effect of irrigated and rainfed cropping systems on carbon and nitrogen mineralization was studied at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Maximum C and N mineralization observed under irrigated cropping systems than rainfed. Sorghum-chickpea- groundnut showed highest mineralization under irrigated condition. While, monocropping and intercropping with legume crop enhances the rate of mineralization under rainfed situation. Mineralization was found to be highest during grand growth period of crops. Application of integrated nutrient supply increased C and N mineralization as compared to their individual application. The FYM+wheat straw+green manuring application augmented the mineralization under soybean- wheat crop sequence.

Organic C and N, two of the major constituents of soil organic matter, need to be managed to reverse the trends of nearly a century of cultivation. Carbon inputs come from C fixation as result of crop production. Nitrogen restored to the soil from atmospheric deposition and biological fixation. Major portion of these nutrients are present in unavailable forms, which further becomes available to plants for their nutrition by certain microbial activities.

The mineralization of C and N plays significant role in the availability of nutrients. However, the rate of mineralization is different under the various cropping systems (Schimel ,1986).

Nitrogen present in crop residues can contribute a significant amount of it to the next crop. Residues from leguminous crops often contribute substantially to total N pool than non- leguminous crops. Carbon and nitrogen release from soil organic matter during decomposition and mineralization by microorganisms is an important source of C and N for plants in both fertilized and unfertilized soil. Hence the knowledge of the relative magnitude of mineralization is essential for better understanding of the organic matter balance in the soil which provides the most reliable index of soil sustainability and productivity in a number of ways.

MATERIAL AND METHODS

The laboratory study was carried out in the department of Agricultural Chemistry and Soil Science, Dr. PDKV, Akola. Surface soil samples (0-30 cm) were collected from the different experimental fields of Central Research Station of University under irrigated and rainfed cropping systems viz., multiple sequence cropping systems, intercropping and monocropping. The soil was clayey in texture, alkaline in reaction (pH 7.9), medium in available N (180 kg ha^{-1}), low in available P (11.38 kg ha^{-1}), high in available K (340 kg ha^{-1}) and medium in organic C (0.46%).

Soil samples were taken before sowing of first crop, at grand growth and at harvest of each crop in sequence. In case of intercropping, grand growth stage value considered as an average value of both the crops. While at harvest, soil samples were taken after completion of the cropping cycle. Nutrient management details are given in Table 1. In the treatments, organics were applied before sowing of the crop and N was applied in two splits (half at sowing and remaining 30 DAS). Full dose of P and K was applied at the time of sowing. In case of pigeonpea, full dose of N and P was given at the time of sowing.

In order to study the C and N mineralization, 25g soil sample was placed in 500ml conical flask. Moisted it with water up to 80 per cent of its field capacity. Test tube containing 10ml of 1 N NaOH was placed in flask in a suspended manner. Wrap the flask with black paper and Incubate at 25°C for 30 days. The mouth of the flasks was kept completely sealed during the period of incubation. At the end of incubation period, amount of CO_2 trapped in NaOH solution was estimated by titrating the excess of

Assistant Prof., Department of Soil Science & Agril. Chemistry, Dr. PDKV, Akola

alkali with 1 N HCl, in presence of the saturated $BaCl_2$ solution using phenolphthalein as an indicator (Pramer and Schimidt, 1965). While the available N (NH_4 + +NO_3 N) was estimated as per the procedure of Black (1965) by distillation with MgO and then in presence of devardas alloy.

RESULTS AND DISCUSSION

Carbon Mineralization

Maximum C mineralization was observed under irrigated condition as compared to rainfed (Table 2) due to the availability of sufficient moisture, nutrients and favourable soil environment for microbial activity. In irrigated condition maximum C mineralized under sorghum- chickpea- groundnut sequence, followed by sorghum- wheat- green gram. Higher rate of C mineralization under sorghum-chickpea- groundnut sequence may be attributed to addition of leguminous crop residues as well as nitrogen fixed in soil under favourable soil moisture condition. The marked decreased of C mineralization at harvest may be the unfavourable soil environment and reduced microbial activity in the rhizosphere. The present findings are in agreement with those of Schimel *et al.* (1985) who reported that the rate of mineralization declined after harvest due to the lack of rhizosphere products. Soybean- wheat sequence showed the higher C mineralization as compared to sorghum- wheat. However, under rainfed condition, intercropping with legumes further registered higher C mineralization as compared to monocropping. This might be due to the legumes which had favourable effect on C mineralization as a result of increased soil microbiota. Similar results were also noticed by Patil *et al.* (1996). Among the monocropping, highest mineralizable C was recorded under groundnut, followed by green gram. However, it was noticeably lower under sorghum and cotton cropping.

Carbon mineralization increased from planting to flowering in all cropping systems. At harvest it tended to decrease but was slightly higher than its initial level. It was noticed that the C mineralization was less in *Rabi* and summer seasons as compared to *Kharif*. Similar findings were also reported by Susan and Abraham (1995). While comparing the sources of nutrients applied to sorghum- wheat crop sequence, maximum C mineralized was observed in treatment receiving 100 per cent NPK + 10t FYM. Application of fertilizer alone resulted in higher rate as compared to control. Marumoto (1984) concluded that the amount of C mineralized was in order of NPK + FYM > NPK >PK.

Table 1 : Nutrient management (N : P_2O_5 : K_2O kg ha^{-1}) under different cropping systems

1.	Sorghum 100:40:40	-	Wheat 120:60:60	-	Greengram 20:40:40
2.	Sorghum 100:40:40	-	Chickpea 25.:50:00	-	Groundnut 25:50:00
3	Sorghum 100:50:40	-	Wheat 120:60:60		
4	Soybean 30:75:00	-	Wheat 120:60:60		
5	Sorghum 80:40:00	+	Pigeonpea 20:40:00		
6	Cotton 50:25:00	+	Greengram 00:00:00		
7	Sorghum 100:40:40				
8	Cotton 50:25:00				
9	Greengram 20:40:00				
10	Groundnut 25:50:00				

Table 2 : C mineralization (µg C g^{-1} soil d^{-1}) as influenced by cropping systems and nutrient management.

S.N.	Cropping systems	Initial	*Kharif*		*Rabi*		Summer	
			GG	AH	GG	AH	GG	AH
	Irrigated							
1	Sorghum- wheat- greengram	8.93	21.25	9.53	20.84	8.37	20.04	8.97
2	Sorghum- chickpea- groundnut	9.84	24.89	10.24	24.00	9.50	23.83	9.88
3	Sorghum- wheat							
	I Control	5.07	10.91	5.21	10.10	5.20		
	II 100% NPK	9.29	20.87	9.84	20.79	9.41		
	III 100% NPK & FYM 10t	9.98	24.97	10.62	-	-		
4	Sorghum- wheat							
	I Control	6.37	11.90	6.50	10.85	6.38		
	II 100% NPK	10.14	23.82	10.89	23.55	10.36		
	III N through FYM, WS and GM	10.96	27.45	11.65	-	-		
	Rainfed							
5	Sorghum + pigeonpea	6.55	16.47	7.38				
6	Cotton + greengram	5.96	15.49	6.71				
7	Sorghum	4.76	13.42	4.33				
8	Cotton	3.78	11.45	3.93				
9	Greengram	4.82	14.20	4.23				
10	Groundnut	5.82	15.14	5.08				

Note : GG- Grand growth, AH- At harvest

Table 3 : N mineralization (µg N g^{-1} soil d^{-1}) as influenced by cropping systems and nutrient management.

S.N.	Cropping systems	Initial	*Kharif*		*Rabi*		Summer	
			GG	AH	GG	AH	GG	AH
	Irrigated							
1	Sorghum- wheat- greengram	0.70	0.97	0.77	0.86	0.71	0.80	0.68
2	Sorghum- chickpea- groundnut	0.91	1.40	0.98	1.14	0.97	1.02	0.89
3	Sorghum- wheat							
	I Control	0.36	0.47	0.30	0.34	0.24		
	II 100% NPK	0.59	0.78	0.63	0.69	0.59		
	III 100% NPK & FYM 10t	0.81	1.63	0.88	-	-		
4	Sorghum- wheat							
	I Control	0.46	0.57	0.41	0.46	0.34		
	II 100% NPK	0.63	0.86	0.68	0.74	0.64		
	III N through FYM, WS and GM	0.72	1.21	0.81	-	-		
	Rainfed							
5	Sorghum + pigeonpea	0.41	0.63	0.48				
6	Cotton + greengram	0.34	0.58	0.36				
7	Sorghum	0.23	0.34	0.19				
8	Cotton	0.20	0.33	0.15				
9	Greengram	0.29	0.48	0.24				
10	Groundnut	0.32	0.53	0.27				

Note : GG- Grand growth, AH- At harvest

In soybean-wheat sequence, highest C mineralized in the soil at all stages of crop growth was recorded with the application of N through FYM + wheat straw + green manuring, followed by 100 per cent NPK treatment.

Nitrogen Mineralization

Results (Table 3) point out that higher N mineralization was observed under irrigated condition specially in *kharif* season due to optimum moisture content and favourable soil environment which is required for hastening microbial activity. Susan And Abraham (1995) also reported that N mineralization was maximum during rainy season. sorghum- checkpea- groundnut crop sequence recorded the highest N mineralization over sorghum- wheat- green gram. However, higher values were found under soybean- wheat sequence as compared to sorghum- wheat sequence probably be due to the residual effect of soybean crop which added narrow C: N residue, besides N fixation. Among the monocropping, the highest mineralizable N was observed under groundnut, followed by green gram. However, under sorghum and cotton less mineralization rate was observed during growing period. Intercropping consisting of legumes have a notable impact on the dynamics of N. sorghum + pigeonpea intercropping showed higher N mineralization at all stages of crop growth as compared to cotton + green gram. Beneficial effect of intercropping involving legumes over monocroppig was observed at the end of intercropping.

At harvest, the mineralizable N decreased from grand growth stage. This is quite apparent in the sense that the crops grown must have utilized the easily available N and there by depleted mineralizable N from the soil. In tropical ecosystems, N mineralization peaked at the onset of rainy season and gradually declines towards the dry period. Easily decomposable substrate such as glucose, amino acids and amides are abundant in the wet period which enhances the rate of mineralization. Since mineralization is a microbially mediated process, it is logical that mineralization should be faster under conditions of adequate moisture and it should slow down as soil water becomes limiting (Srivastava and Lal, 1998)

In sorghum- wheat cropping sequence maximum N mineralization was recorded with the application of 100 per cent NPK + 10t FYM. Thus, from nitrogen release point of view, application of NPK along with the organic residues or FYM is more beneficial over the use of NPK alone. Whereas, application of FYM + wheat straw + green manuring in soybean- wheat sequence noted the highest N mineralized over fertilizer alone treatment.

From the conspectus of earlier discussion, it may be construed that the mineralizable C and N of these soils throw light on the dependence of seasonal N dynamics on short- term substrate availability from crop roots, rhizosphere products and crop residues. Seasonal changes in the active C and N pools of soil organic matter much depended upon the crop sequence for the quality, quantity and frequency of added substrate and N fertilization.

LITERATURE CITED

Black, C. A., 1995. Method of Soil Analysis, American Society of Agronimy, Inc. Publ. Madison, Wiscosin, USA.

Marumoto, T., 1984. Mineralization of C and N from microbial biomass in paddy soil, Plant and Soil, 76 : 165-173.

Patil, S.B., J.D.Patil, A.J.Patil, S.P. Wani, K.K.Loe and Piara Singh, 1996. Biological properties under different cropping patterns.Progress Report, ICRISAT, Patancheru,Andhra Pradesh : 85.

Pramer, D. and E. L. Schimidt, 1965. Experimental Soil Microbiology, Burgess Pub. Com. Minnesota, U.S.A.

Schimel,D.S., D.S.Colemon, and K.A. Horton, 1985. Soil organic matter dynamics in paired rangeland and cropland topo sequences in North Dakata, Geoderma, 36 : 201-214.

Schimel, D.S., 1986. Carbon and nitrogen turnover in adjacent grassland and cropland ecosystem, Biogeochem, 2:345-357.

Srivastava,S.C. and J.P. Lal, 1998. Nitrogen mineralization in variously treated dryland tropical arable soils, J.Indian Soc.Soil.Sci.,46(1): 9-14.

Susan John, and A. Abraham, 1995. Microbial immobilization and mineralization of nutrients during different seasons of the year, J. Indian Soc. Soil Sci.,43(1)47-52.

PKV Res. J. Vol. 33 (2) : 2009

Nutritional Status of Nagpur Mandarin Orchard in Amravati District

Renu V. Chaware[1] and Ommala Kuchanwar[2]

ABSTRACT

Present investigation was undertaken to evaluate the nutritional status of Nagpur mandarin orchard soil and leaf analysis were done with special reference to healthy and decline trees. It is found that organic carbon was high (2.25 to 9 gm kg^{-1}) in healthy orchards than decline ones (1.50 to 3.75 gm kg^{-1}). Soil nutritional status indicate that available nitrogen, phosphorus and zinc were low to deficient in decline orchards while other nutrients were in sufficient amount in both orchards. In general, soil supporting healthy trees contains high concentration of nutrients as compare to decline ones. Leaf nutrient status showed that N, P, Ca, Mg, S and micronutrients concentration were significantly higher & leaf K was lower in healthy trees than decline orchards. It was further noted that leaf N, P & Zn status represented low to deficient range while K, Ca, Mg, S, Fe, Mn and Cu represent optimum range of nutritional status in both healthy and decline orchards.

Nagpur mandarin(*Citrus reticulata* Blanco) occupies a considerable importance particularly in Vidarbha region of M.S. The best quality of Nagpur mandarin is produced in Vidarbha region,Chindwara Betul, Mansaur and Hushangabad districts of Madhya Pradesh (Srivastava and Singh, 2003) In recent years, it has been observed that orange gardens are declined following a period of satisfactory performance lasting few years. The probable causes of citrus declining in this region are poor characters of orchard soils, faulty management practice of pest and diseases. However, low soil fertility containing less micronutrients like Fe, Mn, Zn, Cu has been widely accepted as one of the major reason of citrus declining. Thus present investigation was undertaken to find out nutritional status of Nagpur mandarin in warud tahsil of Amravati district during the year 2004-2006.

MATERIAL AND METHODS

For the present investigation Nagpur mandarin orchards around Warud, tahsil of Amravati district (Maharshtra) were surveyed and six each healthy and declined orchards were selected on the basis of their yield performance for last five years and visual observations.

For the experiment depth wise soil samples were collected from each orchard. Soil samples were dried in shade, passed gently in wooden pestle and mortar, passed through 2 mm sieve for determination of available nutrients and passed through 0.2 mm sieve for organic carbon. These processed samples were then kept in separate labeled polythene bags for further analysis.

Organic Carbon was determined by Walkley and Black wet oxidation method (Piper 1966). Available nitrogen was determined by alkaline permanganate method (Subbiah and Asija 1956). For Available phosphorus the soil was extracted with Olsen's reagent 0.5 m $NaHCO_3$ of pH 8.5 and in the extract available P was estimated calorimetrically as per Jackson (1967). The available K was estimated in 1 N NH_4 O AC (pH 7) leachate (Jackson, 1967). The available micro-nutrients determined by suing DTPA, TEA extractant using 10 g soil and 20 ml extractant and shaking for 2 hours then leachate was used for available Fe, Cu, Mn and Zn using atomic absorption spectrophotometer (AAS) (Lindsay and Norvell, 1978).

To assess the nutrient status of leaves of Nagpur mandarin, the 5 to 7 month old leaves from 2nd, 3rd and 4th leaf from non fruiting terminals was collected covering all the four directions at a height of 1.5 – 1.8 m from each orchard (Srivastava and Singh 2003).The leaf samples collected were washed sequentially with 2 percent detergent, tap water and distilled water. Then leaf samples were dried at 70° C and homogenized using grinder. The processed samples were presented in paper bags with

1 MSc Student and 2 Assistant Prof., Section of Agril.Chemistry and Soil Science College of Agriculture Nagpur

Table 1: Performance and growth parameters of orange orchards under different locations.

Site No.	Name of farmer	Village	Age of trees (years)	Condition	Growth parameters			Yield parameters	
					Girth (m)	Height (m)	Canopy (m^3)	Number of fruits $tree^{-1}$	Avg. weight of fruit
1	Bhushan Lokhande	Loni	14	Healthy	0.73	4.90	42.70	1070	137.0
2	Nilkanthrao Kandalkar	Dhanodi	12	Healthy	0.65	4.30	38.83	977	141.3
3	Prakash Wankhade	Bahda	12	Healthy	0.68	4.38	39.82	1037	132.4
4	Babarao Kanthak	Temburkheda	08	Healthy	0.54	3.59	28.33	1108	151.3
5	Gulabrao Thote	Dhanodi	09	Healthy	0.57	4.47	20.70	980	142.0
6	Dr. Sudhakar Bande	Warud	15	Healthy	0.68	4.29	44.27	1087	133.2
7	Parimal Pachghare	Loni	07	Declined	0.49	3.67	15.38	203	121.0
8	Babarao Chinchamalatpure	Jamalpur	15	Declined	0.72	5.52	40.90	170	103.9
9	Atul Kshirsagar	Jamalpur	09	Declined	0.56	4.74	23.60	130	120.7
10	Rameshrao Gorde	Pusla	13	Declined	0.68	4.40	37.00	79	97.0
11	Vishnupant Lakhe	Wathoda	16	Declined	0.73	5.00	41.00	132	102.1
12	Babarao Kandalkar	Dhanodi	09	Declined	0.59	4.48	21.30	205	117.3

Table 2: Nutritional status of soils of healthy and declined orchards.

SiteNo.	Depth(cm)	Org C gm kg^{-1}	Total N%	Available major nutrients			
				N kg ha^{-1}	P_2O_5 kg ha^{-1}	K kg ha^{-1}	S(ppm)
1	0–20	5.55	0.056	222.9	37.6	392.0	11.0
	20–50	4.35	0.043	189.1	26.8	296.8	9.4
	50–80	3.60	0.036	177.8	23.2	347.2	8.7
	80–100	2.40	0.032	172.1	21.5	358.4	9.9
2	0–20	5.85	0.056	234.2	38.4	672.0	11.3
	20–50	4.95	0.049	214.5	30.6	638.4	12.1
	50–80	3.60	0.045	208.8	28.6	560.0	11.0
	80–100	2.55	0.036	169.3	19.7	532.0	9.5
3	0–20	5.40	0.052	206.0	25.0	324.0	11.0
	20–50	4.65	0.046	189.1	23.2	284.8	10.1
	50–80	3.60	0.038	186.2	19.7	296.5	9.5
	80–100	2.40	0.029	177.8	14.1	294.4	7.3
4	0–20	4.80	0.061	241.6	31.4	492.8	11.2
	20–50	4.05	0.046	210.3	21.5	324.8	12.1
	50–80	3.15	0.037	194.7	17.3	291.2	10.3
	80–100	2.25	0.030	176.2	13.4	257.6	9.7
5	0–20	5.90	0.058	245.5	26.8	560.0	11.6
	20–50	2.95	0.026	186.2	15.9	390.2	8.3
6	0–20	9.00	0.0896	273.7	38.3	655.2	10.4
	20–50	5.70	0.055	169.3	27.0	527.2	11.1
	50–70	4.05	0.039	160.9	16.8	582.4	8.5
7	0–20	3.30	0.031	206.8	22.0	420.0	9.0
	20–50	2.55	0.024	186.0	17.0	312.8	9.7
	50–80	2.40	0.021	155.2	14.3	296.8	8.5
	80–100	1.95	0.018	149.3	11.2	310.0	6.3
8	0–20	3.50	0.031	208.8	19.8	368.4	9.7
	20–50	3.20	0.029	180.6	16.0	390.8	11.0
	50–80	2.90	0.026	163.6	12.1	280.0	8.4
	80–100	2.25	0.023	149.5	9.9	357.6	7.4
9	0–20	3.00	0.029	177.8	20.2	750.4	10.8
	20–50	2.40	0.022	152.4	19.1	587.2	8.9
	50–80	2.10	0.021	141.1	17.3	465.8	9.4
	80–100	1.50	0.015	135.4	12.5	517.9	7.6
10	0–20	3.75	0.038	197.5	23.6	364.0	11.5
	20–50	3.00	0.029	180.6	20.8	313.6	10.6
	50–73	1.80	0.017	124.1	11.2	374.2	7.6
11	0–20	3.60	0.036	149.5	23.3	554.4	11.4
	20–50	2.70	0.027	141.1	19.8	412.8	8.1
	50–80	2.10	0.019	124.1	14.3	291.2	8.6
	80-100	1.65	0.014	112.8	12.3	327.5	6.5
12	0–20	1.95	0.017	135.4	19.4	571.2	10.6
	20–40	1.50	0.014	121.3	15.9	476.6	9.2

Table 3: Available micro-nutrient status of soils of healthy and declined orchards.

Site. No.	Depth (cm)	Available micro-nutrients (ppm)			
		Fe	Mn	Cu	Zn
1	0 – 20	6.39	14.32	2.33	0.56
	20 – 50	5.42	8.33	2.01	0.63
	50 – 80	8.81	9.75	1.80	0.50
	80– 100	7.20	3.92	1.22	0.41
2	0 – 20	5.82	17.11	3.15	0.84
	20 – 50	6.40	13.71	2.27	0.42
	50 – 80	6.56	6.10	2.18	0.38
	80– 100	8.28	4.92	1.97	0.32
3	0 – 20	4.69	12.72	2.85	0.69
	20 – 50	5.84	11.00	2.76	0.52
	50 – 80	5.01	8.61	2.31	0.30
	80– 100	7.21	6.33	2.40	0.32
4	0 – 20	5.70	14.35	2.30	0.80
	20 – 50	5.83	12.65	2.55	0.62
	50 – 80	6.22	7.37	2.40	0.41
	80– 100	6.15	6.39	2.30	0.41
5	0 – 20	5.09	15.05	2.34	0.63
	20 – 50	6.33	8.27	1.50	0.52
6	0 – 20	6.08	13.43	5.90	0.73
	20 – 50	5.57	14.21	4.87	0.64
	50 – 70	6.94	7.13	3.03	0.42
7	0 – 20	5.03	8.79	2.05	0.42
	20 – 50	5.40	5.48	1.42	0.45
	50 – 80	7.12	5.53	1.51	0.21
	80– 100	5.20	4.98	1.14	0.21
8	0 – 20	4.13	12.07	2.02	0.51
	20 – 50	4.51	7.71	1.44	0.31
	50 – 80	5.17	6.91	2.00	0.30
	80– 100	5.21	4.44	1.05	0.20
9	0 – 20	4.83	10.15	2.25	0.42
	20 – 50	4.72	11.27	2.07	0.39
	50 – 80	4.81	7.30	1.51	0.22
	80– 100	4.49	5.40	1.17	0.20
10	0 – 20	4.29	12.34	2.38	0.51
	20 – 50	4.43	8.29	1.95	0.54
	50 – 73	5.17	4.43	1.78	0.31
11	0 – 20	3.50	11.24	2.88	0.46
	20 – 50	3.90	8.27	1.33	0.36
	50 – 80	3.98	6.62	1.21	0.31
	80– 100	4.10	4.25	1.07	0.30
12	0 – 20	3.13	8.13	2.07	0.39
	20 - 40	3.78	6.76	1.62	0.30

appropriate labels and used for chemical analysis. Total nitrogen in plant samples was determined by Kjeldahl's method (Piper 1966). Total phosphorous was determined calorimetrically using blue filter (Jackson 1967). Total potassium was determined by diluting the extract to appropriate concentration and was directly atomized to the flame photometer (Jackson, 1967). The sulphate content in the digested material was determined by barium sulphate turbidimetry method by reading the absorbance of solution on calorimeter using blue filter. For estimation of calcium and magnesium, the aliquot was titrated against EDTA as per procedure described by Jackson (1958). Fe, Mn, Cu and Zn content in diacid extract were determined using atomic adsorption spectrophotometer (AAS) (Lindsay and Norvell, (1971).

RESULTS AND DISCUSSION

It was observed that about 70 to 80 per cent orange trees in declined orchards were found non-bearing and remaining orange trees are on the way of declining(Table-1). Maximum declining of orange trees may be due to the faulty management and adverse soil quality. It was further observed that in general the health of the orchards was found to be affected by lack of availability of nutrients. Analytical data (Table-2)revels that the Organic carbon content in healthy orchard was higher (2.25 to 9.00 gm kg^{-1}) than those of declined ones (1.50 to 3.75 gm

Table: 4 Leaf nutritional status of healthy and declined orchards.

Orchard No.	Total 'N' (%)	Total 'P' (%)	Total 'K' (%)	Ca (%)	Mg (%)	S (%)
1	2.38 - 2.42	0.14 - 0.16	0.85 - 0.88	3.64 - 3.70	0.59 - 0.65	0.19 - 0.21
	2.40	0.15	0.87	3.78	0.61	0.20
2	2.36 - 2.40	0.12 - 0.14	0.86 - 0.88	3.18 - 3.22	0.52 - 0.62	0.17 - 0.22
	2.37	0.13	0.87	3.20	0.57	0.19
3	2.50 - 2.53	0.16 - 0.17	0.82 - 1.10	3.96 - 4.02	0.68 - 0.74	0.18 - 0.23
	2.51	0.16	0.99	3.86	0.71	0.20
4	2.38 - 2.47	0.12 - 0.14	0.79 - 0.84	2.92 - 3.12	0.56 - 0.68	0.17 - 0.14
	2.43	0.12	0.81	3.02	0.64	0.18
5	2.17 - 2.29	0.15 - 0.17	0.78 - 0.81	3.14 - 3.38	0.58 - 0.62	0.16 - 0.24
	2.3	0.16	0.80	3.37	0.60	0.20
6	2.52 - 2.60	0.14 - 0.18	0.77 - 1.18	3.26 - 3.50	0.68 - 0.75	0.19 - 0.24
	2.55	0.16	1.00	3.34	0.71	0.21
Mean	2.41	0.14	0.89	3.42	0.64	0.19
7	1.78 – 1.87	0.09 - 0.12	1.58 - 1.98	3.04 - 3.14	0.68 - 0.74	0.16 - 0.23
	1.82	0.10	1.73	3.08	0.70	0.19
8	2.05 - 2.11	0.08 - 0.09	0.97 - 1.06	2.70 - 2.74	0.48 - 0.51	0.14 - 0.19
	2.08	0.08	1.00	2.72	0.49	0.16
9	1.64 - 1.75	0.09 - 0.13	0.91 - 0.99	3.06 - 3.18	0.44 - 0.52	0.19 - 0.22
	1.70	0.11	0.95	3.10	0.48	0.20
10	1.93 - 2.05	0.08 - 0.10	0.85 - 0.97	3.16 - 3.27	0.34 - 0.54	0.14 - 0.21
	1.99	0.08	0.89	3.21	0.44	0.18
11	2.00 - 2.10	0.08 - 0.12	0.79 - 0.88	2.30 - 2.72	0.30 - 0.36	0.14 - 0.19
	2.04	0.09	0.83	2.46	0.33	0.16
12	1.87 - 1.93	0.09 - 0.11	0.89 - 1.10	2.78 - 2.90	0.22 - 0.38	0.15 - 0.21
	1.90	0.09	0.97	2.83	0.31	0.17
Mean	1.92	0.09	1.06	2.90	0.45	0.17

Table: 5 Leaf micro-nutrient status of healthy and declined orchards.

Orchard No.	Fe (ppm)	Mn (ppm)	Cu (ppm)	Zn (ppm)
1	132 - 147	26.05 - 30.12	27.0 - 29.02	27.92 - 29.10
	138.6	28.45	7.69	28.37
2	108 - 130	25.07 - 31.50	24.22 - 30.06	26.01 - 31.62
	122.3	28.52	27.40	29.13
3	98 - 107	30.01 - 35.55	28.11 - 31.00	27.27 - 28.86
	102.6	32.54	29.94	28.31
4	129 - 132	31.03 - 41.02	32.01 - 33.19	23.57 - 29.50
	130.6	37.18	32.46	25.79
5	92 - 109	32.0 - 39.03	31.0 - 36.10	19.72 - 24.41
	101.0	6.16	33.96	22.31
6	128 - 1311	35.06 - 37.22	22.70 - 33.31	27.42 - 29.33
	30.0	36.16	28.37	28.08
Mean	120.81	33.16	29.97	26.99
7	87.0 - 102.0	2.87 - 31.30	20.0 - 24.70	19.50 - 23.40
	96.66	27.16	22.00	20.30
8	79.0 - 98.0	21.22 - 23.83	18.0 - 23.19	18.92 - 24.00
	82.66	22.38	20.72	21.54
9	97 - 109	22.02 - 27.0	22.70 - 28.06	19.17 - 22.00
	94.00	24.20	24.92	20.72
10	70.0 - 77.0	28.70 - 31.70	21.01 - 26.81	17.22 - 23.70
	73.66	30.67	23.08	20.93
11	95.0 - 110.01	22.88 - 28.77	20.0 - 23.72	19.80 - 22.08
	02.00	25.61	21.60	20.60
12	97.0 - 103	21.12 - 24.44	19.89 - 29.00	18.72 - 21.03
	100.33	23.18	25.05	19.58
Mean	91.55	25.53	22.89	20.61

kg^{-1}).Healthy orchards contained medium organic carbon while declined comes under low category. Organic carbon showed decreasing trend with soil depth. Soil nutritional status of Nagpur Mandarin orchards in Warud tahsil indicate that soils of orange orchards were low in available nitrogen, most of declined orange orchards contained less available nitrogen(112.8 to 208.8 kg ha^{-1}) as compared to healthy ones(169.3 to 273.7 kg ha^{-1}). Available phosphorus status indicates that soils of healthy orchards are low to medium in P content (13.4 to 38.4 kg ha^{-1}). While declined orange orchards comes under low in available phosphorus (9.9 to 23.6 kg ha^{-1}).All orange orchard soils were high to very high in available potassium status. Sulphur content of healthy orchard soils contained higher amount (7.3 to 12.1ppm) than declined orchards (6.3 to 11.5 ppm).

The available micro-nutrients of Nagpur Mandarin orchard soils (Table-3) showed that available Fe, Mn, Cu, and Zn contents were significantly higher in healthy plant sites than declining area. Considering the critical limits of nutrients as suggested by Lindsay and Norvell (1971), all the orchard soils were well supplied with available iron, copper and manganese except zinc. Similar findings were given by Dhale and Jagdish Prasad (2009) where as most of the declined orchard soils were deficient in available zinc content.

The nutritional status of Nagpur mandarin leaves for major nutrients (Table-4) showed that leaf nitrogen and phosphorus concentration were higher where as potassium concentration was lower in healthy than declining trees. Leaf nitrogen of healthy trees represents optimum range while potassium in healthy and declined trees represents optimum to high range. Amongst secondary nutrients leaf calcium and magnesium status represented optimum range. Calcium and magnesium and sulphur concentration in healthy trees were found higher than declined trees. The micro nutrient status of leaves of orange indicated that Fe, Mn, Cu and Zn concentration in healthy plants were higher than declined trees.

Yield parameters showed that yield was significantly higher in healthy orchards than declined ones. All the major and micronutrients were more in Healthy orchards except K which was higher in both the type of orchards and Zn which was deficient in all orchards. Hence it is concluded that declineness of orchards is due to the nutrient deficiency.

LITERATURE CITED

Dhale S A and Jagdish Prasad 2009 Characterization and classification of sweet orange-growing soils of Jalna District, Maharashtra,Journal of the Indian Society of soil science,57(1): 11-17

Jackson, M. L. 1958. Soil Chemical Analysis .Prentice Hall of India Pvt. Ltd., New Delhi.

Jackson, M. L. 1967 Soil Chemical Analysis Prentice Hall of India, Pvt. Ltd. New Delhi.

Lindsay, W. L. and W. A. Norvell 1971. A micronutrient soil test for zinc iron manganese and copper. Agron. Abst. : . 84.

Lindsay, W. L. and W. A. Norvell 1978. Development of DTPA soil test for Zinc, Iron, Manganese and Copper, Soil Sci. Soc. of America J., 42 : 421-428.

Piper, C. S. 1966. Soil and Plant Analysis. Hans Publishers, Bombey : 368.

Srivastava, A. K. and Shyam Singh 2003 Citrus Nutrition International Book Distributing Co. (Ist Ed,) : 3-5.

Subbiah, B. V. and G. L. Asija 1956. A rapid procedure for the estimation of available nitrogen in soils, Curr. Sci., 25 : 259-260

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Productivity and Nutrient Uptake of Cotton as Influenced by Gypsum in Sodic Vertisol Under Alkali Water Irrigation

B.A.Sonune[1], V. V. Gabhane[2], P. V. Mohod[3], N. M. Konde[4] and B.N.Sagare[5]

ABSTRACT

Field experiment was conducted in sodic Vertisols of Purna valley with different level of gypsum application to soil (0, 25 and 50% GR) and gypsum bed (15 and 30 cm thickness) under alkali irrigation water to evaluate the productivity, nutrient concentration and uptake by cotton (cv. PKV-Hy2) during 1999-00 to 2000-01. Ground water of Purna valley was also alkaline in nature. Cotton productivity significantly increased with increasing level of gypsum and gypsum bed. Though, maximum productivity obtained by 50 per cent GR + water passing through 30 cm gypsum bed, treatment consisting of gypsum application @ 25 per cent GR + water passing through 30 cm gypsum bed also sustained the productivity. Nutrient uptake was also enhanced with increasing level of gypsum except sodium. Highest concentration and uptake of nutrients were noticed in treatment 50 per cent GR + water passing through 30 cm gypsum bed.

Sodic soils are formed under the influence of sodium carbonate pose a serious problem for crop production. Under these soils, availability of water and nutrients uptake to plants is seriously affected due to presence of cations and anions in the root zone. The rhizosphere environment becomes unfavourable for healthy growth of plants although there may be sufficient amount of water and nutrient in soil. Therefore, the concept of nutrient availability vis-à-vis the uptake by plant under normal soil conditions may not be equally applicable for saline and alkali soils. Soils in the Purna valley of Vidarbha region (Vertisols) do not have very high pH and ESP, but owing to the presence of smectites, soil structure deterioration and adverse effect on crop growth has been experienced even at low ESP of 6 (Balpande *et al*., 1996). Similarly, irrigation with brackish water further deteriorates the soil properties which create unfavorable condition for growth and development of crops with nutritional imbalance under normal farming practices.

Amelioration of these soils requires replacement of sodium ion by calcium ion on the cation exchange complex. Several amendments including acids and acid forming material have been used to reclaim these soils. Out of these amendments, gypsum found to be more effective for black clayey soils and can greatly improve the nutrition of plant. Against this background, the present investigation was undertaken to evaluate the effect of gypsum bed with alkali irrigation water on productivity and nutrition of cotton grown in sodic Vertisols of Purna valley in Vidarbha region.

MATERIAL AND METHODS

A field experiment was conducted during 1999-00 to 2000-01 on sodic Vertisols of Purna valley in Vidarbha region (MS) with cotton (PKV Hy-2) as a test crop. Experimental field was representative site of Purna valley having pHs (7.68-8.11), ECe (0.48-0.81 dS m^{-1}), SAR (13.5-17.08), ESP (16.69-19.5), BD (1.60-2.14 Mg m^{-3}) and HC (0.13-0.15 cm hr^{-1}). The tube well water used for irrigation was alkaline in nature (pHiw 8.6, ECiw 1.8 dS m^{-1}, SAR 21.27 and RSC 11.0).

There were nine treatments viz., control (no gypsum), gypsum application (soil) @ 25 and 50 per cent GR and alkali irrigation water passed through 15 and 30 cm gypsum bed and the various combinations of soil application of gypsum and gypsum bed. A specially designed iron tank having size of 1x 1 x 1 m^3 was constructed; the height of gypsum bed in tank was adjusted by placing 6 mm diameter bar at 15 or 30 cm height. The irrigation was given by furrow irrigation method made after two rows of cotton whenever necessary (protective irrigation at 50 % depletion of available soil moisture).

A basal dose of 50: 50: 50 kg NPK was applied in the form of urea, SSP and MOP, while, 50 kg N was top dressed after 30 days of sowing during

1& 4 Senior Res. Asstt., 2. Associate Prof., 3. Junior Res. Asstt. and 5 Ex. Professor & Head, Dept. of Soil Science and Agriculture Chemistry, Dr. PDKV, Akola,

both years. FYM was applied @ 5 t ha $^{-1}$ before one month of sowing, however soil application of gypsum (< 0.5 mm in size) was done prior to last harrowing of experimental field. The representative plant samples and cotton seed from each plot were collected randomly at the time of harvesting, dried and ground. These samples were analysed using standard procedure for N, P, K, Ca, Mg and Na (Chapman and Pratt, 1961) and nutrient content was estimated and nutrients uptake was computed.

RESULTS AND DISCUSSION

Cotton productivity

The different treatments significantly influenced the seed cotton and stalk yield (Table 1). Lowest mean yield (11.6 and 20.6 q ha^{-1} seed cotton and stalk yield, respectively) was observed in control (No gypsum with alkali water). This clearly indicated the adverse effect of alkali irrigation water. This adverse effect was attributed directly or indirectly through RSC and SAR of water (Kanwar and Kanwar, 1971) coupled with sodicity of soil. The reduction in crop yield may also be attributed to disorders in mineral nutrition and toxicity caused by high sodium content in the soil solution. Soil application alone at higher level @ 50 per cent GR (2.5 t ha^{-1}) was significant over its lower level (1.25 t ha^{-1}). However, applications of gypsum bed alone (T_4 and T_5) were at par with each other. Different combinations of gypsum through soil and alkali water passing through gypsum bed further significantly increased the cotton productivity.

Within the various combinations, soil application of gypsum @ 25 per cent GR (1.25 t ha^{-1}) and alkali water passing through 30 cm gypsum bed gave higher yield (18.2 q ha^{-1}) which was 56.6 per cent higher than control. However, this combination was at par with higher level of gypsum application (T_9 and T_8). Decrease in residual alkalinity and sodicity of alkali irrigation water and increase in water soluble Ca by passing it through gypsum bed (Pal and Poonia, 1979) might have resulted in enhancement in seed cotton yield (Sharma *et. al.*, 1998). Highest seed cotton yield (19.2 q ha^{-1}) was observed in T_9, while treatment T_7 (soil application of gypsum @ 50 per cent GR + irrigation water passed through 30 cm bed) also sustained the cotton productivity (18.2 q ha^{-1}) with reducing gypsum quantity from 2.5 to 1.25 t ha^{-1} and these combinations were statistically at par with each other. Application of brackish water along with gypsum helped the removal of Na from the soil profile, appreciable decreased the soil pH, improved the infiltration rate and raised crop yield. The findings are in line with the results reported by Bajwa and Josan (1989), Sekhon and Bajwa (1993) and Sharma *et al.* (1998).

Nutrient concentration

The results indicated that lowest nutrient concentration (except sodium) was noticed in control (no gypsum) under irrigation with alkali water. This clearly indicated that irrigation in sodic Vertisols with alkali water has detrimental effect on nutrient concentration. Application of gypsum had significant effect on N content (Table 2) by gypsum application in soil as well as water passing through gypsum bed. Significantly highest N content (2.25 %) in seed was noticed in treatment receiving gypsum @ 50 per cent GR + 30 cm gypsum bed(T_9) followed by T_3 (2.16 %), T_8(2.14%) and T_5(2.13%) which were found to be at par with each other. Higher level gypsum application either through soil or bed was found significant over their respective lower level. Enhancement in N content could be directly attributed to its increased availability due to amelioration of sodic soil by gypsum (Abrol and Bhumbla, 1979; Singh *et al.*, 1980), which obviously enhanced its absorption by cotton.

