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Effect of Integrated Nitrogen Management on Soil Fertility in Rice - Green Gram Sequence

A. Upendra Rao[1], K. M. Dakshina Murthy[2] and B. Bucha Reddy[3]

ABSTRACT

A two-year (2000-01 and 2001-02) field experiment was conducted to study the direct and residual effect of different integrated nitrogen management practices on soil fertility in rice-greengram system. Application of 75 per cent RDFN + 25 Kg GM N + 25 Kg PM N to rice resulted in the highest available N, P_2O_5 and K_2O status in soil after rice and it was significantly superior over that of 100 per cent RDFN with respect to available N, over that of 100 per cent RDFN through different sources and 125 per cent RDFN with respect to available P_2O_5 and over that of 100 per cent RDFN supplied through different sources with respect to available K_2O. Application of 100per cent RDFN duly substituting 25 kg N through different organic sources resulted comparable soil available NPK in the soil. Similarly application of 125 per cent RDFN duly substituting 50 Kg N through different organic sources resulted at par status of NPK in the soil after rice. Supply of 75 per cent RDFN + 25 kg GM N + 25 Kg PM N to rice resulted significantly higher available P_2O_5 in the soil after green gram over that of application of 100 per cent RDN through different sources during 1st year and application of 100 per cent RDFN and 75 per cent RDFN + 25 kg VC N during 2 year in rice-green gram system.

Intensive cultivation of land without conservation of soil fertility would lead to stringing up of deserts (Swaminathan, 1987). Crop rotation involving leguminous crops and integrated nutrient management are essential to fine-tune the production technology for sustaining agriculture. Nutrients applied to one crop in a cropping system are some times not fully utilized by the crop and enough cumulative residual effect is carried over to next crop in a sequence (Singh and Deka, 1990. The present study was conducted to know the residual effect of integrated nutrient management practices to rice on succeeding crop particularly green gram with reference to dynamics of soil fertility.

MATERIAL AND METHODS

A field experiment was conducted during two consecutive years of 2000-01 and 2001-02 at College farm, College of Agriculture, Acharya NG Ranga, University, Rajendranagar, Hyderabad in a sandy clay loam having pH of 7.9, 230 Kg ha^{-1} of available N, 23 Kg ha^{-1} of available P_2O_5 and 232 Kg ha^{-1} of available K_2O. Rice seedlings of three ages viz., 30, 45 and 60 days old were transplanted with nine nitrogen management practices (N_1 – 75 per cent RDFN + Sun hemp GM @ equivalent to 25 kg N ha^{-1}; N_2 – 75 per cent RDFN + FYM @ equivalent to 25 kg N ha^{-1}; N_3 - 75 per cent RDFN + Vermicompost @ equivalent to 25 kg N ha^{-1}; N4 – 75 per cent RDFN + Poultry manure @ equivalent to 25 kg N ha^{-1}; N_5 – 75 per cent RDFN + GM @ equivalent to 25 kg N ha^{-1} + FYM @ equivalent to 25 kg N ha^{-1}; N_6 –75 per cent RDFN + GM @ equivalent to 25 kg N ha^{-1} + vermicompost @ equivalent to 25 kg N ha^{-1}; N_7 – 75 per cent RDFN + GM @ equivalent to 25 kg N ha^{-1} + PM @ equivalent to 25 kg N ha^{-1}; N_8 – 100 per cent RDFN and N_9 – 125 per cent RDFN) in a split plot design with three replications. The green gram was grown during *Rabi* in the same undisturbed layout in split-split plot design by further subdividing each subplot into two to test the performance of green gram with two fertilizer levels (50 % and 100 % RDF of green gram). Residual effects of rice treatments were also studied on succeeding green gram. Uniform dose of entire P_2O_5 (60 Kg ha^{-1}) and K_2O (40 Kg ha^{-1}) was applied basally to all the treatments. Fertilizer nitrogen was applied as per the treatment in three equal splits each at basal, active tillering and panicle initiation stages. Nutrient content in different organic sources was taken into consideration to supply 25 per cent recommended N on equal nutrient basis.

RESULTS AND DISCUSSION

During both the years, available N, P_2O_5 and K_2O status in the soil after rice was significantly influenced by N management practices of rice and was unaffected by age of seedlings and by their interaction effects (Table 1).

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Table 1. Effect of integrated nitrogen management on available N, P_2O_5 and K_2O status in the soil after rice (kg ha^{-1})

Treatments	Available nitrogen		Available P_2O_5		Available K_2O	
	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02
N Management in rice						
N_1	240.9	251.4	25.59	27.83	241.2	243.0
N_2	241.6	251.3	26.69	27.88	236.4	243.7
N_3	242.3	251.6	26.80	27.94	236.6	244.1
N_4	244.3	252.9	27.13	28.21	237.1	247.0
N_5	249.8	256.2	28.14	29.44	241.7	250.1
N_6	250.1	256.9	28.44	29.50	241.9	251.0
N_7	251.0	257.4	28.80	29.61	242.9	251.9
N_8	237.4	249.8	26.12	27.33	236.0	242.4
N_9	244.2	250.8	27.48	27.58	240.0	242.3
SE (m) ±	6.08	3.61	0.65	0.64	2.60	4.13
C.D (p=0.05)	11.9	7.1	1.25	1.28	5.12	8.10
A x N						
SE (m) ±	8.24	8.00	1.29	1.45	4.40	5.96
C.D (p=0.05)	NS	NS	NS	NS	NS	NS

Table 2. Available N, P_2O_5, K_2O in the soil (kg ha^{-1}) after green gram as influenced by residual and direct effect of fertilization

Treatments	Available Nitrogen		Available Phosphorous		Available Potassium	
	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02
N Management in rice						
N_1	247	260	27.07	27.18	232	236
N_2	249	260	27.32	27.03	232	234
N_3	245	260	27.20	26.81	231	236
N_4	245	262	27.42	27.02	233	236
N_5	250	266	28.57	27.08	237	240
N_6	250	266	28.71	27.32	237	240
N_7	249	267	28.93	27.89	239	241
N_8	243	258	26.80	26.68	231	235
N_9	245	264	28.13	27.31	235	242
SE (m) ±	5.08	5.53	0.55	0.49	4.04	4.05
C.D (p=0.05)	NS	NS	1.10	1.01	NS	NS
Fertilization to Greengram						
F1	245	261	27.13	26.07	233	236
F2	249	265	28.45	28.22	235	240
SE (m) ±	2.05	2.32	0.21	0.24	1.49	2.00
C.D (p=0.05)	NS	NS	0.43	0.49	NS	NS

During both the years, application of 75 per cent RDFN + 25 Kg GM N + 25 Kg PM N (N_7) to rice resulted in highest available N, P_2O_5 and K_2O status in soil after rice. However, it was significantly superior over that of 100 per cent RDFN (N_8) with respect to available N, over that of 100 per cent RDFN through different sources (N_1, N_2, N_3, N_4 and N_6) and 125 per cent RDFN (N_9) with respect to available P_2O_5 and over that of 100 per cent RDFN supplied through different sources with respect to available K_2O. Higher available nutrient status with integrated N management practices might be due to slow decomposition of organic components and the meager losses of N from these fractions, in addition to synergistic effect on P & K transformations as compared to chemical fertilizers over that of the initial nutrients level. Combined use of inorganic and organic source of N in rice increased the NPK status of soil after rice (Premi, 2003). There was higher amount of residual NPK in the soil with application of poultry manure @ 5 t ha^{-1} (Budhar *et al*, 1991). Judicious combination of organic and mineral sources has been known to mutually reinforce the efficiency of both these sources, resulting in higher productivity coupled with maintenance of soil fertility over long period in an eco-friendly manner (Hegde and Dwivedi, 1993).

Application of 100 per cent RDFN duly substituting 25 kg N through different organic sources (N_1, N_2, N_3, N_4) resulted comparable soil available NPK in the soil, similarly application of 125 per cent RDFN duly substituting 50 kg N through different organic sources (N_5, N_6, N_7) resulted at par status of NPK in the soil after rice. There was no significant difference in the status of available NPK in the soil after rice with application of either 100 per cent or 125 per cent RDFN except over P_2O_5 during 2000. Inorganic fertilization alone not capable of maintaining soil fertility (Subhashchandra *et al*, 2000).

During both the years, except available P_2O_5 in the soil, the available nutrient status after green gram was unaffected by residual effects of different seedling ages.,N management practices in rice and direct effects of green gram as well as their interaction were not significant (Table 2). Organic sources applied to preceding rice, either alone or in combination with inorganic N did not change the available NPK status of the soil after harvest of lentil in rice lentil cropping system. Application of 75 per cent RDFN + 25 Kg GM N + 25 Kg PM N (N_7) to rice resulted significantly higher available P_2O_5 in the soil after green gram over that of application of 100 per cent RDFN through different sources(N_1, N_2, N_3, N_4 N_8) during 1st year and application of 100 per cent RDFN (N_8) and 75 per cent RDFN + 25 K g VC N(N_3) during 2nd year in rice-green gram system. Application of 100 per cent RDFN to rice recorded significantly lower available P_2O_5 in the soil after green gram as compared to that of application of 125 per cent RDFN through different sources during 1st year and application of 75 per cent RDFN + 25 Kg GM N + 25 Kg PM N during 2nd year. During both the years, application of 100 per cent RDFN to green gram recorded significantly higher available P_2O_5 in the soil after green gram over that of application of 50 per cent RDFN to green gram in rice - green gram system. These results are in agreement with earlier findings of Gunavardena *et. al.* (1992).

LITERATURE CITED

Budhar, M. N., S. P. Palaniappan and A. Rangaswamy, 1991. Effect of farm wastes and green manuring on lowland rice, Indian J. Agron., 36(2): 251-252.

Gunavardena, B. N., S. K. A. Damso and F. Zapata, 1992. Phosphorus requirement and nitrogen accumulation by three mungbean *(Vigna radiatd)* cultivars, Plant and Soil., 147(2): 267-274.

Hegde, D. M. and B. S. Dwivedi, 1993. Integrated nutrient supply and management as a strategy to meet nutrient demand, Ferti. News., 38(2): 49-59.

Premi, O. P, 2003. Integrated nutrient supply for sustainable rice production in acid alfisol, Indian J. Agric. Res. 37(2): 132-135.

Singh, K. N. and J. Deka, 1990. Integrated nutrient supply system for sustainable crop production. Agronomy Research towards Sustainable Research, IARI Publication: 35-36.

Subashchandra., B. N. Ghosh., P.Singh and R. D.Singh, 2001. Effect of varying fertilization on yield of rice *(Oryza sativd)* - wheat *(Triticum aestivum)* system and soil fertility status, Indian J. Agric. Sci., 71(10): 631-633.

Swamianthan, M. S, 1987. In: International Symposium on Sustainable Agriculture, IRRI, Philippines, May 25-29.

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Utilization of F_2 Population to Exploit Hybrid Vigour in Sesame

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ABSTRACT

Commercial exploitation of heterosis, in absence of stable male sterile line, is laborious and expensive. Utilization of F_2 is an alternative approach to exploit hybrid vigour, wherever the residual heterosis is more and inbreeding depression is less. In the present investigation the presence of residual heterosis was up to 82.55 per cent in F_2 for seed yield plant^{-1} over *Phule Til-1*, a widely cultivated check variety. The crosses, Punjab *Til*-1 x RT-46, JLT-26 x RJS-17 and JLT-26 x SI-32 exhibited highest residual heterosis indicating commercial exploitation of residual heterosis in these cross combinations.

Sesame, *Sesamum indicum* L. is one of the most important ancient edible oilseed crops of India. India is the largest producer and exporter of sesame seed in the world. However, its productivity is very low due to its cultivation under rainfed situation with low input application and also use of low yielding cultivars. Therefore, to have a quantum jump in yield, exploitation of hybrid vigour and heterosis is gaining importance. Development of F_1 hybrids for any crop depends on the extent of magnitude of heterosis for yield and yield attributing traits as well as economical method for producing hybrid seeds. In sesame, several reports suggested presence of significantly high heterosis for yield and yield components. The floral biology such as epipetalous nature of flowers enable, easy hand emasculation and pollination with high per cent of success in seed setting and requirement of low seed rate per hectare compared to other crops increases the scope of heterosis breeding. But in the absence of male sterile lines the process of hand emasculation and pollination for hybrid seed production is highly cumbersome and expensive leading to high cost of hybrid seed. The present investigation was undertaken to study extent of heterosis in F_1 and residual heterosis present in second generation of hybrids i.e. F_2, so that F_2 seed can be utilized in place of costly F_1 seed to get appreciable amount of heterosis with low cost in seed and management. Another aim was to find out whether there is relationship between heterosis and superior segregants in F_2. The extent of heterosis and inbreeding depression can also give an idea about the genetic control of particular characters. To find out practical utility, the present investigation was carried out across the seasons.

MATERIAL AND METHODS

Thirteen sesame genotypes were crossed in line x tester model using five females (JLT-7, JLT-26, Punjab Til-1, RT-125 and Uma) and eight males (NIC-7829, NIC-7941, NIC-8316, SI-32, RJS-17, Keriya-7, BDN local and RT-46) during *kharif*,2003. A portion of the resultant 40 F_1's were raised and plants were selfed to obtain F_2 seeds during summer 2004. The generated materials *viz*. F_1 and F_2 were grown with their parents in a randomized block design with three replications during *Kharif*, 2004 and summer, 2005. In each replication the parents and F_1's were raised in single row and F_2's seven rows (each 4.5 m length) by adopting 45 x 15 cm spacing. Observations were recorded on 10 plants in parents and F_1's and 20 plants in F_2's in each replication for ten quantities characters, namely, days to maturity, plant height, number of branches plant^{-1}, number of capsule plant^{-1}, capsule length, number of seeds capsule^{-1}, test weight, oil content, harvest index and seed yield plant^{-1}. Phule *Til*-1 was used as standard check. Oil content was estimated by NMR technique. The over all poolled mean values of both seasons for each character in parents and hybrids were taken to estimate standard heterosis, inbreeding depression and residual heterosis.

RESULTS AND DISCUSSION

The range and best three crosses exhibiting standard heterosis, inbreeding depression and residual heterosis in desirable direction are presented in Table 1. In the present investigation, the maximum heterosis was observed for seed yield, followed by number of capsules plant^{-1}, harvest index, number of branches plant^{-1}, number of seeds capsule^{-1}, capsule length, test weight, plant

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Table 1. Best three cross combinations showing desirable standard heterosis , residual heterosis and inbreeding depression

S.N.	Characters / crosses	Standard heterosis	Residual heterosis	Inbreeding depression
1	Days to maturity	(-5.13 to 6.59)	(-3.11 to 6.41)	(-5.26 to 0.69)
	JLT-7 x RT-46	-5.13**	-2.75	-2.51
	JLT-26 x RT-46	-5.13**	-1.83	-3.47
	JLT-7 x NIC-7829	-4.03**	-1.10	-2.47
2	Plant height	(-23.39 to 11.52)	(-14.77 to 12.61)	(-16.06 to 18.35)
	JLT-7 x BDN local	11.52**	3.35**	7.32
	JLT-26 x NIC-7879	6.35**	-13.17**	18.35**
	JLT-7 x NIC-7941	6.02**	-8.17**	13.38**
3	No. of branches plant^{-1}	(-7.63 to 44.77)	(-4.29 to 30.00)	(-20.52 to 20.13)
	RT-124 x RJS-17	44.77**	30.00**	10.20**
	Uma x SI-32	42.37**	25.71**	11.70**
	Punjab til-1 x RT-46	41.91**	13.44**	20.13**
4	No. of capsules plant^{-1}	(-4.65 to 89.12)	(-0.78 to 64.15)	(-35.46 to 18.42)
	Punjab til-1 x RT-46	89.12**	64.15**	13.20
	Uma x RT-46	78.42**	49.82**	16.03**
	JLT-26 x RT-46	73.20**	59.44**	7.94
5	Capsule Length	(-3.17 to 16.75)	(-2.72 to 16.17)	(-14.56 to 9.33)
	Uma x Keriya-7	16.75**	15.60**	0.97**
	Punjab Til-1 x Keriya-7	11.71**	8.69**	2.71**
	JLT-26 x BDN local	10.96**	15.49**	-4.09**
6	No. of seeds capsules^{-1}	(1.06 to 31.78)	(-11.55 to 33.27)	(-14.56 to 21.31)
	RT-124 x SI-32	31.78**	-16.90**	11.29**
	Punjab Til-1 x RT-46	31.78**	33.27*	-1.13
	Uma x RT-46	29.35**	20.73**	6.67
7	Test Weight	(-3.92 to 15.69)	(-4.36 to 13.46)	(-8.65 to 12.56)
	Uma x NIC-7941	15.69**	1.16	12.56**
	JLT-7 x Keriya-7	15.26**	11.47*	3.29**
	RT-125 x Keriya-7	13.96**	8.71**	4.61**
8	Oil content	(-3.95 to 2.51)	(-2.29 to 3.71)	(-6.54 to 2.13)
	JLT-26 x BDN local	2.51**	0.65	1.81**
	RT-124 x NIC-7941	2.18**	2.46	0.28
	RT-124 x SI-32	1.94**	3.17	1.21
9	Harvest index	(4.00 to 52.77)	(-11.17 to 29.74)	(1.28 to 29.66)
	JLT-26 x NIC-7941	52.77**	29.74**	15.08**
	JLT-26 x SI-32	46.81**	17.22**	20.18**
	Punjab Til-1 x RT-46	46.26**	10.05**	24.76**
10	Seed yield plant^{-1}	(-4.02 to 105.34)	(2.01to 82.58)	(-43.90 to 22.3)
	Punjab Til-1 x RT-46	105.34**	78.12**	13.26**
	JLT-26 x RJS-17	94.86**	80.57**	7.33**
	JLT-26 x SI-32	93.52**	61.60**	16.49**

Figure in Parentheses indicates range for particular character

height and oil content in positive direction, whereas negative heterosis was observed for days to maturity. Positive and significant heterosis for seed yield, followed by capsule plant^{-1} and harvest index was reported by Sakhare *et al.* (1998). The maximum positive and significant heterosis for seed yield, followed by number of capsules plant^{-1}, number of seeds capsules^{-1}, number of branches plant^{-1} was reported by Senthil Kumar *et al* (2003). For seed yield the crosses, Punjab *Til*-1 x RT-46, JLT-26 x RJS-17 and JLT-26 x SI-32 recorded significant highest standard heterosis of 105.34, 94.86 and 93.52 per cent respectively. The hybrid Punjab *Til*-1 x RT-46 has also recorded significant standard heterosis for number of capsule plant^{-1}, harvest index, number of branches plant^{-1} and number of seed capsule^{-1}. Thus, heterosis for seed yield in this crops was due to simultaneous heterosis of yield attributing traits. It was in close agreement with findings of Karuppaiyan *et. al.* (2000) and Das *et. al.* (2000).

In respect of oil content, the extent of standard heterosis was very narrow and maximum of 2.51 was observed in hybrid JLT-26 x BDN local, which indicated that it could be very difficult to improve this traits and the increment was rather low. Balsane *et al* (1994) observed similar trend for this economic character.

The cross combination, JLT-7 x RT-46, JLT-26 x RT-46 and JLT-7 x NIC-7829 recorded significant negative heterosis for days to maturity and it could be considered for breeding programme to incorporate earliness trait.

Hybrid vigour is based primarily an allelic non additive gene action, while inbreeding depression is on allelic additive gene action (Fasoulas, 1980). Based on this theory, it is essential to study the F_1 and F_2 generation to distinguish whether the observed heterosis is due to fixable genes and to see whether the vigour is maintained or broken down.

In the present investigation, the majority crosses of the showed significant standard heterosis in F_1 and also showed significant inbreeding depression and residual heterosis over standard check in F_2 for character studied. But the magnitude of residual heterosis was more as compared to inbreeding depression for seed yield and important yield components like number of branches, number of capsules plant^{-1} and number of seeds capsule^{-1}.This is because of predominance of additive gene action or transgressive segregation. Similar observations were made by Kar and Swain (2003). In the present , the cross combinations *viz.* Punjab *Til*-1 x RT-46, JLT-26 x RJS-17 and JLT-26 x SI-32 showed substantial amount of standard heterosis and residual heterosis with low inbreeding depression for seed yield and also having white seed colour. However, it requires test verification across the environments for practical utility. Thus, the above crosses combination might be commercially exploited for cultivation in F_2 as the seed production cost was lower. Commercial exploitation of the crosses in F_2 having low inbreeding depression and significantly higher performance in F_2 over rulling check variety has also been advocated in *Brassica compestris* (Singh and Rai, 1995), Pisum (Singh *et. al.* 1995) and Sesame (Kar and Swain, 2003).

LITERATURE CITED

Balsane, A.G., B.B. Pawar and A.D. Dumbre, 1994. Studies on heterosis in sesame, J. Maharashtra Agric.Uni. 19 (1):140-141.

Das, K.; R.K. Chowdhury and A. Roy, 2000. Heterosis for yield and yield components in sesamum (*Sesamum indicum* L.) *P.K.V. Res. J.* 24 (1): 9-11.

Fasoulas, A., 1980. Principles and methods of plant breeding pub. No.11- Dept. of Genetics and Plant Breeding Aristotallian Uni. of Thessalonikii, Greece.

Kar, U.C. and D. Swain, 2003. Residual heterosis in F_2 generation of sesame (*Sesamum indicum* L.). Crop Res. (Hisar). 26 (1) : 126-130.

Karuppaiyan, R.; P. Ramaswamy, N. Arulmozhi, S. Santha, and N. Sundare Sun, 2000 Heterosis and inbreeding depression in sesame (*Sesamum indicum* L.), J.Oilseeds Res. 17 (2): 260-264.

Sakhare, S.B.; M.N. Narkhede and P.B. Ghorpade , 1998. Heterosis for yield and it's component in sesame (*Sesamum indicum* L). Annals Pl. Physiol. 12 (2) : 115-118

Senthil kumar, P.; P. Pushpa, and J.Ganesan, 2003. Heterosis for yield and yield components in sesame (*Sesamum indicum* L.). Sesame and Safflower news letter,No. 18 : 16-17.

Singh, M.N. and B. Rai and R.N. singh, 1995. Potentialities of heterosis breeding in Pisum, Indian Genet.54: 398-401.

Singh, P.K. and B. Rai, 1995. Study of inbreeding depression from F_2 to F_3 generation in inter varietals crosses of Indian rapeseed, *Brassica compstrics* L., Indian J. Genet. 55: 208-213.

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Evaluation of Soybean Germplasm By D^2 Analysis

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ABSTRACT

Using Mahalanobis D^2 137 germplasm lines of soybean were grouped into twelve clusters on the basis of seven quantitative characters of which cluster no. VI and III were the largest clusters consisting of 22 and 21 genotypes, respectively. The maximum inter cluster distance was recorded between cluster-II and VIII (34.276). The variance of cluster mean indicated that the number of pods plant^{-1}(78.48), followed by seed yield plant^{-1}(29.01) and plant height (24.40) had the high variances and hence were highly responsible for the genetic divergence in the present material. The genotypes G-56, W-42, G-105 and W-28 were identified as parent for crossing programme with IC-118057 and NS-14 on the basis of seed yield plant^{-1} and number of pods plant^{-1}.

In India, the area under soybean is 5.68 million ha producing 4.30 million tonnes of seed. The average productivity is 7.58 q ha^{-1} (Anonymous, 2003). During the year 2002-2003 soybean covered an area of about 15.60 lakh ha. in Maharashtra having production of 19.50 lakh tonnes of seed the productivity was 1253 kg ha^{-1} (Anonymous, 2003). In Nagpur district itself, area under soybean cultivation is 182.499 lakh ha having production of 98500 mt(Anonymous, 2006). Soybean, a major oilseed crop of India, is contributing to the extent of one tenth of domestic edible oil pool and the country earns substantial foreign exchange through the export of soy-meal. Soybean protein contains all the essential amino acids vital for human diet. Besides protein and oil, soybean contains 20.9 per cent carbohydrate, 60 per cent polyunsaturated fatty acids (52.3% linolenic acid + 7.29% linoeic), Vitamin A (710 I.U.), Vitamin B (300 I.U.) Vit. C, D, E, K 0.69 per cent, phosphorus 0.0115 per cent, iron 0.0024 per cent, calcium and all other essential amino acids. However, overall improvement in yield, oil and protein content in soybean remains a perpetual task to be accomplished by the plant breeders. Knowledge on genetics of soybean has an immense importance and in tune with immediate need in the selection of parents to be used in hybridization programme for obtaining desirable genetic recombination. The present studies were, therefore, undertaken to ascertain the genetic divergence in available 137 Soybean germplasm lines.

MATERIAL AND METHODS

The experimental material consisted of 137 exotic and indigenous soybean germplasm lines. These genotypes were grown in randomized complete block design in two tier. Each plot consisted of one row with 10 plants with spacing of 45cm x 5cm, at the farm of Agricultural Botany Section, College Of Agriculture, Nagpur during *Kharif* 2004-2005. The observations were recorded for seven characters namely, days to maturity, plant height (cm), number of branches plant^{-1}, number of pods plant^{-1}, 100 seed weight (g), seed yield plant^{-1} and oil content per cent on five randomly selected competitive plants. The data were subjected to Mahalanobis D^2 statistics (Mahalanobis, 1936) and the criterion used by Tocher (Rao,1952) was followed for making group constellation. The computer package of INDOSTAT was used for analysis.

RESULTS AND DISCUSSION

The analysis of variance exhibited significant differences among the soybean genotypes for all the seven characters studied, which indicated the existence of significant amount of variability among the genotypes. The test of significance of differences in the mean values based on Wilk's criterion revealed highly significant differences between the genotypes for the aggregate of seven characters (x^2 = 4417.71 at 952 d. f.). On the basis of D^2 analysis, the 137 genotypes were grouped into twelve clusters (Table-1) . The maximum number of genotypes (22) were included in cluster VI, followed by cluster III (21 genotypes).

The generalized intra cluster distance range was from 9.66 (cluster IX) to 16.00 (cluster I). The maximum inter cluster distance was recorded between cluster II and cluster VIII (D=34.276), followed by cluster II and cluster VII (D=34.236), where as the minimum inter cluster distance (D=13.906) was observed between cluster IX and XII, suggesting that the genetic constitution of the

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Table 1. Distribution of 137 genotypes of soybean in different clusters

Cluster	Total no. of genotypes	Genotypes
I	4	W-42, IC-116359, W28, G-105
II	2	G-56, IC-112038
III	21	WL-1492, EC-250616, WC-128, W-139, W-41, EC-241-401, EC-37-933, IC-96361, NS-9, R-56, IC-117948, W-105, NS-122, W-37, G-94, NIC-19868, JS-335, NS-27, NS-101, NS-56, R-67
IV	16	WC-39, IC-117938, G-89, NS-132, IC-118057, DSB-1, NS-14, W-71, IC-118601, NRC-52, NS-88, EC-49-179, EC-3853, NS-82, NS-85, IC-118362
V	12	G-26, G-76, NS-60, WC-62, IC-18748, R-119, EC-2409333, R-190, R-185, W-63, NS-85, W-113
VI	22	G-4-17, IC-116359, NS-1, IC-118296, R-17, NS-129, NS-130, Kuber, R-62, NS-3813, CHAMATKAR, W-183, DSB-5, NS-96, IC-118476, IC-108448, BRAGG, JS-7105, EC-39-147, IC-118013, EC-385314
VII	15	W-122, IC-118530, IC-11852, IC-118532, IC-118044, IC-18756, IC-118912, IC-118045, IC-118615A, NS-47, IC-118487, IC-118041, IC-118999, IC-96377, IC-184
VIII	7	IC-118042, IC-118912, R-170, IC-208448, IC-118233, IC-118053, Ec-118013
IX	10	WC-13, JS-8021, EC-193153, IC-117946A, W-17, NS-2, R-73, IC-10638, NS-59, NS-26
X	6	G-64, EC-25-1323, NS-126, EC-25146, R-89, W-141
XI	3	WC-19, WC-84, EC-3853231
XII	19	G-35, IC-289034, NS-30, EC-251330, IC-90356, NS-215 (EGLE), IC-118319, RCS-2, R-7, NS-200, R-171, IC-117899, NS-77, EC-2515, WC-63, NS-8, IC-118398, IC-118463

Table 2. Average Intra and Inter- cluster distance ($D = \sqrt{D^2}$) by Tocher's ethod

Cluster	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
I	(16.00)	22.382	19.248	22.294	19.765	22.929	31.521	32.186	26.492	30.287	24.351	28.722
II		(14.356)	19.207	29.246	25.874	28.618	34.236	34.276	20.924	22.783	24.476	26.645
III			(10.720)	16.792	17.627	16.501	24.145	22.020	14.353	21.536	17.519	18.438
IV				(12.457)	17.026	16.031	25.666	20.655	22.674	30.667	21.040	23.777
V					(11.192)	23.176	34.181	30.276	25.225	34.089	27.369	30.109
VI						(11.500)	16.817	15.811	18.775	24.401	18.080	16.685
VII							(11.541)	15.442	21.581	22.912	20.657	15.029
VIII								(10.849)	20.259	25.589	19.571	15.993
IX									(9.668)	16.364	19.599	13.906
X										(14.323)	20.522	16.373
XI											(10.364)	17.396
XII												(11.157)

D= 19.09 Figure in parentheses indicates intra cluster distance

Table-3. Cluster means for seven quantitative characters in soybean

Cluster	Days to maturity	Plant height (cm)	No. of branches plant^{-1}	No. of pods plant^{-1}	100 Seed weight (g)	Seed yield plant^{-1} (g)	Oil content (%)
I	98.87	47.07	2.87	37.85	8.07	8.08	17.84
II	103.00	49.17	4.30	32.76	7.92	6.07	19.86
III	93.97	45.18	2.74	26.04	7.79	5.90	20.60
IV	93.90	44.84	1.47	26.68	8.41	6.79	21.29
V	92.83	44.13	2.48	36.35	7.90	8.72	21.67
VI	94.29	43.31	1.45	20.89	7.35	5.12	19.44
VII	93.80	33.58	1.23	13.67	6.85	2.57	18.32
VIII	93.71	38.33	0.92	14.49	7.74	3.10	21.19
IX	93.45	45.27	2.86	20.05	6.73	3.98	21.13
X	96.00	51.40	3.35	12.74	7.26	2.62	18.97
XI	96.83	38.40	2.37	20.26	9.96	4.00	19.44
XII	94.50	44.02	2.15	15.18	7.05	2.90	19.78
S.D.	2.92	4.94	0.97	8.85	0.86	5.38	1.23
Variance	8.57	24.40	0.94	78.48	0.74	29.01	1.52

Table 4. Contribution of different quantitative characters towards Genetic Divergence (D^2) in Soybean

S.N.	Character	Times ranked Ist	Percentage Contribution
1.	Days to Maturity	163	1.75
2.	Plant Height (cm)	8	0.09
3.	Pods Plant^{-1}	77	0.83
4.	Branches Plant^{-1}	2710	29.09
5.	100 seed weight (g)	985	10.57
6.	Yield Plant^{-1}	4122	44.25
7.	Oil Content, %	1251	13.43
	Total	**9320**	**100.00**

genotypes in one cluster is in close proximity with the genotypes in other cluster of the pair (Table 2).

The comparison of cluster mean (Table 3) for seven characters under study marked considerable genetic differences between groups. The importance of using cluster means based on the correlated data to know the relative importance of the characters in causing genetic divergence was reported by Bains and Sood (1984). The variances of cluster mean were calculated for all the seven quantitative characters and the result

Table 5: Important characteristics of the selected germplasm lines

Genotypes	Days to maturity	No. of pods plant^{-1}	100 seed weight (g)	Seed yield plant^{-1} (g)	Oil content (%)	Growth habit	Flower colour	Pubescence
G-56	102	37.3	8.9	7.2	20.1	In Determinate	Purple	Normal
W-42	96.5	38.4	7.7	8.7	18.4	Determinate	White	Dense
G-105	103	35.4	8.9	6.1	16.9	Determinate	Purple	Normal
W-28	103	31.4	8.1	9.5	18.9	Determinate	Purple	Normal
IC- 118057	93.0	35.3	7.6	6.8	21.1	Determinate	White	Normal
NS-14	93.5	36.7	8.7	5.9	22.1	In Determinate	White	Normal

indicated that the number of pods plant $^{-1}$ (78.5), seed yield plant $^{-1}$ (29) and plant height (24.4) were important sources of variation, which suggests that these characters were highly responsible for genetic divergence in the present material. The contribution of different quantitative characters towards genetic divergence (Table -4) indicated that seed yield plant $^{-1}$, number of branches plant $^{-1}$, oil content, 100 seed weight, days to maturity and number of pods plant^{-1} were important sources of variation. Thus the selection of parents for hybridization and subsequent genetic improvement may be made on the basis of the characters exhibiting maximum variation and expected to be genetically diverse.

This study projects the importance of parents G-56, W-42, G-105, W-28 as parents for obtaining useful segregants in subsequent generation as they have high number of pods plant^{-1}, optimum plant height and determinate growth habit (Table 5). Similarly IC-118057 and NS-14 also appeared promising for their involvement in crossing for the isolation of high yielding segregates.

LITERATURE CITED

Anonymous, 2003. Oilseeds situation - A statistical compendium-2002, DOR, Hydrabad.

Anonymous, 2006. Potential linked credit plan ABARD, Nagpur.

Bains K S and Sood K C. 1984. Resolution of genetic divergence for choice of parents in soybean Breeding, Crop Improvement 11: 20-24.

Mahalanobis P C. 1936. On the generalized distance in statistics, *Proceedings,* National Institute of Science, India, 12:49-55.

Rao C R. 1952. Advanced Statistial Methods in Biometric Research. Ed. II, John Wiley and Sons, Inc. New York.

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Effect of Organic and Inorganic Manures on Growth, Flowering and Seed Yield of Coriander

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ABSTRACT

Application of 50 per cent RDF + 50 per cent vermicompost (T_4) was found effective in increasing plant height (49.88 cm), number of primary (6.44) and secondary branches (15.37), minimum number of days to 50 per cent flowering (39.01), days to seed set to seed harvesting (37.73), maximum fresh weight (22.52 g) and dry weight of plant (15.63 g), number of umbels plant^{-1} (19.99), number of umbellate umbel^{-1} (5.10), number of seeds umbellate^{-1} (4.31), test weight (11.79 g), number of seeds plant^{-1} (439) and seed yield plant^{-1} (6.65 g), which was at par with treatments 50 per cent RDF + 50 per cent FYM (T_5) and 50 per cent RDF + 25 per cent vermicompost + 25 per cent FYM (T_6). However, maximum germination percentage (57.22) was recorded in treatment T_4 which was significantly superior over all other treatments. Minimum value for all above parameters were recorded in treatment control.

Coriander is used as a spice and food flavouring agent throughout the world and enjoys a unique position in seed spices both the herb and spice above all are valued as they add taste to an otherwise monotonous diet. Apart from local consumption, a large quantity of these minor spices being exported to different parts of the world and play a significant role in our national economy. In order to exploit the yield potential of coriander, the feature affecting yield and yield components need to be thoroughly investigated. The addition of organic manures viz., FYM and vermicompost is known to improve fertility status of soil.

Use of organic manures and their combination with inorganic fertilizers has not been tried and exploited to augment its production under Marathwada condition. The present investigation was therefore, undertaken to study the influence of organic manure and inorganic manures on growth and seed yield of coriander Cv. Pant Haritma.

MATERIAL AND METHODS

An experiment was undertaken at Department of Horticulture, Marathwada Agricultural University, Parbhani. Seeds of Coriander were rubbed and sown at 30 x 30 cm (3 to 4 seeds hill^{-1}) on flat bed. The seven treatments were T_1- 100 per cent RDF (60 : 30:30 kg ha^{-1}), T_2-100 per cent vermicompost, T_3-100 per cent FYM, T_4-50 per cent RDF + 50 per cent vermicompost, T_5-50 per cent RDF + 50 per cent FYM, T_6-50 per cent RDF + 25 per cent vermicompost + 25 per cent FYM and T_7-Control

Table 1 : Effect of organic and inorganic mannures on growth and flowering of coriander Cv. Pant Haritma

S. N.	Treatments	Vegetative parameter			Flowering parameter	
		Plant height (cm)	Primary Branches plant^{-1}	Secondary branches plant^{-1}	Days to 50 per cent flowering	No. of days required for seed set to harvesting
1	100 % RDF (60 : 30 : 20 kgha^{-1})	46.45	5.12	13.58	42.78	40.11
2	100 % vermicompost	46.73	4.70	13.40	42.86	41.18
3	100 % FYM	45.29	4.30	12.86	43.72	41.32
4	50 % RDF + 50 % vermicompost	49.88	6.44	15.37	39.01	37.73
5	50 % RDF + 50 % FYM	48.16	5.96	14.27	39.98	38.65
6	50 % RDF + 25 % Vermicompost + 25% FYM	47.55	5.50	14.06	41.04	39.39
7	Control (without any fertilizer)	45.00	3.90	10.36	44.70	42.66
	S.E. (m) ±	0.89	0.24	0.56	0.87	0.61
	C.D. at 5%	2.75	0.76	1.72	2.69	1.89

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Table 2 : Effect of organic and inorganic mannures on seed yield and germination percentage of coriander Cv. Pant Haritma

S.N.	Treatments	Yield parameter							Quality parameter	
		Fresh weight of plant (g)	Dry weight of plant (g)	Umbels plant^{-1}	Umbellate umbel^{-1}	Number of seed umbellate^{-1}	Number of seed plant^{-1}	Seed yield plant^{-1} (g)	Test weight (g)	Germination percentage
1	100 % RDF (60 : 30 : 20 kg ha^{-1})	20.17	12.13	17.51	4.47	3.78	386	5.86	10.76	54.03
2	100 % vermicompost	19.58	10.28	16.89	4.31	3.65	373	5.65	10.40	53.46
3	100 % FYM	19.16	9.96	16.50	4.21	3.56	364	5.51	10.60	52.16
4	50 % RDF + 50 % vermicompost	22.52	15.63	19.99	5.10	4.31	439	6.65	11.79	57.22
5	50 % RDF + 50 % FYM	21.09	13.00	18.96	4.84	4.09	418	6.34	11.46	55.21
6	50 % RDF + 25 % Vermicompost + 25% FYM	20.54	12.67	19.25	4.91	4.16	425	6.23	11.10	54.16
7	Control (without any fertilizer)	18.48	8.96	13.87	3.54	3.00	307	4.64	9.74	51.24
	S.E. (m) ±	0.66	1.07	0.98	0.25	0.21	21.64	0.29	0.29	0.56
	C.D. at 5%	2.06	3.31	3.04	0.77	0.65	66.61	0.92	0.91	1.75

laid out in Randomized Block Design and replicated thrice. Organic manures were added 15 days before sowing (FYM @ 20 t ha^{-1}, vermicompost @ 5 t ha^{-1}). Full dose of P and K and half dose of N was applied at the time of sowing. Top dressing of N was done 30 days after sowing. All the cultural practices were done as and when required. Observations on growth and seed yield were recorded. The observational data were subjected to statistical analysis.

RESULTS AND DISCUSSION

The data presented in Table-1 indicated that maximum plant height (49.88 cm), primary branches $plant^{-1}$ (6.44) and secondary branches $plant^{-1}$ (15.37) were recorded in treatment T_4 (50% RDF + 50% Vermicompost). The minimum plant height (45.00 cm), primary branches $plant^{-1}$ (3.90) and secondary branches $plant^{-1}$ (10.36) were observed in treatment T_7 (control). The present results were in conformity with the findings of Singh and Singh (2003) in onion. This increased vegetative growth might be due to increased availability of nutrient with increased metabolites.

Data regarding flowering depicted in Table 1 revealed that minimum days required for 50 per cent flowering (39.01) and number of days required for seed set to harvesting (37.73) were recorded in treatment T_4 (50% RDF + 50% vermicompost). The maximum days required for 50 per cent flowering (44.70) and number of days required for seed set to harvesting (42.66) were observed in treatment T_7 (Control). The results are in accordance with Sonawane (2003) in Okra crop.

Regarding yield, Table 2 indicated maximum fresh weight of plant (22.52 g), dry weight of plant (15.63 g) umbels $plant^{-1}$ (19.99), umbellate $umbel^{-1}$ (5.10), number of seed $umbellet^{-1}$ (4.31), number of seed, $plant^{-1}$ (439), seed yield $plant^{-1}$ (6.65) were recorded in treatment T_4 (50% RDF + 50% Vermicompost). The minimum fresh weight of plant (18.48), dry weight of plant (8.96), umbels $plant^{-1}$ (13.87), umbellate $umbel^{-1}$ (3.54), number of seeds $umbellate^{-1}$ (3.00), number of seed $plant^{-1}$ (307), seed yield $plant^{-1}$ (4.64) were recorded in treatment T_7 (control). The present findings are supported by the findings of Vasmate (2004) in coriander.

Regarding quality parameter Table-2 showed that maximum test weight (11.79) and germination percentage (57.22) were recorded in treatment T_4 (50% RDF + 50% vermicompost) and minimum test weight (9.74) and germination percentage (51.24) were recorded in treatment T_7 (control). Similar findings were reported by Vasmate (2004) in coriander. Maximum test weight and germination percentage were observed because of availability of nitrogen in the soil for long duration. As vermicompost reduces the leaching losses resulted in increased availability of nitrogen for longer period. There was superior and desired reproductive growth which might have observed more due to, availability of nutrients by the application of organic and inorganic fertilizers. Organic manure increased the water holding capacity as well as activity of beneficial micro-organisms at desired level with subsequent release of nitrogen and organic acid, which helped in reproductive growth and ultimately increased seed yield. The increase in growth and yield might be due to vigorous vegetative growth and accelerated chlorophyll contents which together accelerate the photosynthesis rate and thereby increased the supply of carbohydrates (Chinball, 1992).

From the above results, it can be concluded that application of 50 per cent RDF + 50 per cent vermicompost (T_4) is effective for enhancing plant growth, reproductive parameter, seed yield and quality of coariander.

LITERATURE CITED

Chinball, A.C. 1992. Distribution of nitrogen in the dead leaves runner bean, Bio. Chem. J., 16 : 600-610.

Singh, A and Singh S.P. 2003. Effect of VAM and NPK application on growth and yield of onion (*Allium cepa* L.), Approaches for sustainable development of onion and garlic, 223-227.

Sonawane, K.N., 2003. Studies on efficacy of neem cake vis-à-vis inorganic fertilizers on growth yield and quality of okra (*Abelmoschus esculentus* L.). M.Sc. (Agri.) Thesis (Unpub), M.A.U., Parbhani.

Vasmate, S.D. 2004. Effect of spacings and organic manures on growth and seed yield of coriander. M.Sc. (Agri.) Thesis (Unpub)., M.A.U., Parbhani.

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Fly Ash a Boon for Improving Physico-chemical Properties of Vertisol

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ABSTRACT

A field experiment was conducted at Marathwada Agriculture University , Parbhani during *Kharif* season of 1997-98 on Vertisol in order to study the effect of graded levels of fly ash and FYM on physical properties and yield of groundnut (Var-SB-11) . The results indicate that application of 30 t ha $^{-1}$ fly ash showed reduction in bulk density and water holding capacity while increase in porosity and infiltration rate. Whereas, application of FYM showed decrease in bulk density and increase in water holding capacity, porosity and infiltration rate. The pod yield and haulm yield of groundnut was found to be increased due to application of fly ash and FYM.

Fly Ash is an industrial waste or byproduct of thermal power station which is obtained when pulverized coal is burnt for generation of electricity. The disposal of fly ash at thermal power station demands a search for its utilization in different industries that may hold promise for its large scale consumption. Out of the ten thermal power plants, Parli-Vaijnath is situated in Marathwada region (M.S.). About 781.2 hectare of land is occupied by thermal power station at Parali (V), out of which 445.10 hectare of land corresponding to 56.98 per cent land is occupied by ash bunds. It is observed that very large chunk of thermal power plants has to be left for storage of fly ash. This may pose a problem of acquiring more and more aerable land in future.

The fly ash is relatively lighter and its application to heavy soil may make them porous and less compact improving their drainage and aeration. The fine texture of the fly ash and the presence of several natural elements in it have reflected on number of important physico-chemical properties of soil from the point of view of crop production (Towsend and Hodgson, 1978 and Adrino *et al.*, 1980).

The increasing price of fertilizer limits fertilizer use among the poor farming community. This situation leads to decrease in soil fertility and productivity. Besides natural supply improvement of physical properties and infiltration rates need to be addressed though use of fly ash. With these facts in view, the present investigation was undertaken to find out suitability of fly ash for improving the physico-chemical properties of soil and boosting the yield of groundnut.

MATERIAL AND METHODS

The experiment was conducted at Marathwada Agriculture University , Parbhani during *Kharif* season of 1997-98 on Vertisol with groundnut crop (Var-SB-11) as a test crop. The experiment was laid out in Randomized Block Design with three replications and seven treatments viz. control, fly ash @ 10, 20 and 30 t ha^{-1}, FYM @ 10, 20 and 30 t ha^{-1} Fertilizer dose (25: 50 : 50 NPK kg ha^{-1}) was applied at the time of sowing through Urea, SSP and MOP, respectively. Fly-ash and FYM was applied before sowing of crop. The soil samples were collected before sowing and after harvest of crop and analysed physico-chemical properties by following standard methos (Jackson,1967 and Black, 1965). The experimental soil belongs to the order Vertisol. The soil was clayey in texture,slightly alkaline in reaction (7.86) and medium in organic carbon.

RESULTS AND DISCUSSION

Effect of FLY-ash and FYM on physical properties of soil

Bulk density : The application of various levels of fly ash and FYM significantly reduced the bulk density in soil than control plots (Table 1). Highest reduction i.e. lowest value of BD (1.12 g cm^{-3}) was recorded in treatment 30 t FYM ha^{-1}, while increasing levels of fly ash (0-30 t ha^{-1}) significantly reduced the BD from 1.26 to 1.18 g cm^{-3}. The decrease in bulk density of soil may be attributed to increase in coarse sand and fine sand sized particles due to application of varied levels of Fly-ash which might have altered the configuration and arrangement of the soil particles due to which the soil was loosened and the

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total porosity of soil was increased. Addition of FYM might have helped in development of aggregation in soil which ultimately resulted in increased the porosity and lowered the bulk density. Sarkar *et al.* (1989) also reported the decreased bulk density due to FYM application.

Porosity : The total porosity of soil ranged from 54.35 to 66.94 per cent. Soil porosity significantly increased with increased levels of Fly-ash FYM. Highest porosity (66.94 %) was observed due to application of 30 t ha^{-1} followed by 20 t FYM ha^{-1} and 30 t ha^{-1}

Water holding capacity: The addition of increasing levels of Fly-ash decreased the water holding capacity of soil from 52.10 per cent (control) to 49.18, 47.20, and 44.12 per cent due to application of 10, 20, 30 t ha^{-1} of fly-ash while, increasing levels of FYM increased the water holding capacity from 52.10 per cent (control) to 53.20, 56.20, and 60.47 per cent due to application of 10, 20, 30 t $ha^{-1}$of FYM, respectively.

Infiltration rate: Infiltration rate of soil (Table 1) significantly increased with the increasing levels of Fly-ash and FYM. The lowest Infiltration rate (2.35 cm hr^{-1}) was recorded in the control treatment whereas highest Infiltration rate (3.36 cm hr^{-1}) was recorded in the treatment of 30 t fly-ash ha^{-1}. The increase in porosity and infiltration rate of soil due to addition of Fly-ash and FYM which probably opened up the clayey soils and bigger particles from Fly-ash and improved soil aggregation by FYM might have increased the macropores, resulting in increased porosity of soil. The macropores might help in downward movement of water. Similar results were also reported by Chang (1977).

Effect of fly-ash and FYM on chemical properties of soil

Soil pH: The data presented in Table-2 indicated that there were no significant effects of fly ash levels on soil pH, while the treatments of FYM levels significantly decreased the pH of soil. The lowest pH of soil was recorded i.e. 7.70 in the treatment of FYM 30 t ha^{-1} and the highest pH value of soil i.e. 7.86 was by fly ash 20 t ha^{-1}.

Electrical conductivity:Electrical conductivity significantly increased due to both fly-ash and FYM treatments with increasing levels. The addition of 10, 20 and 30 t fly-ash ha^{-1} showed increased value of electrical conductivity of soil to 0.36, 0.39 and 0.42dSm^{-1} ,respectively. Similarly, increasing levels of FYM 10,20 and 30 t ha^{-1} also increased the electrical conductivity of soil to 0.34, 0.35 and 0.35 dSm^{-1}, respectively.

$CaC0_3$ content :The results on $CaC0_3$ content in soil showed slightly increase by the addition of fly ash, while the $CaCO_3$ content in soil was decreased due to addition of increasing levels of FYM. However, the results are statistically non significant.

Organic carbon: As regards to the results presented on organic carbon per cent in soil indicated the decrease with increasing levels of fly ash treatment, while it was increased significantly with increasing levels of FYM treatments. The lowest (0.59 %) organic carbon content in soil recorded with higher dose i.e. 30 t ha^{-1} of Fly-ash treatment, while the highest (0.85 %) organic carbon content was recorded with 30 t ha^{-1} FYM treatment.

Table 1. Effect of Fly-ash and FYM on physical properties of vertisol

Treatments	Physical properties			
	Bulk density (gm cm^{-3})	Porosity (%)	WHC (%)	Infiltration Rate (cm hr^{-1})
Control	1.26	54.35	52.10	2.35
Fly-ash10 t ha^{-1}	1.23	57.20	49.18	2.74
fly ash 20 t ha^{-1}	1.21	59.47	47.20	3.27
fly ash 30 t ha^{-1}	1.18	62.67	44.12	3.36
FYM 10 t ha^{-1}	1.20	60.10	53.20	2.91
FYM 20 t ha^{-1}	1.16	64.20	56.10	3.07
FYM 30 t ha^{-1}	1.12	66.94	60.47	3.10
SEm±	0.02	0.48	0.56	0.11
C.D.=0.05	0.06	1.48	1.72	0.36

Table 2. Effect of fly ash and FYM on chemical properties of vertisol.

Treatments	Chemical properties			
	pH	EC (ds m^{-1})	CaCo3	Org. 'C' (%)
Control	7.84	0.33	7.35	0.69
Fly-ash10 t ha^{-1}	7.85	0.36	7.39	0.64
Fly ash 20 t ha^{-1}	7.86	0.39	7.42	0.62
Fly ash 30 t ha^{-1}	7.85	0.42	7.44	0.59
FYM 10 t ha^{-1}	7.79	0.34	7.30	0.70
FYM 20 t ha^{-1}	7.74	0.35	7.27	0.78
FYM 30 t ha^{-1}	7.70	0.35	7.24	0.85
SE (m)±	0.014	0.001	0.48	0.020
C.D.=0.05	0.045	0.004	NS	0.082

of fly ash may be attributed to the fact that soluble salts from Fly-ash might have been dissolved in soil moisture and thereby increased the ionic concentration of soil solution. Further, it can be explained that fly ash is a burnt material, it is mostly inorganic one and contains very less organic carbon. The results are in conformity with the findings of Kene *et al.* (1991).In case of FYM addition there was significant reduction in soil pH and EC which might be due to release of organic acids produced during decomposition of added FYM might have buffering capacity which kept soil pH at optimum level. The dissolved ions in the soil solution from FYM could cause increase in EC of soil. Similar results were also reported by Sharma *et. al.* (1983).

The organic carbon status of soil was also improved significantly with addition of various levels of FYM as it contained large amount of organic matter. These observations are in close conformity with the findings of Maurya and Ghosh (1972).

Effect of fly-ash and FYM on yield of groundnut

The pod and haulm yield of groundnut significantly increased due to various levels of Fly-ash and FYM (Table 3). In respect of fly ash treatment maximum yield (15.9 q ha^{-1}) was recorded due to the application of 30 t fly ash ha^{-1} and was at par with 20 t FYM ha^{-1} (15.10 q ha^{-1}). However, in case of FYM each increasing level significantly increased the pod yield and significantly highest pod yield (22.70 q ha^{-1}) was recorded due to application of 30 t FYM ha^{-1}.

Similar trend was observed in case of haulm yield of groundnut in respect of fly ash and FYM treatments.

Table 3. Mean pod yield and haulm yield of groundnut as influenced by varying levels of fly ash and FYM

Treatments	Pod yield (q ha^{-1})	Haulm yield (q ha^{-1})
Control	13.1	48.12
Fly-ash10 t ha^{-1}	14.55	50.49
Fly-ash 20 t ha^{-1}	15.10	53.00
Fly-ash 30 t ha^{-1}	15.90	55.20
FYM 10 t ha^{-1}	17.67	62.77
FYM 20 t ha^{-1}	20.10	70.35
FYM 30 t ha^{-1}	22.70	79.45
SE (m) ±	0.32	0.88
C.D.=0.05	0.99	2.73

Application of fly ash resulted into higher yield may be attributed to over all improvement in soil physical and physico-chemical environment of the clayey soils which could have led to the better nutrients and growth of crop. Similar results were obtained by Matte and Kene (1995).

Correlation studies

Application of varying levels of fly ash and FYM to black soil significantly improved the porosity, water holding capacity and decreased the BD which helped to improve the yield of groundnut crop. Similarly application of fly ash and FYM improved organic carbon and reduced pH, EC which increased the crop yield (Table 4)

Table 4. Correlation coefficients for physical and chemical properties and pod yield of groundnut.

S.N.		Physical properties			
		Porosity	Water holding capacity (%)	Infiltration rate (cm hr^{-1})	Pod yield
1	Bulk density	-0.832**	-0.205	-0.393	-0.734**
2	Porosity		0.274	0.445*	0.910**
3	Water holding capacity			-0.385	0.584**
4	Infiltration rate				-0.193
		Chemical properties			
		EC (dSm^{-1})	$CaCO_3$ (%)	Organic carbon (%)	Pod yield
5	pH	0.713**	0.059	-0.854**	-0.916**
6	EC (dSm^{-1})		0.102	-0.765**	-0.479*
7	$CaCO_3$ (%)			-0.121	0.002
8	Organic carbon (%)				0.735**

Note- * and ** = Significant at 5 and 1 per cent level of probability, respectively.

The increase in electrical conductivity and decrease in organic carbon content of soil due to addition

LITERATURE CITED

Adrino, D.C., A.L.Page, A.A.Elssewi, A.C.Chang, and I. Straughan, 1980, Utilization and disposal Fly-ash and other coal residues in terrestrial ecosystem a review. J. Envi. Qual 9:333 -344.

Black, C.A. (1965). Methods of Soil Analysis Part I and II American Soc. Agron. Madison U.S.A.

Chang,A.C., L.J.Land, A.A.Page and J.E.Warneke, 1977, Physical properties of Fly-ash amended soil, J. Envi. Qual., 6:267-270.

Jackson, M.L. 1967. Soil chemical Analysis, Prentice Holl of India Pvt. Ltd. New Delhi.

Kene,D.R., S.A.Lanjewar, B.M. Ingole and S.D.Chaphale, 1991, Effect of application of coal Fly-ash on Physico-chemical properties of soil, J. Soil and Crop,1(1):11-18.

Matte, D.B., and Kene, D.R.(1995). Utilization of fly ash for the beneficial use in Agriculture, Seminar Sanskrutik Bhavan, TPS Colony, Parali (Vaij.). Dist Beed, M.S., India.

Maurya,P.R. and A.B.Ghosh, 1972, Effect of long-term manuring and rotational cropping on fertility status of alluvial calcareous soil, J. Indian Soc. Soil sci. 20(1):31-43.

Sarkar,A.K., B.S. Mathur, S. Lal and K.P. Sing, 1989. Long term effect of manure and fertilizer on important cropping systems in sub-humid red and lateritic soil, Fert. News 34(4):71-80.

Sharma, N., Srivastava, L.L. and Mishra, B. 1983. Studies on microbial changes in soil as result of continous application of fertilizers, FYM and lime, J. Indian Soc. Soil Sci., 31 : 202-206.

Towsend, W.N. and D.R.Hodgson, 1978. Edophological problems associated with deposits of pulverized fuel ash, Residue Review (1979) 71:83-120.

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Impact of Organic Farming System on Soil Properties – A Case Study

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ABSTRACT

An investigation was undertaken to compare the soil properties under organic and conventional production system, practiced in a cluster of villages in Yavatmal district, Maharashtra. Fifty two surface (0-15 cm) soil samples (41 organic and 11 conventional) were studied and the results indicated that soils under both the systems were alkaline. However, the mean organic carbon in the surface soils under organic system (9.2 g kg^{-1}) was higher than the conventionally cultivated soils (7.0 g kg^{-1}). The soils under organic system had a higher Zn content (0.82 ppm) as against 0.61 ppm in the conventional system. The semi-arid climate of this region induces $CaCO_3$ formation through $Ca(HCO_3)_2$. Organic cultivation reverted this natural degradation by dissolving $CaCO_3$ formed. The study indicated beneficial effect of organic production system on those soil properties that improve nutrient and microbial activity.

Organic production system is becoming popular but whether this system is sustainable is debatable. Its proponents argue that yields could be sustained without increasing the supplies by tightening the nutrient cycles and diversification of soil biota (Thampan 1995). Its critics argue that 15-20 tonnes of manure are annually required to produce the same effect, otherwise obtained through the conventional system (Pieri, 1995) and such huge quantities cannot be generated internally in the tropical farming systems (Bationo and Mokwunye 1991). An investigation was undertaken to compare the chemical and biological properties of soils of an organically managed farm of Yavatmal district, Maharashtra with those of an adjoining conventionally managed farm.

MATERIAL AND METHODS

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. The region has a hot-semiarid climate. Random surface soil samples (0-15 cm) were collected from Akola Bazar, Pimpri, Hatgaon, Borgaon, Pahur and Uttarawadhona under organic systems and conventional systems. Fifty two surface soil samples (forty one under organic and rest conventional) were randomly collected. Organic carbon content in soils was determined by Walkely and Black procedure (Jackson, 1973), pH electrical conductivity (EC) and $CaCO_3$ by standard procedure (Richards, 1954). Exchangeable Ca and Mg following extraction with 1N NH_4OAC (Jackson, 1973) and available Zn following extraction with DTPA and soil microbial biomass carbon (SMBC) (Vance *et al.* 1987). Data on yield of component crop were collected by interviewing the farmers practicing either system.

RESULTS AND DISCUSSION

The range and means of chemical and biological properties of the surface soils have been presented in Table 1. Only those properties which seem to have impact on the organic farming are discussed.

The mean soil pH and the $CaCO_3$ were lower under the organic production system compared to conventional one (Table 1). The mean organic carbon content under organic production system was higher than conventional system. The soils under organic farming in general, had higher organic carbon content, higher available potassium, zinc, higher SMBC and SMBC/SOC ratio. Similar increase in the organic carbon of organically managed soils was observed by Reganold *et al.*(1987) and increase in the available K, SMBC and SMBC/SOC ratio, an index for monitoring organic matter changes in soils were observed by Selvakumari *et al.* (2000) and Warwatkar (2001) respectively. Experimental studies on organic cotton production on Vertisols also indicated that continuous application of FYM and other organic materials improved the soils organic materials improved the soil organic carbon content (Venugupalan and Tarhalkar, 2003).

In the present study, the surface soil samples from conventional production system had pH ranging from 7.70 to 8.30. Due to the improvement in organic carbon content and the subsequent dissolution of $CaCO_3$, the pH of the surface sample soils were slightly lower although the means were not significantly different.

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Table 1 : Range and mean of characteristics of surface soils under organic and conventional farming systems.

Soil Properties	Organic		Conventional		t-test
	Range	Mean	Range	Mean	
pH	7.50 – 8.30	7.90	7.70 – 8.30	8.02	NS
EC (dSm^{-1})	0.15 – 0.32	0.22	0.17 – 0.30	0.24	NS
Org. Carbon ($g\ Kg^{-1}$)	4 - 13	9.2	4.2 – 8.6	7.0	**
$CaCO_3$ (%)	2.90 – 14.70	7.57	3.10 – 15.5	10.27	*
Avail. N ($Kg\ ha^{-1}$)	50.20 – 213.2	140.08	75.2 – 175.6	133.36	NS
Avail. P ($Kg\ ha^{-1}$)	15.1 – 34.3	24.70	15.9 – 30.3	23.73	NS
Avail. K ($Kg\ ha^{-1}$)	371.1 – 1720	927.10	316.6 – 1550	674.10	*
Cu (ppm)	2.25 – 7.38	3.98	2.22 – 6.32	3.55	NS
Zn (ppm)	0.46 – 1.38	0.82	0.40 – 1.02	0.61	**
Mn (ppm)	7.25 – 34.9	14.80	8.75 – 19.1	12.58	NS
Fe (ppm)	6.09 – 22.6	12.52	6.87 – 23.78	11.58	NS
SMBC (%)	0.012 – 0.101	0.054	0.010 – 0.0203	0.024	NS
SMBC/SOC x 100	2.10 – 12.02	6.10	1.35 – 11.97	3.43	NS

** significant at 1% level (t table 2.682) at d.f. 50 * significant at 5% level (t table value 2.01) at d.f. 50

Table 2 : Yield ($q\ ha^{-1}$) of crops under organic and conventional production system

Crop	Organic		Conventional	
	Range	Mean	Range	Mean
Cotton	5.83 – 17.50	12.33	5.62 – 15.00	11.78
Pigeonpea*	5.00 – 17.91	13.34	3.75 – 15.00	11.00
Sorghum	8.75 – 20.00	11.42	6.66 – 26.25	11.49
Soybean	8.33 – 20.83	15.66	7.22 – 28.25	13.48
Sugarcane	343.7 – 600.0	439.5	875	875
Wheat	30.35 – 35.00	32.67	28.58	28.58
Turmeric	75.00	75.00	66.00	66.00
Mung bean*	8.00 – 15.62	11.82	2 – 5	3.5
Urid bean*	9.00 – 11.25	10.12	NA	-
Gram	10.00 – 10.93	10.46	10.00 – 11.66	11.38
Groundnut	NA	-	2.5 – 12.5	7.5

* Generally grown as intercrop but for comparison the yield were recalculated as pure crops.

Among miocronutrients, Zn was limiting in the cotton growing soils of this region (Gajbhiye *et al.* 1993). Available Zn content under organic system was more than conventional system. Thus organic production system improved the availability of Zn.

The yields of the component crops were similar under organic and conventional production system (Table 2). However, the diversity of crops and cropping system were higher under the organic production and this ensured spread of risk under adverse climatic conditions.

LITERATURE CITED

Bationo, A. and A.U. Mokwunye 1991. Role of manures and crops residues in alleviating soil fertility constrains to crop production, Fert. Res., 29 : 117-125.

Gajbhiye, K.S., S.T. Gaikwad, J.L. Sehgal and R. Gupta 1993. Micronutrient status and deficiency delineation in Vertisols and their intergrades. Agropedol. 3 : 59-58.

Jackson, M.L. 1973. Soil chemical analysis. Oxford and IBH Pvt. Ltd., New Delhi.

Pieri, C. 1995. Technological options for controlling soil organic matter losses in tropical rainfed cropping systems. In Dulal R. and Roy R. N. (eds.) Integrated Plant Nutrient Supply, FAO Fert. Plant Nut. Bull. 12, FAO, Rome.

Reganold John P., L.F. Elliott, and Y. L. Unger 1987. Long term effect of organic and conventional farming on soil erosion, Nature, 330 : 370-372.

Richards, L.A. 1954. Drainage and irrigation of saline alkaline soils. USDA Handbook No. 60, U.S. Govt. Printing Office, Washington D.C.

Selvakumari, G., M. Baskar, D. Jayanthi and K.K. Mathan 2000. Effect of intergrades of flyash with fertilizers and organic manures on nutrient availability, yield and nutrient uptake of rice in Alfisols, J. Indian Soc. Soil Sci. 48, 268-278.

Thaman, P.K. 1995. Organic Agriculture. Peekay Tree Crops Development Foundation, Cochin, Kerala, : 354.

Vance, E.D., P.C. Brookes and D.S. Jankinsen 1987. An extraction method for measuring soil microbial biomass, Soil Biol. and Biochemi, 19 : 703 – 707.

Venugopalan, M.V. and P. P. Tarhalkar 2003. Evaluation of organic recycling techniques in improving the productivity of rainfed cotton on marginal soil, Trop. Agric. 80 : 163-167.

Warwatkar, R.C. 2001. Impact of land utilization on microbial biomass in Vertisols of Nagpur, M.Sc. Thesis (Unpub), Dr. PDKV, Akola.

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

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ABSTRACT

An investigation entitled "Dynamics of nitrogen 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 N fractions were improved with the application of N in combination with FYM, zinc and sulphur. Fractions of N 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 N fractions in soil followed the order insoluble humin –N > hydrolysable NH_4^+ - N + amino sugar – N > amino acid – N > acid soluble humin-N > fixed NH_4^+ - N > NO_3 – N > Exchangeable NH_4 – N.

Most of the nitrogen in the soil is organically bound, however, only small fraction of it remains in available form. Large proportion of organic nitrogenous substances in soil can be considered as potential reserves of nitrogen from plant nutrients point of view. Under the normal soil condition, inorganic nitrogen is continuously formed from the organic sources by mineralization process. In turn, some inorganic nitrogen is transformed to organically bound form by soil microorganisms. In this way, there are many possible transformations that can lead to various organic and inorganic products or the formation of soluble and insoluble forms of nitrogen or may be fixed in the lattice structure as native fixed ammonium in soils.

Continuous application of manures and fertilizers are bound to influence the various fractions of soil N, besides influencing other soil properties. Results from long-term experiments, in India, have clearly demonstrated that the addition of organic manures and inorganic fertilizers for over a long period had favourable effect in increasing the soil N fractions.

Studies on N dynamics by Lin *et al.* (1973) revealed that the average contribution of non-hydrolysable N, total hydrolysable N, amino acid N, hydrolysable NH_4^+ - N and unidentified NH^4- N to the total N were 24.4, 75.6, 35.7, 25.0 and 10.8 per cent, respectively.

MATERIAL AND METHODS

The present investigation entitled "Dynamics of nitrogen 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 phosphorus 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 nitrogen forms, (a) inorganic forms of N : Exchangeable NH_4^+ - N, NO_3^- - N, fixed NH_4^+ - N; (b) organic forms of N : Hydrolyzed NH_4^+ - N + amino sugar-N; soluble N i.e. amino acid-N, acid soluble humin-N, insoluble humin-N were determined by the procedure suggested by Cheng and Kurtz (1963).

RESULTS AND DISCUSSION

The data presented in Table 1 revealed that after harvest of sorghum, the relative abundance of N fractions in soil were in the order of insoluble humin-N (24.5%) > hydrolysed NH_4^+ - N + amino sugar – N(18.73%) > amino acid-N (15.81%) > acid soluble humin-N (14.24%) > fixed NH_4^+ - N (10.48%) > NO_3^- - N (9.92%) > exchangeable NH_4^+ - N (9.29%) and contributed 21.54 to 28.69 per cent, 18.12 to 19.82 per cent, 15.21 to 16.40 per cent, 12.17 to 14.68 per cent, 9.75 to 10.11per cent, 10.12 to 10.34 per cent, 9.01 to 9.52 per cent of total N, respectively. Significantly highest values of forms of N were recorded

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Table 1: Fractions of soil nitrogen (mg N 100 g^{-1} soil) as influenced by long-term fertilization after harvest of sorghum crop

S. N.	Treatments	Exchangeable NH_4^+ - N			Exchangeable NO_3^- - N			Fixed NH_4^+ - N			Hydrolyzed NH_4^+ – N + amino sugar-N		
		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	3.48	3.56	3.52	4.12	4.09	4.10	4.09	4.06	4.07	8.15	8.18	8.16
T_2	100% RD NPK	4.49	4.52	4.50	4.79	4.82	4.80	4.91	4.82	4.86	8.41	8.42	8.41
T_3	150 RD NPK	5.29	5.32	5.30	5.61	5.65	5.63	5.48	5.42	5.45	9.58	9.48	9.53
T_4	100% RD NPK (S free)	4.40	4.43	4.41	4.75	4.86	4.80	4.72	4.78	4.75	8.39	8.32	8.35
T_5	100% RD NPK + 10 kg Zinc sulphate	4.68	4.77	4.72	5.41	5.59	5.50	5.49	3.65	3.62	8.59	8.63	8.61
T_6	100% RD NP	3.59	3.60	3.59	4.49	4.52	4.50	4.12	4.26	4.19	8.18	8.15	8.16
T_7	100% RD N	3.45	3.56	3.50	3.69	3.66	3.67	3.72	3.76	3.74	7.68	7.64	7.66
T_8	100% RD NPK + FYM 10 t ha^{-1} (kharif)	5.40	5.42	5.41	5.78	5.73	5.75	5.49	5.59	5.54	11.32	11.21	11.26
T_9	100% RD NPK (S free) + 37.5 kg S ha^{-1} (through gypsum)	4.60	4.62	4.61	5.19	5.21	5.20	5.28	5.39	5.33	8.48	8.42	8.45
T_{10}	FYM 10 t ha^{-1} (kharif)	3.19	3.25	3.22	3.68	3.78	3.73	3.64	3.60	3.62	6.89	6.90	6.89
T_{11}	75% RD NPK	3.72	3.76	3.74	4.69	4.75	4.72	4.41	4.42	4.41	8.25	8.21	8.23
T_{12}	Control	3.18	3.22	3.20	3.62	3.72	3.67	3.59	3.60	3.59	6.41	6.45	6.43
	SE(m)±	0.022	0.0029	0.016	0.0049	0.0045	0.0049	0.0049	0.0058	0.0053	0.0090	0.022	0.017
	CD at 5%	0.062	0.0081	0.045	0.014	0.012	0.0138	0.013	0.016	0.014	0.025	0.063	0.047

S. N.	Treatments	Amino Acid – N			Acid soluble humin-N			Insoluble humin- N			Total Nitrogen		
		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	6.42	6.47	6.44	6.10	6.13	6.11	10.45	10.50	10.47	39.23	41.52	40.37
T_2	100% RD NPK	7.36	7.32	7.34	6.58	6.62	6.60	11.08	11.10	11.09	46.67	47.65	47.16
T_3	150 RD NPK	8.31	8.35	8.33	7.09	7.15	7.12	11.61	11.69	11.65	48.12	49.52	48.82
T_4	100% RD NPK (S free)	7.28	7.22	7.25	6.38	6.41	6.39	10.79	10.89	10.84	45.16	46.61	45.88
T_5	100% RD NPK + 10 kg Zinc sulphate	7.70	7.74	7.72	7.08	7.11	7.09	11.39	11.46	11.42	48.01	50.81	49.41
T_6	100% RD NP	6.51	6.57	6.54	6.15	6.19	6.17	10.51	10.57	10.54	40.78	43.87	42.37
T_7	100% RD N	6.12	6.16	6.14	6.08	6.10	6.09	10.38	10.40	10.39	39.04	41.02	40.03
T_8	100% RD NPK + FYM 10 t ha^{-1} (kharif)	9.35	9.29	9.32	8.32	8.36	8.34	12.22	12.26	12.24	55.89	57.71	56.80
T_9	100% RD NPK (S free) + 37.5 kg S ha^{-1} (through gypsum)	7.65	7.62	7.63	6.82	6.87	6.83	11.21	11.25	11.23	46.89	47.83	47.38
T_{10}	FYM 10 t ha^{-1} (kharif)	5.81	5.85	5.83	4.74	4.80	4.77	10.19	10.25	10.22	36.49	38.60	37.54
T_{11}	75% RD NPK	6.62	6.65	6.63	6.22	6.29	6.25	10.78	10.81	10.79	42.98	43.08	43.03
T_{12}	Control	5.40	5.44	5.42	4.31	4.34	4.32	10.15	10.21	10.18	34.09	36.88	35.48
	SE (m) ±	0.014	0.0067	0.011	0.14	0.0063	0.10	0.0066	0.0014	0.0061	0.024	0.12	0.087
	CD at 5%	0.040	0.019	0.031	0.41	0.018	0.32	0.019	0.021	0.071	0.069	0.34	0.245

Table 2: Fractions of soil nitrogen (mg N 100 g^{-1} soil) as influenced by long-term fertilization after harvest of wheat crop

S. N.	Treatments	Exchangeable NH_4^+ - N			Exchangeable NO_3^- - N			Fixed NH_4^+ - N			Hydrolyzed NH_4^+ – N + amino sugar-N		
		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	3.52	3.58	3.55	4.18	4.25	4.21	4.02	4.09	4.05	8.18	8.16	8.17
T_2	100% RD NPK	4.42	4.52	4.47	5.01	5.10	5.05	5.01	4.98	4.99	8.48	8.44	8.46
T_3	150 RD NPK	5.28	5.30	5.29	5.10	5.20	5.15	5.30	5.42	5.36	9.48	9.45	9.46
T_4	100% RD NPK (S free)	4.12	4.20	4.16	4.82	4.85	4.83	4.71	4.76	4.73	8.29	8.26	8.27
T_5	100% RD NPK + 10 kg Zinc sulphate	4.61	4.65	4.63	5.09	5.12	5.10	5.12	5.14	5.13	8.62	8.65	8.63
T_6	100% RD NP	3.55	3.58	3.56	4.45	4.57	4.51	4.18	4.28	4.23	8.19	8.25	8.22
T_7	100% RD N	3.51	3.55	3.53	3.62	3.72	3.67	3.82	3.79	3.80	7.61	7.68	7.64
T_8	100% RD NPK + FYM 10 t ha^{-1} (kharif)	5.35	5.39	5.37	5.75	5.79	5.77	5.42	5.48	5.45	11.32	11.28	11.30
T_9	100% RD NPK (S free) + 37.5 kg S ha^{-1} (through gypsum)	4.49	4.55	4.52	5.05	5.01	5.03	5.12	5.42	5.27	8.52	8.55	8.53
T_{10}	FYM 10 t ha^{-1} (kharif)	3.18	3.28	3.23	3.59	3.69	3.64	3.61	3.69	3.65	6.88	6.95	6.91
T_{11}	75% RD NPK	3.62	3.71	3.66	4.69	4.60	4.64	4.42	4.46	4.44	8.21	8.38	8.29
T_{12}	Control	3.15	3.19	3.17	3.09	3.15	3.12	3.58	3.68	3.63	6.64	6.60	6.62
	SE(m)±	0.063	0.0086	0.014	0.0096	0.0087	0.0092	0.016	0.011	0.014	0.0067	0.0063	0.0038
	CD at 5%	0.18	0.023	0.041	0.027	0.025	0.025	0.047	0.033	0.039	0.022	0.018	0.010

S. N.	Treatments	Amino Acid – N			Acid soluble humin-N			Insoluble humin- N			Total Nitrogen		
		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	6.42	6.49	6.45	6.18	6.13	6.15	10.45	10.55	10.50	42.21	44.91	43.56
T_2	100% RD NPK	7.31	7.39	7.35	6.59	6.68	6.63	11.12	11.15	11.13	46.81	47.71	47.28
T_3	150 RD NPK	8.42	8.38	8.40	7.16	7.15	7.15	11.69	11.73	11.71	49.18	50.83	50.00
T_4	100% RD NPK (S free)	7.17	7.29	7.23	6.46	6.48	6.47	10.89	10.92	10.90	46.19	48.40	47.29
T_5	100% RD NPK + 10 kg Zinc sulphate	7.71	7.75	7.73	7.11	7.18	7.14	11.39	11.48	11.43	47.51	49.57	48.54
T_6	100% RD NP	6.61	6.68	6.64	6.22	6.27	6.24	10.61	10.67	10.64	42.92	43.98	43.45
T_7	100% RD N	6.21	6.25	6.23	6.15	6.19	6.17	10.38	10.43	10.40	38.32	40.62	39.47
T_8	100% RD NPK + FYM 10 t ha^{-1} (kharif)	9.40	9.32	9.36	8.61	8.41	8.51	12.20	12.28	12.24	57.92	58.82	58.38
T_9	100% RD NPK (S free) + 37.5 kg S ha^{-1} (through gypsum)	7.61	7.68	7.64	6.82	6.86	6.84	11.21	11.27	11.24	47.41	49.57	48.54
T_{10}	FYM 10 t ha^{-1} (kharif)	5.79	5.88	5.83	4.81	4.88	4.84	10.18	10.29	10.23	37.15	38.64	37.89
T_{11}	75% RD NPK	6.62	6.69	6.65	6.30	6.32	6.31	10.78	10.85	10.81	45.18	46.68	45.93
T_{12}	Control	5.42	5.53	5.45	4.31	4.38	4.34	10.08	10.19	10.13	36.89	37.98	37.43
	SE(m)±	0.0038	0.019	0.014	0.0058	0.0045	0.0012	0.40	0.010	0.18	0.010	0.49	0.30
	CD at 5%	0.011	0.053	0.039	0.0164	0.0126	0.0035	1.17	0.029	0.52	0.031	1.42	0.89

with the application of 100 per cent RD NPK along with 10 t FYM ha^{-1} (T_8) in *Kharif* followed by 150 per cent RD NPK alone (T_3) and lowest value of N were observed in control (T_{12}).

The data presented in Table 2 revealed that after harvest of wheat the relative abundance of N fractions in soil were in the order of insoluble humin-N (23.97%) > hydrolysed NH_4^+ - N + amino sugar – N (18.33%) > amino acid-N (15.51%) > acid soluble humin-N (14.00%) > fixed NH_4^+ - N (10.03%) > NO_3 – N (9.99%) > exchangeable NH_4^+ - N (8.96%) and contributed 20.96 to 27.06 per cent, 17.68 to 19.35 per cent, 14.56 to 16.03 per cent, 11.59 to 14.57 per cent, 9.33 to 9.69 per cent, 8.83 to 9.88 per cent, 8.46 to 9.19 per cent of total N respectively. Significant highest values of forms of N were recorded with the application of 100 per cent RD NPK along with 10 t FYM ha^{-1} (T_8) in *Kharif* followed by 150 per cent RD NPK alone (T_3) and lowest value of N were observed in control (T_{12}). Cheng and Kurtz (1963) observed that 90 per cent added N in soil was in hydrolytic product of soil organic matter as amino acid-N, amino sugar N-and other soluble-N.

An increase in the rate of applied N was found to be associated with an increase in the build up of total –N and available-N and also the organic matter content of the soil (Santhy *et al.*, 2001). Similar trend was noticed by Mahankar (1978), Hiwase (1995), Basumatary and Talukdar (1998), Ravankar *et al.* (1998) and Gajbhiye (2002).

LITERATURE CITED

Basumatary, A. and M.C. Talukdar, 1998. Long term effect of integrated nutrient supply system of fractions of N and K in an Inceptisol of Assam, J. Indian Soc. Soil Sci., 46(3) : 451 – 453.

Cheng, H.H. and L.T. Kurtz, 1963. Chemical distribution of added nitrogen, Proc. Soil Sci. Soc. American 30 : 312 – 316.

Gajbhiye, 2002. Dynamics of nitrogen fraction under long-term fertilization to sorghum-wheat sequence in vertisols, M.Sc. Thesis (Unpub.), Dr. PDKV, Akola.

Hiwase, R.B., 1995. Effect of long-term application of fertilizer and organics on the distribution of forms of soil nitrogen in sorghum-wheat cropping sequence. M.Sc. Thesis (Unpub.), Dr. PDKV, Akola.

Lin, C.H.; A.H. Cheng and C.C. Tseng, 1973. Nitrogen status and nitrogen supplying power of Taiwan soil. J. Taiwan Agric. Res. 22 (3) : 186 – 203 (From Soil Ferti. Harpenden, 38 (1) : 1, 1975).

Mahankar, S.T., 1978. Transformation and distribution of nitrogen fractions on the continuous manuring and fertilization. M.Sc. Thesis (Unpub.), Dr. PDKV, Akola.

Ravankar, H.N.; K.T. Naphade; R.B. Puranik and R.T. Patil, 1998. Long-term changes soil fertility status under sorghum-wheat sequence on Vertisol. All India Co-ordinated Research Project on long term fertilizer experiment, IISS (Pub.) 292 - 297. (Ed.) Swarup, Reddy and Prasad.

Santhy, P.; P. Muthuvel and D. Selvi, 2001. Nitrogen fractions status and impact on yield, uptake and available nitrogen in long term fertilizer experiment, Madras Agric J., 88 (1) : 26 – 31.

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Characterisation of Pearlmillet Hybrids and Their Parental Lines Through Electrophoresis

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ABSTRACT

The present investigation entitled, "Characterisation of pearlmillet hybrids and their parental lines through electrophoresis was undertaken during 2006-07 at Seed Technology Research Unit, MPKV, Rahuri (Maharashtra). The experimental material consists of six hybrids and their parental lines. The number of bands ranged between 5 to 10 with total thirty number of bands in figure first while bands ranged between 6 and 9 with total twenty seven number of bands in figure second. The banding pattern of soluble protein in different genotypes showed variations among the hybrids and parental lines. The cultivar can be differentiated from each other with respect to presence or absence of particular band and intensity of band. Every genotype exhibited a unique banding pattern. The qualitative polymorphism was sufficient to discriminate the cultivar (Dadlani M. and K.R. Koundal, 1987).

The genuineness is most important characteristic of good quality seed. In scientific seed production careful attention should be paid at every stage to maintain its genuineness. The varietal characterisation has, therefore, attained a critical importance in crop improvement programme. Different varieties are commonly identified on the basis of their taxonomic differences of seed, seedling and mature plant but now a days many chemical and biochemical tests have been developed for this purpose. (Kumar, *et. al.* 1995).

Grow out test or field testing is advocated to determine genetic purity among varieties by implying a standard check for comparing test samples. Though this method is genuine and most reliable usually takes one entire growing season to perform the test and obtain results. In addition this, testing has to be done outside the seed testing laboratory and adequate field facilities must be available. Varietal characterisation of seed or seedling stage greatly save space and effort by screening of large population for certain described characters by finding genetic marker which have important implications for plant breeding. A major disadvantage of relying on differences on morphological characteristics to characterise among varieties is that many of newer varieties have seeds and seedlings with similar characteristics. Therefore, present study was conducted to characterise pearlmillet hybrids and their parental lines by using electrophoretic test.

MATERIAL AND METHODS

The electrophoretic analysis of six hybrids and their parental lines of pearlmillet was carried out in Seed Technology Research Unit, Mahatma Phule Krishi Vidyapeeth, Rahuri during 2006-07. Polyacrylamide gel electrophoresis (PAGE) of soluble proteins with 25 seeds of each genotype Electrophoresis was done as per the procedure described by Dadlani and Varier (1993).

S. N.	Genotypes	S. N.	Genotypes
1	RHRBH-9808	10	DHBH-2097
2	RHRB-13A	11	RHRB-5A
3	RHRBI-1314	12	RHRBI-138
4	RHRB-13B	13	RHRB-5B
5	RHRBH-2028	14	RHRBH-8609
6	RHRBI-1019	15	RHRBH-1A
7	DHBH-3050	16	RHRB-1B
8	RHRB-14A	17	RHRBH-8924
9	RHRB-14B	18	RHRBI-458

The band intensity was visually recorded as absence or presence of specific bands. The banding pattern of seed storage protein was considered as finger prints of hybrids and parental lines. The genotypes were separated into different groups according to intensity and presence or absence of particular bands. The relative migration (Rm) value of each band was calculated as follows.

$$\text{Rm value} = \frac{\text{Distance migrated by the protein band from the origin (cm)}}{\text{Distance migrated by tracking dye (cm)}}$$

The Rm value for each genotype was recorded separately.

RESULTS AND DISCUSSION

The banding pattern of soluble proteins in different genotypes presented in Fig. 1 and 2 revealed

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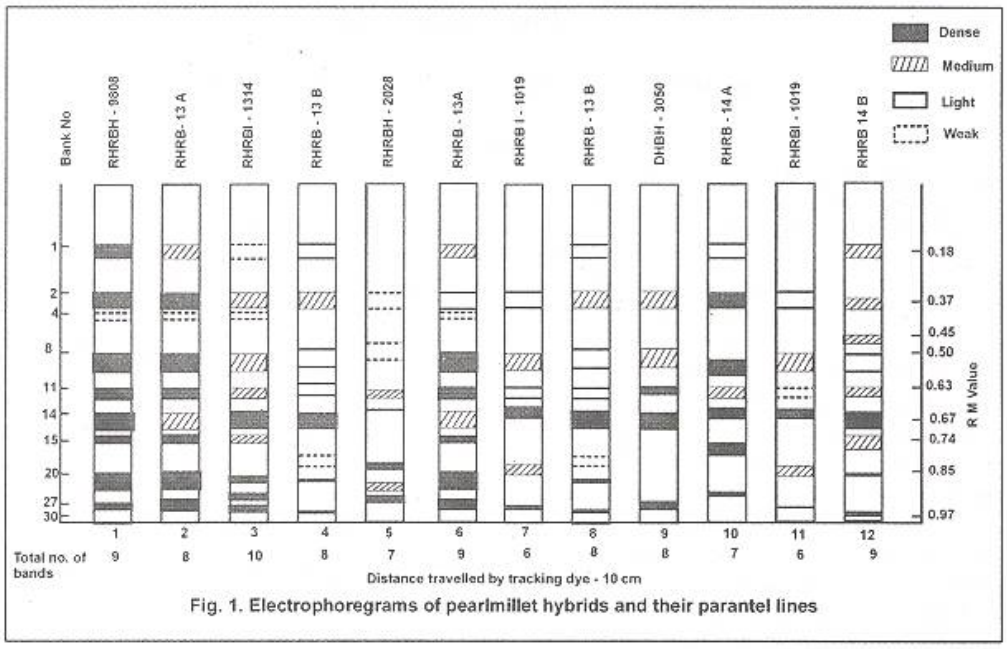

Fig. 1. Electrophoregrams of pearlmillet hybrids and their parantel lines

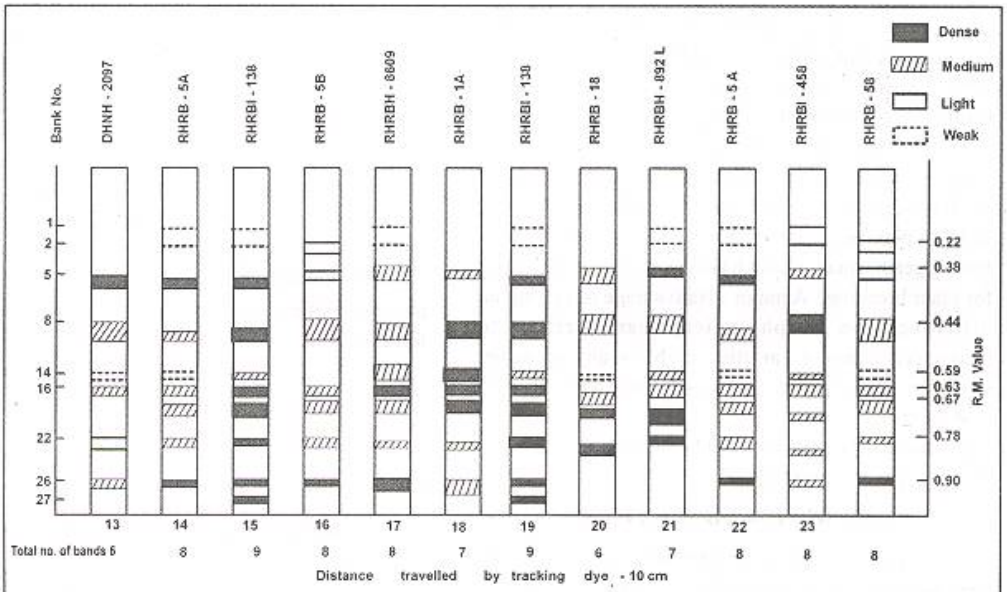

Fig. 2. Elec trophoregrams of pearlmillet hybrids and their parental lines

Table 1. Banding pattern of nine pearlmillet genotypes

S. N.	Rm value	RHRBH-9808	RHRB-13A	RHRBI-1314	RHRB-13B	RHRBH-2028	RHRBI-1019	DHBH-3050	RHRB-14A	RHRB-14B
1	0.18	++++	+++	+	++	-	-	-	++	+++
2	0.32	++++	++++	+++	+++	+	++	+++	++++	-
3	0.34	-	-	-	-	-	-	-	-	+++
4	0.38	+	+	+	-	-	-	-	-	-
5	0.45	-	-	-	-	-	-	-	-	-
6	0.47	-	-	-	-	+	-	-	-	+++
7	0.49	-	-	-	++	-	-	+++	-	-
8	0.50	++++	++++	+++	-	-	+++	-	-	++
9	0.52	-	-	-	-	-	-	-	++++	-
10	0.59	-	-	-	++	-	-	-	-	-
11	0.60	++++	++++	+++	-	-	++	++++	+++	+++
12	0.61	-	-	-	-	+++	-	-	-	-
13	0.66	-	-	-	-	++++	++++	-	++++	-
14	0.67	++++	+++	++++	++++	-	-	++++	-	++++
15	0.74	++++	++++	+++	-	-	-	-	-	+++
16	0.76	-	-	-	-	-	-	-	++++	-
17	0.80	-	-	-	+	-	-	-	-	-
18	0.82	-	-	-	-	++++	-	-	-	-
19	0.83	-	-	-	-	-	+++	-	-	-
20	0.85	++++	++++	-	-	-	-	-	-	++++
21	0.86	-	-	++++	-	-	-	-	-	-
22	0.87	-	-	-	++++	-	-	-	-	-
23	0.88	-	-	-	-	+++	-	-	-	-
24	0.91	-	-	++++	-	-	-	-	++++	-
25	0.92	-	-	-	-	++++	-	-	-	-
26	0.93	-	++++	-	-	-	-	-	-	-
27	0.94	++++	-	-	-	-	-	++++	-	-
28	0.95	-	-	++++	-	-	++++	-	-	-
29	0.96	-	-	-	++++	-	-	-	-	-
30	0.97	-	-	-	-	-	-	-	-	++++
	-	=	Absent			+++	=	Medium		
	+	=	Weak			++++	=	Dense		

Table 2. Banding pattern of nine pearlmillet genotypes

S. N.	Rm value	DHBH-2097	RHRB-5A	RHRBI-138	RHRB-5B	RHRBH-8609	RHRB-1A	RHRB-1B	RHRBH-8924	RHRBI-458
1	0.18	-	+	+	-	+	-	-	+	++
2	0.22	-	-	-	++	-	-	-	-	-
3	0.29	-	-	-	-	+++	-	-	-	-
4	0.30	-	-	-	++	-	+++	+++	++++	+++
5	0.31	++++	-	-	-	-	-	-	-	-
6	0.32	-	++++	++++	-	-	-	-	-	-
7	0.43	-	-	-	-	-	-	+++	+++	++++
8	0.44	+++	-	++++	+++	-	-	-	-	-
9	0.45	-	-	-	-	+++	++++	-	-	-
10	0.46	-	-	+++	-	-	-	-	-	-
11	0.47	-	+++	-	-	-	-	-	-	-
12	0.57	-	-	-	-	+++	-	-	-	-
13	0.58	-	-	-	-	-	++++	-	-	-
14	0.59	+	+	-	+	-	-	-	+++	-
15	0.60	-	-	-	-	-	-	+	-	+++
16	0.63	+++	+++	++++	+++	++++	++++	-	+++	+++
17	0.65	-	-	-	-	-	-	+++	-	-
18	0.67	-	-	-	+++	+++	++++	-	-	-
19	0.68	-	++++	++++	-	-	-	-	-	-
20	0.70	-	-	-	-	-	-	++++	++++	-
21	0.71	-	-	-	-	-	-	-	-	+++
22	0.78	++	+++	++++	+++	-	-	-	++++	-
23	0.79	-	-	-	-	+++	+++	-	-	-
24	0.80	-	-	-	-	-	-	++++	-	-
25	0.81	-	-	-	-	-	-	-	-	+++
26	0.90	+++	+++	++++	++++	++++	+++	-	-	+++
27	0.95	-	-	++++	-	-	-	-	-	-

-	=	Absent		+++	=	Medium	
+	=	Weak		++++	=	Dense	
++	=	Light					

qualitative and quantitative variations among the hybrids and parental lines.

The number of bands in different genotypes given in figure first ranged between 5 and 10 with the total number of 30 bands in this group. While in figure second number of bands varied from 6 to 9 with total of 27 bands. In group I, all the genotypes recorded four common bands with few exceptions. These were band no. 2nd, 8th, 11th and 14th with corresponding Rm value 0.32, 0.50, 0.60 and 0.67, respectively.

In figure second, all genotypes recorded two common bands with few exceptions. These were band No. 16th and 26th with corresponding Rm value 0.63 and 0.90, respectively. However, certain bands differed in their banding intensities and Rm values were helpful in identifying them individually. Every genotype exhibited a specific banding pattern. The qualitative polymorphism was sufficient to discriminate the cultivars (Patil R.B., 2000). The pearlmillet genotypes could be differentiated on the basis of the presence or absence of specific bands and the intensity of band as evident in Fig. 1 and 2.

The hybrid RHRBH-9808 and its parental lines showed three common bands *viz.*, 1st, 2nd, 14th with Rm value 0.18, 0.32 and 0.67, respectively. Hybrid RHRBH-9808 could be differentiated from its parental lines due to presence of band no. 27th (Rm value 0.94). restorer line RHRBI contained highest number of bands (10).

The hybrid RHRBH-2028 and its restorer line RHRBI-1019 had only two common bands i.e. band no. 13 with Rm value 0.66 and band no. 2 (Rm value 0.32). All other bands were specific to hybrid only.

The electrophoregram of hybrid DHBH-3050 showed that only one band i.e. band no. 11th (Rm value 0.60) was common in hybrid as well as parental lines but band intensity was different. Hybrid DHBH-50 had minimum no. of bands i.e. five bands. Due to this it could be identified easily from other genotypes on the basis of number of bands. Similar results have been reported by Dadlani and Varier (1993).

In figure second, hybrid DHBH-2097 possessed six bands, female RHRB-5A and maintainer RHRB-5B had 8 bands. While its restorer line RHRBI-138 had nine bands. The electrophoregram of hybrid DHBH-2097 and its parental lines showed that only three bands were common in hybrid as well as in parental lines *viz.*, 16th, 22nd and 26th with Rm value 0.63, 0.78 and 0.90, respectively.

The hybrid RHRBH-8609 possessed eight bands, while its female RHRB-1A and male RHRB-1B had 7 and 6 bands, respectively. The restorer RHRBI-138 produced 8 bands. Except bands 1st, 3rd and 12th all other bands of hybrid and its female parent were common. These results are in conformity with those reported by Varier *et al.* (1993).