The effect of gypsum application on P and K content was found significant in pooled results. However, the results are non significant in respect of P content in stalk. The highest P concentration (0.68%) was noticed due to soil application of gypsum @ 50 per cent GR (T_3). Among different combination of gypsum, higher P content (0.67 %) recorded in treatment T_6 and this combination was at par with other combinations (T_7, T_8 and T_9). K concentration of seed was ranged from 0.89 to 1.11 per cent. Maximum concentration was noticed in treatment T_9(1.11%), followed by T_3 (1.09), T_7(1.07) and T_6 (1.06) which were at par with each other. Similarly, gypsum application alone in soil and through bed was at par with each other. Compared to gypsum bed alone, soil application of gypsum recorded higher values of K concentration. These results are in conformity with the findings reported by Singh *et al.* (1980) and Tiwari *et al.* (1994). Like

Table 1. Cotton productivity (q ha^{-1}) as influenced by gypsum bed technique

S.N.	Treatments	Seed cotton			Stalk yield		
		99-00	00-01	Mean	99-00	00-01	Mean
T_1	No gypsum (control)	13.3	9.9	11.6	17.0	24.3	20.6
T_2	Gypsum @ 25 % GR	14.2	13.6	13.9	18.8	25.0	21.9
T_3	Gypsum @ 50 % GR	15.9	15.8	15.9	22.0	29.6	25.8
T_4	15 cm gypsum bed	15.3	13.2	14.2	27.4	25.9	26.7
T_5	30 cm gypsum bed	16.2	13.8	15.0	30.3	28.3	29.3
T_6	Gypsum @ 25 % GR + 15 cm gypsum bed	18.1	15.6	16.9	33.0	33.3	33.2
T_7	Gypsum @ 25 % GR + 30 cm gypsum bed	19.0	17.3	18.2	33.2	39.3	36.3
T_8	Gypsum @ 50 % GR + 15 cm gypsum bed	19.1	18.9	19.0	34.1	41.4	37.8
T_9	Gypsum @ 50 % GR + 30 cm gypsum bed	19.8	19.6	19.2	34.5	48.4	41.5
	SE (m)±	1.1	0.8	0.5	1.7	1.8	1.1
	CD at 5%	3.2	2.4	1.2	4.8	5.0	3.3

Table 2. Average N, P and K content (%) of cotton as influenced by gypsum under alkali irrigation water (Pooled mean)

S.N.	Treatments	Nitrogen		Phosphorous		Potassium	
		Seed	Stalk	Seed	Stalk	Seed	Stalk
T_1	Control	1.72	0.48	0.51	0.124	0.89	1.07
T_2	Gyp @ 25 % GR	1.81	0.60	0.66	0.141	1.01	1.40
T_3	Gyp @ 50 % GR	2.16	0.78	0.68	0.157	1.04	1.71
T_4	15 cm gyp bed	1.79	0.67	0.66	0.138	0.95	1.30
T_5	30 cm gyp bed	2.13	0.68	0.63	0.127	0.99	1.35
T_6	Gyp @ 25 % GR + 15 cm gyp bed	2.09	0.72	0.67	0.144	1.06	1.48
T_7	Gyp @ 25 % GR+ 30 cm gyp bed	2.06	0.77	0.66	0.144	1.07	1.58
T_8	Gyp @ 50 % GR + 15 cm gyp bed	2.14	0.70	0.66	0.129	1.09	1.58
T_9	Gyp @ 50 % GR + 30 cm gyp bed	2.25	0.90	0.64	0.165	1.11	1.74
	SE (m)±	0.04	0.03	0.03	0.02	0.04	0.09
	CD at 5%	0.12	0.08	0.08	NS	0.11	0.28

Table 3. Average Ca, Mg, and Na content (%) of cotton as influenced by gypsum under alkali irrigation water irrigation (Pooled mean)

S.N.	Treatments	Calcium		Magnesium		Sodium	
		Seed	Stalk	Seed	Stalk	Seed	Stalk
T_1	Control	0.28	0.35	0.21	0.27	0.329	0.50
T_2	Gyp @ 25 % GR	0.43	0.53	0.31	0.36	0.292	0.40
T_3	Gyp @ 50 % GR	0.66	0.78	0.52	0.43	0.245	0.36
T_4	15 cm gyp bed	0.54	0.64	0.39	0.36	0.325	0.47
T_5	30 cm gyp bed	0.59	0.72	0.48	0.40	0.289	0.46
T_6	Gyp @ 25 % GR + 15 cm gyp bed	0.64	0.77	0.54	0.47	0.233	0.43
T_7	Gyp @ 25 % GR+ 30 cm gyp bed	0.73	0.89	0.62	0.50	0.213	0.41
T_8	Gyp @ 50 % GR + 15 cm gyp bed	0.74	0.90	0.60	0.53	0.223	0.44
T_9	Gyp @ 50 % GR + 30 cm gyp bed	0.80	0.96	0.65	0.54	0.199	0.34
	SE (m)±	0.04	0.05	0.03	0.02	0.07	0.06
	CD at 5%	0.12	0.16	0.08	0.07	0.02	NS

Table 4. N, P and K uptake (kg ha^{-1}) by cotton as influenced by gypsum under alkali irrigation water (Pooled mean)

S.N.	Treatments	N			P			K		
		Seed	Stalk	Total	Seed	Stalk	Total	Seed	Stalk	Total
T_1	Control	19.21	10.41	29.62	5.84	2.75	8.59	10.26	21.06	31.32
T_2	Gyp @ 25 % GR	25.14	13.44	38.58	9.11	3.17	12.28	14.01	30.11	44.12
T_3	Gyp @ 50 % GR	34.24	20.54	54.78	10.73	4.11	14.84	16.54	43.17	59.72
T_4	15 cm gyp bed	24.82	17.60	42.42	9.34	3.64	12.98	13.37	34.61	47.99
T_5	30 cm gyp bed	31.70	19.87	51.57	9.39	3.69	13.09	14.86	39.21	54.07
T_6	Gyp @ 25 % GR + 15 cm gyp. bed	34.92	23.88	58.81	11.23	4.80	16.03	17.77	49.25	66.97
T_7	Gyp @ 25 % GR+ 30 cm gyp. bed	37.39	21.79	65.18	11.94	5.29	17.24	19.38	57.48	76.87
T_8	Gyp @ 50 % GR + 15 cm gyp. bed	40.70	26.86	67.56	12.52	4.97	17.50	20.74	59.45	80.19
T_9	Gyp @ 50 % GR + 30 cm gyp. bed	44.06	38.08	82.14	12.53	6.93	19.46	21.87	71.06	92.94
	SE (m)±	1.18	1.41	2.21	0.58	0.46	0.79	0.78	3.22	3.47
	CD (p=0.05)	3.54	4.24	6.61	1.73	NS	2.37	2.33	9.64	10.40

Table 5. Ca, Mg and Na uptake (kg ha^{-1}) by cotton as influenced by gypsum under alkali irrigation water (Pooled mean)

S.N.	Treatments	Ca			Mg			Na		
		Seed	Stalk	Total	Seed	Stalk	Total	Seed	Stalk	Total
T_1	Control	3.20	7.44	10.64	2.44	5.69	8.13	4.04	9.46	13.49
T_2	Gyp @ 25 % GR	5.87	11.94	17.81	4.36	8.12	12.48	4.11	8.70	13.11
T_3	Gyp @ 50 % GR	10.46	20.93	31.40	8.21	11.34	19.56	3.89	9.59	13.48
T_4	15 cm gyp bed	7.61	16.56	24.17	5.40	9.68	15.21	4.80	12.81	17.61
T_5	30 cm gyp bed	8.83	20.84	28.67	7.08	11.83	18.92	4.52	13.29	17.65
T_6	Gyp @ 25 % GR + 15 cm gyp bed	10.65	27.92	38.57	9.06	15.52	24.59	4.08	14.48	18.56
T_7	Gyp @ 25 % GR+ 30 cm gyp bed	13.15	33.14	46.30	11.12	18.42	29.53	3.96	15.18	19.14
T_8	Gyp @ 50 % GR + 15 cm gyp bed	14.06	34.91	48.99	11.42	20.50	31.92	4.25	17.31	21.56
T_9	Gyp @ 50 % GR + 30 cm gyp bed	15.7	44.44	57.15	12.80	23.08	35.89	3.93	14.66	18.59
	SE (m)±	0.75	2.41	2.69	0.54	1.06	1.5	0.25	1.44	2.36
	CD (p=0.05)	2.25	7.25	8.05	1.61	3.18	4.47	NS	NS	NS

major nutrients, Ca and Mg content also significantly increased with increasing level gypsum (Table 3). Highest concentration of Ca (0.80 and 0.96% in seed and stalk, respectively) was noticed in the treatment T_9, followed by T_8 (0.74 and 0.90 % in seed and stalk, respectively) and T_7 (0.73 and 0.89% in seed and stalk) which were at par with each other. Maximum concentration of magnesium (0.65 and 0.54% in seed and stalk, respectively) was noticed in treatment T_9, followed by T_8 (0.60 and 0.53 %) and T_7 (0.62 and 0.50 %) which were at par with each other

The concentration of sodium decreased significantly with each increment in gypsum application (soil or gypsum bed). Maximum reduction was noticed in T_9 (0.199 and 0.34% in seed and stalk, respectively), followed by T_7 and T_8. Higher level of gypsum either through soil or gypsum bed alone was found significant over their respective lower level. While, result was found non-significant in case of cotton stalk. The absorption of Na, K, Ca and Mg is mostly governed by their respective status on the exchangeable phase of soil. Since,

gypsum application increased the Ca+Mg cation whereas Na decreased on exchange complex. Absorption of Ca, Mg and K increased while Na decreased.

Uptake of nutrients

Application of gypsum significantly influenced the nutrient uptake. Nitrogen uptake linearly increased with increment in gypsum either in soil or through gypsum bed over control (Table 4). Pooled results indicated that the higher levels of gypsum either through soil or through gypsum bed were superior over their respective lower levels. Among different combinations, significantly maximum uptake was recorded in treatment T_9 (44.06, 38.08 and 82.14 kg ha^{-1} in seed, stalk and total uptake, respectively) which was followed by T_8 (40.70, 26.86 and 67.56 kg ha^{-1}) and T_7 (37.39, 21.79 and 65.18 kg ha^{-1}). Application of gypsum either through soil or gypsum bed or their combination significantly increased the P uptake over control. On the basis of mean values, it was observed that uptake of P by cotton ranged from 5.84 to 12.53, 2.75 to 6.93 and 8.59 to 19.46 kg ha^{-1}. Application of gypsum @ 50 per cent GR plus water through 30 cm gypsum bed increased P uptake upto 12.53, 6.93 and 19.46 kg ha^{-1} in seed, stalk and total, respectively which was at par with T_8, T_7 and T_6

The K uptake by seed also responded significantly to gypsum application. Its uptake ranged from 10.26 to 21.87, 21.06 to 71.06 and from 31.32 to 92.94 kg ha^{-1} in seed, stalks and total uptake, respectively. In general, impact of soil application of gypsum and gypsum bed alone on K uptake are more or less same as noticed in P uptake. Within the various combinations significantly higher K uptake was recorded in treatment T_7 (19.38, 57.48 and 76.87 kg ha^{-1} in seed, stalk and total uptake respectively) and it was at par with T_8. Increase in K uptake might be attributed to preferential translocation of K and expense of Na due to chemical reclamation which is reflected in the K:Na ratios; the ratio increased with gypsum application. Poonia and Bhumbla (1973a; 1973b) also reported significant response in uptake of major nutrients due to soil reclamation by gypsum.

Application of gypsum either through soil or through gypsum bed significantly increased Ca and Mg uptake by cotton (Table 5). Pooled data revealed that each increment in gypsum level caused a linear increase of Ca and Mg uptake and incorporation of higher level of gypsum (soil application) found superior over lower level alone. However, use of both gypsum beds alone was at par with each other (T_4 and T_5) except Mg uptake by seed. Within the various combinations treatment T_9 recorded highest Ca and Mg uptake, followed by T_8 and T_7. Calcium has been shown ameliorate the detrimental effect of sodicity on growth of plants (Deo and Kanwar, 1968). Increase in Ca content on the exchange complex phase of soil resulted greater absorption and uptake of Ca due to addition of gypsum. This result are in consonance with the findings of Poonia and Bhumbla (1973a, 1973b) and Singh *et al.* (1980) who have also observed similar effect on uptake of Ca, Mg and Na due to gypsum application.

Unlike to other nutrients, gypsum application did not influence significantly the Na uptake. The uptake by seed showed reduction while no definite trend was noticed in stalk and total uptake. This might be owing to dilution effect on decreasing trend of Na compared with increasing level of gypsum.

CONCLUSION

Thus, it could be concluded that the soil application of gypsum @ 1.25 t ha^{-1} (25 % GR) and irrigation of alkali water passed through 30 cm gypsum bed found more beneficial in enhancing the cotton productivity, nutrient concentration and uptake in sodic Vertisols of Purna valley in Vidarbha region.

LITERATURE CITED

Abrol, I. P. and D.R. Bhumbla, 1979. Crop responses to differential gypsum applications in a highly sodic soil and the tolerance of several crops to exchangeable sodium under field conditions, Soil Sci., 127(2):79-85.

Bajwa, M.S. and A.S.Josan, 1989. Effect of gypsum and sodic irrigation water on soils and crop yields in rice-wheat rotation, Agric. Water Manage, 16:53-61.

Balpande, S.S., S.B. Deshpande and D.K. Pal, 1996. Factors and processes of soil degradation in Vertisols of the Purna valley, Maharashtra, India, Land Degrad and Dev., 7:313-324.

Chapman, H.D. and P.F. Pratt, 1961. Methods of Analysis for Soils, Plants, and Waters, Div. Agric. Sci., Univ. Calif., USA.

Deo, R. and J.S. Kanwar, 1968. Effect of saline irrigation waters on the growth and chemical composition of wheat, J. Indian Soc. Soil Sci., 16: 365-370.

Kanwar, B. S. and J. S. Kanwar, 1971. Effect of residual sodium carbonate in irrigation water in plant and soil, Indian J. Agric. Sci., 41:54-56.

Pal, R. and S.R. Poonia, 1979. Dimensions of gypsum bed in relation to residual sodium carbonate of irrigation water, size of gypsum fragments and flow velocity, J. Indian Soc. Soil., Sci.,27(1): 5-10.

Poonia, S. R. and D. R. Bhumbla, 1973a. Effect of gypsum and carbonate on plant yield and chemical composition and calcium availability in a non-saline sodic soil, Plant & Soil, 38 :71-80.

Poonia, S. R. and D. R. Bhumbla, 1973b. Availability of Ca from $CaSO_4$ in a highly saline- sodic soil, Plant and Soil, 38 : 675-678.

Sekhon, B. S. and M. S. Bajwa, 1993. Effect of organic matter and gypsum in controlling soil sodicity in rice-wheat-maize system irrigated with sodic water, Agric. Water Manage., 24:15-25.

Sharma, D. N., V. K. Sharma and B. S. Dagur, 1998. Ground water quality and crop production. Nat. Sem. on Strategies for Management of Poor Quality Waters in Agriculture, Aug. 4-5. CSSRI, Karnal, India 29-44.

Singh, D., R. K. Tripathi, P. K. Vijay, J. C. Mediratta and K. N. Bansal, 1980. Comparative effects of gypsum and pyrite on soil properties and yield of wheat and rice, J. Indian Soc. Soil Sci., 28 (2) : 213-218.

Singh, N.T., 1991. Quality criteria for saline and sodic irrigation waters. Indian Fmg, 41:7-10.

Tiwari, R.J., K. Dwivedi and S.K. Verma, 1994. Effect of gypsum application on nutrient content in cotton leaves grown on a sodic Vertisols, Crop Res.,7 (2) : 193-196.

PKV Res. J. Vol. 33 (2) : 2009

Small Scale Production of Biodiesel from Jatropha and Karanj Oil

S.M. Bhoyar[1] and Swati Dindorkar[2]

ABSTRACT

A simple, cost effective technique and batch-type small-scale "PKV-Biodiesel Processor" has been developed at Agro Product Development Research Centre, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.) India, to cater the domestic / farm level needs of quality non-conventional liquid fuel. The processor achieved Base-catalysed Transesterification within a hour by using strong polar–bonded chemical Sodium Methoxide. The biodiesel produced was tested for its quality and observed to be an excellent fuel for agricultural equipments /machineries. The average recovery of methyl esters was ranged between 83.75 to 92.47 per cent and 10 to 19 percent glycerin as a byproduct. The density and viscocity of Jatropha biodiesel (JME) and Karanj biodiesel (KME) were 890, 872 kg m^{-3} and 4.60, 4.52 $mm^{-2}s^{-1}$, respectively. The cloud and pour point of JME was –4 °C and -9 °C, whereas, KME showed –2 °C and -6 °C. Regarding combustion properties of biodiesel i.e. flash and fire point Jatropha biodiesel was 158 °C and 240°C, whereas, Karanj biodiesel was 174 °C and 215 °C, respectively. The pH of biodiesel after washing was 7.00 ± 0.25, showed near neutral in reaction and suitable for any diesel engine mode. The average smoke mean value of biodiesel was 38.5 per cent with average smoke mean temperature 70°C. The energy content i.e gross calorific value of JME was 35.5 MJ kg^{-1} and KME was 34.2 MJ kg^{-1}. Thus, the biodiesel produced by using "PKV-Biodiesel Processor" is of good quality and satisfy the Indian standards (BIS). Planning Commission Report, 2002.

Biodiesel, non-conventional liquid energy from oil yielding plants has a reality now and would become a viable option towards National Energy Security. Indian crude oil import from OPEC and other countries is nearly 70 per cent of the annual requirement. The Indian demand of high-speed diesel in the country was 39.8 million tons (2001-2002) and will increases up to 52.3 million tons by 2006-2007 (Tiwari, 2002). The concept of using vegetable oil as a fuel dates back to 1900, when Dr. Rudolf Diesel, inventor of CI engine, utilized groundnut oil as a fuel in his engine at Paris Exhibition. Later on in the year 1911-12, Dr. Diesel stated that " The diesel engines can be fed with vegetable oils and would be helpful considerably in the development of agriculture of the country which uses it", furthermore, he added that, "Use of vegetable oil for engine fuel may seem insignificant today but such oil may become in due course of time as important as petroleum products of the present time". Now time has alarming to review the statements of Dr. Rudolf Diesel, due to the regular and sharp increase prices of crude petroleum products and diminishing oil reserves. In recent years several countries (mainly USA & EU) have initiated biodiesel programmes on large scale with special package for its promotion. A major breakthrough has been made in the use of transesterified plant oils. Current estimates reavealed that, overall biodiesel production capacity of the world is at 1.3 million tonnes (Korbitz, 2002). Govt. of India also launched "National Mission on Biodiesel" from 2004 by considering *Jatropha curcas* (Ratanjyot) and *Pongamia pinnata* (*Karanj*) as a biofuel crops due to their multi-advantages, important amongst all significant oil content and can be grown on wastelands in any type of soil and climatic conditions.

Indian farmers are now ready to shoulder this *"Bio-fuel Revolution"* and also started inclusion of bio-fuel crops in their farming system as per the suitability. Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) being Agricultural University with a mandate to work for the benefit of farmers, developed and perfected a simple, low-cost and small-scale biodiesel production technique and processor to encourage and safeguard the interests of farmers participating in National Biodiesel Mission, as well as to cater the domestic day to day liquid fuel need of the farming community in India (Bhoyar, 2005).

1. Associate Prof., Department of Soil Science and Agril. Chemistry, and 2. M.Tech. Student, Department of UCES & EE, Dr.PDKV, Akola

MATERIAL AND METHODS

A batch-type biodiesel processor is consisting of stainless steel vessel of 20 lit. capacity provided with both gas and electrical heating coil and temperature gauge. A low RPM motor is fitted at the top of the vessel for stirring of the material. A separate stainless steel can is provided for careful and safety handling of sodium methoxide solution. Control panel consisted of thermostat and regulator for effective regulation of temperature and stirring speed during the process of transesterification. The complete setup is mounted on the stand for easier handling. The semi-transparent plastic vessels were used for separation and washing of the biodiesel. The small air bubble generator was provided for speedier and effective washing of the biodiesel.

Base-catalysed transesterification process was used for production of the methyl ester i.e. biodiesel. Sodium Methoxide, a strong polar-bonded chemical was a mixture of calculated amount of sodium hydroxide in to unhydrous methanol, which breaks transfatty acids or triglycerides in to glycerin and ester chain. Sodium hydroxide acts as a catalyst to accelerate the adjustment of the equilibrium in order to achieve a high yield of the ester. The sample of 12 lit. oil was used for each batch and 3 lit. sodium methoxide was taken for the transesterification. The biodiesel produced was tested for its physical and combustion properties and to run some of the agricultural equipments.

Important Preprocessing Considerations

i) **Quality of oil:** The oil of *Jatropha / Karanj* should be fresh and filtered.

ii) **Preparation of Sodium Methoxide:** Sodium Methoxide solution is to be prepared in a separate plastic can carefully by dissolving 4–7 g sodium hydroxide (depending on quality and FFA content of oil) in to 250 ml. methanol (100 % excess of its stoichiometric value of the oil) is based on the total fatty acid content of particular oil (which is usually 12.5 per cent methanol by volume i.e. 125 ml of methanol).

iii) **Temperature and stirring:** The temperature of oil during processing should be around 60 °C with smooth continuous stirring, so that there should not be overheating and splashing.

iv) **Washing and drying:** After washing pH of the biodiesel should be around 7.00 ± 0.25, so that complete NaOH should be removed and for drying heated to 110 °C temperature for 10 min. to remove moisture impurities before use.

Process of Transesterification

Transesterification is the general term used to describe the important class of organic reactions where an ester is transformed into another through interchange of the alkoxy moiety. The original ester reacts with an alcohol, the transesterification process is called alcoholysis. Transesterification is an equilibrium reaction and the transformation occurs essentially by mixing the reactants. However, the presence of catalyst accelerates the reaction. In order to achieve a high yield of the ester, the alcohol has to be used in excess. In the transesterification of Jatropha/Karanj oil, a triglyceride reacts with an alcohol in the presence of base (NaOH), producing a mixture of fatty acid alkyl esters and glycerol. The overall process is sequence of three consecutive and reversible reactions, in which diglycerides and monoglycerides are formed as intermediates. The stoichiometric reaction requires 1 mol of a triglyceride and 3 mol of the alcohol. However, an excess of the methanol is used (1:6 ratio) to increase the yields of the methyl esters and to allow its phase separation from the glycerol formed. The stepwise process of biodiesel production by using "PKV-Biodiesel Processor" is given below.

1. 12 lit. measured quantity of fresh, moisture free Jatropha/Karanj oil was put in to the reactor and heated up to 60°C temperature with slow stirring.
2. 3 lit. solution of sodium methoxide was poured slowly in to the vessel containing oil (mixture of NaOH & CH_3OH). The temperature (60°C) and stirring speed (without splashing) in the reactor was maintained for hour.
3. After an hour reactant material was poured in to semitransparent vessel and allowed to cool down at room temperature for settling and separation of glycerin (thick dark brown) at bottom.
4. The upper biodiesel (yellowish brown) was put in to another transparent vessel for washing containing equal amount of tap water (air bubble

generator was used for faster and effective washing).

5. Separate upper washed biodiesel from the bottom milky NaOH water. The pH of biodiesel was tested and it was around 7.00.

6. The biodiesel was heated to 110°C for 10 min. to remove excess water molecule. Then cooled to room temperature before use.

RESULTS AND DISCUSSION

The biodiesel of Jatropha (JME) and *Karanj* (KME) produced by using "PKV-Biodiesel Processor" was characterised for physical and combustion properties and the results obtained are given below.

Recovery of Biodiesel

The data (Table1) showed that, the average recovery of biodiesel from Jatropha oil (92.47 %) was more than that of the biodiesel from Karanj oil 83.75 per cent. Whereas, the byproduct glycerin obtained was more from Karanj oil (19%) as compared to Jatropha oil (10.57%). The comparative more recovery of biodiesel from the Jatropha oil over the Karanj oil might be due to less content of triglycerides in oil, which was directly reflected on the lower recovery of glycerin.

Physical Properties of Methyl Esters

Two important physical properties density and viscosity were determined. Both of these properties are directly related to the efficient and smooth supply of the fuel to the engine. The data obtained are presented in Table 2 revealed that, the density and viscosity of both JME and KME were within the permitted limits of BIS. The average density of JME was 890 kg m^{-1} and its viscosity was 4.60 mm^2 s^{-1}. However, density of KME was 872 kg m^{-1} with viscosity 4.52 mm^2 s^{-1}. The density and viscosity of the methyl esters were closer to the density (849 kg m^{-3}) and viscosity (3.49 mm^2 s^{-1}) of the petroleum diesel. Hence, there will be no problem of use of biodiesel for any diesel engine as well as it can be blended easily at any proportion with the fossil diesel. Similar results were observed by Pryde, 1982.

Combustion Properties of Methyl Esters

The data in respect of combustion characteristics of biodiesel viz. are presented in Table3.

Flash and fire point: The average flash and fire point of JME was 158 °C which was lower than the flash point of KME 183 °C. It means that when methyl ester reaches to respective temperature the vaporization starts and after mixing with air gives a momentary flash. However, the fire point of JME was 240 °C, which was higher than KME fire point (210 °C), the temperatures at which the vapor-air mixtures burns at least for 5 seconds.

Cloud and pour point: The cloud and pour point of JME were –4 °C and -9 °C, whereas, KME were –2 °C and -6 °C, respectively. Both of these properties are least important in the Indian conditions.

Calorific Value: The gross calorific value of JME was 35.5 MJ kg^{-1} and KME was 34.2 MJ kg^{-1}. Both methyl esters have calorific value lower than the diesel (44.77 MJ kg^{-1}).

Table1. Average recovery of methyl esters and glycerin

Particulars	Biodiesel recovery (%)	Byproduct glycerin (%)
Jatropha oil	92.47	10.57
Karanj oil	83.75	19.00

Table2. Physical characteristics of methyl esters.

Characteristics	JatrophaMethyl Ester	KaranjMethyl Ester	ProposedBIS
Density (kg m^{-3})	890	872	870-900
Viscosity (mm^2 S^{-1})	4.60	4.52	3.5-5.0

Table3. Combustion characteristics of methyl esters.

Characteristics	JatrophaMethyl Ester	KaranjMethyl Ester
Flash point (°C)	158	183
Fire point (°C)	240	210
Cloud point (°C)	-4	-2
Pour point (°C)	-9	-6
Calorific value (MJ kg^{-1})	35.5	34.2

Table 4. Emission study of methyl esters.

Characteristics	JatrophaMethyl Ester	Conventional Diesel
Smoke mean value (%)	38.5	46.4
Smoke mean temperature (°C)	70.0	75.0

Testing of Biodiesel for Engine Running and Smoke Emission

The methyl esters produced with the help of simple, low-cost "PKV-Biodiesel Processor" was successfully tested without blending (B-100) for running of power tiller, tractor, electricity generation and irrigation pumps (Verma and Gupta, 2000). The pollution testing of tractor (PUC) was carried out and the results presented in Table 4 revealed that, the average smoke mean value of the JME was 38.5 per cent and was found to be lower than the conventional diesel (46.49%). The average mean temperature of the smoke was also lower down up to 70 °C by biodiesel which was recorded 75.0 °C with diesel fuel in tractor. Reduction in the smoke mean value due to biodiesel means reduction in the emission of particulate matter which polluted the environment. Hence, use of biodiesel can be helpful to reduce environmental pollution and temperature.

From the experimentation, it can be concluded that, biodiesel produced by "PKV-Biodiesel Processor" on small scale was of standard quality and met the requirement of BIS. Biodiesel can be used as an alternate and non-conventional fuel to run all kinds of farm equipments and machineries without alteration. Biodiesel is helpful to reduce the environmental pollution and temperature.

LITERATURE CITED

Korbitz, W., 2002. "New trends in Developing Bio-diesel World-wide". Evaluating & Exploring the Commercial Uses of Ethanol, Fuel Alcohol & Bio-diesel, Singapore, 22-23.

Planning Commission Report on Biofuel. Govt of India, New Delhi, 2004 : IV, 56.

Bhoyar Sanjay, 2005. Biodiesel: Indian Prospective – Review article, Crop Protection and Production, Vol 2 (1): 1-6.

Tiwari, D.N., 2002. Keynote Address, International Convention on "Biofuels-driving Indian Future" Nov 7-9, New Delhi.

Verma, S. R. and P.K. Gupta, 2000. Bio-diesel as substitute for petroleum oil, Agricultural Engineering, 24 (3) : 40-62.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Effect of Sulphur and Zinc on Yield and Nutrient Uptake of Semi *Rabi* Sesamum

V.P. Dange[1], S.D. Jadhao[2], P.V. Mohod[3] and D.N. Anokar[4]

ABSTRACT

A field experiment on sesamum was conducted during semi *Rabi* season of 2001-02 with nine treatment combinations viz; recommended dose of fertilizer (25: 25:0 kg of NPK, respectively), 1 tonne FYM, 20 kg elemental sulphur and 5 kg $ZnSO_4$. The grain and straw yield of sesamum was significantly increased with the application of sulphur, zinc and organic manure. The highest grain yield (810.82 kg ha^{-1}) was obtained due to application of RDF + 2O kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM which was significantly superior to all other treatments. Similar trend was observed in case of straw yield also. The application of sulphur, zinc and organic manure significantly increased the uptake of nutrients like N, P, and K. Maximum uptake of N, P and K was observed in treatment RDF + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM). Application of RDF + 20 kg ha^{-1} elemental sulphur +5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM (T_8) to semi *Rabi* sesamum was economically profitable to the cultivator and it gave maximum net monetary return as compared to other treatments.

Oilseeds constitute the second largest agricultural produce, next only to food grains. Sesamum *(Sesamum indicum* L.) is commonly known as *Til* is one of the important edible oilseed crops cultivated in India. Its primary centre of origin is south - western Africa. India occupies the first place both in regard to acreage and production. In India, total area under this crop was 21.80 lakh ha with production 0.73 million tonnes and average was 334 kg ha^{-1} during 2001-2002 (FAO, 2001). Sulphur plays an important role in improving the quality and marketability of the produce as reported by Kanwar (1976). Sulphur is associated with synthesis of vitamins (biotin, thiamine), S- containing amino acids, metabolism of carbohydrates, protein and lipids. In recent years, adoption of high yielding varieties of crops, intensive cropping system and extensive use of sulphur free fertilizer lowered sulphur status of soil. However, sulphur deficiency has received little attention so far; sulphur deficiency symptoms are difficult to separate from nitrogen deficiency symptoms, except that sulphur deficiency is expressed first on younger leaves. Zinc deficiency retards photosynthesis and N-metabolism flowering, and fruit development are reduced and growth period is prolonged resulting in delayed maturity. The end result is lower yield and poor quality. There is paucity of information regarding the response of sesamum crop to the application of sulphur and zinc in the tropical black cotton soils of the region and therefore, the study of their effect on yield, nutrient uptake and quality needs special consideration. Keeping this in view, the present investigation was undertaken.

MATERIAL AND METHODS

A field experiment on sesamum was conducted at the experimental field of department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) during Semi *Rabi* season of 2001.The experimental soil was montmorillonite hyperthermic, clay loam, shallow, typic Ustorthents Kanpur series and appeared slightly alkaline in reaction with pH value 7 .75, Sandy clay loam in texture, medium in organic carbon, very low in available nitrogen, low in available phosphorus, very high in available potassium and deficient in available sulphur and DTPA extractable zinc.Certified seed of sesamum (N-8) was obtained from S.R.S. Oilseed, Dr. P.D.K.V. Akola for sowing. Sowing of crop was done in the second week of September with nine treatments viz.; T1 – Control, T2- 25:25:0 NPK ha^{-1} (RDF), T3- RDF + 1 t FYM ha^{-1}, T4-RDF + 20 kg elemental sulphur ha^{-1}, T5- RDF + 5 kg $ZnSO_4$ ha^{-1}, T6 – RDF + 1 t FYM ha^{-1} + 20 kg elemental sulphur ha^{-1}, T7- RDF + 1 t

1. M. Sc. Student, 2. Associate Prof., 3. Junior Res. Asstt. and 4. Assistant Prof., College of Agriculture, Dr. PDKV, Akola.

FYM ha^{-1} + 5kg Zn ha^{-1}, T8- RDF + 20 kg elemental sulphur ha^{-1} + 5kg Zn ha^{-1} + 1 t FYM ha^{-1} and T9- RDF + 20 kg elemental sulphur ha^{-1}+ 5kg Zn ha^{-1}. Nitrogen, phosphorus were applied in the form of urea and DAP, respectively at the time of sowing as basal dose. Zinc and sulphur were applied in the form of zinc sulphate and elemental sulphur, respectively. Sulphur was added before 10 days of sowing while zinc was applied with NPK fertilizer dose.

Nitrogen, phosphorus, potassium content in plant samples, straw and grain were analyzed as per the standard method. The data for plot wise yield of crop and its nutrient uptake were statistically analyzed in Randomized Block Design replicated four times as per the method suggested by Panse and Sukhatme (1971).Economics of treatments was calculated by gross monetary return, net monetary return, additional cost, additional benefit and benefit cost ratio.

RESULTS AND DISCUSSION

Grain and Straw yield

The data presented in Table 1 revealed that the grain and straw yield of sesamum crop varied significantly due to different treatments. The highest seed yield (810.82 kg ha^{-1}) was recorded by recommended dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM which was significantly superior to all other treatments. Similarly, the next treatment, recommended dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ was also significantly superior to all other treatments except recommended dose + 1 t ha^{-1} FYM + 5 kg ha^{-1} $ZnSO_4$ and recommended dose + 1 t FYM ha^{-1} + 20 kg ha^{-1} elemental sulphur and these treatments were at par with each other. The same trend was found in straw yield also. Similar findings as regards to the effect of sulphur and zinc in combination with FYM were reported by Panchabhai (1991), Tiwari *et. al.*, (1995), Subramaniyan *et. al.*, (1999) and Narkhede *et. al.* (2001).Patil *et. al.* (1981) reported that application of boron and sulphur both in presence of FYM showed a significant increase in the yield of pods over control.

Total uptake of nitrogen

From the data presented in Table 2, it was observed that the uptake of nitrogen by grain, straw and grain + straw was significant. The highest uptake of nitrogen in grain was observed in recommended dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnS0_4$ + 1 t ha^{-1} FYM , which was significantly more uptake than all other treatments. Similarly the treatment, recommended dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ was also significantly superior to all other treatments except recommended dose + 1 t ha^{-1} FYM + 20 kg ha^{-1} elemental sulphur and recommended dose + 1 t ha^{-1} FYM + 5 kg ha^{-1} $ZnSO_4$. As regards to uptake of nitrogen in straw, recommended dose + 20 kg ha^{-1} elemental sulphur +

Table 1: Effect of sulphur and zinc on grain and straw yield of sesamum

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T1- Control	295.83	881.56
T2-25:25:0 NPK ha^{-1} (RDF)	491.65	1435.64
T3- RDF + 1 t ha^{-1} FYM	529.99	1642.98
T4- RDF + 20 kg ha^{-1} elemental sulphur	624.98	1923.64
T5- RDF + 5 kg ha^{-1} $ZnSO_4$	600.82	1892.60
T6 – RDF + 1 t ha^{-1} FYM + 20 kg ha^{-1} elemental sulphurz	716.65	2278.97
T7- RDF + 1 t ha^{-1} FYM + 5 kg ha^{-1} $ZnSO_4$	706.65	2233.04
T8 – RDF + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM	810.82	2691.93
T9- RDF + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$	727.48	2378.89
' F ' test	Sig.	Sig.
SE(m)±	25.19	81.15
CD at 5%	73.52	236.87

Table 2: Effect of sulphur and zinc on uptake of nutrients

Treatments	Uptake of Nitrogen(kg ha^{-1})			Uptake of phosphorus(kg ha^{-1})			Uptake of potassium(kg ha^{-1})		
	Grain	Straw	Grain + Straw	Grain	Straw	Grain + Straw	Grain	Straw	Grain + Straw
T1 - Control	8.28	3.66	11.94	0.87	1.68	2.55	0.78	10.11	10.89
T2 - 25:25:0 NPK ha^{-1} (RDF)	14.78	6.04	20.82	1.58	3.93	5.51	1.73	20.84	22.57
T3 - RDF + 1 t ha^{-1} FYM	16.45	7.33	23.78	2.37	4.97	7.34	2.09	25.08	27.15
T4 - RDF + 20 kg ha^{-1} elemental sulphur	20.19	9.29	29.48	3.58	6.68	10.27	3.09	31.02	34.12
T5 - RDF + 5 kg ha^{-1} $ZnSO_4$	18.27	8.72	27.00	2.89	6.19	9.08	2.76	30.09	32.85
T6 - RDF + 1 t ha^{-1} FYM + 20 kg ha^{-1} elemental sulphur	22.98	12.70	35.68	4.76	11.11	15.87	4.02	40.43	44.63
T7 - RDF + 1 t ha^{-1} FYM + 5 kg ha^{-1} $ZnSO_4$	22.48	10.73	33.21	3.79	10.71	14.50	3.69	38.16	41.85
T8 - RDF + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM	28.21	16.68	44.90	5.68	16.44	22.12	5.40	51.19	56.60
T9 - RDF + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$	24.31	10.81	35.13	3.79	13.25	17.04	4.17	41.78	45.95
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	0.91	0.53	1.39	0.24	0.47	0.60	0.20	1.22	1.42
CD at 5%	2.66	1.56	4.05	0.71	1.38	1.76	0.60	3.56	4.16

5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM which was significantly more than all other treatments.The recommended dose + 20 kg ha t elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM had recorded highest uptake (grain + straw) of nitrogen and which was significantly superior to all other treatments. The similar trend was reported by Nageshwar *et. al.* (1995) and Samui *et. al.* (1981).

Total uptake of phosphorus

Table 2 revealed that the uptake of phosphorus by grain, straw and total uptake were found significant. The maximum uptake of phosphorus in grain was found by application of recommended dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$+1 t ha^{-1} FYM, which was more than all other treatments. This was followed by T_6 (recommended dose + 1 t ha^{-1} FYM + 20 kg ha^{-1} elemental sulphur) and given significant uptake of phosphorus than other treatments. Similar trend was observed in uptake of phosphorus by straw.As regard to total uptake of phosphorous by grain + straw, the maximum uptake was recorded by treatment T8 (recommended dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM) which was significantly more than all other treatments. This was followed by T_9 (recommended dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$) which was also significantly more uptake of phosphorous than other treatments except T_6 (recommended dose + 1 t ha^{-1} FYM + 20 kg ha^{-1} elemental sulphur) and T7 (recommended dose + 1 t ha^{-1} FYM + 5 kg ha^{-1} ZnSo4) in respect of total uptake of phosphorus (grain + straw).Above findings were supported by Sacchidannad *et. al.*, (1980) in soybean, Samui *et. al.*, (1981), in mustard crop.

Total uptake of Potassium

Data presented in Table 2, indicate the uptake of potassium by grain, straw and grain + straws was found significant. The highest uptake of potassium by grain was observed in treatment T8 (recommended dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM) which was significantly more than other treatments except T6 (recommended dose + 1 t ha^{-1} FYM + 20 kg ha^{-1} elemental sulphur) and T7 (recommended dose + 1 t ha^{-1} FYM + 5 kg ha^{-1} $ZnSO_4$) and they were at par with each other. Similarly, highest uptake of potash was observed in T8 (recommended dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha t ZnSO4 + 1 t ha^{-1} FYM). This was followed by T9 (recommended dose

Table 3: Effect of sulphur and zinc on economics of treatmen

Treatments	Gross Monetary Return (Rs.)	Net Monetary Return (Rs.)	Additional Cost (Rs.)	Additional benefit (Rs.)	B:C ratio
T1 - Control	5916.6	3324.1	-	-	-
T2 - 25:25:0 NPK ha^{-1} (Rec. dose)	9833	5000.5	2240	3916.4	1.74
T3 - Rec. dose + 1 t ha^{-1} FYM	10599	5267.3	2740	4683.2	1.7
T4 - Rec. Dose + 20 kg ha^{-1} elemental sulphur	12499.6	6207.1	3700	6583	1.77
T5 - Rec. Dose + 5 kg ha^{-1} $ZnSO_4$	12016.4	6433.9	2990	6099.8	2.04
T6 - Rec. Dose + 1 t ha^{-1} FYM + 20 kg ha^{-1} elemental sulphur	14333	7540.5	4200	8416.4	2.00
T7 - Rec. Dose + 1 t ha^{-1} FYM + 5 kg ha^{-1} $ZnSO_4$	14133	8050.5	4008	8216.4	2.05
T8 - Rec. Dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM	16216.4	8673.9	4950	10299.8	2.08
T9 - Rec. Dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$	14549.6	7552.1	4450	8633	1.94

Cost of sesamum seed	:	Rs.2000 q^{-1}
Cost of elemental sulphur	:	Rs.70 kg^{-1}
Cost of $ZnSO_4$	:	Rs.150 kg^{-1}

+ 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$), which was significant than other treatments. The highest uptake of potassium in grain + straw was observed in treatment T8 (recommended dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM) which was, significantly more than all other treatments.