The hybrid RHRBH-8924 possessed seven bands, while its parental lines possesses 8 bands each but their relative position and band intensities was different. Hybrid could be distinguished from restorer due to presence of bands *viz.*, 14th, 20th and 22nd corresponding Rm value 0.59, 0.70 and 0.78, respectively. The band number 16th with corresponding Rm value 0.63 was common in hybrid as well as its parental lines.

CONCLUSION

The genotype studied exhibited a unique banding pattern discriminating the genotypes from each other. Which states that banding pattern of seed storage protein can be considered as 'finger prints' of hybrids and parental lines.

LITERATURE CITED

Dadlani, M. and A. Varier. 1993. Electrophoresis for variety identification. Technical Bulletin, Division of Seed Sci. and Technol., IARI, New Delhi. 2-5.

Dadlani, M. and K.R. Koundal. 1987. Polyacrylamide gel electrophoresis of seed proteins for cultivar identification. In : Agrawal, P.K. and Dadlani, M. (Eds.) Techniques in Seed Sci. and Technol. 171-178.

Kumar, A., R.K. Chowdhary and R.L. Kapoor. 1995. Identification of pearlmillet hybrids and their parental lines using seed and seedling characters, chemical test and gel electrophoresis. Seed Sci. and Technol. 23 : 21-32.

Patil, R.B. 2000. Progress report of Adhoc project on 'Identification of stable diagnostic morphological traits, biochemical test and electrophoretic techniques for distinguishing crop varieties and genetic purity test'. Seed Technology Research Unit (NSP), MPKV, Rahuri.

Varier, A., V. Vashisth and P.K. Agrawal. 1993. Identification of composite varieties of pearlmillet using PAGE of total soluble proteins and isoenzymes, Seed Res. Sp. Vol. No. 1 : 400-407.

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Effect of Time of Harvest on Root Yield and Quality of Ashwagandha

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ABSTRACT

A field experiment to study the effect of time of harvest on root yield and quality of Ashwagandha (*Withania somnifera* Dunal) variety JA-20 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 seeds were sown in the first week of September by drilling method at line to line spacing of 30 cm in the plot size of .1.8 x 2.4 m^2. The treatments were comprised of five harvesting times viz, at flowering initiation, 50Per cent flowering, 100 Per cent flowering, berry ripening stage and at maturity. Significantly highest root yield (7.33 q ha^{-1}) was recorded with the harvesting at 100 Per cent flowering stage and berry ripening stage. The crude content was found to increase with the harvesting time. The highest fibre content was recorded at maturity stage. The total alkaloids content was significantly highest at 50Per cent flowering stage followed by 100Per cent flowering stage. Significantly lowest content was noticed at flower initiation stage. However, the yield of total alkaloids was significantly highest with 100Per cent flowering stage over all the treatments.

Ashwagandha crop is found throughout drier parts of India. It is an erect branched under shrub up to 1.25 m in height, covered with stellate tomentum leaves 5-10 x 2.5 to 5.00 cm ovate with 6 to 13 mm long petiole. The flowers are greenish yellow usually 5 together in sub sessile umbelli form cymes. It is a cross pollinated having fruits of 6.00 mm diameter, much enclosed inflated calyx and turns red at maturity. The roots are compact and light brown in colour.

Ashwagandha roots contain alkaloids (Withanine, Somniferin, etc.) and steroidal lactones (Withanolides). The roots are being used for rheumatic pain, general debility, mental disorders and gynecological problems, also used as tonic for hiccup, cold, cough, female disorders, as a sedative, in care of ulcers, etc.

The time of planting and harvesting of medicinal and aromatic plants are most crucial factors for synthesis of secondary metabolites i.e. alkaloids. 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 elegance. Therefore, to determine the stage of harvesting for maximum root yield and alkaloid content of Ashwagandha 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 Ashwagandha (*Withania somnifera.* Dunal) variety JA-20 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 seeds were sown in the first week of September by drilling method at line to line spacing of 30 cm in the plot size of .1.8 x 2.4 m^2. The treatments were comprised of five harvesting times viz, T_1- at flowering initiation, T_2- 50 Per cent flowering, T_3 - 100 Per cent flowering, T_4-Berry ripening and T_5 -at maturity tried in Randomized Block Design with four replications.

The growth observations as well as post harvest observations were recorded as per the treatments. The total alkaloid content was determined as per the titre-metric method (Anonymous, 1998) and crude fibre content was estimated by the method described by Chopra and Kanwar (1980)

RESULTS AND DISCUSSION

Root yield:

The root yield was found significantly influenced by the harvesting time. Further it was observed that the dry root yield was successively increased with the harvesting time up to 100 Per cent flowering stage and significantly highest root yield (7.33 q ha^{-1}) was recorded with the harvesting at 100Per cent flowering stage (T_3) over all the treatments except berry ripening (T_4) stage (Table 1). The root yield (6.95 q ha^{-1}) obtained with berry ripening stage was statistically at par.

Quality of Roots :

The fibre content in Ashwagandha roots was in the range of 14.07 to 26.85Per cent and the content was

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Table: 1 Effect of time of harvest on root yield and quality of Ashwagandha

	Dry Root Yield (q ha^{-1})				Fibre content (%)		
Treatments	**2003-04**	**2004-05**	**2005-06**	**Pooled mean**	**2004-05**	**2005-06**	**Pooled mean***
T_1 – Flower initiation	3.32	2.66	2.69	2.89	14.71	13.42	14.07
T_2 – 50 % Flowering	5.32	4.34	4.84	4.83	21.09	20.17	20.63
T_3 – 100 % Flowering	10.64	5.63	5.72	**7.33**	23.66	24.66	24.16
T_4 – Berry Ripening	9.67	5.47	5.73	6.95	26.10	26.29	26.19
T_5 – Maturity	7.20	5.41	5.45	6.02	26.82	26.89	26.85
SE(m)±	0.42	0.23	0.35	0.22	0.69	0.92	0.61
CD(0.05)	1.30	0.71	1.09	0.54	2.10	2.86	1.49
CV%	11.65	9.72	14.57	13.39	6.09	8.33	7.77

* Pooled means of two years

Table: 2 Effect of time of harvest on root yield and quality of Ashwagandha

	Total Alkaloids (%)				Total alkaloids (Kgha^{-1})			
Treatments	2003-04	2004-05	2005-06	Pooled mean	2003-04	2004-05	2005-06	Pooled mean
T_1 – Flower initiation	0.581	0.516	0.430	0.508	1.86	1.37	1.15	1.46
T_2 – 50 % Flowering	0.813	0.617	0.555	**0.661**	4.23	2.68	2.69	3.20
T_3 – 100 % Flowering	0.639	0.620	0.608	0.622	6.58	3.50	3.47	**4.51**
T_4 – Berry Ripening	0.407	0.598	0.592	0.532	3.89	3.28	3.39	3.52
T_5 – Maturity	0.523	0.595	0.584	0.567	3.62	3.22	3.180	3.34
SE(m)±	0.023	0.019	0.026	0.013	0.329	0.20	0.22	0.18
CD(0.05)	0.073	0.059	0.082	0.033	1.015	0.62	0.69	0.46
CV%	8.034	6.60	9.61	8.02	16.30	14.45	16.31	19.53

found to increase with the harvesting time(Table 1). The highest fibre content was recorded at maturity stage. The higher fibre content of the roots is not desirable by the industry. The harvesting time also influenced the total alkaloids content (%) and it was significantly highest at 50Per cent flowering stage (T_2), followed by T_3 (100% flowering stage). Significantly lowest content was noticed at flower initiation stage (T_1). However, the yield of total alkaloids was significantly highest with 100Per cent flowering stage over all the treatments (Table 2).

These results are in accordance with the findings of Patel *et. al.* (2003).They have also reported the increased trend of root yield with harvesting period. The days required for 100Per cent flowering to berry ripening stage of Ashwagandha during the present investigation were in between 120 to 150 days, respectively. The research work carried out at Mandsaur centre of AICRP on medicinal and aromatic plants revealed that the total alkaloids and crude fibre contents of the roots increased from flower initiation to maturity stage. However the crude fibre content was low at berry ripening stage as compared to maturity stage and it was concluded that the Ashwagandha crop should be harvested at berry ripening stage (Anonymous, 2003).

In the present study, although significantly highest root yield was recorded with 100Per cent flowering stage, however the yield recorded at berry ripening stage was at par, suggestive of the harvesting of Ashwagandha crop in-between 100 Per cent flowering to berry ripening stage for optimum root yield with good quality parameters.

LITERATURE CITED

Anonymous, (1998): Biennial Report of All India Coordinated Research Project on Medicinal and Aromatic Plants, NRC for Medicinal and Aromatic Plants, Boriavi, Anand (Gujrat) : 254

Anonymous, (2003): Biennial Report of All India Coordinated Research Project on Medicinal and Aromatic Plants, NRC for Medicinal and Aromatic Plants, Boriavi, Anand (Gujrat) : 179

Chopra S.L. and J.S.Kanwar (1980): Analytical Agricultural Chemistry, Kalyani Publishers, Ludhiyana-New Delhi, : 341

Patel, C.V., D.H. Patel, S.A.Patel and S.Sriram: (2003).Effect of seed rate and cropduration on root yield and quality of Ashwagandha *(Withania somnifera)*, J.Med. & Aro.Pl.Sci 25(1):54-57

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Teaching Attitude of Academic Staff in Agricultural University

K.T.Lahariya

ABSTRACT

The study related to the teaching attitude of the academic staff in agricultural university was conducted in Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola and was confined to the academic staff imparting instruction in agriculture at undergraduate degree programme. The findings of the study revealed that, majority of the respondents (77.48%) reported to hold highly favourable teaching attitude. The correlational analysis revealed that, the inservice training, availability of instructional aids and facilities, teaching methods and aids' use, job involvement and achievement motivation established positive and significant correlationship with attitude of teacher respondents towards teaching. The path analysis showed, the teaching experience had not only produced substantial direct effect but also served as a vehicle for the maximum indirect effect of other variables on teaching attitude. It was as an important determinant of attitude towards teaching. The Job preference exerted positive and maximum indirect effect on teaching attitude of respondents. The regression analysis distinguished that, the characteristics, inservice training and job involvement contributed significantly towards the variation in teaching attitude of respondents to the tune of 26.29 per cent.

In teaching phenomenon the teaching attitude, subject matter and students are more important for the teacher. The role of teacher in technological and advanced educational systems, in general, and agricultural education, in particular, has also become difficult. Earlier, the teacher was the only source of information and was to guide and facilitate for information (Verma, 2002). In the present era of information technology to discharge the duties effectively as a generator, facilitator of knowledge and assimilator, the teacher is expected to produce dynamic graduates and without favourable teaching attitude of the teacher, this will never be achieved.

Attitude is the degree of positive or negative affect associated with some psychological object. Attitude is a preconditioned factor for any action (Thrustone and Chave, 1946). Attitude in an individual plays an important role in determining one's behaviour with respect to a particular psychological object (Rambabu *et al*, 2000). For the present study teaching attitude was considered as the degree of positive or negative reactions of an individual teacher towards teaching.

MATERIAL AND METHODS

The research was carried out in Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola and was restricted to two constituent colleges viz., College of Agriculture Akola and College of Agriculture, Nagpur and two affiliated colleges viz., Shri. Shivaji College of Agriculture, Amravati and Anand Niketan College of Agriculture, Warora. The study was confined to the academic staff viz., Associate and Assistant professors imparting instruction in agriculture at undergraduate degree programme. For the investigation, a well-structured and pre-tested questionnaire was used. The questionnaires were administered to 176 teacher respondents, however responses were obtained from 111 teacher respondents only. The exploratory and analytical research designs of social research were used.

Teaching attitude was measured with the help of scale developed by Jhansi Rani (1985). The scale consisted of fourteen statements, seven of them were positive and seven were negative. The attitude was measured on five point response continuum viz, strongly agree, agree, undecided, disagree and strongly disagree. The scoring pattern adopted for each response continuum for positive statements was 5,4,3, 2 and 1, respectively and inverse was the pattern for negative statements i.e. 1,2,3,4 and 5, respectively. The total teaching attitude score for each was obtained by summing up the scores on all statements of teaching attitude scale. The minimum and maximum possible score a respondent could get ranged in between 14 and 70. The raw scores obtained, as per the scale norms were then converted in to Teaching Attitude Index (TAI) by using the following formula

$$\text{Teaching Attitude Index (TAI)} = \frac{\text{Obtained TA Scores}}{\text{Maximum obtainable TA Scores}} \times 100$$

On the basis of teaching attitude index the respondents were then grouped into four categories viz.

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Highly unfavourable (Upto 25), Unfavourable (26-50), Favourable (51-75) and Highly favourable (Above 75).

RESULTS AND DISCUSSION

Distributional analysis

Favourable attitude is pre-requisite for effective work performance. In view of this teaching attitude of the respondents was studied and presented in Table 1.

Table-1: Distribution of respondents according to their teaching attitude level

S.N.	Teaching attitude level	Respondents	
		Number	Percentage
1	Highly unfavourable	01	0.90
2	Unfavourable	02	1.80
3	Favourable	22	19.82
4	Highly favourable	86	77.48
	Total	111	100.00

Mean index = 82.78 SD = 8.86

With respect to the teaching attitude of the respondents, nearly majority (77.48 %) respondents were in the category of highly favourable teaching attitude (Table-1). The percentage of the respondents in favourable category was 19.82 per cent. Nigligible proportion i.e. 1.80 per cent and 0.90 per cent of the respondents were found in unfavourable and highly unfavourable category of teaching attitude, respectively. By and large, it is inferred that majority of respondents were in highly favourable teaching attitude. These findings support the observations of Jhansi Rani and Reddy (1985).

Relational analysis

The results pertaining to the correlation and path analysis of teaching attitude of the respondent academic staff are presented in Table 2.

It is observed from the Table 2 that, job involvement, availability of instructional aids' and facilities, achievement motivation, teaching methods and aid's use, and inservice training were positively and significantly related with the teaching attitude of the

Table 2: Path analysis of the correlates of teaching attitude of respondents

S. N.	Correlates	Coefficient of correlation'r'	Path coefficients		
			Direct	Total indirect effect	Maximum effect indirect effect through other variable
1	Age (X_1)	-0.0461	0.0488	-0.0949	0.1109(X_5)
2	Educational qualification (X_2)	0.0980	0.0697	0.0282	0.0475(X_{13})
3	Post held (X_3)	-0.1507	-0.1680	0.0173	0.0373(X_5)
4	Total service experience (X_4)	-0.0337	-0.0852	0.0515	0.1099(X_5)
5	Teaching experience (X_5)	0.0955	0.1989	-0.1034	0.0947(X_6)
6	Inservice training. (X_6)	0.2106*	0.2088	0.0018	0.0807(X_5)
7	Membership of periodicals (X_7)	0.0726	0.0075	0.0652	0.0351(X_6)
8	Contribution in terms of publications (X_8)	0.0164	-0.0329	0.0493	0.0108(X_{13})
9	Work load (X_9)	-0.0367	-0.0880	0.0543	0.0488(X_5)
10	Availability of instructional aids and facilities (X_{10})	0.2536**	0.2034	0.0501	0.0464(X_{11})
11	Teaching methods and aid's use (X_{11})	0.2129*	0.1078	0.1051	0.0877(X_{10})
12	Job preference (X_{12})	0.0971	-0.0623	0.1593	0.0555(X_{13})
13	Job Involvement (X_{13})	0.2687**	0.2499	0.0187	0.0316(X_{14})
14	Achievement motivation (X_{14})	0.2492**	0.1145	0.1347	0.0909((X_{11})

** Significant at 0.01 level of probability *Significant at 0.05 level of probability

respondents, whereas the characteristics job preference, educational qualification, teaching experience, membership of periodicals, contribution in terms of publications, post held, age, workload and total service experience had not shown noteworthy link with the attitude of the respondents towards teaching.

The direct and total indirect effect of different variables under study on teaching attitude presented in Table-2 indicate that, the job involvement had positive and maximum direct effect (0.2499), followed by inservice training (0.2088), availability of instructional aids and facilities (0.2034), teaching experience (0.1989) on teaching attitude of the respondents.

The post held (-0.1680) exerted maximum but negative direct effect on teaching attitude, it might be due to the reason that, teacher though possess high total service experience but low teaching experience possess low teaching attitude. Thus it could be inferred that, the respondents with high job involvement, inservice training, availability of instructional aids and facilities and teaching experience hold highly favourable teaching attitude. Highly favourable teaching attitude is very important to improve the teaching competency.

It is further noted that, job preference exerted positive and maximum indirect effect (0.1593) on attitude towards teaching through other factors. The achievement motivation, teaching methods and aids use, workload, total service experience, contribution in terms of publications and educational qualification exerted the substantial positive total indirect effect on teaching attitude. Total service experience and age exerted recognizable negative indirect effect. It is very surprising to reveal that senior teachers with more experience and age did not show positive direct effect. It may be due to higher total service experience but a lesser amount of teaching experience, lack of job satisfaction as well as incentives and recognization on the part of organization.

Further, it is observed that, age, total service experience and inservice training had exerted maximum indirect effect on teaching attitude through teaching experience. This is quite obvious because these parameters facilitate better performance. Thus teaching experience had not only produced substantial direct effect but also served as a vehicle for the production of indirect effect of other variables on teaching attitude and emerged as an important determinant of teaching attitude.

The results pertaining to regression analysis of teaching attitude are presented in Table 3.

The results presented in Table 3 revealed that, the effect of inservice training (t=2.1977) and job involvement (t=2.5379) was significant in explaining the variation in teaching attitude. The influence of other

Table 3: Regression analysis of teaching attitude of respondents

S. N.	Characteristics	Partial regression coefficient'b'	Standard error (SE) of 'b'	't' value
1	Age	0.0320	0.1813	0.1768
2	Educational qualification	0.3159	0.4444	0.7108
3	Post held	-2.4944	1.5512	1.6080
4	Total service experience	-0.0480	0.1559	0.3081
5	Teaching experience	0.1380	0.0773	1.7847
6	Inservice training.	0.7919	0.3603	2.1977*
7	Membership of periodicals	0.0284	0.4015	0.0709
8	Contribution in terms of publications	-0.0112	0.0384	0.2923
9	Work load	-0.0600	0.0697	0.8615
10	Availability of instructional aids and facilities	0.2536	0.1317	1.9258
11	Teaching methods and aids use	0.1678	0.1611	1.0416
12	Job preference	-0.3127	0.4926	0.6348
13	Job Involvement	0.2474	0.0975	2.5379*
14	Achievement motivation	0.1621	0.1472	1.1013

** Significant at 0.01 level of probability
* Significant at 0.05 level of probability

R^2=0.2629
F-value = 2.45

variables was not significant. All variables fitted in a regression equation accounted for 26.29 per cent variation in teaching attitude, (R^2= 0.2629) with the value of 'f' ratio 2.45, which was not significant.

CONCLUSION

The distributional analysis concluded that, majority of the respondents though reported to hold highly favourable teaching attitude, the remaining one fourth respondents need to be inspired to create a favorable attitude. Self-motivation towards the teaching with awareness of responsibilities and free hand working to achieve high teaching attitude will be helpful to change the attitude of the teacher respondents to improve the teaching competency.

The correlational analysis concluded that, the inservice training, availability of instructional aids and facilities, teaching methods and aid's use, job involvement, achievement motivation and job preference matters in determining teaching attitude of the respondents, promoting these aspects for better Teaching-learning climate, mentoring by superiors and attention at an organizational level will definitely change the situation.

The path analysis concluded that, out of set of variables, the teaching experience had not only produced substantial direct effect but also served as a vehicle for the production of indirect effect of other variables on teaching attitude. It was as an important determinant of attitude towards teaching. The Job preference exerted positive and maximum indirect effect on teaching attitude of respondents

The regression analysis concluded that, the characteristics inservice training and job involvement contributed significantly towards the variation in teaching attitude of respondents to the tune of 26.29 percent.

LITERATURE CITED

Jhansi Rani, G.1985: Scientific productivity of agricultural scientists –An activity approach.,Ph. D.Thesis (Unpub.), ANGRAU, Hyderabad.

Jhansi Rani, G. and S.V.Reddy.1985: Scientific productivity of agricultural scientists, J. Res. APAU.13: 84-89.

Rambabu, P., P. Venkataramaiah and P. Punna Rao.2000: A scale to measure attitude of farmers towards indigenous technology. Maharashtra J. Extn. Educ, 19: 82-85.

Thurstone, L.L and L. Chave.1946: The measurement of attitude, American J. Sociology, 52: 39-50.

Verma, Romesh. 2002: Teacher in Twenty First Century, Uni. News, 40 (4): 2-8.

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Participation of Youths in Rural Development

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ABSTRACT

Present study was conducted in randomly selected four taluka of Parbhani and Hingoli districts of Marathwada region of Maharashtra State to know the profile of rural youths, its relations with participation in rural development programmes and problems faced by the youths in participation in rural development programmes. From each taluka two villages and from each village 15 respondents between 18 to35 years were selected randomly, thus sample comprised of 120 youths. The data were collected with the help of structured schedule. From the study it is found that majority of the youths were educated up to high school, agriculture was their main occupation, having low income with medium size and joint family, small land holding, medium extension contact and high social participation. As regards relationship, the characteristics viz. education, annual income, size of family, social participation and extension contact showed positive relationship with participation of youth in rural development programmes, while occupation and extension contact were found to have positive relationship with the participation of youths in farming activity. Lack of cooperation from villagers, villagers not showing faith in youth and villagers not giving recognition to social work done by youths were some of the problems expressed by youths. The statistical methods like percentage, frequency and co-efficient of correlation were employed for the analysis of data.

India is said to be a land of youths and villages. Youths are the cream of the society, physical and mental energy of youth is the backbone of progress of society. Hence, it is essential to encourage and assist them to become mature and responsible as contributing members of the society. Youths constitute a vital human resource with tremendous energy and potential to contribute to development process in the country. Youths' active participation is basic for successful rural development programme. Hence, it was essential to study profile of youths and their participation in rural development programmes with following objectives.

1. To study the personal and socio-economic characteristics of rural youths
2. To find out relationship between personal and socio-economic characteristics of youths and their participation in rural development programmes.
3. To identify problems faced by the youths in participation in rural development programmes.

MATERIAL AND METHODS

The study was conducted in randomly selected two districts of Marathwada region viz. Parbhani and Hingoli. From each district two taluka i.e. Parbhani and Jintur from Parbhani Dist. and Aundha Nagnath and Sengaon from Hingoli Dist. were selected randomly. From each taluka two villages and from each village 15 respondents between 18 to35 years were selected randomly. Thus sample was comprised of 120 youths. The data were collected with the help of structured interview schedule. The statistical methods like percentage, frequency and co-efficient of correlation were employed for the analysis of data.

RESULTS AND DISCUSSION

I) Personal and socio-economic characteristics of youths

A close perusal of the Table 1 indicates that 33.33 per cent of the youths were educated upto high school, 21.67 per cent up to college level, 17.50 per cent up to primary level and 15.83 per cent up to secondary level, whereas 11.67 were illiterate. Similar findings were also reported by Kolhe (1992) and Nale (2003).

It was further observed that majority of youths (60.00 %) having agriculture as main occupation followed by 30.00 per cent youths found to have occupation as agriculture + business, while 8.33 per cent youths' occupation was labour,. Only 1.67 per cent youths found to have occupation as agriculture + service.

A look at Table 1 indicates that about 50.00 per cent youths had low annual income (up to Rs.22, 800),

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Table 1. Distribution of youths according to their personal and socio-economic characteristics (n=120)

S.N.	Category	No	Percentage
A	**Education**		
	Illiterate	14	11.67
	Primary	21	17.50
	Secondary	19	15.83
	High School	40	33.33
	College	26	21.67
B	**Occupation**		
	Labourer	10	8.33
	Agriculture	72	60.00
	Agril. + Business	36	30.00
	Agril. + Service	02	1.67
C	**Annual Income**		
	Low (up to Rs.22,800/-)	59	49.17
	Medium (Rs.22,801 to 70,150)	48	40.00
	High (70151 & above)	13	10.83
D	**Size of family**		
	Small (up to 4)	33	27.50
	Medium (5 to 6)	55	45.83
	Big (7 & above)	32	26.67
E	**Type of family**		
	Joint	68	56.67
	Nuclear	52	43.33
F	**Land Holding**		
	Landless	15	12.50
	Marginal (upto 1 ha.)	19	15.83
	Small (1.1 to 2 ha.)	34	28.34
	Medium (2.1 to 4 ha.)	25	20.83
	Semi medium (4.1 to 10 ha.)	22	18.33
	Big (10.1ha. & above)	05	4.17
G	**Extension Contact**		
	Low (up to 2)	39	32.50
	Medium (3 to 4)	61	80.83
	High (5 & above)	20	16.67
H	**Social Participation**		
	Low (1 to 2)	39	32.50
	Medium (3 to 4)	31	25.83
	High (5 & above)	50	41.67

40.00 per cent youths had medium annual income (Rs.22801 to 70,150), whereas 10.83 per cent youths were in the high annual income group (Rs.70.151 and above).

It is noticed from the Table 1 that about 46.00 per cent of the youths had medium size of family, nearly equal number of youths (27.50 & 26.67 %) had small and big size of family. Similarly, 56.67 per cent youths belonged to joint family whereas 43. 33 per cent youths were from nuclear family. This finding is in line with the findings of Manay Shakuntala and Farzana Chamon (2000) and Nale (2003).

Further Table 1 indicates that 28.34 per cent youths had small land holding, 20.83 per cent medium, 18.33 per cent semi medium, 15.83 per cent marginal and 4.17 per cent youths having big land holding, whereas 12.50 per cent youths were landless. This finding is similar to the finding of Manay Shakuntala and Farzana Chamon (2000) and contradictory to the findings of Upadhye (1993) and Nale (2003).

It was depicted from Table 1 that majority of the youths (80.83 %) belonged to medium extension contact category, while 32.50 per cent and 16.67 per cent of youths belonged to low and high extension contact categories, respectively. The level of social participation of 41.67 per cent youths was high while 32.50 per cent and 25.83 per cent youths were in low and medium level of social participation category. This finding is contradictory to the findings of Upadhey (1993) and Nale (2003).

II) Relationship of personal and socio-economic characteristics of youths with Participation in rural development programmes

It is observed from Table 2 that education, annual income, size of family , social participation and extension contact were found to have positive relationship with participation of youths in rural development programme. This meant that with increase in the level of education, annual income, size of family, social participation and extension contact, there was corresponding increase in the participation of youths in different rural development programmes. The other selected independent variables viz. age, occupation, type of family and land holding could not show any relationship with participation of youths in different rural development programmes. The results are in agreement with the findings of Nural *et al.* (1997) and Nale (2003).

Table 2: **Relationship of personal & socio- economics characteristics of youths with participation in Rural Development Programmes**

S.N.	Characteristics	Co-efficient of correlation 'r' value	
		Participation in Rural Development Prog	Participation in farming
1.	Age	0.183	0.007
2.	Education	0.292**	0.084
3.	Occupation	0.168	0.206*
4.	Annual Income	0.226*	-0.093
5.	Size of family	0.316**	0.005
6.	Type of family	0.127	0.039
7.	Land Holding	0.169	0.026
8.	Social Participation	0.384**	0.124
9.	Extension Contact	0.347**	0.198*

** Significant at 0.01 level of probability * Significant at 0.05 level of probability.

Table 3: **Problems faced by youths in participation in Rural Development Programmes.**

S.N.	Problems	No	Percentage
1.	Lack of co-operation from villagers	71	59.16
2.	Villagers do not show faith in youths	62	51.66
3.	Villagers do not give importance to the opinion of youth	34	28.33
4.	Lack of guidance from voluntary organizations	25	20.83
5.	Village leader do not take interest in village development activities	41	34.16
6.	Overlapping of programme implemented	15	12.5
7.	Lack of spare time	36	30.00
8.	Parents dislike youths participation in village development programme.	17	14.16
9.	Villages do not give recognition to good social work done by youths.	49	40.83

III) Relationship of personal and socio-economic characteristics of youths with participation in farming.

It is evident from Table 2 that occupation and extension contact were found to have positive relationship with the participation of youths in farming. This meant that with the increase in the level of occupation and extension contact there was corresponding increase in the participation of youths in farming. However, age, education, annual income, size of family type of family, land holding and social participation could not show any relationship with participation of youths in farm activities.

VI) Problems faced by youths in participation in Rural Development Programmes

It is clear from Table 3 that the most important problems as perceived by the youths in order of importance were, lack of cooperation from villagers (59.16 %) villagers not showing faith in youths (51.66 %),

villages not giving recognition to good social work (40.83 %), village leaders not taking interest in development activities (34.16 %), lack of spare time (30.00 %) and villagers do not give importance to the opinion of youths (28.35 %).

The other minor problems were lack of guidance from voluntary organizations (20.83 %), parents did not like youths participation in village development programme (14.16 per cent).

CONCLUSION

It is concluded from study that majority of the youths were educated up to high school, agriculture was their main occupation, having low income with medium sized joint family, small land holding, medium extension contact and high social participation. As regards relationship, the characteristics viz. education, annual income, size of family, social participation and extension contact showed positive relationship with participation of youth in rural development programmes. The characteristics like occupation and extension contact were found to have positive relationship with the participation of youths in farming activity. Lack of cooperation from villagers, villagers did not show faith in youth and villagers did not give recognition to social work done by youths were some of the problems expressed by youths.

The extension agencies in the village should try to take the advantage of youths in the villages with higher education, high annual income, higher social participation and high extension contact to popularize various rural development activities in the public at large.

LITERATURE CITED

Kolhe, B.N.,1992. Leisure time activities of rural youth. M.Sc. (Agri.) Thesis (Unpub), Marathwada Agriculture University, Parbhani.

Manay Shankuntala and Farzana Chamon, 2000. Socio-economic characteristics of rural families, Maharashtra J. Extn. Educ., 19 : 325-328.

Nale, S.C., 2003. Changing participation of rural youth in farming. M.Sc. (Agri.) Thesis (Unpub), Marathwada Agriculture University, Parbhani.

Nural Anwar, A.B.M., Abul Kashem, M. and Mehboob, S.G. (1997). Interest, participation and time use of rural youth in selected agriculture activities. Indian J. Extn. Educ., 23 : 3-4.

Upadhye, R.M., 1993. Role of rural youth in farm and home decisions. M.Sc. (Agri.) Thesis, (Unpub), Marathwada Agriculture University, Parbhani.

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Constraints in Floricultural Entrepreneurship as Perceived by Floriculturists

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ABSTRACT

The study was conducted in Patur tahsil of Akola district with a view to assess the constraints faced by the floriculture entrepreneurs in cultivation of flowers. A total of 40 floriculturists entreprenеur were selected from Patur tahsil. The findings of study revealed that majority of the respondents were young age, medium floriculturists having area under flowers in the range between 1 to 2 ha and post graduation with a source of credit such as bank. Regarding the findings of constraints analysis it was found that unavailability of equipments and input for planting, unavailability of cold storage facility, unavailability of desirable market price, low yield level, load shading of electricity, higher cost of cultivation and lack of knowledge about proper variety.

Floriculture is the most common and popular with rural people of India. During the year 2004-2005, the area under floriculture in India was 88,600 ha with 5.09 lakh tones of flowers and in Maharashtra it was about 9600 ha with the production of 52160 tones (Anonymous, 2004).

Floriculture is comparatively nothing but complicated one, as it involves specialized operations starting from selection of soil, varieties, planting material, application of fertilizers, growth regulator spray, packing and transport. Flowers are also affected by pests and diseases and we can not expect that all the technologies generated by research system would reach all the farmers, even with the functioning of well established development department engaged in transfer of such technologies. Though floriculture is commercial, farmers do not get botanical yield since they are not fully aware of scientist's generated technologies, do not possess the expected knowledge and conviction to grow flowers in their fields. Problem related to infrastructure, transport and storage facilities also causes a huge amount of post harvest losses (Kumar, 2007).

There are so many floriculturists in Patur region of Akola district of Vidarbha region in Maharashtra state. Since farmers generally grow non descriptive local variety, this results in poor crop productivity which is far below the national as well as state level.

Hence, it is worth to study constraints perceived by floriculturists so that the personnel like scientists, development workers, policy makers and planers who are concerned with these floriculturists can appropriately develop working strategy for development of floriculturists by removing constraints that prevails at present. the study was conducted with the objectives :

1) To study the socio-personal and situational characteristics of floriculturists.
2) To identify constraints as perceived by floriculture entrepreneurs in cultivation of flowers.

MATERIAL AND METHODS

The present study was conducted in Patur tahsil of Akola district which was selected purposively as it has considerable area under floriculture. A total of 40 floriculturist entrepreneurs were selected from Patur tahsil purposively by population study method. The data were collected through structural interview schedule and subjected to statistical anslysis by simply using frequency and percentage.

RESULTS AND DISCUSSION

I) Socio Personal and Situational Characteristics of respondents

A) Age : It was noticed that (Table 1) more than one third (40.00%) of the respondents were in young age group, while 30.00 per cent of the respondents each were in middle and old age group.

B) Education: It was observed that, equal number (27.50%) of the respondents were educated upto post graduate and high school level. Equal number (15.00%) of them were educated upto college and middle school level. Whereas 12.50 per cent of respondents were illiterate and only 2.50 per cent of them were educated upto primary education.

C) Land holding : It can be seen from the present investigation that, 75.00 per cent of the respondents had medium size of land holding while, 20.00 per cent of them

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Table 1: Distribution of the respondents according to their socio- personal and situational characteristics

S. N.	Characteristics	Category	Frequency(N=40)	Percentage
1.	Age	i) Young	16	40.00
		ii) Middle	12	30.00
		iii) Old	12	30.00
2.	Education	i) Illiterate	05	12.50
		ii) Primary	01	2.50
		iii) Middle	06	15.00
		iv) High School	11	27.50
		v) College	06	15.00
		vi) Post graduate	11	27.50
3.	Land holding	i) Marginal	02	5.00
		ii) Small	08	20.00
		iii) Semi-medium	24	60.00
		iv) Medium	06	15.00
		v) Large	00	0.00
4.	Area under flowers	i) Upto 1 ha	10	25.00
		ii) 1.01 to 2 ha	18	45.00
		iii) 2.01 to 3 ha	08	20.00
		iv) Above 3 ha	04	10.00
5.	Annual income	i) Up to Rs 50,000	11	27.50
		ii) Rs 50,001 to 1,00,000	19	47.00
		iii) Rs 1,00,001 to 1,50,000	06	15.00
		iv) Above Rs 1,50,000	04	10.00
6.	Credit source	i) Bank	20	50.00
		ii) Moneylender	10	25.00
		iii) Neighbourer	00	00.00
		iv) Relatives	03	07.50
		v) Co-operative societies	07	17.50

had marginal size of land holding and only 5.00 per cent of the respondents had small size of land holding.

D) Area under flowers : The findings showed that maximum number (45.00 %) of the respondents had put the area under flowers in the range between 1.01 to 2 ha, followed by 25.00 and 20.00 per cent of them putting the area under flowers upto 1 ha and 2.01 to 3 ha, respectively whereas 10.00 per cent of respondents had put the area under flowers above 3 ha.

E) Annual income : It was observed that 47.50 per cent of the respondents had annual income in the range between Rs. 50,000 to 1,00,000, followed by 27.50 per cent of the respondents who had annual income upto Rs. 50,000 and 15.00 per cent had annual income in the range between 1,00,000 to 1,50,000. Only 10.00 per cent of the respondents had annual income above Rs. 1, 50,000.

F) Credit source : Vast majority of the respondents (50%) per cent had indicated bank as a major source of credit, while 25.00 per cent of them had indicated source of credit as co-operative societies, followed by money lender (17.50%), and relatives (07.50%).

II) Constraints in Floriculture Entrepreneurship :

It is evident from Table 2 that, unavailability of equipment for planting (42.50%) was a major constraint expressed by the entire floriculturists followed by unavailability of seeds/ sets/ cuttings (40%) among the production constraints.

Unavailability of cold storage facility (80%) was the another major constraint, followed by unavailability of preservatives/ chemicals (57.50%) as encountered in floriculture entrepreneurship among the storage constraints. Low market price (75%), unavailability of

Table 2 : Constraints in Floriculture Entrepreneurship as perceived by Floriculturists

S. N.	Constraints	Frequency	Percentage	Rank
I	**Production constraints**			
1	Unavailability of seed/ sets/ cuttings	16	40.00	2
2	Unavailability of fertilizers	10	25.00	5
3	Unavailability of fungicides	12	30.00	4
4	Unavailability of insecticides	14	35.00	3
5	Unavailability of equipments for planting	17	42.50	1
II	**Storage Constraints**			
1	Unavailability of cold storage facility	32	80.00	1
2	Unavailability of preservative/chemicals	23	57.50	2
III	**Market constraints**			
1	Unavailability of market	22	55.00	2
2	Unavailability of transport facility	21	52.00	3
3	Unavailability of desirable market price	29	72.00	1
IV	**Situational constraints**			
1	Low yield level	29	72.50	1
2	Unavailability of irrigation	13	32.50	4
3	Unavailability of labour	14	35.00	3
4	Load shading of electricity	28	70.00	2
V	**Economic constraints**			
1	High cost of cultivation	29	72.50	1
2	Unavailability of loan facilities	17	42.50	3
3	Unavailability of credit supply and services	14	35.00	4
4	High labour wages	21	52.50	2
VI	**Technical constraints**			
1	Lack of knowledge about proper variety	23	57.50	1
2	Lack of knowledge about market	15	37.50	4
3	Lack of information sources	18	45.00	3
4	Low extension contract	20	50.00	2
5	Lack of skill	13	32.50	5
6	Unawareness of post harvest practices	13	32.50	5

market (55%) and unavailability of transport facility (52.50%) were the constraints faced by the floriculturists in marketing. These findings are in line with Pathak (1992) who reported that unavailability of market and transport of flower by truck / tractor were expensive (82.00%).

Low yield level (72.50%) and load shading of electricity (70%) were the situational constraints. In that order, high cost of cultivation (72.50%) and high labour wages (52.50%) were the major identified economic constraints. The present findings are supported by Pathak (1992), who reported that, higher rate of wages for labour (78.43%) and lack of skilled labour for flower cultivation (74.51%). The important technical constraints such as lack of knowledge about proper variety (57.50%) and low extension contact (50%) were expressed by the floriculturist.

The study has brought out number of constraints faced by the floriculturists. These constraints need urgent attention of the policy markers. It is important to ensure that, the floriculturists interested in expanding activity be identified and every help be rendered to them for solving the problems in expansion of enterprise which may be considered as guidelines for this purpose.

LITERATURE CITED

Anonymous 2004. Indian Horticultural Database.

Kumar N.2007.Indian Floriculture Mission, 2010, Agriculture Today, 10(1): 21-23.

Pathak, S.V. 1992. Consultancy Pattern and Adoption Behaviour of Floriculturist, in Akola district, M.Sc. Thesis (Unpub), Dr. PDKV, Akola

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Standardized Scale to Measure Teaching Competency of Academic Staff

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ABSTRACT

To know the present status of respondent academic staff in terms of competency possessed, systematic and accurate instrument was felt necessary however, the teaching competency scales earlier developed and advocated were very few and found not applicable in the present changed scenario of agricultural education system, hence a teaching competency scale was developed, standardized and used for systematic and accurate measurement of teaching competency of the respondents.

The teaching competency level of its academic staff governs the standard of any educational system in the turn. The teaching competency status plays an important role in differentiating the individuals from each other. Teacher of agriculture is required to possess both professional and technical competencies to teach crop production effectively in the secondary institution of learning (Obasi *et al*, 1994). Competency is a synonym for ability. It means a satisfactory degree of ability for performing certain implied kind of tasks (Veerbhadraiah, 2000). Competency refers to state of being well qualified to perform an activity, task or job function (Michale *et al*, 2001). Competencies are the characteristics of an individual, which underlie performance of behaviour at work (Rao and Rao, 2002).

Teaching competency in the present study is defined in two ways.

1) Teaching competency refers to the extent of knowledge, skill, mental abilities and other qualities possessed by an academic staff, which aids to perform the teaching job in an effective way.
2) Teaching competency of academic staff is defined as the ability of an individual, which aids to express the possessed knowledge, skill, mental abilities and other qualities in planning, executing and evaluating the teaching- learning process.

MATERIAL AND METHODS

Procedure for standardization of Teaching Competency Scale (TCS)

1) Identification and selection of Indicators, Sub-Indicators and items of Teaching Competency.

The indicators, sub-indicators and items of teaching competency of academic staff were identified on the basis of reviewed literature on the teaching competency. The nature of duties performed by academic staff was also considered and discussion with experts in the field of extension education, psychology, management and social sciences, the identified indicators framed were: 1) Knowledge, 2) Skill, 3) Mental abilities, 4) Other qualities / competencies.

Thus initially four main indicators were selected, for fourth indicator i.e. other qualities / competencies, again eight relevant sub-indicators identified and framed were: Planning ability, Teaching ability, Creativity, Communication competency, Guiding ability, Self-development, Evaluation ability and professional ethics.

Thus initially framed four main indicators and eight sub-indicators were then put for further analysis by identifying relevant items in each main and sub-indicator. Thus, in all, 110 items were identified and carefully edited in the light of 14 criteria suggested by Edwards (1957) and then considered as an indicative of the teaching competency. These items were arranged logically for further analysis.

2) Deciding relevancy of indicators, sub-Indicators and items of teaching competency.

The selected indicators of teaching competency were referred to the experts, researchers, social scientists, psychologists, experts in management and administration. In all, 50 selected judges were contacted. Out of 50 judges to whom indicators of the Teaching Competency were mailed, only 31 responded. Thus, 62 per cent responses from the judges were obtained which were quite satisfactory in this regard to draw the valid conclusions. The responses were collected as most relevant, relevant, somewhat relevant and not relevant by assigning numerical score of 4,3,2 and 1, respectively. The judgment given by the judges were used to work out mean relevancy score with the help of formula, as follows ;

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$$\text{Mean Relevancy} = \frac{\text{Actual score obtained for each item}}{\text{Number of judges responded}}$$

All indicators and sub-indicators were found to be most relevant as per the scoring of judges. After obtaining the mean relevancy score out of 110 items put for judges scoring, 53 items having score; equal to or greater than mean relevancy score (2.86) were selected.

The judges were requested to identify relevancy of indicators and rank them according to their importance in measuring the teaching competency of the academic staff. After receiving the responses of the judges, all indicators as per their original sequence were found fit; hence they were selected as such. To select the items under each indicator rank averages were worked out, the i^{th} item to which most of the judges ranked first was placed at rank one and in the same manner other items were arranged. The average of the scores allotted by judges to the i^{th} item under each indicator, the i^{th} item with maximum average score was placed at the rank one and other items were ranked in the descending order. Selected indicators and items under each indicator were subjected to non- respondent teachers for self, their superiors and students rating for testing reliability and validity.

3) Reliability Test of the Scale

A scale is said to be reliable when it consistently produces the same results when applied to measure the same phenomenon for time to time (Kerlinger, 1964). For assessing the reliability of the present TCS, test retest method was used.

Test retest method

The test retest method of measuring reliability consists of administering the test two times to the subjects at two different times and determining the correlation between the test and retest scores. In this way, two administration of the same test yielded two independent sets of scores. These two sets, when correlated gave the value of reliability co-efficient. A product moment correlation coefficient 'r' was computed between two sets of scores for the scale.

For testing the temporal reliability of the teaching competency scale test retest method was used. The scale was applied to the 20 non-sample academic staff, their superiors and students. The same scale was applied twice at an interval of fortnight to the same respondents. The coefficient of correlation of the scale scores received for non-sample academic staffs, their superiors and students at two different times were observed to be 0.79; 0.77 and 0.81, respectively, indicates quite high temporal reliability and stability of the scale.

4) Testing validity of the scale

The validity is the property of the scale ensures that the obtained teaching competency score correctly measures the variable it is supposed to measure. In the present study the validity of the scale was established by using following method.

Concurrent validity

The criterion related validity of the present teaching competency scale for academic staff was established on the basis of concurrent validity, which tests the usefulness of the scale relating to how well the score corresponds to some outside criterion of the variables being measured. The present the case relationship of a scale score with the known group was used as criterion for testing validity. A random sample of 10 non-sample academic staff, with relatively high and 10 with relatively low teaching competency were judged. The rank order correlation between the scores of the two categories was quite high (0.78) and significant at 1.00 per cent level of probability. It strongly indicates the validity of the scale.

RESULTS AND DISCUSSION

The results obtained in the form of final format of a teaching competency scale, norms for its use, measurement and categorization, are discussed as follows.

1) Final format of Standardized Teaching Competency Scale (TCS)

S. N.	TC indicators and Items	Response Category *				
		VM	M	F	L	VL
1.	**Knowledge**	-	-	-	-	-
i)	Possess basic knowledge of specialized subject.					
ii)	Possess knowledge of current trends in specialized subject.					
iii)	Possess knowledge of teaching.					
iv)	Possess knowledge of student's psychology.					

2	**Skill**	-	-	-	-	-
i)	Possess communication skill.					
ii)	Possess effective teaching skill.					
iii)	Possess lesson plan preparation skill.					
iv)	Possess student motivation skill.					
v)	Possess student evaluation skill.					
vi)	Possess skill to use Audio Visual Aids.					
3	**Mental abilities**	-	-	-	-	-
i)	Ability to generalize the facts.					
ii)	Ability to relate experiences.					
iii)	Ability to draw inferences.					
iv)	Ability to motivate the students.					
v)	Ability to think of alternatives.					
4	**Othe" Qualities \ competencies**					
4.1	**Planning ability**					
i)	Plans to present subject appropriately.					
ii)	Plans to ensure continuity of learning.					
iii)	Plans for effective time management.					
4.2	**Teaching ability**					
i)	Teaches in manner appropriate to the level of students.					
ii)	Teaches as per educational objectives.					
iii)	Interacts with the students to receive their feedback.					
iv)	Maintains free environment for students to express their views.					
4.3	**Creativity**					
i)	Find appropriate resources to teach the subject effectively					
ii)	Makes lesson interesting for students active participation					
iii)	Contributes to well being of students to achieve educational goal.					
iv)	Makes effective use of Audio-Visual Aids.					
4.4	**Communication competency**					
i)	Has Clarity in communication.					
ii)	Uses simple language.					
iii)	Presents subject appropriately.					
iv)	Uses effective communication methods.					
4.5	**Guiding ability**					
i)	Maintains good rapport with the students.					
ii)	Demonstrate an ability to keep students on task.					
iii)	Supervises progress of students.					
iv)	Answer the student's questions.					
v)	Cooperate the student to solve their educational difficulties.					
4.6	**Self development**	-	-	-	-	-
i)	Strives for professional improvement in all areas.					
ii)	Demonstrates updating of technical subject matter.					
iii)	Evaluates one self to improve subject knowledge continuously.					
iv)	Interested in higher studies.					
v)	Maintains consistent development.					
4.7	**Evaluation ability**					
i)	Makes unbiased evaluation of academic progress.					
ii)	Monitors' students work effectively.					
iii)	Keeps records of educational activities.					
iv)	Regular to inform the students about their progress.					

4.8	**Professional Ethics**	-	-	-	-	-
i)	Understands moral responsibilities.					
ii)	Learns from experiences.					
iii)	Derives happiness from the profession.					
iv)	Understands legal responsibilities.					
v)	Aware of professional updates.					
vi)	Receptive to professional criticism.					
vii)	Makes use of feedback from students.					
viii)	Makes use of feedback from peers.					
ix)	Makes use of feedback from superiors.					

* VM = Very much, M = Much, F = Fair, L = Less and VL = Very less.

2) Norms for use of the TC Scale.

The final format of teaching competency scale was composed of 53 statements and all were positive. Each statement has to be rated on five-point response continuum namely very much, much, fair, less and very less. The numerical scores assigned to these response categories were 5,4,3,2 and 1, respectively. The teaching competency score was calculated by summing up the scores obtained by respondents on all the items and considered as individual's score the teaching competency score on this scale ranged from a minimum 53 to a maximum of 265. The Teaching Competency Index (TCI) was then worked out with the help of the formula given below.

$$\text{Teaching Competency Index (TCI)} = \frac{\text{Obtained TC Scores}}{\text{Maximum obtainable TC Scores}} \times 100$$

The superiors' and students' rating for teaching competency of respondents were collected and measured separately by applying the same scale. The scores obtained by superiors and students for respondents on the entire five continuums for all the 53 items were summed up and converted to TC Index. The respondents (by self, superiors' and students' rating) were then grouped into four categories on the basis of TC index range as Poor (Up to 25), Average (26 to 50), Above average (51 to 75) and Good (Above 75).

CONCLUSION

The scale was found to be reliable and valid. Therefore, it can correctly measure the teaching competency of academic staff to the maximum precision possible and can yield results when used on different occasions involving the same / different respondents. This scale could also be used to measure the teaching competency and indicators constituting teaching competency of academic staff as self- rating, superior's rating and student's rating, beyond the study area with necessary modifications in the wordings of the scale items.

LITERATURE CITED

Edwards, E. L. 1957. Techniques of attitude scale construction. Application century crafts, Inc, New York

Kerlinger, F.N.1964: Foundations of Behavioural Research. Holt, Rinehart and Winston Inc, New York.

Michale, S.J, Teja and Leana.2001: Eric Identifiers: ED456841. http://www.google.com.

Obasi, M.O, E. Onwakwe and Udeagbara.1994: Teaching competencies for effective teaching of crop production, Indian J. Extn.Educ. 30 (1&4): 101-105.

Rao, P.P and M. Rao. 2002: Potential appraisal of agricultural extension human resource - A SWOT Analysis, Manage Extn. Review. Jul - Dec; 84 -92.

Veerbhadraiah, V. 2000: Human resource development in Extension organizations. Manage Res. Review. 1: 121-123.

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Effect of Sources and Levels of Sulphur on Economic Yield, Nutrient Uptake and Residual Fertility Status of Inceptisol by Rice Sye-75

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ABSTRACT

The field experiment was conducted for three years (1995-1997) during *Kharif* on an Inceptisol to study the effect of sources and levels of sulphur on the economic yield, nutrient uptake and building-up of soil available nutrient status under rice-rice cropping system. The results of three years and pooled mean showed that the economic rice yield recorded to 20 kgha^{-1} sulphur application through gypsum than elemental sulphur and its (1:1) combination. Uptake of N, P, K and S increased linearly with each addition of sulphur from 20 to 60 kg ha^{-1}. Increase in application of S increased the soil S status and it was found increased in exchangeable Ca and Mg.

The deficiency of S in the tropics is more widespread. The cause of greater deficiency is more in weathered soils, intensively leached coarse textured soils and high intensity of cropping under heavy rainfall area. Sulphur deficiency already been identified in rice growing area of Bhandara and Chandrapur district of Easterrn Vidarbha Zone (Balkundi, 1997). Misra (1997) reported that application of 45 kg S ha^{-1} alongwith a full dose of NPK increased the rice yield under rice-rice cropping system and mean annual S uptake was 20 kg ha^{-1} to produce a paddy yield of 7 t ha^{-1}. Therefore, the experiment was conducted to study the response of rice crop to different sources and levels of sulphur.

MATERIAL AND METHODS

A field experimental was conducted during *Kharif* 1994-1995 to 1996-97 at Regional Rice Research Station (NARP), Sindewahi, Dist. Chandrapur in randomized block design with three replications on inceptisol. Twelve treatment combinations were studied (Table 1). The sulphur was applied through elemental S, gypsum and its combination (1:1) @ 20, 40 and 60 kg S ha^{-1} alongwith full dose of NPK (100:50:50: kgha^{-1}). The full dose of P, K, S and half dose of N was applied at the time of transplanting seedling and remaining dose of N was applied as top dressing, half each at tillering and panicle initiation stage. The N, P and K were applied through urea, diammonium phosphate, single super phosphate and murate of potash. The composite soil sample (0-15 cm) was collected before starting of experiment and after the harvest of crop. The soil samples were air dried under shade and analysed for pH, EC, organic carbon, available N, P, K, S and exchangeable Ca and Mg as per standard procedure (Piper, 1996 and Jackson 1973). The soil of the experimental plot was sandy clay loam in texture with pH 6.8, E.C. 0.35 dSm^{-1}, organic C 0.41per cent, available N 204.6 kgha^{-1}, available P 18.3 kgha^{-1}, available K 336 kgha^{-1} and available S 7.4 mg kg^{-1} soil.

RESULTS AND DISCUSSION

Yield :

The results in table 1 revealed that, the grain and straw yield of rice differed significantly among the sources irrespective of levels tried. Maximum grain yield (40.76 q ha^{-1}) and straw yield (57.26 q ha^{-1}) were obtained at 60 kg S ha^{-1} applied through elemental S and gypsum (1:1) alongwith full dose of NPK in pooled result (T – 12). The result was at par with maximum levels, which received sulphur. After critical examination of the data, it is observed that the economic yield of rice crop was obtained by appliation of 20 kg S ha^{-1} through gypsum. Yield increases to S application have been reported for a number of crops, the mean responses to S being 24 per cent in cereals at application rates of 20-40 kg S ha^{-1}(Anonymous, 1997). The effect was most prominent when S was applied in combination with 40 kg P_2O_5 ha^{-1} through DAP (Sen, 1997). Increase in application of S through elemental sulphur reduced the yield and respond to lower level at 20 kg S ha^{-1} because sulphate is reduced to sulphides particularly to H_2S and in the absence of metals like iron, may build up in the soil to cause sulphide injury to the rice plant (Mohanty, 1997).

Economy Yield :

The significantly maximum grain yield (40.76 q ha^{-1}) and cost of additional yield (Rs 1980/-) were obtained at 60 kg S ha^{-1} applied through elemental S and gypsum

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Table 1: Grain and straw yield of paddy as influenced by different sources and levels of sulphur.

Treatments		Grain yield qha^{-1}			Pooled	Straw yield qha^{-1}			Pooled
		1994-95	95-96	96-97	mean	94-95	95-96	96-97	mean
T-1	Control (No. NPK and S)	32.62	19.61	30.23	27.49	57.93	26.35	34.11	39.46
T-2	NPK (100:50:50 kg ha^{-1}) through Urea, SSP, MOP	41.28	25.32	41.46	35.99	60.72	40.85	48.61	50.06
T-3	NPK (100:50:50 kg ha^{-1}) through Urea, DAP, MOP	40.43	24.51	41.67	35.54	65.81	42.89	48.61	50.06
T-4	NPK through Urea, DAP, MOP+20 kg ES ha^{-1}	42.04	26.14	43.91	37.34	67.40	43.10	49.84	53.45
T-5	NPK + 40 Kg ES ha^{-1}	40.03	27.90	43.51	37.13	64.10	44.74	49.02	52.62
T-6	NPK + 60 Kg ES ha^{-1}	39.63	23.28	43.30	37.01	60.91	45.14	47.39	51.15
T-7	NPK + 20 Kg S ha^{-1} through Gypsum	45.71	26.96	41.87	38.19	67.40	42.87	46.77	52.35
T-8	NPK + 40 Kg S ha^{-1} through Gypsum	45.34	27.94	42.48	38.60	66.18	43.46	46.98	52.21
T-9	NPK + 60 Kg S ha^{-1} through Gypsum	43.26	28.58	42.69	38.15	66.18	45.01	48.82	53.74
T-10	NPK + 10 Kg ES+10 Kg S ha^{-1} through Gypsum	43.75	27.55	42.28	37.87	68.26	47.18	48.20	54.55
T-11	NPK + 20 Kg ES+20 Kg S ha^{-1} through Gypsum	43.75	28.95	43.10	38.60	68.63	47.79	48.82	55.08
T-12	NPK + 30 Kg ES+30 Kg S ha^{-1} through Gypsum	46.56	31.12	44.53	40.73	72.30	48.20	51.27	57.26
	'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	SE (m) ±	1.53	1.76	0.71	0.87	2.47	1.42	0.74	1.31
	C.D. at (5%)	4.51	5.17	2.09	2.55	7.1	4.17	2.16	4.05

Table 2: Grain yield and economics of paddy as influenced by different sources and levels of sulphur.

Treatments	Treatments details	Pooled Mean	Additional yield over T3	Cost of additional yield Rs.ha^{-1}	Cost of ES/ gypsum	Net profit	Cost / benefit ratio
T-1	Control (No. NPK and S)	27.49					
T-2	NPK (100:50:50 kg ha^{-1}) through Urea, SSP, MOP	35.99					
T-3	NPK (100:50:50 kg ha^{-1}) through Urea, DAP, MOP	35.54					
T-4	NPK through Urea, DAP, MOP+20 kg ES ha^{-1}	37.34	1.82	761	480	281	1:0.59
T-5	NPK + 40 Kg ES ha^{-1}	37.13	1.61	673	960	-287	-
T-6	NPK + 60 Kg ES ha^{-1}	37.01	1.47	614	1440	-826	-
T-7	NPK + 20 Kg S ha^{-1} through Gypsum	38.19	2.64	1104	158	954	1:0.99
T-8	NPK + 40 Kg S ha^{-1} through Gypsum	38.60	3.05	1275	316	959	1:3.03
T-9	NPK + 60 Kg S ha^{-1} through Gypsum	38.15	2.64	1104	474	630	1:1.33
T-10	NPK + 10 Kg ES+10 Kg S ha^{-1} through Gypsum	37.87	2.32	970	319	651	1:2.04
T-11	NPK + 20 Kg ES+20 Kg S ha^{-1} through Gypsum	38.60	3.06	1279	638	641	1:1.00
T-12	NPK + 30 Kg ES+30 Kg S ha^{-1} through Gypsum	40.73	5.20	2194	957	1217	1:1.27
'F' test		Sig.					
SE (m) ±		0.87					
C.D. at (5%)		2.55					

Note:
20 kg S =20 kg ES 105.3 kg gypsum^{-1}
40 kg S =40 kg ES 210.6 kg gypsum^{-1}
60 kg S =60 kg ES 316.9 kg gypsum^{-1}

Grain rate @ Rs.418 /- quantal^{-1}
Gypsum rate @ Rs.1.50/- kg^{-1}
Elemental S @ Rs.24.0/- kg^{-1}

Table 3: Mean total uptake of (grain and straw) N, P, K and S by paddy as influenced by different sulphur treatments (kgha^{-1})

Treatments	Nitrogen			Mean	Phosphorus			Mean	Potassium			Mean	Sulphur			Mean
	94-95	95-96	96-97		94-95	95-96	96-97		94-95	95-96	96-97		94-95	95-96	96-97	
T-1	48.77	26.03	36.54	37.11	15.43	8.28	11.35	11.69	49.30	28.60	41.97	39.96	9.56	6.10	8.33	8.00
T-2	62.13	39.46	53.82	51.80	19.67	12.25	17.34	16.42	55.03	44.50	77.15	58.89	10.69	9.90	12.74	11.11
T-3	63.54	39.89	52.29	51.91	20.52	12.85	16.26	16.54	59.71	47.10	78.13	61.65	11.18	10.00	12.61	11.26
T-4	67.04	42.11	58.31	55.82	24.11	15.40	18.87	19.46	56.42	44.50	82.07	61.00	11.59	10.10	13.76	11.82
T-5	64.20	44.52	59.59	56.10	20.93	14.40	19.29	18.21	57.29	48.90	91.46	65.89	12.47	11.70	14.27	12.81
T-6	63.93	45.76	59.08	56.26	21.28	15.15	18.47	18.31	53.17	48.40	87.94	43.17	12.83	12.70	14.63	13.39
T-7	70.95	42.96	5303	55.65	24.16	14.72	16.78	18.55	62.53	47.60	73.04	61.06	12.30	10.70	13.07	12.02
T-8	71.85	45.60	56.31	57.92	22.06	14.50	18.19	15.25	58.36	46.80	81.82	62.33	13.60	12.00	14.33	13.31
T-9	70.52	47.96	59.24	59.15	21.57	14.18	18.92	18.22	60.42	49.80	90.92	67.05	14.30	13.00	14.88	14.06
T-10	72.24	47.67	54.80	58.24	20.91	13.62	17.55	17.36	59.16	50.10	79.32	62.87	12.70	12.60	14.88	13.39
T-11	72.14	48.97	59.63	60.25	22.23	15.03	19.53	18.93	60.24	51.00	90.61	67.28	15.50	13.70	15.90	15.03
T-12	75.22	56.02	64.00	65.08	24.12	16.15	21.26	20.51	65.40	54.00	86.13	68.51	16.60	15.10	17.62	16.44
SE (m) ±	0.83	0.56	0.69	1.38	0.80	0.52	0.33	0.47	0.90	1.00	0.93	0.36	0.65	0.76	0.69	0.33
C.D. at (5%)	2.43	1.65	2.03	4.04	2.36	1.51	0.97	1.39	2.63	2.94	2.73	1.01	1.90	2.21	2.03	0.96

Table 4: Nutrients status of soil after harvest of paddy crops as influenced by different sources and levels of sulphur.

Treatments	Treatments details	pH	Organic C (g kg-1)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})	Available S (mg kg^{-1})	Exch. Ca2+ (cmol (p+) kg^{-1})	Exch. Mg 2+(cmol (p+) kg^{-1})
T-1	Control (No. NPK and S)	6.7	3.9	172.48	17.1	224.0	7.2	10.6	4.3
T-2	NPK (100:50:50 kg ha^{-1}) through Urea, SSP, MOP	6.7	4.9	206.98	18.4	268.8	8.2	11.1	4.4
T-3	NPK (100:50:50 kg ha^{-1}) through Urea, DAP, MOP	6.6	4.7	203.84	18.1	291.2	7.3	10.9	4.2
T-4	NPK through Urea, DAP, MOP+20 kg ES ha^{-1}	6.7	5.6	181.89	18.3	268.8	8.5	11.1	4.3
T-5	NPK + 40 Kg ES ha^{-1}	6.7	5.8	181.89	18.5	291.7	8.8	11.5	4.4
T-6	NPK + 60 Kg ES ha^{-1}	6.6	5.7	185.02	18.4	293.6	8.8	12.5	4.7
T-7	NPK + 20 Kg S ha^{-1} through Gypsum	6.7	6.3	194.43	18.3	291.2	8.1	11.6	4.3
T-8	NPK + 40 Kg S ha^{-1} through Gypsum	6.7	6.5	200.70	18.4	291.2	8.5	12.5	4.7
T-9	NPK + 60 Kg S ha^{-1} through Gypsum	6.7	6.1	206.98	18.5	298.4	8.5	12.5	4.8
T-10	NPK + 10 Kg ES+10 Kg S ha^{-1} through Gypsum	6.7	5.6	203.84	18.1	291.2	8.2	12.5	4.4
T-11	NPK + 20 Kg ES+20 Kg S ha^{-1} through Gypsum	6.7	5.6	213.25	18.3	291.2	8.5	12.7	4.7
T-12	NPK + 30 Kg ES+30 Kg S ha^{-1} through Gypsum	6.8	5.8	210.11	18.8	291.2	8.8	13.2	4.7
	SE (m) ±	0.05	0.07	1.93	0.04	2.51	0.04	0.05	0.05
	C.D. at (5%)	-	0.20	5.65	0.11	7.34	0.13	0.14	0.1

(1:1) alongwith full dose of NPK (T – 12). The result was at par with maximum levels, which received sulphur. However, after critical observation of three years and pooled mean data showed that the maximum economic rice yield and cost benefit ratio (1: 5.99) was recorded to 20 kg S ha^{-1} application through gypsum than elemental sulphur and its (1:1)combination alongwith recommended dose of fertilizer at transplanting (Table 2).

Uptake of Nutrients

Nutrient N, P, K and S uptake in rice significantly increased in the treatments where S was applied than control and full dose of NPK application. Uptake of N, P, K and S increased significantly with each addition of S from 20-60 kg ha^{-1}. Similar results were reported by Singh (1997). Maximum uptake of total N (65.08 kg ha^{-1}), P (20.51 kg ha^{-1}), K (68.51 kg ha^{-1}) and S (16.44 kg ha^{-1}) was recorded at 60 kg S ha^{-1} applied through combination of elemental sulphur and gypsum (1:1) in pooled mean (Table-3). The mean annual S uptake was 20 kg ha^{-1} to produce a paddy yield of 7 t ha^{-1} (Misra, 1997). Sulphur requirement of rice crop is around 3-4 kg $tonne^{-1}$ of grain produce (Mohanty, 1997, Mahapatra, 1997).

Available Soil Nutrients

Results on the available soil nutrient status after the harvest of 3rd year rice crop are presented in Table-4. From the results it is observed that the availability of nutrients N, P, K and S was significantly influenced and it was found decreased where S was not applied. Use of full dose of NPK without S resulted depletion of 6.7 kg of available S ha^{-1} (Misra, 1997). Continuous use of recommended rates of S free NPK fertilizers on a soil testing adequate in S, resulted in its deficiency (Takkar, 1997). The increased in the nutrient status and organic carbon content with slightly decreased in pH was observed with increase in the application of S. The S content of soil was found to have a positive correlation with organic C and negative correlation with soil pH (Mohanty, 1997). The significant increase in available S from 7.4 to 8.8 mg kg^{-1} were observed due to increase in application of elemental sulphur, Mahapatra (1997) reported that elemental S and pyrite have residual effect, while others have negligible residual effect. Das and Ghosh, (1995) reported that release of available sulphur was more by addition of gypsum in acidic Hapludaft and maintaining higher available sulphur in soil. In addition, it is observed that linear increased in application of S increased the exchangeable Ca and Mg.

LITERATURE CITED

Anonymous, 1997. Summary, conclusions and economic recommendations Bhubaneswar and Bhopal workshop, Sulphur in balanced fertilizer use, TSI : 51-56.

Balkundi S.V., 1997. Marketing and production of sulphur containing fertilizers in Maharashtra. Present status and future needs. Sulphur in balanced fertilizer use TSI : 16-17.

Das, Kabita D and Geetanjali Ghosh, 1995. Availability of s as influenced by different sources of S fertilizers, organic matter, temperature and period of incubation in different soils. Seminar, on development in soil. Abst. J. Indian Soc. Soil Sec. Sc. C-17 : 48.

Jackson, M.L., 1973. Soil chemical analysis, Prentice Hall of India, Pvt. Ltd. New Delhi : 111-271.

Mahapatra, I.C., 1997. Inaugural Address. Sulphur in balanced fertilizer use, TSI: 57-61.

Misra, U.K., 1997. Soil sulphur deficiencies and crop responses to sulphur in Orissa, Sulphur in balanced use, TSI : 62-63.

Mohanty, S.K., 1997. Sulphur requirement of rice and its management. Sulphur in balanced fertilizer use, TSI : 64-65.

Piper, C.S., 1996. Soil and Plant analysis. Inter-Science Publishers I.N.D.C. New York : 55 – 275.

Sen, S.N., 1997. Sulphur management in pulses and soil seed in West Bengal. Sulphur in balanced fertilizer use, TSI : 74.

Singh Vijay, 1997. Soil sulphur deficiencies and crop responses to sulphur in the alluvial soil of Madhya Pradesh. Sulphur in balanced fertilizer use, TSI : 95 – 96.

Takkar, P.N., 1997. Inaugural Address. Sulphur in balanced fertilizer use, TSI : 82-84.

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Adoption of Eucalyptus Cultivation Practices by the Eucalyptus Growers in Rainfed areas

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ABSTRACT

The present investigation was carried out amongst 100 randomly selected respondents growing eucalyptus for the last 5 years to ascertain knowledge and adoption of eucalyptus cultivation as agro-forestry land use pattern. Majority of eucalyptus growers had knowledge about the package of practices like harvesting of plantation, intercropping in plantation, site selection, land preparation, seedling quality of eucalyptus and fertilizer application. Majority of eucalyptus growers adopted the important practices of eucalyptus cultivation like type of soil, filling of pits before planting and intercropping. For the better adoption of agro-forestry as a land use pattern by the farmers, it was suggested to have a continuous persuasion and sincere efforts by extension workers, forest department personnel and other related agencies.

Diversified land use pattern is need of the time to uplift the economic condition of Indian farmers. Since from the ancient history of mankind, rural people are dependent on forest resources for meeting their every day need and for additional income, as well. Agro-forestry has to develop on wasteland, sloppy land, and by field boundaries. Eucalyptus is one of the best timber and paper pulp trees mostly grown on farm bunds, river bank and fallow land. Government of Maharashtra had also introduced the programme of social and farm forestry in the year 1983. Through this programme, inputs and technical guidance are made available to the people to raise forest trees along with field crops on individual farm in rainfed areas (Hegde, 1992).

Despite of government efforts to promote agro-forestry on all fronts, the agro-forestry development is slow and discouraging. Considering this fact, it was felt necessary to undertake a study to assess the constraints regarding knowledge and adoption of eucalyptus growers towards recommended practices of eucalyptus plantation (Ingle *et. al*, 1990).

MATERIAL AND METHODS

The study was undertaken in Darwha and Yavatmal Panchayat Samiti of Yavatmal district of Maharashtra state. This district is entirely under rainfed cropping system, having annual average rainfall of 1170 mm. Data were collected from 100 respondents growing eucalyptus since last five years. Data were collected with the help of structured schedule. Selected recommendations regarding cultivation of eucalyptus plantation were grouped into 14 items on the basis of their nature to assess knowledge level and extent of adoption among the growers. The respondents eliciting correct reply to the question secured a score of '1' while the respondents eliciting wrong or no reply secured a score of '0'. The total score for all 14 items was indicative of the knowledge of the respondent. Similarly, in case of adoption the same items were tested under full, partial and no adoption assigning a score of 2, 1, and 0, respectively.The practice wise knowledge of eucalyptus growers revealed that all the respondents had knowledge about harvesting of eucalyptus plantation. More than three-forth of the respondents had knowledge about intercropping (97%), site selection (95%), preparation of land and seedling quality (91%), fertilizer

RESULTS AND DISCUSSION

A) Knowledge

Table 1. Distribution of the respondents according to practice wise knowledge about eucalyptus cultivation.

S.N.	Name of practices	Frequency
1.	Site selection	95
2.	Preparation of land	91
3.	Spacing	79
4.	Digging of pits	69
5.	Preparation of mixture of soil, sand and F.Y.M.	35
6.	F.Y.M. application	81
7.	Method of planting	65
8.	Seedling quality	91
9.	Seedling per hectare	57
10.	Direction of planting	49
11.	Fertilizer application	84
12.	Intercropping	97
13.	Harvesting	100

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application (84%), F.Y.M. application (81%) and recommended spacing (79%). Whereas 69 per cent, 65 per cent and 57 per cent of the respondents had knowledge about digging of pits, methods of planting and eucalyptus seedling required per hectare, respectively. More than one-third of the respondents had knowledge about direction of planting (49%), and preparation of mixture of soil, sand and F.Y.M. (35%).

B) Adoption

It is observed from Table 2 that most of the respondents i.e. above 80 per cent had fully adopted the package of practices viz. site selection (91%), intercropping (88%) and harvesting of eucalyptus plantation (84%). More than 70 per cent of them also had the full adoption of the practical like preparation of land (73%) and seedling quality (76%). Over half of the respondents had fully adopted package of practices like spacing (67%), planting method (59%), digging of pits (57%) and eucalyptus seedling per hectare (53%). More than one third of the respondents adopted the recommended method of F.Y.M. application (44%), direction of planting (49%), while only 18 per cent of the respondents followed the preparation of mixture of soil, sand and F.Y.M. as recommended. (Zade, 1992 and Umale *et. al.*, 1991)

Table 2. Distribution of the respondents according to practice wise adoption of the eucalyptus cultivation.

S.N.	Name of practices	Adoption (n=100)		
		Full adoption	Partial adoption	Non adoption
1.	Site selection	91	9	0
2.	Preparation of land	73	0	27
3.	Spacing	67	33	0
4.	Digging of pits	57	20	23
5.	Preparation of mixture of soil, sand and FYM	18	15	67
6.	F.Y.M. application	44	33	23
7.	Method of planting	59	41	0
8.	Seedling quality	76	24	0
9.	Seedling per hectare	53	47	0
10.	Direction of planting	49	0	51
11.	Fertilizer application	0	0	100
12.	Intercropping	88	0	12
13.	Harvesting	84	16	0

Method of planting and seedling per hectare were partially adopted by 41 per cent and 47 per cent of the respondents respectively, 33 per cent following by 30 per cent of them who had partially adopted the practices, namely F.Y.M. application and recommended spacing. However, the percentage of respondents adopting partially the practices like digging of pits (20%), preparation of soil, sand and F.Y.M. (15%), seedling quality (24%) and harvesting (16%) was meager. Quite a few respondent partially adopted site selection.

It is also clear from table 2 that relatively high proportion of the respondents i.e. more than 50 per cent did not adopt recommended package of practices like preparation of mixture of soil, sand and F.Y.M., direction of planting. While one-fourth of the respondents did not adopt recommended practices like preparation of land, digging of pits of F.Y.M. application, respectively. It is interesting to note that none of the respondents adopted practice of like fertilizer application to the eucalyptus plantation..

CONCLUSION

On the basis of results obtained, it can be concluded that majority of eucalyptus growers had knowledge about package of practices like harvesting of plantation, intercropping in plantation, site selection, land preparation and seedling quality of eucalyptus. This also indicates that there is a need to strengthen the efforts to educate the farmers so as to increase the knowledge regarding other practices of eucalyptus cultivation.

The non adoption of package of practices might be because of financial constraints, lack of knowledge of these practices, etc. For increasing adoption of eucalyptus plantation successfully, continuous persuasion and sincere efforts are necessary by extension workers, forest department personnel and other related agencies.

LITERATURE CITED

Hegde, N. G. 1992. Role of NGOs in promoting agro-forestry, Range Management and Agro-forestry, 13 (2) : 191-197.

Ingle, P. O. P. S. Chauhan, R. B. Ulemale and B. J. Jadhao 1990. Appraisal of Agro-forestry in Vidarbha Region of Maharashtra State, PDKV Res. J., 14 (1) : 80-83.

Umale, P. B., R. S. Bhople and M. A. Sagane 1991. Adoption of Agro-forestry by farmers. Maharashtra. J. Extn. Educ., X (1) : 145-148.

Zade, U. B. 1992. Constraints in Adoption of teak plantation, M.Sc. Thesis (Unpub) Dr. PDKV, Akola.

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Adoption of Scientific Storage Practices of Food Grains by Rural Women

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ABSTRACT

A study on adoption behaviour of women towards scientific storage practices of food grains was conducted on 168 women respondents from three blocks in Raipur district of Chhattisgarh state. A structured interview schedule was used to assess their adoption behaviour regarding scientific storage practices. The findings of study revealed that majority of the rural women had medium level of adoption behaviour regarding scientific storage practices of food grains. Findings further revealed that education, annual income, mass media exposure and scientific orientation of rural women had positive and significant relationship with adoption of scientific storage practices of food grains. While, the other variables, namely, age, land holding and socio-economic status did not have any significant correlation with adoption behaviour.

Agriculture is supposed to be the family enterprise in which almost all the family members are engaged in any of the agricultural operations. Women are assumed as a 'weaker sex' performing a crucial role in carrying out all the agricultural operations. Women's involvement in agricultural operations begins with preparation of field for sowing and continues up to the field operations like sowing, inter culturing and harvesting of produce. Even women's involvement does not end at harvesting of crops but it continues till the storage of harvested produce. The national sample survey has shown that the percentage contribution of women in agriculture was higher than men where most of the key operations were done by female labour. (Agrawal, 1987). According to Rajmala Devdas (1985), about 82.20 per cent of women worker in the rural sector were employed as family helpers on farm.

Farmers are used to reserve at an average of 40 per cent of the agricultural produce for consumption, for paying wages to labours, for seed, etc,. Post harvest losses in stored grains due to insect, pests, rodents, etc., are the area of concern. Generally, women are engaged in storage of produce. Women use traditional methods like sun drying for prevention of produce from insect, pests and rodents attack. Now there are various chemical, mechanical, biological methods as well as storage structures available to keep the stored produce free from insect, pests and rodents, attack and ultimately saving the produce from post harvest losses. The present investigation was an attempt to ascertain the adoption behaviour of women regarding scientific storage practices of food grains. Keeping this in view, the present investigation was carried out with the specific objectives as follows:

1. To study the profile of rural women respondents.
2. To study the adoption of scientific storage practices of food grains.
3. To study the relationship between the profile of rural women and adoption of scientific storage practices of food grains.

MATERIAL AND METHODS

In order to determine the adoption behaviour of rural women regarding scientific storage practices of food grains, this study was conducted in purposively selected Raipur district, Chhattisgarh. Raipur district consists of 15 blocks. Out of these, three blocks viz. Arang, Abhanpur and Dharsiva were selected for study. In all, twenty-one villages; seven from each block were selected for study. A proportionate random sample of 168 respondents was drawn from these twenty-one villages. Data were collected with the help of structured interview schedule. Collected data were analyzed and worked out frequency, percentage and mean score. Correlation analysis was applied to see the relation between the profile of respondents and their adoption behaviour towards scientific storage practices of food grains.

RESULTS AND DISCUSSION

I) Profile of respondents:

The data in Table 1 revealed that majority of the respondents were middle aged (52.97%), educated up-to middle school (60.71%), small and marginal farmers (55.95%), earners of annual income below Rs.40,000 (53.58%) occupying middle level positionof socio economic status (64.28%) and moderate mass media (75.00%) and scientific orientation (71.34%).

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Table 1: Distribution of respondents according to their profile

S.N.	Category	Frequency	Percentage
1	Age		
	Young	73	43.45
	Middle	89	52.97
	Old	06	03.58
2	Education		
	Illiterate	50	29.76
	Primary school	36	21.43
	Middle school	66	39.28
	High school	13	07.75
	College	03	1.78
3	Land holding		
	Marginal	52	30.95
	Small	42	25.00
	Medium	48	28.57
	Big	26	15.47
4	Annual income (Rs)		
	Up to Rs 20,000	34	20.25
	20,001 to 40,000	56	33.33
	40,001 to 60,000	24	14.28
	60,001 to 80,000	33	19.64
	Above 80,000	21	12.50
5	Socio economic status		
	Low	29	17.56
	Medium	108	64.28
	High	31	18.46
6	Mass media exposure		
	Low	17	10.12
	Medium	126	75.00
	High	25	14.88
7	Scientific orientation		
	Low	17	10.12
	Medium	120	71.34
	High	31	18.45

II) Practice wise adoption of scientific storage practices of food grains:

Practice wise adoption of scientific storage practices of food grains was studies and the data obtained have been presented in Table 2.

A critical look at Table 2 reveals that cent percent of respondents followed the practice of sun drying before storing of food grains so as to protect the attack of stored grain pests by reducing the moisture content at optimum level through sun drying. This was followed by over three fourth of respondents (78.57%) who took care while stacking the gunny bags in godowns. However, the adoption of other grains storage practices was found to be meager among the majority of the respondents. In other words, majority of the respondents do not adopt the practices like precautionary measures while reusing the pre used gunny bags (86.91%), use of scientific storage structures (92.27%) and use of chemical control of rodents (95.24%). It was interesting to note that none used the other scientific practices such as chemical control for stored grains pests, precautionary measures for retaining the viability of grains to be used as seed, use of fumigation and use of oil for treating the pulses to protect from stored grain pests.

By and large, it could be stated that the respondents, in majority , used the practices involving low cost/no cost technology that is, sun drying the grains and stacking the gunny bags duly filled in with food grains. However, other scientific grain storage practices were not adopted by majority of the respondents is a serious concern as regards to storage of produce, resulting in heavy post harvest losses.

The plausible reason for such findings might be that the respondents might be unaware about these scientific practices. The use of chemical control against stored grain pests and improved grain storage structures is the need of the hour so as to save the food grains from post harvest losses.

III) Level of adoption of scientific storage practices:

On the basis of adoption score obtained the respondents, they were grouped into 3 level namely low, medium and high with the help of mean $\pm$ s.d. and the data obtained have been furnished in Table 3.

A glance at Table 3 reveals that majority of the respondents were mediocre in adoption of scientific storage practices (70.70%). The percentage of the respondents appearing in low and high level of adoption was found to be meager (17.36% & 11.94%), respectively.

IV) Relationship between profile of rural women and their adoption of scientific grain storage practices:

The data in Table 4 reveal that the variable namely education, annual income, mass media exposure and scientific orientation had positive and significant relation with adoption behaviour of women regarding scientific grain storage practices. However, the other variables namely age, land holding and socio-economic status did not show any significant association. The plausible reason behind significant correlation of education, annual income and mass media exposure with

Table2. **Distribution of respondents according to their practice wise adoption of scientific grain storage practices of food grains.** (n=168)

S.N.	Practices	Adoption	Non adoption
1	Sun drying of food grains before storage.	168 (100.00)	0 (0.00)
2	Exercising care while stacking the grain bags.	132 (78.57)	36 (21.43)
3	Precautionary measures while reusing pre-used gunny bags.	22(13.09)	146 (86.91)
4	Using improved grain storage structures.	13 (7.73)	155 (92.27)
5	Using chemical for controlling rodents.	8 (4.76)	160 (95.24)
6	Chemical control measures against stored grain pests.	0 (0.00)	168 (100.00)
7	Use of fumigation.	0 (0.00)	168 (100.00)
8	Using of oil for controlling pest of pulses.	0 (0.00)	168 (100.00)
9	Precautionary measures for retaining viability of seeds.	0 (0.00)	168 (100.00)

The figures in parenthesis indicate percentage.

Table 3: **Distribution of respondents according to adoption level of scientific grain storage practices.** (n=168)

S.N.	Category	Frequency	Percent
1	Low	29	17.36
2	Medium	119	70.70
3	High	20	11.94

Table 4: **Correlation coefficients between the profile of respondents and their adoption of scientific grain storage practices.**

S.N.	Profile	Correlation coefficient V
1	Age	-0.0987 NS
2	Education	0.4478**
3	Land holding	0.0393 NS
4	Annual income s	0.4228**
5	Socio-economic status	0.0978 NS
6	Mass media exposure	0.5035**
7	Scientific orientation	0.4375**

** significant at 0.01 level of probability NS- Non significant

adoption behaviour might be that education leads to seek more information from various mass media exposure and more mass media exposure leads towards gaining knowledge about scientific grain storage practices; knowledge in terms leads towards adoption. Individuals with better socio-economic status can afford to get exposed themselves for seeking first hand information leading to behave in positive manner towards adoption of technology. The findings of study are in line with the findings of Kulkarni (1990) and Rasekar (1998)

CONCLUSION

On the basis of the findings, it could be concluded that the rural women in majority were non adopters of the improved scientific storage practices and thus they appeared in medium level of adoption. The findings of correlational analysis revealed that education, annual income, mass media exposure and scientific orientation had significant correlation with the adoption of scientific storage practices. The findings thys tend to imply that there is a wide scope for adoption of scientific storage practices of food grains by the rural women. This can be achieved through concerted efforts of extension agencies of State Department of Agriculture, Zila Parishad and the State Agricultural University by way of organizing group discussion, launching save grain campaign, demonstration and village level exhibition exhibiting the improved storage structures and demonstrating the chemical control of rodents and stored grain pests. The rural women having higher level of education, income, mass media exposure and scientific orientation may be used as opinion leaders for influencing the rural women informally for promoting the adoption of scientific storage practices of food grains and use of improved storage structures.

LITERATURE CITED

Agrawal, B.1987: Women poverty and agricultural growth in India., Paper presented in All India Agricultural Communication Workshop, Varanasi.

Kulkarni, M.V., Nandapurkar, G.C. and Chitnis, D.H. 1990: Knowledge of farm women regarding improved agricultural practices. Maharashtra J.Extn.Educ..9: 141-145

Rajmala P. Devdas. 1985: Role of women in modern agriculture., Indian Farming; 3: 25-29

Rasekar, A.K. 1998: Adoption of scientific grain storage practices by farm families M.Sc (Agri) Thesis (Unpub.), Dr. PDKV.Akola

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Energy Balance of Cottonseed Biodiesel Production

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ABSTRACT

Energy balance is the equilibrium of energy content (energy available for doing work) of the fuel to the energy used in production of fuel in its whole lifecycle. Biodiesel has approximately 85 per cent of the energy potential of petroleum diesel. The recovery of methyl esters was 96 percent and fulfills the BIS and ASTM D-6751 limits. The calorific value of the cotton seed methyl ester was 43.95 MJ kg^{-1} with 4.92 cSt kinematic viscosity and 179 ^{o}C flash point. The agriculture and oil expelling inputs for biodiesel production were 21.85 and 1.86 MJ kg^{-1}, whereas, energy return value from the byproducts oil cake and glycerin was 9.64 MJ kg^{-1}. The energy balance of CSME was found 1 :1.62. i.e. 162 per cent more energy is available from the cottonseed biodiesel than used for its production. Thus the biodiesel production from cottonseed oil has positive life cycle energy balance.

Biodiesel is a fully renewable liquid fuel, that can be used as an alternative to fossil petroleum diesel. Technically biodiesel is methyl esters of fatty acid. It is most commonly produced by reacting triglycerides with a primary alcohol (methanol) and base (sodium hydroxide). The process is referred as "Base Catalysed Transesterification" and resultant products are methyl esters (biodiesel) and glycerine. When high levels of free fatty acids are present in feedstock, then the acid catalyzation process is recommended. Depending upon the quality of oil transesterification reactions can be either base catalysed or acid catalysed, but base catalysis is often preferred because it is more rapid than acid catalysis (Knothe *et al.*, 2003).

The most common sources of triglycerides used for biodiesel production is plant origin seed oils of edible/ non-edible nature.

Commonly used oils for biodiesel production in European countries are rapeseed, sunflower, cottonseed, castor and canola, and soybean in United States. India being deficit in edible oil resources, the non-edible oils like *Pongamia* (karanja), *Jatropha* (*Chandrajyoti*), *Neem*, *Mahua*, etc. are promoted for biodiesel production.

Energetically, biodiesel has approximately 85 per cent of the energy potential of petroleum diesel. When blended with petroleum diesel at levels less than 20 per cent (v/v), from environmental point of view, biodiesel burns much more cleanly than petroleum diesel with dramatic reductions in most pollutant levels, except for slightly higher NOx emission.

Energy balance is the equilibrium of energy content (energy available for doing work) of the fuel to the energy used in production of fuel in its whole life cycle. An energy balance is simply a ratio of the energy of the fuel product to the energy inputs. The frequently cited fossil energy balance for soybean oil biodiesel is 3.2:1 (Sheehan *et al.* 1998), it means for every unit of fossil energy input 3.2 units of fuel energy are produced. National Renewable Energy Laboratory (NREL) in its 1988 report also evaluated the lifecycle energy balance of soydiesel as 3.2:1.

Cotton is the most vital commercial crop popularly known as "White Gold" and plays a key role in economical and social affairs of the world. In India, it is cultivated mainly for fiber cotton, hence the present study was undertaken for production of cotton seed methyl ester (CSME) i.e. biodiesel by using small scale "PKV-Biodiesel Processor" and energy balance to evaluate potential of cottonseed oil as renewable biofuel source.

MATERIAL AND METHODS

Production of Biodiesel

Small capacity batch type "PKV-Biodiesel Processor" was developed in the project at Department of UCES & EE , Dr. PDKV, Akola and was used for production of biodiesel from cottonseed oil (CSME). The base catalysed transesterfication process used for production of CSME is as follows.

1. Twelve litre fresh, moisture free cottonseed oil was put in the reactor and heated up to 60 ^{o}C temperature with slow stirring.

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2. Two point four litre solution of sodium methoxide was poured gradually in to the reactor containing heated oil.
3. The oil temperature (60 °C) and slow stirring speed (without splashing) was maintained for the period of one hour.
4. After an hour, material was transferred to semitransparent vessel and allowed to cool down for settling and separation of glycerin.
5. The upper yellowish brown coloured biodiesel was put in to another semitransparent vessel containing equal amount of tap water for washing i.e. to remove the catalyst NaOH, as such remained in the reactant and soluble in water. Bubble generator was used for faster and effective washing.
6. When pH of upper yellowish biodiesel reached to 7.0 ± 0.25 (Neutral) it was separated from bottom milky water containing NaOH and heated to 110 °C to remove excess water, if present.
7. The finished product CMSE was cooled down to room temp. before using as a fuel.

Characteristics of Biodiesel :

The physical, chemical and combustion properties of CSME were determined by using standard procedures and equipments as per ASTM D 6751 specifications for biodiesel passed in 2002. Specific gravity was calculated by measuring density by Relative density bottle, Kinematic Viscosity and Calorific value were measured by using Brookfield Viscometer and Bomb Calorimeter, respectively. Cold flow properties like Cloud point and Pour point were measured by Cloud point and Pour point apparatus. Flash point was measured by Abbey Flash and fire point apparatus. Copper strip corrosion was determined by Copper strip Water bath method.

Energy Balance:

The data and oil of cottonseed variety AKA-7 cultivation data at Cotton Research Unit, Central Research Station, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola were collected and used for calculating energy balance of cottonseed biodiesel.

The heat of combustion measures the quantity of energy released when a sample of fuel is burned in a constant volume enclosure, which is used as an indicator of energy content of the fuel. The calorific value of the CSME was calculated by using an Oxygen Bomb Calorimeter.

The surcharge values are added to the energy values of materials depending on the amount of energy required by its production process and the amount of energy taken by the devices, which capture that energy.

RESULTS AND DISCUSSION

Small capacity batch type "PKV-Biodiesel Processor" and process developed in the project was used for production of biodiesel from cottonseed oil. The recovery of biodiesel was 96 percent with the byproduct

Table 1: Energy content and embodied energy values.

Energy Source	Energy Content(MJ unit^{-1})	Surcharge to be added	Assigned Values
Electrical (kWh)	3.60	8.40 (based on 80 % efficiency)	12.00
Steam (kg)	0.4642	0.09284(based on 80 % efficiency)	0.5570
Methanol (Kg lit^{-1})	13.31	2.729(based on energy required for methanol formation)	16.04
NaOH/KOH (kg)	—	11.859 (based on formation energy requirement)	11.895
Nitrogen (kg)	60.60	NA	60.60
Phosphorus (kg)	11.10	NA	11.10
Potassium (kg)	6.7	NA	6.70
FYM (kg)	0.30	NA	0.30
Diesel (Lit.)	56.31	NA	56.31
Meal (kg)	0.567	NA	0.563
Cotton seed (kg)	25.0	NA	25.0
Glycerin (kg)	11.23	NA	11.23

Table 2: Recovery of methyl esters and glycerin from cottonseed oil and their testing for Physical, chemical and combustion properties.

S.N.	Particulars	Value
1	Methyl esters (%)	96
2	Glycerin (%)	14
1	Specific gravity (g ml^{-1})	0.93
2	Kinematic viscosity (cSt)	4.92
3	Calorific value / Heating value (MJ kg^{-1})	47.02
4	Cloud point (^{0}C)	11
5	Pour point (^{0}C)	4
6	Flash point (^{0}C)	179
7	Copper strip corrosion	2a

glycerine 14 per cent of oil used. The Cotton seed methyl Ester (CSME) was tested for its physical, chemical and combustion characteristics (Table 2) and results revealed that, the specific gravity of CSME was 0.93 g ml^{-1} with 4.92 cSt kinematic viscocity. The cloud and pour point was 11 and 4 ^{0}C, respectively. The flash point was 179 ^{0}C with 43.95 MJ kg^{-1} calorific/heating values. Cottonseed biodiesel showed 2a copper strip corrosion.

Energy input- The average yield of cotton at research field was 1200 kg ha^{-1}, which gave 912 kg ha^{-1} cottonseed. It was crushed in expeller to obtain oil and recovery was 136.8 kg ha^{-1}; and 136 Kg oil yields 131Kg biodiesel ha^{-1} (96% ester). Thirteen kg seed was sown which comes to energy value of 2.48 MJ Kg^{-1} (13 multiplied by energy value of cotton seed i.e. 25. so, 325 MJ per ha and 325 divided by 131). The input energy of manures and fertilizer was 16.15 MJ Kg^{-1} and diesel fuel energy value for implementation of entire package of practices was 3.22 MJ Kg^{-1}. The total agricultural energy input for cultivation of one ha cotton was 21.85 MJ lit^{-1}. The total electrical energy required for the extraction and refining was 0.981 MJ Kg^{-1}.

The data presented in Table 3 for energy input and output for production of biodiesel , reveal that the input of electrical energy was 9.41 MJ Kg^{-1} and chemical energy (an endothermic reaction) was 3.56 MJ Kg^{-1} i.e. total energy required for production of methyl ester was 12.965 MJ Kg^{-1}.The byproducts of the production process were cottonseed meal and glycerin; the meal had 41 per cent protein and was used as a cattle feed particularly for milking animals. One kg of this meal replaced the cereal/grain meal equivalent to 2.5 kg of cereal/grain meal due to its higher protein content. The energy value for cereal/grain meal was 0.563MJ kg^{-1}. The amount of meal produce was approximately 84 per cent of the cottonseed ha^{-1} which was about 766.08 kg ha^{-1} energy values were 7.93 and 1.71 MJ Kg^{-1}, respectively . Glycerin recovery was 14 per cent weight basis. One ha yielded (131 x 0.14) 18.34 kg glycerin and its energy value was 1.572 MJ Kg^{-1}. Thus, total 9.64 MJ Kg^{-1} energy from the byproducts was recovered from the total input energy i.e. 35.71 MJ Kg^{-1}.