Economics of Treatments

The data presented in Table 3 revealed that the economics of the treatment was influenced by effect of sulphur, zinc and organic manure. The maximum gross monetary return was obtained by application of recommended dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM (T8) which was followed by recommended dose + 2O kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ (T9). The same trend was found in case of net monetary return. Maximum return was obtained due to recommended dose +20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1 t ha^{-1} FYM which was followed by T7 . In case of benefit: cost ratio the maximum B:C ratio was found more in T8 (recommended dose + 20 kg ha^{-1} elemental sulphur + 5 kg ha^{-1} $ZnSO_4$ + 1t ha^{-1} FYM) over other treatments.

LITERATURE CITED

FAO, 2001. www.fao.org

Kanwar, J.S., 1976. Calcium, magnesium and sulphur, chapter-7 of soil fertility, Theory and Practice, ICAR, New Delhi.

Nageshwar Lal; S.K.Sarawgi, ; R.S. Tripathi, and M.C. Bhambri, 1995. Effect of nitrogen, potassium and sulphur on seed yield, nutrient uptake, quality and economics of summer sesamum, Indian J. Agron, 40 (2): 333 - 335.

Narkhede, T.N.; S.S. Wadile; D.C.Attarde, ; R.T. Suryawanshi and A.S. Deshmukh 2001. Response of macro and micro nutrient in combination with organic matter (FYM) on yield of sesamum, J. Soil and Crop, 11(2):203 - 205.

Panchabhai, S.S., 1991. Study of effect of NPK in combination with S, Zn, Mg and organic matter on the uptake of nutrient and yield of sesamum, Thesis (Unpub.) M.Sc., Dr.PDKV, Akola

Panse, V.G. and P.V. Sukhatme, 1971. Statistical methods for agricultural workers, ICAR, New Delhi.

Patil, J.D ; P.H.Shinde; D.A.More and G.K. Zende, 1981. Effect of application of Boron, Sulphur and FYM on the yield and quality of groundnut, J. Maharashtra Agric.Univ., 6 (1): 17-18.

Sacchindanand, B.N. J. Sawarkar; R. S. Ghurayya; D.A.Shinde and S.B.Shinha, 1980. Response of soybean (Glycine max) to sulphur and phosphorus, J. Indian Soc. Soil Sci, 28 (2): 189 - 192.

Samui, R.C.; P. Bhattacharaya and S.K.Dasgupta, 1981. Uptake if nutrients by mustard (*Brassica Juncea* L.) as influenced by zinc and iron application, J. Indian Soc. Soil Sci., 29 (1): 101 - 106.

Subrahmaniyan K.; P. Sridhar and N. Arulmozi, 1999. Response of Sesamum (Sesamum indicum) to sulphur and micronutrient with and without farmyard manure under irrigated condition, Indian J. Agron., 44 (4) : 826 – 829.

Tiwari, K.P., K. N. Namdeo, R.K.S. Tomar, and T.S. Raghu, 1995. Effect of macro and micronutrient with organic manure on the production of sesamum, Indian J. Agron, 40 (1): 134 – 136.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Effect of Time of Harvest on Root Yield and Quality of Safed Musli

S.G. Wankhade[1], P.P. Khode[2], S.V.Gholap[3] and S.A.Agashe[4]

ABSTRACT

A field experiment to study the effect of time of harvest on root yield and quality of safed musli (*Chlorophytum borivilianum* Santapu and Fernades) was conducted at Nagarjun Medicinal Plants Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) during 2003-04 to 2005-06. The soil of the experimental site was slightly calcareous, alkaline and clayey in texture, sufficient in available K, however low in organic carbon, available N and Olsen's P. The treatments comprised of five harvesting times viz, at 90 days after planting (DAP), at 120 DAP, at 150 DAP, at 180 DAP, at 210 DAP and at 240 DAP tried in Randomized Block Design with four replications. Significantly highest fresh root yield was recorded due to harvesting at 180 DAP but it was at par with 150 DAP. Dry root yield due to harvesting at 240,210,180 DAP were statistically similar but significantly superior to the rest of the treatments under study indicating to start harvesting safed musli from 180 DAP. Significantly lowest saponin content was recorded due to harvesting at 240 DAP which was at par with 210 DAP. On the contrary the saponin yield was significantly highest with the harvesting at 180 DAP, followed by the saponin yield obtained with 210 and 240 DAP.

The roots of *Chlorophytum borivilianum* have great medicinal value due to saponin content and are used extensively in Ayurvedic medicines. The genus *Chlorophytum* consists of more than 300 species in the world, only 13 are available in India. Out of which six are more important. The species *Chlorophytum borivilianum* contains more saponin and good yielding potential as compared to other species of Safed musli and, therefore, it has commercial value. The root of Safed musli contains the saponin (4-17%), steroid sapogenin (1 to 2 %), carbohydrates (40 %), proteins (10 to 12 %) and calcium to some extent with some water-soluble minerals. Sapogenins are used in the commercial preparation of steroidal hormones. The roots are mainly used to treat general debility and male sterility. It is also advised as a supplementary therapy for blood purification, nervous disorder and some gynecological problems. The dried fasciculated roots are reputed to have aphrodisiac properties and form an important ingredient of herbal tonics prescribed in Ayurvedic system of medicine in India.

The time of planting and harvesting of medicinal and aromatic plants are most critical factors for synthesis of secondary metabolites. Besides that, it is necessary to process a crude drug so as to preserve it for a longer time with quality and also to acquire better pharmaceutical elegant and therefore, to determine the optimum stage of harvesting for maximum root yield and saponin content of Safed musli roots, the present investigation was undertaken.

MATERIAL AND METHODS

A field experiment to study the effect of time of harvest on root yield and quality of safed musli (*Chlorophytum borivilianum* Santapu and Fernades) was conducted at Nagarjun Medicinal Plants Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) during 2003-04 to 2005-06. The soils of the experimental site was slightly calcareous, alkaline and clayey in texture, sufficient in available K, however low in organic carbon, available N and Olsen's P. The treatments comprised of five harvesting time viz, T_1- at 90 Days After Planting (DAP) T_2-at 120 DAP, T_3 at 150 DAP, T_4-at 180 DAP, T_5- at 210 DAP and T_6- at 240 DAP tried in Randomized Block Design with four replications. The planting of fasciculated roots (Single root hill^{-1}) at 30 x 15 cm^2 spacing was done in the plot size of of 1.8 x 4.5 m^2 during the month of June.

The ancillary observations as well as post harvest observations were recorded as per the treatments. The moisture content was estimated by AOAC method (1985). The saponin content was determined as per the procedure described by Birk *et. al.*, (1963).

1.Associate Prof., 2. Assistant Prof., 3. Junior Res.Asstt and 4. Junior Res. Fellow, All India Networking Research Project on Medicinal and Aromatic Plants, Dr. PDKV, Akola

Table 2: Effect of time of harvest on root quality of Safed musli (*Chlorophytum borivilianum*)

Treatments	Moisture (%)				Saponin (%)				Saponin yield (Kg ha^{-1})			
	2003-04	2004-05	2005-06	Pooled mean	2003-04	2004-05	2005-06	Pooled mean	2003-04	2004-05	2005-06	Pooled mean
T_1 – 90 DAP	85.62	84.19	83.12	84.06	7.740	7.688	7.450	7.625	32.64	23.75	24.73	27.04
T_2 – 120 DAP	83.97	79.80	80.95	80.83	7.370	7.295	7.350	7.333	36.59	34.85	33.43	34.95
T_3 – 150 DAP	83.19	78.51	79.25	79.68	7.158	7.163	6.900	7.083	39.02	41.63	40.51	40.39
T_4 – 180 DAP	81.35	76.35	77.67	77.52	7.153	7.140	6.875	7.058	46.67	50.29	46.78	47.91
T_5 – 210 DAP	80.14	75.98	77.27	77.07	6.523	6.315	6.300	6.366	43.33	45.91	43.52	44.25
T_6 – 240 DAP	78.08	75.59	79.70	77.57	6.338	6.223	6.000	6.183	42.92	45.71	41.87	43.50
SE (m) ±	1.12	1.58	0.58	0.56	0.192	0.207	0.080	0.093	2.46	2.31	1.70	1.38
CD (0.05)	3.40	4.77	1.75	1.69	0.581	0.623	0.240	0.281	7.41	6.97	5.12	4.15
CV%	2.75	4.04	1.46	2.45	5.47	5.93	2.36	4.65	12.25	11.47	8.80	12.05

Table 1: Effect of time of harvest on root yield of Safed musli (*Chlorophytum borivilianum*)

Treatments	Fresh Root Yield (q ha^{-1})				Dry Root Yield (q ha^{-1})			
	2003-04	2004-05	2005-06	Pooled mean	2003-04	2004-05	2005-06	Pooled mean
T_1 – 90 DAP	29.30	24.97	22.65	25.64	4.23	3.10	3.32	3.54
T_2 – 120 DAP	31.39	29.33	25.12	28.61	4.96	4.77	4.55	4.76
T_3 – 150 DAP	32.38	33.68	29.74	31.93	5.45	5.81	5.88	5.72
T_4 – 180 DAP	34.89	34.57	32.05	33.83	6.52	7.05	6.81	6.79
T_5 – 210 DAP	33.63	30.50	29.40	31.17	6.65	7.27	6.90	6.93
T_6 – 240 DAP	30.93	29.02	30.60	30.18	6.75	7.34	6.95	7.01
SE (m)±	1.11	1.272	0.65	0.74	0.32	0.26	0.21	0.18
CD (0.05)	3.37	3.83	1.96	2.23	0.98	0.77	0.66	0.56
CV%	6.97	8.38	4.61	8.56	11.32	8.72	7.65	11.16

RESULTS AND DISCUSSION

Root yield :

The fresh and dry root yields were significantly influenced by the time of harvest (Table 1). The highest fresh root yield (33.83 q ha^{-1}) was recorded with the harvesting at 180 DAP (T4) and it was significantly superior over 90, 120, 210 and 240 DAP. The dry root yield (7.01 q ha^{-1}) was significantly highest with the harvesting of 240 DAP, however; it was at par with the harvesting period of 210 and 180 DAP indicating that safed musli can be harvested from 180 DAP. The lowest root yield was recorded with the harvesting period of 90 DAP, which might be due to the higher moisture content of the roots at early stage of harvesting.

After 90 DAP, the leaves of the Safed musli get dried indication of physiological maturity. However, the roots harvested at this stage were fleshier with higher moisture content, which ultimately get compacted with the period, resulted into the increased root yield with the delayed harvesting. These results are in agreement with the findings of Sharma and Verma (1987), who have also recorded the increased tuber yield of potato with the delayed harvesting.

Quality of Roots :

The moisture content of fresh roots was in the range of 77.02-84.06 per cent and the content of fresh root was found to decrease with increasing in harvesting time. Significantly higher moisture (84.06 %) content was recorded with the harvesting at 90 DAP(Table 2). The saponin content (%) decreased successively with the delayed harvesting and significantly lowest content was recorded due to harvesting at 240 DAP which was at par with 210 DAP. On the contrary in terms of saponin yield (kg ha^{-1}), it was noticed that significantly highest saponin yield (47.91 kg ha^{-1}) was produced by the treatment of 180 DAP followed by the saponin yield obtained with 210 and 240 DAP.

Although the saponin content was found in decreasing trend with the delayed harvesting of roots, the dry root as well as total saponin yield was significantly highest with the harvesting period of 180 DAP. Since the produce of Safed musli is sold on the basis of dry root weight, the balance between dry root weight and total saponin yield is essential before harvesting the crop. These results are supported by the findings of Randhawa and Gill (1995) who have recorded maximum herb yield and oil yield at complete flowering stage of the *Ocimum basilicum* L.

LITERATURE CITED

A.O.A.C., 1985. Association of Official Analytical Methods of Analysis. 13th Edn. Washington, D.C.

Birk, Y., B. Gestiner and I. Ishyya, 1963, A thermo stable hemolytic factor in soybeans, *Nature*, 197 : 1089-90.

Randhawa, G.S. and B.S. Gill, 1995. Transplanting, harvesting and yield of french basil *(Ocimum basilicum* L), J. Herbs, Spices and Medicinal Plants, 3(1) : 45-46

Sharma,I.P. and U.K.Verma, 1987. Effect of planting and harvesting dates on yield and yield attributes of potatoes, J. Indian Potato Assoc. 14(1-2):48-51

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Dynamics of Phosphorous Forms in Soil Under Long Term Fertilization to Sorghum-Wheat Sequence in Vertisols

V.D. Guldekar[1] and S.N. Ingle[2]

ABSTRACT

An investigation entitled "Dynamics of phosphorous forms in soil under long term fertilization to sorghum-wheat sequence in Vertisols was undertaken during the year 2002-03 and 2003-04 on the existed long term fertilizer experiment, CRS, Dr. PDKV, Akola. The twelve treatments replicated four times in a Randomized Block Design comprised of NPK levels with and without FYM, sulphur and zinc. The status of P fractions were improved with the application of N in combination with FYM, zinc and sulphur. Fractions of P evaluated showed an appreciable buildup under 100 per cent NPK + 10 t FYM ha^{-1} followed by 150 per cent NPK. The relative abundance of native P fractions in soil followed the order of Ca-P > Org.P > Al-P > R-S-P > Fe-P > Occl-P > Saloid-P.

Phosphorous is one of the major essential plant nutrients and without its adequate supply the plant can neither reach its yield potential nor complete a normal reproductive process. Phosphorous deficiency in Indian soils is very serious and in alarming proportions in many situations due to which the use of P fertilizers is increasing at a very rapid rate. But, the efficient use of fertilizer P by the crop is very low, ranging from 10-20 per cent. The fixation of added P in soils considerably affects the availability of P to the crop, specially in alkaline and calcareous soils.

Phosphorous exists in the soil in organic and inorganic forms, of which the P bound to iron, aluminium and calcium and reductant soluble phosphates are known to be present in significant amounts that determine its availability to crops, but, the information on the transformation of added fertilizer P into various insoluble and organic P fractions is meager. Secondly, all forms of P in the soil are known to supply the nutrient to the soil solution, but, the relative proportions of their contribution to the labile pool from which the plant absorbs the nutrients vary (Aulakh, 1990).

MATERIAL AND METHODS

The present investigation entitled "Dynamics of phosphorous forms in soils under long-term fertilization to sorghum-wheat sequence in Vertisols" was undertaken during the year 2002-03 and 2003-04 on the existed long-term fertilizer experiment, CRS, Dr. PDKV, Akola. The twelve treatments replicated four times in a Randomized Block Design comprised of NPK levels with and without FYM, sulphur and zinc. The soil of the experimental site was Vertisols, particularly montmorillonite type, Hyperthermic family of Typic Haplusterts. The soil was slightly alkaline reaction, medium in organic carbon, low in available nitrogen and phosphorous and high in available potassium. Plotwise surface (0-30 cm depth) soil samples were collected before sowing and after harvest of sorghum and wheat crop. The fractions of Phosphorous : Saloid bound phosphorous, Aluminium bound phosphorous, Iron bound phosphorous, Reductant soluble phosphorous, Occluded phosphorous, Calcium phosphorous and Organic phosphorous were determined by the procedure suggested by Peterson and Coney (1966).

RESULTS AND DISCUSSION

The data presented in Table 1 revealed that the better understanding of the role of different phosphate fractions in the availability of soil phosphorous, the inorganic phosphorous has been divided into Ca-P, Al-P, Fe-P and R-S-P, etc. The relative abundance of native P fractions in soil followed the order of Ca-P > Al-P > R-S-P > Fe-P > occl-P > saloid-P. Inorganic phosphorous differences due to various treatments were statistically significant in soil before sowing of wheat crop during both the years of study and ranged from 277.01 to 517.64 ppm. It was found lower in FYM alone/control and highest in 100

1. Ph.D. Scholar, and 2. Head, Department of Soil Science and Agril. Chemistry, Dr. PDKV, Akola.

Table 1: Fractions of phosphorous in soil (ppm) as influenced by long –term fertilization after harvest of sorghum crop

S.N.	Treatments	Saloid-P			Al-P			Fe-P			Cal-P			Red.-P		
		02-03	03-04	Pooled mean	02-03	03-04	Pooled mean	02-03	03-04	Pooled mean	02-03	03-04	Pooled mean	02-03	03-04	Pooled mean
T_1	50% RD NPK	3.51	4.51	4.02	52.15	51.39	51.77	25.80	24.93	25.36	213.78	212.98	213.38	39.55	37.94	38.74
T_2	100% RD NPK	7.39	7.80	7.59	59.93	58.11	59.32	26.36	25.97	26.17	233.70	230.15	231.92	43.59	40.99	42.29
T_3	150 RD NPK	11.81	13.87	12.84	65.85	66.36	66.11	30.48	29.88	30.18	260.90	260.60	260.75	55.15	55.29	55.22
T_4	100% RD NPK (S free)	8.49	7.23	7.86	61.35	59.34	60.34	27.31	26.99	27.15	234.33	231.03	232.68	45.54	44.40	44.97
T_5	100% RD NPK + 10 kg Zinc sulphate	11.82	13.60	12.71	66.04	65.68	65.86	26.25	30.07	28.16	239.92	241.89	240.90	54.76	54.10	54.43
T_6	100% RD NP	8.10	8.39	8.25	62.48	61.95	62.22	26.05	28.66	27.36	239.51	237.02	238.26	50.80	49.46	50.13
T_7	100% RD N	3.99	3.34	3.66	50.29	51.67	50.98	21.41	24.15	22.78	208.40	207.06	207.73	34.43	32.55	33.49
T_8	100% RD NPK + FYM 10 t ha^{-1} (Kharif)	12.97	12.87	12.89	72.24	70.60	71.42	34.60	36.17	35.39	330.70	330.31	330.50	57.03	56.31	56.67
T_9	100% RD NPK (S free) + 37.5 kg S ha^{-1} (through gypsum)	8.22	8.97	8.60	62.17	63.12	62.65	26.47	28.44	27.45	237.61	239.22	238.42	52.91	51.70	52.30
T_{10}	FYM 10 t ha^{-1} (kharif)	2.51	3.84	3.17	44.56	46.85	45.10	20.96	19.95	20.46	207.71	206.41	207.06	31.61	28.70	30.15
T_{11}	75% RD NPK	4.07	4.96	4.52	58.84	57.16	58.00	24.85	26.51	25.68	220.11	217.78	218.95	39.91	39.30	39.64
T_{12}	Control	3.00	2.88	2.94	36.77	84.56	35.66	20.71	19.82	20.27	207.42	203.51	205.46	26.83	26.98	26.91
	SE(m)±	0.023	0.0066	0.017	0.10	0.021	0.080	0.010	3.49	2.47	2.04	2.08	1.45	0.013	0.57	0.41
	CD at 5%	0.067	0.019	0.048	0.29	0.061	0.225	0.031	9.83	7.39	5.88	5.94	4.32	0.038	1.66	1.15

Continue.....

S. N.	Treatments	Occl.-P			IO-P			O-P			Total phosphorous		
		02-03	03-04	Pooled mean	02-03	03-04	Pooled mean	02-03	03-04	Pooled mean	02-03	03-04	Pooled mean
T_1	50% RD NPK	22.60	20.86	21.73	391.99	389.16	390.57	98.96	102.35	100.66	496.77	504.41	499.09
T_2	100% RD NPK	22.96	21.66	22.17	406.77	402.54	404.66	111.55	109.25	110.40	521.19	518.14	519.97
T_3	150 RD NPK	28.23	28.84	28.53	428.80	429.96	429.38	179.76	183.00	181.38	636.29	645.79	641.04
T_4	100% RD NPK (S free)	23.98	23.35	23.67	405.30	406.17	405.73	108.49	113.49	111.24	530.96	527.02	528.99
T_5	100% RD NPK + 10 kg Zinc sulphate	25.52	24.65	25.08	418.79	421.04	419.92	169.61	123.48	171.55	604.46	601.56	603.01
T_6	100% RD NP	24.23	23.69	23.96	406.98	404.88	405.93	132.77	128.57	130.67	565.26	571.66	568.31
T_7	100% RD N	21.52	20.49	21.01	348.47	348.06	345.76	99.36	101.50	100.43	480.60	478.56	479.58
T_8	100% RD NPK + FYM 10 t ha^{-1} (*Kharif*)	29.81	32.68	31.25	518.57	516.71	517.64	267.19	270.96	269.08	688.59	692.63	690.61
T_9	100% RD NPK (S free) + 37.5 kg S ha^{-1} (through gypsum)	24.68	24.60	24.64	418.85	416.70	417.77	163.89	159.96	161.92	598.89	602.79	600.84
T_{10}	FYM 10 t ha^{-1} (*Kharif*)	16.51	16.88	16.88	345.35	342.09	343.72	90.17	87.99	89.08	453.61	459.10	456.36
T_{11}	75% RD NPK	20.96	22.38	21.77	403.24	404.24	403.74	99.99	102.26	101.13	510.44	508.67	509.55
T_{12}	Control	16.23	14.88	15.55	278.14	275.87	277.01	68.96	66.67	67.82	417.04	421.36	419.20
	SE(m)±	0.014	0.014	0.0094	0.23	0.26	0.32	0.43	0.022	0.30	0.087	4.004	2.81
	CD at 5%	0.040	0.042	0.026	0.74	0.77	0.94	1.21	0.061	0.84	0.250	11.50	7.92

Table 2: Fractions of phosphorous in soil (ppm) as influenced by long –term fertilization after harvest of wheat crop

S.N.	Treatments	Saloid-P			Al-P			Fe-P			Cal-P			Red.-P		
		02-03	03-04	Pooled mean	02-03	03-04	Pooled mean	02-03	03-04	Pooled mean	02-03	03-04	Pooled mean	02-03	03-04	Pooled mean
T_1	50% RD NPK	5.06	5.65	5.35	54.51	53.61	54.06	26.86	28.10	27.15	216.24	215.44	215.84	41.92	39.64	40.78
T_2	100% RD NPK	9.02	7.80	8.41	62.30	59.75	61.02	26.86	27.96	28.15	223.76	232.60	234.40	45.95	43.35	44.65
T_3	150 RD NPK	12.57	14.86	13.71	68.69	67.94	68.31	32.46	31.89	32.18	263.26	262.96	263.11	58.80	57.65	58.23
T_4	100% RD NPK (S free)	8.38	8.78	8.58	63.71	61.60	62.65	28.45	30.01	29.23	236.88	233.48	235.18	47.90	46.77	47.33
T_5	100% RD NPK + 10 kg Zinc sulphate	12.42	14.56	13.49	68.50	67.62	68.06	28.23	31.86	30.05	242.37	244.34	243.36	57.12	57.76	57.44
T_6	100% RD NP	8.97	8.96	8.81	64.85	64.21	64.53	29.67	28.97	29.32	239.98	241.68	240.83	53.16	51.83	52.49
T_7	100% RD N	4.07	5.50	4.78	53.29	52.42	52.06	23.40	25.70	24.56	210.76	209.05	209.90	36.80	34.92	35.86
T_8	100% RD NPK + FYM 10 t ha^{-1} (*Kharif*)	13.72	13.86	13.79	75.90	72.86	74.38	37.26	37.96	37.61	334.35	333.95	334.15	60.68	58.68	59.68
T_9	100% RD NPK (S free) + 37.5 kg S ha^{-1} (through gypsum)	9.20	9.96	9.58	65.17	64.87	65.02	28.04	30.65	29.34	242.16	240.48	241.32	56.56	54.07	55.31
T_{10}	FYM 10 t ha^{-1} (*Kharif*)	3.57	3.87	3.72	46.92	48.60	47.76	22.40	21.90	22.15	210.16	208.81	209.49	33.98	30.69	32.33
T_{11}	75% RD NPK	4.98	5.81	5.39	61.21	59.42	60.31	26.86	28.10	27.48	223.76	220.44	222.10	42.33	41.66	42.00
T_{12}	Control	2.96	4.41	3.68	39.12	36.56	37.84	22.42	21.54	21.98	209.87	205.50	207.69	29.83	28.97	29.40
	SE(m)±	0.017	0.0081	0.013	0.21	0.034	0.15	0.014	0.43	0.31	0.11	2.59	1.84	0.17	0.010	0.20
	CD at 5%	0.048	0.023	0.036	0.62	0.098	0.42	0.041	1.24	0.87	0.33	7.46	5.49	0.47	0.031	0.61

S. N.	Treatments	Occl.-P			IO-P			O-P			Total phosphorous		
		02-03	03-04	Pooled mean	02-03	03-04	Pooled mean	02-03	03-04	Pooled mean	02- 03	03-04	Pooled mean
T_1	50% RD NPK	24.86	22.51	23.68	395.32	394.42	395.37	102.25	104.52	103.38	501.02	504.06	502.54
T_2	100% RD NPK	24.95	23.64	24.24	411.10	408.20	409.65	113.80	111.80	112.80	524.44	522.10	523.92
T_3	150 RD NPK	31.48	30.84	31.16	432.80	436.20	434.00	182.02	185.26	183.64	640.54	649.45	644.99
T_4	100% RD NPK (S free)	26.24	25.34	25.79	410.30	409.41	409.85	112.15	116.25	114.20	535.21	530.68	532.94
T_5	100% RD NPK + 10 kg Zinc sulphate	27.77	26.63	27.20	423.04	425.28	424.16	171.87	175.74	173.80	608.71	604.21	606.46
T_6	100% RD NP	26.48	25.68	26.08	411.30	409.20	410.25	135.02	132.23	133.62	569.51	575.02	572.66
T_7	100% RD N	23.78	22.48	23.13	353.65	351.62	351.62	101.62	103.76	102.69	484.60	482.21	483.40
T_8	100% RD NPK + FYM 10 t ha^{-1} (*Kharif*)	32.06	34.67	33.36	522.89	519.96	521.43	269.45	273.22	271.33	692.92	696.29	694.60
T_9	100% RD NPK (S free) + 37.5 kg S ha^{-1} (through gypsum)	26.94	26.59	26.76	422.10	420.20	421.15	165.89	162.96	164.42	602.85	604.45	603.65
T_{10}	FYM 10 t ha^{-1} (*Kharif*)	19.50	18.50	19.00	352.80	348.37	350.58	92.42	90.24	91.33	457.87	462.76	460.31
T_{11}	75% RD NPK	23.22	24.57	23.89	408.50	406.50	407.50	102.62	104.61	103.61	514.70	511.67	513.18
T_{12}	Control	19.48	16.86	18.17	282.40	280.10	281.25	72.22	70.33	71.27	421.30	425.02	423.16
	SE(m)±	0.011	0.068	0.049	0.064	0.0661	0.057	0.043	0.046	0.022	14.43	4.33	10.65
	CD at 5%	0.033	0.198	0.138	0.179	0.176	0.168	0.122	0.128	0.063	41.48	12.45	30.03

per cent NPK + 10 t ha^{-1} FYM followed by 150 per cent NPK. The inorganic P in soil contributed 73.07 per cent of the total P.

The organic phosphorous content in soil before sowing of wheat crop during both the years of the study, under the influence of different treatment ranged from 67.82 to 269.08 ppm and was statistically significant. Organic P in soil was found highest in 100 per cent NPK + 10 t FYM ha^{-1} treatment plot and lowest in control plot. Prasad *et al.* (1986) reported that Vertisols contained 17.6 to 309.9 ppm organic P, whereas in this experimental soil organic P was found 67.82 to 269.08 ppm which was increased due to different treatments under sorghum- wheat crop sequence and might be due to addition of biomass through plant residues. The organic P in soil contributed 24.48 per cent of the total P.

The inorganic phosphorous has been divided into Ca-P, Al-P, Fe-P and R-S-P etc. The data presented in Table 2 revealed that, the relative abundance of native P fractions in soil followed the order of Ca-P > Al-P > R-S-P > Fe-P > Occl.-P > Saloid-P. Inorganic phosphorous differences were statistically significant in soil after harvest of wheat crop during both years of study and ranged from 281.25 to 521.43 ppm. It was found lower in FYM alone/control and highest in 100 per cent NPK + 10 t FYM ha^{-1} followed by 150 per cent NPK. The inorganic P in soil contributed 73.40 per cent of the total P.

The organic phosphorous content in soil after harvest of wheat crop during both years of study, under the influence of different plots was statistically significant. Organic P in soil was found highest in 100 per cent NPK + 10 t FYM ha^{-1} treated plot and lowest in control plot. Prasad *et al.* (1986) reported that Vertisols contained 17.6 to 309.9 ppm organic P. Whereas in this experimental soil, organic P was found 71.27 to 271.33 ppm and was increased due to different treatments under sorghum-wheat crop sequence which might be because of biomass addition through plant remains. The organic P in soil contributed 27.78 per cent of the total P. It is evident that subsequent to P fertilization, only small portion of added P is absorbed by plants and the remainder is retained and fixed in the soil in various relatively insoluble forms which is due to high P fixing nature of Vertisols. In acid soils P is known to form relatively insoluble compounds of iron and aluminium. Whereas, in alkaline soils containing lime the formation of calcium phosphate is possible. The results obtained from P fractionation study indicated that all the fractions of P evaluated showed an appreciable build up under 100 per cent NPK + FYM followed by 150 per cent NPK. Among the inorganicP fraction estimated, saloid-P constituted the least i.e.1.51per cent of the total P. The relative status of P fractions in the soil followed the order of Ca-P >Org.-P >Al-P>R-S-P>Fe-P > Occl.-P >Saloid-P.

The soil test values also indicated build up of available P in phosphorous receiving plots and depletion in control and FYM alone plots. Inorganic P fractions like Al-P, Fe-P, Ca-P, R-S-P and Occl-P in the soil contributed 10.91, 5.16, 43.54, 8.46 and 4.60 per cent of the total P, respectively.

Similar observations were also reported by Cheng and Jackson (1958), Yaduvanshi and Tripathi (1985) and Dash *et al.* (1990).

LITERATURE CITED

Aulakh, M.S. 1990. P-S inter-relations for soybean on P & S deficient soil, Soil Sci., 150:705-709.

Cheng, S.C. and M.L. Jackson, 1958. Soil phosphorous fractions in some representative soils, J. Soil Sci., 9 : 109-119.

Dash, R.N.; S.R. Mohanty and S. Patnaik, 1990. Transformation and availability of P in soils from acidulated phosphate rock under stimulated wheat-rice or rice-wheat moisture conditions, J. Indian Soc. Soil Sci., 38 : 613-620.

Peterson, G.W. and R.B. Coney, 1966. A modified Chang and Jackson procedure for routine Fractionation of Inorganic soil phosphates, Proc. Soil Sci. Soc. American, 30 : 563.

Prasad, S.N.; B.P. Sahi and S.P. Singh, 1986. Forms of P and response of wheat in Vertisols of Bihar, J. Indian Soc. Soil Sci., 34 : 2197 – 301.

Yaduvanshi, H.S. and B.R. Tripathi, 1985. Changes in Inorganic P fractions under intensive system of cropping in typic Hapludalf, J. Indian Soc. Soil Sci., 33(4) : 908.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Management of Mechanical Damage to Soybean Seed During Processing

R. T. Kausal[1], G. S. Jeughale[2], S. D. Sarnaik[3], R.N. Jane[4] and S.V. Sarode[5]

ABSTRACT

An efforts were made to suggest the suitable processing technology for management of mechanical damage to soybean seed during processing. The experiments were conducted at Seed Technology Research Unit, Dr. PDKV, Akola, M.S., India during 2005-06, 06-07 and 2007-08. Seed quality was significantly affected by moisture content and type of handling equipment. In case of bucket elevator maximum damage observed in seed lot of 9 per cent moisture content resulting in to loss in germination and vigour. The amount of damaged seed is found significantly reduced by using inclined belt conveyor at both moisture levels (9 and 12 %). The mechanical damage at 12 per cent moisture content was 5.1 per cent by bucket elevator and 2.0 per cent by inclined belt conveyor. This may be due to fact that during lifting seed by bucket elevator the layer seed mass is cut off by edges of cups and while discharge it throw with centrifugal force against the metal surface causing damage to seed . This may not happen while using inclined belt conveyor. In inclined belt conveyor seed mass slowly lifted and discharged causing less damage to seed.

Soybean known as the golden bean, grown on a large area in Maharashtra state of India. The area under seed production in the state was 46,553ha in 2006-07 and produced 6,09,421q of seed. From these only 3,88,807q seed was passed i.e. having germination above 70 per cent Anonymous (2007). Thus a large quantity of seed is failed to meet the desired level of germination, which is treated as fail seed. One of the major reason of failure of substantial quantity of seed is due to mechanical damage received to seed during processing especially during handling. Soybean seed possess a delicate and fragile seed coat (especially the seed coat of yellow cultivars), which is relatively thin and radical lies in as extremely vulnerable position, which is highly susceptible to mechanical damage. Due to slight injury soybean seed looses its germinability. It is not uncommon that considerable amount of seed showed decline in germination even after processing. While processing of soybean seed maximum mechanical damage received to seed during elevating stage. Generally vertical bucket elevators are used to feed the soybean seed to different machines from receiving pit. This stage proves to be the most critical stage causing maximum damage where the seed is lifted to about 7 to 8 m from receiving pit to discharge end . This may be due to the fact that during elevating the seed by bucket elevator the layer of seed mass is cut off by the edges of cups and the seed is discharged with centrifugal force against a metal surface of discharge pipe causing injury to seed resulting in to loss of seed quality. The extent of mechanical damage can be reduce considerably if inclined belt conveyor is used in place of bucket elevator. In inclined belt conveyor the seed mass is slowly lifted and discharge to feed hopper thus mechanical damage received to seed is very less and thus reducing the loss of seed quality, Hence the study was conducted to evaluate the seed quality of soybean by using inclined belt conveyor and bucket elevator as a handling equipments and to suggest suitable processing technology for maintaining the seed quality by minimizing mechanical damage.

MATERIAL AND METHODS

The experiments were conducted at Seed Technology Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, and M.S., INDIA in the year 2005-06, 2006-07 and 2007-08. Soybean seed lots of two moisture content levels i.e. 9.0 and 12 per cent were selected and processed on a modern seed processing plant independently using two types of elevating equipments i.e. bucket elevator and inclined belt conveyor independently for lifting the seed mass from receiving pit to feed hopper pipe (inlet of seed cleaner cum grader). The flow diagram of processing is stated below

1. Seed Research Officer, 2. & 3. Junior Res. Asstt. 4. Assistant Seed Res. Officer, Seed Technology Research Unit, and 5. Director of Research, Dr. PDKV, Akola

During processing samples were drawn at each outlet points as stated below.

1) Inlet of elevator i.e. raw seed
2) Outlet of elevator
3) Inlet of seed cleaner cum grader
4) Outlet of seed cleaner cum grader
5) Inlet of specific gravity separator
6) Outlet of specific gravity separator.

The seed collected from each point were tested for mechanical damage percentage, germination percentage, physical purity percentage, seed coat crack percentage, and seedling length and vigour index. All the seed quality tests were conducted as per standard procedure in the rules for seed testing Anonymous, (1985). The statistical analysis was done by using Factorial Randomized Block Design (FRBD) as per standard procedure Panase and Sukhatme, (1976).

RESULTS AND DISCUSSION

The pooled data of three years is presented in Table no 1 and 2 for both the moisture content seed lots i.e. 9 and 12 per cent. The data presented in the tables indicated that, seed quality was significantly affected by moisture content and type of handling equipment while processing. The seed received for processing contains 9.5 and 8.4 per cent mechanical damage, which increases to 15.7 and 13.5 per cent while elevating by bucket elevator and 13 and 10.5 per cent by inclined belt conveyor at seed moisture content of 9 and 12 per cent respectively. At both moisture levels maximum damage noticed in seed lifted by bucket elevator, the elevating stage proves to be the most critical stage causing maximum damage during processing.

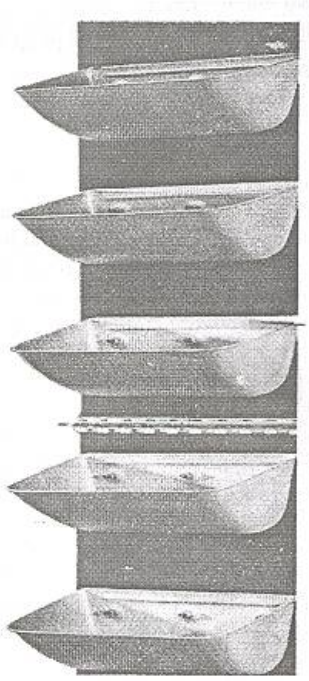
In case of bucket elevator maximum damage i.e. 6.2 per cent observed in seed lot of 9 per cent moisture content resulting in to loss in germination by 6.8 per cent and vigour by 163 points. Where as, in case of belt conveyor the mechanical damage was 4.1 per cent at same moisture content i.e. 9 per cent with reduction in germination by 4.3 per cent and vigour by 66 points. Apart from the visible damage some hidden damages also observed either in form of seed coat crack or damage to embryo, which further enhance the reduction in seed quality.

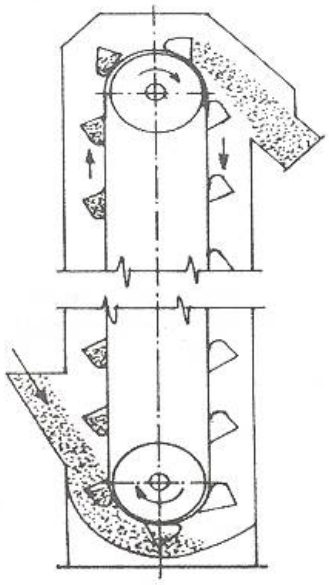
At 12 per cent moisture content, the mechanical damage to seed was 5.1 and 2.0 per cent, in case of bucket elevator and inclined belt conveyor respectively resulting in loss of germination by 5.1 and 2.9 per cent and vigour 127 and 66 points, respectively, which ultimately reduces the quality of seed.

The amount of damaged seed is found significantly reduced by using inclined belt conveyor at both moisture levels.

The main cause of mechanical damage may be due to fact that during lifting seed by bucket elevator the layer of seed mass is cut off by edges of cups and while discharge it throw with centrifugal force against the metal wall of discharge pipe causing mechanical damage to seed. This may not happen while using inclined belt conveyor. In inclined belt conveyor seed mass slowly lifted and discharged to the feed hopper of grading machine. So very less impact received to seed, thus the percentage of mechanically damaged seed is significantly less as compare to seed lifted by vertical bucket elevator. The similar results were observed by Parde *et al* (2002) they stated that the vertical bucket elevator significantly decreased germination and increase seed coat damages, they also stated that seed lot having 12 per cent moisture content suffered less loss in seed quality than seed lots of 10 per cent moisture content. Present findings also corroborate with the findings of Vearasilp *et.al* (2001) they recorded, transportation of soybean seed by bucket elevator caused high percentage of seed breakages during processing.