Energy balance presented in Figure 1 and Table 3 also clarifies that gross energy input during the entire biodiesel production process was 36.68 MJ Kg^{-1}, from which the byproduct energy recovered during the process (9.64 MJ Kg^{-1}) was subtracted, which gave the net energy input of 27.04 MJ for production of one Kg of CSME. The total output energy obtained was 43.95 MJ kg^{-1}. From the overall production process i.e. from cotton crop life cycle analysis for biodiesel production had a net energy gain of 162 per cent and hence the energy balance of biodiesel was 1 : 1.62

Table 3: Input and output energy balance in cottonseed oil biodiesel production

S.N.	Energy type	Energy value (MJ Kg^{-1})
	(A) Input energy	
1	Agriculture	21.85
2	Expelling & refining	1.86
3	Esterfication	12.97
	Total	36.68
4	(B) Byproducts energy	9.64
5	(C) Total input energy Kg^{-1} of biodiesel produced (A-B)	27.04
6	(D) Total output energy (43.95 MJ lit^{-1})	43.95
7	Total energy gain (D/C X 100)	162.0%
	Energy balance for cottonseed biodiesel	1 : 1.62

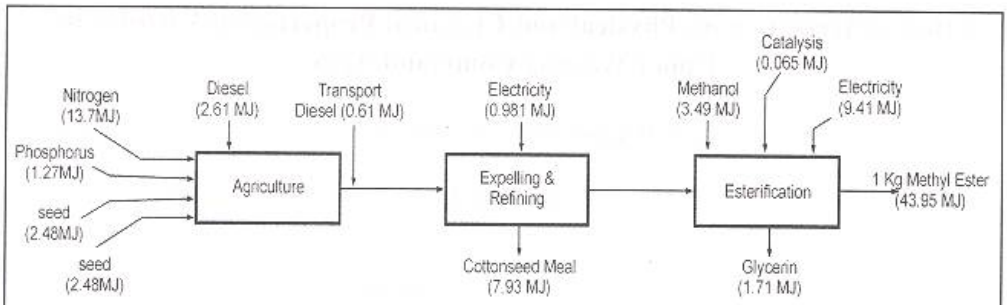

Fig 1 : Energy Inputs and outputsKg^{-1}of cottonseed Biodiesel production

Thus, it can be concluded from this investigation and as illustrated in Fig. 1 that, biodiesel produced from cottonseed oil exhibit physical, chemical and combustion properties well within ASTM and BIS limits. The energy balance of CSME was found 1 :1.62. i.e. 162 per cent more energy is available from the cottonseed biodiesel than energy consumed for its production. Thus the biodiesel production from cottonseed oil has positive life cycle energy balance.

LITERATURE CITED

Knothe G., R.O. Dunn,,and M.O. Bagby, 2003. Biodiesel : The Use of Vegetable oils and Their Derivatives as Alternative Diesel Fuels, Oil Chemical Research, Active Website : http://nbb.org/resources /reports /database/gen/19961201-gen-162.pdf

NREL 1988 Lifecycle Assesment of Petroleum Based Diesel Fuel and Biodiesel: Final Scoping Document, National Renewable Energy Laboratory, Active website: www.NREL.gov eterson, C.L., Wangner, G.L. and D.L. Auld. 1983. Vegetable oil substitute foe diesel fuel. Trans. ASAE (1-4), 322-327.

Sheehan, J., V. Camobreco, J. Duffield, M.Graboski, and H. Shapouri. 1998. An overview of biodiesel and petroleum diesel life cycles. www.nrel.gov /docs / legosti / fy98 / 24772.pdf.

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Effect of Irrigation on Physical and Chemical Properties of Vertisols in Upper Wardha Command Area

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ABSTRACT

Representative soil profiles from Upper Wardha Command area were studied to see the effect of irrigation on soil physical and chemical properties. The soils are clayey (45.2 to 62.5 %) with high water holding capacity of 53 to 78 percent, low saturated hydraulic conductivity of 0.01 to 3.82 cm hr^{-1} and bulk density of 1.15 to 1.37 Mg m^{-3}. The soils are mainly Vertisols with pH 7.6 to 8.9, calcareous in nature and have high cation exchange capacity. The exchangeable sodium percentage (ESP) and sodium adsorption ratio (SAR) ranged from 0.54 to 19.22 and 1.09 to 12.0. The irrigated soils showed sodicity and low HC. The soil properties described here will be useful in management of these soils for sustainable crop production.

In the new strategy of agriculture great emphasis is given on intensive cropping with an adequate fertilization and judicious use of irrigation water for increasing agricultural production particularly in command areas. Therefore, a knowledge of physical and chemical properties of soils of command area is very essential for irrigation water management and sustainable crop production. The Upper Wardha command area covers Wardha, Yavatmal and Amaravati districts of Maharashtra which comprises mostly the black cotton soils. Therefore, the present investigation was carried out to characterize the soils of Upper Wardha command area for their physical and chemical properties and to ascertain the likely changes in soil properties due to irrigation.

MATERIAL AND METHODS

Six soil profiles representing the soils of Ashti and Arvi tahsils of Upper Wardha command area were studied. The soils of pedon 1 to 5 are irrigated and pedon 6 is un-irrigated. The study area extends from 21° 10' to 21° 18' N latitude and 78°5 to 78°15 E longitude. The average elevation of the study area varies from 310 to 400 m from mean sea level. Geology of the area is mainly Deccan Trap basalt. Soils of the area are thus developed from basaltic alluvium. The climate of the study area is semi-arid sub-tropical with an annual rainfall of 979 mm.

The soil samples were analysed for mechanical composition following international pipette method (Piper, 1966). The saturated hydraulic conductivity was determined using a permeameter by the constant head method of Richards (1954). The fine earth fraction (< 2 mm) was analysed for pH, cation exchange capacity (CEC) and exchangeable cations according to methods outlined by Jackson (1973), free calcium carbonate by rapid titration method and organic carbon by Walkely and Black method. The saturation extract of the soils were analysed for their electrical conductivity and soluble cations and anions and the sodium adsorption ratio (SAR) was calculated according to the method outlined by Richards (1954).

RESULTS AND DISCUSSION

The soils were observed to be deep and showed presence of slickensides, wide cracks which extended upto considerable depth. All the soils were clayey with clay content ranging from 45.2 to 62.5 per cent (Table 1). Pal and Deshpande (1987) also reported high content of clay and smectitic mineralogy in these soils. Bulk density at maximum water holding capacity varied from 1.15 to 1.37 Mg m^{-3}. Comparatively Mg m^{-3} low values of bulk density in these soils can be ascribed to the high clay content and dominated by montmorillonite, which is of expanding type. Maximum water holding capacity of soils varied from 53 to 78 per cent. Hydraulic conductivity of soils varied from 0.01 to 3.82 cm hr-1 (Table-1) and showed rapid decreasing trend with depth in all the pedons. The correlation coefficient between HC and clay showed a negative significant relation (r= -0.50) at 1 per cent level.

Soil pH ranged from 7.6 to 8.8 which is moderately to strongly alkaline in reaction (Table-2). The soils were non-saline as indicated by the electrical

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Table 1. Physical properties of soils.

Depth (cm)	Horizon	Size class and particle diameter (mm)			Bulk Density (W max) ($Mg\ m^{-3}$)	Maximum Water Holding Capacity (%)	Hydraulic Conductivity ($cm\ hr^{-1}$)
		Sand (2.0 - 0.05)	Silt (0.05 - 0.002)	Clay (< 0.002)			
		% of less than 2 mm					
		Pedon 1 : Talegaon - I					
0-13	Ap	7.8	40.6	51.6	1.35	70	1.69
13-35	A	8.9	37.7	53.4	1.33	75	0.28
35-60	Bw	8.4	33.1	58.5	1.27	75	0.23
60-100	Bss1	11.5	28.4	60.1	1.21	77	0.01
100-150	Bss2	13.6	24.6	61.8	1.20	78	0.01
		Pedon 2 : Parsoda					
0-11	Ap	13.4	28.5	58.1	1.25	65	0.78
11-33	Bw	12.8	27.7	59.5	1.23	66	0.72
33-86	Bss1	11.8	27.4	60.8	1.19	70	0.17
86-120	Bss2	10.6	27.0	62.4	1.15	71	0.10
		Pedon 3 : Antora					
0-20	Ap	16.4	25.8	57.8	1.29	69	2.81
20-36	Bw1	18.9	23.0	58.1	1.25	70	2.56
36-64	Bw2	16.7	22.5	60.8	1.24	75	2.43
64-106	Bss1	15.4	24.3	60.3	1.19	75	2.92
106-145	Bss2	15.2	22.3	62.5	1.18	78	2.72
145-160	BC	17.4	28.5	54.1	1.33	64	1.99
		Pedon 4 : Manikpur					
0-10	Ap	11.6	32.5	55.9	1.27	65	0.81
10-20	A	10.8	30.7	58.5	1.21	66	0.35
20-55	Bw	9.4	30.4	60.2	1.19	72	0.31
55-84	Bss	11.3	29.3	59.4	1.19	70	0.25
84-120	BC	21.1	24.3	54.6	1.34	54	1.89
		Pedon 5 : Delwadi					
0-15	Ap	7.8	35.3	56.9	1.31	64	2.30
15-37	A	12.8	29.4	57.8	1.27	67	2.18
37-62	Bw	15.3	24.1	60.6	1.24	73	2.58
62-118	Bss	13.2	26.0	60.8	1.19	72	1.35
118-150	BC	14.6	31.8	53.6	1.27	64	1.58
		Pedon 6 : Talegaon - II					
0-20	Ap	12.8	37.6	49.6	1.30	65	3.82
20-32	A	10.7	36.7	52.6	1.28	70	3.74
32-70	Bw	9.6	35.2	55.2	1.25	73	3.20
70-100	Bss	13.4	30.2	56.4	1.21	76	3.01
100-120	BC	22.6	32.2	45.2	1.37	53	3.81

Table 2. Chemical properties of soils

Depth (cm)	pH (1:2.5 H_2O)	ECe ($dS\ m^{-1}$)	Free $CaCO_3$ (%)	Organic Carbon (%)	Extractable bases					Base Saturation (%)	Exchag-eable Na (%)	Exchan-geable Mg (%)	Exchan-geable Ca/Mg	Sodium Adsorption Ratio	Soluble Na (%)
					Ca	Mg	Na	K	CEC						
					<— cmol (p^+) kg^{-1} —>										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Pedon 1 : Talegaon - I															
0-13	8.1	1.16	11.6	0.45	23.00	18.14	0.65	0.8	44.10	96.6	1.47	41.14	1.3	2.25	47.5
13-35	8.3	0.78	11.8	0.19	23.97	16.20	1.33	0.8	44.56	94.9	2.98	36.36	1.5	3.28	60.9
35-60	8.5	1.21	10.2	0.13	21.21	19.39	2.40	0.9	46.40	94.6	5.17	41.78	1.1	5.24	68.9
60-100	8.7	1.51	9.1	0.10	14.89	24.06	5.18	0.8	48.26	93.1	10.74	49.85	0.6	12.0	84.0
100-150	8.9	1.74	6.8	0.10	11.79	28.84	6.36	0.7	50.12	95.2	12.70	57.55	0.4	11.1	82.8
Pedon 2 : Parsoda															
0-11	8.0	0.53	7.1	0.38	31.67	15.20	0.58	1.1	51.24	94.8	1.14	29.66	2.1	1.46	42.0
11-33	8.0	0.82	7.6	0.17	30.16	17.51	0.80	1.1	52.36	94.7	1.52	33.44	1.7	2.6	55.5
33-86	8.5	1.11	10.3	0.11	26.09	21.54	2.73	1.0	53.40	96.2	5.11	40.34	1.2	6.31	75.90
86-120	8.8	1.24	10.9	0.10	22.49	21.29	10.87	0.9	56.55	98.2	19.22	37.65	1.1	6.49	76.5
Pedon 3 : Antora															
0-20	7.6	0.75	3.7	1.23	39.80	11.40	0.31	0.9	55.82	93.9	0.56	20.42	3.5	1.3	35.9
20-36	7.6	0.64	4.0	1.10	39.30	13.16	2.99	0.8	57.84	97.2	5.17	22.75	3.0	1.25	35.8
36-64	7.6	0.63	3.8	0.84	37.50	16.21	2.56	0.8	58.96	96.8	4.34	27.50	2.3	1.09	33.7
64-106	7.9	0.63	4.7	0.35	37.10	19.47	0.51	0.7	58.54	98.7	0.87	33.26	1.9	2.27	50.8
106-145	8.0	0.61	5.2	0.14	28.20	25.29	1.32	0.8	59.61	93.3	2.21	42.42	1.1	2.71	57.8
145-160	8.1	0.58	9.0	0.10	23.10	22.61	0.98	0.7	51.44	92.1	1.90	43.96	1.0	2.06	52.6
Pedon 4 : Manikpur															
0-10	7.8	0.66	2.4	1.12	32.00	21.60	0.37	1.0	57.25	96.0	0.64	37.73	1.5	2.24	55.1
10-20	7.9	0.68	2.6	0.85	34.50	22.30	0.91	0.9	60.55	96.8	1.49	36.83	1.5	2.63	55.8
20-55	7.9	0.57	2.9	0.54	30.81	23.97	3.27	0.9	61.80	95.4	5.29	38.79	1.3	3.91	67.9
55-84	7.9	0.78	8.8	0.23	28.83	25.11	3.44	0.8	62.24	93.5	5.53	40.35	1.1	5.08	71.5
84-120	7.7	0.58	9.0	0.12	23.50	22.06	0.26	0.7	48.60	95.7	0.54	45.39	1.1	1.44	42.8

Depth (cm)	pH (1:2.5 H_2O)	ECe (dS m^{-1})	Free $CaCO_3$ (%)	Organic Carbon (%)	Extractable bases					Base Saturation (%)	Exchag-eable Na (%)	Exchan-geable Mg (%)	Exchan-geable Ca/Mg	Sodium Adsorption Ratio	Soluble Na (%)
					Ca	Mg	Na	K	CEC						
					<—— cmol (p^+) kg^{-1} ——>										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Pedon 5 : Delwadi															
0-15	7.7	0.46	6.5	0.86	34.43	19.73	2.92	0.9	60.24	96.2	4.85	32.75	1.7	1.32	39.0
15-37	8.0	0.35	6.6	0.66	37.29	18.16	2.80	1.0	61.38	96.5	4.56	29.58	2.1	1.09	37.6
37-62	7.9	0.39	7.4	0.18	33.21	22.11	2.64	1.0	61.85	95.3	4.27	35.75	1.5	1.22	38.5
62-118	7.9	0.44	11.4	0.13	30.33	24.57	3.18	0.9	62.15	94.9	5.12	39.54	1.2	3.94	65.3
118-150	7.9	0.56	11.3	0.10	25.20	20.74	3.93	0.8	54.24	93.4	7.25	38.24	1.2	3.86	65.5
Pedon 6 : Talegaon - II															
0-20	7.8	0.83	10.0	0.79	29.90	13.64	0.47	0.9	46.65	96.3	1.00	29.25	2.2	1.41	40.1
20-32	7.8	0.84	10.6	0.28	28.46	17.94	0.55	1.0	48.52	98.8	1.13	36.98	1.6	1.4	39. 5
32-70	7.9	0.88	9.4	0.24	27.66	20.34	0.67	0.9	51.64	96.0	1.29	39.39	1.4	1.58	45.0
70-100	7.9	0.78	11.2	0.23	26.03	22.14	0.63	0.8	51.20	96.9	1.23	43.24	1.2	1.96	52.7
100-120	7.9	0.64	5.9	0.10	21.36	18.14	0.56	0.8	44.68	91.4	1.25	40.60	1.2	1.68	49.0

conductivity of saturated extract, which ranged from 0.35 to 1.74 dSm^{-1}. The organic carbon content varied from 0.1 t 1.23 per cent and followed a decreasing trend with depth. The $CaCO_3$ content ranged from 2.4 to 11.6 per cent. The high CEC (44.10 to 62.24 cmol (p+) kg^{-1}) and base saturation (91.4 to 98.8) per cent indicate the potential of these soils in terms of fertility (Table 2). Among the exchangeable cations Ca was dominant, followed by Mg, Na and K. The calcium showed decreasing trend with depth whereas magnesium increased with depth. The Ca/Mg ratio varied from 0.4 to 3.5 showing decreasing trend with depth. The ESP varied from 0.54 to 19.22 whereas EMP ranged from 20.42 to 57.55 and increased with depth (Table 2). All the three parameters ESP, EMP and Ca/Mg ratio caused the lowering of hydraulic conductivity as the correlation co-efficient showed a significant negative correlation at 1 per cent level between HC and ESP (r = -0.52) and HC and ESP + EMP (r = -0.51), however, HC and Ca/Mg ratio showed a significant positive correlation (r = 0.42) at 5 per cent level.

In saturation extract soluble sodium percentage and SAR, ranged between 33.66 to 84.02 and 1.09 to 12.0 respectively and generally increased with depth (Table 2). The accumulation of high ESP at lower part of profile (pedon 1 and 2) may be attributed to the precipitation of calcium in semi arid climate which caused increase in SAR and in turn results in increase of ESP. Problem might have been further aggravated due to medium to high salinity of well water for several years (Balpande *et al.* 1996). In case of pedon 3, 4 and 5, SAR and ESP raised in surface or below surface horizons i.e. in root zone due to the capillary rise of salts during the discrete moisture stage, which may be the effect of canal irrigation in recent years. Pedon 6 showed no accumulation of salt and sodicity as it is an unirrigated soil. Similar results in terms of HC, ESP and SAR were reported by Bharambe *et al.* (1999) and Kadu *et al.* (2003).

It can be concluded that the soils of Upper Wardha command area are deep, clayey, calcareous, moderately alkaline with high base saturation and CEC having high potential for crop production. However, irrigated soils showed development of sodicity and very low hydraulic conductivity as compared to unirrigated soils. Considering the hydraulic properties, the proper selection of crops, provision of surface drainage and proper irrigation scheduling are essential for sustainable crop production.

LITERATURE CITED

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 Degradation and Development 7: 313 - 323.

Bharambe, P.R., S.G. Kadam, S.D. Shinde, and D.K. Shelke, 1999. Characterization of Soils of Majalgaon Canal Command Area, Water Management Centre, Marathwada Agriculture University, Parbhani, Maharashtra, J. Indian Soc. Soil Sci., 47 (4): 749-759.

Jackson, M.L., 1973. Soil Chemical Analysis, Prentice Hall of India: New Delhi.

Kadu, P.R., P.H. Vaidya, S.S. Balpande, P.L.A. Satyawati, and D.K. Pal, 2003. Use of hydraulic conductivity to evaluate the suitability of Vertisols for deep rooted crops in semi arid parts of Central India, Soil Use and Management 19: 208-216.

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

Piper, C.S., 1966. Soil and Plant Analysis. (Hans Publishers, Bombay: India).

Richards, L.A. (Ed), 1954. Diagnosis and Improvement of Saline and Alkali Soils. USDA Agriculture Handbook, Vol. 60, (US Government Printing Office: Washington, DC).

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Dynamics of Organic Carbon Fractions as Influenced by Manures and Fertilizers Under Sorghum-Wheat Sequence in Vertisol

Vandana Kotangale[1] and H. N. Ravankar[2]

ABSTRACT

A field experiment was undertaken during 2001-02 and 2002-03 on the old long-term fertilizer experiment started since 1988 at Central Research Station (CRS), Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola to study the effect of manures and fertilizer application on different fractions of organic carbon under sorghum – wheat cropping sequence in Vertisol. There were four replications and fourteen treatments comprised of NPK levels with and without FYM, sulphur and zinc framed under Randomized Block Design. The results revealed that fractions of organic carbon such as fulvic acid, humic acid and humin were found highest under the treatment 100 per cent RD of NPK + 10 t FYM ha^{-1}, followed by 150 per cent RD of NPK which was significantly superior over all other treatments. Fulvic acid and humic acid varied widely in different treatments of organic and inorganic. General impact of manuring + fertilizer was better in improving organic carbon fractions over control. Significantly highest content of all organic carbon fractions were recorded with the application of FYM alone over control indicating the significance of FYM in IPNS and their relationship with yield.

Integrated Nutrient Management (INM) is an alternative to maintain and enhance organic matter status of Indian soils. This approach of nutrient management aims at efficient and judicious use of all the major sources of plant nutrients in an integrated manner, so as to maintain and improve soil organic carbon (SOC) for sustained crop productivity without any deleterious effect on physico-chemical and biological properties of the soil on long-term basis. Long-term fertilizer experiments also proved that balanced use of NPK fertilizer either maintain or slightly enhance the SOC over the initial values and application of farm yard manure improved soil organic carbon which was associated with increased crop productivity. Different fractions of organic carbon have been isolated on the basis of solubility and named as humic acid, fulvic acid and humin (Kononova, 1966). These are humus materials, which are most resistant to mineralize and decompose. The humic acid carbon (HA-C) comprise 25 to 42 per cent and fulvic acid carbon (FA-C) comprise 11-45 per cent of soil organic carbon. Hence, an attempt has been made to study the dynamics of organic carbon fractions as influenced by manures and fertilizers under sorghum-wheat sequence in Vertisol.

MATERIAL AND METHODS

The present investigation was superimposed during the year (2001-02 and 2002-03) on the old long-term fertilization experiment started since 1988 at Central Research Station (CRS), Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. There were fourteen treatments replicated four times in Randomized Block Design which comprised of NPK levels with and without FYM, sulphur and zinc. The soil of the experimental site was Vertisol, containing montmorillonitic clay, with hyperthermic family of Typic Haplusterts. The soil was slightly alkaline in reaction, medium in organic carbon, very low in available nitrogen, low in total N and available phosphorus and high in available potassium. The different fractions of soil organic carbon were estimated as per the procedures described by Stevensons (1982).

RESULTS AND DISCUSSION

Fractions of organic carbon

Continuous manuring and fertilization at the same site for long period affected the dynamics of organic carbon fractions (Table 2). The organic carbon fractions such as fulvic acid – carbon (FA-C), humic acid – carbon (HA-C) and humin was found highest under the treatment (T_{13}) 100 per cent RD of NPK + 10 t FYM ha^{-1}, followed by the treatment (T_5) 150 per cent RD of NPK in both sorghum and wheat crop. The FA content was mostly affected particularly due to addition of FYM indicating the significance of FYM in IPNS. These findings are corroborated with the results of Manna (2002) who reported the improvement in FA-C in the treatment receiving NPK and NPK + FYM.

Humic acid – carbon (HA-C) was comparatively lower than the fulvic acid - carbon (FA-C) in the treatment receiving NPK + FYM and NPK, possibly due to higher root biomass and regular application of newly humified

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Table 1. Details of treatments

Sr. No.	Treatments	NPK (kg ha^{-1})		Fertilizer source
		Sorghum	Wheat	
1.	T_1 - Control	-	-	-
2.	T_2 - 50 % RD NPK	50:25:30	60:30:30	Urea, SSP, MOP
3.	T_3 - 75 % RD NPK	75:37.5:30	90:45:45	Urea, SSP, MOP
4.	T_4 - 100 % RD NPK	100:50:40	120:60:60	Urea, SSP, MOP
5.	T_5 - 150 % RD NPK	150:75:60	180:90:90	Urea, SSP, MOP
6.	T_6 - 100 % RD NPK (S free)	100:50:40	120:60:60	Urea, DAP, MOP
7.	T_7 - 100 % RD NPK + 10 kg S ha^{-1} through gypsum	100:50:40	120:60:60	Urea, SSP, MOP
8.	T_8 - 100 % RD NPK + 47.5 kg S ha^{-1} through gypsum	100:50:40	120:60:60	Urea, DAP, MOP
9.	T_9 - 100 % RD NPK + 10 kg $ZnSO_4$ 7 H_2O ha^{-1}	100:50:40	120:60:60	Urea, SSP, MOP
10.	T_{10} - 100 % RD NPK + 20 kg $ZnSO_4$ 7 H_2O ha^{-1}	100:50:40	120:60:60	Urea, SSP, MOP
11.	T_{11} - 100 % RD N	100:00:00	120:00:00	Urea
12.	T_{12} - 100 % RD NP	100:50:00	120:60:00	Urea, SSP
13.	T_{13} - 100 % RD NPK + 10 t FYM ha^{-1} (*kharif*)	100:50:40	120:60:60	Urea, SSP, MOP
14.	T_{14} - FYM 10 t ha^{-1} (*Kharif*)	—	—	—

Table 2. Long-term effect of manures and fertilizers on organic carbon fractions at harvest of sorghum and wheat in Vertisol

Treatments		Fulvic acid (%)		Humic acid (%)		Humin (%)	
		Sorghum	Wheat	Sorghum	Wheat	Sorghum	Wheat
T_1	- Control	0.22	0.22	0.18	0.19	0.42	0.40
T_2	- 50 % RD NPK	0.25	0.23	0.21	0.21	0.44	0.42
T_3	- 75 % RD NPK	0.26	0.25	0.23	0.23	0.45	0.43
T_4	- 100 % RD NPK	0.28	0.27	0.23	0.23	0.49	0.47
T_5	- 150 % RD NPK	0.33	0.31	0.25	0.26	0.59	0.56
T_6	- 100 % RD NPK (S free)	0.26	0.25	0.21	0.22	0.47	0.44
T_7	- 100 % RD NPK + 10 kg S ha^{-1} through gypsum	0.27	0.28	0.23	0.23	0.49	0.51
T_8	- 100 % RD NPK + 47.5 kg S ha^{-1} through gypsum	0.29	0.30	0.24	0.25	0.52	0.51
T_9	- 100 % RD NPK + 10 kg $ZnSO_4$ 7 H_2O ha^{-1}	0.27	0.27	0.22	0.23	0.48	0.46
T_{10}	- 100 % RD NPK + 20 kg $ZnSO_4$ 7 H_2O ha^{-1}	0.29	0.27	0.24	0.24	0.51	0.50
T_{11}	- 100 % RD N	0.25	0.24	0.21	0.21	0.48	0.44
T_{12}	- 100 % RD NP	0.27	0.27	0.23	0.23	0.46	0.46
T_{13}	- 100 % RD NPK + 10 t FYM ha^{-1} (*kharif*)	0.34	0.32	0.26	0.28	0.65	0.57
T_{14}	- FYM 10 t ha^{-1} (*Kharif*)	0.26	0.27	0.24	0.24	0.46	0.47
	SE (m)±	0.010	0.0077	0.0082	0.0073	0.027	0.019
	CD at 5 %	0.028	0.021	0.022	0.020	0.075	0.053

manure to the soil. General impact of manuring + fertilizer was better in improving fulvic acid over fertilizer alone. The maximum value of humic acid were observed under the treatment 100 per cent RD of NPK in combination with FYM 10 t ha^{-1}, followed by 150 per cent RD of NPK which was significantly superior over all other treatments in both sorghum and wheat crop. From the results it can be inferred that humin fraction constitutes the bulk of

Table 3. Effect of long-term fertilizer application on grain and fodder / straw yield (q ha^{-1}) under sorghum-wheat cropping sequence

Treatment	Grain		Fodder / Straw	
	Sorghum	Wheat	Sorghum	Wheat
T_1 - Control	2.80	0.85	6.41	1.21
T_2 - 50 % RD NPK	17.26	8.76	39.9	12.64
T_3 - 75 % RD NPK	22.93	13.76	53.11	19.81
T_4 - 100 % RD NPK	30.54	25.29	70.58	36.62
T_5 - 150 % RD NPK	37.20	28.28	86.37	41.28
T_6 - 100 % RD NPK (S free)	29.12	23.55	64.05	33.85
T_7 - 100 % RD NPK + 10 kg S ha^{-1} through gypsum	30.67	25.79	71.62	36.71
T_8 - 100 % RD NPK + 47.5 kg S ha^{-1} through gypsum	33.06	26.72	75.83	38.12
T_9 - 100 % RD NPK + 10 kg $ZnSO_4 7 H_2O$ ha^{-1}	33.53	26.14	77.57	37.81
T_{10} - 100 % RD NPK + 20 kg $ZnSO_4 7 H_2O$ ha^{-1}	33.57	26.87	78.36	37.38
T_{11} - 100 % RD N	14.63	7.51	36.18	10.88
T_{12} - 100 % RD NP	19.74	16.43	52.42	23.76
T_{13} - 100 % RD NPK + 10 t FYM ha^{-1} (*kharif*)	39.35	30.75	91.32	44.61
T_{14} - FYM 10 t ha^{-1} (*Kharif*)	7.17	2.08	16.53	3.00
SE (m) ±	0.93	0.59	0.93	0.75
CD at 5 %	2.59	1.64	2.60	2.10

organic matter and being highest under the treatment 100 per cent RD of NPK + 10 t FYM ha^{-1}. All the treatments were significantly superior over control. Soil organic carbon fractions under FYM alone were higher than those of control. Similar results were recorded by Kononova (1966) who reported that the soil systematically supplied with FYM had higher content of humic acid over control.

Grain and fodder / straw yields of sorghum and wheat

The grain and fodder / straw yields of sorghum and wheat were increased with the application of fertilizers in combination with organic manure Table 3. Treatment (T_{13}) 100 per cent RD of NPK + 10 t FYM ha^{-1} recorded significantly highest grain and fodder / straw yield, followed by (T_5) 150 per cent RD of NPK. The increase in the fertilizer level from 50 to 100 per cent RDF recorded significantly higher grain and fodder / straw yields.

Similarly, the use of sulphur containing fertilizer significantly increased the yield of both sorghum and wheat over the sulphur free fertilizer. Further, application of 20 kg zinc sulphate along with 100 per cent RDF showed significant increase in the grain and fodder / straw yield of both sorghum and wheat. The total productivity of sorghum – wheat cropping system was significantly increased with the application of 100 per cent RD of NPK + 10 t FYM ha^{-1} (T_{13}), followed by 150 per cent RD of NPK (T_5). Thus, integrated use of organics and inorganics resulted in achieving highest crop productivity, but use of only FYM was not able to increase crop yield at a sustainable level. Similar results were also reported by Naphade *et. al.* (1995) and Ravankar *et. al.* (1998).

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LITERATURE CITED

Kononova, M. M. 1966. Soil organic matter, Pergman Press, London : 1-123.

Manna, M. C. 2002. Long-term effect of fertilizers and manures on soil organic pools and C-sequestration under different cropping systems in sustainable agriculture. Lecture presented in Winter School (ICAR) on integrated nutrient management for sustainable agriculture : 275-279.

Naphade, K. T., V. N. Deshmukh, S. S. Rewatkar and G. H. Bade. 1995. Utilization of nutrients by sorghum – wheat cropping sequence on Vertisol under varying nutrient management, J. Maharashtra Agric. Univ., 20(3) : 355-357.

Ravankar, H. N., K. T. Naphade, R. B. Puranik and R. T. Patil. 1998. Long-term changes in soil fertility status under sorghum – wheat sequence on Vertisol. All India co-ordinated research project on long-term fertilizer experiment, IISS (Pub.) : 292-297. (Ed. Swarup, Reddy and Prasad).

Stevensons, F. J. S. 1982. Humus Chemistry, John Wiley and Sons, New York.

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Growth Performance of *Shatavar* as Influenced by Spacing and Duration

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ABSTRACT

A field experiment to study the growth performance of *Shatavar (Asparagus racemosus* Willd) as influenced by spacing and duration was conducted at Nagarjun Medicinal Plants Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) during 1999-2000 to 2003-04. 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 seedlings were raised in the month of June and after 4 weeks were transplanted in the experimental plots. The plot size of 5.4 x 3.6 m for each treatment combination comprising of three plant spacing viz 60 x 60, 60 x 90 and 90 x 90 cm^2 and three harvesting times viz, 18, 21 and 24 months after planting were tried in Factorial Randomised Block Design with three replications.

Significantly highest fresh root and dry root yield was recorded with the spacing of 60X60 cm over rest of the treatments followed by 60X90 and 90x90 cm. The pooled data also indicated that the fresh as well as dry root yield was progressively increased with harvesting period and significantly highest fresh and dry root yield was noticed with harvesting period of 24 months, followed by 21 months and 18 months duration.

Shatavar (Asparagus racemosus Willd) a perennial, prickly climber having excessively branches with small (one cm) recurved spines bending downwards. The leaves are 2-6 in sessile, flowers are white/pinkish, born in sessile and the fruits are round pea shape with one or two seeds. The roots are tuberous, fleshy, 15-40 cm long, may be more than 100 in numbers, grayish-white and cultivated both for medicinal and ornamental purpose. Found throughout India in the tropical and subtropical parts up to 1200 m wild or cultivated.

The tubers (roots) contain saponins, phosphorus, riboflavin, thiamin, potassium, calcium and other chemical compounds. The tonic prepared from shatavar tubers is best for women. It is being commonly used to increase the milk secretion , urinary problems and as a blood purifier. The herb has no toxicity and has great reputation in Ayurveda.

However, the area under cultivation is negligible due to non-availability of agro techniques for cultivation of Shatavar. In a process of the development of the agro technologies, the present investigation was undertaken to assess the optimum plant population and harvesting time for maximum tuber yield with quality produce.

MATERIAL AND METHODS

A field experiment to study the growth performance of shatavar *(Asparagus racemosus* Willd) as influenced by spacing and duration was conducted at Nagarjun Medicinal Plants Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) during 1999-2000 to 2003-04. 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 seedlings were raised in the month of June and after 4 weeks were transplanted in the experimental plots. The plot size of 5.4 x 3.6 m for each treatment combination comprising of three plant spacing viz 60 x 60, 60 x 90 and 90 x 90 cm^2 and three harvesting times viz, 18, 21 and 24 months after planting were tried in Factorial Randomised Block Design with three replications.

The growth observations as well as post harvest observations were recorded as per the treatments. Saponin content in tuberous root was estimated by the procedure described by Birk *et al.*, (1963).

RESULTS AND DISCUSSION

Effect of spacing:

It is observed from the pooled data, that spacing affected the root yields of *Shatavar* significantly and it was in the range of 4.13 -8.81 t ha^{-1}(Fresh root yield) and 0.46 – 1.08 t ha^{-1}(Dry root yield). Significantly highest fresh root (8.81t ha^{-1}) and dry root (1.08 t ha^{-1}) yield was recorded due to spacing of 60 x 60 cm^2 over rest of the

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Table 1: Growth of *Shatavar* as influenced by spacing and duration

(Pooled means of three years)

Treatments	Plant Height (cm)	No of shoots	No. of Roots plant^{-1}	Length of Root (cm)	Girth of Root (cm)	Fresh weight of Roots (g plant^{-1})	Fresh Roots yield (t ha^{-1})
Spacing (s) (cm)							
60x60	195	10.96	83.25	15.80	2.95	318.29	8.81
60x90	189	13.03	85.62	17.11	2.94	333.74	6.17
90x90	181	13.77	90.14	16.96	3.00	336.29	4.13
SE (m) ±	6.41	0.65	2.69	0.33	0.035	11.65	0.21
CD (0.05)	**NS**	**NS**	**Ns**	**1.01**	**NS**	**NS**	**0.64**
Duration (months)							
18	181	11.18	78.96	14.87	2.95	230.00	4.51
21	191	12.70	87.77	16.59	2.96	313.29	6.06
24	184	13.88	92.29	18.40	2.98	445.03	8.55
SE (m) ±	6.41	0.65	2.69	0.33	0.035	11.65	0.21
CD (0.05)	**NS**	**NS**	**8.07**	**1.01**	**NS**	**34.94**	**0.64**
Interaction							
SE (m) ±	11.10	1.13	4.66	0.58	0.062	20.18	0.37
CD (0.05)	**NS**	**NS**	**13.97**	**NS**	**NS**	**NS**	**NS**
CV%	17.93	26.96	NS	10.60	6.27	18.38	17.53

Table 2: Dry Root yield and saponin content of *Shatavar* as influenced by spacing and duration (Pooled means of three years)

Treatments	Dry Roots yield (t ha^{-1})	Saponin content (%)	Saponin (Kg ha^{-1})
Spacing (s) (cm)			
60x60	**1.08**	5.16	**55.43**
60x90	0.79	5.15	40.75
90x90	0.46	5.19	23.78
SE (m) ±	0.032	0.024	1.78
CD (0.05)	**0.097**	**NS**	**5.34**
Duration (months)			
18	0.56	5.17	28.98
21	0.73	5.15	37.76
24	**1.04**	5.18	**53.23**
SE (m) ±	0.032	0.024	1.78
CD (0.05)	**0.097**	**NS**	**5.34**
Interaction			
SE (m) ±	0.056	0.043	3.08
CD (0.05)	**NS**	**NS**	**NS**
CV%	21.64	2.49	23.16

treatments, followed by 60 x 90 and 90 x 90 cm(Table 1 and 2).

The above results are in conformity with those findings (Anonymous, 2000) reported by the research centers of AICRP on Medicinal and Aromatic Plants, Anand, (Gujrath) and Faizabad, (UP). Gholap, *et .al.* (2005) also reported the highest yield of fresh and dry roots of safed musli when planted at closer spacing.

Effect of duration:

The pooled data also indicated that the fresh as well as dry root yield was progressively increased with harvesting period and significantly highest fresh (8.55 t ha^{-1}) and dry root (1.04 t ha^{-1}) yield was noticed with harvesting period of 24 months, followed by 21 months and 18 months duration.

The growth parameters like plant height, number of shoots, girth of roots, no. of roots and saponin content was not influenced by the plant density as well as harvesting time, except length of root, which was significantly more in 60X90 cm spacing and duration of 24 months(Table 1). Saponin content was not influenced by the different treatments under study. These results are in agreement with the findings reported by Mohan Kumar, *et. al.* (1995) on tapioca crop. The tuber yield was found to increase progressively with the delayed harvesting from 6 to 10 months and maximum yield was recorded with 10th month's stage of harvesting.

LITERATURE CITED

Anonymous,2000: Biennial Report of All India Coordinated Research Project on Medicinal Plants on Medicinal and Aromatic Plants, NRC for Medicinal and Aromatic Plants Boriavi, Anand (Gujrat) : 182

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

Gholap, S.V., V.K.Mahorkar, S.G.Wankhade, S.S.Wanjari and S.W.Jahagirdar, 2005. Effect of organic manure and plant spacing on growth, yield and quality of Safed musli, PKV Res. J. 29(1):13-16

Mohan Kumar, C.R., R.C.Mandal and N. Hrishi, 1995 Effect of plant density ,fertility levels and stages of harvest on cassava production, J. Root Crops, 1:58-62

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Kinetics of Soybean Stover and Wheat Straw Decomposition by Lignocellulolytic Fungi

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ABSTRACT

Recycling of the farm residues after composting has a tremendous potential improvement and maintenance of soil health. The incubation study in order to reduce the period of decomposition of the 1:1 mixture of soybean stover and wheat straw reported that the reduction in C:N ratio from 107.01 (Initial) to 9.59 and 10.18 can be possible within 42 days by using *T.harzianum + T.reseei + T.viride + Trichurus* (4 fungul) and *T.harzianum + T.viride + Trichurus* (3 fungal) combinations, respectively. The 2 per cent mixture of Urea and SSP was beneficial as a starter food material for isolates. Control (without fungus inoculation) showed very less reduction in C:N ratio only up to 61.41 within eight week. The decomposition rate was slower up to third week and thereafter hastened with the increase in the combinations of fungus species, which also reflected on the improvement in the total NPK content in compost. Significantly highest 2.30 per cent nitrogen and 0.126 per cent phosphorus was reported by 3 fungus and 4 fungus treatment, while potash content was 0.143 and 0.148 per cent, respectively, over the 0.60 per cent N, 0.06 per cent P and 0.098 per cent K content of initial status of the mixture. The *T. viride* and *Trichurus* lignocellulolytic fungus helped to increase the rate of decomposition of crop residues, however, combination of four fungus Sp. *(T.harzianum + T.viride + T.reseei + Trichurus)* or three fungus Sp. *(T.harzianum + T.viride + Trichurus)* brought down the C:N ratio of soybean stover and wheat straw mixture to desired level within 35 to 42 days for getting well decomposed and nutritious compost.

Decomposition is a biological process in which the micro-organisms break down the different crop residues under optimum temperature and moisture condition, which reduce C:N ratio (Mishra *et al.*, 2001). Thus, microbes are the miracle workers, which are responsible for decomposition. Majority of organic matter is lignocellulotic in nature and it takes about 10-15 months to get decomposed under natural conditions. In order to reduce the period of decomposition of various organic materials, it is essential to find out proper and efficient strains of microbes, which can play important role in decomposition and accelerate the entire recycling processes. By selection of proper fungi and by utilizing some ameliorative effect the process of decay can be hastened which will solve the higher inputs in intensive cultivation with ultimate aim of increasing food production through sustainable soil health.

The organic matter has direct effect on the biological fertility of agricultural substances. It is known fact that the organic matter in the form of crop residue has a profound effect on the physical, biological and chemical properties of soil. Also about 40 per cent of the nutrients of the crop can be met through recycling of this organic material (Gaur *et al.*, 1971). Considering the energy shortage, food safety and environmental concern, utilization of renewable sources is the need of the hour in sustainable agriculture.

MATERIAL AND METHODS

The farm wastes decomposition experiment was conducted in Agro Product Development Research Centre, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2004-05. Soybean stover and wheat straw required for the experiment were collected from the Central Research Station, Akola. *Trichoderma harzianum, Trichoderma .reseei, Trichoderma .viride* and *Trichurus* all the cultures were grown separately on potato dextrose broth. Two per cent mixture solution of Urea and Single Super Phosphate was used as starter to meet the initial food requirement of fungus to decompose the 1:1 proportion mixture of the soybean and wheat crop residues. The sixteen treatment combination experiment was laid out in completely randomized design with two replications in two litre capacity Erlenmeyer flasks. The details of treatment combinations are as follows.

Treat.	Treatment Details
T_1	Control
T_2	*T. harzianum*
T_3	*T. reseei*
T_4	*T. viride*

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T_5	*Trichurus*
T_6	*T.harzianum+ T.reseei*
T_7	*T.harzianum+ T. viride*
T_8	*T. harzianum + Trichurus*
T_9	*T.reseei+ T.viride*
T_{10}	*T.reseei+ Trichurus*
T_{11}	*T.viride+ Trichurus*
T_{12}	*T.harzianum+ T.reseei + T.viride*
T_{13}	*T.harzianum+ T.reseei+ Trichurus*
T_{14}	*T.reseei+ T.viride+ Trichurus*
T_{15}	*T.harzianum+ T.viride+ Trichurus*
T_{16}	*T.harzianum+ T.reseei+ T.viride + Trichurus*

Analysis of straw mixture and compost during the experimentation for organic carbon (Bremner, 1970), nitrogen (Piper, 1966), phosphorus and potassium (Jackson, 1967) content and statistical interpretation was carried out by the procedure given by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Organic matter of plant body is mainly constituted of cellulose material, which is also bound by hard poly-saccharide material like lignin and hemicellulose. Ligno-cellulolytic fungi acts and assimilate into easily degradable carbon source of complex matter. In view of significance of plant residual compost, the present studies were undertaken to investigate the rate of decomposition of soybean and wheat straw by such ligno-ceilulolytic microbes.

Changes during the Course of Decomposition of Farm Residues Mixture:

Complex community of fungi is responsible for the major chemical transformation in decomposition, dissipating the plant polysaccharides and carbon dioxide and the most important converting proteins to ammonium. Four species of fungus and their eleven respective combinations were studied for making quick and quality compost from the mixture of soybean stover and wheat straw. The initial status of the soybean and wheat crop residues mixture was 64.21 per cent carbon, 0.60 per cent Nitrogen, 0.06 per cent Phosphorus, 0.098 per cent Potash with 107.01:1, C:N ratio. From third week of incubation weekly observations in respect of total carbon content, total nitrogen, phosphorus and potassium content and weight losses of decomposing material were recorded and presented in following subheads.

Total carbon content:

Data presented in Table 1 revealed that, there was overall reduction in carbon content of the decomposing material. The reduction was found to be statistically significant in all weeks except third week and it was brought down in consecutive weeks due to different treatments. The total carbon content decrease ranged between 55.61 to 66.84 per cent due to the all fungal treatments while the control treatment showed lesser i.e. 42.64 per cent decrease in "C" content.

The data were statistically significant in the succeeding weeks in respect of reduction in carbon content. After the fourth week the lowest carbon content 35.27 per cent was recorded by *T.harzicmum + T.viride + Trichurus* (T_{15}) treatment and it was found to be significantly low only over control (47.56%). The carbon content for fifth, sixth, seventh and eighth week was observed significantly lowest in the treatment combination of all four fungus (T_{16}) and lowest carbon content amongst all was 21.29 per cent after eight week. However, maximum carbon content was observed in control (T_1) during study period.

The data revealed that, in third week the rate of decomposition was slower and significantly increased in subsequent weeks due to influence of fungus species. The combinations of fungal species hastened the rate of decomposition. During decomposition, fungus utilized cellulose as an energy source and lost in the form of CO_2 during assimilation of microbes. The maximum carbon loss in third and fourth week of incubation was also reported by Sridevi *et al,* (2003).

Changes in N P K Content:

The effect of various fungal treatments on total nitrogen content was significant in third, fourth, seventh and eight week of study (Table 2). At the end of incubation study the treatment consisting of all four-fungus species (T_{16}) was reported highest nitrogen content. In the third week, it was increased up to 0.96 per cent followed by 1.46 per cent (fourth week), 2.21 per cent (fifth week), 2.27 per cent (sixth week), 2.28 per cent (seventh week) and up to 2.30 per cent eight week of incubation. The data indicated that after eight week significantly highest and numerically same (2.30 %) total N was recorded in treatment of T_{15} and T_{16}. Similar results were also supported by Gawde, (2001) and Gathe (2001). The total N content due to effect of all 15 fungal treatments after

Table 1: Weekly changes in total carbon content of soybean stover and wheat straw mixture during decomposition

Treatments		Total carbon content (%) after						% decrease in TOC over initial
		III Week	IV Week	VWeek	VI Week	VII Week	VIII Week	
T_1	Control	50.68	47.56	46.60	41.15	38.91	36.83	42.64
T_2	*T.harzianum*	46.28	40.99	38.59	29.62	29.14	28.50	55.61
T_3	*T.reseei*	46.76	42.11	35.55	30.26	28.34	27.87	56.60
T_4	*T. viride*	41.31	35.71	31.70	27.06	26.42	26.42	58.85
T_5	*Trichurus*	45.80	37.95	35.07	31.70	28.50	27.06	57.86
T_6	*T.harzianum* + *T.reseei*	46.44	40.99	34.59	31.22	28.50	26.70	58.36
T_7	*T.harzianum* + *T.viride*	44.52	36.67	33.95	25.78	25.30	25.30	60.60
T_8	*T.harzianum* + *Trichurus*	45.32	38.91	35.71	30.10	26.26	24.50	61.84
T_9	*T.reseei* + *T.viride*	45.60	41.47	38.27	28.18	26.50	24.50	61.84
T_{10}	*T.reseei* + *Trichurus*	46.12	38.27	34.91	26.58	24.98	24.50	61.84
T_{11}	*T.viride* + *Trichurus*	44.84	37.15	33.50	25.46	24.33	24.18	62.34
T_{12}	*T.harzianum*+ *T.reseei* + *T. viride*	45.48	38.11	33.95	25.46	24.66	23.70	63.09
T_{13}	*T.harzianum* + *T.reseei* + *Trichurus*	45.64	38.43	32.99	26.10	24.34	24.01	62.60
T_{14}	*T.reseei* + *T.viride* + *Trichurus*	45.64	38.75	32.50	28.50	24.26	24.34	62.09
T_{15}	*T.harzianum* + *T.viride* + *Trichurus*	45.48	35.22	31.70	22.90	22.73	22.58	64.34
T_{16}	*T.harzianum* + *T.reseei* + *T.viride* + *Trichurus*	41.63	38.27	28.02	21.78	21.46	21.29	66.84
	SE(m)±	6.16	2.77	2.80	2.52	2.59	1.98	-
	CD at 5 %	NS	8.22	8.33	7.47	7.72	5.89	-

eight week was statistically at par and significantly superior over control (T_1).

After eight week of incubation the phosphorus and potash content in the decomposed material was estimated and their increase over the control was significant (Table 3). Significantly highest and numerically equal 0.126 per cent total phosphorus content was observed in the T_{15} and T_{16} treatments and 0.148 per cent total potash was reported by combination of all four fungus (T_{16}). However, the lowest P and K content in decomposed residues were observed in control and were 0.090 and 0.108 percent, respectively.

The data in respect of percent increase in N, P and K presented in Table 3 stated that, there were increase in the total NPK content in the decomposed straw with the increase in the combinations of lignocellulolytic fungi (T_2 to T_{16}). The increase in the total N content was increased from 275.00 to 283.33 per cent, total P was 75 to 110 per cent and total K was 37.76 to 51.02 per cent over the initial status of the soybean stover and wheat straw mixture. The lowest NPK increase (23.33, 50.00, 10.20 percent) were observed in control (T_1) after eight week of incubation study. Similar findings in respect of increase in total N, P and K content were also recorded by Patil *et al.*, (1994) and Bhuyan (2004)

Changes in C:N ratio:

During decomposition C:N ratio of organic matter underwent progressive changes (Table 4). As decomposition proceeded carbon-dioxide released but nitrogenous material tended to accumulate in the cells of

Table 2: Weekly changes in total nitrogen content of soybean and wheat wheat straw mixture during decomposition

Treatments		Total nitrogen content (%) after					
		IIIWeek	IV Week	V Week	VIWeek	VII Week	VIII Week
T_1	Control	0.63	0.64	0.64	0.67	0.72	0.74
T_2	*T.harzianum*	0.85	1.25	1.96	2.20	2.23	2.25
T_3	*T.reseei*	0.76	1.12	1.94	2.16	2.21	2.23
T_4	*T. viride*	0.85	1.25	1.96	2.20	2.25	2.27
T_5	*Trichurus*	0.76	1.33	1.94	2.18	2.20	2.25
T_6	*T.harzianum + T.reseei*	0.85	1.33	2.11	2.20	2.23	2.28
T_7	*T.harzianum + T.viride*	0.85	1.40	2.12	2.21	2.25	2.28
T_8	*T.harzianum + Trichurus*	0.78	1.37	2.12	2.21	2.23	2.27
T_9	*T.reseei + T.viride*	0.85	1.37	2.12	2.23	2.25	2.28
T_{10}	*T.reseei + Trichurus*	0.85	1.40	2.12	2.23	2.25	2.28
T_{11}	*T.viride + Trichurus*	0.85	1.44	2.16	2.25	2.27	2.28
T_{12}	*T.harzianum+ T.reseei + T.viride*	0.89	1.44	2.16	2.25	2.27	2.28
T_{13}	*T.harzianum +T.reseei + Trichurus*	0.89	1.42	2.16	2.25	2.27	2.28
T_{14}	*T.reseei + T.viride + Trichurus*	0.96	1.44	2.18	2.25	2.27	2.28
T_{15}	*T.harzianum + T. viride + Trichurus*	0.96	1.46	2.18	2.25	2.27	2.3
T_{16}	*T.harzianum+ T.reseei + T.viride + Trichurus*	0.96	1.46	2.21	2.27	2.28	2.3
	SE(m)±	0.027	0.025	1.75	0.57	0.043	0.047
	CD at 5 %	0.083	0.076	NS	NS	0.129	0.142

organism which carried out decomposition, so that C:N ratio progressively reduced. The initial C:N ratio of the mixture of the soybean stover and wheat straw was 107.01: 1 and which was reduced down by *T. viride* (T_4) alone to 11.64, the combination of two fungus *T. viride* + *Trichurus* (T_{11}) to 10.60, the combination of three fungus *T. harzianum* + *T. viride* + *Trichurus* (T_{15}) up to 9.81 and the lowest 9.26, C:N ratio was reported in the combination of all four fungus combination treatment (T_{16}) after eight the week of incubation.

Data presented in table 4 showed that, C:N ratio of soybean stover and wheat straw was narrowed down over the period during decomposition by various fungus isolates, the results are in line with the findings of Yadav and Subbarao (1977) and Gawade (2001).The faster decomposition of soybean and wheat straw mixture and lowering down C:N ratio between 10-12 within fifth and sixth week (i.e. 35 & 42 days) due to the mixture of *T.harzianum* + *T.viride* + *T.reseei* + *Trichurus* (T_{16}) and T *T.harzianum* + *T.viride* + *Trichurus* (T_{15}), respectively might be ascribed due to enrichment of straw mixture with 2 per cent solution of urea and SSP as a starter. Similar observation in respect of very fast decomposition and reduction in C:N ratio and organic material due to enrichment of nitrogenous fertilizer was recorded by Gupta and Idani (1970).

Table 3. Total N, P and K status of compost of soybean and wheat straw mixture.

Treatments		TotalN%	% increase over initial	Total P%	% increase over initial	Total K%	% increase over initial
T_1	Control	0.74	23.33	0.090	50	0.108	10.20
T_2	*T.harzianum*	2.25	275.00	0.105	75	0.135	37.76
T-!	*T.reseei*	2.23	271.67	0.099	65	0.133	35.71
T_4	*T.viride*	2.27	278.33	0.105	75	0.135	37.76
T_5	*Trichurus*	2.25	275.00	0.099	65	0.132	34.69
T_6	*T.harzianum + T.reseei*	2.28	280.00	0.108	80	0.137	39.80
T_7	*T.harzianum + T.viride*	2.28	2.80	0.117	95	0.139	41.84
T_8	*T.harzianum + Trichurus*	2.27	278.33	0.111	85	0.138	40.82
T_9	*T.reseei + T.viride*	2.28	280.00	0.114	90	0.139	41.84
T_{10}	*T.reseei + Trichurus*	2.28	280.00	0.117	95	0.139	41.84
th	*T.viride + Trichurus*	2.28	280.00	0.123	105	0.140	42.86
T_{12}	*T.harzianum + T.reseei + T. viride*	2.28	280.00	0.123	105	0.140	42.86
T_{13}	*T.harzianum + T.reseei + Trichurus*	2.28	280.00	0.120	100	0.140	42.86
T_{14}	*T.reseei + T.viride + Trichurus*	2.28	280.00	0.123	105	0.142	44.90
T_{15}	*T.harzianum + T.viride + Trichurus*	2.3	283.33	0.126	110	0.143	45.92
T_{16}	*T.harzianum + T.reseei + T.viride + Trichurus*	2.3	283.33	0.126	110	0.148	51.02
	SE (m) ±	0.047	-	0.0032	-	0.0019	-
	CD at 5 %	0.142	-	0.0094	-	0.0057	-

Table 4 : Weekly changes in C:N ratio during decomposition of soybean stover and wheat straw

Treatments		C:N ratio after						% decrease
		III Week	IV Week	V Week	VI Week	VII Week	VIII Week	over initial
T_1	Control	80.44	74.31	72.81	61.41	54.04	49.77	53.49
T_2	*T.harzianum*	54.45	32.79	19.69	13.46	13.07	12.67	88.15
T_3	*T.reseei*	61.53	37.60	18.32	14.01	12.82	12.50	88.31
T_4	*T. viride*	48.60	28.57	16.17	12.3	11.74	11.64	89.12
T_5	*Trichurus*	60.26	28.53	18.08	14.54	12.95	12.02	88.76
T_6	*T.harzianum + T.reseei*	54.64	30.82	16.39	14.19	12.78	11.73	89.03
T_7	*T.harzianum + T.viride*	52.38	26.19	16.01	11.67	11.29	11.10	89.62
T_8	*T.harzianum + Trichurus*	58.10	28.40	16.84	13.62	11.78	10.79	89.91
T_9	*T.reseei + T.viride*	53.64	^30.27	18.05	12.64	11.78	10.75	89.95
T_{10}	*T.reseei + Trichurus*	54.25	27.34	16.47	11.92	11.10	10.75	89.95
T_{11}	*T.viride + Trichurus*	52.75	25.80	15.50	11.32	10.72	10.6	90.09
T_{12}	*T.harzianum + T.reseei + T. viride*	51.10	26.47	15.71	11.32	10.86	10.39	90.29
T,3	*T.harzianum+ T.reseei + Trichurus*	51.28	27.06	15.27	11.60	10.72	10.53	90.15
T_{14}	*T.reseei + T.viride + Trichurus*	47.54	26.90	14.91	12.67	10.78	10.68	90.01
T_{15}	*T.harzianum + T.viride + Trichurus*	47.38	24.13	14.54	10.18	10.01	9.81	90.83
T_{16}	*T.harzianum + T.reseei + T.viride + Trichurus*	43.36	26.21	12.68	9.59	9.41	9.26	91.34

Thus from the incubation study it can be concluded that, the combination of lignocellulolytic fungus isolates help to faster decomposition of crop residues. The fungus isolates *T. viride* and *Trichurus* help to increase the rate of decomposition. However, the use of four *(T.harzianum +T.viride +T.reseei + Trichurus)* or three *(T.harzianum + T.viride +Trichurus)* fungus isolate combination brought down the C:N ratio of the mixture of soybean stover and wheat straw with in the 42 days for getting the good quality and nutritious compost.

LITERATURE CITED

Bhuyan,P.K., 2004. Effect of bio-agents and sources of organic materials on quality of compost. M.Sc. Thesis (Unpub.), Dr.PDKV,Akola.

Bremner, J.M. 1970. Total organic carbon in methods of soil analysis Part-2. Chemical and microbiological properties. Page, A.L. (Ed) Amer. Soc. Agron. Inc. & Soil Sci. Amer. Inc. Madison, Wisconsin, USA. 475 - 594.

Gaur, A.C., K.N. Sadasivan, O.P. Vimal and R.S.Mathur. 1971. A study on the decomposition of organic matter in an alluvial soil, CO2 evolution, microbial and chemical transformation, *PL Soil,* 34:17-28.

Gawde,S.G., 2001.Studies on celluloytic fungi in decomposition and enrichment of agricultural wastes M.Sc. Thesis (Unpub.) Dr. PDKV, Akola

Gathe, A.G. 2001. Studies on celluloytic fungi in disposal of agricultural wastes. M.Sc.Thesis (Unpub),Dr.PDKV.,Akola.

Gupta, R.C.and M.A. Idani, 1970. Utilization of organic material by enrichement with nitrogen ; Indian. J. Agric.Sci. 40(3):211-215

Jackson, M.L., 1967. Soil Chemical analysis. Prentice Hall Inc., New York, USA.

Mishra, B., P.K.Sharma and K.F. Bronson, 2001. Kinetics of wheat straw decomposition and nitrogen mineralization in rice field soil, J. Indian. Soc. Soil. Sci., 49 (2): 249-254.

Panse, V.G. and P.V. Sukhatme, 1978. Statistical methods for agricultural workers. ICAR, New Delhi.

Patil,M.N., K.B.Zade, K.T. Naphade and P.T. Kharkar, 1994. Decomposition of organic material in soil in relation to nutrient minerlization, J. maharashtra Agric. Univ. 18 (3):348-351.

Piper, C. S., 1966. Soil Chemical Analysis. Hans Publications, Bombay.

Sridevi, S. J., C. Katyal, K.Srinivas and K. L.Sharma, 2003. Carbon minerlization and microbial biomass dynamics in soil amended with plant residues and residue fractions, J. Indian Soc. Soil Sci.,52(2):133-139.

Yadav,K.S. and I.Subbarao, 1977. Studies on celluloytic and lignolytic micro-roganisms. Ph.D.Thesis IARI, New Delhi.

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Suitability of Different Organic Substrates for Mass Multiplication of *Trichoderma* spp.

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ABSTRACT

The suitability of different organic substrates for mass production of different *Trichoderma* spp. viz., *T.harzianum, T.viride, T.hamatum* and *T.virens* was evaluated. Four locally available organic substrates viz., wheat straw, pigeonpea husk, soybean straw, paddy bran alone and their combinations i.e. wheat straw+ pigeonpea husk, paddy bran + soybean straw and pigeonpea husk + paddy bran were tested. All the *Trichoderma* spp showed increase in the growth rate from 7th to 21st day. Wheat straw *(T.harzianum-* 89.2 xl 0^6 cfu g^{-1}, *T.viride*-93.4 x 10^6 cfu g^{-1}, *T. hamatum - 73.2* x 10^6 cfu g^{-1}, *T. virens-* 61.8 x 10^6 cfu g^{-1}) recorded maximum number of propagules at 21st day. Combinations of the substrates were also found efficient to support the growth on wheat straw + pigeonpea husk. Minimum number of propagules were recorded in paddy *bran (T.harzianum*-46.5 x 10^6 cfu g^{-1}, *T.viride*- 45.2 x 10^6 cfu g^{-1}, *T.hamatum* - 42.2 x l0^6 cfu g^{-1}, *T.virens*- 27.6 x 10^6 cfu g^{-1}) at 21st day. Wheat straw proved to be the best organic substrate for mass multiplication *of Trichoderma* spp.

Trichoderma species, are effective biocontrol agent among many economical important plant pathogenic fungi. Mass multiplication of biocontrol agents is an important aspect because the success of biocontrol technology mostly depends on its mass production. Economic mass production of micro-organisms can be achieved by using readily available and cheaper agricultural products. Mukhopadhyay (1987) reviewed the various methods of mass multiplication of antagonistic fungi. Cheap substrate like sorghum grains was reported as good substrate for mass multiplication of antagonist (Upadhyay and Mukhopadhyay, 1986). The present investigation was aimed to identify certain organic substrates for quick mass multiplication *of Trichoderma* spp.

MATERIAL AND METHODS

Four different organic substrates viz., wheat straw, soybean straw, pigeonpea husk, paddy bran along with their suitable combinations like wheat straw + pigeonpea husk, paddy bran + soybean straw and pigeonpea husk + paddy bran were evaluated for mass multiplication of *T.harzianum, T.viride, T.hamatum* and *T.virens.* All these substrates were finely chopped and dried. The substrates were taken and moisture adjusted to 60 per cent (W/V). Each substrate @10g was filled in polypropylene bags (25x30cm) tied and sterilized at 1.05 kg/ cm^2 for 30 min. for two successive days. Each bag was inoculated with two mycelial discs (9mm) taken from the peripheri of the respective *Trichoderma* spp. cultures, previously grown on potato dextrose agar. The bags were tied and incubated at 27±2^{0}C for 21 days. Observations on cfu g^{-1} were recorded at 7th, 14th, 21st day for the evaluation of *Trichoderma* spp population by serial dilution method.

RESULTS AND DISCUSSION

Table 1. Effect of different organic substrate on population of *Trichoderma harzianum* (x 10^6 cfu g^{-1})

Organic substrate	Days after Inoculation		
	7th day	14th day	21st day
Wheat straw	77.8	83.7	89.2
Pigeonpea husk	67.2	71.2	74.4
Soybean straw	54.9	59.6	62.4
Paddy bran	41.4	42.6	46.5
Wheat straw+ Pigeonpea husk	71.8	75.3	77.8
Paddy bran + Soybean straw	46.2	49.1	50.8
Pigeonpea husk + paddy bran	62.3	69.4	72.2
SE(m)+	1.49	1.63	1.26
CD(P=0.01)	6.28	6.90	5.32

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Table 2. Effect of different organic substrate on population of *Trichoderma viride*

Organic substrate	Days after Inoculation		
	7th day	14th day	21st day
Wheat straw	84.2	87.6	93.4
Pigeonpea husk	71.2	73.4	76.2
Soybean straw	63.2	64.3	66.2
Paddy bran	43.3	44.3	45.2
Wheat straw + Pigeonpea husk	74.4	77.6	82.0
Paddy bran + Soybean straw	52.8	54.4	55.4
Pigeonpea husk + paddy bran	69.6	72.4	75.6
SE(m)±	1.63	2.26	2.59
CD(P=0.01)	6.87	9.53	10.90

Table 3. Effect of different organic substrate on population of *Trichoderma hamatum* (xlO^6 cfu g^{-1})

Organic substrate	Days after Inoculation		
	7th day	14th day	21st day
Wheat straw	67.9	70.2	73.2
Pigeonpea husk	63.1	64.1	65.6
Soybean straw	45.9	48.8	49.8
Paddy bran	38.4	40.8	42.2
Wheat straw + Pigeonpea husk	65.3	67.6	69.2
Paddy bran + Soybean straw	43.6	44.3	45.5
Pigeonpea husk + paddy bran	50.2	52.3	53.9
SE(m)+	1.58	1.94	1.99
CD(P=0.01)	6.68	8.19	8.38

Table 4. Effect of different organic substrate on population of *Trichoderma virens* (xl0^{6}cfug^{-1})

Organic substrate	Days after Inoculation		
	7th day	14th day	21st day
Wheat straw	55.6	60.1	61.8
Pigeonpea husk	40.2	42.8	44.3
Soybean straw	31.6	35.4	36.4
Paddy bran	22.8	26.1	27.6
Wheat straw + Pigeonpea husk	45.0	47.0/	49.4
Paddy bran + Soybean straw	26.8	29.0	30.7
Pigeonpea husk + paddy bran	33.5	35.8»	38.3
SE(m)+	1.79	1.42	1.63
CD(P=0.01)	7.57	6.01	6.90

Wheat straw *(T.harzianum*- 89.2 x 10^6 cfu g^{-1}, *T.viride-93.4* x10^6 cfu g^{-1} *T.hamatum-73.2* x 10^6 cfu g^{-1}, *T.virens*- 61.8 x 10^6 cfu g^{-1}) was found to provide maximum propagules 21 days after inoculation in all the *Trichoderma* spp. At 7th day the number of propagules were minimum, while it increased from 7th to 21st day. *T. viride* grew profusely and gave maximum number of propagules than the other species. Paddy bran was the poor substrate and gave minimum number of propagules(*T. harzianum*-46.5x10^{6}cfu g^{-1}, *T.viride*- 45.2 x 10^6 cfu g^{-1}, *T. hamatum*- 42.2 x 10^6 cfu g^{-1}, *T.virens-27.6* x 10^6 cfu g^{-1}) at 21st day in all the *Trichoderma* spp. The lower growth in paddy bran indicates that they may not produce adequate quantity of cellulose or might be some inhibitors which are non preferred for the growth (Panicker and Jeyarajan, 1993). Ravankar *et al.* (2000) also tested different substrates *viz.*, cotton stalk, safflower straw, wheat straw, sugarcane trash, groundnut husk, sunflower, green gram stover and parthenium with seed for decomposition. Wheat straw stands fifth among all these substrates in the rate of decomposition. Singh *et al.* (1996) used various agro based substrates and revealed that wheat bran + malt medium support fast

growth. While, Gaur *et al.*(2005) reported that paddy husk was found as poor substrate for *Trichoderma* spp. coincides the present results. Upadhyay *et al.* (2004) also recorded the same kind of results where the second best substrate after wheat bran was wheat straw followed by rice husk. Results regarding the combination of some cereal brans were quoted by Dubey (2002), in which highest growth of *T.viride* and *Gliocladium virens* was recorded in pulse bran + saw dust followed by wheat + pulse bran. Hence wheat straw proved efficient in supporting the growth of *Trichoderma* spp and could be used for mass multiplication.

LITERATURE CITED

Duvey S.C., 2002. Mass multiplication of antagonists and standardization of effective dose for management of web blight of Urd and Mung bean, Indian Phytopati, 55(3) : 338-441.

Gaur, R.B., B., R. N. Sharma and R. R. Sharma, 2005. Shelf life of talc based formulation of *Trichoderma* and soil application for biological control of dry root-rot of Chickpea, J. Mycol. Pl. Pathol, 35(2) : 380-384.

Mukhopadhyay, A. N., 1987. Biological control of soil borne plant pathogen by *Trichoderma* spp., Indian, J. Mycol. Pl. Pathol, 17 : 1-10.

Panicker. S and R. Jeyarajan, 1993. Mass Multiplication of Bio -control agent *Trichoderma* spp, Indian J. Mycol. Pl. Pathol, 23(3) : 328-330.

^Ravankar, H. N., Ritu Patil and R. B. Puranik, 2000. Decomposition of different organic residues in soil, PKV Res. J. 24(1) : 23-25.

Singh. J., R. S. Singh and H. V. Singh, 1996.'Selection of Substrates for growth and sporulation of different antagonists of *R. solani* in mass culture Pl. Dis. Res., 11(2) : 132-136.

Upadhyay, J. P. and A. N. Mukhopadhyay, 1986. Biological control of *Sclerotium rolfsii* by *T. harzianum* in sugarbeet, Trop. Pest. Manage, 32 : 215-220.

Upadhyay, J. P., H. C. Lal and S. Roy, 2004. Effect of fungicides, cakes and plant byproducts on the development *of T. viride*, J. Mycol. Pl. Pathol. 34 (2)

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Effect of Different Media and Temperature on Mycelial Growth of Wild *Pleurotus* sp. and *P. eous*

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ABSTRACT

Mycelial growth of wild *Pleurotus* sp. was less observed as compared to *P. eous* on different solid media, liquid culture media and at different temperature levels. Malt yeast extract agar media was found best for radial growth and malt yeast extract liquid culture was found best for biomass production (fresh and dry mycelial weight) of wild *Pleurotus* sp. and *P. eous*. However, complete and potato dextrose agar media were found inferior for radial growth and biomass production of both *Pleurotus* spp. The growth pattern of *P. eous* was almost similar as of wild *Pleurotus* sp. on malt yeast extract and glucose peptone agar, except presence of concentric rings with regular margin. The fresh and dry mycelial weight of wild *Pleurotus* sp. did not significantly influence by different liquid media. Dry mycelial weight of *P. eous* were significantly more in malt yeast extract. Significantly higher radial growth and biomass of wild *Pleurotus* sp. and *P. eous* was recorded at 25° and 30°C, respectively. However, it was adversely affected either with increase or decrease in temperature from 25° to 30°C.

Prime edible mushrooms are white button, oyster (*Pleurotus* spp.), paddy straw (*Volverialla* spp.) and white milky (*Calocybe indica*). Unlike other mushrooms, *Pleurotus* species show much diversity in their adoption to varying agroclimatic conditions. This flexible nature of this genus gives more cultivated species than any other mushrooms. In nature, dozens of *Pleurotus* species are under cultivation and these are suited to different climatic zones. The cultivation of oyster mushroom is more popular in developing countries due to easy and cheap production technology, choice of species and suitability depend on varying agroclimatic conditions. Intensive research is going on to develop production technology of different species of *Pleurotus* suited to different agroclimatic zones on locally available substrate, but information lacking on locally available pink oyster mushroom. The newly collected wild pink oyster (*Pleurotus* sp.) and cultivated *P. eous* was cultured and studied the effect of different media and temperature on mycelial growth.

MATERIAL AND METHODS

The experiment was conducted at the Mushroom Research Laboratory, Department of Plant Pathology, College of Agriculture, I.G.A.U., Raipur (C. G.)

Effect of media on radial growth and biomass of *Pleurotus* spp.

The effect of different media was studied on radial growth of different *Pleurotus* spp. A disc of 5 mm diameter was cut from pure culture of *Pleurotus* spp. inoculated in the centre of Petri dishes. The Petri dishes were molted with different media viz., glucose peptone agar, potato dextrose agar (PDA), malt-yeast extract agar and complete agar medium aseptically. These Petri dishes were incubated at 25 ± 2°C and the observations on radial growth on different media were recorded after completion of growth in any one of the treatments. Observations on colony characters of *Pleurotus* spp. were also recorded. Three replications were maintained.

For fresh and dry mycelial weight, 50 ml broth of all the above media was taken in 150 ml flask. The flasks were inoculated with 5 mm disc of actively growing mycelium of both *Pleurotus* spp. The flasks were then incubated at 25 ± 2°C. The mycelial weight (fresh and dry) was determined after 12 days of incubation when the media was completely covered with the mycelial mats of both *Pleurotus* spp. The mycelial mats were filtered through Whatman filter paper No. 1 and weighed on "ATCO" make electronic top pan balance of 0.01 g sensitivity. The mycelium was continuously dried in an oven at 60°C for 24 hours and dry weight of the same was recorded. Three replications were maintained.

Effect of temperature on radial growth and biomass of *Pleurotus* spp.

The effect of different temperature was studied on radial growth of different *Pleurotus* spp. Four levels of temperature (20, 25, 30, 35° C) were used for the study. Twenty ml of glucose peptone agar medium was taken in each Petri dish and inoculated with a 5 mm disc of actively growing mycelium of *Pleurotus* spp. After inoculation,

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they were kept in BOD incubator. The radial growth was recorded when mycelium reached 90 mm in any one of the treatments, maintained in three replications.

For fresh and dry mycelial weight at different temperatures, 50 ml broth of glucose peptone medium was kept in 150 ml flask. The flask was inoculated with 5mm disc of actively growing mycelium of *Pleurotus* spp. After inoculation, the flasks were kept in BOD incubator at different temperatures (20, 25, 30, 35°C). The mycelial weight (fresh and dry) was determined when the media was completely covered with the mycelial mats of *Pleurotus* spp. The mycelial mats were filtered through Whatman filter paper No. 1 and weighted on "ATCO" make electronic top pan balance of 0.01 g sensitivity. The mycelium was dried and dry weight was recorded. In each treatment three replications were maintained.

RESULTS AND DISCUSSION

Effect of solid media on radial growth of wild *Pleurotus* sp. and *P. eous*.

The wild *Pleurotus* spp. showed considerably less (41.99 to 65 mm) radial growth with respect to different

Table 1: Effect of media on radial growth and colony characteristics of wild *Pleurotus* sp. and *P. eous*.

Media	Wild *Pleurotus* sp.		*Pleurotus eous*.	
	Radial growth (mm)*	Colony characters	Radial growth (mm)*	Colony characters
Glucose peptone agar	59.00	White, flat thin scattered and growth was raised in center, dichotomously branched was observed at periphery and margin irregular.	77.50	Bright white, fluffy, raised growth at center with concentric rings and margin regular.
Potato dextrose agar	55.62	White, flat, thin scattered and growth was raised in center, margin irregular.	67.50	White, flat, thin scattered and growth was raised in center, margin irregular.
Malt-yeast extract agar	65.00	Dull white, flat, thin, scattered and margin irregular	88.50	Dull white, flat, thin, scattered with two concentric rings and margin irregular
Complete agar	41.99	White, flat with dichotomously branched at periphery and margin irregular	49.00	White raised cottony growth at periphery, margin irregular.
'F' value	S		S	
SE (m) ±	4.7754		1.479	
CD (P = 0.05)	15.573		4.823	

* Average of three replication

Table 2: Effect of liquid culture media on biomass of wild *Pleurotus* sp. and *P. eous*.

Types of Medium	Wild *Pleurotus* sp.			*Pleurotus* sp.		
	Biomass		Average	Biomass		Average
	Fresh* mycelial weight (g)	Dry* mycelial weight (g)		Fresh* mycelial weight (g)	Dry* mycelial weight (g)	
Glucose peptone	3.97	0.18	2.07	5.59	0.27	2.93
Potato dextrose	3.57	0.16	1.86	4.88	0.18	2.53
Malt-yeast extract	4.56	0.24	2.40	6.48	0.29	3.38
Complete broth	2.41	0.13	1.27	3.21	0.16	1.68
F value	NS	NS	-	NS	S	-
SE(m) ±	0.540	0.029	0.793	0.030		
CD (P=0.05)				0.098		

* Average of three replication

Table 3: Effect of temperature on radial growth and biomass of wild *Pleurotus* sp. and *P. eous*.

Temperature	Wild *Pleurotus* sp.				*Pleurotus eous.*			
	Radial growth (mm)	Biomass		Average	Radial growth (mm)	Biomass		Average
		Fresh mycelial weight (g)*	Dry mycelial weight (g)*			Fresh mycelial weight (g)*	Dry mycelial weight (g)*	
20°C	53.33	4.12	0.22	2.17	73.00	4.16	0.24	2.20
25°C	70.66	4.66	0.26	2.46	89.16	5.77	0.34	3.05
30°C	60.66	5.04	0.28	2.66	78.66	5.91	0.35	3.13
35°C	33.33	1.43	0.11	0.77	54.00	1.32	0.10	0.71
F. Value	S	S	S	S	S	S		
SE (m)	2.862	0.175	0.023		1.777	0.696	0.0266	
CD(P = 0.05)	9.334	30.5719	40.0764		5.796	2.271	0.0869	

* Average of three replication

media as compared to *P. eous* (49.00 to 88.50mm). Maximum radial growth of wild *Pleurotus* sp (Table 1) was recorded on malt-yeast extract (65 mm), followed by glucose peptone agar (59 mm). However, minimum growth was recorded in case of complete agar (41.99 mm) and potato dextrose agar (55.62 mm). It was noticed that growth of wild *Pleurotus* sp. on malt yeast extract agar was dull white, flat, spray scattered with irregular margin. On the other hand, growth obtained on complete agar medium had white, flat, dichotomously branched with irregular margin. In rest of the medium, growth pattern varied from white, scattered and irregular margin. Similar findings were reported by Bhanwar (2003), who observed slower growth of local strain 26 and 29 of *Pleurotus* than *P. eous* and *P. sajor-caju*.

Effect of Liquid culture media on biomass of wild *Pleurotus* sp. and *P. eous*.

On an average, biomass production of wild *Pleurotus* sp. was slightly differed with respect to different media (Table 2). Maximum biomass production was obtained on malt-yeast extract (2.4 g) followed by glucose peptone (2.07 g) and potato dextrose liquid culture (1.86 g). However, it was least (1.27g), in complete liquid culture. The fresh and dry mycelial weight of wild *Pleurotus* sp. did not significantly influence by different media. In *P. eous*, the average biomass production on different liquid media varied from 1.68 to 3.38 g. Fresh mycelial weight of *P. eous* did not differ significantly in different liquid media, though it varied from 3.21 to 6.48 g, but dry mycelial weight of *P. eous* was significantly more observed in malt yeast extract (0.29g), followed by glucose peptone (0.27 g). However, it was best in complete (0.16g) and potato dextrose (0.18 g). These results are in agreement with Rathod *et al.* (2002) and Kim *et al.* (1997).

Effect of temperature on radial growth and biomass of wild *Pleurotus* sp. and *P. eous*.

The results clearly indicate that the variation in temperature influenced the radial growth, fresh and dry mycelial weight of wild *Pleurotus* sp. and *P. eous* (Table 3). The radial growth of wild *Pleurotus* sp. was significantly higher (70.66mm) at 25°C, while, it was lower at 35°C (33.33mm), 20°C (53.33mm) and 30°C (60.66mm). Maximum biomass production of wild *Pleurotus* sp. was observed at 30°C (2.66 g), followed by 25°C (2.46 g) and 20°C (2.17 g), while minimum biomass was recorded at 35°C (0.77 g). Fresh as well as dry mycelial weight of wild *Pleurotus* sp. was significantly higher at 30°C (5.04g and 0.28g), followed by at 25°C (4.66g and 0.26g) whereas, it was significantly lower at 35°C (1.43g and 0.11g), followed by 20°C (4.12g and 0.22g). In *P. eous*, the radial growth, fresh and dry mycelial weight was comparatively more at varying temperature ranges as compared to wild *Pleurotus* sp. Significantly more radial growth (89.16 mm) was noticed at 20°C whereas, it was significantly less (54.00 mm) at 35°C ,followed by 20°C (73.00 mm) and 30°C (78.66 mm). The biomass of *P. eous* was considerably higher at 30°C (3.13 g), followed by 25°C (3.05g) and 20°C (2.20g) while least biomass was observed at 35°C (0.71 g). Significantly higher fresh and dry mycelial weight of *P. eous* was recorded at 30°C (5.91 g and 0.35g), followed by 25°C (5.77 g and 0.34 g) and 20°C (4.16 g and 0.24 g). However, it was significantly low noticed at 35°C (1.32 g and 0.10 g). The present findings corroborate the results of Periasamy and Natarajan (2002).

LITERATURE CITED

Bhanwar, R. R. 2003. Influence on agronomic and Management Practices on growth and yield of *Pleurotus* spp. (Oyster mushroom), Thesis submitted to IGAU. Raipur, (C. G.) : 69.

Kim-Kyungsoo, You, Changhyun, Kong, Wong, Wonsik, Kin, Young Ho, Cha, Dongyeul, Ko, Misuk, Kim, K. S., You, CH, Kong W. S., Kim, Y, Cha, Uy, Ko, M.S. 1997. High temperature adaptable oyster mushroom (*Plarotus floridy*) new variety sachulnutaribeousat No. 2. ROA. of Industrial Crop Sci, 39 : 2 : 49-53.

Periasamy, K. and K. Natarajan, 2002. Selection, cultivation and nutritive value of wild and improved strains of Pleurotus_dijamor var roseus, Mush. Res., 11(2) : 81-84.

Rathod, P. L., R. T. Gohokar, and S. S. Parhatay, 2002. Cultivation of *Pleurotus florida* on various substrate, J. Mycol. Pl. Pathol. 32(3) : 375.

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Table 1 : Effect of antibiotics, combinations of antibiotics with fungicides and neem seed extract on Bacterial pustule intensity

Treatements	% Disease Intensity			Pooled mean	Percent Disease control
	2003-04	2004-05	2005-06		
T-1 Streptocycline 100 ppm	21.76	20.93	30.39	24.36	31.16
	(27.71)	(27.20)	(33.44)	(29.60)	
T-2 Streptocycline 200 ppm	16.30	16.94	20.74	17.99	49.13
	(27.78)	(24.27)	(27.02)	(25.10)	
T-3 Streptocycline 100 ppm + Mancozeb 0.25 %	19.81	20.64	23.61	21.35	39.63
	(23.37)	(27.01)	(29.04)	(27.56)	
T-4 Streptocycline 100 ppm + Copper oxychloride 0.3%	17.87	18.66	21.76	19.43	45.00
	(24.94)	(25.60)	(27.68)	(26.13)	
T-5 Kasumin 3 ml/L water	25.84	27.13	27.97	26.98	26.45
	(30.46)	(31.38)	(31.91)	(31.31)	
T-6 NSKE 5%	23.70	21.02	25.09	23.27	31.50
	(29.08)	(27.25)	(30.04)	(28.86)	
T-7 Control (Water spray)	34.63	30.74	40.74	35.37	–
	(35.98)	(33.70)	(39.65)	(36.51)	
F Test	Sig.	Sig.	Sig.	Sig.	–
SE (m) ±	0.92	0.34	1.03	1.04	
C.D. P = 0.05	2.74	1.00	3.07	3.19	

Table 2 : Effect of antibiotics, combinations of antibiotics with fungicides and neem seed extract on seed yield and ICBR.

Treatements	% Disease Intensity			Pooled	ICBR
	2003-04	2004-05	2005-06	mean	
T-1 Streptocycline 100 ppm	15.90	6.90	14.35	12.38	1:0.58
T-2 Streptocycline 200 ppm	18.28	8.53	15.79	14.00	1:1.66
T-3 Streptocycline 100 ppm + Mancozeb 0.25 %	17.60	7.58	16.07	13.73	1:1.42
T-4 Streptocycline 100 ppm + Copper oxychloride 0.3%	17.95	8.23	15.63	13.95	1:1.62
T-5 Kasumin 3 ml/L water	15.99	6.73	15.38	12.70	1:0.64
T-6 NSKE 5%	16.70	7.25	14.80	12.93	1:1.59
T-7 Control (Water spray)	15.30	3.43	13.90	11.89	—
'F' Test	N.S.	Sig.	Sig.	Sig.	
SE (m) ±	-	0.38	0.33	0.39	
C.D. at 5 %	-	1.12	1.03	1.19	

The results were statistically significant for 2 years (Table 2). Maximum seed yield i.e. 14 q ha^{-1} was obtained in streptocycline 200 ppm treatment and was followed by streptocycline 100 ppm + copper oxychloride 0.3 per cent (13.95 q ha^{-1}) and streptocycline 100 ppm + mancozeb 0.25 per cent (13.73 q ha^{-1}) with the level of significance. In control treatment, 11.89 q ha^{-1} seed yield was obtained. Incremental cost benefit ratio was highest i.e. 1:1.66 in streptocycline 200 ppm and was followed by streptocycline 100 ppm + copper oxychloride 0.3 per cent (1:1.62), 5 per cent neem seed extract (1:1.59) and streptocycline 100 ppm + mancozeb 0.25 per cent (1:1.42).

Streptocycline (0.01%) proved the best antibiotic for controlling bacterial pustule infection of soybean have been reported by (Srivastava and Bais, 1985). Streptocycline + copper fungicides controlled bacterial pustule disease of soybean have been reported by (Thapliyal and Dubey, 1986; Tombre *et al*., 1989 and Santha Lakshmi Prasad, 2007). Thrimurthy and Agrawal, (1992) reported that Fytolon 0.3 per cent + streptocycline 300 mg lit^{-1}. minimised the bacterial pustule development. Carbendazim 0.05 per cent + streptocycline 300 ppm, followed by Dithane M-45 + streptocycline 300 ppm. reduced significantly the pustule development over control. In the present studies, spraying of streptocycline 200 ppm alone and streptocycline 100 ppm + copper oxychloride 0.3 per cent and streptocycline 100 ppm + Mancozeb 0.25 per cent in combination minimised bacterial pustule infection and increased seed yield.

LITERATURE CITED

Anonymous, 2008. "Krishisavadani", published by Directorate of Extension Education, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola : 9.

Manglekar, R.K. and J.G.Raut, 1997. Survey of soybean diseases in Vidarbha and influence of few diseases on plant and yield parameter, PKV Res.J., 21(1):103-104.

Santha Lakshmi Prasad M., 2007. Integrated Disease Management in soybean. Manual on Integrated Pest Management in oilseed crops, Directorate of oil seeds Research, ICAR, Rajendranagar, Hydrabad.

Shrivastava, S.S.L. and B.S. Bais, 1985. Chemical control of bacterial leaf pustule of soybean, Indian Phytopathol, 38 : 351-353.

Thapliyal, P.N. and K.S. Dubey, 1986. Chemical control of bacterial pustule of soybean, Indian Phytopathol, 39 : 461-462.

Thrimurthy, V.S. and K.C. Agrawal, 1992. Efficacy of streptocycline in controlling bacterial pustule (*Xanthomonas sojense*) of soybean, Indian J. Mycol and Pl. Pathol, 22 (2) : 190-191.

Tombre, P.A., B.P. Kurndkar and B.R. Kawle, 1989. Chemical control of bacterial pustule of soybean, Indian phytopathol., 42 : 340.

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Efficacy of Different Neem Based Products on Pigeonpea Seed During Storage

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ABSTRACT

An experiment was conducted to study the potential use of botanicals against store grain pest of pigeonpea at Seed Technology Research Unit, Dr. PDKV, Akola, M.S., India, for three years. The different neem products viz; NSK powder, Neem cake, Neem oil, Neem INDIA, Econeem and Nimbicidine were used and compared with Deltamethrin 2.5 wp @ 1 ppm along with untreated control. After drying in shade, the treated seed was stored in gunny bag-lets of 2 kg. capacity. The observations on germination, moisture content and insect infestation percentage were recorded at the interval of every three months of storage period. The treatments had significant differences regarding insect infestation and germination and non-significant differences in case of moisture content percentage. Amongst, Nimbicidine 300 ppm @ 5ml kg^{-1} seed alone was found most effective in insect infestation below the Minimum Seed Certification Standard (MSCS) i.e.0.5 per cent after twelve months storage period. This treatment was also found significantly superior in respect of having high germination.

Availability of quality seed is of fundamental importance to farmers. Seed has a catalytic impact in expansion of seed programme in the country. Quality seed is the basic input and all other inputs are contingent upon it for being optimally effective. Therefore, protection of seed from insect pest during storage is having a vital role to provide the quality seed at the time of sowing. Stored Pigeonpea seed is prone for severe infestation by beetles of the family Bruchidae. The genus *Collosobruchus* commonly known as pulse beetle invariably attack seeds of pigeonpea during storage causing heavy losses and if the damage is more than 0.5 per cent, disqualify the seed to satisfy the Minimum Seed Certification Standard. For the management of these losses during storage various chemical insecticides are used. But many effective insecticides have been banned for health and environmental reason. In recent years several plants have been identified which can be used as safe and renewable sources of insecticides (Dethier, 1947, Jacobson, 1977, Sing and Pant, 1980, Verma and Pandey, 1981). Hence an experiment was conducted to avoid environmental hazards of chemical and to evaluate plant products to control storage insect for maintaining the Minimum Seed Certification Standard of pigeonpea seed.

MATERIAL AND METHODS

An experiment was conducted at Seed Technology Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.) India during the year 2005-06, 2006-07 and 2007-08. The different neem based products viz. (T_1) NSK product @ 5g (T_2) Neem cake @ 5 g, (T_3) Neem dry leaf powder @ 5 g, (T_4) Neem oil @ 5 ml, (T5) and (T_6) Neem INDIA @ 2.5 and 5 ml, (T_7) and (T_8) Econeem@ 2.5 and 5 ml, (T_9) Nimbicidine 300 ppm @ 5 ml were compared with (T_{10}) Deltamethrin 2.5 wp @ 40 mg and (T_{11}) untreated control. One kg of freshly harvested seed of Pigeonpea Var. C-11 having high percentage of germination (> 75%) and low moisture content (< 10%) was taken for each treatment. Required quantities of neem-based products were diluted in 5-ml. water to treat one kg seed for proper coating. Each treatment was replicated thrice. After treatment seed was dried in shade, packed in gunny bag lets (2 kg capacity) and kept in storage under ambient condition. Observation on germination, insect infestation, and moisture content percentage were recorded at an interval of every three months during the storage period as per standard procedure in the rules for seed testing Anonymous, (1985). The statistical analysis was done by using Completely Randomised Design (CRD) as per standard procedure, Panase and Sukhatme, (1976).

RESULTS AND DISCUSSION

1. Effect of different treatments on germination percentage :

The pooled data of three years (2005-06, 2006-07, 2007-08) is presented in Table 1. The results indicated that different Neem based product recorded significantly

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Table 1. Effect of different treatments on seed germination (Pooled data)

Treatments		Germination Percentage			
		2005-06	2006-07	2007-08	Pooled Mean
T_1	NSK Power @ 5 g kg^{-1} seed	83.12	82.95	82.35	82.80
		(65.73)*	(65.50)	(65.12)	(65.50)
T_2	Neem cake @ 5 g kg^{-1} seed	84.56	83.70	83.08	83.78
		(66.81)	(66.19)	(65.65)	(66.19)
T_3	Neem dry leaf powder 5 g kg^{-1} seed	83.69	83.54	82.49	82.57
		(65.35)	(65.27)	(65.20)	(65.27)
T_4	Neem oil @ 5 ml kg^{-1} seed	84.53	85.50	83.99	84.67
		(66.81)	(67.62)	(66.34)	(66.89)
T_5	Neem India @ 2.5 ml kg^{-1} seed	83.99	83.12	83.87	83.66
		(66.34)	(65.73)	(66.27)	(66.11)
T_6	Neem India @ 5 ml kg^{-1} seed	84.54	83.00	83.42	83.65
		(66.81)	(65.65)	(65.96)	(66.11)
T_7	Econeem @ 2.5 ml kg^{-1} seed	83.49	84.88	83.20	83.85
		(65.96)	(67.05)	(65.80)	(66.27)
T_8	Econeem @ 5 ml kg^{-1} seed	84.62	84.12	83.40	84.04
		(66.89)	(66.50)	(65.96)	(66.42)
T_9	Nimbicidine 300 ppm @ 5 ml kg^{-1} seed	**87.25**	**87.54**	**87.54**	**87.44**
		(69.04)	**(69.30)**	**(69.30)**	**(69.21)**
T_{10}	Deltamethrine 2.5 wp @ 40 mg kg^{-1}seed	**86.31**	**88.16**	**87.74**	**87.41**
		(68.28)	**(69.82)**	**(69.47)**	**(69.21)**
T_{11}	Untreated Control	81.08	81.11	79.58	80.58
		(64.16)	(64.23)	(63.08)	(63.79)
	SE (m) ±	0.51	0.39	0.22	0.30
	CD at 5%	1.54	1.17	0.67	0.91
	'F' test	Sig	Sig	Sig	Sig

Figure in parentheses are arcsin value

higher germination percentage than untreated control. Amongst the various treatments Nimbicidine 300 ppm @ 5 ml kg^{-1} seed recorded maximum germination percentage (87.25%) which was at par with Deltamenthrin 2.5 WP treated seed (86.31%) during 2005-06. However, during 2006-07 and 2007-08 Deltamethrin 2.5 WP treated seed recorded maximum germination percentage of 88.16 and 87.74 per cent respectively, which was at par with Nimbicidin 300 ppm (87.54 %). The data on pooled mean indicated that Nimbicidine 300 ppm and Deltamethrin 2.5 WP recorded highest germination percentage (87.44% and 87.41 %, respectively) over other treatments.

2. Effect of different treatments on insect infestation in the seed:

The pooled data of three years presented in Table 2, that the level of infestation is significantly less in all treatment over control. However, the treatment, Deltamethrin 2.5 WP recorded lowest insect infestation (0.16%), which was found at par with Nimbicidine 300 ppm (0.17%). The maximum insect infestation was recorded in untreated control. The pooled means of three years study also indicate the same trends, i.e. untreated seed was highly infested with insect (9.50%) over other treatments.

Table 2: Effect of different treatments on insect infestation (Pooled Data)

Treatment		Insect Infestation Percentage			
		2005-06	2006-07	2007-08	Pooled mean
T1	NSK Power @ 5 g kg^{-1} seed	1.61 (1.26)*	2.02 (1.42)	1.94 (1.39)	1.85 (1.36)
T2	Neem cake @ 5 g kg^{-1} seed	1.34 (1.15)	1.36 (1.16)	1.77 (1.33)	1.49 (1.22)
T3	Neem dry leaf powder 5 g kg^{-1} seed	1.29 (1.13)	1.19 (1.09)	1.62 (1.26)	1.36 (1.16)
T4	Neem oil @ 5 ml kg^{-1} seed	1.04 (1.01)	1.34 (1.15)	1.50 (1.22)	1.29 (1.13)
T5	Neem India @ 2.5 ml kg^{-1} seed	1.16 (1.07)	1.11 (1.05)	1.32 (1.14)	1.19 (1.09)
T6	Neem India @ 5 ml kg^{-1} seed	1.09 (1.04)	1.08 (1.03)	1.33 (1.15)	1.16 (1.07)
T7	Econeem @ 2.5 ml kg^{-1} seed	0.94 (0.96)	0.89 (0.94)	1.63 (1.27)	1.15 (1.07)
T8	Econeem @ 5 ml kg^{-1} seed	1.04 (1.08)	0.88 (0.93)	1.62 (1.27)	1.18 (1.08)
T9	Nimbicidine 300 ppm @ 5 ml kg^{-1} seed	**0.17 (0.41)**	**0.15 (0.38)**	**0.15 (0.38)**	**0.15 (0.38)**
T10	Deltamethrine 2.5 wp @ 40 mg kg^{-1} seed	**0.16 (0.40)**	**0.14 (0.37)**	**0.14 (0.37)**	**0.14 (0.37)**
T11	Untreated Control	**9.12 (3.01)**	**9.74 (3.12)**	**9.65 (3.10)**	**9.50 (3.08)**
	SE (m)±	0.080	0.053	0.033	0.058
	CD at 5%	0.23	0.15	0.098	0.17
	'F' test	Sig	Sig	Sig	Sig

Figure in parentheses are square root value.