Inclined Belt Conveyor





Bucket Elevator

Table 1 : Effect of Elevating equipment on the seed quality of Soybean seed during processing at 12 % m.c. (Pooled data)

Processing	Mechanical damage			Germination			Phy. Purity %		
	C1	C2	Mean	C1	C2	Mean	C1	C2	Mean
P1	8.4	8.4	8.4	75.3	75.3	75.3	95.1	95.5	95.3
	(16.8)	(16.9)	(16.9)	(60.2)	(60.2)	(60.2)	(77.2)	(77.7)	(77.4)
P2	13.5	10.5	12.0	70.2	72.4	71.3	93.7	94.5	94.1
	(21.5)	(18.9)	(20.2)	(56.9)	(58.3)	(57.6)	(75.4)	(76.4)	(75.9)
P3	14.7	11.2	12.9	69.1	71.5	70.4	93.8	94.5	94.1
	(21.5)	(19.5)	(21.0)	(56.2)	(57.7)	(57.0)	(75.5)	(76.4)	(75.9)
P4	3.4	2.8	3.1	70.0	80.1	75.2	97.7	98.1	97.9
	(10.5)	(9.7)	(10.1)	(56.8)	(63.5)	(60.1)	(81.3)	(82.0)	(81.7)
P5	3.4	2.8	3.1	74.7	80.1	77.5	97.7	98.0	97.8
	(10.5)	(9.7)	(10.1)	(59.8)	(63.5)	(61.6)	(81.2)	(81.8)	(81.5)
P6	2.7	1.9	2.3	80.6	85.2	83.0	98.7	99.0	98.9
	(9.5)	(7.8)	(8.6)	(63.9)	(67.3)	(65.6)	(83.5)	(84.1)	(83.8)
Mean	7.9	5.7		73.4	77.6		96.4	96.8	
	(15.2)	(13.78)		(58.98)	(61.78)		(79.04)	(79.77)	
	P	C	PxC	P	C	PXC	P	C	PxC
SE(m)±	0.17	0.29	0.42	0.51	0.89	1.26	0.17	0.29	0.42
CD(5%)	0.50	0.87	1.23	1.51	2.62	3.71	0.50	0.87	1.23

Processing	Recovery %			Seed coat crack %			Vigour Index		
	C1	C2	Mean	C1	C2	Mean	C1	C2	Mean
P1	100	100	100	11.3	11.5	11.4	1211	1217	1214
	(90)	(90)	(90)	(19.6)	(19.8)	(19.7)			
P2	100	100	100	17.2	14.2	15.7	1084	1151	1117
	(90)	(90)	(90)	(24.5)	(22.1)	(23.3)			
P3	100	100	100	18.9	14.9	16.9	1063	1135	1099
	(90)	(90)	(90)	(25.8)	(22.7)	(24.3)			
P4	86.0	86.2	86.1	4.1	2.9	3.5	1259	1325	1292
	(68.0)	(68.2)	(68.1)	(11.6)	(9.8)	(10.7)			
P5	85.9	85.9	85.9	4.5	3.2	3.9	1247	1323	1285
	(67.9)	(67.9)	(67.9)	(12.3)	(10.3)	(11.3)			
P6	82.3	83.0	82.7	4.5	1.9	3.1	1318	1516	1417
	(65.1)	(65.6)	(65.4)	(12.3)	(7.9)	(10.1)			
Mean	96.0	96.1		9.2	7.1		1197	1278	
	(78.5)	(78.6)		(17.7)	(15.4)				
	P	C	P X C	P	C	P X C	P	C	P X C
SE (m) ±	0.11	0.20	0.28	0.48	0.83	1.18	14.20	24.60	34.80
CD at 5%	0.34	0.60	0.85	1.42	2.46	3.48	41.67	72.18	102.08

Figure in parentheses are arcsin values

C1 = Bucket elevator
C2 = Belt conveyor
P1 = Inlet of elevator
P2 = Outlet of elevator
P3 = Inlet of seed cl. cum grader
P4 = Outlet of seed cleaner cum grader
P5 = Inlet of sp. gr. separator
P6 = Outlet of sp. gr. Separator

Therefore it is concluded that, use of inclined belt conveyor is found much safer than bucket elevator for maintaining seed quality at both the moisture content levels. The loss of seed quality was minimum at 12 per cent moisture content as compare to 9 per cent moisture content.

LITERATURE CITED

Anonymous, 1985.International Rules for Seed Testing. Seed Sci. & Technol. 13: 314-323.

Anonymous, 2007.Annual Report of Maharashtra State Seed Certification Agency.: 22-23.

Panase, V.G.and P.V. Sukhatme, 1976.Statastical Method for Agricultural Workers.ICAR,New Delhi :195-197.

Parde, S.R., R.T.Kausal, Digvir S Jayas and Noel D.G. White, 2002.Mechanical Damage to Soybean Seed during Processing, J. Stored Products Research 38 (4): 385-394.

Table 2 : Effect of Elevating equipment on the seed quality of Soybean seed during processing at 9% m.c. (Pooled data)

Processing	Mechanical damage			Germination			Phy. Purity %		
	C1	C2	Mean	C1	C2	Mean	C1	C2	Mean
P1	9.5	9.5	9.5	74.9	75.3	75.0	95.3	95.2	95.3
	(17.9)	(18.1)	(18.0)	(59.9)	(60.2)	(60.0)	(77.4)	(77.36)	(77.4)
P2	15.7	13.0	14.4	68.1	71.0	69.5	93.3	94.1	93.7
	(23.3)	(21.4)	(22.3)	(55.6)	(57.4)	(56.5)	(74.9)	(75.9)	(75.4)
P3	16.8	13.8	15.3	66.5	70.6	68.4	92.9	95.5	94.3
	(24.2)	(21.8)	(23.0)	(54.6)	(56.9)	(55.8)	(74.5)	(77.73)	(76.11)
P4	3.5	3.0	3.2	73.7	77.1	75.5	95.6	98.3	97.1
	(10.8)	(9.9)	(10.3)	(59.1)	(61.4)	(60.2)	(77.9)	(82.42)	(80.20)
P5	3.9	3.1	3.5	72.9	76.8	74.9	97.4	98.3	97.9
	(11.3)	(10.0)	(10.7)	(58.6)	(61.2)	(59.9)	(80.8)	(82.63)	(81.73)
P6	3.1	2.2	2.6	78.4	80.4	79.4	98.8	99.05	98.9
	(10.0)	(8.4)	(9.2)	(62.3)	(63.7)	(63.0)	(83.7)	(84.43)	(84.1)
Mean	8.7	6.6		72.4	75.2		95.8	97.0	
	(16.2)	(14.9)		(58.3)	(60.1)		(78.2)	(80.03)	
	P	C	PxC	P	C	PXC	P	C	PxC
SE(m)±	0.18	0.32	0.46	0.18	0.13	0.44	0.50	0.87	1.24
CD(5%)	0.55	0.95	1.35	0.53	0.91	1.30	1.48	2.57	3.63

Processing	Recovery %			Seed coat crack %			Vigour Index		
	C1	C2	Mean	C1	C2	Mean	C1	C2	Mean
P1	100	100	100	13.4	13.4	13.4	1239.5	1241.5	1240.5
	(90)	(90)	(90)	(21.4)	(21.4)	(21.4)			
P2	100	100	100	20.8	16.6	18.5	1076.0	1171.4	1124.1
	(90)	(90)	(90)	(27.1)	(24.0)	(25.5)			
P3	100	100	100	22.4	17.3	19.8	1055.0	1152.4	1104.0
	(90)	(90)	(90)	(28.2)	(24.6)	(26.4)			
P4	84.9	84.0	85.1	6.4	5.0	5.7	1210.0	1290.4	1250.2
	(67.1)	(67.4)	(67.3)	(14.6)	(12.9)	(13.8)			
P5	84.8	85.5	84.9	7.5	4.9	6.1	1197.5	1283.1	1240.3
	(67.0)	(67.2)	(67.1)	(15.8)	(12.7)	(14.3)			
P6	82.7	89.5	86.3	3.5	2.4	2.9	1281.5	1357.3	1319.4
	(65.4)	(71.1)	(68.3)	(10.7)	(8.9)	(9.8)			
Mean	95.8	96.6		11.3	9.0		1176.8	1249.3	
	(78.2)	(79.3)		(19.6)	(17.4)				
	P	C	P X C	P	C	P X C	P	C	P X C
SE (m) ±	0.67	1.16	1.64	0.35	0.61	0.86	8.54	14.80	20.94
CD at 5%	1.96	3.40	4.82	1.03	1.79	2.54	25.0	43.42	61.41

Figure in parentheses are arcsin values

C1 = Bucket elevator
C2 = Belt conveyor
P1 = Inlet of elevator
P2 = Outlet of elevator
P3 = Inlet of seed cl. cum grader
P4 = Outlet of seed cleaner cum grader
P5 = Inlet of sp. gr. separator
P6 = Outlet of sp. gr. Separator.

Vearasilp, Suchada, Somchai Pa-oblek, Nattasak Krittigamas, Sa-nguansak Thanapornpoonpong, Sangtiwa Suriyong, Elke Pawelzik, 2001. Assessment of Post Harvest Soybean Seed Quality Loss. Conference of International Agricultural Research for Devlopment, Bonn :102-105

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Bioefficacy of Promising Botanicals Against Insects Infesting Stored Wheat Seed

U.K. Kadam[1], M. P. Badgujar[2] and P. R. Palande[3]

ABSTRACT

The present experiment was conducted at Seed Technology Research Unit, MPKV, Rahuri during 2004-05, 2005-06 & 2006-07 on wheat seed starting from June in every year with an objective to avoid environmental hazards of the chemical insecticides and to strengthen the use of ecofriendly products in organic seed production and to find out the efficacy of botanicals against major insect pests of stored wheat seed. The results revealed that the germination percentage recorded by all the treatments after nine months of storage period were higher as compared to untreated control. The highest germination and the least seed damage was recorded by deltamethrin 2.5 WP @ 1ppm followed by soap nut (*Sapindus trifoliatus*) powder @ 20g kg^{-1} seed after nine months of storage period.

Wheat (*Triticum aestivum*) is one of the most widely used staple foods in the world of agriculture. Among the wheat growing countries of the world, India ranks second both in area and production. In India, the area and production of wheat in the year 2005-06 were 26.48 mha and 69.35mt, respectively (Anonymous, 2007). The wheat seed is attacked by a number of different insect pests under storage condition in which *Rhyzopertha dominica* Fab. causes vast damage to cereals and grains. It is a very serious pest of wheat and are also found feeding on bajra, jowar, rice, gram, maize and pulses in storage. Only larval stage is destructive, adult being harmless. The larvae start feeding on the germ portion of grains and feed into them. It reduces the grain to frass with great speed and renders it unfit for human consumption. This cause great economic loss both in quantity and quality. The germination of seed is also affected. To combat the problem heavy doses of chemical insecticides are used to control *R. dominica*. But now it has developed resistance to a number of theses chemical insecticides (Collins *et al.*, 1993; Srivastava, *et. al.*, 2000). The present work has been conducted to study some alternate methods for control of insect pest *R. dominica*. Biopesticides are safer, eco-friendly and biodegradable. In recent years several plants have been identified which can be used as safe and renewable sources of insecticide (Dethier 1947, Jacobson 1977, Singh and Pant 1980, Verma *et. al*,. 1980 & Verma and Pandey, 1981). Use of plant extracts is now-a-days gaining importance because of its safety, non-toxic to natural enemies, biodegradable, easily available and cheaper. Use of extracts of such plants like neem (*Azadirachta indica*) is now gaining momentum since several active insecticidal neem compounds, including azadirachtin, are feeding inhibitors and growth disruptors for most insect orders (Schmutterer, 1990).

MATERIAL AND METHODS

The storage trial was conducted for three consecutive years from 2004-05, 2005-06 & 2006-07 at Seed Technology Research Unit, MPKV, Rahuri in Factorial CRD design having 10 treatment and three replication.

One kg of freshly harvested certified seed of wheat var. HD-2189 having high percentage of germination and less than 10 per cent of moisture was taken for each treatment. Required quantity of pesticides was diluted in 5 ml water to treat 1 kg of wheat seed for proper coating. After drying in shade, seeds were packed in gunny bag-lets of 2 kg capacity and kept in room temperature under ambient conditions. The temperature and relative humidity of the room was recorded on standard week basis.

Germination and moisture were determined as per ISTA rules (Anonymous, 1985). Insect Infestation was carried out by counting the damaged seed and per cent damage was worked out. The data were analyzed using factorial completely randomized design.

1.Assistant Seed Res. Officer and 2 & 3. Senior Res. Asstt., Seed Technology Research Unit , MPKV, Rahuri Dist- Ahmednagar (MS)

Table 1. Pooled mean of Insect Infestation in Wheat seeds under storage condition (2004-05, 2005-06 & 2006-07)

Tr. No.	Treatments	Insect infestation (%) at storage period (months)			
		0	3	6	9
T_1	Neem (*Azadirachta indica*) dry leaf powder @ 10 g kg^{-1} seed	0.00 (0.00)	4.33 (2.48)	5.67 (3.25)	6.67 (3.82)
T_2	Neem (*Azadirachta indica*) dry leaf powder @ 20 g kg^{-1} seed	0.00 (0.00)	2.33 (1.34)	4.33 (2.48)	5.22 (3.00)
T_3	Soap nut (*Sapindus trifoliatus*) powder @ 10 g kg^{-1} seed	0.00 (0.00)	1.22 (2.42)	2.56 (1.47)	4.22 (2.42)
T_4	Soap nut (*Sapindus trifoliatus*) powder @ 20 g kg^{-1} seed	0.00 (0.00)	0.22 (0.13)	1.11 (0.63)	2.11 (1.21)
T_5	Vasambu (*Achorus calamus*) rhizome powder @5 g kg^{-1} seed	0.00 (0.00)	5.11 (2.26)	7.67 (4.40)	8.89 (5.10)
T_6	Vasambu (*Achorus calamus*) rhizome powder @10g kg^{-1} seed	0.00 (0.00)	4.89 (2.80)	6.33 (3.63)	7.11 (4.08)
T_7	Turmeric powder @5g kg^{-1} seed	0.00 (0.00)	6.11 (3.50)	10.56 (6.06)	13.67 (7.85)
T_8	Turmeric powder @ 10g kg^{-1} seed	0.00 (0.00)	6.55 (3.76)	8.89 (5.10)	11.89 (6.83)
T_9	Deltamethrin 2.5 WP @ 1 ppm (40 mg kg^{-1} seed)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.89 (0.51)
T_{10}	Untreated control	0.00 (0.00)	10.22 (5.87)	15.33 (8.82)	17.89 (10.30)
Interaction (T x months)		S.E (m). ± 0.36		C.D. at 5 % 1.02	

Figures in parentheses are weighted means.

Samples of treated seed were drawn and observations of per cent germination, per cent moisture and per cent infestation were recorded at three months interval i.e. '0' month, '3' months, '6' months and '9' months of storage period. The experiment was carried out for three consecutive years.

RESULTS AND DISCUSSION

Seed Infestation

The different botanicals and deltamethrin 2.5WP @ 1ppm controlled the seed damage when compared with untreated control. The per cent infestation was negligible at 0, 3, 6 & 9 months of storage period when treated with deltamethrin 2.5 WP @ 1 ppm, followed by soap nut powder @ 20g kg^{-1} seed. The seed treated with deltamethrin 2.5 WP @ 1ppm recorded least insect infestation (0.89%) followed by soap nut powder @ 20g kg^{-1} seed (2.11%) after 9 months of storage period. Use of botanicals is now-a-days gaining importance due to the hazardous effect of chemical insecticides.

Table 1 reveals that wheat seed treated with deltamethrin 2.5WP @1ppm and soap nut powder @ 20g kg^{-1} seed were found effective for control of storage grain pest of wheat seed.

Seed germination

It is observed from the pooled mean that the germination percentage of wheat seed was highest at 0 month then afterwards the germination percentage lowered at 3, 6 and 9 months of storage period.

Table 2. Pooled mean of Germination in Wheat seeds under storage condition (2004-05, 2005-06 & 2006-07)

Tr. No.	Treatments	Germination (%) at storage period (months)			
		0	3	6	9
T_1	Neem (*Azadirachta indica*) dry leaf powder	97.56	92.45	82.44	81.78
	@ 10g kg^{-1} seed	(78.60)	(67.66)	(55.55)	(54.88)
T_2	Neem (*Azadirachta indica*) dry leaf powder	97.89	95.44	85.56	84.33
	@ 20g kg^{-1} seed	(80.77)	(72.98)	(58.82)	(57.51)
T_3	Soap nut (*Sapindus trifoliatus*) powder	96.56	94.56	87.33	83.89
	@ 10g kg^{-1} seed	(79.50)	(71.21)	(60.86)	(57.05)
T_4	Soap nut (*Sapindus trifoliatus*) powder	97.66	96.11	90.11	87.22
	@ 20g kg^{-1} seed	(78.16)	(74.26)	(64.39)	(60.75)
T_5	Vasambu (*Achorus calamus*) rhizome powder	97.22	92.11	81.22	80.11
	@ 5g kg^{-1} seed	(76.83)	(67.16)	(54.32)	(53.26)
T_6	Vasambu (*Achorus calamus*) rhizome powder	97.78	92.78	89.11	83.78
	@10g kg^{-1} seed	(79.21)	(68.20)	(62.44)	(56.95)
T_7	Turmeric powder @5 g kg^{-1} seed	97.78	89.11	81.22	79.78
		(79.63)	(63.08)	(54.34)	(52.93)
T_8	Turmeric powder @10g kg^{-1} seed	97.67	90.78	82.44	81.11
		(78.61)	(65.12)	(55.55)	(54.22)
T_9	Deltamethrin 2.5 WP @ 1 ppm (40 mg kg^{-1} seed)	97.78	97.00	94.33	92.44
		(79.50)	(76.37)	(70.82)	(67.74)
T_{10}	Untreated control	97.22	86.11	80.44	76.22
		(77.58)	(59.51)	(53.56)	(49.69)
Interaction	(T x months)	S.Em.±		C.D. at 5 %	
		1.65		4.67	

Figures in parentheses are weighted means.

The wheat seed treated with deltamethrin 2.5 WP @ 1ppm recorded highest germination (92.44%) after nine months of storage period. Among all the botanicals, the wheat seed treated with soap nut powder @ 20g kg^{-1} seed recorded 98, 96, 90 & 87 per cent germination at 0, 3, 6 & 9 months of storage period, respectively (Table2).

Seed Moisture

There was no effect of all the treatments on moisture content. However the moisture content ranged from 8.07 to 8.61 per cent after 9 months of storage period (Table 3).

LITERATURE CITED

Anonymous, 2007. Agricultural Research Data Book-2007. 212.

Anonymous, 1985. International Rules for Seed Testing, Seed Sci. Tech., 13:307-320.

Collins, P.J., Lambkin, T.M., Bridgemen, B.W., Pulvirenti, C. 1993, Resistance to grain protectant insecticides in coleopterous pests of stored cereals in Queensland, Australia, J. Eco. Entomol., 86 : 239 - 245.

Dethier, V.G. 1947. Chemical Insect Attractant and Repellents, Levis and Co. London.

Jacobson, M. 1977. Isolation and identification of toxic agents from plants, In Host Plant Resistance to Pests (Hedin P.A. Ed.153 ACS Symposium series 62 American Chemical Society, Washington, D.C.

Srivastava, C., Sinha, S.R., Sinha S.N. 2000. Occurrence of insecticide resistance in lesser

Table 3. Pooled mean of moisture in Wheat seeds under storage condition (2004-05, 2005-06 & 2006-07)

Tr. No.	Treatment	Moisture (%) at storage period (months)			
		0	3	6	9
T_1	Neem (*Azadirachta indica*) dry leaf powder @ 10g kg^{-1} seed	8.48 (4.86)	11.36 (6.52)	10.25 (5.88)	8.29 (4.75)
T_2	Neem (*Azadirachta indica*) dry leaf powder @ 20g kg^{-1} seed	8.57 (4.91)	11.23 (6.45)	10.08 (5.79)	8.61 (4.94)
T_3	Soap nut (*Sapindus trifoliatus*) powder @ 10g kg^{-1} seed	8.54 (4.90)	11.28 (6.48)	10.22 (5.86)	8.44 (4.84)
T_4	Soap nut (*Sapindus trifoliatus*) powder @ 20 g kg^{-1} seed	8.54 (4.90)	11.36 (6.52)	10.27 (5.89)	8.32 (4.77)
T_5	Vasambu (*Achorus calamus*) rhizome powder @ 5g kg^{-1} seed	8.57 (4.92)	11.49 (6.60)	10.23 (5.87)	8.40 (4.82)
T_6	Vasambu (*Achorus calamus*) rhizome powder @10g kg^{-1} seed	8.64 (4.95)	11.26 (6.47)	10.36 (5.95)	8.08 (4.63)
T_7	Turmeric powder @ 5g kg^{-1} seed	8.53 (4.89)	11.29 (6.49)	10.31 (5.92)	8.56 (4.91)
T_8	Turmeric powder @ 10g kg^{-1} seed	8.58 (4.92)	11.41 (6.55)	10.22 (5.86)	8.19 (4.70)
T_9	Deltamethrin 2.5 WP @ 1 ppm (40 mg kg^{-1} seed)	8.55 (4.90)	11.35 (6.52)	10.35 (5.94)	8.07 (4.63)
T_{10}	Untreated control	8.58 (4.92)	11.33 (6.51)	10.29 (5.90)	8.41 (4.82)
Interaction (T x months)		S.E (m) ± 0.18		C.D. at 5 % 0.51	

Figures in parentheses are weighted means.

grain borer *Rhyzopertha dominica*, Annals of Agric. Res., 12.93-95.

Singh, R.P. and N.C. Pant, 1980. Lycorine a resistance factor in the plants of family Amaryllidaceae against Desert Locust, *Scistodera gregaria* F. Indian J. Entomol., 42 (3): 469-472.

Schmutterer, H. 1990. Properties and potential of natural pesticides from neem tree *Azadirachta indica*, Annual Rev. Entomol.. 35: 251-297.

Verma, G. S., U.K. Pandey, and Mamta Pandey, 1980. Response of some plant origin insecticides against pests of cruciferous vegetables, *Bagrada cruciferarum* Kirk (Hemiptera: Pentatomidae). J. Advanced Zool., 1(2):111-116.

Verma, G.S. and U.K. Pandey. 1981. Studies on the effect of *Acorus calamus, Cimicifuga foelida, Gynandropsis gynandra* extract against insect pests of cruciferous vegetables, Painted bug *Bagarda cruciferarum* Kirk (Hemiptera: Pentatomidae) Zielxchriti fur angewandle Zoologie.68 (II): 109-113.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Mapping of Quantitative Traits Locis for Panicle Length in Double Haploid Population of Rice

M. S. Dudhare[1], R. N. Dhawale[2], S. D. Karnewar[3] and S. K. Mishra[4]

ABSTRACT

A double haploid mapping population consisting 75 lines of a cross between the irrigated *Indica* variety IR64 and the upland *Japonica* variety Azucena was used in the present experiment. The complete set of double haploid lines along with parents was evaluated under two sets of condition, 1. Transplanted with water stress and 2. Transplanted with no stress over two years. Water stress was imposed at flowering and observations were recorded. A total of 2 putative QTLs for panicle length were detected, which were found to be explaining a minimum of 11.1 per cent to maximum of 14.3 per cent of phenotypic variation, individually. These QTLs were mapped on the rice genome and linked DNA markers had been validated for use in the marker assisted breeding program.

Chhattisgarh is an important agricultural state of eastern India. Rainfed rice occupies more than 75 per cent of the total rice area, which usually suffers from drought causes a significant reduction in rice yield. The rainfall pattern of the last ten years at Raipur indicates that the late duration varieties are prone to terminal drought almost every year; medium duration varieties are prone to terminal drought almost every second year. In this part of the world late and medium duration varieties cover more than 70 per cent area. Developing early duration varieties is not a good option as these are prone to damage by rain at maturity as well as the yield penalty incurred due to the early maturity. There is atmost need to develop drought tolerant lines suited to both upland and rainfed

lowland situations. Rice is most susceptible to yield reduction by water deficit during panicle emergence and flowering and there is a need to screen genotypes separately which are tolerant to vegetative stage or anthesis stage. Recently QTL mapping studies in rice revealed two important results on the genetic basis of quantitatively inherited traits. First, identification of few QTLs each having relatively large phenotypic effect and second, the complex phenotype tend to show greater QTL x E interaction, which makes marker-aided selection (MAS) for QTL to genetic improvement of complex trait difficult. Considering this aspect in view, a study of identification and molecular mapping of QTLs for panicle length in rice was undertaken.

MATERIAL AND METHODS

A population of 75 Double Haploid (DH) lines derived from a cross between the irrigated *indica* variety IR64 and the upland *japonica* variety Azucena (Guiderdoni *et al.* 1992) developed at IRRI, was used in the present investigation. IR64 is high yielding improved semidwarf *indica* rice variety suitable for irrigated habitats, where as Azucena is a more drought tolerant *japonica* rice variety. Populations of 75 Double Haploid (DH) lines were grown in randomized complete block design with two replications under two different environmental conditions viz., 1. Transplanted with water stress (TD) and 2. Transplanted with irrigated conditions (TI). In both conditions, the seeds were sown in a bed and seedlings were transplanted to a paddy field 31 days latter, with single plant hill^{-1} spaced at 15 X 20 cm. Each plot included three lines with ten plants per line. All normal packages of practices were followed to raise a good crop. The drought condition was imposed by stopping irrigation at 50per cent flowering stage. Observations were recorded in each replication. The length of main panicle of each plant was measured from the base to the tip of panicle, excluding awns, if any, at the time of harvesting. The mean values over ten plants were considered for

1. Assistant Prof., Department of Agril. Botany, Dr. PDKV, Akola, 2. Assistant Prof., M.G. College of Agril. Biotechnology, Nanded and 3. Professor, School of Bioscience, Pt. Ravishankar Shukla Univ., Raipur (CG)

analysis. The mean data for two replications under transplanted with water stress, transplanted with irrigated condition were analyzed for QTLs identification. MAPMAKER / QTL 1.1 was used for interval mapping (Locating the QTLs between flanking molecular marker by maximum – likelihood estimation) (Lander *et al.*, 1987), and to estimate the percentage of the total phenotypic variance explained by each QTL. A threshold of LOD > 1.5 was used test[-1] to claim the presence of a QTL.

RESULTS AND DISCUSSION

A total number of QTLs detected under different environmental condition and different season is presented in Fig 3. In general identified QTL can be classified in two types, first type represent major gene that affect quantitative traits, which are detected with large LOD score (>10). The second types include most of QTL identified in rice, which have relative small effect. In this study, 2 QTLs were identified and had small phenotypic effect and LOD score of <10 this is expected as a different characters are under different genetic control and depend on its complexity along with variable level of QTL X E interaction. This is in agreement with the Li *et al.*, (1999) who reported that more than 80 per cent of loci identified in rice are of this type. Number of QTLs identified in this study has been reported by other workers to be present on the same chromosome. e.g. Subramaniam and Madhava Menon (1973) and Yan *et al.* (1998a) reported the QTLs on same chromosome for said traits. These QTLs, which are common, stable and if their relative contribution is also high can be the real candidate for MAS and even the map based cloning (Fig. 3). The difference in location of QTLs for various traits may be because of different cross combination used in this analysis, as the detection of QTL is based on allelic differences between parental lines, different population size, statistical threshold for detecting putative loci, the number of markers used in the analysis (Yano and Sasaki, 1997).

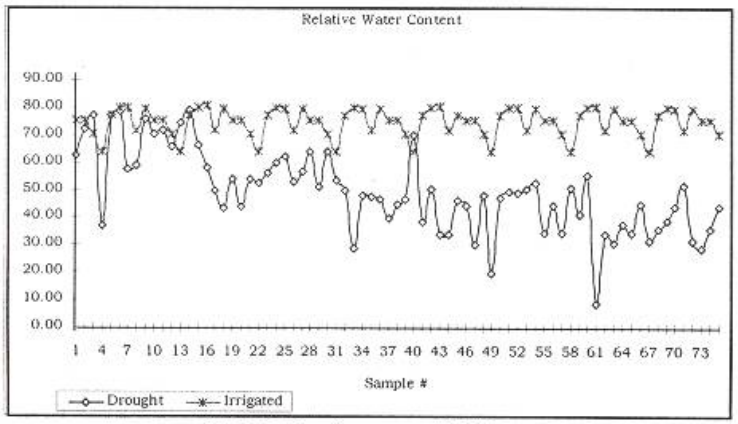


Fig 1 Field performance of DH lines

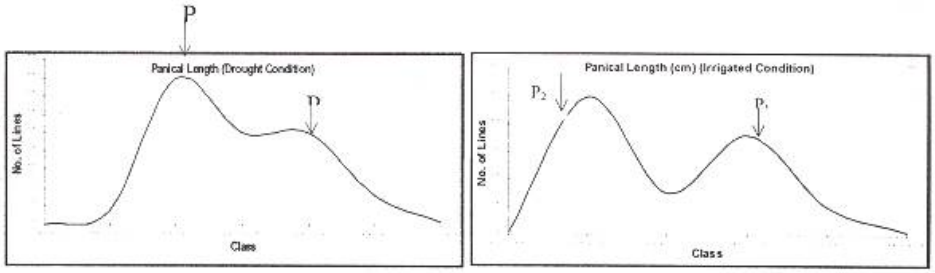


Fig 2. Frequency Distribution of DH Lines

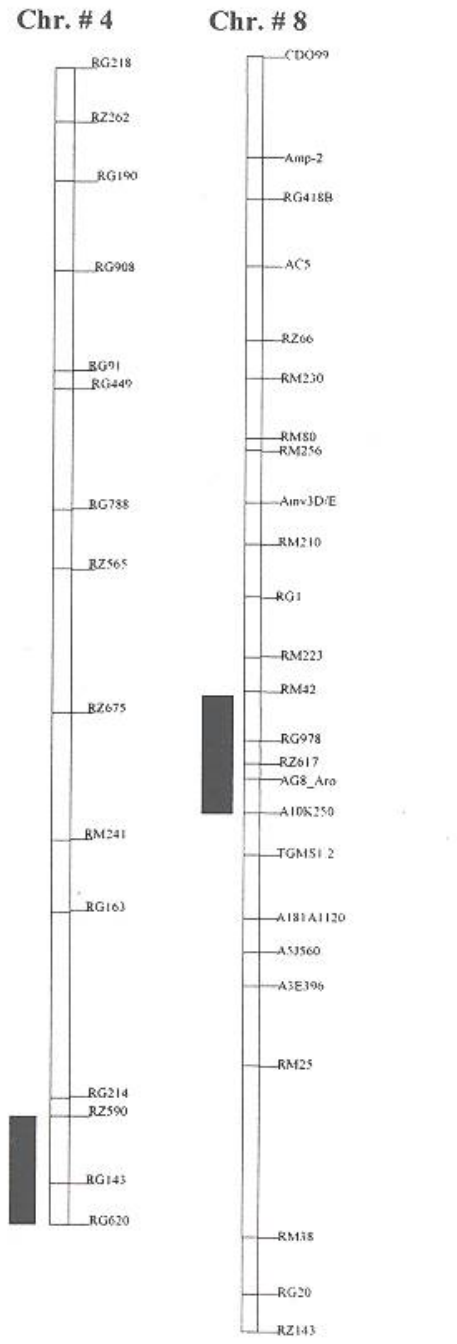


Fig. 3 Putative QTLs for Relative Water Content

Frequency distribution of DH lines

The field performance of double haploid lines were graphically presented in Fig. 1. Observations were recorded for panicle length traits on five randomly selected plants in each plot of individual genotypes, grown over two seasons and two different environmental conditions under the Randomized Compete Block Design with two replications. The distribution of individual lines for each character was graphically plotted to assist the symmetry and continuity of the distribution. The graph of DH lines along with parents for each trait is presented in Fig. 2. The segregation pattern did not follow near normal distribution. Since the characters studied in the present investigation are known to be quantitative in nature. The skewed distribution of many plant showing values close to zero was expected in *indica X japonica* crosses, which typically show high level of sterility. The population cannot be classified into discrete classes, this indicated the polygenic nature of inheritance therefore its inheritance cannot be followed through the simple Mendelian inheritance (Rao, 1953). The perfect normal distribution can be distorted by various factors like environmental interaction and different types of gene (QTL) interactions. For said trait studied in the present investigation, transgressive segregation was observed, thus the DH population exhibited greater amount of variability compared to parents Fig. 2. This also indicated that both the parents differ for their allelic composition for all the traits under study. Different types of gene interactions have been reported by Rahman *et al.*, 1981.

QTLs Analysis

QTL is segment of chromosome affecting the trait, not necessarily a single locus. The idea of using genetic markers to locate the individual quantitative trait locus responsible for variation in quantitative traits goes back nearly to the beginning of modern genetics (Sax, 1923). Recent progress in DNA markers and development of high density molecular maps of rice (Causse *et al.*, 1994) has allowed the localization of QTL and determination of relative magnitudes of their effect on the trait in rice.

Identification of QTLs for Panicle Length

For this character one QTL was identified under water stress on chromosome number 6 with LOD score of 1.6 between markers Pgi_2 - RG424 having negative additive effect and explained 11.1 per cent of phenotypic variation. However, under irrigated condition one QTL was detected on chromosome number 9 with LOD score of 2.2 between marker RM667 – RG451 having positive additive effect and explained 14.3 per cent of phenotypic variation. Maheswaran *et al.,* (2000) reported the QTLs for grain trait on chromosome # 4 and 6. The difference in location of QTLs for various traits may be because of different cross combination used, as the detection of QTL is based on different criteria e.g. allelic differences between parental lines, different population size, statistical threshold for detecting putative loci and the number of markers used in the analysis (Yano and Sasaki, 1997).

LITERATURE CITED

Causse, M. A., T. M. Fulton, Y. G. Cho, S.N. Ahn, J. Chunwongse, K. Wu, J. Xiao, Z. Yu, Ronald, P.C., Harrington, S.E., Second, G., S.R. Mccouch, and S.D.Tanksley, 1994. Saturated molecular map of the genome based on interspecific backcross population, Genetics 138 : 1251-1274.

Guiderdoni, E., E. Galinato, Luis, and G. Vergara, 1992. Anther culture of tropical *japonica x indica* hybrids of rice, Euphytica, 62 : 219-224.

Lander, E. S., P. Green, J. Abrahamson, A. Barlow, M. J. Daly, S. E. Linear and L. New Burg. 1987. Mapmaker: an interactive computer package for constructing primary genetic linkage maps of experimental and natural populations, Genet..1 : 174-181.

Li, Z. K., L.J. Luo, H.W. Mei, A.H. Paterson, X.H. Zhao, D.B. Zhong, Y.P. Zhong, X. Q. Yu, L. Zhu, and R. Tabien, 1999. A "defeated" rice resistance gene acts as a QTL against a virulent strain of *Xanthomonas oryzae* pv. *oryzae*. 1999, Mol. Gen. Genet. 261(1):58-63.

Maheswaran, M., N. Huang, S. R. Sreerangaswamy and S. R. McCouch, 2000. Mapping quantitative trait loci associated with days to 50 % flowering and photoperiod sensitivity in rice. Molecular Breeding. 6 (2): 145-155.

Rahaman, M., A. K. Patwary, and A. J. Miah, 1981. Combining ability in rice. Indian J. Agric. Sci.51 (8): 543-546.

Rao, C. R., 1953. Advanced statistical methods in Biometrical Research. John willey and son. Inc. New York : 390.

Sax, K., 1923. The association of size differences with seed-coat pattern and pigmentation in *Phaseolus vulgaris*. Genetics 8: 552-560.

Subramaniam, S and P. Madhavmenon, 1973. Genetic analysis of Quantitative characters in rice through diallel crosses. Madras Agric. J. 60,1097-1102.

Yan, J. Q., J. Zhu, C. X. He, M. Benmoussa, and P. Wu, 1998a. Quantitative trait loci analysis for the development behavior of tiller number in rice. Theor. Appl. Genetic. : 267-274.

Yano, M. and T. Sasaki, 1997. Genetic and molecular dissection of quantitative traits in rice. Plant molecular Biology. 35 (1-2). 145-153.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Performance of Onion Genotypes Under Akola Conditions

Y.D. Sonawane[1], N.D. Jogdande[2] and T.S. Deshmukh [3]

ABSTRACT

The present investigation was conducted during the *Rabi* season of 2004-2005 at farmer's field at Chandur, Dist. Akola. An experiment was laid out in Randomized Block Design with ten genotypes and three replications. The result revealed that, among the ten varieties of onion, the variety Akola Safed recorded maximum weight of fresh bulb as well as cured bulb, diameter of bulb, total soluble solid (%) and marketable bulb yield per ha^{-1} under Akola conditions.

Onion is one of the most important bulbous vegetable crops and it is commercially grown in India from ancient times. In India, the present status of onion production is 60.40 lakh tonnes with area 3.64 lakh hectare and average productivity is 105.57 q ha^{-1} and in Maharashtra the present status of onion production is 16.2 lakh tonnes with area 92600 hectare and average productivity is 121 q ha^{-1}. Maharashtra is leading onion growing state accounting for more than 16 per cent area and 25 per cent production. In Maharashtra Nashik, Jalgaon, Ahmednagar, Pune, Sangli, Satara and Solapur are the major onion growing districts. (Anonymous, 2006). Area under onion cultivation is also increasing day by day. Very few varieties are available for cultivation in Vidarbha. Hence listing of different genotypes under local condition is essential for commercial cultivation of onion.

MATERIAL AND METHODS

The present investigation was conducted in randomized block design with ten genotypes (*viz.*, V_1-Local-1, V_2-Local-2, V_3-Local-3, V_4-Local-4, V_5-Local-5, V_6-Local-6, V_7-Kalwan Local, V_8-Chandur Local, and varieties V_9-Akola Safed and V_{10}-Agrifound Light Red) replicated thrice during the *Rabi* season of 2004-2005 on farmer's field at Chandur, Dist. Akola. The eight weeks old seedlings of uniform height from the nursery beds were transplanted at a distance of 10 cm x 10 cm in the main field on flat beds of size 3.0 x 1.5 m. Recommended package of practices were followed during experimentation to raise the crop successfully. The observations were recorded at 15 days interval on various growth parameters, yield and quality of onion bulb as influenced by different genotypes. Growth observation (viz., plant height (cm), number of leaves plant^{-1} and days required for harvesting) of the five randomly selected plants from each plot were recorded. After harvesting of the crop the post harvest observations i.e. neck thickness and diameter of bulb (cm), weight of fresh bulb and cured bulb (g), total soluble solid content (%) and yield of marketable, unmarketable bulbs. Unmarketable bolted and twined bulbs number, weight and yield of plot^{-1} were also recorded. The data were analyzed statistically as per the standard procedure.

RESULTS AND DISCUSSION

The different observations recorded on growth contributing characters (Table 1) during the course of present investigation revealed that plant height increased up to the stage 90 DAT. At the stage of 15 to 60 DAT, the plant height was not significantly influenced by the genotypes of onion. However, at the stage of 75 and 90 DAT, there were significant differences in respect of height of plant. The maximum height of plant (69.93 cm) was observed in the variety V_{10}-Agrifound Light Red while, it was minimum (58.93 cm) in genotype V_7-Kalwan Local. These result are in close agreement with the findings of Jadhav *et al.* (1990), Makwana *et al.* (1999) and Mohanty *et al.* (2000) at different places with different varieties in onion crop. The number of leaves plant^{-1} (cm^2) were not significantly influenced by the genotypes of onion upto the 60 days stage after transplanting and thereafter, it was significantly influenced by the genotypes of onion at the stage of 75 and 90 DAT (Table 2). The maximum number of leaves plant^{-1} was recorded in genotype V_1-Local-1 (19.33) and minimum in the genotypes V_4-Local-4 and V_6-local-6 (13.33). This might be due to the different varietal character of onion. Similar results were reported by Jadhav *et al.* (1990) and Mohanty *et al.* (2002) under different climatic conditions with different varieties of onion.

1. M.Sc. Student, 2. Head, Department of Horticulture, and 3. Ph.D. Scholar, Department of Agronomy, Dr. PDKV, Akola

Table 1. Plant height and number of leaves plant^{-1} as influenced by genotypes of onion

Treatments (Genotypes)	Days after transplanting											
	Height of onion plant (cm)						Number of leaves plant^{-1}					
	15	30	45	60	75	90	15	30	45	60	75	90
V_1 – Local -1	22.33	35.73	44.23	56.53	63.43	68.13	2.33	4.66	7.33	9.33	12.66	19.33
V_2 – Local -2	22.36	36.63	43.86	55.43	60.43	67.26	2.66	4.33	7.66	10.00	12.00	14.66
V_3 – Local -3	21.33	36.90	43.83	54.40	60.76	64.93	3.00	5.00	7.00	9.66	12.00	14.33
V_4 – Local -4	22.66	34.46	42.46	56.33	62.23	61.56	2.33	4.66	7.66	10.33	12.33	13.33
V_5 – Local -5	22.40	37.73	44.26	56.53	62.83	65.60	2.66	4.33	6.66	10.66	13.00	14.00
V_6 – Local -6	21.80	35.36	43.60	54.43	59.76	60.60	3.33	3.66	7.66	9.66	11.66	13.33
V_7 – Kalwan Local	21.70	35.93	43.46	54.73	60.93	58.93	2.66	4.66	7.66	10.33	12.33	15.00
V_8 - Chandur Local	22.20	34.63	43.60	53.30	60.13	60.90	2.60	4.33	7.33	10.00	12.66	14.33
V_9 - Akola Safed	22.36	33.40	43.08	57.26	65.66	68.30	2.00	4.00	7.33	11.00	13.33	16.33
V_{10} - Agrifound Light Red	22.70	35.26	43.30	56.40	66.23	69.93	3.00	3.66	7.00	10.33	13.66	15.66
SE (m)±	0.452	1.262	0.54	1.08	1.064	1.77	0.38	0.41	0.56	0.76	0.51	0.76
CD at 5%		—		—	2.98	4.97		—		—	1.45	2.1

Table 2. Neck thickness, height, diameter, weight of fresh, cured bulb and total soluble solid content of bulb as influenced by the genotypes of onion

Treatments (Genotypes)	Neck thickness of bulb (cm)	Height of bulb (cm)	Diameter of bulb (cm)	Weight of fresh bulb (g)	Weight of cured bulb (g)	Total soluble solid of bulb (%)
V_1 – Local -1	0.76	4.56	5.50	86.46	74.40	9.43 (3.07)
V_2 – Local -2	0.70	4.26	5.56	87.40	73.96	8.53 (2.92)
V_3 – Local -3	1.10	4.73	5.73	93.53	86.26	9.03 (3.00)
V_4 – Local -4	0.80	4.50	5.13	77.33	63.30	7.96 (2.82)
V_5 – Local -5	1.23	4.26	5.60	86.60	71.20	8.63 (2.93)
V_6 – Local -6	0.73	4.36	5.46	80.60	70.20	8.86 (2.97)
V_7 - Kalwan Local	0.83	4.76	5.20	80.93	68.23	9.06 (3.009)
V_8 - Chandur Local	0.76	4.06	5.43	85.93	76.50	8.73 (2.95)
V_9 – Akola Safed	0.88	4.66	6.23	109.33	100.26	9.73 (3.11)
V_{10} - Agrifound Light Red	0.86	4.23	5.13	84.60	76.26	9.63 (3.103)
SE (m)±	0.10	0.09	0.13	2.41	1.24	0.151
CD at 5%	0.28	0.26	0.37	6.77	3.50	0.426

* Figures in parentheses indicates square root transformation

Table 3 : Number and weight of bolted, twined onion bulb; marketable and unmarketable yield of onion as influenced by the genotypes of onion

Treatments (Genotypes)	Weight of bolted onion bulb (g)	Weight of twined onion bulb (g)	No. of bolted bulb ha^{-1}	No. of twined bulb ha^{-1}	Weight of bolted bulb ha^{-1} (kg)	Weight of twined onion bulb ha^{-1} (kg)	Marketable yield plot^{-1} (kg)	Unmarketable yield plot^{-1} (kg)	Marketable yield ha^{-1} (q)	Unmarketable yield ha^{-1} (q)
V_1 – Local -1	79.60	73.90	3653.00	3663.00	106.06	287.54	17.50	1.46	480.76	40.26
V_2 – Local -2	60.33	80.30	6410.25	7326.00	142.16	602.46	10.43	2.21	286.62	60.71
V_3 – Local -3	98.30	87.20	7326.00	4578.75	262.16	402.06	17.63	1.08	484.42	30.21
V_4 – Local -4	80.80	76.20	1831.50	1831.50	53.50	137.72	15.26	1.03	419.41	28.38
V_5 – Local -5	63.13	76.23	2747.25	8241.75	63.13	492.12	14.33	2.05	393.77	56.31
V_6 – Local -6	81.33	78.20	9157.00	2747.25	271.40	358.97	15.50	1.63	425.81	44.86
V_7 - Kalwan Local	76.33	78.90	3663.00	5494.50	100.53	574.01	12.31	1.51	338.36	41.66
V_8 - Chandur Local	73.73	85.56	4578.75	6410.25	122.00	309.31	13.41	1.58	368.58	42.12
V_9 -Akola Safed	85.06	83.86	2747.25	3663.00	85.06	144.96	18.91	1.39	519.68	38.31
V_{10} -Agrifound Light Red	81.90	78.16	1831.50	1831.50	55.50	155.43	18.08	0.89	496.79	24.71
SE (m) ±	1.65	1.28	847.03	1217.17	24.60	105.00	0.93	0.64	14.33	4.51
CD at 5%	4.64	3.61	2379.00	3418.60	69.09	294.90	1.51	1.54	41.66	12.68

The diameter, height, neck thickness, weight of fresh and cured bulb and total soluble solid content (%) of bulb were significantly influenced by the genotypes of onion (Table 2). The maximum diameter of bulb was recorded in the variety V_9-Akola Safed (6.23 cm), followed by the genotype V_3-Local-3 (5.73 cm), whereas, the genotype V_4-Local-4 and variety V_{10}-Agrifound Light Red recorded minimum diameter of bulb (5.13 cm) and found to be at par with the genotypes V_7-Kalwan Local (5.20 cm), V_8-Chandur Local (5.43 cm), V_6-Local-6 (5.46 cm) and V_1-Local-1 (5.50 cm). Significantly maximum height of bulb was recorded in the genotypes V_7-Kalwan Local (4.76 cm) which was at par with the genotype V_3-Local-3 (4.73 cm), while, it was minimum in the genotype V_8-Chandur Local (4.06 cm). This might be due to the different varietal character of onion. Similar result using different varieties of onion were reported by Jadhav *et al.* (1990) and Mohanty *et al.* (2002). The genotype V_2-Local-2 recorded minimum neck thickness of bulb (0.70 cm). The differences in the neck thickness are due to the different genotype character of onion. These results are in close agreement with the finding of Mohanty *et al.* (2000). The maximum weight of fresh bulb was recorded in the variety V_9-Akola Safed (109.33 g) while it was minimum in the genotype V_4-Local-4 (77.33 g). As regard the weight of cured bulb the variety V_9-Akola Safed recorded the maximum (100.26 g) weight of cured bulb, however it was minimum in the genotype V_4-Local-4 (63.30 g). Similar results were reported by Jadhav *et al.* (1990). Total soluble solid (%) of onion bulb was recorded maximum in the variety V_9-Akola Safed, followed by the variety V_{10}-Agrifound Light Red (9.63%), whereas, it was minimum in the genotype V_4-Local-4 (7.96%). The average weight of bolted and twined bulb was significantly maximum in the genotype V_3-Local-3 (98.30 g and 87.20 g) and it was minimum in the genotype V_2-Local-2 (60.33 g and 73.90 g). Significantly minimum number of bolted and twined bulb was recorded in genotype V_4-Local-4 and variety V_{10}-Agrifound Light Red (both 1831.50 bulb ha^{-1}) that were at par with the genotype V_5-Local-5 (2747.25 bulb ha^{-1}), V_9-Akola Safed (2747.25 bulb ha^{-1}), V_1-Local-1 (3663 bulb ha^{-1}) and V_7-Kalwan Local (3663 bulb ha^{-1}). The maximum number of bolting (9157 ha^{-1}) was recorded in the genotype V_6-Local-6 found to be at par with the genotype V_3-Local-3 (7326 bulb ha^{-1}). Similar result was reported by Bhamburkar *et al.* (1986). The maximum twined bulb onion was recorded in the genotype V_5-Local-5 (8241.75 bulb ha^{-1}) which was followed by the genotype V_2-Local-2 (7326 bulb ha^{-1}). Similar results were recorded in different varieties of onion by Jadhav *et al.* (1990).

The marketable and unmarketable bulb yield plot^{-1} and per hectare of onion was significantly influenced by the different genotypes of onion (Table 5). The variety V_9-Akola Safed recorded the maximum yield of marketable bulbs ha^{-1} (519.68 q ha^{-1}) and found to be at par with the variety V_{10}-Agrifound Light Red (496.79 q ha^{-1}), and V_3-Local-3 (484.42 q ha^{-1}) whereas, the genotype V_2-Local-2 produced minimum yield of marketable bulb (286.62 q ha^{-1}). However, the variety V_{10}-Agrifound Light Red got minimum yield of unmarketable bulb (24.71 q ha^{-1}) which was at par with the genotype V_4-Local-4 (28.38 q ha^{-1}) and V_3-Loacl-3 (30.21 q ha^{-1}), whereas it was maximum in the genotype V_2-Local-2 (60.71 q ha^{-1}). From the result of present investigation, it was clearly revealed that overall performance of all the genotypes under study was satisfactory. All the varieties produced yield more than 300 q ha^{-1} except V_2-Local-2 (286.62 q ha^{-1}). Similar results under different set of climatic conditions as influenced by the varieties of onion were reported by Jadhav *et. al.* (1990) and Mohanty *et. al.*, (2002).

LITERATURE CITED

Anonymous, 2006. Onion production in India. at http://www.fao.com

Bhamburkar, A. S. ; J. M. Rajput and L. V. Kulwal, 1986. Bolting in onion influenced by dates of planting, nitrogen and cultivars, PKV Res J., 10(2) : 115-116.

Jadhav, R. S.; N. N. Shinde and M. B. Sontakke, 1990. Performance of onion (*Allium cepa* L.) varieties in *Rabi* season, Prog. Hort., 22(1-4): 84-86.

Makwana, A. N.; Y. M. Pasaliya and N. N. Gajipara 1999. Effect of different levels of saline irrigation water on growth and yield of some onion varieties, J. Applied Hort., 5(1-2) : 80-82.

Mohanty, B. K.; M. M. Hossain and A. M. Prusti 2000. Varietal assessment on common onion for horticultural fruits during *Kharif* season. The Orrisa J. Hort., 28(2) : 8-11.

Mohanty, B. K.; M. M. Hossain and A. M. Prusti 2002. Performance of onion cultivars in *Kharif* season, Advances in Plant Sci., 15(2) : 603-606.

PKV Res. J. Vol. 33 (2) : 2009

Development of Power Operated Grass Cutter

S. H. Thakare[1], A. A. Deogirikar[2], A. N. Banwade[3] and A. B. Bhinge[4]

ABSTRACT

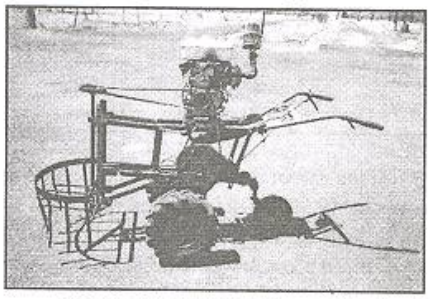
A Power Operated grass cutter was developed in the Department of Farm Power and Machinery, Dr Panjabrao Deshmukh, Krishi Vidyapeeth, Akola. A petrol start, kerosene run, Honda make, 3.6 hp (1200 to 3600 rpm) engine was used as prime mover. The cutting blade was operated at 1200 rpm and the forward speed was kept 2.5 km/h with engine through V-belt and pulley assembly. The machine could cut the grass of 1.5 mm average stem diameter at 52 mm height from ground level with 0.0954 ha h^{-1} field capacity and 84.8 per cent field efficiency. The fuel consumption of the machine was 0.66 lit h^{-1} (kerosene) and 0.1 lit h^{-1} (petrol). The operational cost of the machine was calculated to be Rs 242 day^{-1} of 8 h.

India is an agricultural country where most of the population is engaged in the farming occupation. Farmers put their intensive efforts for the maximum returns from their field, which could be achieved only by timely operation and proper utilization of machinery. The most common problem encountered by the farmers throughout the country is control of weeds. The weeds interfere with the agricultural operations, increase labour cost, add - to the cultivation cost and reduce crop yield (Anonymous, 2001). In India, farmers have to spend a big share of cultivation cost on weed control using manual methods. Labourers hired on per day basis instead of area basis makes the operation lengthy. Also these manual methods are time and labour consuming. Keeping these facts in consideration, an engine operated walking type grass cutter was designed, developed and successfully tested in field.

MATERIAL AND METHODS

A 30 cm diameter 'S' shaped blade with two sharp cutting edges was designed for the cutter. Width of cut(is)can be used for interculture operation in the row crops.

The available rotational speed at the engine shaft was 1200 to 3600 rpm that could be changed with the throttle provided on the engine. For maximum torque at full throttle, the engine was operated at 2000 rpm and the cutting blade at 1200 rpm. The speed reduction was achieved by designing V-belt and pulley assembly (Khurmi, 1984). With this rotational speed of blade, the peripheral speed of the blade obtained was 18.85 m/s^{1}, which was in the range of critical speeds; this could reduce energy required for cutting grass(Anonymous, 1977). From same engine pulley, a drive was provided to the ground wheel. A rear wheel was designed so as to steer or turn the grass cutter easily.



The grass cutter (Fig 1) was tested on the field of College of Agril Engg and Technology, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The standard procedure was followed to evaluate its performance. It was operated at an average forward speed of 2.5 km h^{-1} the average moisture content, diameter, height and cutting height above ground level of grass was 1.42 mm, 850 mm and 55.3 mm respectively. The performance of the cutter was compared with other methods of grass cutting.

RESULTS AND DISCUSSION

The forward bending of the dwarf stems (below 480mm height) which were not fully matured and were yet green could not be cut due to push developed by implement and hence were escaped from cutting unit. Similarly extra long grass (about 1500 mm) escaped from cutting unit.

1&2. Assistant Prof., and 3 & 4. B. Tech Students, Department of Farm Power Mechanery, Dr PDKV, Akola

Table 1 Operational costs for different grass cutting devices.

Grass cutting devices	Dao	Local Sickle	Maharashtra Sickle	Long handle slasher	Hand held bush cutter	Power tiller attached rotary cutter	RC grass cutter	Dr PDKV grass cutter
Operational cost, Rs ha^{-1}	1400	1050	980	728	547	455	278	242

Energy required for grass cutting with developed grass cutter was 10.2 man-h (20 MJ), which was lowest amongst other methods for grass cutting

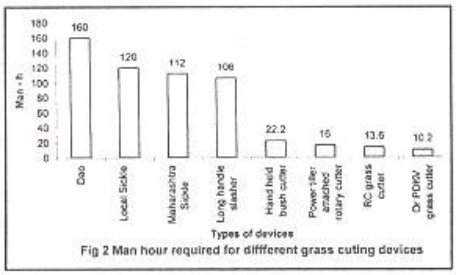


Fig 2 Man hour required for diffferent grass cuting devices

At the end of the row, the implement took on an average 19.33 s. This could be reduced with practice or skill of the operator. The actual field capacity of the implement was found to be 0.0954 ha h^{-1} (Fig. 3)

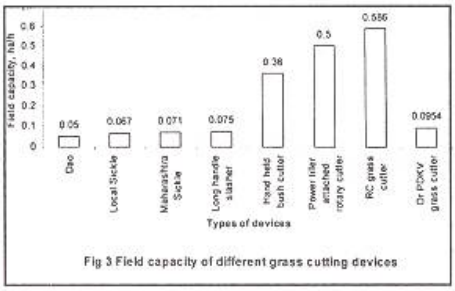


Fig 3 Field capacity of different grass cutting devices

The implement could cut the grass with 87.39 per cent cutting efficiency and 84.8 per cent field efficiency when operated with 2.5 km h^{-1} forward speed. The field performance index of the implement calculated to be 85.98, which is quite acceptable.

As the engine was petrol start and kerosene run, on average, petrol requirement was 0.1 lit h^{-1} (1.04 lit ha^{-1}) and kerosene was 0.66 lit h^{-1} (7 lit ha^{-1}). Its cost of operation was calculated to be Rs 30.25 h^{-1} (Rs 242 ha^{-1}) considering wages of operator as Rs 50 day^{-1} of 8 h which was observed to be the lowest compared to the other methods of grass cutting (Table 1). The implement can save about 75 per cent of cost of cutting over manual method.

The implement worked satisfactorily, observed most economical, time and labour saving as compared to other local methods of grass cutting.

LITERATURE CITED

Anonymous, 2001. Design and development of power operated grass cutter, B.Tech Thesis (Unpub), College of Agril. Engg and tech., Dr. PDKV, Akola

Khurmi R.S., 1984. Strength of materials, S. Chand and Co., New Delhi.

Anonymous, 1977. Studies on cutting force requirement for harvesting of wheat, M.Tech. Thesis (Unpub.), IIT, Kharaghpur.

❖ ❖ ❖

PKV Res. J. Vol. 33 (2) : 2009

Adoption Behaviour and Impact of Watershed Development Programme on Tribals in Melghat Area

M. K. Rathod[1] and P. O. Ingle[2]

ABSTRACT

The study was conducted in Dharni tahsil of Melghat. From 20 selected watershed villages 300 *Korku* tribals were interviewed. For the evaluation of watershed programmes, soil and water conservation practices were ranked with the help of judges. Ranked score was calculated and then converted into index. In the study area of Melghat, majority of tribal respondents i.e. 73.00, 78.00 and 89.67 per cent had low level of knowledge, moderate to highly favourable attitude and extremely low level of adoption of soil and water conservation practices, respectively. After implementation of watershed development programmes, knowledge of *Korku* tribals was increased by 107.60 per cent, but only 42.60 per cent increase in adoption of SWCPs was recorded. Average increase in knowledge and adoption of *Korku* tribals about watershed practices in the area of NWDPRA was comparatively more than the tribals of IWDP area.

Melghat is a scheduled area of Maharashtra State and main residents of this area are *Korku*- a Scheduled Tribe community. In Melghat area nearly 75 per cent population is tribals who are mainly engaged in the rainfed agriculture. Average rainfall of this area is 1000 to 1350 mm, which is erratic in nature and unevenly distributed. Despite of sufficient rainfall, *Korku* farmers are not able to achieve the required crop productivity because; they are unable to use desired quantity of rain water as they have very low level of knowledge about soil and water conservation practices. Continuous soil erosion since last several years have left the soils poor. It needs to rehabilitate by conserving soil and water for sustainable tribal agriculture. The govt. made sincere efforts in this direction by implementing the watershed development programmes in Melghat area. Expecting the benefits of watershed programmes, present study was emphasized on adoption behaviour of tribal farmers about watershed practices.

MATERIAL AND METHODS

The present study was conducted in Dharni *Panchayat Samiti* of Melgat, District Amravati (M.S.). From the locale of study, 20 watershed villages were selected purposively on the basis of maximum physical work done and maximum expenditure targets achieved and the overall coverage of different activities. From all the selected villages, 15 tribal farmers from each village were randomly selected. In total, 300 tribal farmers were selected and personally interviewed.

On the basis of judges' response, soil and water conservation practices were listed and ranked according to the importance of practices. Then weightage of individual of practice was determined by using the formula developed by Dhanorkar (1998). It was then converted into knowledge and adoption index.

RESULTS AND DISCUSSION

Distribution of respondents according to knowledge, attitude and adoption about soil and water conservation practices.

a) Extent of knowledge

It is observed that 67.28 per cent small farmer respondents had low knowledge level about soil and water conservation practices (Table 1). In medium farmers group, majority of the respondents (87.30%) had low level of knowledge. Similarly, majority of the large farmer respondents i.e. 73.33 per cent had low level of knowledge about soil and water conservation practices recommended through WDP. Land holding of respondents was significantly associated with the extent of knowledge about SWCPs ($X^2 = 10.81$ significant at 0.05 level of probability).

1. Assistant Prof. of Extension Education, Agriculture College, Nagpur. and 2. Ex-Head Department of Extension Education, Dr. PDKV, Akola.

Table 1. Distribution of respondents according to extent of knowledge about soil and water conservation practices

S. N.	Knowledge level	Respondents							
		Small farmers		Medium farmers		Large farmers		Total	
		No.	%	No.	%	No.	%	No.	%
1	Extremely low	10	06.17	03	04.76	08	10.67	21	07.00
2	Low	109	67.28	55	87.30	55	73.33	219	73.00
3	Medium	43	26.55	05	07.94	12	16.00	60	20.00
	Total	162	100	63	100	75	100	300	100
	Mean	32.93		28.04		27.79		30.62	
	SE (m) ±	0.85		0.53		0.49		0.51	

$X^2 = 10.80$* Significant at 0.05 level of probability

A comparison between different land holding farmer groups revealed that majority of the respondents had low knowledge level. The findings of Intodia *et. al.*, (1996) and Patil *et. al.*, (2000) are complementary to the present findings.

Only 20 per cent of the total respondents had moderate knowledge level about SWC. The probable reason was that the tribals of Melghat are not much interested on their own in seeking knowledge about technology of SWCPs. Rathod (1997) also found the mediocre information seeking behaviour of tribal of Ramtek tahsil. Tribals didn't involve themselves in extension activities in this regard. They are interested in only those activities, which have been traditionally shaded. Pulamte and Babu (1992) also reported that the tribals from shifting cultivation had traditional knowledge and practices and did not believe in modern technology.

b) Attitude

It is seen from Table 2 that, most of the small farmers (47.3 and 32.10%) were observed in moderately favourable and moderately high favourable attitude towards soil and water conservation, respectively. In medium farmers group, 41.27 per cent respondents were found in moderately favourable category, followed by 39.68 per cent of respondents in moderately high favourable category of attitude. In large farmers group, increase favourability in attitude towards SWCPs had been observed. Relatively higher proportion of large farmers (41.33 %) had relatively more favourable attitude. Hence, it is concluded that *Korku*

Table 2. Distribution of respondents according to attitude towards soil and water conservation practices

S. N.	Knowledge level	Respondents							
		Small farmers		Medium farmers		Large farmers		Total	
		No.	%	No.	%	No.	%	No.	%
1	Unfavourable	06	3.7	00	00	02	2.67	08	2.67
2	Less favourable	17	10.50	04	6.35	00	00	21	7.0
3	Moderately favourable	77	47.53	26	41.27	23	30.67	126	42.00
4	Moderately high favourable	52	32.10	25	39.68	31	41.33	108	36.00
5	Highly favourable	10	6.17	08	12.7	19	25.33	37	12.33
	Total	162	100	63	100	75	100	300	100
	Mean	41.43		42.53		43.95		42.29	
	SE (m) ±	0.22		0.32		0.52		0.20	

$X^2 = 25.036$** $F = 15.20$**

respondents had moderate to highly favourable attitude towards SWCPs. But, the need is to pursue the tribal farmers for adoption of these practices.

To find out the variation in the attitude of small, medium and large land holding farmers, the analysis of variance (F test) was made. F value (15.20) was found to be significant at 1 per cent level of probability. It indicates that there was significant difference in attitude of farmers with different land holdings.

The mean value further indicated that favourability of attitude was associated with the size of land holding that means the farmers with large holding had more favourable attitude towards SWCPs as compared to the medium and small farmers.

Corroborating to the present findings, Kapgate and Ingle (1990) and Kulkarni and Bhusare (1990) observed favourable attitude of *Gond* tribals and Dhanorkar (1998) has reported moderately favourable attitude of tribals towards improved agricultural practices.

c) Extent of adoption

Data in Table 3, points out that majority of the respondents i.e. 85.80, 96.83 and 92.00 per cent, among small, medium and large *Korku* respondents respectively were found to be in extremely low category of adoption of SWCPs. The plausible reason behind it might be that the *Korku* farmers still believe and practice the indigenous technology of soil and water conservation. Thus, although the method may not be most scientific still then they have been found using effective traditional practices of soil and water conservation since long time which are considered to be immaculate. Rao and Rao (1994), Ingle and Kude (1997), Dhanorkar (1998) and Patil *et. al.*, (2000) have reported extremely low level of adoption of recommended practices among tribal farmers. Their observations are complementary to the present revelation.

Extremely low adoption of SWCPs of *Korku* farmers was because, there was some fear in their mind about watershed technology being executed by the Agriculture Department. They were not so eager to get information about watershed development technology, because they didn't have proper knowledge about the advantages of new recommended watershed technologies or their traditional and conservative mind was not ready to accept the merits of modern technology of SWC. Unsuccessful execution of watershed technologies by the government agencies was also the reason of their fear, which has demotivated the tribals in some cases. Similar findings were reported by Nikhade *et. al.* (1995), Dhanorkar (1998) and Tidke (1998)

Impact of watershed development programmes on knowledge and adoption of SWCPs on tribals

From Table 4, it is seen that, before the programme mean knowledge index of small, medium and large tribal respondents was around 25, which has increased after the programme upto 112.24 per cent in case of small farmers, 97.19 per cent in marginal and 106.29 per cent in large farmers. Mean adoption index about soil and water conservation practices of the respondents at the base year was just above 20, and after programme it increased by 45.97, 34.76 and 41.88 per cent in case of small, medium and large land holding groups, respectively. Naik and

Table 3. Distribution of respondents according to extent adoption about soil and water conservation practices and allied activities

S. N.	Adoption level	Respondents							
		Small farmers		Medium farmers		Large farmers		Total	
		No.	%	No.	%	No.	%	No.	%
1	Extremely low	139	85.80	61	96.83	69	92.00	269	89.67
2	Low	23	14.20	02	3.17	06	8.00	31	10.33
3	Medium	00	00	00	00	00	00	00	00
	Total	162	100	63	100	75	100	300	100
	Mean	10.27		7.98		8.54		9.36	
	SE (m)±	0.56		0.57		0.53		0.35	

$X^2 = 14.08$ Significant at 0.01 level of probability

Table 4. Impact of watershed development programme on knowledge and adoption of SWCPs on the tribals

S. N.	Respondents	Knowledge index		% Change	Adoption index		% Change
		Mean			Mean		
		Before	After		Before	After	
1	Small farmers	25.84	54.84	112.24	20.76	30.30	45.97
2	Medium farmers	25.78	50.84	97.19	22.10	29.78	34.76
3	Large farmers	25.98	53.60	106.29	21.10	29.94	41.88
4	Total farmers	25.87	53.70	107.60	21.32	30.40	42.60

Jayaramaiah (1997) also found such increase in adoption level of marginal, small and big farmers after the implementation of WDP which made them aware about watershed activities. The increase in adoption was less than fifty per cent (42.60%). Corroborating to the present findings Nikhade *et. al.* (1995) and Ingle and Kude (1997) have indicated similar findings.

CONCLUSION

On the basis of the outcome it is concluded that *Korku* farmers had moderately high favourable attitude toward watershed development activities. Despite of that they had low level of knowledge and had adopted few soil and water conservation practices during watershed development programmes. The project was able to bring favourable impact among the tribals of Melghat. Due to the implementation of WDP, information gaining of Korku farmers about SWCPs was highly benefited, but adoption was not increased to that extent.

LITERATURE CITED

Dhanorkar, T. S., 1998. Impact of government and non-government organizations on agricultural growth of Madia tribals in Gadchiroli dist. of Maharashtra State, Ph.D. Thesis (Unpub.), Dr. PDKV, Akola.

Ingle, P. O. and N. R. Kude, 1997. Evaluation of watershed development project with reference to low and no cost soil and water conservation practices, PKV. Res. J., 21(1) : 64 - 67.

Intodia, S. L, Snehlata Maheshwari, Meena Sandhya and D. Solanki, 1996. Post harvest technology of Rajasthan, Tribal Res. Bull, 18 (2) : 35-38.

Kapgate, J. G and P. O. Ingle, 1990. Adoption behaviour of tribals, Tribal Res. Bull., 12 (2): 26-28.

Kulkarni, R. R. and M. D. Bhusare, 1990. Agricultural technology and consequent socio-economic changes among tribals, Tribal Res. Bull., 12 (1):

Naik, R. G. and K. M. Jayaramaiah, 1997. Adoption of watershed management practices and productivity levels attained by farmers in Mittemari watershed Indian, J. Ext. Educ. 33 (1& 2): 53-57.

Nikhade, D. M.; R. S. Bhople; P. S. Shinde and G. R. Bonde, 1995. Agricultural beliefs and its influence on adoption of sorghum technology by *Korku*, Tribal Res. Bull., 17 (2): 36-39.

Patil, P. G.; V. U. Borse and P. B. Kharde, 2000. Correlates of knowledge and adoption of Kokani tribal farmers, Tribal Res. Bull., 22 (1): 30-36.

Patil, P. G.; V. U. Borse and P. B. Kharde, 2000. Socio-economic status of Kokani tribe of Dhule dist., Tribal Res. Bull., 22 1(1): 1-8.

Pulamte, L. and A. Ramesh Babu, 1992. Differential trait of farmers practicing, shifting and settled cultivation, Maharashtra J. Ext. Educ., 28 (1 &2): 35-42.

Rao, P. Puma and V. Gopalkrishna Rao, 1994. Desirable agricultural technology for tribal farmers, Agril. Ext. Rev., 6 (4): 17.

Rathod, M. K., 1997. Information seeking behaviour of tribal farmers, M.Sc.Thesis (Unpub), Dr. PDKV, Akola.

Tidke, G. R., 1998. Farm communication and adoption among tribals of Melghat, Ph.D. Thesis (Unpub.), Dr. PDKV, Akola.

❖ ❖ ❖

Effect of Mineral Supplementation on Macro-Micro Mineral Profile in Goats

S.W. Mude[1], S.P. Waghmare[2], S.G. Mode[3], A.Y. Kolte[4] and N. P. Babhulkar[5]

ABSTRACT

The present investigation was carried out to evaluate the effect of mineral mixture on serum macro-micro mineral profile in pregnant goats. The overall findings of the present study showed that the supplementation of mineral mixture during advance stage of pregnancy in does improved level of serum macro and micro mineral profile and reduced post-parturient complications. Mineral mixture in diet of pregnant goat particularly during last month of gestation is essential to optimize the productive and reproductive performance of does.

The mineral requirements of goat are not being met by the forages, which are grown on the deficient soils and, therefore, need supplementation of deficient minerals through mineral mixture in the diet to meet the requirement for optimum productive and reproductive efficiency in goats. In the present experiment, the effect of mineral mixture was evaluated on serum macro-micro mineral profile in pregnant goats to overcome the reproductive problems.

MATERIAL AND METHODS

Twenty pregnant does about 120 days of gestation grazing on natural pasture and bushes were selected. All the goats were subjected for serum macro and micro mineral profile *viz.* calcium (Ca), phosphorus (P),. copper (Cu), iron (Fe), zinc (Zn), manganese (Mn) and divided into two equal groups. First group (T1) was maintained on natural pasture without supplementation of mineral mixture as a control group. Another group (T2) was supplemented with mineral mixture @ 15 g animal^{-1} once daily orally upto 60 days before natural grazing. All the animals under study were observed for post parturient complications during kidding.

Macro-minerals *viz.* Ca, P were estimated by using serum auto analyzer (Span Autochem 2011) and micro mineral profile viz. copper, iron, zinc, manganese by using Atomic Absorption Spectrometer (Varian, Specta 220) on 0 day (before supplementation) and on 30th and 60th day post supplementation. Data were analyzed by using standard statistical procedure (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

The mean serum macro and micro mineral profile in control and mineral supplemented group at '0' day (before supplementation) and 30th & 60th day of post supplementation is presented in Table 1.

Table 1 : Serum macro-micro mineral profile in mineral supplemented and non supplemented group.

Parameters	Groups	'0' day	30th day	60th day
Ca	T1	7.11±0.12	7.00±0.29	7.48±0.12
	T2	7.06 ± 0.06	8.46±0.37	9.54±0.31
P	T1	3.70±0.06	3.27±0.07	3.96±0.15
	T2	3.75±0.04	3.44±0.07	5.33*±0.27
Zn	T1	0.57±0.05	1.08±0.12	1.46±0.14
	T2	0.60±0.06	1.32±0.15	1.94±0.22
Cu	T1	0.83±0.01	0.79±0.08	0.59±0.06
	T2	0.89±0.03	1.14±0.05	1.05*±0.03
Fe	T1	0.96±0.04	1.13±0.09	1.91±0.22
	T2	0.95±0.06	1.58±0.17	2.41*±0.20
Mn	T1	0.045±0.003	0.068±0.004	0.084±0.007
	T2	0.046±0.004	0.066±0.005	0.164±0.084

* indicates significant difference between different periods within the groups.

1. M.V.Sc. Student, 2 & 3. Associate Prof., 4. Professor, Department of Medicine, P.G.I.V.A.S., Akola and 5. Livestock Development Officer, Akola

The levels of serum calcium recorded in the present study were lower as compared with the normal serum calcium level documented by Dhok (1999). The findings of present study showed deficiency of calcium in pregnant does. The deficiency of calcium in pregnant does could be attributed to inadequate dietary source of Ca during pregnancy.

It is apparent from the Table 1 that serum Ca level persistently showed improvement in supplemented group. This variation might be due to availability of calcium through mineral mixture supplementation to this group during late pregnancy and lactation in goats. Similar improvement in serum calcium level was also observed by Bhoshale (2005) after supplementation of mineral mixture during late pregnancy and lactation.

The mean serum inorganic phosphorus level in pregnant does before initiation of treatment were 3.70 ± 0.06 and 3.75 ± 0.04 mg/dl in control and supplemented group, respectively indicating slightly lower level of serum inorganic phosphorus in pregnant does when compared with normal serum inorganic phosphorus level stated by Prasad (1996), Jain *et. al.*, (2000) and Bhoshale (2005). The decrease in serum inorganic phosphorus level in pregnancy could be attributed to deficiency of phosphorus in forage indicating need for supplementation of phosphorus during late pregnancy in goats. Bhoshale (2005) opined that the demand of phosphorus for fetal organogenesis in late gestation and draining through milk during early lactation might be the cause of low serum phosphorus level during late pregnancy.

It is also evident from the Table 1 that the mean serum inorganic phosphorus level of control (3.96 ± 0.15) and supplemented group (5.33 ± 0.27) at 60th day were highly significant ($P < 0.01$) indicating improvement in the level of serum inorganic phosphorus in T2 group at the end of experiment.

The average serum zinc concentration in pregnant does at '0' day (before supplementation) was 0.57 ± 0.05 and 0.60 ± 0.06 ppm in control and supplemented group, respectively. The serum levels of zinc observed in this study were lower than those reported by Jain *et al.* (2000) and Bhoshale (2005). These findings showed deficiency of zinc in pregnant does. The lower zinc concentration in serum might be due to zinc deficiency in soil of Akola district as reported by Dhok (1999). It is suggested that there is increase metabolic need of zinc during pregnancy for normal development and growth of fetus, because zinc is thought to be involved in both chondrogenesis and in calcification process. Thus, Zinc supplementation is must in zinc deficient area.

The goats supplemented with minerals showed persistent improvement in the level of zinc on 60th day post supplemented as compared to control group. Though, the difference is statistically non-significant but higher level of serum zinc was registered in the supplemented group (T2). The findings of present investigation corroborate the finding of Sarmah *et. al.*, (2003) and Bhoshale (2005) who also observed significant improvement in the level of zinc concentration after supplementation of mineral mixture in goats.

The mean copper level in serum of pregnant does from control (0.83 ± 0.01 ppm) and mineral supplemented group (0.89 ± 0.03 ppm) was slightly lower at '0' day when compared with normal serum copper level reported by Dhok (1999) and Jain *et. al.*, (2000), The deficiency of copper during late pregnancy might be due to its low content in pasture or impairment in gut absorption by the excess of other minerals . The copper deficiency leads to lower conception rate and abortion between two and five months of pregnancy. Postnatal growth of kids retarded in copper deficiency and their requirements are not met unless supplemented (Goel, 1999).

It is evident from the Table 1 that significant difference ($P<0.01$) existed between 60th day mean serum copper level in control and supplemented group showing significantly higher level of serum copper in supplemented group than control group.

The serum levels of iron observed in pregnant does were lower than those reported by Bhoshale (2005), indicating deficiency of iron in pregnant does. The deficiency of serum iron in pregnant does might be due to its low content in pasture or forage. The findings of the present study are in agreement with findings of Dhok (1999) who also observed iron deficiency in female goats of Akola district.

In mineral supplemented group serum iron level (2.41 ± 0.20 ppm) was significantly ($P<0.01$) higher as compared to control group (1.91 ± 0.22

ppm) at the end of experiment indicating significant improvement in the level of serum iron. Similar findings were also observed by Sarmah *et. al.*, (2003).

The mean levels of serum manganese in pregnant does before initiation of treatment were 0.045 ± 0.003 and 0.046 ± 0.004 ppm in control and supplemented group, respectively. The mean serum manganese levels of 60th day were 0.084 ± 0.007 and 0.164 ± 0.084 ppm in control and supplemented group, respectively, which did not differ significantly . Though, the difference is statistically non-significant, apparently higher level was observed in mineral supplemented group as compared to control group within the experimental period.

Post-parturient complications (such as retention of placenta, mastitis, metritis, abortion, still birth etc.) observed in does of control group were higher than treatment group and can be attributed to deficient intake of nutrients mainly macro and micro mineral during late pregnancy in control group. The reduction in post-parturient complications in supplemented group might be due to supplementation of mineral mixture in late pregnancy.

From the present study, it is concluded that supplementation of mineral mixture during advance stage of pregnancy in does improved the levels of serum macro micro mineral profile and reduced the post parturient complication during kidding.

LITERATURE CITED

Bhoshale, D.S., 2005. Effect of multimineral supplementation on postparturient disease and perinatal mortality in goats. M.V.Sc. Thesis (Unpub) submitted to MAFSU, Nagpur.

Dhok, A.P., 1999. Mineral status of goats in relation to common tree leaves fed in Akola district. M.B.Sc.Thesis (Unpub), Dr. PDKV, Akola.

Goel, A.K., 1999. Role of minerals and vitamins in goat production, Dairy guide., 1 (XIX) : 30-35.

Jain, R.K., S.P. Tiwari, M.S. Chari, G.K. Dutta, R.K. Nema, R.C. Dhir and S. Rajagopal, 2000. Mineral status of local forages and their effect on blood levels of goats, Indian J. Ani. Sci., 70 (5): 521-523.

Prasad, B., 1996. Veterinary Clinical Diagnostic Technology, 1st Edn. CBS publishers and Distributors, New Delhi.

Sarmah, B.C., D.J. Kalita and D.N. Sarmah, 2003. Effect of mineral supplementation on retention and blood mineral profile of Assam local goats, Indian J. Ani. Nutri., 20 (4) : 467-470.

Snedecor, G.W. and W.G. Cochran, 1994. Statistical methods 8th Edn, IOWA State University Press, USA, Oxford and IBH Publication, New Delhi : 591.

❖ ❖ ❖

Research Note

Severity of *Colletotrichum* Blight in *Piper longum*

In Maharashtra, Pimpri (*Piper longum*) is cultivated in an area of 100-125 ha. In Akola-Amravati region farmers are cultivating a particular race of *Piper longum* L. *Colletotrichum* is a major disease causing organism in *Piper longum*. It attacks the leaves and berries, in leaves the infection is confined to leaf blade and may occasionally extended to leaf sheath. Elliptical to oblong spots of variable size appears on both the surface of leaves but more on the upper surface. In case of severe infection, most of leaves may dry up, presenting a bad appearance in the field. In such cases the loss may be more than 50 per cent (Ramkrishnan, 1954). The pathogen is also observed on stem and berries of *Piper longum*. A survey was conducted around Akot and Anjangaon tahsils during August to December 2007, to know the incidence and intensity of *Colletotrichum* blight of *Piper longum*. Fifteen Pimpri fields were selected from each tahsils and from each fields, 15 plants were selected randomly for the observations viz; Average No. of leaves, branches and berries per vine and Per cent disease incidence and intensity on leaves stem and berry.

The infection of leaves was rated in 0-4 scale as given in Annual Report of All India Co-ordinate Research Project on Betelvine (1988).

Table 1: Survey for *Colletotrichum* blight incidence and intensity on leaves, stem and berry of *Piper longum* in Akot tahsil

Plant part	Leaves			Stem or branches			Berry or fruit	
Month	Average No. of leaves/ vine	Per cent disease incidence	PDI	AverageNo. of branches per vine	Per cent disease incidence	PDI	Average No. of berry per vine	Per cent disease incidence
August	174.16	26.42	20.16	21.77	12.76	9.83	43.54	3.37
September	198.42	27.39	23.45	24.81	17.27	11.56	51.6	4.48
October	238.14	24.56	18.76	33.26	10.42	9.29	64.29	2.8
November	243.53	24.19	17.34	34.02	7.81	6.53	58.87	2.75
December	232.84	24.07	16.29	34.79	6.95	6.68	67.49	2.93
Average	217.41	25.32	19.20	29.73	10.73	9.08	57.15	3.26

Table 2: Survey for *Colletotrichum* blight incidence and intensity on leaves, stem and berry of *Piper longum* in Anjangaon tahsil

Plant part	Leaves			Stem or branches			Berry or fruit	
Month	Average No. of leaves/ vine	Per cent disease incidence	PDI	AverageNo. of branches per vine	Per cent disease incidence	PDI	Average No. of berry per vine	Per cent disease incidence
August	126.38	24.82	20.05	18.05	10.78	7.59	31.59	3.04
September	143.62	27.12	23.22	20.51	14.86	8.48	37.34	6.10
October	138.86	23.41	16.59	19.83	9.17	5.84	34.48	2.29
November	150.78	22.96	16.28	22.46	7.24	4.67	41.12	3.40
December	154.14	21.11	15.98	22.87	6.40	4.28	40.86	2.59
Average	142.75	23.88	18.42	20.74	9.69	6.17	37.07	3.48

Foliar disease rating scale as under

Grade	Details
0	No disease spot on leaf
1	Trace (5% infected area of leaf or internodes with maximum lesion)
2	Moderate (6 to 10% infected area or internodes with maximum lesion)
3	Severe (11 to 25% infected area or internodes with maximum lesion)
4	Very severe (above 25% infected area or internodes with maximum lesion)

The survey was conducted during *Kharif* 2007, the data presented in table 1 showed that the disease was noticed in second fort night of July in Akot area and since then its severity was recorded on monthly interval up to December 2007. In August 2007 the disease incidence of 26.42, 12.76 and 3.37 per cent was observed on leaves, branches and berries respectively. Whereas the intensity of disease was 20.16 and 9.83 per cent on leaves and branches, respectively.