Table 3: Effect of different treatment on seed moisture content

Treatments		Moisture Content			
		2005-06	2006-07	2007-08	Pooled mean
T1	NSK Power @ 5 g kg^{-1} seed	9.07(3.01)*	8.91(2.98)	9.02(3.00)	9.00(3.00)
T2	Neem cake @ 5 g kg^{-1} seed	9.51(3.08)	9.14(3.02)	9.22(3.03)	9.29(3.04)
T3	Neem dry leaf powder 5 g kg^{-1} seed	9.52(3.08)	9.03(3.00)	9.25(3.04)	9.26(3.04)
T4	Neem oil @ 5 ml kg^{-1} seed	9.11(3.01)	9.12(3.01)	9.39(3.06)	9.20(3.03)
T5	Neem India @ 2.5 ml kg^{-1} seed	9.17(93.02)	8.89(2.98)	9.22(3.03)	9.09(3.01)
T6	Neem India @ 5 ml kg^{-1} seed	9.19(3.03)	8.89(2.98)	9.32(3.05)	9.13(3.02)
T7	Econeem @ 2.5 ml kg^{-1} seed	9.40(3.06)	8.93(2.98)	9.42(3.06)	9.25(3.04)
T8	Econeem @ 5 ml kg^{-1} seed	9.19(3.03)	8.82(2.96)	9.29(3.04)	9.10(3.01)
T9	Nimbicidine 300 ppm @ 5 ml kg^{-1} seed	9.19(3.03)	8.94(2.98)	9.39(3.06)	9.17(3.02)
T10	Deltamethrine 2.5wp @ 40 mg kg^{-1} seed	9.19(3.03)	8.97(2.99)	9.24(3.03)	9.13(3.02)
T11	Untreated Control	9.79(3.12)	9.12(3.01)	9.76(3.12)	9.55(3.09)
	SE (m)±	0.021	0.023	0.032	0.022
	CD at 5%	-	-	-	-
	'F' test	NS	NS	NS	NS

Figure in parentheses are squareroot value

3. Effect of different treatment on seed moisture content:

The moisture content in the seed for all the three years was found non-significant and remained within the safe limit, throughout the storage period.

The above results on seed germination and seed infestation percentage corroborate with the findings of Schmutterer, 1990, Kathirvelu and Ezhilkumar, 200 and Anonymous, 2006, they observed that neem based products are feeding inhibitors and growth disruptors with maximum mortality for most storage insect pests.

Thus the present investigation revealed that the seed treatment of Nimbicidine 300 ppm @ 5 ml kg^{-1} is found effective for maintaining the insect infestation below 0.5 per cent and higher germination than MSCS i.e. 75 per cent of pigeonpea seed for the storage period of 12 months.

LITERATURE CITED

Anonymous, 1985. International rules for Seed Testing Seed Sci. Technol., 13 : 307-320.

Anonymous, 2006. Annual report, AICRP, National Seed Project (Crops) ICAR, New Delhi.

Dethier, V.G., 1947. Chemical Insect Attractant and Re;ellents. Levis and Co. London.

Jacobson, M., 1977. Isolation and identification of toxic agents from plants. In Host Plant Resistnace to Pests (Hedin P.A. Ed.) p. 135 ACS Symposium series 62 American Chemical Society, Washington, D.C.

Kathirvelu, C. and S. Ezhilkumar, 2003. Preliminary screening of botanicals against lesser grain borer (*Rhyzopertha dominica* Fab. In stored paddy). Insect-Environment 9(4) : 160-161.

Panse, V.G. and P.V. Sukhatme, 1954. Statistical methods for agricultural workers. 1st Edition, ICAR, New Delhi : 110-120.

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

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

Verma, G.S. and U.K. Pandey, 1981. Studies on the effect of *Acorns calamus, Cimicifuga foelida. Gynandropsis gynandra* extract against insect pests of cruciferous vegetables. Painted bug *Bagarda cruciferarum* Kirk (Hemiptera : Pentatomidae) Zielxchriti fur angewandle Zoologie. 68 (11) : 109-113.

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Efficacy of Various Neem Formulations Against Cotton Bollworms

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ABSTRACT

Various neem formulations viz; azadirachtin 300 ppm 5 ml lit^{-1}, azadirachtin 1500 ppm 2.5 ml lit^{-1}, azadirachtin 10000 ppm 1ml lit^{-1}, NSE 5 per cent and endosulphan 35 EC 0.07 per cent were evaluated against cotton bollworms. The pooled results evidenced the effectiveness of endosulphan 35 EC 0.07 per cent against cotton bollworms. Amongst the neem formulations azadirachtin 10000 ppm 1 ml lit^{-1}, azadirachtin 1500 ppm 2.5 ml lit^{-1} and NSE 5 per cent were found effective in recording minimum infestation of bollworm complex in green fruiting bodies, open bolls at harvest, loculi damage due to pink bollworm and higher seed cotton yield. ICBR was also found maximum in these treatments.

Cotton is an important commercial crop and plays a key role in the economy of the country. In India, cotton is cultivated on an area of 87.4 lakh ha with 29.80 lakh ha area under cotton in Maharashtra. The productivity of cotton is variable in the country being as low as 194 kg lint ha^{-1} in Maharashtra as compared to National average of 294 kg lint ha^{-1} (Anonymous, 2002).

Amongst the various factors responsible for low yields, the loses caused by insect pests are of major importance. Cotton crop is damaged by various insect pests from sowing to maturity in different cotton growing areas of World, of which 162 species are associated with cotton in India. Amongst these, 12 species are of major importance resulting in an annual loss of 50-60 per cent in total production.

Sole reliance on chemical insecticides and their continual use has resulted in several problems like insecticide resistance, pest resurgence, destruction of natural enemies, residue problems, etc. So the efforts are made to evaluate the efficacy of various neem formulations against cotton bollworms. The neem (*Azadirachta indica* A Juss.) is the promising tree from practical utility of pest management. Out of 25 active compounds identified, azadirachtin is the most important one. (Butterworth and Morgan, 1968; Jones *et al.*, 1989)

MATERIAL AND METHODS

A field experiment was conducted at Regional Research Centre, Amravati, Maharashtra during the *Kharif* season in 2000-2001,2002-2003 and 2003-2004 to evaluate the efficacy of various neem formulations against cotton bollworms. The experiment was laid in Randomized block design with four replications. In this, six treatments including untreated control were evaluated. Rajat variety of cotton was sown at a spacing of 60 x 30 cm in a plot of 5.4 x 5.4 m size. The first spray was given at 5 per cent bollworm infestation. The subsequent three applications were made at an interval of 15 days.

Observations were recorded on five randomly selected plants in each net plot (3.6 x 4.2 cm). The pre-treatment observations were recorded 24 hours before application of treatment and post treatment observations at 7 and 14 days after treatment on the following aspects:

1. Infestation of bollworm complex in green fruiting bodies, 2. Infestation of bollworm complex in open bolls at harvest. and 3. Yield of seed cotton.

RESULTS AND DISCUSSION

(a) Bollworms infestation in green fruiting bodies

The pooled data of three years revealed that, all the treatments were found to be significantly superior over untreated control in reducing bollworm infestation in green fruiting bodies at 7 days after treatment (Table 1). Endosulphan 35 EC (0.07 %) recorded minimum infestation (10.91%). The next effective treatment was azadirachtin 10000 ppm 1 ml lit^{-1}, which recorded 12.42 per cent infestation, followed by azadirachtin 1500 ppm 2.5 ml lit^{-1} (13.28 %) and both these treatments were on par with each other. Endosulphan 35 EC (0.07 %) recorded minimum infestation (13.35 %) in green fruiting bodies at 14 days after treatment. Amongst the neem formulation, azadirachtin 10000 ppm 1 ml lit^{-1} ranked first recorded 15.35 per cent bollworm complex infestation followed by azadirachtin 1500 ppm 2.5 ml lit^{-1} (16.02 %) and NSE 5 per cent (16.27 %) and they were statistically at par with each other.

(b) Bollworms infestation in open bolls at harvest.

The treatment differences were significant and all the treatments were found to be significantly superior over untreated control, recording the minimum infestation of bollworm complex in open bolls at harvest. Amongst

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Table 1: Effect of different insecticides on bollworm complex infestation.

Treatments	Av.(%) infestation of bollworm comples												Av (%) loculi damage due to pink bollworm			
	Green fruiting bodies								Open bolls							
	7 days after application				14 days after application											
	1st Yr	2nd Yr	3rd Yr	Pooled mean	1st Yr	2nd Yr	3rd Yr	Pooled mean	1st Yr	2nd Yr	3rd Yr	Pooled mean	1st Yr	2nd Yr	3rd Yr	Pooled mean
Azadirachtin 300 ppm	11.06	12.08	18.00	13.75	15.65	15.62	20.86	17.38	49.04	37.93	58.04	48.34	14.28	9.97	19.99	14.75
5ml lit^{-1}	(3.30)*	(3.50)*	(4.24)*	(3.68)*	(3.95)*	(3.94)*	(4.55)*	(4.15)*	(43.71)**	(37.99)**	(52.14)**	(46.61)**	(3.77)*	(3.15)*	(4.46)*	(3.79)*
Azadirachtin 1500 ppm	10.30	11.82	17.71	13.28	14.14	14.96	18.96	16.02	45.69	37.01	54.99	45.90	12.51	9.64	19.21	13.79
1ml lit^{-1}	(3.19)	(3.43)	(4.20)	(3.61)	(3.75)	(3.85)	(4.34)	(3.98)	(42.49)	(37.45)	(47.90)	(42.61)	(3.49)	(3.08)	(4.38)	(3.64)
Azadirachtin 10000 ppm	10.24	10.46	16.56	12.42	13.09	12.61	20.34	15.35	45.48	35.97	56.15	45.86	12.19	8.68	19.19	13.35
1ml lit^{-1}	(3.19)	(3.22)	(4.06)	(3.49)	(3.61)	(3.54)	(4.51)	(3.88)	(42.40)	(36.83)	(48.52)	(42.58)	(3.48)	(2.94)	(4.37)	(3.60)
NSE 5%	10.70	12.76	17.85	13.77	13.35	15.45	20.02	16.27	46.84	39.78	54.65	47.10	13.20	10.40	17.76	13.79
	(3.26)	(3.56)	(4.22)	(3.68)	(3.65)	(3.94)	(4.47)	(4.01)	(43.16)	(39.08)	(47.68)	(43.31)	(3.62)	(3.22)	(4.21)	(3.68)
Endosulphan 35 EC	9.62	9.28	13.83	10.91	11.55	11.27	17.23	13.35	44.78	28.38	47.62	40.26	12.16	7.24	14.97	11.46
@ 0.07 %	(3.09)	(3.04)	(3.72)	(3.28)	(3.39)	(3.35)	(4.15)	(3.63)	(41.94)	(32.19)	(43.65)	(39.26)	(3.48)	(2.68)	(3.87)	(3.34)
Untreated control	14.62	14.63	20.26	16.50	21.93	20.21	24.75	22.30	63.33	52.33	69.38	61.68	18.86	12.65	25.05	18.85
	(3.81)	(3.82)	(4.50)	(4.04)	(4.67)	(4.49)	(4.97)	(4.71)	(52.73)	(46.35)	(56.49)	(51.85)	(4.33)	(3.56)	(5.00)	(4.30)
'F' test	Sig	Sig	Sig	Sig.	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m)±	0.11	0.07	0.06	0.047	0.06	0.10	0.09	0.046	1.33	1.36	1.52	0.79	0.15	0.09	0.10	0.06
CD at 5%	0.34	0.21	0.18	0.14	0.18	0.30	0.27	0.13	4.01	4.11	4.57	2.38	0.47	0.29	0.30	0.18
CV %	6.93	4.16	3.01	4.49	3.14	5.19	4.05	4.00	5.99	7.11	6.14	6.21	8.48	6.25	4.57	5.50

* Figures in the parentheses are square root transformed values. ** Figures in the parentheses are arc sine transformed values.

Table 2: Effect of different insecticides on yield of seed cotton.

Treatments	Yield of seed cotton q ha^{-1}				Cost benefit
	1st Yr	2nd Yr	3rd Yr	Pooled mean	ratio
Azadirachtin 300 ppm 5ml/lit	7.14	8.07	6.76	7.32	1:1.12
Azadirachtin 1500 ppm 1ml/lit	8.03	8.02	6.88	7.64	1:1.73
Azadirachtin 10000 ppm 1ml/lit	8.68	9.85	6.81	8.44	1:2.34
NSE 5%	8.23	6.99	7.80	7.67	1:2.25
Endosulphan 35 EC @ 0.07 %	8.66	9.92	10.68	9.75	1:4.66
Untreated control	7.10	6.13	5.84	6.35	-
'F' test	N.S	Sig	Sig	Sig	-
SE(m)±	0.09	0.69	0.41	0.40	-
CD at 5%	-	2.07	1.23	1.19	-
CV%	16.33	16.89	17.06	18.04	-

the neem formulations minimum infestation (45.86 %) was recorded by azadirachtin 10000 ppm 1 ml lit^{-1}, followed by azadirachtin 1500 ppm 2.5 ml lit^{-1} (45.90 %), NSE 5 per cent (47.10%) and azadirachtin 300 ppm 5 ml lit^{-1} (48.34 %).

The pooled data revealed that all the treatments were significantly superior over untreated uncontrol, recording minimum loculi damage due to pink bollworm. The treatment endosulphan 35 EC (0.07%) recorded the minimum (11.46 %) loculi damage. Amongst the neem formulations, azadirachtin 10000 ppm 1 ml lit^{-1} recorded 13.35 per cent loculi damage due to the pink bollworm, followed by azadirachtin 1500 ppm 2.5 ml lit^{-1} (13.79 %) and NSE 5 per cent (13.79 %) and both these treatments were at par with each other.

(c) Seed cotton yield

Three years pooled data (Table 2) revealed that significantly maximum seed cotton yield (9.75 qt ha^{-1}) was obtained due to the treatment of endosulphan 35 EC (0.07 %). Neem formulation treatments were statistically at par with each other, azadirachtin 10000 ppm 1ml lit^{-1} recorded (8.44 q ha^{-1}) more seed cotton yield, followed by NSE 5 per cent (9.75 q ha^{-1}) and azadirachtin 1500 ppm 2.5 ml lit^{-1} (7.64 q ha^{-1}). Maximum ICBR (1:4.66) was recorded due to endosulphan 35 EC (0.07 %), followed by azadirachtin 10000 ppm 1ml lit^{-1} (1:2.34) and NSE 5 per cent (1:2.25) (Table 2). Raut, (2000) studied bioefficacy of some insecticides and neem products against *Heliothis armigera*, Hubner on Tomato and reported that, Neemactin 0.15 EC 5 ml lit^{-1} of water, Neem Gold 0.15 EC 3 ml lit^{-1} of water and Neemax 5 g lit^{-1} of water were the alternative best treatment to chemical insecticides for the control of larval population of *Heliothis armigera* on Tomato and increased the yield, being ecofriendly.

Pradeepkumar *et al*, (2000) reported that *H. armigera* population was always under control in all the other plant products and some of them were at par with Neem oil 5 per cent. Karamkar and Bhole (2000) reported that 2 per cent Neemark, 1 per cent Neemark and 2 per cent Nimbitor were found superior over endosulphan against second and fourth instar larvae of *Spodoptera litura* Fab. Desai and Patil (2000) observed that the seed kernel extract of *Azadirachta indica* exhibited promising antifeedant activity against *Spodoptera litura* Fab.

LITERATURE CITED

Anonymous, 2002. AICCIP, Annual Report of project co-ordinator releases at the Annual Group meeting at CICR, Nagpur (March 22-24, 2002) 1-3.

Butterworth, J.H and E. D. Morgan, 1968.Isolation of substance that suppresses feeding in locust, Chem Commun, 1: 23-24.

Desai, S.K and R. S. Patil, 2000. Antifeedant properties of some plant material extracts against *Spodoptera litura,* Pestol., 24 (8) : 62-64.

Jones, P. S., S. V. Ley., E. D. Morgan and D. Sanafianos, 1989. The chemistry in the neem tree : 19-45 (CRS Press, Boca Raton, USA).

Karamkar, M. S. and S. R. Bhole, 2000. Studies of efficacy of some neem products against second and fourth instar larvae of *Spodoptera litura* Fab., Pestol. 24 (80) : 55-57.

Pradeepkumar K., P. Nagaraja Rao and Asif Tanweer 2000: *Helicoverpa armigera* larval control with certain plant products in the cotton Agro-Ecosystem, Pestol. 24 (8): 9-13.

Raut, S. K., 2000. Bioefficacy of some insecticides and neem products against *Heliothis armigera* Hubner on tomato, Pestol. 4 (8): 30.31.

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Effect of Different Levels of Pineapple Pulp on Quality of Lassi

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ABSTRACT

Lassi was prepared from standardized cow milk of 4 per cent fat with different levels of pineapple pulp i.e. 2.5 per cent (T_1), 5.0 per cent (T_2), 7.5 per cent (T_3) and 10.0 per cent (T_4) while treatment (T_0) was without pineapple pulp. In each treatment sugar was used @ 12 per cent. It was observed that fat and protein content of Lassi decreases while total solids and titratable acidity increases with the increased level of pineapple pulp. In respect of sensory qualities, score for colour, appearance, flavour, body and texture and overall acceptability increases proportionately by the addition of pineapple pulp up to certain level and thereafter decreases.

Fermented milk products occupy an important place in the diet of Indians where majority of the population is vegetarians and for them milk and milk products are one of the main source of animal protein. Fermented milks are known throughout the world for their taste, nutritive values and therapeutic properties. Not only all the constituents of milk are available but they are in a more easily assimilable form in lassi as a result of lactic fermentation. Lassi is the product resulting from the growth of a selected culture usually lactic *Streptococci* in heat treated whole or partially skimmed milk at the desired ripeness (0.75-0.80%), the coagulum is broken, admixed with sugar or sugar syrup and flavour (Pal and Gupta, 1985).

Recently, there has been an increasing trend to fortify the product with fruit pulp or fruit juice and are considered good source of minerals and vitamins. Pineapple fruit is good source of vitamin A, B and rich in vit. C and calcium. It also contains phosphorus and iron. Pineapple fruit contains sugar 13 per cent, protein 0.6 per cent and acid 0.6 per cent. Hence, supplementation of lassi with pineapple pulp will not only improve it's flavour but also it's overall nutritional quality, the taste and the appeal.

It is however, noted that there is little and scanty work done on dahi based products in respect of it's technology, preservation, flavour development etc. In order to accomplish the demand of people for good quality fermented beverages, there is a need to produce lassi by utilization of fruit pulp or juice. Therefore, an attempt has been made in this investigation to study the effect of different levels of pineapple pulp on the quality of lassi.

MATERIAL AND METHODS

Fresh cow milk was obtained from Agricultural College Dairy Farm, Nagpur. The milk was strained through clean muslin cloth, separated and standardized at 4.0 per cent fat level by using Pearson square method, heated to 90°c for 15 minutes, mixed thoroughly and cooled to incubating temperature of 20-22°c. The milk was inoculated by adding 1 per cent starter culture consisting of *Streptococcus lactis* ssp. *diacetilactis* and *Streptococcus lactis* ssp. *cremoris* and then filled in sterilized plastic cups. The filled cups were incubated at 20-22°c for 12-16 hours in BOD incubator to obtain a good quality curd. The set curd was broken down by slow agitation. The pineapple pulp, sugar and chilled water was properly mixed with the curd in order to have a homogenous mixture of lassi. The prepared pineapple pulp blended lassi was packed in 150 ml sterilized plastic cups and stored in refrigerator at 5°c. The treatment details are given in Table 1 and proposed per cent combination of lassi with different levels of pineapple pulp are given in Table 2.

The samples of fresh product were analysed for chemical properties i.e. Fat, Total solids, Acidity and

Table 1 : Treatments adopted during the course of study

Treatments	Levels of pineapple pulp (%)
T_0	0.0
T_1	2.5
T_2	5.0
T_3	7.5
T_4	10.0

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Table 2 : Proposed per cent combination of lassi with different levels of pineapple pulp.

Treatments	Pineapple Pulp	Dahi	Water	Cane sugar
T_0	0.0	78.0	10	12
T_1	2.5	75.5	10	12
T_2	5.0	73.0	10	12
T_3	7.5	70.5	10	12
T_4	10.0	68.5	10	12

Protein as described in BIS Hand book of Food Analysis-Dairy products in SP:18 part XI (1981) as well as sensory qualities i.e. Colour, Appearance, Flavour, Body and Texture and Overall acceptability. The sensory qualities of the product were determined by judging the product by a panel of five judges. The 100 point numeric score as described by Nelson and Trout (1964) was adopted for sensory evaluation of the product. The experiment was laid out in CRD with 5 treatments and 4 replications. The data obtained was analysed statistically according to method described by Snedecor and Cochran for chemical analysis and Kruskal-Wallis non-parametric test was used for the sensory evaluation.

RESULTS AND DISCUSSION

The results on chemical properties and sensory evaluation of pineapple pulp blended lassi described as under.

Chemical composition of milk and pineapple pulp used during investigation

The milk standardized to 4 per cent fat had 14.05 per cent total solids, 3.70 per cent proteins and acidity of milk was 0.13 per cent. Pineapple pulp used had very low content of fat and proteins i.e. 0.10 and 0.40 per cent respectively. The total solids and acidity of pineapple pulp was 55.81 and 0.44 per cent, respectively (Table 3).

Table 3 : Chemical composition of milk and pineapple pulp (per cent)

Parameters	Milk	Pineapple pulp
Fat	4.00	0.10
Protein	3.70	0.40
Total Solids	14.05	55.81
Acidity	0.13	0.44

Chemical composition of lassi

It is observed from Table 4 that, average fat and protein percentage was higher in plain lassi as compared to pineapple pulp blended lassi. Highest fat (3.89%) and protein (3.13%) content was noted in plane lassi i.e. treatment T_0 (control) while lowest fat (2.79%) and protein (2.23%) content was observed in treatment T_4 with 10 per cent pineapple pulp. It was also observed that average total solids and titratable acidity of lassi blended with pineapple pulp was higher as compared to plain lassi. Highest total solids (22.79%) and titratable acidity (1.315%) was noted in treatment T_4 with 10 per cent pineapple pulp while lowest total solids (21.59%) and titratable acidity (0.727%) was recorded in treatment T_0 (control) without pineapple pulp.

Table 4 : Average chemical composition of lassi (per cent).

Treatments	Fat	Total solids	Titratable acidity	Protein
T_0	3.89^a	21.59^e	0.727^e	3.13^a
T_1	3.62^b	21.88^d	0.800^d	2.90^b
T_2	3.40^c	22.19^c	0.867^c	2.68^c
T_3	3.02^d	22.47^b	0.920^b	2.46^d
T_4	2.79^e	22.79^a	1.315^a	2.23^e
SE (m) ±	0.004	0.106	0.131	0.005
C.D.	0.017	0.026	0.030	0.022

Values with different superscripts differ significantly ($P<0.05$)

Statistical analysis of the data showed that treatment T_0 was superior over T_1, T_2, T_3 and T_4 for fat and protein respectively, whereas treatment T_4 was significantly superior over treatment T_0, T_1, T_2 and T_3, respectively in respect of total solids and titratable acidity.

The results indicated that with the increase in pineapple pulp level, there is proportionate decrease in fat and protein content of lassi whereas total solids and titratable acidity increases proportionately.

These results are in agreement with the results obtained by Shelar (2001) who also noted that with the increase in mango pulp level there is proportionate decrease in the fat content of lassi. Bachhav (2005) stated that with the increase in levels of fruit pulp there is

Table 5 : Sensory evaluation of lassi blended with pineapple pulp

Treatments	Colour (10)	Appearance (15)	Flavour (45)	Body and Texture (30)	Overall acceptability(100)
T_0	7.02[3]	8.49[3]	35.88[3]	21.59[3]	73.01
T_1	7.37[2]	9.08[2]	36.79[2]	22.06[2]	75.50
T_2	8.24[1]	11.53[1]	37.41[1]	22.87[1]	80.05
T_3	6.72[4]	7.21[4]	34.85[4]	20.75[4]	69.54
T_4	6.05[5]	6.96[5]	33.70[5]	20.19[5]	66.91
X^2 cal.	16.45	14.25	18.28	16.85	14.44
X^2 tab	9.78	9.78	9.78	9.78	9.78
.Results	Sig.	Sig.	Sig.	Sig.	Sig.

Results of Kruskal-Wallis non-parametric test is significant at 5 per cent level of significancy at 4 d.f. as X^2 cal.$\geq X^2$ tab. Values with different superscripts indicates respective ranks. The lowest rank (1) indicates the best treatment. The next number (2) indicates next preferred treatment and so on.

proportionate decrease in the level of protein content of yoghurt. Desai *et al.* (1994) noted that with the increase in the fruit pulp level there is proportionate increase in the total solids content of yoghurt. Titratable acidity of flavoured lassi proportionately increases with the increase in the level of fruit pulp (Badhe, 2003).

Sensory evaluation of lassi

Colour : Data presented in Table 5 in respect of colour of lassi indicated that highest mean score 8.24 out of 10 was observed for the treatment T_2 with 5.0 per cent pineapple pulp, whereas treatment T_4 with 10.0 per cent pineapple pulp scored lowest 6.05. Statistically treatment T_2 was superior over rest of the treatments. Similarly treatment T_1 was superior over treatment T_0, T_3 and T_4.

The results are in close agreement with the results obtained by Bachhav (2005), who reported that drinking yoghurt prepared from 3 and 6 per cent sapota and grape fruit pulps, respectively was superior over plain drinking yoghurt.

Appearance : It is observed from Table 5 that, the highest mean score 11.53 out of 15 in respect of the appearance of lassi was observed in the treatment T_2 while, lowest 6.96 for the treatment T_4. Statistically treatment T_2 was superior over rest of the treatments. Treatment T_1 was superior over treatment T_0, T_3 and T_4.

The results obtained are more or less in agreement with the results obtained by Badhe (2003) who reported that lassi with 6 per cent level of fruit pulp was good in appearance as compared to lassi with 9 per cent fruit pulp.

Flavour : The flavour of the lassi was improved with the addition of pineapple pulp upto certain level and thereafter it decreases proportionately. This might be due to the increased level of acidity incorporated by pineapple pulp. It could be seen from Table 5 that, lassi blended with 5.0 per cent pineapple pulp recorded highest mean score (37.41 out of 45) in respect of flavour for the treatment T_2, lowest score 33.70 for the treatment T_4 whereas, score obtained by plain lassi was 35.88 for the treatment T_0. Statistically treatment T_2 was superior over rest of the treatments. Treatment T_1 was superior over treatment T_0, T_3 and T_4.

The results obtained are corroborated with the results obtained by Desale (1995), who found that incorporation of 7.5 per cent mango pulp was most acceptable in lassi. Similarly, the use of 5 per cent mango pulp could also produced lassi of nearly equal quality. Kosikowski (1969) pointed out that cultured buttermilk flavoured with a variety of fruits concentrates produced beverages highly acceptable in texture, flavour and appearance.

Body and texture : From Table 5 it is revealed that, highest mean score 22.87 out of 30 in respect of body and texture was obtained for the treatment T_2 i.e. lassi blended with 5.0 per cent pineapple pulp while, lowest score 20.19 for the treatment T_4 with 10 per cent pineapple pulp whereas, score obtained by plain lassi i.e. T_0 was 21.59. Statistically,

treatment T_2 was superior over rest of the treatment. From the data obtained, it is revealed that as the level of pineapple pulp increases the score for body and texture of lassi also increases upto certain limit and thereafter it decreases gradually.

The results obtained are more or less in agreement with the results obtained by Bachhav (2005), who reported that score for body and texture of lassi increases as the fruit pulps increased upto certain limit thereafter it decreases gradually.

Overall acceptability : It is observed from Table 5 that, the highest mean score 80.05 out of 100 in respect of the overall acceptability of lassi was observed in treatment T_2 while, lowest 66.91 for the treatment T_4. Statistically treatment T_2 was superior over rest of the treatments. Treatment T_1 was superior over treatment T_0, T_3 and T_4. It showed that with the increase in the level of pineapple pulp, the overall acceptability of lassi increases upto certain limit and thereafter it decreases proportionately.

These results are in agreement with the results obtained by Bachhav (2005) who stated that the overall acceptability of drinking yoghurt prepared from 3 and 6 per cent sapota and grape fruit pulps, respectively were superior over plain yoghurt.

Thus, it may be concluded that lassi blended with different levels of pineapple pulp significantly affect the sensory quality of the product. Lassi prepared with 5.0 per cent pineapple pulp scored highest as compared to all other treatments in respect of colour, appearance, flavour, body and texture and overall acceptability and found best.

LITERATURE CITED

Bachhav, Y.B., 2005. Utilization of fruit pulps in the preparation of drinking yoghurt, M.Sc.(Agri) Thesis (Unpub.), Dr. PDKV, Akola.

Badhe, S.K., 2003. Utilization of different fruit pulps in the preparation of lassi, M.Sc. (Agri) Thesis (Unpub.), Dr. PDKV, Akola.

Desai, S.R., V.A. Toro and S.V. Joshi, 1994. Utilization of different fruits in the manufacture of yoghurt, Indian J.Dairy Sci., 47(10):870-874.

Desale, R.J., 1995. Studies on preparation of fruit flavoured lassi. M.Sc. (Agri) Thesis (Unpub.), Dr. PDKV, Akola.

Kosikowski, 1969. A technical survey of commercial cultured skim milk or buttermilk manufacture in U.S., Dairy Sci. Abstr., 6(1) : 11.

Nelson, J.A. and G. M. Trout, 1964. Judging dairy products. IV Edition. Olson publ. Co. Miwoukee. : 302-306.

Pal, D. and S.K. Gupta, 1985. Sensory evaluation of Indian milk products, Indian Dairyman, 37(2) : 465-474.

Shelar, H.S., 2001. Utilization of low fat blended milk with mango fruit pulp for lassi preparation, M.Sc. (Agri) Thesis (Unpub.), Dr. PDKV, Akola.

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Effect of Intermilking Period on Quantity and Quality of Milk of Crossbred Cows

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ABSTRACT

The effect of intermilking period on quantity and quality of milk of crossbred cows was studied and reviewed in this paper. The experiment was laid out in switchover design with three treatments. Twelve crossbred cows were divided into three equal groups on the basis of milk yield. The cows were allotted three treatments i.e. 10 h. (T_1), 11 h. (T_2), 12 h. (T_3). The experiment was conducted for a period of 45 days. The study revealed that intermilking period influenced the milk yield of crossbred cows. Milk yield increased with increasing milking interval up to 12 h.. However, quality of milk in terms of fat, lactose, total solids decreased with increasing milking interval, whereas protein and moisture increased with increasing milking interval. Intermilking period had no effect on solid-not-fat, titratable acidity, pH, ash and specific gravity of milk of crossbred cows. Therefore it can be concluded that 12 hr., intermilking period is the ideal intermilking period as far as milk yield is concerned.

Milk is one of the most wholesome supplements to the unbalanced diet for growing lacto-vegetarian millions in India. Due to its composition, high nutritive value and easy digestibility, milk has become a very important component of diet. The composition of the milk may vary due to the influence of different factors like season, food, intermilking period, frequency of milking, disease, breed, individuality, age and stage of lactation.Intermilking period is the period between two successive milking and is probably one of the important factor influencing the quantity and quality of milk. The effect of unequal milking interval indicates that cow milked at either 9 or 15 hours daily interval produced 1 to 3 per cent less milk per lactation than cow milked at equal interval (Banerjee, 2005). Intermilking period also affects the milk quality i.e. milk composition (Stelwagen and Lacey-Hulbert, 1966).

MATERIAL AND METHODS

Twelve crossbred milch cows were selected for the present study and divided into three equal groups and subjected to following treatments in a switch over manner. The observations on each group were recorded for a period of 15 days and 5 days gap was maintained between two successive experimental periods.

Following treatments allotted for experiment.

Tl- 10 h. intermilking period
T2- 11 h. intermilking period
T3- 12 h. intermilking period The experimental cows were milked as per regular practice of full hand method of milking twice daily at morning 6 A.M and in the evening at 4.P.M, 5 P.M and 6 P.M in group I, II and III respectively. Milk sample collected from 12 crossbred cows were subjected to physical analysis like titratable .acidity, specific .gravity, pH and chemical analysis like fat, protein, lactose, total solids, solids-not-fat, ash and moisture. The data collected were arranged in switch over design and was statistically analyzed.

RESULTS AND DISCUSSION

Milk Production

Significant increases in milk production of cows observed with increasing milking interval. The average milk production per animal in different treatments i.e. 10 h. (Tl), 11 h. (T2) and 12 h. (T3) were 4.60, 4.89 and 5.23 kg., respectively and corresponding values of average total milk of twelve crossbred cows of each treatment was 55.22, 58.78 and 62.79 kg., respectively. These results indicate that the crossbred cows milked at 12 *ht* (T3) milking interval produced more milk than cows milked at 10 h (T_1) and 11 h (T_2). Milking at equal interval is ideal for milking.

Bruckmaier and Hilger (2000) reported that milk ejection occurs fastest at milking interval of 12 h and delayed at short milking interval which might be the reason of increased milk yield in 12 h interval. Brien *et al,*

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Table 1 - Milk yield and its quality influenced by various treatments

Treatments	Av. Total Milk Yield (Kg)	Av. Fat (%)	Av. Protein (%)	Av. Lactose (%)	Av. T.S (%)	Av. SNF (%)	Av. Ash (%)	Av. Moisture (%)	Av. Titratable Acidity (%)	Av. PH	Av. Specific Gravity Yield
Tl	4.60	4.57	3.14	4.56	12.95	8.38	0.665	87.05	0.135	6.51	1.029
T2	4.89	4.27	3.21	4.42	12.57	8.30	0.667	87.43	0.139	6.50	1.029
T3	5.21	3.97	3.30	4.33	12.27	8.30	0.675	87.72	0.138	6.50	1.029
'F' test	*	*	*	*	*	NS	NS	*	NS	NS	NS
SE.±(m)	0.067	0.0022	0.0019	0.0030	0.005	0.016	0.001	.0.0025			
CD	0.20	0.0066	0.0055	0.0090	0.015			0.0075			

- Significant at 5% level of probability

(1998) observed that cows milked at 12 h interval produced significantly more milk than those milked at 16:8 h interval.

Fat content of milk

The average fat content of milk per animal in different treatments i.e. 10 h 11 h and 12 h were 4.57, 4.27 and 3.97 per cent, respectively and corresponding values of average total milk fat of twelve crossbred cows of each treatment was 54.9, 51.3 and 47.7 per cent, respectively. Significantly decreases in milk fat content with increasing milking interval. These results indicated that the crossbred cows milked at 10 h$ milking interval produced more milk fat than at 11 h and 12 hfmilking interval. Delamaire and Flament (2006) reported that fat yield decreases with increasing milking interval.

Protein content of milk

Significant increase in protein content of milk of cows observed with increasing milking interval. The average protein content per animal in different treatments i.e. 10 h, 11 h and 12 h were 3.14, 3.21 and 3.30 per cent, respectively and corresponding values of average total protein content of milk of twelve crossbred cows of each treatments was 37.75, 38.54 and 39.63 per cent, respectively. These results indicated that the crossbred cows milked at 12 h milking interval produced more protein content as compared to 10 h and 11 hi milking interval. Stelwagen *et al.* (1997) reported that protein content increase at extending milking interval.

Lactose content of milk

The average lactose content of milk per animal in different treatments i.e. 10 h, 11 h and 12 h were 4.56, 4.42 and 4.33 per cent respectively and corresponding values of average total lactose content of milk of twelve crossbred cows of each treatment was 54.80, 53.06 and 52.00 per cent, respectively. Lactose content in milk was significantly decreased with increasing milking interval.These results indicated that the crossbred cows milked at 10 h milking interval produced more lactose content in milk than at 11 h and 12 h milking interval. Wheelock *et al.* (1966) reported that lactose concentration decreased with extending milking interval.

Total solids content of milk

The average total solids content of milk per animal in different treatments i.e. 10 h, 11 h and 12 h were 12.95, 12.57 and 12.27 per cent, respectively and corresponding values of average total solids content was 155.39, 150.84 and 147.30 per cent, respectively. Total solids content of milk decreased significantly with increasing milking interval.

Solids-not-fat content of milk

The average solids-not-fat content of milk,per animal in different treatments i.e. 10 h 11 h and 12 h were 8.87, 8.30 and 8.31, respectively and corresponding values of average total solids-not-fat content of milk of each treatment was 100.50, 99.60 and 99.67 per cent, respectively. These results indicated that solids-not-fat

content of milk was more or less constant at different milking interval. Solids-not-fat content in milk significantly not affected due to milking interval. Fernando and Sphar (1983) reported that solid-not-fat content in milk not affected due to milking.

Moisture content of milk

Significant increase in moisture content of milk with increasing milking interval was observed. The average moisture content per animal in different treatments i.e. 10 h, 11 hand 12 h were 87.05, 87.43 and 87.72 per cent, respectively and corresponding values of total moisture content of milk was 1044.62, 1049.16 and 1052.70 per cent, respectively.

These results indicated that the crossbred cows milked at 12 h, (0.761) and 11 h (0.43) milking interval produced more moisture content in milk as compared to 10 h milking interval.

LITERATURE CITED

Banerjee G.C., 2005, A Textbook of Animal Husbandry. 8th edition, Oxford and IBH publishers, New Delhi.

Brien, B., J. Connel and W. Meaney, 1998, Effect of milking intervalon milk yield, composition and quality. Farm and Food 8(1); 28-30.

Bruckmaier, R.M and M. Hilger, 2000, Milk ejection dairy cows at different degrees of udder filling. J. Dairy Res. 68: 369-376.

Delamaire, E. and J. Ginard-Flament, 2006, Increasing milking intervals decrease the mammary blood flow and mammary uptake of nutrients in dairy cows. J. Dairy Sci. 89: 3439-3446.

Fernando and Sphar, 1983, Milk composition is different at various interval after the last milking. J. Dairy Sci. 66: 1155.

Stelwagen, K. and Lacey-Hulbert, 1966, Intermilking period effect the milk quality J. Dairy Sci. 77: 301-402.

Stelwagen, K., V.C. Farr, H.A. McFadden and S.R Davis, 1997, Time course of milk accumulation induced opening of mammary tight junction and blood clearance of milk components. Anim. J.. Physiol 273: 379-386.

Wheelock, J. V, J.A.F. Rook and F.H. Dodd, 1966, The effect of varying interval between milking on milk secretion rate. J. Dairy Res. 33- 161.

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Mode of Feeding Adopted by Crossbred Cattle Owners of Akola District

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ABSTRACT

Total 135 crossbred cattle owners were randomely selected from landless, marginal, small, medium and large categories of Akola district. Out of the five category, majority of farmers fed home grown by products and agrucultural residues like jowar kadbi, wheat straw etc. and 77.04 per cent farmers leave their cows for grazing and only 22.96 per cent were practiced stall feeding. About 88.89 per cent fed roughages after chaffing with 1-2 kg. homemade concentrate mixture. Concentrate feeding was also more in medium category crossbred cattle owners. Majority of crossbred cattle owners used home made concentrate and jowar straw under roughages.

Crossbreeding has been widely accepted and is being, followed for the improvement of dairy cattle all over the country. The crossbred cows can produce 3-4 time more milk as compared to local cows (Parmar and Gill, 1988). As a thumb rule, for the sake of economy, feeding of green fodder to the crossbred at the level of 1/10 of their body weight along with concentrate mixture is recommended. To produce a balanced ration to crossbred cattle it becomes necessary to ascertain their nutritional requirement, for productive as well as reproductive prupose. Feeding standard have not been adequetty established for crossbreds of exotic and Indian cattle (Malik *et al.*, 1991). Keeping these view in mind, present research paper focused on mode of feeding adopted by crossbred cattle owners of Akola district to provide valuable information regarding adoption of feeding practice by dairy farmers.

MATERIAL AND METHODS

To asses the mode of feeding by crossbred cattle owners of Akola district, randomely three Tahsils namely, Akola, Murtizapur and Akot were selected. In each Tahsil a cluster of three villages was selected. Total 135 crossbred cattle owners were randomely selected from landless, marginal, small, medium and large categories and contacted for collecting data personally through pretested questionaires. For assesing the mode of feeding the date collected on type of ration, type dry fodder, type of green fodder, type of feeding practices,processing of dry fodder, processing of concentrates and feeding of additive etc. was utilized.

The feeding practices, followed by Crossbred Cattle owners were compared with recommended feeding practices. The data analysed statistically as per the method suggested by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

The results on mode of feeding adopted by the crossbred cattle owners are presented in Table 1 indicated that maximum number of cattle owner and concentrate. Whereas, only 30-22 per cent of crossbred cows were reared by the farmers on dry roughages plus occasional supply of green fodder. Majority of the crossbred cattle owners were feeding roughages consisting Jowar Kadbi+Wheat straw to their livestock. The results on feeding practices adopted are in conformity with Agrawal *et al.* (1989).

Table 1 also revealed that 70.37 per cent farmers formulated ration comprising of dry fodder and concentrate and green grams during a rainy season for 69.78 per cent of the cross bred cows. Whereas, only 30.22 per cent of cows were reared by the farmers only on dry roughages plus occasional supply of green grasses available during rainy season. Thus a substantial number of cows were deprived from concentrates.

As far as feeding practices are concerned majority of owner (77.04%) followed grazing + stall feedidng and about 75.82 per cent cows were rearted under this practices. These result are in agreement with Tayappa and Setty (1978) while stall feeding was practiced by 22.96 per cent farmers covering 20 per cent cows.

With regards to mode of feeding, it was further noticed that maximum per cent of crossbred Cattle owners fed chaffing of dry fodder, where as chaffing with salt sprinkling was practiced by 11.11 per cent. The practice

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Table 1 : Mode of feeding adopted by crossbred cattle owners

Mode of Feeding	No. of farmer	No. of cows
Type of ration		
Roughages+Concentrates	90(70.37)*	127(69.78)
Roughages	45(29.63)	55(30.22)
Total	135(100.00)	182(100.00)
Type of dry fodder		
Kadbi	102(75.56)	134(73.63)
Kadbi+Wheat straw etc.	33(24.44)	48(26.37)
Total	135(100.00)	182(100.00)
Type of green fodder		
Green grass	135(100.00)	182(100.00)
Total	135(100.00)	182(100.00)
Type of feeding practices		
Stall feeding	31(22.96)	44(24.18)
Grazing+stall feeding	104(77.04)	138(75.82)
Total	135(100.00)	182(100.00)
Processing of dry fooder		
Chaffing	120(88.89)	158(86.81)
Chaffing with saltSprinkliing	15(11.11)	24(13.19)
Total	135(100.00)	182(100.00)
Processing of concentrates		
Without soaking	110(81.84)	150(82.42)
Soaking	25(18.52)	32(17.58)
Total	135(100.00)	182(100.00)
Feeding of additives, supplement		
Common salt	84(62.22)	23(67.58)
No supplement	42(31.11)	43(23.62)
Supplement	9(06.67)	16(8.79)
Total	135(100.00)	182(100.00)

*Figure in parentheses indicating percentage to the total

of soaking concentrate followed by 18.52 per cent fed. It is also noticed that 31.11 per cent owners were not aware of the use of supplement in the ration. The common salt was used feeding is very minor quantity per day to Crossbred Cattle. Most of the cattle owners were not aware of the use of mineral mixture in the daily ration of the animal. These results are in agreement with Gupta and Arneja (1981). Majority of the crossbred cattle owners were using homemade mixture in the concentrates and Jowar straw under roughages.

LITERATURE CITED

Agrawal, S.B., R.K. Patel and K.N.S. Sharma (1989):Estimation of Dairy milk yield of bovines and their feed availability in rural area of Karnal, Indian J. Anim. Res. 2:67-71

Gupta, A.K. and C.S. Arneja (1981): Animal Husbandry practices practiced by farmers, Livestock Adviser 6(3):24-26.

Malik, R., R.P. Gupta and M.S. Malik, 1991. Effect of feeding different nutrients density rations on the growth parameters of crossbred heifers, Indian J. Dairy Sci., 44(1):20-23

Parmar, O.S. and G.S. Gill, 1998. Impact of crossbreeding dairy cattle on increased milk production in the Punjab State. Livestock Adviser. 13(5).

Panse, V.G. and P.V. Sukhatme, 1967. Statistical methods for Agricultural workers, II[nd] Ed. ICAR, New Delhi

Tayappa, S .T. and S.V.S. Setty, 1978. A study of crossbred dairy cattle management practices adopted by the dairy farmers around Banglore, Indian Dairyman. 28 : 613-616

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Quality and Yield Parameters of Marigold as Influenced by Integrated Nutrient Management

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ABSTRACT

An experiment on effect of integrated nutrient management on flower quality and yield of marigold revealed that, an application of 70 per cent RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1} was found to be superior by recording significantly maximum number of flowers $plant^{-1}$, yield of flowers $plant^{-1}$ and yield $hectare^{-1}$. Also, the quality parameters like length of flower stalk, longevity and diameter of flowers were also significantly and positively influenced by the same treatment.

Marigold flowers have special importance during festival days especially on *Diwali* and *Dashehara*. There is a constant demand for flowers throughout the year for various functions, festivals, marriages and floral decorations. For the production of economical yield of better quality marigold flowers, it is necessary to adopt a proper agrotechnique by applying important nutrients containing an organic manure and biofertilizers. In India, an area under the commercial cultivation of flowers during the year 2004-2005 was about 88,600 ha with the annual production of 5.09 lakh tonnes of flowers. Likewise, in Maharashtra, the area under commercial flower crops was about 9600 ha with the production of 52160 tonnes of flowers (Anonymous, 2004).

By using bioinoculants like *Azospirillum* and phosphorous solublizing bacteria the cost of cultivation can be reduced to some extent. In modern agriculture, the use of chemical fertilizers is an essential ingredient for keeping sustainability of yield, but it poses problems to soil health in long span of time. Therefore, it is necessary to restrict the use of chemical fertilizers to certain limit. The current trend is to explore the possibility of supplementing chemical fertilizers with organic fertilizers especially with biofertilizers of microbial origin alone or in combination with limited use of chemical fertilizers. Presently, very scanty information is available on reduced doses of chemical fertilizers in combination with biofertilizers. Hence, keeping these views in mind, a field experiment was undertaken on effect of integrated nutrient management on flower quality and yield of marigold.

MATERIAL AND METHODS

A field experiment was conducted in *Kharif* season during the year 2005-2006 at the farm of Horticulture Section, College of Agriculture, Nagpur. The experiment was laid out in Randomized Block Design (RBD) with ten treatments and three replications. Seeds of marigold variety 'African double orange' were made available from Pocha Seeds Company, Pune. The seeds were sown on raised beds on 7th June, 2005 and the uniform sized and healthy seedlings were transplanted on 7th July, 2005. The treatment details are given in Table 1. Observations were recorded on quality and yield of marigold, as below.

Flowering

The first flower bud appearance on each plant was noted immediately after the minute flower bud was visible to the naked eyes after transplanting. Days required for emergence of flower bud from transplanting date were recorded and the days required were averaged. The flower buds were observed for their opening and the days required from flower bud appearance to flower bud opening were calculated and the mean values were worked out. The longevity of flowers in days was recorded till the petals showed wilting symptoms. Days required from flower bud opening to the wilting of flower petals were considered as longevity of flowers and the mean values of longevity period were averaged.

Flower quality

On 60th day of crop growth, the diameter of fully opened flowers was measured in centimeters on two perpendicular axes and mean values were worked out. Similarly, on the same day of observation, the length of flower stalk was also measured in centimeters from the point of it's origin to the neck of flower and an averaged values were computed.

Flower yield

The fully opened flowers were harvested at each picking. The total number of flowers per plant was

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counted and the values were averaged. The weight of fresh flowers per plant picked at each harvest was recorded in grams and the total yield of flowers obtained plant^{-1} from six pickings was calculated. The weight of fresh flowers obtained from six pickings in each net plot treatment was added and thus the total yield plot^{-1} was worked out. The total yield obtained treatment wise in net plot was multiplied with hectare factor and the yield of flowers in tonnes hectare^{-1} was computed.