In September, maximum per cent disease incidence and intensity was observed. It was 27.39, 17.27 and 4.48 per cent on leaves, stems and berries respectively, while disease intensity was 23.45 and 11.56 per cent on leaves and stems, respectively. During October to December, a declined trend was noticed. In general, it is found that average number of leaves, branches and berries on *Piper longum* was 217.41, 29.73 and 57.15 and the disease incidence was 25.32, 10.73 and 3.26 per cent. On leaves and branches per cent disease intensity was 19.20 and 9.08 per cent, respectively.

It is observed from the data presented in table 2 that during the August, the incidence on leaves, stems and berries were 24.82, 10.78 and 3.04 per cent respectively while on leaves and stems the disease intensity was 20.05 and 7.59 per cent.

Maximum severity 27.12 per cent on leaves, 14.86 per cent on stem or branches and 6.10 per cent on berries or fruits with the disease intensity 23.22 per cent on leaves and 8.48 per cent on stem or branches during September. From October to December months the per cent disease incidence and intensity was comparatively less than the recorded values in September 2007. The decreasing trend was observed from October to harvest of crop as both incidence and intensity.

The average per cent disease incidence on leaves, stem and berry was 23.88, 9.69 and 3.48, respectively and disease intensity was 18.42 and 6.17 per cent on leaves and stems, respectively.

From the above results, it is cleared that the maximum disease incidence with maximum intensity on leaves, stems and berries were observed during September. From the October onwards a decreasing trend was noticed. Perhaps the reason is maximum relative humidity up to September 2007 and then subsequent decrease from October onwards.

Alam (2004) noticed that per cent disease intensity of *Colletotrichum* blight ranges from 12 to 32.4 per cent. Suseela Bhai *et al.* (1988) and Naik *et al.* (1990) also stated that disease development was in between July to September ranging 32 to 44 per cent. These observations regarding the disease severity was found to be in concurrence with the findings of the earlier workers.

LITERATURE CITED

Alam, S. 2004: Post inflectional biochemical changes due to *Colletotrichum gloeosporioides in Piper longum*. Thesis (unpub.) M.Sc. Agril. Dr. PDKV, Akola.

Naik, M. K., P. C. Hiremath and R. K. Hegde, 1990: Effect of environmental factors on the incidence of ansthracnose of betelvine. *Curr. Res.* 19 (10): 174-175.

Ramakrishnan, T. S. 1954: Leaf spot of turmeric (*Curcuma longa* L.) caused by *Colletotrichum capsici*. (Syd.) Butler and Bisby. *Indian Phytopath.* 7: 111-117.

Suseela bhai, R., J. Thomas and R. Naidu, 1988: Anthracnose a new disease of small cardamom. *Curr. Sci.* 57(24): 1346-1347.

Plant Pathology Section,
College of Agriculture,
Dr. PDKV, Akola

C. U. Patil
S. B. Bramhankar

Identification of Urdbean Genotypes Resistant Against Disease and Pests

Urdbean (*Vigna mungo* L. Hepper) is one of the important grain legumes grown in the country. In Maharashtra urdbean is grown during *Kharif* and *Summer* season. The area under crop is about 4.90 lakh hectares with an average production of about 1.97 metric tons having productivity level of 4.8 kg ha^{-1}. (Anonymous, 2007). A number of factors are responsible for low yield level, however, powdery mildew is one of the most important biotic constraints that adversely affecting its productivity. Urdbean crop is affected by more than 64 species of insect pests (Lal, 1985). Among them whitefly (*Bemisia tabaci* Genn.) has been reported to cause losses ranging from 30 to 70 per cent particularly spreading mungbean yellow mosaic virus (MYMV) in Urdbean (Marimuthu *et. al.*, 1981) key pests *viz.*, sucking pests, stem damage, defoliators and pod borers are responsible for yield reduction.

In Maharashtra, Patel and Patel (1983) reported losses caused by the pest complex of urdbean to the tune of 10 million $annum^{-1}$.

For effective chemical control measures of insect pests and diseases like powdery mildew are available but a few growers adopt them. It was, therefore, considered worthwhile to identify the sources of resistance against the major insect pests and powdery mildew disease.

Twenty nine germplasm along with check were screened against powdery mildew. Each test entry was sown in a plot of two rows of 5 meter length with powdery mildew infector-cum-spreader rows of highly susceptible check 'Kopergaon-1' after every test entries and replicated twice in RBD design. In addition, two rows of infector were planted around the experimental plot. Dusting of spores mass with severely infected plants was also done in screening nursery to create epiphytotic conditions. The disease intensity of powdery mildew was as per the formula given by Mayee and Datar (1985).

The same promising genotypes of urdbean were screened along with standard check TPU-4 against white flies, *Bemisia tabaci* Genn., *jassids*, *Empoasca* spp., pod borers, *Helicoverpa armigera*, *Spodoptera litura*, *Maruca testulalis* at Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra) during *Kharif* season 2006. The materials were sown in a two rows of 4 m length in RBD having two replications and recommended cultural practices were followed to raise the crop under pesticide free conditions.

Observations to record the incidence of white flies, *Bemisia tabaci* were taken on five randomly sampled plants at 30 days after sowing , when the pest population was at its peak. Population count of *B. tabasi* were taken with the help of split cylindrical cone (60 cm height and 45 cm diameter) which was made of wooden/ aluminum angle frame and covered with black cloth on all sides except one which was fitted with rectangular glass pane (285 cm x 585 cm) with bottom open. While taken observation the glass pane side was kept facing the sun, so that the flies could migrate to the screen. Simultaneously, the number of jassids nymphs and adults were also recorded on the glass screen. The observations on pod damage due to pod borers were recorded at harvest on five randomly sampled plants by counting the total number of healthy and damaged pods. From which per cent pod damage was calculated.

Powdery mildew :

Among twenty-nine germplasm, twenty genotypes *viz.*, TPU-4 (Check), Phule U-9228-11, Phule U-9503-2, Phule U-9403-11-1, Phule U-9417-3, Phule U-9503-3-1, Phule U-9708-6, Phule U-2003-2-6-2-2, Phule U-2003-2-0-8-1, Phule U-2003-2-2-31-2, Phule U-2003-2-68-2, Phule U-2003-2-105-2, Phule Nath, AKU-18, TAU-1, TAU-2, TAU-4, TAU-57, BDU-1, JU-86 did not show evidence of infection and gave resistant reaction (up to 10 %) against powdery mildew. Eight genotypes showed moderately resistant reaction for powdery mildew. These resistant genotypes may be utilized as a donor parents for powdery mildew.

Jassids:

. The data on surviving pest population of jassids showed that the jassids population among the test entries fluctuated from 1.0 jassids 5 $plants^{-1}$ on Phule U -2003-2-0-81 to 13.0 jassids 5

Table 1: Field reaction of urdbean entries against insect pests and disease

S. N.	Entries	Pest population 5 plants^{-1}		% Pod damage	Powdery mildew
		Jassids	White fly		
1	TPU-4 (Check)	2.5	1.5	3.63	2.50
2	Phule U-9228-11	6.0	1.0	21.38	10.00
3	Phule U-9402-1	5.5	1.0	11.79	15.00
4	Phule U-9403-1	4.0	1.5	16.44	12.50
5	Phule U-9503-2	7.5	1.5	12.79	7.50
6	Phule U-9403-3	3.0	1.5	8.29	16.25
7	Phule U-9403-11-1	10.5	2.0	10.50	5.00
8	Phule U-9417-3	8.5	3.0	23.45	10.00
9	Phule U-9503-3-1	5.0	2.5	12.59	0.00
10	Phule U-9503-8	2.5	1.5	11.84	20.50
11	Phule U-9701-10	4.5	1.5	14.25	12.50
12	Phule U-9708-6	3.5	1.0	7.22	10.00
13	Phule U-2003-2-6-2-2	1.5	2.0	10.84	6.25
14	Phule U-2003-2-0-8-1	1.0	1.0	6.38	6.25
15	Phule U-2003-2-1-10-3	2.0	2.5	18.32	13.50
16	Phule U-2003-2-116-3	4.0	3.0	6.68	18.75
17	Phule U-2003-2-2-31-2	3.5	2.0	10.08	7.50
18	Phule U-2003-2-68-2	4.5	1.5	12.86	7.50
19	Phule U-2003-2-105-2	4.5	3.5	13.04	10.00
20	Phule Nath	3.0	1.5	5.70	6.25
21	AKU-18	3.0	8.5	6.71	6.25
22	AKU-9904	10.0	0.5	23.99	25.00
23	TAU-1	11.0	2.0	10.83	8.75
24	TAU-2	13.0	6.5	7.76	7.50
25	TAU-4	8.5	2.5	12.69	8.75
26	TAU-15	5.0	3.5	10.05	10.75
27	TAU-57	6.0	3.0	16.88	0.00
28	BDU-1	5.0	3.5	14.89	10.00
29	JU-86	4.5	1.5	12.46	7.50
30	Kopergaon-1	-	-	-	90.80
	Mean	**5.17**	**2.28**	**12.19**	
	SD ±	**2.97**	**1.65**	**4.92**	

plants^{-1} on TAU -2 with the mean jassids population of 5.17 ± 2.97. The entries *viz.*, Phule U- 2003-2-6-2-2, Phule U-9708-6, Phule U-2003-2-1-10-3 found to be minimum jassids population than check TPU-4.

White fly:

The white fly population fluctuated from 0.50 pest population 5 plants^{-1} on AKU-9904 and Phule U– 9708-6 to 8.50 pest population 5 plants^{-1} on AKU-18 with the mean pest population of 2.28 ± 1.65. Five entries *viz.*, AKU-9904, Phule U -9402-1, Phule U-2003-2-0-81, Phule U -9708-6, Phule U -9228-11 found to be minimum white fly population than check TPU-4.

Pod borer damage:

The pod damage due to different pod borers among the test entries in between 3.63 per cent in check TPU-4 to 23.99 per cent in AKU-9904 with the mean pod damage of 12.19 ± 4.92 per cent. None of the genotypes found less susceptible to pod borer over check TPU-4. However, six genotypes *viz.*, AKU-18, TPU-4, Phule U-2003-2-3-2-2, Phule U 2003-2-0-81, Phule Nath, Phule U -

9708-6 found to be significantly promising against pod borers damage than mean pod damage (12.19 %) and it was at par with it; of these, only one genotypes Phule U-2003-2-0-8-1 was found to be significantly promising against sucking pests as well as pod borers in Urdbean.

LITERATURE CITED

Anonymous, 2007. Districtwise General Statistical Information of Agriculture Department (Maharashtra State), Part-II.

Lal, S.S. 1985. A review of insect pests of mungbean and their control in India, Tropical Pest Managemnent 31 (2) : 105-114.

Marimuthu T., C.L. Subramanian and R. Molina, 1981. Assessment of yield losses due to yellow mosaic infection in mungbean, Pulse Crops News Letter 1: 104.

Mayee, C. D. and V. V. Datar, 1985. Phytopathometry. Tech. Bull., 1, Marathwada Agril. Univ., Parbhani : 146.

Patel, R,K, and J. R. Patel, 1983. Crop losses due to insect pest in Gujarat State, Indian J. Entomology, Special issue, 1: 27-32.

Pulses Improvement Project
MPKV, Rahuri

G. P. Deshmukh
S.K. Patil
P.W. Harer
J.V. Patil

❖ ❖ ❖

Efficacy of Some Chemical Insecticides Against Thrips and Whiteflies on Cotton Through Seed Treatment and Stem Smearing Technique

Field efficacy of five systemic insecticides namely Thiamethoxam 70 WS, Imidacloprid 70 WS, Acetamiprid 20 SP, Thicloprid 21.7 SC and Monocrotophos 36 WSC was evaluated through seed treatment and stem smearing technique against thrips and whiteflies on cotton var. PKV – Rajat. The trial was laid out in Randomized Block Design with ten treatments and three replications at experimental field of entomology Dr. PDKV, Akola, during *Kharif* 2006-07. the crop was sown on 1sth July and emerged on 5th July. Results revealed that, the treatment Thicloprid 21.7SC (ST) proved most effective, followed by Thicloprid 21.7 SC (SS), Monocrotophos 36 WSC was most effective in lowering whitefly population, followed by Thiamethoxam 70 WS (SS), Imidacloprid 70 WS (SS), Imidacloprid 70 WS (ST) and Acetamiprid 20 SP (ST). The highest yield was recorded in the treatment with Thiamethoxam 70 WS, followed by Acetamiprid 20 SP and Monocrotophos 36 WSC.

Cotton is an important fibre and oil seed crop of India and contributing 1/3 rd of total foreign exchange earning of the country, providing 65 percent of raw material to Textile Industry (Mayee and Rao 2002). In India the area under cotton crop during 2006-2007 was 91.32 lakh ha. with a production of 27 bales and productivity 503 kg lint ha^{-1}. However, Maharashtra state occupies an area of about 31.24 lakh has under cotton crop with the production of 55 lakh bales and productivity of 299 kg lint ha^{-1} as against Indias average productivity of 503 kg lint ha^{-1}.

Among the 25 pests reported on cotton, in Maharashtra, the sucking pests especially, thrips, "*Thrips tabaci*" and whiteflies, "*Bemisia tabaci*" attained the status of economically important. Indiscriminate use of conventional insecticides through foliar applications posed several problems on environment and non-target insects. Therefore the present investigation was carried out to test the efficacy of nitroguanidine analogue insecticides viz, Imidacloprid, Thiamethoxam, Acetamiprid and Thicloprid through seed dressing and stem smearing against thrips and whiteflies .

Field experiment was conducted in Randomized Block Design with ten treatments and three replications on the field of Department of Entomology, Dr. PDKV, Akola during *Kharif* 2006 -

Treatments		Average number of thrips and whiteflies/ 3 leaves/plant	
T_1 -	thiamethoxam 70 WS @ 5g kg^{-1}	11.76(3.42)	1.39(1.18)
T_2 -	Imidacloprid 70 WS @ 10 g kg^{-1}	9.14(3.02)	1.42(1.19)
T_3 -	Acetamiprid 20 SP @ 20 g kg^{-1}	15.02(3.87)	1.44(1.20)
T_4 -	Thicloprid 21.7 SC @ 10 ml kg^{-1}	7.46(2.73)	1.59(1.26)
T_5 -	Thiamethoxam 70 WS 1:20 dilution.	14.03(3.74)	1.43(1.19)
T_6 -	Imidacloprid 70 WS 1:20 dilution	10.38(3.22)	1.45(1.21)
T_7 -	Acetamiprid 20 SP 1:20 dilution.	15.33(3.92)	1.48(1.22)
T_8 -	Monocrotophos 36 WSC 1:1 dilution	9.12(3.02)	1.35(1.16)
T_9 -	Thicloprid 21.7 SC 1:20 dilution	9.05(3.01)	1.57(1.25)
T_{10} -	Untreated control	14.32(3.78)	1.56(1.25)
	'F' Test	Sig.	NS
	SE (m) ±	0.029	0.057
	CD at 5%	0.08	0.16

2007. Thiamethoxam 70 WS, Imdiacloprid 70 WS, Acetamiprid 20 SP, Thicloprid 21.7 Sc and Monocrotophos 36 WSC were evaluated through seed treatment and stem smearing technique for their efficacy against thrips and whiteflies on cotton, var. PKV-rajat.

Weekly observation were recorded on the number of thrips and whiteflies from 7 to 77 and 35 to 77 DAE respectively, by randomly selecting five plants from each treatment plot. Three leaves each from top middle and bottom on canopy of selected plants were observed for thrips and whiteflies count. Seed treatment of test chemicals were undertaken before sowing and stem smearing was done at 20 and 40 DAE. Data of all observations was consolidated and subjected to statistical analysis for interpretation of results.

Data presented in table 1 shows that, seed treatment of Thicloprid 21.7 Sc @ 10 ml kg^{-1} was recorded least population of thrips i.e. 7.46 $plant^{-1}$ and it was significantly superior over all other treatments. Next effective treatment was thicloprid 21.7SC, 1:20 dilution (SS), and being on par with Monocrotophos 36 WSC 1.1 dilution (SS) and Imidacloprid 70 WS, 10 g Kg^{-1} (ST) with thrips population of 9.06, 9.12 and 9.14 $plant^{-1}$, respectively.

The treatment of Imidacloprid 70 WS @ 1:20 dilution was found next effective in reducing thrips population followed by Thiamethoxam 70 WS @ 5g kg^{-1} seed. Rest of the treatments did not showed significant difference over untreated control. The data on whiteflies population in different treatments presented in Table 1 was statistically non significant. However, the treatment with Monocrotophos 36 WSC 1:1 dilution (SS) recorded comparatively lower whitefly incidence (1.35 $plant^{-1}$) followed by Thiamethoxam 70 WS 5g kg^{-1} (ST), Imidacloprid 70 WS, 10g Kg^{-1} (ST).

Thiamethoxam 70 WS @ 1:20 dilution, Acetamiprid 20 SP @ 20 g Kg^{-1} (ST), Imidacloprid 70 WS, 1:20 dilution, Acetamiprid 20 SP, 1:20 dilution, Thicloprid 21.7 SC, 1:20 (SS), untreated control and Thicloprid 21.7 SC @10 ml kg^{-1}.

Allen *et. al.*, (1999) compared various insecticides for control of thrips and found that gaucho (0.2 ai $acre^{-1}$) provided high level of control of thrips.

Karakhantanal *et. al.* (2002) reported the minimum number of leaf hopes and whiteflies $plant^{-1}$ upto 40 DAG in plots treated with oxydemeton methyl 25EC 1.5 lit ha^{-1} and Imidacloprid 70 WS @ 10 g kg^{-1} seed.

LITERATURE CITED

Allen, C.T., M.S. Kharboutli, T.L.Kirkpatrick, G.M. Larnez, 1999, insecticides for thrips control Fayetteville, USA, Arkansas agricultural experiment station university of Arkansas special reprot, Arkansas agricultural experiment station (2000) no. 198: 140-145.

Karabhantanal, S.S. M. Bheemanna, B.V. Patil, 2002. Studies on the insect pest managemtn schedule against rainfed cotton varieties. J. Cotton. Res. Dev. 16 (2) : 199-202.

Mayee, C.D. and M.R. K. Rao, 2002. Current cotton production and protection scenarios including G.M. cotton. Agrolook, April-June : 14-20.

Department of Entomology
Dr. PDKV, Akola

R.B. Bhakray
S.M. Thakre
S.K. Aherkar
N.S. Satpute

❖ ❖ ❖

Effect of Scheduling of Drip Irrigation and Polythene Mulches on Okra

Okra *(Abelmoschus esculentus* L. Moench) is one of the most important vegetables grown in India. Drip irrigation can save water upto 40 to 70 per cent as well as increase the crop production to the extent of 20 to 100 per cent (Reddy and Reddy, 2003). becomes essential to give more concern for scheduling of irrigation which will help to achieve higher productivity, optimum use of water with better irrigation efficiency Plastic mulches involve spreading of polythene sheet over soil surface to conserve moisture, raise soil temperature and minimize weed growth (Thiruvelavan, *et al.,* 2001). The present investigation was, therefore, undertaken to overcome the shortage of water in the late summer season and lower temperatures in the month of Dec - Jan.

The field experiment was conducted during *Rabi*-hot weather season of 2006-2007 on lateritic soils at College of Agriculture, Dapoli. The trial was conducted in split plot design with three replications. The main plot treatments were irrigation scheduling of drip irrigation while in sub plot mulch treatments were accommodated. The soil of the experimental plot was clay loam in texture with 28.8 per cent field capacity and 14.20 per cent wilting point values. The okra variety *Arka Anamika* was sown on 13th December, 2006 with a spacing of 60 x 30 - 30, cm in paired row pattern for drip irrigation and 45 x 30 cm for check basin irrigation. The turbo-key drippers with a discharge of 3.02 Iph at 0.6 kg-cnv^2 operating pressure were used. The crop was supplied with 7 tonnes of poultry manure with 150:50:50 kg N, P and K ha^{-1}. Nitrogen was applied through urea in four equal splits at the time of sowing and 30, 60 and 90 DAS. For drip irrigation last three nitrogen doses were given through irrigation system. For check basin nitrogen doses were given as per recommendation. In addition, 50 kg P_2O_5 and K_2O ha^{-1}, supplied at the time of sowing as a basal dose by band placement in the form of single super phosphate and muriate of potash, respectively. Before sowing, the treatment wise mulches were spread in the field. The irrigation was scheduled alternate day based on pan evaporation data.

The data on mean dry matter production plant^{-1} at 30 DAS indicated that the reatment combination T_1M_3 recorded significantly superior mean dry matter production plant^{-1} over rest of the treatment combinations and was at par with treatment T_3M_3. While at 90 DAS the treatment combination T_3M_3 recorded statistically superior mean dry matter production plant^{-1} over rest of the treatment combinations.

In case of okra fruit yield, the treatment combination T_1M_3 recorded significantly superior fruit yield than rest of the treatment combinations. However, the former treatment was at par with T_2M_3, T_1M_2, T_2M_2, T_3M_3, T_3M_2 and T_5M_3. Transparent and black polythene mulch was distinctly efficient in raising the soil temperature as well as conserving the soil moisture. Black polythene mulch showed added benefit of efficient control of weeds in the crop. The highest soil temperature recorded under transparent, black polythene, straw mulch and control was 29.2, 28.3, 26.9 and 26°C, respectively during the morning hours. The temperature raised

Table 1. Mean dry matter, fruit yield, economics and water use efficiency of okra as influenced by scheduling of irrigation and mulches

Treatments	Mean dry matter plant^{-1} (g)		Fruit yield (t ha^{-1})	Input cost (Rs. ha^{-1})	Gross income (Rs. ha^{-1})	Net income (Rs. ha^{-1})	B:C ratio	Water used (ha-cm)	Water saving over check basin (%)	Water use efficiency (q ha^{-1} cm)
	At 30 DAS	At 90 DAS								
T_1M_0 - Check basin irrigation as per recommendation with no mulch	0.63	14.90	8.24	56,064	82,400	-8,647	0.90	85.00	-	0.96
T_1M_1 - Check basin irrigation as per recommendation with straw mulch	0.96	27.03	9.56	64,979	95,600	-8,034	0.92	85.00	-	1.12
T_1M_2 - Check basin irrigation as per recommendation with black polythene	2.30	44.90	26.64	77,664	2,06,400	69,522	1.50	85.00	-	2.42
T_1M_3 - Check basin irrigation as per recommendation with transparent polythene	3.43	63.76	21.69	65,979	2,16,900	91,885	1.73	85.00	-	2.55
T_2M_0 - Drip, 100 per cent of ET with no mulch	0.70	16.46	10.00	47,203	1,00,000	53.00	1.00	37.00	57	2.71
T_2M_1 - Drip, 100 per cent of ET with straw mulch	0.96	37.26	11.71	55,227	1,17,100	4,954	1.04	37.00	57	3.17
T_2M_2 - Drip, 100 per cent of ET with black polythene	1.63	55.10	18.46	68,803	1,84,600	45,589	1.32	37.00	57	5.01
T_2M_3 - Drip, 100 per cent of ET with transparent polythene	2.23	77.53	19.29	56,227	1,92,900	66,956	1.53	37.00	57	5.23
T_3M_0 - Drip, 80 per cent of ET with no mulch	0.56	15.53	10.60	47,203	1,06,000	5,053	1.05	30.00	64	3.47
T_3M_1 - Drip, 80 per cent of ET with straw mulch	0.73	32.00	10.05	55,227	1,00,500	-8,879	0.91	30.00	64	3.29
T_3M_2 - Drip, 80 per cent of ET with black polythene	1.06	46.80	18.13	68,803	1,81,300	42,639	1.30	30.00	64	5.94
T_3M_3 - Drip, 80 per cent of ET with transparent polythene	2.43	86.53	18.27	55,227	1,82,700	58,456	1.47	30.00	64	5.99
T_4M_0 - Drip, 60 percent of ET with no mulch	0.56	12.46	9.76	47,203	97,600	-1,947	0.98	24.00	71	4.02
T_4M_1 - Drip, 60 percent of ET with straw mulch	0.93	39.20	9.75	56,227	97,500	-11,379	0.89	24.00	71	4.01
T_4M_2 - Drip, 60 percent of ET with black polythene	1.26	52.70	16.05	68,803	1,60,500	25,305	1.18	24.00	71	6.61
T_4M_3 - Drip, 60 percent of ET with transparent polythene	1.46	68.66	16.18	56,227	1,61,800	41,039	1.33	24.00	71	6.66
T_5M_0 - Drip, 40 percent of ET with no mulch	0.60	17.76	7.15	47,203	71,500	-23,697	0.75	18.00	79	3.97
T_5M_1 - Drip, 40 percent of ET with straw mulch	0.76	24.43	8.82	55,227	88,200	-19,129	0.82	18.00	79	4.90
T_5M_2 - Drip, 40 percent of ET with black polythene	1.13	47.73	13.93	68,803	1,39,600	7,889	1.05	18.00	79	7.76
T_5M_3 - Drip, 40 percent of ET with transparent polythene	1.36	74.26	18.28	56,227	1,82,800	58,539	1.47	18.00	79	10.17
S. E. (m) ±	0.30	2.13	1.23	-	-	-	-	-	-	-
C. D. at 5 %	1.00	6.63	3.72	-	-	-	-	-	-	-

DAS - Days after sowing

by transparent and black polythene over the control was 3.2 and 2.3°C, respectively. The yields of okra under higher availability of soil moisture (as in case of T_1 and T2) and transparent mulch and black polythene mulch treatment and their combination was higher due to raising of soil temperature and conservation of soil moisture by reducing the evaporation from soil surface. The transparent polythene mulch also helped in reducing the attack of sucking pest like white flies, thrips, aphids during the initial stage of crop growth due to the reflection of sunlight incident upon it. It was also observed that the black polythene attracted the aphids which resulted in reduction of yields of okra in comparison with the transparent polythene mulch. The treatment T_5M_3 (Drip, 40 per cent of ET with transparent polythene) reported statistically equal fruit yield of okra due to efficient conservation of applied moisture and raising the soil temperature and saved about 79 per cent of irrigation water over the check basin and thereby recorded a highest field water use efficiency (10.17 q ha^{-1} cm).

The highest input cost of production of okra was observed by treatment combination T_1M_2, which was associated with higher cost of black polythene mulch and higher labour requirement for check basin irrigation layout used. The higher cost of black polythene was due to use of thicker film (24 micron) as against the 7 micron thickness in case of transparent polythene. The thicker black polythene was used to maintain -the opaqueness. The quantity of transparent and black polythene ha^{-1} was 60 and 240 kg ha^{-1}, respectively. The treatment combination TiMs recorded the highest net profit of Rs.91,865 ha^{-1}, followed by the treatment combination T_1M_2 of Rs.69,522 ha^{-1} and T_1M_2 of Rs.66,956 ha^{-1}. The highest B:C ratio of 1.73 was recorded by treatment combination T_1M_3, followed by T_2M_3 of 1.53. Irrigation water supplied for okra crop during entire growth period was 85.00, 37.00, 30.00, 24.00 and 18.00 ha-cm for T_1, T_2, T_3, T_4 and T_5, respectively. The water saved in T_2, T_3, T_5 and Ts treatments over the check basin was 57, 64, 71 and 79 per cent, respectively. The highest water use efficiency (10.17 q ha^{-1}cm) was recorded in the treatment combination T_5M_3 (Drip, 40 % of ET with transparent polythene). The treatment T_5M_3 (Drip, 40 per cent of ET with transparent polythene) used 24.00 ha-cm of irrigation water and saved about 79.00 per cent of irrigation water in comparison with T_1M_3 and produced statistically equal average fruit yield of okra. The irrigation water thus saved could be used to bring the additional area under cultivation, thereby increasing total productivity and water productivity in the agriculture. Similar findings were reported by Vankar (2004).

It could be concluded from the present investigation that, under ample water availability for getting the maximum yield, net profit and B:C ratio from okra cultivation, the crop may be grown with check basin irrigation as per recommendation (85 ha^{-1} cm) with transparent polythene with a water use efficiency of 2.55 q ha^{-1}cm. Under moderate availability of irrigation water, okra may be grown under drip irrigation scheduled at 100 per cent of ET (36.94 ha^{-1}cm) with transparent polythene for obtaining water use efficiency of 5.23 q ha^{-1} cm and B:C ratio of 1.53. Under limited water availability, the crop may be grown with drip and irrigation scheduled at 40 per cent of ET (17.97 ha^{-1}cm) with transparent polythene. It has recorded the highest water use efficiency of 10.17 q ha^{-1} cm with B:C ratio of 1.47.

LITERATURE CITED

Reddy, T. Y. and G. H. S. Reddy, 2003. Principles of Agronomy, Kalyani Publishers, Rajindar Nagar, Ludhiana: 378-382.

Thiruvelavan, P.; Ganesh Kumar and B. Ramaraj, 2001. Plastics in vegetable culture, Kissan World, 28(12): 39-40.

Vankar, R.R., 2004. Response of okra to micro-irrigation systems and mulches under lateritic soils of Konkan, M.Sc. (Agri.) Thesis (Unpub), Dr. B.S.K.K.V., Dapoli

Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (M.S.)

P. O. Khambal
P. P. Shinde

❖ ❖ ❖

Productivity and Quality Parameters of wheat as Influenced by Organic and Inorganic Fertilization

To increase productivity as well as quality of wheat , nutrient supply in a sustainable way is a key factor . Organic agriculture is a holistic approach based upon a set of process that lead to sustainable ecosystem , safe and nutritive food and social justice. They offer the best possible means of restoring and maintaining the productivity of soil . Therefore, the present study was undertaken to study the effect of organic and inorganic fertilizers on productivity, quality, nutrient uptake and soil fertility status after harvest of wheat .

A field experiment was carried out at Mission School Block, Central Research Station, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Rabi* 2006-07 in a randomized block design with ten treatments replicated three times .The experiment was laid down in clayey soil having pH 7.97, EC 0.52 dSm^{-1},low Available nitrogen 235.44 kg ha^{-1}, very low available phosphorus 19.80 kg ha^{-1} and medium available potassium 240.80 kg ha^{-1}. The treatments consisted of T_1-125 per cent recommended N through FYM (31.25 t ha^{-1}) + seed inoculation with biofertilizers (i.e.Azotobacter + phosphate solubilizing bacteria), T_2 - 100 per cent recommended N through FYM (25.00 t ha^{-1}) + biofertilizers, T_3- 125 per cent recommended N through vermicompost (09.60 t ha^{-1}) + biofertilizers, T_4-100 per cent recommended N through Vermicompost (07.60 t ha^{-1}) + biofertilizers ,T_5 - 125 per cent recommended N through soybean straw (16.89 t ha^{-1}) + biofertilizers, T_6 - 100 per cent recommended N through Soybean straw (13.51 t ha^{-1}) + biofertilizers ,T_7-100 per cent recommended dose of fertilizer (RDF) i.e. 100:50:50 kg N, P_2O_5 and K_2O ha^{-1}, T_8 - 75 per cent RDF (i.e. 75: 37.5:37.5 Kg N, P_2O_5 and K_2O ha^{-1}), T_9 - 50 per cent RDF (i.e. 50: 25:25 Kg N, P_2O_5 and K_2O ha^{-1}), T_{10} - Absolute control . Hundred and 125 per cent N through FYM, vermicompost and soybean straw was quantified on the basis of their nitrogen content. Soybean straw was incorporated one month before sowing with treatment of decomposing culture . Plant and soil samples were analyzed for nutrient content by following standard methods described by Jackson (1967) and Piper (1966). Plant height was recorded at the time of harvesting .Azotobacter and PSB culture was applied @ 20 g kg^{-1} seed before sowing. Available N in the soil samples was determined by alkaline permanganate method (Subbiah and Asija, 1956). To obtain protein content in grain, nitrogen determined (by Kjeldhal's method as described by Jackson, 1967) was multiplied with the factor 5.70.Starch content in grain was estimated as per the procedure described by Sadashivan and Manikram (1997).

Highest plant height was recorded with an application of 100 per cent RDF (T_2), followed by T_8 .Prasad *et. al.*, (1991) observed that application of RDF increase plant height. The highest grain yield 36.81 q ha^{-1} was recorded in T_7 which was 209.32 per cent higher over control (T 10 i.e.11.90 q ha^{-1}) and was at par with T_1,T_2,T_5 and T_6 . Likewise the highest straw yield (53.01 q ha^{-1}) was also noted in T_7 which was 203.08 per cent highest than the straw yield recorded in T_{10} (control). This was ascribed due to higher availability of nutrients at right time through added fertilizers. A significant increase in the uptake of NPK was observed (Table 1) with an application of 100 per cent RDF, followed by T_7 and T_5 over control. Similar findings in respect to uptake of NPK were also reported by Singh *et. al.*, (2006).The sufficient supply of NPK from the different sources was responsible for the significantly higher N, P and K uptake in wheat compared to control . The highest protein and starch content of 12.19 and 64.25 per cent respectively was noted in treatment T7 i.e. 100 per cent RDF. Similar trend of effectiveness in protein and starch content was reported by Anonymous (2004) and Singh and Pathak (2003), respectively.

Maximum decrease in pH and EC in soil was observed with treatment T_3.The results are in accordance with the findings of Basak *et. al.*, (1990).The after harvest soil organic carbon and available NPK status was remarkably increased (Table 2) with incorporation of FYM, followed by soybean straw and vermicompost along with biofertilizers .It was due to prevention of nutrients from oxidation and leaching , increase in microbial activity along with improvement in soil physical and chemical properties and slow release of K by FYM .Similar findings were reported by Kachroo and Dixit (2006).

Table 1. Yield, uptake of nutrients, protein and starch content as influenced by different treatments

Treatments	Plant height (cm)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Total Nitrogen uptake (kg ha^{-1})	TotalPhosphorus uptake (kg ha^{-1})	TotalPotassium uptake (kg ha^{-1})	Protein (%)	Starch (%)
T_1	67.06	14.46	20.60	44.81	04.43	51.50	11.43	60.75
T_2	64.13	13.81	20.02	41.29	03.77	50.43	11.05	60.50
T_3	76.02	20.56	30.01	66.46	06.66	74.80	11.41	62.48
T_4	71.93	19.80	29.10	63.31	06.33	71.10	11.74	62.18
T_5	68.86	15.75	22.67	46.95	04.75	54.86	11.45	61.73
T_6	64.73	14.06	20.38	42.27	03.94	49.05	11.34	61.40
T_7	82.84	36.81	53.01	143.54	14.01	142.93	12.19	64.25
T_8	77.33	32,97	47.81	127.32	11.65	123.17	12.08	63.80
T_9	73.26	29.04	42.10	109.52	09,48	103.01	11.85	63.65
T_{10}	63.80	11.40	17.49	31.42	03.09	39.05	09.40	59.21
SE (m) ±	2.39	2.05	2.95	7.30	00.74	06.88	00.09	00.01
CD at 5 %	7.30	6.11	8.76	21.70	02.22	20.45	00.27	00.04

Table 2 Chemical properties of soil as influenced by different treatments at harvest of wheat

Treatments	P^{H}	EC (dSm-^{1})	Organic carbon (%)	Available Nitrogen (Kg ha^{-1})	Available Phosphorus (Kg ha^{-1})	Available Potassium (Kg ha^{-1})
T_1	7.94	0.32	0.61	271	16.64	273.12
T_2	7.95	0.33	0.60	264	16.42	268.43
T_3	7.92	0.28	0.59	258	14.98	260.07
T_4	7.93	0.29	0.59	253	14.60	255.87
T_5	7.12	0.30	0.60	263	16.12	268.09
T_6	7,94	0.29	0.59	259	15.91	262.11
T_7	8.00	0.36	0.55	252	14.46	262.19
T_8	7.99	0.35	0.54	246	13.91	254.24
T_9	7.98	0.34	0.53	242	13.12	241.54
T_{10}	7.97	0.35	0.51	231	11.46	236.26
SE (m) ±	0.02	0.02	0.01	0.14	00.49	04.93
CD at 5 %	0.07	0.06	0.04	12.31	01.45	14.66
Initial	7.97	0.35	0.53	235.44	12.80	240.80

LITERATURE CITED

Anonymous, 2004. Report on All India Coordinated Wheat and barley Improvement project . (2) : 44-45.

Basak , R.M. , B. Laster ., K.R.F. Gautam and N.C. Dabnath, 1990. Effect of earthworm on soil fertility. Envinron. and Ecol., 8 (3) : 1065 –1066 .

Jackson, M.L. 1967. Soil chemical analysis, Prentice Hall of India, Pvt. Ltd., Delhi.

Kacharoo, D.and A.K.Dixit, 2006. Residue management practices using fly ash and various crop residue for productivity of rice- wheat cropping system under limited moisture condition, Indian J. Agro., 50. (4) : 249 - 252 .

Piper, C.S., 1966. Soil and plant analysis, Int. Sci. Publishers, Univ. Adelaide, Australia Asian, Ed.

Prasad, kamla., P. Singh and Ved prakash, 1991. Response of irrigated wheat to planting method, seed and fertilizer levels, Indian J. Agron., 26 (1) : 44 - 48.

Sadashivan,S.and A. Manikram,1997. Estimation of starch by anthrone reagent , Biochemical Method : 11-12.

Singh , R.N .and R.K.Pathak, 2003. Response of wheat (Triticum aestivum) to integrated nutrition of K, Mg, Zn, S and biofertilization , J.Indian Soc. Soil Sci. 51 (1) : 56-60.

Singh ,G., O.P.Singh, R.G. Singh , R.K.Mehta, V.Kumar and R.P.Singh, 2006. Effect of INM on yield and nutrient uptake of rice-wheat cropping system of low land of eastern U.P., Indian J. Agron.,51.(2):44-48

Subbiah, B.V. and G.V. Asija, 1956. A rapid procedure for estimation of Available nitrogen in soil, Current Sci., 25(8) : 259 - 260.

Wheat Research Unit,
Dr. PDKV, Akola

S. S. Mane
D. B. Dhumale
D.G. Kanawade

❖ ❖ ❖

Correlation Coefficient Between Soil and Plant Parameters, Nutrient Contents, Uptake, Grain and Straw Yield of Rice at Different Growth Stages

Rice production of India increased more than four fold from about 20.58 million tones in 1950-51 to about 127.60 million tones in 2000. The comparison of productivity indicates that, all India average productivity of rice is (2.96 t ha^{-1}). Maharashtra (1.63 t ha^{-1}) and Konkan region (2.48 t ha^{-1}) is far below the world average (3.70 t ha^{-1}). These figure indicate the increase in productivity which can be attributed to the use of high yielding varieties, fertilizers, irrigation, etc., and the yield potential of rice crop need yet to be augmented which at present, is in the region of 4 to 6 t ha^{-1}, depending upon the climatic condition and varieties selected. However, behavior of applied nutrient content are modified in field conditions leading to the losses due to leaching or fixation. Soil properties are modified due to submergence under rice cultivation and the nutrient composition at the time of crop growth could not be judged merely by sampling the soil before or after the crops.

An investigation entitled "Correlation coefficient between soil and plant parameters, nutrient contents, uptake, grain and straw yield of rice at different growth stages." was conducted at the main farm of the department of Agronomy, College of Agriculture, Dapoli in *Kharif*, 2000-2001. The experiment was laid out in Factorial Randomized Block Design comprising 27 treatments combinations replicated two times. The experiment was conducted on lateritic soil, acidic in nature, high organic carbon content, high available N, low in available phosphorous and available potassium. The relationship between rapid soil and plant tissue testing analysis with parameters, nutrient content, nutrient uptake and nutrient availability in soil and with the grain and straw yields of rice along with their interrelationships were studied by calculating correlation coefficients (Panse and Sukhatme, 1967).

It can be seen from table-1 that plant height had significant positive relationship with the number

Table 1 : Correlation coefficiant (r-values) between soil and plant parameters, nutrients content, uptake, grain and straw yield of rice at 30 DAT.

	No. of tillers	No.of leaves	DMP	N Content	P Content	K Content	P-Tissue test	K—tissue test	pH	EC	Organic carbon	Available N	Available P_2O_5	Available K_2O	P-soil test	K-soil test	Grain yield	straw yield
Plant height	0.506**	0.602**	0.371**	0.350**	0.357**	0.380**	0.099	0.337*	-0.368**	0.332*	-0.093	0.596**	0.108	0.092	0.364**	0.288*	0.708**	0.716**
No. of tillers		0.796**	0.221	0.200	0.291*	0.379**	-0.039	0.300*	-0.204	0.192	0.005	0.318*	0.106	0.093	0.408**	0.287*	0.413**	0.484**
No. of leaves			0.309*	0.227	0.140	0.502**	0.000	0.306*	-0.202	0.246	-0.074	0.414**	0.040	0.168	0.499**	0.253	0.518**	0.553**
DMP				-0.172	0.146	0.190	0.042	0.263	-0.294*	0.230	-0.182	0.338*	0.099	0.178	0.313*	0.308*	0.437**	0.325*
N content					0.178	0.284*	0.191	0.241	-0.079	0.187	-0.129	0.319*	0.118	0.120	0.218	0.074	0.217	0.236
P content						0.277*	-0.178	0.215	-0.303*	0.312*	-0.026	0.005	0.310*	0.068	-0.032	0.002	0.341*	0.294*
K content							-0.171	-0.033	-0.158	0.224	0.092	0.289*	0.285*	0.233	0.217	0.177	0.421**	0.362**
P-tissue test								0.479**	-0.126	0.340*	-0.013	0.278*	0.206	0.113	0.311*	0.102	0.020	0.173
K-tissue test									-0.273*	0.500**	-0.296*	0.296*	0.055	0.099	0.352**	0.142	0.331*	0.444**
pH										-0.432**	0.188	-0.221	-0.042	0.079	0.021	-0.184	-0.251	-0.233
EC											-0.073	0.423**	0.377**	0.197	0.233	0.251	0.412**	0.384**
Organic carbon												-0.204	0.201	0.145	-0.042	0.145	-0.123	-0.034
Available N													0.318*	0.057	0.625**	0.442**	0.471**	0.369**
Available P_2O_5														0.172	0.335*	0.317*	0.062	0.101
Available K_2O															0.009	0.225	0.049	-0.073
P-Soil test																0.506**	0.359**	0.348**
K-Soil test																	0.148	0.036
Grain yield																		0.758**

DMP = Dry Matter Production
ES = Electrical conductivity

* Significant at 5% level of probability
** Significant at 1% level of probability

Table 2 : Correlation coefficiant (r-values) between soil and plant parameters, nutrients content, uptake, grain and straw yield of rice at 60 DAT.

	No. of tillers	No.of leaves	No.of panicles	DMP	N Content	P Content	K Content	P-Tissue test	K—tissue test	pH	EC	Organic carbon	Available N	Available P_2O_5	Available K_2O	P-soil test	K-soil test	Grain yield	straw yield
Plant height	0.679**	0.689**	0.776**	0.571**	0.631**	0.461**	0.304*	0.327*	0.393**	-0.117	0.545**	0.276*	0.275*	0.037	0.050	0.344*	0.377**	0.762**	0.637**
No. of tillers		0.851**	0.693**	0.585**	0.452**	0.299*	0.412**	0.271*	0.329*	0.125	0.263	0.169	0.392**	0.085	0.020	0.415**	0.413**	0.602**	0.594**
No. of leaves			0.724**	0.572**	0.442**	0.240	0.381**	0.175	0.264	0.076	0.182	0.181	0.363**	0.078	-0.071	0.367**	0.307*	0.563**	0.564**
No. of panicles				0.511**	0.469**	0.286*	0.317*	0.253	0.150	-0.130	0.351**	0.178	0.311*	0.024	-0.075	0.355**	0.282*	0.548**	0.530**
DMP					0.489**	0.205	0.525**	0.295*	0.394**	0.217	0.263	0.111	0.576**	0.213	-0.205	0.458**	0.259	0.574**	0.629**
N content						0.382**	0.279*	0.177	0.401**	0.007	0.414**	0.210	0.429**	-0.045	-0.105	0.291*	0.263	0.388**	0.327*
P content							0.093	0.323*	0.213	-0.252	0.354**	-0.004	0.145	0.130	0.134	0.106	0.365**	0.480**	0.349**
K content								0.468**	0.317*	0.258	0.162	0.099	0.506**	0.197	0.105	0.364**	0.260	0.234	0.257
P-tissue test									0.131	0.081	0.182	0.081	0.487**	0.359**	-0.038	0.423**	0.289*	0.363**	0.201
K-tissue test										-0.128	0.171	0.299*	0.301*	0.080	0.280*	0.229	0.396**	0.284*	0.382**
pH											0.024	-0.291*	0.204	-0.019	-0.098	0.109	-0.101	-0.002	0.032
EC												0.026	0.145	-0.002	0.128	0.151	0.282*	0.427**	0.161
Organic carbon													0.205	0.233	0.178	0.085	0.145	0.166	0.154
Available N														0.286*	-0.053	0.650**	0.246	0.290*	0.398**
Available P_2O_5															0.084	0.507**	0.214	0.033	0.177
Available K_2O																0.152	0.261	-0.038	-0.027
P-Soil test																	0.555**	0.298*	0.311*
K-Soil test																		0.360**	0.246
Grain yield																			0.758**

Table 3 : Correlation coefficient (r-values) between soil and plant parameters, nutrients content, uptake, grain and straw yield of rice at 90 DAT.

	No. of tillers	No.of leaves	No.of panicles	DMP	N Content	P Content	K Content	% N grain	% P grain	% K grain	N Uptake	P Uptake	K Uptake	pH	EC	Organic carbon	Available N	Available P_2O_5	Available K_2O	Grain yield	straw yield
Plant height	0.566**	0.579**	0.608**	0.416**	0.521**	0.560**	0.544**	0.269*	0.354**	0.051	0.807**	0.808**	0.717**	0.229	0.382**	0.560**	0.428**	0.061	0.199	0.804**	0.647**
No. of tillers		0.431**	0.629**	0.229	0.215	0.334*	0.137	0.132	0.324*	0.320*	0.483**	0.540**	0.522**	0.262	0.367**	0.350**	0.323*	0.154	0.186	0.465**	0.523**
No. of leaves			0.789**	0.406**	0.348**	0.310*	0.342*	0.009	0.221	0.161	0.462**	0.551**	0.429**	0.177	0.265	0.287*	0.378*	0.223	0.118	0.471**	0.390**
No. of panicles				0.475**	0.451**	0.352**	0.278*	0.163	0.144	0.113	0.488**	0.504**	0.537**	0.210	0.328*	0.201	0.275	0.094	0.082	0.427**	0.500**
DMP					0.195	-0.069	0.334*	0.307*	-0.023	0.108	0.329*	0.238	0.353**	0.161	0.135	0.199	0.437**	-0.037	-0.222	0.280*	0.274**
N content						0.543**	0.414**	0.435**	0.137	-0.009	0.595**	0.433**	0.564**	0.409**	0.420**	0.347*	0.090	-0.049	-0.041	0.429**	0.503**
P content							0.349**	0.136	0.339*	0.120	0.487**	0.558**	0.519**	0.517**	0.384**	0.352*	-0.008	0.037	0.254	0.494**	0.434**
K content								0.394**	0.145	0.181	0.489**	0.378**	0.563**	0.106	0.239	0.334*	0.335*	0.203	0.187	0.342*	0.376**
% N grain									-0.009	0.087	0.373**	0.233	0.413**	0.273*	0.296*	0.250	0.266	0.112	-0.166	0.207	0.305*
% P grain										0.421**	0.272*	0.479**	0.243	0.048	0.240	0.235	0.241	0.174	0.319*	0.338*	0.280*
% K grain											0.145	0.184	0.224	0.126	0.111	-0.032	0.409**	0.443**	0.069	0.095	0.192
N Uptake												0.854**	0.894**	0.249	0.448**	0.496**	0.413**	0.129	0.057	0.903**	0.830**
P Uptake													0.791**	0.261	0.434**	0.481**	0.397**	0.092	0.130	0.930**	0.780**
K Uptake														0.236	0.389**	0.351**	0.415**	0.185	0.098	0.765**	0.928**
pH															0.322*	0.117	0.011	0.059	0.093	0.247	0.195
EC																0.393**	0.168	0.153	0.040	0.359**	0.275*
Organic carbon																	0.256	-0.096	0.141	0.470**	0.243
Available N																		0.486**	0.066	0.338	0.369**
Available P_2O_5																			0.174	-0.016	0.151
Available K_2O																				0.042	0.041
Grain yield																					0.758**

DMP = Dry Matter Production
ES = Electrical conductivity

* Significant at 5% level of probability
* Significant at 1% level of probability

of tillers, number of leaves, dry matter production, percent N,P,K content, K-tissue test, EC, available N in soil, P-soil test, K-soil test and was dependent on these parameters. The grain and straw yields of rice have also shown positive and highly significant relationship with plant height. Plant height also indicated negative highly significant relationship with pH. The numbers of tillers were positively significantly related with number of leaves, P and K content of plants, K-tissue test, available N, P-K-soil test, grain and straw yield. Tripathi and Chaubey (1996) found a highly positive significant relationship between total numbers of tillers and grain yield. Positive significant relationship of P and K – soil test with available N and P_2O_5 by and large indicated that these values are interdependent. Since under submergence most of the nitrogen is in NH_4+ forms and its behavior of fixation and release is similar to that of K such relationship between available N and K – soil test.

From the data presented in Table 2 it could be seen that the plant height of rice plant showed a positive significant relationship with number of tillers, number of leaves, number of panicles, DMP, N, P, and K content. P-tissue test, K-tissue test, EC, organic carbon, available N, P-K-soil test and also grain and straw yield. Highly positive significant relationship between number of tillers and grain yield was also reported by Tripathi and Chaubey (1996). Soil and plant parameter like N and K content, K-tissue test, available N, P-soil test, grain and straw yield showed a highly significant correlation with dry matter production (DMP). P content had positive significant relationship with P-tissue test, EC, K-soil test, grain and straw yield. P-tissue test showed positive significant relationship with available N, available P_2O_5, P-soil test, K-soil test and grain yield.

AT 90 DAT (Table 3) the tissue and soil testing was not done as the crop was matured and was harvested. At 90 DAT plant height, number of tillers, number of leaves and number of panicles were found to be highly and significantly related with each other whereas, DMP was seen to be significantly dependent upon plant height, number of leaves and number of panicles. Percent N, P and K in straw determines the plant parameters like plant height, number of leaves and number of panicles were significantly correlated with each other. The percent N and P content straw were also seen to affect the percent P and K content of straw, thereby indicating existence of a particular N:K and P:K ratio in rice straw (Bhargava and Raghupathi, 1993). The uptake of N, P and K was observed to be significantly related with plant height, number of tillers, number of panicles, DMP, percent N,P,K in straw, N percent in grain and P percent.

In conclusion, it can be stated that the data presented indicated fairly good relationship amongst plant parameters, N,P,K content, N, P, K uptake, P and K-tissue test values, P and K-soil test values and grain and straw yields thereby indicating that the data obtained are consistent with the existing concepts of nutrient availability in the soil and plant growth. Further, P and K- tissue test and P and K-soil test values also correlated well with nutrient content, uptake, plant growth and ultimate grain and straw yields.

LITERATURE CITED

Bhargava, B.S. and H.B. Raghupathi, 1993. Analysis of plant material for Macro and Micronutrients edited byHLS Tandon. Method of Analysis of Soils, Plants, Waters and Fertilizers, FDCO, New Delhi : 49-82.

Panse, V.G. and P. V. Sukhatme, 1967. Statistical methods for agriculture workers. 2nd Ed. I.C.A.R., New Delhi.

Tripathi, B.N. and C.W. Chaubey, 1996. Effect of organic sources of plant nutrient in conjuction with chemical fertilizers, on the bulk density, yield and uptake of nutrient by rice. Oryza., 33 : 200-207.

Department of Soil Science & Agril. Chemistry
Dr. PDKV, Akola.

P. N. Magare
S. S. Mane

❖ ❖ ❖

Chemical Thinning of Nagpur Mandarin

Nagpur mandarin (*Citrus reticulate* Blanco) is one of the remunerative commercial fruit crops of Vidarbha region, Maharashtra state. Being a major cash crop of this region, the area under culvitation has extended over 10.46 lakh hectares. For more Monetory returns the growers use to keep the fruits on trees as much as tree bears. Randhawa (1971) reported that the tree when produced lare number of fruits exhausted partially or completely and the harvested fruits were small in size and poor in quality in Nagpur mandarin. Thus, the roots are starved resulting into deterioration of tree health (Singh *et. al.*, 1999). The optimum number of fruits as per the capacity of tree may help to achieve desired exportable quality of fruits for which thinning is necessary. The mechanical fruit thinning is tedious, more expensive and does not give desired objective. Therefore, the attempts were made to thinout heavily fruited trees of *Mrig bahar* by using grown regulators. The experiment was conducted at Regional Fruit Research Stationb, Katol during the year 2003 to 2006 on heavily fruited fifteen years' old Nagpur mandarin trees in randomized block design with various treatments. Five replications and two trees for each treatment were used. The foliar application of ethrel (150, 200, 250 and 500 ppm) and NAA (300, 350 and 400 ppm) treatments were done at pea size stage fruits and the observations were recorded on total fruit drop, fruit and physico-chemical parameters of the fruits at monthly interval and the data obtained were statistically analysed.

The data presented in Table 1 revealed that, the maximum fruit drop was noticed where NAA 400 ppm was spread (2738 fruits), followed by Ethrel 500 ppm spray (2522 fruits). This might be due to production of ethylene which produces abscission layer in fruit peduncle and finally fruit drops (Ravindrakumar *et. al.*, 1988). Brar *et. al.*, (1992) reported the effective thinning of fruits with 300 ppm of ethephon applied one week after flowering in Kinnow mandarin, supports the present investigation.

Minimum number of fruits retained on tree were recorded in treatment T7 (806 fruits) and T4 (844 fruits) respectively. The weight and diameter of fruits were found significantly increased in treatment T7 and T4 where the effectivethinning of Nagpur mandarin fruits were occurred. Total soluble solids acidity and per cent in fruits were not affected due to the application of growth regulators. Josan and Sharma (1987) support the present investigation.

Table 1. Total fruit drop, number of fruit retained, per cent fruit drop and physico-chemical analysis of fruit as influenced by different growth regulators in *Mrig bahar* of Nagpur mandarin.(Pooled mean)

S. N.	Treatments	Total fruit drop	No. of fruits retained	Fruit drop%	Fruit weight (g)	Fruit diameter (cm)	TSS%	Acidity %	TSS/ Acidity Ratio
T_1	Ethrel 150 ppm	1954	983	66.4	125.1	6.48	9.6	0.76	12.63
T_2	Ethrel 200 ppm	2244	937	70.4	130.1	6.52	9.6	0.81	11.85
T_3	Ethrel 250 ppm	2263	982	69.4	135.2	6.64	9.7	0.82	11.83
T_4	Ethrel 500 ppm	2522	844	74.5	148.8	6.88	9.8	0.80	12.25
T_5	NAA 300 ppm	2051	913	69.0	134.4	6.71	10.0	0.78	12.82
T_6	NAA 350 ppm	2051	917	69.9	146.5	6.71	9.9	0.80	12.37
T_7	NAA 400 ppm	2738	806	77.2	153.8	6.85	9.9	0.76	13.03
T_8	Control	1558	1517	50.7	116.4	5.33	9.7	0.80	12.12
	S E (m) +	94	85	2.5	2.2	0.10	0.2	0.02	0.60
	C.D. 5%	285	257	7.5	6.8	0.29	N.S.	N.S.	N.S.

LITERATURE CITED

Brar,S.S,. P.P.S. Minthas and G.S. Kundal, 1992. Chemical thinning of Kinnow mandarin, Acta. Hort., 64:1300.

Josan,J.S. and J.N. Sharma, 1987. Chemical thinning of Wilking mandarin Indian J. Hort., 44:172-176.

Randhawa.G. S., 1971. Use of plant growth regulator and gibberellins in horticulture, ICAR pubr, New Delhi.: 38-47.

Ravindrakumar, Ranvirsing and K.K. Mishra, 1988. Effect of growth regulator and urea spray on

the regulation of crop in lemon. Indian J. Hort. 45 (2): 162-66.

Singh, Parmpal; A.S.Dhatt and J.S. Randhawa, 1999. Effect of fruit thinning on starch content in twig and root bark of Kinnow mandarin, Proc. International Sym. on Citriculture held at Nagpur, 23-27 Nov., 1999 : 688-691.

Regional Fruit Research Station
Katol, Dist. Nagpur

V. R. Zade
V. P. Pardey

❖ ❖ ❖

Effect of Fertilizers on Content and Uptake of Primary Nutrients by Rice in Konkan Region

Peculiarity of rice cultivation in Konkan region is mainly its dependence upon mansoon rains. Thus, rainfed rice is the most important crop contributing towards the rice production in Konkan region. Terse (1989) pointed out that the large proportion of the lateritic soil from south Konkan are low to medium in available potassium status, whereas medium black soil from North Konkan are medium to high in available K status. Potassium deficiency limits the crop growth to lesser extent than nitrogen and phosphorus but the potassium removed by rice is always greater than the uptake of any other nutrients including nitrogen (Khanvilkar and Ramteke, 1993).

The major nutrients required by rice are nitrogen, phosphorus and potassium. Nitrogen is considered as a "King pin" in paddy fertilization due to the almost universal response by the rice to N application under most of the physiological conditions (Lindt, 1953). The present investigation entittled " Effect of fertilizers on content and uptake of primary nutrients by rice in Konkan region during the year *Kharif* 2000-2001 on the main farm of Agronomy, college of Agriculture, Dapoli, Distt. Ratnagiri. The experiment was laid out Factorial Randomized Block Design comprising 27 treatments comparisons replicated two times. The soil of experiment was lateritic, acidic in nature, high organic carbon content, high available nitrogen but low in available phosphorus and potassium. The treatmentwise plant samples collected for dry matter accumulation were used for determination of nutrient content, *viz.*, N, P and K, after recording the dry weights, the samples were ground in Willey type grinding machine and stored in plastic bags for further analysis. The samples at 30, 60 and 90 days after transplanting (DAT) were analysed for N, P and K content and uptake by rice. Plant analysis, total nitrogen (microkjeldahl method), total P and K described by Tandon (1993).

The N content of the straw as affected by various treatments (Table 1) indicated that the content of nitrogen in straw was significantly influenced by the application of N, except the N content at 30 DAT and nitrogen content in grain. The interaction N x K in straw was significant at 30 DAT and N_1K_0 combination indicated maximum N content which was significantly superior over N_0K_0, N_0K_1 and N_1K_2 but at par with remaining. Increase in the dose of N from 0 to 50 kg ha^{-1} significantly increased N content which was at par at N_2 level (100 kg N ha^{-1}). (Anonymous 1976).

The data pertaining to the periodical P concentration in rice plants as affected by various treatments are presented in Table 1 indicated that P concentration decreased with crop age. At 90 DAT, P concentration was higher in grain as compared to straw which indicated that the phosphorus is mobilized from vegetative parts and got accumulated in grains during ripening stages of crop growth (Kanwar, 1976). Progressive decline in P concentration with crop age in rice plant was reported by Zheng and Xiao (1992). However, K_1 and K_2 were at par with each other. N_1P_0, N_1P_2 and N_2P_2 indicated highest concentration of P at 60 DAT.

The potassium content of plants as affected by fertilizers (Table 1) indicated that K content of the straw by and large decreased from 30 DAT to 90 DAT. The K content goes on decreasing after 60 DAT upto harvest (90 DAT) which may be attributed to the dilution aftect. The fact that K accumulation takes place more in straw than in grain indicated that the straw is K accumulating zone of rice. P application @ 50 kg P_2O_5 ha^{-1} indicated significantly higher K content over its application @ 0 and 25 kg P_2O_5 ha^{-1}. K application @ 25 and 50 kg K_2O ha^{-1}

Table 1: Effect of application of fertilizers on content of nitrogen, phosphate and potassium in plants of rice at 30, 60 and 90 DAT

Treatment	N%				P%				K%			
	Straw				Straw				Straw			
	30 DAT	60 DAT	90 DAT	Grain	30 DAT	60 DAT	90 DAT	Grain	30 DAT	60 DAT	90 DAT	Grain
T_1 $N_0P_0K_0$	1.75	1.65	0.53	1.10	0.16	0.12	0.03	0.20	1.62	1.56	1.20	0.13
T_2 $N_0P_0K_1$	2.20	1.91	0.67	1.26	0.19	0.13	0.05	0.21	2.22	1.86	1.82	0.17
T_3 $N_0P_0K_2$	2.25	2.12	0.65	1.35	0.18	0.13	0.05	0.22	2.32	1.99	1.88	0.15
T_4 $N_0P_1K_0$	1.91	1.68	0.60	1.21	0.16	0.13	0.04	0.22	2.10	1.85	1.56	0.18
T_5 $N_0P_1K_1$	1.98	1.69	0.72	1.37	0.17	0.10	0.04	0.21	2.07	1.99	1.78	0.17
T_6 $N_0P_1K_2$	1.96	1.89	0.74	1.17	0.19	0.14	0.06	0.25	2.20	2.03	1.73	0.17
T_7 $N_0P_2K_0$	2.11	1.89	0.63	1.31	0.17	0.11	0.04	0.21	1.92	1.91	1.78	0.17
T_8 $N_0P_2K_1$	1.79	1.69	0.58	1.13	0.18	0.11	0.04	0.22	2.10	1.99	1.41	0.18
T_9 $N_0P_2K_2$	2.24	2.11	0.78	1.26	0.20	0.14	0.06	0.22	2.00	1.86	1.86	0.18
T_{10} $N_1P_0K_0$	2.23	2.11	0.84	1.35	0.18	0.14	0.06	0.23	2.20	2.03	1.63	0.16
T_{11} $N_1P_0K_1$	1.98	1.79	0.64	1.16	0.19	0.15	0.05	0.23	2.05	2.08	1.83	0.19
T_{12} $N_1P_0K_2$	2.05	2.05	0.81	1.30	0.19	0.13	0.06	0.23	2.30	2.09	1.83	0.17
T_{13} $N_1P_1K_0$	2.14	2.12	0.74	1.34	0.18	0.13	0.05	0.22	1.87	1.85	1.78	0.16
T_{14} $N_1P_1K_1$	2.21	2.15	0.74	1.33	0.18	0.13	0.04	0.21	2.17	2.03	1.88	0.17
T_{15} $N_1P_1K_2$	2.00	1.93	0.61	1.23	0.16	0.11	0.04	0.22	2.12	2.00	1.83	0.17
T_{16} $N_1P_2K_0$	2.13	2.14	0.81	1.28	0.16	0.15	0.05	0.21	2.37	1.92	1.85	0.17
T_{17} $N_1P_2K_1$	2.21	2.12	0.77	1.35	0.18	0.15	0.05	0.23	2.25	1.99	1.91	0.19
T_{18} $N_1P_2K_2$	1.86	1.77	0.67	1.20	0.20	0.13	0.05	0.25	2.22	2.12	1.61	0.19
T_{19} $N_2P_0K_0$	2.11	1.90	0.65	1.20	0.16	0.11	0.03	0.21	2.25	1.88	1.63	0.16
T_{20} $N_2P_0K_1$	2.11	1.94	0.74	1.21	0.16	0.12	0.04	0.22	2.22	2.08	1.81	0.18
T_{21} $N_2P_0K_2$	2.00	2.11	0.74	1.33	0.17	0.11	0.04	0.24	2.02	2.03	1.63	0.17
T_{22} $N_2P_1K_0$	2.14	2.13	0.77	1.38	0.18	0.14	0.04	0.20	2.22	2.12	1.80	0.15
T_{23} $N_2P_1K_1$	2.13	2.14	0.75	1.37	0.18	0.10	0.04	0.21	2.25	2.08	1.68	0.18
T_{24} $N_2P_1K_2$	2.09	2.05	0.63	1.24	0.17	0.14	0.05	0.24	1.92	1.91	1.88	0.18
T_{25} $N_2P_2K_0$	1.97	1.80	0.68	1.21	0.16	0.10	0.03	0.22	2.10	1.93	1.58	0.18
T_{26} $N_2P_2K_1$	2.09	2.10	0.67	1.35	0.18	0.14	0.05	0.24	2.27	2.10	1.84	0.21
T_{27} $N_2P_2K_2$	2.21	2.14	0.67	1.38	0.17	0.16	0.06	0.22	2.22	2.17	1.89	0.19
SE (m) ±	0.024	0.023	0.017	0.023	0.003	0.002	0.002	0.003	0.055	0.026	0.049	0.005
CD at 5%	NS	0.068	0.049	NS	NS	0.006	0.006	NS	NS	0.077	NS	NS

indicated K content of grain which was significantly superior over K_0. The results of the present study are in agreement with Pandey and Agarwal, 1991.

The uptake of nitrogen (Table 2) as affected by various treatment indicated that the increase in the supply of N alone increased its availability to plants and this together with the higher levels of P and K could ensure increased root growth and consequently facilitate better absorption. The uptake of nutrients is related to crop age of rice which increases from tillering plase onwards and decrease at harvest (Sobhana and Chandrasekharan, 1991). It could be concluded that the application of N had significant effect on N uptake, while P_2O_5 and K_2O application and interaction effects between N x P, N x K, P x K and N x P x K were not significant.The Table 2 indicated that the N application @ 50 and 100 kg ha^{-1} (N_1 and N_2) was found to increase the P uptake by rice grain significantly over its no application (N_0). However, N_1 and N_2 were at par with each other. The interaction between N x P, which was significant indicated that significantly highest P uptake was observed in combination N_1P_0 P uptake was also significantly influenced by K_2O application and N x K interaction was observed to be significant. This is probably due to the fact that under submerged conditions solubilization of P is affected and response to applied P is not found (Kanwar, 1976). The interaction effects N x P, N x K, P x K and N x P x K were not found to be significant for P uptake by grain and total P uptake. Data presents in Table 2 further revealed that more K accumulated in straw than in grain. These ranges in agreement with Wankhade and Pandrangi (1988b). The uptake of K at 50 kg N ha^{-1} was significantly higher as compared to control. While, effect of application of P_2O_5 and

Table 2: Effect of application of fertilizers on uptake of nitrogen, phosphorous and potassium (kg ha^{-1}) in plants of rice

Treatment		Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})			Potassium (kg ha^{-1})		
		Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T_1	$N_0P_0K_0$	23.82	14.31	38.13	4.32	0.80	5.13	2.81	32.41	35.22
T_2	$N_0P_0K_1$	34.91	23.98	58.89	5.81	1.78	7.59	4.71	60.52	69.91
T_3	$N_0P_0K_2$	33.31	20.09	53.41	5.64	1.54	7.19	3.85	58.13	61.98
T_4	$N_0P_1K_0$	28.98	18.35	47.33	5.26	1.22	6.48	4.31	47.72	52.03
T_5	$N_0P_1K_1$	32.68	20.61	53.30	5.08	1.14	6.22	4.11	50.97	55.08
T_6	$N_0P_1K_2$	29.66	27.69	57.35	6.33	2.24	8.57	4.31	64.75	69.06
T_7	$N_0P_2K_0$	34.87	23.37	58.24	5.58	1.48	7.06	4.52	66.04	70.56
T_8	$N_0P_2K_1$	27.76	17.17	44.93	5.40	1.18	6.58	4.42	41.76	46.18
T_9	$N_0P_2K_2$	36.45	30.46	66.91	6.36	2.33	8.69	5.20	72.63	77.84
T_{10}	$N_1P_0K_0$	34.93	26.32	61.25	7.97	2.63	10.60	5.54	71.61	77.16
T_{11}	$N_1P_0K_1$	41.71	27.07	68.79	8.26	2.11	10.38	6.83	7742	84.25
T_{12}	$N_1P_0K_2$	42.15	32.95	75.10	7.45	2.43	9.89	5.51	78.51	84.02
T_{13}	$N_1P_1K_0$	37.87	25.28	63.15	6.21	1.70	7.92	4.51	60.82	65.33
T_{14}	$N_1P_1K_1$	39.91	26.57	68.48	6.30	1.43	7.73	5.10	67.53	72.63
T_{15}	$N_1P_1K_2$	29.32	21.83	51.15	5.24	1.43	6.67	4.05	65.52	69.57
T_{16}	$N_1P_2K_0$	43.53	35.59	77.80	7.14	2.19	9.28	5.77	83.92	89.69
T_{17}	$N_1P_2K_1$	34.93	26.31	59.99	5.95	1.70	7.65	4.91	65.27	70.18
T_{18}	$N_1P_2K_2$	39.12	26.17	65.29	8.14	1.65	0.09	6.19	62.88	69.07
T_{19}	$N_2P_0K_0$	36.96	24.32	61.29	6.46	1.20	7.58	4.92	61.00	65.92
T_{20}	$N_2P_0K_1$	39.62	26.49	66.11	7.19	1.43	8.62	5.88	64.79	70.67
T_{21}	$N_2P_0K_2$	39.62	24.08	63.70	7.14	1.30	8.44	5.06	53.04	58.10
T_{22}	$N_2P_1K_0$	45.33	28.81	74.14	6.57	1.49	8.06	4.92	75.23	80.15
T_{23}	$N_2P_1K_1$	40.20	28.07	68.27	6.16	1.49	7.65	5.28	62.87	68.15
T_{24}	$N_2P_1K_2$	37.68	25.62	63.30	7.29	2.03	9.32	5.46	76.48	81.95
T_{25}	$N_2P_2K_0$	32.16	26.55	58.71	5.84	1.65	7.01	4.78	65.62	70.40
T_{26}	$N_2P_2K_1$	47.63	27.25	74.88	8.55	2.03	10.58	7.48	74.86	82.34
T_{27}	$N_2P_2K_2$	51.02	30.52	81.54	8.13	2.72	10.58	7.02	86.13	93.15
SE (m) ±		1.824	1.244	2.922	0.318	0.080	0.384	0.253	3.282	3.492
CD (P=0.05)		5.298	3.613	8.490	0.925	0.231	1.114	0.734	9.535	10.144

K_2O and interaction between N x P, N x K, P x K and N x P x K was found to be not significant. The results also indicated that rice plant absorb more K than N and P and that the absorption of K occurred even at the later stages of growth. The uptake was lowest at tillering and gradually increased to reach a maximum at harvest.

LITERATURE CITED

Anonymous, 1976. Rice IPI Bulletin – 3, Switzerland.

Kanwar, J.S., 1976. Soil fertility theory and Practice. I.C.A.R., New Delhi.

Khanvilkar, S.A. and J.R. Ramteke, 1993. Use of potassium in Maharashtra Agric. Proc. of workshop held on March 20, 1993 at KKV, Dapoli. 89 – 96.

Lindt, 1953. Rice fertilization. Rice Journal. 56 (3) : 31-32.

Pande R. and M. M. Agarwal, 1991. Indian J. Agron. 36 (4): 459 – 463.

Sobhana, S. and P. Chandrasekharan, 1991. Madras Agric. J. 78 : 9 – 12.

Tandon, H.L.S., 1993. Methods of Analysis of Soil, Plants, Water and Fertilizers, FDCO, New Delhi, India. 24-30, 58-62.

Terse, G.V., 1989. M.Sc. Agri. thesis (Unpub.) submitted to KKV, Dapoli.

Wankhade, S.G. and R.B. Pandrangi, 1988b. Ann. Plant Physiology. 2 (1): 30 – 36.

Zhang and Xiao, 1992. Indian J. Soil Sci. 77: 7-11.

Department of Agril. Chemistry and Soil Science, Dr. PDKV, Akola

P.N. Magare
S.N. Ingle

❖ ❖ ❖

Simple, Broad, Coriander Leaf type Mutant in Kabuli Chickpea

Normally, the leaves of cultivated chickpea (*Cicer arietinum* L.) are oddpinnate compound bearing pairs of leaflets placed opposite or subopposite; rarely as recorded by Howard *et al.* (1915). It is well known that several distinct agricultural types exist in *Cicer arietinum* L. with marked differences in colour, shape and sizes of their leaves, flowers, pods and seeds (Argikar, 1952). Indian chickpea, however, has been found to be more mutable than any other economic crop plant and yet new types are occasionally evinced. Number of spontaneous mutants in chickpea for different morphological characters has been reported earlier, available in the literature. Some of them are narrow leaf (Ramanujam and Singh, 1945), mutant with alternate leafler arrangement, giant type, long branches, amutant with fascicular leaflets and bold mutant (Argikar, 1952), mutant with open flower, short bushy type, thick stemed (Dahiya *et al.*, 1984) and open and small leaf mutant (Pundir and Reddy, 1998). However, very little of this variation has been utilized in plant breeding. An effort is made to describe simple, broad leaved spontaneous mutant in chickpea spotted in *Kabuli* chickpea variety '*Virat*' during the course of plant breeding and testing work.

The simple, broad leaf with typical coriander type (Fig. 1) is the peculiarity of present mutant. The mutant plant has thus a distinct morphological type. The length, breadth and leaf area (cm^2) of simple, broad coriander type mutant with parental line and standard check and the morphological features and characters of economic importance are presented in table 1 & 2, respectively. The mutant plant is erect growing measured about 23.70 inch in height (range 45-71 cm) standing on a round main stem about 9 mm in diameter which, at a height of about 2 inch from ground level, divaricates into three to four main branches on an average and several secondary branches. The leaves are simple, broad measuring about 32.5 x 14.2 mm without leaflets just like coriander type, hence designated as 'simple, broad coriander type' mutant, the another distinguishing character. Thus, this mutant has typically distinct appearance for its leaf character and can be easily identified as a distinct morphological type.

The mutant completed its 50 per cent flowering in 65 to 70 days. The flower was normal, white in colour with all the floral parts. Initially, many flowers failed to set any pod even fifteen days after flower initiation with the possibility of male sterility or so, but confirmed under 1 per cent KII stain under microscope showed full fertility. On an average, mutant bears about 21 pods, each measuring 25 x 17 mm containing one seed having creamish white colour. This type is late maturing, matures within 128 to 142 days.The cross compatibility between this mutant and some normal types and their inheritance needs to be investigated with more objectives.

Table 1: Leaf area (cm^2 $plant^{-1}$) of spontaneous coriander type mutant in kabuli chickpea.

Mutants/genotypes		Length (mm)	Breadth (mm)	Area (cm^2)
Simple, broad coriander leaf	Range	31.00 to 34.00	14.00 to 14.80	44.02 to 50.32
	Mean ± SE	32.5 ± 0.645	14.2 ± 0.189	46.15
Virat(Parental line)	Range	10.00 to 10.60	7.80 to 9.40	78.00 to 99.64
	Mean ± SE	10.40 ± 0.141	8.80 ± 0.346	9.15
PKV Kabuli-2(Standard check)	Range	10.80 to 11.00	9.20 to 9.60	101.20 to 103.68
	Mean ± SE	10.90 ± 0.058	9.40 ± 0.082	10.25

LITERATURE CITED

Argikar, G.P. 1952. Some unreported mutants in *Cicer arietinum* L., Indian J. Bot. Soc., 31:362-369.

Dahiya, B.S.; V. S. Lather, I. S. Solanki and Ram Kumar, 1984. Useful spontaneous mutants in chickpea, International. Chickpea News letter :11:4-7.

Table 2. Distinguishing morphological and agronomic characters of simple, broad, coriander type mutant , parental line and standard check in Kabuli chickpea.

Mutants/genotypes	Plant height (cm)	No. of primary branches plant^{-1}	No. of secondary branches plant^{-1}	Leaf type	Leaf area (cm^2 plant^{-1})	Days to 50 % flowering	No. of pods plant^{-1}	Pod length (mm)	Pod width (mm)	No. of seeds pod^{-1}	Maturity
Simple, broad, coriander leaf	65.5	4.0	10	Simple, broad, coriander type	46.15	65.5	21.5	2.5	1.7	1.0	136
Virat (Parental line)	47.3	5.75	12	Oddpinnate compound	9.15	60.5	18.0	2.2	1.5	1.2	118.5
PKV Kabuli-2 (Standard check)	60.2	5.50	14	Oddpinnate compound	10.25	49.3	25.0	2.3	1.8	1.3	111.0

Fig. 1:Simple, Broad, coriander leaf type mutant in kabuli chickpea

Howard, A.; G.L.C.Howard and A.R.Khan, 1915. Some varieties of Indian gram. Mem. Dep. Agric. Bot. series, 7: 213-235.

Ramanujam, S. and H. Singh, 1945. Narrow leaf-another mutation in gram, Indian J. Genet. Pl. Breed., 5: 46-50.

Pundir, R. P. S. and G.V. Reddy, 1998. Two new traits-open and small leaf in chickpea (*Cicer arietinum* L.), Euphytica, 102 (3): 357-361.

Section of Agril. Botany,
College of Agriculture, Nagpur

N.H. Sable
Vandana Kalamkar

❖ ❖ ❖

Performance of Bt Cotton Hybrids With Respect to Different Spacing and Fertilizer Levels Under Rainfed Condition in Vidarbha

Cotton is an important commercial crop grown in 9.14 m ha with production of 27.0 m bales and contributes 30 per cent of foreign exchange earning of the country (Anonymous, 2006). Cotton is predominantly a major cash crop of *(Kharif* season in Vidarbha region of Maharashtra. Cultivation of cotton is well known for the excessive consumption of pesticides for the management of insect pest. For safe and sustainable agriculture the use of pesticides should be reduced. Bt cotton hybrids which are resistant to bollworm especially for *Helicoverpa armigera* may play a key role in reducing the excessive consumption of pesticides for the control of bollworm. Bt (*Bacillus thuringiensis)* transgenic cotton (*Gossypium hirsutum* L.) is spreading rapidly in Vidarbha region.

Among the various factors affecting the productivity of cotton hybrids, plant population and nutrient requirement for every released Bt cotton hybrid need to be evaluated to realize the maximum yield potential of Bt cotton hybrids. Keeping this in View, a study was undertaken to find out the optimum fertilizer levels and spacings for new Bt cotton hybrids

The field experiment was conducted at Cotton Research Unit, Dr. PDKV, Akola during the *Kharif* season 2006-07. The experiment was laid out in split plot design with two spacings (SI - 90 x 90 and S2 - 90 x 60 cm) and three Bt cotton hybrids *Viz.*, JKCH- 99 Bt, JKCH- 666 Bt and Bunny Bt as main plot treatments and two fertilizer levels Fl -50 : 25 : 25 (100 % RDF), F2 - 62.5 : 31.25 : 31.25 N, P_2O_5 and K_2O Kg ha^{-1} (125 % RDF) as sub plot treatments, replicated thrice. The experimental field was clayey (61.2 % clay) in texture with low available nitrogen (193.8 kg ha^{-1}), Phosphorous (14.2 kg ha^{-1}) and high available potassium (427 kg ha^{-1}) with medium organic carbon content (4.13 g kg^{-1}). The sowing was undertaken in the last week of June. Half dose of nitrogen and full dose of Phosphorous, Potassium was applied at the time of sowing and remaining half dose of nitrogen was applied at 30 DAE. Systemic insecticides were used for the control of sucking pest. Seed cotton yield and yield contributing

Table 1: Seed cotton yield and yield attributes as influenced by various treatments.

Treatments	Seed cotton yield (kg ha^{-1})	No. of bolls harvested plant^{1}	Seed cotton yield plant^{-1} (g)	Boll weight (g)
I) Main Treatments	**a) Spacing (cm)**			
S_1 - 90x90 (12345)	1145	22.84	93.73	4.18
S_2 - 90x60 (18518)	1216	19.95	68.40	3.38
S.E (m) ±	19.53	0.50	1.56	0.15
C.D. at 5 %	61.55	1.55	4.82	0.56
b) Cotton hybrids				
V_1 - JKCH 99Bt	936	22.61	71.57	3.00
V_2 -JKCH 666Bt	1392	22.62	96.03	4.26
V3 - Bunny Bt	1212	18.96	75.59	4.09
S.E. (m) ±	23.92	0.61	1.91	0.18
C.D. at 5 %	75.38	1.89	5.90	0.56
II) Sub treatment	**a) Fertilizer levels (N, P_2O_5 & K_2O kg ha^{-1})**			
F_1 - 50+25+25 (100 %RDF)	1111	20.48	76.01	3.71
F_2 - 62. 5+31. 25+31. 25 (125 % RDF)	1249	22.31	86.11	3.86
S.E. (m) ±	16.75	0.80	1.32	0.12
C.D. at 5 %	51.63	NS	4.17	NS
C.V. %	7.02	16.01	6.93	13.55
Interaction	Sig.	Sig.	Sig.	NS

characters along with economics in terms of net returns were studied.

Closer spacing of 90 x 60 cm (S_2) recorded significantly higher seed cotton yield of Bt cotton hybrids than wider spacing of 90 x 90 cm (SI). The results was in accordance with the findings of Nehra *et. al.,* (2004) and Buttar and Singh (2006). However, the reverse results were observed in respect of number of bolls plant^{-1}, seed cotton yield plant^{-1} and boll weight.

Bt cotton hybrid JKCH 666Bt produced significantly higher seed cotton yield (14.85 %) than Bunny and JKCM 99Bt hybrids. Similarly, Bunny Bt hybrid was Significantly superior to JKCM 99 Bt hybrid. Number of bolls plant^{-1} was highest in JKCH 99 Bt hybrid being at par with JKCH 99Bt hybrid but these both hybrids were significantly superior to Bunny Bt hybrid. As regards to seed cotton yield plant^{-1}, JKCH 666 Bt hybrid recorded significantly highest yield than JKCH 99Bt and Bunny Bt hybrid. However, later two hybrids were at par with each other. Significantly higher boll weight was observed in JKCH 666Bt and Bunny Bt than JKCH 99Bt hybrid.

Application of 125 per cent RDF recorded significantly higher seed cotton yield and seed cotton yield per plant than RDF (50+25+25 N, P_2O_5 & K_2O kg ha^{-1}). The similar results were also reported by Raut *et. al.,* (2005). However the number of bolls per plant and boll weight did not influence significantly due to fertilizer levels (100% RDF and 125% RDF)

From one year study it can be concluded that new Bt cotton hybrids respond to 125 per cent recommended dose of fertilizer with 90 x 60 cm spacing under rainfed condition.

LITERATURE CITED

Anonymous, 2006. Annual Report 2005-06, All India Coordinated Cotton Improvement Project Navsari.

Butter G.S. and Paramjit Singh, 2006. Performance of Bt cotton hybrids at different plant populations in south western region of Panjab, J. Cotton Res. Dev., 20(1) ; 97-98.

Nehra, P.L., K.C. Nehra And P.O. Kumawat, 2004. Response of Bt cotton hybrids to different spacing in canal command area of north-western Rajastan, J. Cotton Res. Dev. 18 (2): 189-190.

Raut, R.S., J.G. Thokale and S.S. Mehtre, 2005. Response of cotton cultivars to varying spacing and fertility levels, J. Cotton Res. Dev. 19 (2): 191-193.

Cotton Research Unit,
Dr. PDKV, Akola

P.D.Bhalerao
P.P.Gawande
B.R.Patil
P.U.Ghatol

❖ ❖ ❖

Constraints Perceived by the Members of Co-operative Milk Producing Societies of Akola Tahasil

Agriculture, which is the backbone of Indian economy. About 60 per cent of the population is directly dependent on agricultural sector for their livelihood. The population is increasing day by day which is affecting the capita land holding of the country. As a result, farmer faced the difficulty for having maximum return from their piece of land. However, 70 per cent of the land of the country is un irrigated and it depends on the natural rains.

Therefore it is a need of an hour for the farming community of the country to look beyond the agriculture. Farmers have to find out the ways other than agriculture for obtaining the returns for their socio-economical upliftment. Many subsidiary businesses like poultry, fish farming, diary, honey bees production, sericulture etc. are available. Government is also providing the subsidies to the farmers for establishing these kind of enterprises. Among the various subsidiary business diarying and farming forms the symbiosis kind of relationship with each other. Milch animals require green fodder for higher milk production while the Cow dung, FYM are enhancing the crop production.

India, ranks first in milk production with annual milk production of 100 million metric tones during 2007-08. (Anonymous, 2008) Government is giving subsidies to the farmers for the purchase of milch animals, and also encouraged for establishment of the co-operative milk societies at the rural area for the economic and social up liftment of the farmers These co-operative societies are performing the crucial role in economic up-liftment to the farmers. The study was carried out with an aim to find out the constraints perceived by the members in development and progress of co-operative milk producer's societies.

Among the 168 villages of Akola tahasil of Maharashtra State, there were 50 villages where milk producer's co-operative societies were established as per the official record available at District Central Co-operative Milk Society, Akola. When these 50 milk producers' co-operative societies were visited it was found that only 7 milk producers co-operative societies were functioning while the remaining 43 co-operative societies were not working. Therefore 7 functioning co-operative societies were studied.

The lists of members of functioning co-operative societies were obtained by personally visiting the offices of societies. The data regarding the constrains in development and progress of co-operative milk societies were collected with the help of scrutinized interview schedule prepared with more emphasis on the objective under study from 10 per cent members of each functioning and non functioning milk co-operative societies by personally interviewing with them. The responses obtained from these members were grouped and thus the data collected were analyzed for the statistical testes like mean, percentage etc.

The members expressed various constrains in proper functioning, progress and development of co-operative milk societies. The various responses obtained from the members of functioning and non-functioning co-operative societies are tabulated in Table 1.

Constraints perceived by the members of functioning co-operative milk society:

Table 2 revealed that among the 10 per cent studied members for the constraints maximum number of the respondents (76.27%) were not satisfied with the price per liter of milk offered by the

Table 1 : Constraints perceived by the members of co-operative milk societies.

Code list	Constrains
A	Milk producer co-operative society did not pay the bills in stipulated time.
B	Rate of milk per liter provided by co-operative society was less than the private milk sector.
C	No efforts made by society for production or supply of green fodder.
D	Milk producers co-operative society did not provide financial help with lower interest for purchase of milch animals to the members.
E	Milk producers co-operative societies were not taking efforts for the care and management, medicinal aid to milch animals to increase the milk production.

Table 2: Constraints perceived the members of functioning co-operative milk societies.

S.N.	Name of co-operative milk society	Total number of members	Number of survey members	Constraints perceived				
				A	B	C	D	E
1	Rameshwar cooperative milk society, Malkapur	89	9	4	7	3	3	2
2	GopalKrishna,cooperative milk society, Nimbhora	78	8	6	5	4	7	3
3	Sant Gajanan, cooperative milk society, Umri	65	6	3	4	2	3	0
4	Sant Krupa, cooperative milk society, Kanchanpur	81	8	4	7	5	5	0
5	Shrikrishna cooperative milk society, Guddhi	73	7	5	6	2	4	4
6	Jai Shivaji cooperative milk society, Chikhalgaon	102	10	8	8	6	6	2
7	Shri Datta cooperative milk society,Wani Rambhapur	112	11	7	8	5	6	2
	Total	248	59	37	45	27	34	13
				(62.71)	(76.27)	(45.76)	(57.62)	(20.34)

co-operative milk producers society. This was the major constraint behind the less milk collection at co-operative milk producers society. Nearly 62.71 per cent of the members were not satisfied with the payment structure for the collected milk at the society. These members reported that the co-operative societies should make the payment of bill at regular interval to its members.

While 57.62 per cent of the respondents opinion that co-operative societies should provide financial help at lower interest rates for purchase of milch animals to its members. These members perceived that this will directly increase the milk collection at the society. 45.76 and 20.34 per cent of members expected the help for production and supply of green fodder to milch animals of the members, management medical aid to animals at an regular interval from societies respectively.

Kalra *et. al.* (1994) and Sohal *et. al.*, (1992) also noticed than the purchase price of the milk paid by the private sector was more than that of the co-operative societies.

LITERATURE CITED

Anonymous, 2008. Bharat Book Berau, Milk and Dairy Products in India, Production, Consumption and Exports Milk and Dairy Products in India - Production, Consumption and Exports

Kalra, K.K., R. Singh and A.K.Chauhan, 1994. An economic analysis of milk production and marketing system of diary business. National Diary Research Institute, Karnal, Annual Report, (ICAR)106-107

Sohal, T.S. , Singh, J.N and J.P. Singh, 1992. Impact of intensive extension education on the adoption of scientific dairy farming by land less rural families around Karnal. Indian Journal of Diary Sci., 35 (4) : 447-453

Department of AH & Diary,
Dr. PDKV, Akola

R.T.Raghuwanshi
S.D.Sarnaik
D.N.Nalge
S.P. Pande

Mortality in Osmanabadi Goats in Vidarbha Region of Maharashtra

Low mortality rates among the goats are often viewed as an indication of adaptability of a particular breed to new environment. Further, the mortality has considerable economic importance with the intensification pattern on a goat farm indicates the type of management, survivability and incidence of diseases and/or ailments occurring on a particular goat farm. There is very little available information on mortality of *Osmanabadi* goats in *Vidarbha* region of Maharashtra. Hence an attempt was made to find out the prevalence of diseases and/or ailments at this farm and also to find out the relation of mortality with age, season and sex.

Data was collected from *Osmanabadi* Goat unit of Krishi Vigyan Kendra, Central Institute for Cotton Research, Nagpur, Maharashtra. for a period of nine years from 1999 to 2007. The etiology of the dead goats was confirmed on the basis of post mortem examination at Veterinary Polyclinic, Nagpur under the jurisdiction of Animal Husbandry Department of Maharashtra .The data was analyzed and certain inferences were drawn.

Yearwise mortality pattern showed that ,maximum annual death rate was 14.29 per cent each during 1999 and 2005, followed by year 2004 (11.43 per cent) years 2003 and 2006 (8.57%) and least (5.71 %) during the year 2001.From this it is evident that, the mortality amongst *Osmanabadi* goats varied significantly over the period eight years between 1999 to 2006 and it ranged between 5.71 percent to 14.29 per cent. Almost more or less similar incidence of mortality were reported by Mehta *et. al*. 1995 (4.7 % in *Sirohi* goats); Tomer *et al.*1997 (3.8 % in *Sirohi* goats); Arun *et al.* 2000 (2.8 % in *Kutchi* goats); and Arun *et. al.*, 2002 (4.3% in *Kutchi* goats.). Whereas higher incidence of mortality were reported by Kanaujia *et al.*1985 (28 .3 %) in Beetal and it's crosses . The effect of sex was clearly seen on mortality. The cases of mortality outnumbered the males.

As far as the season of mortality is concerned, the cases of deaths due to respiratory failure were observed during the winter months i.e. December, January and February. The cases of death due to combined respiratory failure and bronchitis were observed during winter months of December and January. The cases of death due to combined Asphyxia and internal haemorrhage were also observed during winter months of December and January. The cases of death due to pneumonia occurred during winter month February. It is imperative to mention here that during the winter months i.e. December, January and February there is fairly chilly weather in Vidarbha region and the atmospheric temperature goes as low as 8° C which might have resulted in Bronchitis and congestion leading to Asphyxia respiratory failure of goats. It was specifically observed that, maximum mortality (63.16%) took place during winter months. This finding is in close agreement with Arun *et al.* (2002) who also reported that highest mortality (55.4 %) took place in *Kutchi* goats during winter months. The mortality was lowest (10.53 %) in autumn and summer and intermediate (21.05 %) in rainy season. During present study, no mortality was observed during spring season but Arun *et al.* (2002) have reported 15.3 per cent mortality in *Kutchi* goats during this season. This might be due to different climatic conditions and location of studies.

As regards the cause of deaths is concerned, maximum (26.32 %) deaths were due to respiratory failure. The mortality caused due to pneumonia was 15.79 per cent. Both these ailments caused maximum mortality in winter season. This finding is in tune with Mittal (1976) and Chawla (1982). The mortality caused due to biting of carnivorous animals was 15.79 per cent. Combined ailments Asphyxia and Internal haemorrhage caused 10.64 per cent of deaths. Whereas other ailments viz. toxaemia due to cystitis, septicaemia, respiratory failure and ruminal acidosis, pregnancy toxaemia and hepatitis, bronchopneumonia etc. caused 5.26 per cent mortality each.

There was not a single case of mortality during the months of March and April all over the period of nine years. In the month of May in summer, the mortality was due to combined infections viz. respiratory failure and ruminal acidosis. The

mortality due to biting of carnivorous animals occurred during the months of May and August. This might be due to the breeding season and corresponding aggressive nature of these animals during this period. The mortality due to biting of creeping animals (serpents) occurred during the months of August. This may be due to flooding of burrows of serpents during the month of August with rain water which force them to come out. The mortality due to pregnancy toxaemia and hepatitis occurred during the month of September. The mortality due to toxaemia due to cystitis and septicaemia occurred during the month of October. There was not a single case of mortality during the month of November all over the period of nine years. This might be attributed to pleasant (neither cool nor hot) weather during this month.

It can be concluded from the present investigation that the kids should be protected from chilly weather during winter months so as to check their mortality from various ailments viz. pneumonia, bronchopneumonia etc. and respiratory failureetc. Proper housing should be provided to them proper housing should be provided to them .Further the management of goats should be sound.

The effect of sex was clearly seen on mortality. The cases of mortality outnumbered the males. Out of total mortality, mortality in females was observed to be 73.68 per cent whereas in males it was 26.32 per cent. All the kids which died were below three months of their age. This finding is in agreement with Mittal (1976) who reported that about 70 per cent kids died below three months of age in Barbari and Jamunapari breed.

LITERATURE CITED

Arun Kumar,. R.C. Sharma and B.S Mehta , 2000. Studies on replacement index and mortality patterns of Kutchi Goats. Indian J. Smalll Ruminants, 8 (2) : 104-107

Arun Kumar, A.K. S. Tomar, B.S. Mehta, and A.L .Arora , 2002. Replacement index in a flock of Sirohi goats under semi-arid conditions of Rajasthan, Indian J. Small Ruminants, 6: 64-67

Chawla, D.S., D.S. Bhatnagar,. and R.R. Mishra ,1982. Factors affecting kid mortality in dairy goat, Indian J. Ani. Sci., 52:166-171.

Kanaujia , A.S., A. K. Vinayak , B.L. Pandere, and D.S. Balain,1985. Studies on survivability in Beetal and Black Bengal goats and their crosses, Indian J. Ani. Produc. & Management 1 : 183-188

Mehta , B.S, B.U. Khan , N.P. Singh and K.S. Pajai, 1995. Annual Report AICRP on Goat Improvement, Sirohi Unit, Avikanagar, 1995

Mittal, J.P. 1976., A study on mortality in kids, Indian Veterinary J., 53:681-684

Tomer, S.S., R.C. Sharma, and R.B. Singh, 1966. Study on female losses up to a age at first kidding and replacement rate in dairy goats, J. Dairying, Food and Home Science, 15: 41-44

KVK, CICR, Nagpur

S.N. Rokde
U.V. Galkate
R.M. Zinjarde
S.G. Thote

Efficacy of Autogenous Vaccine Against Subclinical Mastitis in Cows with Relation to Milk Biochemical Profile

The subclinical mastitis is milder but most dangerous form which is characterized by biochemical alternations in milk. Autogenous vaccines have been proved effective in the treatment (Hwang *et. al.*, 2000) and prophylaxis (Mellenberger, 1977) of mastitis. The present investigation was undertaken to evaluate the therapeutic efficacy of autogenous vaccine in restoring altered milk biochemical profile is SCM.

Cross bred cow (12) in mid lactation positive for SCM by Modified California Mastitis Test (MCMT) were randomly divided into two equal groups having 6 cows each. One group was kept as untreated control (T_1). Group T_2 comprising 6 affected quarters was treated with autogenous vaccine prepared from the *Staphylococcus* organisms isolated from milk of respective cow @ 5 ml subcutaneously on alternate day for 15 days. One group of 6 apparently healthy cows free from SCM was also kept as normal healthy control (T_3). The milk samples were collected from all the cows on day 0, 3, 7, 10 and 15 post treatment for estimation of pH (digital pH meter0, sodium and potassium (Roy and Sen, 1991), chloride (Shoenfield, 1956), lactose (Roy and Sen, 1991). The data obtained were analyzed as per the method described by Snedcor and Cochran (1989).

Out of the 16 SCM affected quarters, 6 (37.5%) quarters recovered within 15 days of treatment with autogenous vaccine. The average values for pH, sodium, potassium, lactose, chloride and total protein in milk ranged between 6.53 $\pm$ 0.02 to 6.57 $\pm$ 0.02, 55.57 $\pm$ 2.26 to 60.84 $\pm$ 1.18 mg dl^{-1}, 137.72 + 4.56 to 140.11 + 1.59 mg dl^{-1}, 4.28+0.15 to 4.33 + 0.31 gm dl^{-1}, 108.69 + 1.61 to 112.17 + 1.82 mg dl^{-1} and 2.89 + 0.03 to 2.92 + 0.03 gm dl^{-1}, respectively in normal healthy group T_3. In subclinical mastitic cows sodium (6.75 $\pm$ 0.02 to 6.79 + 0.02 m dl^{-1}), chloride (173.22 + 5.8 to 175.13 + 3.96 mg dl^{-1}) and total protein (3.77 + 0.04 to 3.96 + 0.07 mg dl^{-1}) significantly increased and potassium (128.83 + 1.34 to 131.51 + 1.25 mg dl^{-1}) and lactose (3.66 + 0.06 to 3.68 + 0.05 mg dl^{-1}) decreased significantly as compared to normal healthy group (Waghmare *et. al.*, 2002). After treatment with autogenous vaccine, the pH, sodium and chloride were significantly decreased and potassium and lactose increased but the improvement was not sufficient enough to bring the milk biochemical profile to normal after treatment.

The results indicated the partial efficacy of autogenous vaccine in restoring the altered milk biochemical parameters, due to elevation of serum antibodies which cause opsonization of microorganism and thus enhance phagocytic activity of PMN, which subsequently reduced the udder inflammation and reversed the increased permeability of the blood capillaries (Hwang *et. al.*, 2000).

LITERATURE CITED

Hwang Cheol Yong, Pak Sonll and Han Hongryul, 2000. Effect of antugenous toxoid-bacterin in the lactating cows with *Staphylococcus aureus* subclinical mastitis, J. Vet. Med. Sci., 62 (8) : 875-880.

Melleberger, R.W., 1977. Vaccination Against Mastitis, J. Dairy Sci., 60 (6) : 1016-1021.

Roy, N.K. and D.C. Sen, 1991. Textbook of Practical Dairy Chemistry. Ist End. Kalyani Publishers. New Delhi.

Shoenfield R.G., 1956. Estimation of Chloride, Clin. Chem., 10(6), : 533.

Snedcor, G.W. and W.g. Cochran, 1989. Statistical method : 6th Edn. The Iowa State University Press, Ames Iowa, U.S.A.

Waghmare, S.P., R.D. Dadekar, I. Khan, V.L. Doiphode and A. Handa, 2002. Efficacy of 'Cobacton LC' in subclinical Mastitis in cows with reference to effect on biochemical profile of milk, Ind. Vet. Med. J., 26 : 113-115.

Department of Veterinary Medicine
PGIVAS, Akola

S. G. R. Daimi
S. P. Waghmare
S. G. Mode

Effect of Lead Acetate on Organ Weights of Broilers Administered at Different Dose Levels

The present investigations were carried out in the Department of Veterinary Pathology, PGIVAS, Akola. Seventy five, day old broiler chicks (Hubb, C & M Farming Ltd, Raipur) were randomly divided into three groups, each group thus comprising 25 birds. Group I (control) birds were given commercial diet with normal drinking water while group II and III birds were given commercial diet with lead acetate at dose level of 250 ppm and 400 ppm in drinking water respectively for a period of 2nd to 6th week. Six birds from each group were sacrificed at the end of 6th week. After gross pathological examinations, carcass and organ weights of liver, lungs, heart, kidneys, thymus and bursa of fabricius were recorded using digital monopan balance (Electro Tech, Mumbai) to study the effect of lead toxicity on organ weights. Average absolute organ weight, organ body weight ratio was calculated by using following formula (Sinha, 1998).

$$\text{Organ body weight ratio} = \frac{\text{Organ weight (g)} \times 100}{\text{Carcass weight (g)}}$$

Statistical analysis of data was carried out as per method described by Snedecor and Cochran (1994). Average absolute organ weight and body weight ratio are given in Table 1. Data analyzed statistically indicated non significant mean variation in absolute and body weight ratio of liver, lungs, heart and kidneys. Present observations of non significant influence of lead treated on organ weight ratio of birds are in agreement with those reported by Morgan *et al* (1975), Stone *et al* (1977) and Shakoor *et al* (2000).

Significant reduction in average absolute thymus and thymus-body weight ratio was observed due to lead acetate in present study. Similar findings of lower thymus weights were reported by Youssef *et al* (1996) in broilers given lead acetate. This lower weight of thymus in treatment group birds could be possible direct toxic effect of lead on thymus causing depletion of lymphoid cells.

Mean values of absolute and body weight ratio of bursa fabricius was significantly higher in group I than values in both treatment group birds. Similar findings of significant decrease in bursal weights in lead treated group birds were reported by Youssef *et al* (1996). In contrast to these findings Morgan *et al* (1975) reported non significant differences in relative weights of bursa in Japanese fed lead acetate at 500 ppm and 1000 ppm levels.

The lower bursal weights in lead acetate treatment group birds could be possible due to toxic effect of lead on avian lymphocytes causing apoptosis and decrease in their number in bursal follicles (Shukla *et al* 2004).

LITERATURE CITED

Berg, L. R.; J.O. Nordstrom and L. E. Ousterhout, 1980. The prevention of chick growth depression due to dietary lead by increased dietary calcium and phosphorus levels. Poultry Sci. 59: 1860-1863.

Morgan, G.W.; F.W. Edens; P. Thaxton and C.R. Parkhurst, 1975. Toxicity of dietary lead in Japanese quail; Poultry Sci. 54: 1636-1642.

Shakoor, A., P.K. Gupta, M. Kataria, and S.K. Dwivedi 2000. Effect of simultaneous exposure to aluminum and lead on growth in male albino rats. Indian J. Toxicol. 7 (2): 51-56

Sinha Biny Kumar, 1998. Post Mortem Techniques and Diagnostic Procedures with Interpretations, 2nd Edn., Pushpa Prakashan , Bihar Veterinary College, Patna.

Shukla, G.; L.K. Singhal; D.D. Singh; R. Kumarand and R.S. Chauhan, 2004. Lead induced apoptosis in avian lymphocytes. J. Immunol. Immunopathol. 6 (S-1): 106-109

Snedecor, G. W. and W. G. Cochran, 1994. Statistical Methods, 8th Edn., Iowa State Univ Press, Ames, IOWA.

Stone, C.L., M.R.S. Fox, A.L. Jones and K.R. Mahaffey 1977. δ-Aminolevulinic acid dehydratase – A sensitive indicator of lead exposure in Japanese quail. Poultry Sci. 56: 174-181.

Youssef, S.A.H., A.A. El-Sanousi, N.A. Afifi and A.M.A. AL-Brawy, 1996. Effect of subclinical toxicity on the immune response of chicken to New Castle Disease Virus Vaccine. Research Vet. Sci. 60: 13-16

Department of Pathology
PGIVAS, Akola

Shafiqur Rahaman
L.A. Khan
M.G. Brahmankar
D.B. Kale

Table 1: Average organ weights (gms) and organ body weight ratio.

Group	Liver		Lungs		Heart		Kidneys		Thymus		Bursa	
	Average Weight	Liver body weight ratio	Average Weight	Lungs body weight ratio	Average Weight	Heart body weight ratio	Average Weight	Kidneys body weight ratio	Average Weight	Thymus body weight ratio	Average Weight	Bursa body weight ratio
I	38.77	3.45	.65	0.56	8.96	0.59	12.88	0.98	8.13^{c}	0.734^{c}	2.64^{c}	0.191^{c}
	±2.41	±0.92	8±0.60	±0.05	±1.38	±0.03	±0.64	±0.11	±0.17	±0.056	±0.20	±0.021
II	36.63	2.72±	7.41±	0.48±	7.87±	0.55±	11.46±	0.83±	6.93^{b}±	0.538^{b}±	2.07^{b}±	0.160^{b}±
	±3.25	0.51	0.71	0.04	0.19	0.03	0.53	0.10	0.12	0.050	0.15	0.011
III	34.78	1.88	6.91	0.42	7.40	0.49	10.89	0.76	6.11^{a}	0.376^{a}	1.60^{a}	0.115^{a}
	±2.11	±0.18	±0.19	±0.02	±0.95	±0.02	±0.75	±0.10	±0.12	±0.036	±0.06	±0.007
Pooled Mean	36.73	2.70	7.66	0.48	8.09	0.54	11.74	0.86	7.06	0.549	2.10	0.155
	±2.59	±0.5	±0.50	±0.04	±0.82	±0.03	±0.64	±0.10	±0.14	±0.047	±0.14	±0.013
F test	NS	NS	NS	NS	NS	NS	NS	NS	**	**	**	**
CD at 5%	-	-	-	-	-	-	-	-	0.42	0.14	0.44	0.04

Mean values with common alphabet as superscript do not differ significantly.

NS = Non Significant.

** = Significant at 1% level of probability

Indigenous Traditional Knowledge for Treatment of Goats in Vidarbha Region of Maharashtra

Indian agriculture has a very old history dating back to Neolithic age of 7500-6500 B.C. Ethno Farming system(EFS) refers to a system adopted in a society to maintain their livelihood on sustainable basis with least possible damage to the nature and still being practiced by the Indian farmers (Sardana,2001).Animal husbandry has been a supplementary business to agriculture and is providing employment to 2/3 population in arid region .Livestock farming by its very nature offers a scope for commercialization and has been recognized as an instrument for drought proofing (Rohilla and Mathur,2003). Grenier defines Indigineous traditional knowledge (ITK) as the unique, traditional and local knowledge existing within and developed around specific conditions of women and men indigineous to a particular geographic area. ITK is used at the local level by communities in developing countries as the basis for decision making pertaining to food security, human and animal health, education, natural resource management and other vital activities (Anonymous,2002).However the use of ITK's have been discouraged with the introduction of allopathic and homeopathic medicines (Rohilla *et al.*,1999).Considering the importance of ITK involved in the animal husbandry and health management practices (Kumar *et. al.*, 1998, Gupta *et. al.*,2000, Singh *et. al.*,2001), an attempt has been made to collect and compile the information on this important aspect. A survey was conducted in Nagpur district to assess ethnoveterinary practices employed by the farmers to treat their livestock against various ailments and the findings are narrated underneath.

A ground mixture of Pimpali 5g, Jeera i.e. Cuminseed (*Cuminum cyminum*) 15 g, Sunth i.e. dried ginger (*Zinziber officinale*) 20 g, Chitrak (*Plumbago zeylanica*) 5g,Owa i.e. Ajwain (*Thymus vulgaris* Linn.) 20 g, Kale mire i.e. black pepper (*Piper nigrum*)5 g, Wavding (*Embelia ribes*) 10 g and Hirda (*Terminalia chebula*) 20 g is prepared and fed @ 20 to 30 g head^{-1} day^{-1} to the animal suffering from Colic i.e. Stomach ache.

A ground mixture of Hirda (*Terminalia chebula*) 30 g, Aonla(*Phyllanthus embelica*) 20 g , Murudsheng (*Helicteres isora*) 15 g, Erandale-tel i.e. oil extracted from caster (*Ricinus communis* L.) 20 ml and Sonamukhi leaves 15 g is prepared and fed @ 20 to 30 g head^{-1}day^{-1} to the animal suffering from constipation.

A ground mixture of Owa i.e. Ajwain (*Thymus vulgaris* Linn.) 20 g, Coriyonder seed i.e. Dhaniya(*Coriandrum sativum* Linn) 10 g, Cuminseed (*Cuminum cyminum*) 15 g, Coarse anise i.e. Badi saunf (*Foeniculum vulgare*) 10 g, turmeric 15 g and Kalanamak i.e. black salt 30 g is prepared and fed @ 20 to 30 g head^{-1} day^{-1} to the animal suffering from bloat.

A mixture of Aonla(*Phyllanthus embelica*) 20 g, Owa i.e. Ajwain (*Thymus vulgaris* Linn.) 20 g, Chitrak (*Plumbago zeylanica*) 5g, Pimpali (*Piper longum*) 5 g, Sunth i.e. dried ginger(*Zinziber officinale*) 10 g, Hirda (*Terminalia chebula*)15 g, Kalanamak i.e. black salt 25 g, Jira i.e. Cuminseed (*Cuminum cyminum*) 15 g fed along with some quantity of Gur i.e. crude sugar is prepared and it is fed to the animal suffering from Anorexia i.e.Loss of appetite @ 20 to 30 g head^{-1} day^{-1},. A mixture of Bel (*Aegle marmelas*) 20 g, rind of Dalimb i.e. pomegranate fruit (*Punica granatum*) 20 g, Kuda 30 g, Deshi babul dink i.e. gond i.e. dried form of secretion from *Acasia nilotica* 25 g and katha i.e. catechu from Khair (*Acasia catechu*) 5 g is prepared and it is fed to the animal suffering from diarrhea @ 20 to 30 g head^{-1} day^{-1}.

A paste made up of haldi i.e. Turmeric (*Curcuma longa*) 15 g, Korphad (*Aloe vera*) 5 g, Jesthamadh i.e. Mulethi (*Glycyrrhiza glabra*) 8 g, Arjunstick i.e. rind of arjun tree (*Terminalia arjuna*), Katha i.e. catechu from Khair (*Acasia catechu*) 2 g, Tulsi (*Ocimum sanctum*)5 g, Jakhamjodi 5 g, Kadulimb tel (i.e. oil of *Azatirachta indica*) 4 ml and geru 50 g is prepared and a little of this mixture is applied on the inner side of mouth of ailing animals.

For respiratory disorders such as corrhiza, cold, cough, a mixture of Adulsa (*Adhatoda vasica*) 30 g black pepper (*Piper nigrum*)10 g, Tulsi (*Ocimum sanctum*) 20 g, Sunth i.e. dried ginger(*Zinziber officinale*) 10 g, Kasni 20 g and kantakari i.e. Bhuibal (*Sida humilis*) 10 g is prepared and is fed to the

ailing animals @ 20 to 30 g head^{-1} day^{-1}. Apart from this remedy, a mixture of Kapur i.e. camphor 4g, Pudina (*Mimosa pudica*) 5 g, Nilgiri Tel i.e. Oil of Eucalyptus 20 ml is prepared and 10 drops of this mixture are added to water boiling in a narrow mouthed vessel and the ailing animal is assisted to inhale the medicated fumes/vapors coming out of the snout of the vessel. These medicated fumes/ vapors have a soothing effect on the respiratory tract of ailing animal.

A powder of Korphad (*Aloe vera*) 20 g, Hirabol (*Balsamodendron myrrha*) 10 g, Ulatkambal 9 -10 g, leaves , bamboo (*Dendrocalamus strictus*) 20 g, Ashok (*Saraca indica*)) 20 g, Gokharu (*Tribulus terrestris*) 15 g and tagar 5 g is fed to the animal suffering from anestrus condition@ 20 to 30 g.

A powder of *kamalbi* (i.e. Seed of lotus), Shinghada (*Trapa bispinosa*) [a fruit grown in water] and Putrajiva (*Putrajiva roxburghi rghii*) 25 g each is given is prepared and fed to the ailing doe @ 20 g head^{-1} day^{-1} from the day of insemination upto a period of two months.

A powder of kalonji i.e. seed of onion (*Allium cepa*) 20 g, roots of kallawi (*Gloriosa superba*) 15 g, eshwari (*Aristlochia indica*) 20 g, harmal (*Peganum harmala*) 10 g, tamb (*Claviceps purpurea*) 10 g, rind of cotton root (*Gossypium* spp.) 15 g and satapa (*Ruta graveolens*)10 g is prepared and fed to the animal suffering from anestrus condition@ 30 to 40 g.

For controlling skin infections, a mixture of karanj tel (oil of *Pongamia pinnata*) 10 ml, kadulimb tel (oil of Azadirachta indica) 10 ml, Tulsi tel (*Ocimum sanctum*) 5 ml, haldi i.e. turmeric(*Curcuma longa*) 5 g, Kanher –a red coloured flowering plant (*Nerium odorum*) 3 g, Arjun (*Terminalia arjuna*) 5 g is prepared and applied on the affected portion.

A powder of Jiwanti (*Dendrobium macraei*) 40 g, Shatawari (*Asparagus racemosus*) 40 g and Ashwagandha 20 g is prepared and fed to the animal whose milk yield has either been declined or there is total failure to give milk@ 5 g head^{-1} day^{-1} for 10 consecutive days.

As a remedy on swelling of limbs, a mixture of Nilgiri tel (oil of Eucalyptus)15 ml ,wintergreen oil 15 ml, tarpin tel (terpentine oil) 20 ml, Nirgudi (*Vitex nirgundi trifolia*)15 ml, Kapur (*Cinnamomum camphora*) 4 g , Lasun i.e. garlic (*Allium sativum*) 5 g and Sunth i.e. dried ginger (*Zinziber officinale*) 4 g mixed in half litre til oil i.e. oil extracted from sesamum (*Sesamum indicum* L.) and it is used for massaging the affected portion.

LITERATURE CITED

Anonymous., 2002 About indigenous knowledge, Indian Farmers Digest 35:11-13.

Gupta P., A. Singhal, and S. Tyagi, 2000. Indigenous practices in Animal Husbandry, Asian Agricultural History 4:31-38

Kumar, D., H.C. Tripathi, S. Chandra, S. K. Tandan, Jawahar and J. K. Malik, 1998. Folklore use of phytomedicines in treatment of some ailments of livestock in India and Nepal an update. Indian Veterinary Medical Journal 22:171-178

Rohilla ,P P., K. M. Bujurbaruah, G. Singh and M. Kumar, 1999. Indigenous Technical knowledge used for animals treatment in foothills of Nagaland. Indian Veterinary Medical Journal 12: 121-123.

Rohilla ,P P. and D.C. Mathur, 2003. Indigenous Traditional knowledge used for treatment of small ruminants in arid region, Indian J. Small Ruminants in Vidarbha Region of Maharashtra, 9(2): 133-135

Sardana, V. 2001. Indigenous Technical knowledge of farmers since ancient times, Indian Farming 5:13-14

Singh ,G., K. Khate, K. M. Bujurbaruah and S. K. Mondal, 2001. Phytomedicines used for treatment by tribal in remote area of Nagaland, Indian Veterinary Medical J., 25: 291-292

Section of A.H. & Diary,
College of Agriculture, Nagpur

S. N Rokde
R. M. Zinjarde
A. S. Ingole

❖ ❖ ❖

Particulars about PKV Research Journal as per Press and Regulation of Book Act (Clause 8)

FORM IV

1.	Place of Publication	:	Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
2.	Periodicity of Publication	:	Six monthly
3.	Printer's Name	:	Mr. Mohan G. Thakre
4.	Nationality	:	Indian
5.	Address	:	Tanvi Graphics, Ranpise Nagar, Akola
6.	Publisher's Name	:	Dr. S.V. Sarode
7.	Nationality	:	Indian
8.	Address	:	Director of Research, Dr. PDKV, P.O. Krishi Nagar, Akola
9.	Editor-in-Chief	:	Dr. S.V. Sarode
10.	Nationality	:	Indian
11.	Address	:	Editor-in-Chief Dr. PDKV, P.O. Krishi Nagar, Akola - 444 104 (Maharashtra)
12.	Owner's Name	:	Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola

I, S.V. Sarode declare that the particulars given above are true to the best of my knowledge and belief.

Date : 24th Oct., 2009

Dr. S.V. Sarode
Publisher

SUGGESTIONS FOR AUTHORS

General : The PKV Research Journal is published twice a year to promote the cause of research and disseminate the knowledge in the field of agricultural sciences. Subject matter should fall in the categories of (i) Original research articles (ii) Research notes and (iii) Review papers.

Manuscript : It should be typed on full scape good quality, double spaced, on one side of the page only, with sufficient margin, 5 cm on the left side and 2.5 cm on each of the remaining sides. The author(s) may submit paper in duplicate. He may not type his name, designation and acknowledgement on the first copy. All sheets in the copy should be of one side only and should not ordinarily exceed 10 in numbers including tables. Writing style should be simple, concise and precise. Presentation of article should have the components in the following sequence : TITLE, NAME (S) OF AUTHOR(S), FOOT NOTE, ABSTRACT, INTRODUCTION (without heading), MATERIAL AND METHODS, RESULTS AND DISCUSSION, ACKNOWLEDGEMENT if any and LITERATURE CITED. Format of Research note may be as per the pattern of PKV Res. J. Vol. 17 No. 2 of 1992. All calculations, tables, figures, names, quotations, citations, etc. should be carefully verified before submission.

The metric system of measurements should be followed and standard abbreviations be used.

The paper need necessarily to be accompanied by an undertaking that it is not published earlier in any journal. The author(s) are advised to adhere to the format of this journal strictly. In the event of not following the format, the paper(s) may not be attended to.

Title : The title of the article should be short and precise and should be followed in the next line, by name(s) of author(s). Foot note on the first page should include the department(s) contributing the article, designation and present address of author(s).

Abstract : Concise summation of findings not exceeding 200 words should be written at the beginning of the papers. The abstract should start with the objective. It should be intelligible without reference to the original paper. It should be written in such a way that will facilitate abstracting of the paper in the world of abstracts.

Table : Type each table on a separate sheet. They should be numbered in arabic numerals with title of the table in the same line. Table should be placed at the end of the manuscript, but its place in the text should be indicated.

Figures : Identify graphs, line drawings and photographs with consecutive arabic numbers as Fig. 1, Fig. 2. Place figures after tables. Photographs must be clear, glossy prints, original graphs and drawing must be in Indian ink or equivalent on plain white drawing paper. Lettering should be large and bold enough to permit reduction. Each figure number should placed on the back of each figure in pencil for identification.

Nomenclature : The latin binomial or trinomial and authority must be should for all plants, insects and pathogens at first listing either in the title or when first mentioned in the text. Crop varieties (not experimental lines and strains) should be identified by a single quotation mark at first listing only. Generic and specific names should be in italic e.g. *Lycopersium esculentum* Mil Morgtobe.

Reference : They should be double space throughout and arranged alphabetically according to author's names and should be placed under the heading "**LITERATURE CITED**" at the end of the article. Each reference should contain the name of author with initials, the year of publication, title of article, the abbreviated title of publication, volume and page e.g.

Sarode, S.V. and U.S. Kulkarni, 1998. Sustanability of *Helicoverpa armigera* (Hubner) on weed partheninum hysterophorous, Indian J. Entomol., 60 (4) : 421-422

Kawarkhe, V.J., R.N. Jane and Manisha Deshmukh, 2003.Effect of nitrogen and specing levels on growth and flower yield of China Aster, PKV Res. J., 27 (2) : 163-165.

In the text, the reference should be indicated by author's name followed by year of publication. When more than one paper by the same author appears in a single year they should be distinguished as a, b, c,.....

Please refer to annexure of PKV Res. J. Volume 11(2), 1987 for abbreviation of journals to be given under **LITERATURE CITED**.

Correspondence : Manuscripts should be sent in duplicate directly to Editor-in-Chief, PKV Research Journal, Director of Research, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola - 444 104 (Maharashtra). Manuscripts are examined by the Editorial Board and referred to competent referees.

The Editorial Board takes no responsibility for the facts of the opinions expressed in the journal which rests with the authors.

Published by Dr. S.V. Sarode, Director of Research, Dr. PDKV, Akola for and on behalf of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India in 2006 and Printed by him at Tanvi Graphics, Ranpise Nagar, Akola

RESEARCH NOTE

CONTENT

Vol. 33 No. 2 July, 2009