Statistical analysis

The data obtained on various characteristics were analysed by analysis of variance procedure (Gomez and Gomez, 1984). The appropriate standard error of mean S.E. (m) and the critical difference (C.D.) were calculated at 5 per cent level of probability.

RESULTS AND DISCUSSION

Flowering

An early flower bud emergence (35.26 days) was observed in the treatment T_2 and it was at par with the treatment T_1 (36.20 days), both the treatments being significantly superior over rest of the treatments. However, maximum period (44.13 days) was recorded in the treatment T_{10} and it was at par with the treatment T_9 (43.40 days). Whereas, the treatments T_5 (37.00 days) and T_8 (42.40 days) took the medium period for producing the first flower bud after transplanting. The days required for opening of flower bud from bud emergence were found to be significantly influenced due to different treatments. The treatment T_2- 70 per cent RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1} had recorded significantly minimum period (42.46 days) for opening of the flowers. While, significantly maximum period (50.46 days) was recorded in the treatment T_{10}- dung slurry 1400 liters + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1} (Table 1).

This might be due to the reason that the treatment plots receiving an adequate supply of nutrients showed an increase in vegetative growth in early stages and ultimately might have given rise to an early opening of flower buds from flower bud emergence. The results conformed the findings of Chadha *et al.* (1998) in marigold.

The data regarding longevity of intact flowers were found to be the significant. Maximum longevity (18.13 days) was observed in the treatment T_2 and found to be significantly superior over all other treatments except the treatments T_1 (17.80 days) and T_5 (17.76 days). Next better treatments were T_6 (15.20 days), T_3 (15.03 days), T_7 (15.03 days), T_4 (14.60 days) and T_8 (12.23 days), in that order. An increase in longevity period of flowers might be due to the reason that, an application of adequate nutrients might have been resulted into increase in vegetative growth in early stage before reproductive phase and later on, the plants might have transferred their nutritive energy for longer retention of flowers. Similar type of results was also reported by Sehrawat *et al.* (2003).

Table 1: Effect of integrated nutrient management on flowering of marigold

Treatment	Flowering of marigold		
	Days required for emergence of first flower bud after	Days required for opening of flower bud from bud	Longevity of transplanting emergence flower (days)
T_1 - RDF (100 kg N, 50 kg P_2O_5 and 25 kg K_2O ha^{-1})	36.20	42.66	17.80
T_2 - 70% RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	35.26	42.46	18.13
T_3 - 50% RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	41.80	47.93	15.03
T_4 - 30% RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	41.80	48.66	14.60
T_5 - Vermicompost 6 t ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	37.00	43.73	17.76
T_6 - Vermicompost 5 t ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	39.93	46.73	15.20
T_7 - Vermicompost 4 t ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	41.33	47.80	15.03
T_8 - Dung slurry 2000 lit. ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	42.40	48.73	12.23
T_9 - Dung slurry 1700 lit. ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	43.40	48.80	10.36
T_{10}- Dung slurry 1400 lit. ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	44.13	50.46	9.03
S.E. (m)±	0.491	0.210	0.333
C.D. at 5%	1.457	0.623	0.623

Flower Quality

Regarding the diameter of marigold flowers, significantly maximum diameter of flower (7.54 cm) was produced under the treatment T_2 which was significantly superior over rest of the treatments except the treatment T_1 (7.29 cm). However, the treatment T_{10} had shown significantly least diameter of fully opened flower (6.51 cm) and was at par with the treatments T_9 (6.60 cm), T_8 (6.62 cm), T_4 (6.65 cm), T_3 (6.67 cm), T_7 (6.76 cm) and T_6 (6.80 cm). An application of adequate nutrients, particularly the nitrogen might have stimulated the cell division and cell elongation which would have been resulted into an increase in diameter of flowers. These observations are in agreement with the findings of Belorkar *et al.*, (1992) in marigold.

The data on length of flower stalk showed that, significantly maximum length of flower stalk (8.75 cm) was observed in the plants receiving 70 per cent RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1} (T_2). Whereas, minimum length of flower stalk (7.77 cm) was recorded with the plants getting dung slurry 1400 liters + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1} (T_{10}). This might be due to an adequate availability of nutrients to the plants which might have increased the vegetative growth and it would have been reflected in production of more stalk length of flowers. These results are in accordance with the findings of Hameed and Sekar (1998) in marigold.

Regarding the number of flowers per plant, data in Table 2 revealed that, the treatment T_2- 70 per cent RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1} had produced significantly maximum number of flowers (46.00) per plant. While, other treatments found next in order in this regard were T_1 (40.00), T_5 (39.00), T_7 (32.00), T_6 (31.00), T_3 (29.66) and T_4 (27.33). However, significantly minimum number of flowers per plant (25.33) was observed with the treatment T_{10} and it was at par with the treatments T_9 (26.33) and T_8 (27.00). It is reveled from the data that the number of flowers recorded was more in the treatment, where an application of 70 per cent N, P_2O_5 and K_2O along with biofertilizers was done. This increase in number of flowers might be due to proper boosting of plants with an adequate application of nutrients.

An increase in vegetative growth of plants might be responsible for an increased reproductive growth of plants; and thus, it would have been helpful in increasing the production of more flowers per plant. The results are conformed by the reports of Anuradha *et al.* (1988) in marigold.

Flower Yield

Per plant yield of marigold flowers was influenced significantly by different nutrient treatments. Significantly maximum yield of flowers plant^{-1} (224.56 g) was harvested from the treatment T_2 over all other treatments and it was followed by the treatments T_1 (211.12 g), T_5 (209.44 g) and T_6 (204.88 g). However, significantly minimum plant^{-1} yield of flowers (178.25 g) was recorded in the treatment T_{10} and it was followed by the treatment T_9 (184.24 g).

An increase in yield might be due to the better growth observed with an application of higher levels of

Table 2: Effect of integrated nutrient management on quality parameters of marigold flowers

Treatment	Quality parameters of marigold flowers		
	Diameter of fully opened flower (cm)	Length of flower stalk (cm)	No. of flowers plant^{-1}
T_1 - RDF (100 kg N, 50 kg P_2O_5 and 25 kg K_2O ha^{-1})	7.29	8.52	40.00
T_2 - 70% RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	7.54	8.75	46.00
T_3 - 50% RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	6.67	7.83	29.66
T_4 - 30% RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	6.65	7.79	27.33
T_5 - Vermicompost 6 t ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	7.03	8.39	39.00
T_6 - Vermicompost 5 t ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	6.80	8.14	31.00
T_7 - Vermicompost 4 t ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	6.76	8.30	32.00
T_8 - Dung slurry 2000 litres ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	6.62	7.97	27.00
T_9 - Dung slurry 1700 litres ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	6.60	7.80	26.33
T_{10}- Dung slurry 1400 litres ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	6.51	7.77	25.33
S.E. (m)±	0.118	0.057	0.635
C.D. at 5%	0.348	0.171	1.885

Table 3: Effect of integrated nutrient management on yield parameters of marigold flowers

Treatment	Yield parameters of marigold flowers		
	Yield of flowers plant^{-1} (g)	Yield of flowers plot^{-1} (kg)	Yield of flowers per ha (t)
T_1 - RDF (100 kg N, 50 kg P_2O_5 and 25 kg K_2O ha^{-1})	211.12	4.63	10.71
T_2 - 70% RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	224.56	5.19	12.01
T_3 - 50% RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	119.84	4.16	9.62
T_4 - 30% RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	196.00	4.01	9.28
T_5 - Vermicompost 6 t ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	209.44	4.56	10.55
T_6 - Vermicompost 5 t ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	204.88	4.37	10.11
T_7 - Vermicompost 4 t ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	196.24	4.29	9.93
T_8 - Dung slurry 2000 litres ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	188.32	3.88	8.98
T_9 - Dung slurry 1700 litres ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	184.24	3.79	8.77
T_{10}- Dung slurry 1400 litres ha^{-1} + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1}	178.25	3.51	8.12
S.E. (m)±	0.175	0.094	0.115
C.D. at 5%	0.518	0.279	0.340

nutrient. Thus, the maximum height of plant, spread of plant and number of branches plant^{-1} would have produced more number of flowers plant^{-1} due to more number of nodes, internodes and apical buds available plant^{-1} for producing more number of flower buds. An increase in yield plant^{-1} with an application of increased doses of nitrogen has also been reported by Bhavanisanker and Vanangamudi (1999) and Sehrawat *et al.* (2003).

Yield plot^{-1} of marigold flowers was increased with an application of increased levels of nutrients through integrated nutrient management (Table 3). Similar trend was observed in case of per plot and per hectare yield of marigold flowers in which the treatment of 70 per cent RDF + *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1} (T_2) had produced significantly maximum flowers yield (5.19 kg plot^{-1}, 12.01 t ha^{-1}) per plot than all the treatments. Similar findings were recorded by Chandrikapure *et al.* (1999), Ravindran *et al.* (1986) and Anuradha *et al.* (1988) in marigold.

LITERATURE CITED

Anonymous 2004. Indian Horticulture database

Anuradha, K.; K. Pampapathy and N. Narayana, 1988. Effect of N and P_2O_5 on the nutrient composition and uptake by marigold (*Tagetes erecta* L.). South Indian Hort., 36(4) : 209-211.

Belorkar, P. V.; B. N. Patil; V. J. Golliwar and A. J. Kothare, 1992. Effect of nitrogen levels and spacings on growth, flowering and yield of African marigold (*Tagetes erecta* L.), J. Soils and Crops, 2(1): 62.

Bhavanisanker, K. and K. Vanangamudi, 1999. Integrated nutrient management in gundumalli (*Jasminum sambac* L.) South Indian Hort., 47 (1-6): 111-114

Chadha, A. P. S.; S. V. S. Rathore and R. K. Ganeshe, 1998. Influence of N and P fertilization and ascorbic acid on growth & flowering of African marigold (*Tagetes erecta* L.), South Indian Hort., 47(1-6) : 342-344.

Chandrikapure, K. R.; K. T. Sadawarte; D. M. Panchabhai and B. D. Shelke, 1999. Effect of bioinoculants and graded doses of nitrogen on growth and flower yield of marigold (*Tagetes erecta* L.), The Orissa J. Hort., 27 (2) : 31-34

Gomez, K.A. and A. A. Gomez, 1984. Statistical procedures for agriculture research, 2nd Ed. Singapore, A Wiley-International Publication.: 20 – 25

Hameed Shahul A. and K. Sekar, 1998. Effect of graded levels of nitrogen and phosphorus on yield and quality of African marigold (*Tagetes erecta* L.), South Indian Hort., 47 (1-6): 339-341

Ravindran, D. V. L.; R. Ramarao and E. Nagabushanam Reddy 1986. Effect of spacing and nitrogen levels on growth, flowering and yield of African marigold (*Tagetes erecta* L.) South Indian Hort.,34(5):314-319.

Sehrawat, S. K. ; D. S. Dahiya; Sukhbir Singh and G. S. Rana, 2003. Effect of Nitrogen and pinching on growth, flowering and yield of marigold (*Tagetes erecta* L.) cv. African giant double Orange, Haryana J. Hort. Sci., 32 (1 & 2) : 59-61

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Effect of Meteorological Parameters on Evaporation from Small Reservoirs in Anand Sagar, Shegaon

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ABSTRACT

Sizable quantities of water are lost by evaporation from storage reservoirs. Effect of various meteorological parameters on the pan evaporation to predict evaporation from Anand Sagar reservoir have been evaluated using collected data at Manasgaon fully climatic station under hydrology project (Government of Maharashtra). Correlation and simple linear regression analysis were used to study the influence of individual meteorological parameters on evaporation. The highest values of correlation coefficients were obtained for evaporation with air temperature, while lowest values for correlation coefficients were found for evaporation with bright sunshine hours. Influence of relative humidity on evaporation was found to be negative and the effect of wind speed on evaporation was found to be positive.

Evaporation tends to be a silent, almost unnoticed component of the hydrologic cycle. It is the process of transforming liquid water into vapor and transferring it from the ground to the air (Doorenbos and Pruitt, 1977). The process occurs in two ways, evaporation and transpiration collectively known as evapotranspiration (ET). Evaporation from free water surfaces is of great importance in hydrometerological studies. The essential requirement in the evaporation process is the energy for vaporization and removal of water vapor from evaporating surface (Bhakar, 2004).This energy is provided by various meteorological parameters namely solar radiation, air temperature, air humidity and wind speed.

Small reservoir storage is an ideal from the standpoint of operational efficiency, but generally less effective than ground water or large dams for water conservation because the high surface area to volume ratio of small reservoir leads to high evaporation losses (Gleick, 1993 and Sakthivadivel *et al.*, 1997). The standard definition of small dams is a structure less than 15 meters high and with an embankment volume generally less than 0.75 million cubic meters (BOR, 1987 and ICOLD, 1998). Small reservoirs often serve multiple uses such as bathing, washing, animal husbandry, and aquaculture in addition to irrigation. With the rapid increase in the developmental activities of the country, the need for conservation of stored water is keenly felt. The huge cost at which the storage reservoirs are built calls for minimizing evaporation to the maximum extent possible. It is assumed that one half of the water stored in small reservoir throughout the year is lost by direct evaporation. For convenience the study is restricted to evaporation from water bodies. In the present study a small reservoir at "Anand Sagar" a recreational park constructed by Shri. Sant Gajanan Maharaja Sansthan, Shegaon in Buldana district of Maharashtra State has been selected. The authorities are facing acute shortage of water during summer in spite of storing about 0.41 mm^3 of water in the reservoir. Along with the seepage, evaporation is also a major factor that contributes to these losses. The study is confined to the influence of various meteorological parameters on the evaporation in the reservoir (Fig.1).

The study was conducted at "Anand Sagar", Shegaon with the help of meteorological parameters from Manasgaon. The particulars of these two locations are given in the Table 1.

Table 1. : Location of the study area

Particulars	Shegaon*	Mansgaon*
District	Buldana	Buldana
Tahasil	Shegaon	Shegaon
Latitude	20046'00"	20054'45"
Longitude	76041'30"	76041'27"
Altitude	271.20 m	250.00m.
Rainfall	700.00 (9 yrs. WRD)	737.00 mm. (15 yrs)

Collection of Evaporation and Meteorological data

The data of pan evaporation, air temperature, relative humidity, and wind speed and sun shine hours was collected from meteorological station under Hydrology Project (Water Resources Division, Amravati)

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at Manasgaon. Meteorological data for a period of fifteen years (1990-2004) was used for the study.

The Pan Evaporameter observations were taken with the standard class A pan (modified) covered with wire mesh, conforming I.S.:5973-1970. (Specifications for Pan Evaporameters). The pan rests on a white painted wooden grill about 100 mm above the ground.

Air temperature data was obtained from maximum and minimum thermometers housed in a Stevenson Screen conforming to I.S.5948-1970. Thermo-hygrograph (I.S.5901 & 5900-1970) and dry and wet bulb thermometers located in Stevenson Screen were used to provide relative humidity values. Wind speed is measured by cup cone anemometer. The anemometer conforming to I.S.5912-1970 is installed at 3.00 m. height above the ground. Bright sunshine hours are measured with the help of Campbell Stokes sun shine recorder conforming I.S.7243-1974. The sunshine recorder is positioned over a brick pillar at a height of 3m.above the ground and at such a place where there is no obstruction to the sunrays at any time of the day during the whole year.

A pan evaporameter and a standard rain gauge were installed at Anand Sagar, the location under study. However, the data available is limited to the period of only one year. The data for other meteorological parameters like wind speed, sunshine hours, relative humidity and air temperatures is collected from a fully climatic station under hydrology project (Government of Maharashtra) at Manasgaon about 9 Km. from Shegaon. The minimum evaporation network requirement (recommended by WMO, 1983) is one observatory per 50000 Sq.km. In view of the larger variability of the weather systems in the tropical regions, IMD recommends a density of one station per 5000 Sq.km. (Design Manual, Hydro-meteorology). As a cross check the averaged evaporation data for fifteen years (1990-2004) from Manasgaon is compared with that collected at Shegaon for one year 2004-05 are found to be in resemblance.

RESULTS AND DISCUSSION

Variation of Climatic Parameters with respect to time.

The methods for calculating evapotranspiration from meteorological data require various climatologically and physical parameters. Some of the data are measured directly in weather stations. Other parameters are related to commonly measured data and can be derived with the help of a direct or empirical relationship. There are numerous empirical methods for estimating ET (Thornthwaite, 1948). The more physically-based ones are essentially combination models, since they combine the aerodynamic approach to estimating sensible heat flux with the energy balance equation to calculate ET as the residual.

Pan Evaporation

The variations of pan evaporation data from class A pan (modified) are depicted in fig.1 which shows that the maximum evaporation of 21.57 mm day^{-1} occurs during May and minimum evaporation of 1.06 mm occurs during August. The average annual evaporation rate was found to be 7.60 mm day^{-1}. It is evident from fig 1 that there is considerable variation from the average value of pan evaporation.

Air Temperature

Figure 2 shows the variations in maximum, minimum and mean air temperatures with respect to time. The mean air temperature data was obtained by averaging the maximum and minimum values. It is evident from figure 2 that the maximum air temperature of 43.5°C occurs during May and minimum temperature of 9.4°C occurs during December. The average annual air temperature was found to be 27.1°C

Relative Humidity

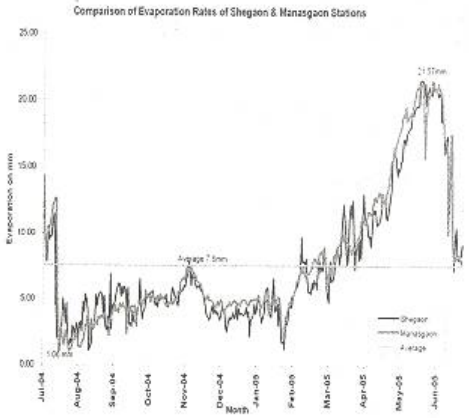
Maximum, minimum and mean values of relative humidity are depicted in fig.3. The maximum relative humidity of 93.32 percent occurs during August and minimum relative humidity of 25.27 per cent occurs during May. The average annual value of relative humidity was found to be 62.67 percent.

Wind Speed

As the anemometer is installed at the height of 3.00 m. above the ground, the wind speed values are measured at 3.00 m. However, as in most of the evaporation models, the wind speeds values are measured or estimated at 2.00 m. height are used. Therefore wind speed values measured at 3.00 m. height were converted to 2.00 m. height using the following equation (Allen *et al*, 1998):

Wind Speed

$$U_2 = U_3 = \frac{4.87}{\ln(67.8Z_3 - 5.42)}$$



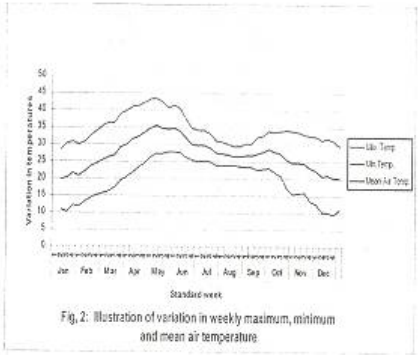


Fig. 2: Illustration of variation in weekly maximum, minimum and mean air temperature

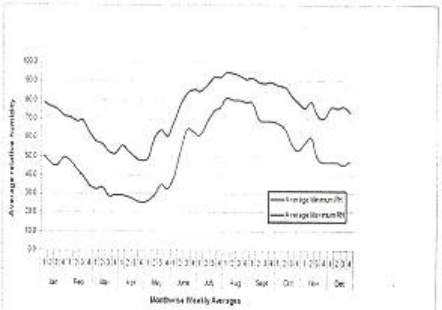


Fig. 3: Illustration of variation in weekly maximum and minimum relative humidity

Fig. 4: Illustration of Variation in weekly wind speed

Fig.5: Illustration of variation in weekly sunshine hours

Where, U_2 = estimated wind speed at 2.00 m. height above ground in m/sec;

U_3 = measured wind speed at 3.00 m. height above ground in m/sec;

Z_3 = Height of measurement above ground in meter.

The values of wind speed at 2.00 m. height are shown in figure 4. The maximum wind speed 10.21 m/sec.occurs during May and the minimum wind speed of 1.96 m. /sec. occurs during November. The average annual value of wind speed at 2m. height was found to be 5.19 m/sec.

Bright Sunshine Hours

The values of bright sunshine hours are plotted in fig.5. which shows a quite irregular trend with respect to time. The Maximum bright sunshine of 10.22 hours occurs during May. The minimum bright sunshine of 2.36 hours occurs during August, due to overcastting of sky during monsoon. From figure 5 it is evident that the bright sunshine hours increase from January to May. The average annual value of bright sunshine hours was obtained as 7.33.

Influence of Meteorological Parameters on Evaporation

In order to find the degree of association between evaporation values and the climatic parameters, the statistical approach of finding significance by evaluating correlation coefficient of respective parameters has been used. A linear regression analysis was done to establish a relation between weekly evaporation a climatic parameters. The weekly average data of air temperature (T), relative humidity (RH), wind speed at 2.00m.height (U_2), and sunshine hours (S) were used to obtain the relationship of evaporation with these factors.

Correlation coefficients and standard errors of liner regression equations showing the relationship of evaporation (E_p) with air temperature (T), relative humidity (RH), wind speed (U2) and sunshine hours (S) are given in Table 2. The best fit is considered to be the one in which there is a highest correlation coefficient. The level of significance was tested using the t-test. It is evident that the highest value of correlation coefficient exists for evaporation and air temperature, while the lowest correlation coefficient was obtained for evaporation and sunshine hours. The study shows a negative correlation between evaporation and relative humidity. Similar results were also obtained by Singh *et al.*,1981, Senapati *et. al.*,1985 and Chandra *et al.*,1988. Considering the results, it may be concluded that the climatic factors in general acted in concert, either having low or high correlation with evaporation.

Tasumi, 1999 have found that the seepage and percolation losses from small tanks in Sri Lanka account for 20 per cent of reservoir volume against 5 per cent of reservoir volume in large dams. In a study of Boreal lakes in Northwestern Ontario, Keller *et al.*, 1996 showed that from the 1970s to the 1990s, despite considerable interannual variability, there was an increase of air temperature (+1.6°C), a general decline in precipitation (~60percent of highest years), an increase in evaporation (~50percent) and an increase in annual solar radiation.

Considering the result, it may be concluded that air temperature was proved to be an important factor for influencing the evaporation. Influence of relative humidity on evaporation was found to be negative and effect of wind speed on evaporation was found to be positive. Bright sunshine hour does not appear to influence the evaporation significantly.The influence of climatic parameters on evaporation and agricultural crops based reference evapotranspiration (ETOA) was found to be identical.

LITERATURE CITED:

Allen, R.G., L. S. Pereira, D. Raes and M. Smith, 1998. Crop evapotranspiration-Guidelines for computing crop water requirements, FAO Irrigation and drainage Paper. 56, Rome, Italy:

Table 2. Correlation coefficient and standard errof of linear regression equations showing the relationship of evaporation with air temperature, relative humidity, wind speed and bright sunshine hours.

S.N.	Prediction Equipment	Correlation coefficient	Standard Error (mm day^{-1})
1.	Ep = -9.89 + 0.57 T	0.839	1.64
2.	Ep = 12.34 - 0.11 RH	-0.545	2.53
3.	Ep = 1.26 + 0.78 U2	0.717	2.10
4.	Ep = 2.20 + 0.46 S	0.365	2.81

Ep = Evaporation in mm day^{-1}
T = Temperaturein °C
RH = Relative Humidity in per cent
U_2 = Wind Speed at 2m height in mm^{-1}
S = Duration of Bright Sunshine hours

Food and Agriculture Organization of the United Nations ISBN 92-5-104219-5.

Bhakar, S.R. 2004. Effect of climatic parameters on on evaporation and evapotranspiration. Journal of Indian Water Resources Society, 24(1),12-18.

BOR. 1987. Design of small dams. Denver, CO, USA: Bureau of Reclamation, United States Department of Interior.

Chandra, A., V.J. Shrikhande and R. Kulshreshtha.1988. Relationship of Pan Evaporation with meteorological parameters. Journal of Indian Water Resources Society, 8(2), 41-44.

Doorenbos, J. and Pruitt, W.O. 1977. Guidelines for predicting crop water requirement, FAO irrigation and drainage paper no. 24, FAO, Rome, Italy., pp. 156.

Gleick, P. 1993. Water in crisis: A guide to the world's fresh water resources. Oxford, England: Oxford University Press.

ICOLD.1998. Position paper on dams and environment, at http://genepi.louis-jean.com /cigb/ chartean.html.International Commission on Large Dams.

Keller, A., J. Keller and D. Seckler. 1996. Integrated water resource systems: Theory and policy implications. IWMI Research Report 3. Colombo, Sri Lanka: International Water Management Institute.

Sakthivadivel, R., N. Fernando and J. Brewer, 1997. Rehabilitation planning for small tanks in cascades: A methodology based on rapid assessment. IWMI Research Report 13. Colombo, Sri Lanka: International Water Management Institute.

Senapati, P.C., N. Mishra and R. Lal, 1985. Relationship between pan evaporation and meteorological parameters, Bhubneswar (Orissa). Journal of Indian Water Resources Society, 5, 27-32.

Singh, R.V., H.S. Chauhan and A.B.M. Ali, 1981. "Pan evaporation as related to meteorological parameters," J. Agril. Engg, 18(1), 48-53.

Tasumi, M. 1999. Water balance and return flow in reservoir cascade irrigation system of Sri Lanka. Submitted to Department of Agriculture, Grad. School of Tottori University, Tottori, Japan.

Thornthwaite, C.W. 1948. An approach toward a rational classification of climate. Geograph. Rev., 38. : 55.

WMO, 1983. Guide to meteorological Instruments and observing practices. WMO n'8 (fifth edition), Geneva.

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RESEARCH NOTE

Sustaining Wheat Productivity Through Integrated Nutrient Management

Nutrient supply is a key factor in increasing productivity of wheat but escalation in the prices of fertilizers and in spite of heavy inputs the crop yields are declining, which leads to give a greater emphasis on supplementing the chemical fertilizers with low priced sources of nutrient such as organics and biofertilizers which sustain the soil health for longer period (Gawai and Pawar, 2006). Therefore, the present study was undertaken to find out efficient combination of organic and inorganic fertilizers under irrigated condition.

A field experiment was carried out at Central Demonstration Farm, Wani Rambhapur, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Rabi* 2005-06 in a randomised block design with eleven treatments replicated three times .The experiment was laid down in clayey soil (Typic Usoochrepts) having pH 8.12 , EC 0.52 dSm^{-1} , Available nitrogen 234.00 kg ha^{-1}, available phosphorus 11.00 kg ha^{-1}, and available potassium 613.00kg ha^{-1}. The treatments consisted of T_1- Absolute control, T_2 - 100 per cent recommended dose of fertilizer (RDF) i.e. 120:60:60 kg N, P_2O_5 and K_2O ha^{-1}, T_3- Biofertilizer inoculation i.e. Azotobacter + phosphate solubilizing bacteria (PSB), T_4- 75 per cent RDF + 25 per cent N through soybean straw (SS) @ 4.54 t ha^{-1}, T_5 - 75 per cent RDF + 25 per cent N through soybean straw @ 4.54 t ha^{-1} + seed inoculation with Azotobacter + PSB, T_6 – 75 per cent RDF + 25 per cent N through vermicompost (VC) @ 1.97 t ha^{-1}, T_7 – 75per cent RDF + 25 per cent N through vermicompost @ 1.97 t ha^{-1} + seed inoculation with Azatobacter + PSB, T_8 – 50 per cent RDF + 50 per cent N through soybean straw @ 9.09 t ha^{-1}, T_9 – 50 per cent RDF + 50 per cent N through soybean straw @ 9.09 t ha^{-1} + seed inoculation with Azotobacter + PSB, T_{10} – 50 per cent RDF + 50 per cent N through vermicompost @ 3.94 t ha^{-1}, T_{11} – 50 per cent RDF + 50 per cent N through vermicompost (VC) @ 3.94 t ha^{-1} + seed inoculation with Azotobacter + PSB. 50 and 25 per cent N through 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 per kg seed before sowing. To obtain protein content in grain, nitrogen determined by Kjeldhal's method (as described by Jackson , 1967) was multiplied with the factor 5.70.

Table 1. Growth, yield, uptake of nutrients and protein content as influenced by different treatments

Treatments	Plant height (cm)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Nitrogen uptake (kg ha^{-1})	Phosphorus uptake (kg ha^{-1})	Potassium uptake (kg ha^{-1})	Protein (%)
T_1	68.33	12.22	17.84	24.42	4.46	10.90	9.36
T_2	85.33	29.78	42.28	92.93	24.63	48.14	13.24
T_3	72.67	16.48	23.56	34.10	6.78	14.54	9.76
T_4	77.67	23.99	34.54	58.67	14.33	32.05	11.00
T_5	80.67	25.19	36.27	70.31	17.93	34.70	11.80
T_6	81.00	27.04	38.66	77.27	20.15	38.49	12.25
T_7	83.33	28.15	39.49	86.12	22.10	43.49	12.46
T_8	75.00	22.41	32.71	49.64	11.67	22.37	10.35
T_9	76.67	23.15	34.08	59.01	13.04	28.07	10.85
T_{10}	78.33	24.25	34.92	61.58	15.35	27.83	11.40
T_{11}	80.00	25.09	35.76	68.14	17.15	33.81	11.95
SE(m)±	1.35	1.65	2.02	3.54	0.62	0.96	0.28
CD at 5%	3.96	4.65	5.69	9.94	1.76	2.71	0.79

Highest plant height was recorded with an application of 100 per cent RDF (T_2), followed by T_7 which was at par with T_2. These results are also in conformity with the results reported by Ingle *et al.*(2005).Grain and straw yields were significantly influenced by different treatments. The highest grain yield 29.78 q $ha^{-1}$was recorded in T_2 which was 143.69 per cent higher over control and was at par with T_5, T_6 and T_7, likewise the highest straw yield (42.28 q ha^{-1}) was noted in T_2. This was ascribed due to higher availability of nutrients through RDF ,vermicompost, soybean straw and biofertilizers. These results are in agreement with the earlier findings of Pathak *et al.*(2005).

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 highest protein content of 13.24 and 12.46 per cent were recorded in T_2 and T_7. Similar trend of effectiveness in protein content was reported by Singh and Pathak (2003).

LITERATURE CITED

Gawai, P.P. and V.S. Pawar, 2006. Integrated nutrient management in sorghum chickpea cropping sequence under irrigated conditions. *Indian J. Agron.*, 51(1):17-20.

Ingle, A.V.; D.K.Shelke.;V.D.Aghav and M.L.Karad 2005.Effect of irrigation schedule and nutrient management on growth and yield of wheat, J.Soil and Crop., 14 (2):275-282.

Jackson, M.L. 1967. Soil chemical analysis, Prentice Hall of India, Pvt. Ltd., Delhi.

Pathak , S.K.;S.B.Singh.;R.N.Zha and R.P.Sharma, 2005.Effect of nutrient management on nutrient uptake and change in soil fertility in maize-wheat cropping system, Indian J. Agron.50(4):225-226.

Piper, C.S. 1966. Soil and plant analysis, Int. Sci. Publishers, Univ. Adelaide. Australia Asian, Ed.

Singh ,R.N. and R.K. Pathak ,2003 . Response of wheat (Triticum aestivum). 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 .

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Long-Term Effect of Integrated Nutrient Management on Growth and Yields Under Sorghum - Wheat Cropping Sequence in Vertisol

Sorghum-wheat is one of the cropping sequence which is gaining popularity under intensive cultivation on Vertisol. Integrated plant nutrient is one of the key components of intensive agriculture. The cereal – cereal cropping sequence has high requirements for major nutrients and may adversely affect crop production on long run and hence, adequate nutrient management for this cropping sequence needs attention for sustainable soil productivity. Therefore, considering the significance of integrated use of plant nutrients in increasing their efficiencies and crop productivity, the present investigation was undertaken to study long-term effects of integrated nutrient management on growth and yields under sorghum – wheat cropping sequence in Vertisol.

The present investigation was superimposed during the year (2001-02 and 2002-03) on the old long-term fertilizer experiment started since 1988 at Central Research Station (CRS) Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. There were fourteen treatments replicated four times in Randomized Block Design which comprised of NPK levels with and with out FYM, sulphur and zinc.

The soil of the experimental site was Vertisol, containing montmorillonitic clay, with hyperthermic family of Typic Haplusterts. The soil was slightly alkaline in reaction, medium in organic carbon, very low in available nitrogen, low in total N and available phosphorus and high in available potassium.

The plant height of sorghum as well as wheat were significantly and progressively increased from 30 DAS to grain formation stage with the age of crop. Highest plant height was observed in the treatment of 100 per cent RD of NPK in combination with FYM at all the growth stages, followed by 150 per cent RD of NPK. Similar results were reported by Anabayan and Palaniappan (1991) and Dhonde *et al.* (2004).

Data on dry matter accumulation of sorghum and wheat at harvest stage, significantly increased with the treatments of fertilizer application. Similar to the trend of plant height dry matter production was significantly highest under the treatment 100 per cent RD of NPK + 10 t FYM ha^{-1}, followed by 150 per cent RD of NPK and 100 per cent RD of NPK + 20 kg Zn SO_4 in sorghum as well as wheat. Beneficial effect of inorganic fertilizers in combination with organic manures were also reported by Nagre *et al.* (1990) and Brechelt (1991).

The manuring and fertilization treatments significantly influenced grain and fodder / straw yields of sorghum and wheat (Table 1). Significantly highest grain and fodder/ straw yield of sorghum and wheat was recorded under the treatment 100 per cent RD of NPK + 10 t FYM ha^{-1}, followed by 150 per cent RD of NPK whereas lowest grain yield was recorded under control. Ravankar *et. al.* (1998) also reported the advantage of conjunctive use of FYM and NPK for achieving higher productivity.

Data indicated that integrated nutrient management with incorporation of NPK + FYM were found to be significantly superior over 100 per cent RD of NPK through inorganic fertilizers. Sulphur application enhanced sorghum and wheat yield significantly over control. The results showed that use of organic manure alone gave low yield than integrated use of FYM along with recommended dose of nutrient through inorganic fertilizers. According to Naphade *et. al.* (1995) the productivity of cereal-cereal cropping sequence could only be significantly increased with conjunctive use of NPK and FYM or organics.

LITERATURE CITED

Anabayan, K. and S. Palaniappan. 1991. Effect of application of coir compost, enriched FYM and hydrophilic polymer on soil moisture content, growth and yield of hybrid sorghum, J. Agron. and Crop Sci. 166(2) : 112-116.

Table 1. Effect of long-term fertilizer application on grain and fodder/straw yield (q ha^{-1}) under sorghum-wheat cropping sequence

Treatments		Grain		Fodder / straw	
		Sorghum	Wheat	Sorghum	Wheat
T_1	- Control	2.80	0.85	6.41	1.21
T_2	- 50 % RD NPK	17.26	8.76	39.9	12.64
T_3	- 75 % RD NPK	22.93	13.76	53.11	19.81
T_4	- 100 % RD NPK	30.54	25.29	70.58	36.62
T_5	- 150 % RD NPK	37.20	28.28	86.37	41.28
T_6	- 100 % RD NPK (-S)	29.12	23.55	64.05	33.85
T_7	- 100 % RD NPK + 10 kg S	30.67	25.79	71.62	36.71
T_8	- 100 % RD NPK + 47.5 kg S	33.06	26.72	75.83	38.12
T_9	- 100 % RD NPK + 10 kg $ZnSO_4$	33.53	26.14	77.57	37.81
T_{10}	- 100 % RD NPK + 20 kg $ZnSO_4$	33.57	26.87	78.36	37.38
T_{11}	- 100 % RD N	14.63	7.51	36.18	10.88
T_{12}	- 100 % RD NP	19.74	16.43	52.42	23.76
T_{13}	- 100% RD NPK + FYM 10 t ha^{-1} (*Kharif*)	39.35	30.75	91.32	44.61
T_{14}	- FYM 10 t ha^{-1} (*Kharif*)	7.17	2.08	16.53	3.00
	SE (m) ±	0.93	0.59	0.93	0.75
	CD at 5 %	2.59	1.64	2.60	2.10

Brechelt, A. 1991. Effect of various organic manures on the efficiency of Azospirillum Lipoferum, J. Agron. and Crop Sci. 166(3) : 162-168.

Dhonde, M. B., R. P. Andhale and S. H. Shinde. 2004. Effect of integrated nutrients management on growth and yield of sorghum (*Sorghum bicolor*), J. Maharashtra Agric. Univ. 29(2) : 130-132.

Nagare, K. T., R. P. Kokate and P. V. Thorve. 1990. Effect of nitrogen and azotobactor on dry matter production, concentration and uptake of nitrogen by sorghum, PKV Res. J. 14(2) : 188-190.

Naphade, K. T., V. N. Deshmukh, S. S. Rewatkar and G. H. Bade. 1995. Utilization of nutrients by sorghum – wheat cropping sequence on vertisol under varying nutrient management, J. Maharashtra Agric. Univ. 20(3) : 355-357.

Ravankar, H. N., K. T. Naphade, R. B. Puranik and R. T. Patil. 1998. Long-term changes in soil fertility status under sorghum – wheat sequence on vertisol. All India co-ordinated research project on long-term fertilizer experiment, IISS (Pub.) : 292-297 (Ed. Swarup, Reddy and Prasad).

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Plant Testing Kits Evaluation and Their Efficacy in Comparison to Standard Laboratory Analysis Under Experimental Condition with Rice as Test Crop

Rice is a major food crop in the world, cultivated on about 150.30 million hectares of land with total production of 563.18 million tonnes and average productivity of 3.74 t ha^{-1} (Anonymous, 1998). It is staple food crop of more than 60 per cent of world population. In India, rice is grown on 44.55 million hectares with annual production of 127.60 million tonnes and its average productivity is 2.96 tonnes ha^{-1} (Anonymous, 2000a). In Maharashtra, it is cultivated on an area of about 14.77 lakh. hectares with annual production of about 26.14 lakh tonnes (1998-1999) and its productivity is 1.63 t ha^{-1} (Anonymous, 2000b). The Konkan region is major rice growing tract of Maharashtra having 4.54 lakh hectares (about one third of land) under rice. The total annual rice production in the region is about 11.29 lakh tonnes with an average productivity of 2.48 t ha^{-1} (Anonymous, 1998-1999).

Rapid plant testing refers to the chemical test which can be made rapidly with low cost per determination in the field itself and the corrective measures in nutrient imbalances can be suggested on the spot. The laboratory analysis, though authentic, is time consuming and serves as a post mortem of the crop conditions.

Leaf is the principal site of plant metabolism, therefore changes in nutrient supply are reflected in the composition of index tissue. These changes are more pronounced at certain stages of plant growth and development and the leaf nutrient concentration at specific growth stages are related to crop performance. It is therefore, worthwhile to test the plant under field conditions to obtain certain data which may be useful in long run.

The present investigation entitled "Plant Testing Kits evaluation and their efficacy in comparison to standard laboratory analysis under experimental condition with rice as a test crop" a field experiment was conducted at the main farm of the department of Agronomy, College of Agriculture, Dapoli, Distt. Ratnagiri in year *Kharif* 2000-2001. The experiment was laid out in Factorial Randomised 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 P_2O_5 and low available K_2O. The kits for plant testing (P-tissue test, K-tissue test) under the field conditions were developed by preparing reagents required for these tests as described by Jackson (1967) and Gupta (1996).

The P-tissue test of 3rd leaf of rice plants as affected due to various fertilizer treatments have been presented in table 1. At 30 days after transplanting (DAT)

application of P_2O_5 increased significantly the P content of 3rd leaf (P-tissue test), whereas, at 60 DAT the N application affected it significantly. Burns and Hutsby (1984) reported a wide range of P concentration in plant sap from 0 to 160 mg mL^{-1}.

Data further reveled that P-tissue test values decreased with the age of the crop from 30 DAT to 60 DAT. This is probably due to the translocation of P from the vegetative to the reproductive organs. Dilution due to increase in growth and translocation due to the appearence of newer growth result in a decrease in the concentration of nutrients (Kanwar, 1976). Interaction effect of application of P_2O_5 and N fertilizers on P-tissue testing are presented in table 2. indicate the P-tissue test values at 30 and 60 DAT. Application of 50 kg P_2O_5 ha^{-1} was significantly superior over P_0 (0 kg P_2O_5 ha^{-1}) and P_1 level (25 kg P_2O_5 ha^{-1}). P_1 and P_2 were at par with each other. N application @ 100 kg ha^{-1} significantly increased the P-tissue test values over control. It can be concluded that tissue test analysis of 3rd leaf of rice indicated a significant increase in P concentration in cell sap due to the application of N and P_2O_5. While K_2O application and interaction between N x P, N x K, P x K, and N x P x K were observed to be non-significant.

The data presented in table 1 indicate the potassium concentration in 3rd leaf (K-tissue test) of rice plants at 30 and 60 DAT growth interval. The K-tissue test values were observed to be higher at 30 DAT than among different treatments Krishnamoorthy (1971) indicated 10,800 mg mL^{-1} to be the critical limit for rice based on the analysis of 3rd leaf.

Potassium concentration in plant sap reported by Burns and Hutsby (1984) ranged from 50 to 2000 mg mL^{-1} and 240 to 2000 mg mL^{-1}, in the sap of $Ca(NO_3)_2$ fed plants and (NH_4NO_3) fed plants, respectively.

The data revealed (Table 1) that the application of N, P_2O_5 and interaction effect of N x P, N x K, P x K and N x P x K was not significant at 30 and 60 DAT, whereas, the only effect of K_2O was observed to be significant in both the periods of observations. Significant effect of K_2O application at 30 and 60 DAT are presented in table 2.1. The maximum K content at 30 DAT and at 60 DAT was recorded due to K_2O application (50 kg K_2O ha^{-1}). Application of K_2O @ 50 kg ha^{-1} was found to be significantly superior over (0 and 25 kg K_2O ha^{-1}, respectively) at 60 DAT. It can be concluded that the tissue test of 3rd leaf of rice indicated significant increase in K-concentration in cell sap due to the application of K_2O. The application of other major nutrients *viz.*, N and P_2O_5 and their interaction were observed to be non-significant.

Table 1: Effect of application of fertilizers on tissue test (3rd leaf) of P and K (P-K tissue test) (mg mL^{-1}) in plant sample at 30 and 60 DAT

Treatments		P (mg mL^{-1})		K (mg mL^{-1})	
		30 DAT	60 DAT	30 DAT	60 DAT
T_1	$N_0P_0K_0$	237.05	182.35	2080	1560
T_2	$N_0P_0K_1$	291.76	218.82	3640	2600
T_3	$N_0P_0K_2$	237.05	182.35	4160	3640
T_4	$N_0P_1K_0$	309.99	218.82	3120	2080
T_5	$N_0P_1K_1$	401.17	237.05	4160	3640
T_6	$N_0P_1K_2$	455.87	237.05	4680	4160
T_7	$N_0P_2K_0$	510.58	237.05	3120	2600
T_8	$N_0P_2K_1$	309.99	200.58	3120	2600
T_9	$N_0P_2K_2$	455.87	237.05	4680	4160
T_{10}	$N_1P_0K_0$	309.99	237.05	3640	3120
T_{11}	$N_1P_0K_1$	255.29	255.29	4680	3120
T_{12}	$N_1P_0K_2$	237.05	200.58	4680	3640
T_{13}	$N_1P_1K_0$	255.29	255.29	3640	3120
T_{14}	$N_1P_1K_1$	401.17	218.82	4160	3640
T_{15}	$N_1P_1K_2$	510.58	237.05	4160	3640
T_{16}	$N_1P_2K_0$	309.99	237.05	4160	3120
T_{17}	$N_1P_2K_1$	455.87	291.76	3640	3120
T_{18}	$N_1P_2K_2$	455.87	309.99	4160	3640
T_{19}	$N_2P_0K_0$	364.70	291.76	3640	3120
T_{20}	$N_2P_0K_1$	291.76	291.76	4680	3120
T_{21}	$N_2P_0K_2$	401.17	255.29	4160	4160
T_{22}	$N_2P_1K_0$	401.17	309.99	4160	2600
T_{23}	$N_2P_1K_1$	309.99	237.05	4680	3640
T_{24}	$N_2P_1K_2$	455.87	255.29	5200	4160
T_{25}	$N_2P_2K_0$	364.70	255.29	3640	2600
T_{26}	$N_2P_2K_1$	455.87	309.99	4680	3640
T_{27}	$N_2P_2K_2$	547.05	364.70	5200	4680
	SE (m)±	29.481	12.443	281.38	255.46
	CD (P=0.05)	NS	36.150	NS	NS

Table 2: P–tissue test values (mg mL^{-1}) by tissue testing kits as affected by N and P application at 30 and 60 DAT

	(Effect of P_2O_5 application)				(Effect of N application)			
	30 DAT				60 DAT			
	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean
N_0	255.29	389.01	425.48	356.60	194.50	230.97	224.89	216.79
N_1	267.45	389.01	407.25	354.57	230.97	237.05	279.60	249.21
N_2	352.54	389.01	455.88	399.14	279.60	267.44	309.99	285.68
Mean	291.76	389.01	429.54		235.02	245.15	271.49	
	P-SE± = 29.481				N-SE± = 12.443			
	P-CD(0.05) = 85.647				N-CD(0.05) = 36.150			

Table 2.1 : K- tissue test values (mg mL^{-1}) by tissue testing kits as affected by K application at 30 and 60 DAT

	(at 30 and 60 DAT : effect of K_2O application)							
	30 DAT				60 DAT			
	K_0	K_1	K_2	Mean	K_0	K_1	K_2	Mean
N_0	2777.33	3640.00	4506.67	3640.00	2080.00	2946.67	3986.66	3004.45
N_1	3813.33	4160.00	4333.33	4102.22	3120.00	3293.83	3640.00	3351.28
N_2	3813.33	4680.00	4853.33	4448.89	2773.33	3466.67	4333.33	3524.45
Mean	3466.67	4160.00	4564.45		2657.78	3235.72	3986.66	
	K-SE± = 281.384				K-SE± = 225.467			
	K-CD(0.05) = 817.467				K-CD(0.05) = 655.020			

LITERATURE CITED

Anonymous, 1998. FAO production year book. 52 : 64-65.

Anonymous, 1998-99. Epitome of Agriculture in Maharashtra part I, Part II. 45-47.

Anonymous, 2000 a. 'Loksatta', The marathi daily news paper (Lokrang supplement). 8 October. 3.

Anonymous, 2000 b. Economic survey of Maharashtra 1999-2000. Govt. of Maharashtra, Mumbai, 129.

Burns, I.G. and W. Hutsby, 1984. Commun in Soil Sci. and Plant Anal., 15 (12): 1463 – 1480.

Gupta, G.P., 1996. Proc. soil and water testing for maximizing crop production. Dept. of Soil Science, JNKVV, Jabalpur.

Jackson, M.L. 1967, Soil chemical Analysis. Wisconsing Prentice Hall of India Pvt. Ltd., New Delhi. 46, 128, 152, 206, 286.

Kanwar, J.S., 1976. Soil fertility theory and practice, I.C.A.R., New Delhi.

Krishnamoorthy, C.H., 1971. Proc. int. Symp. Soil Fertility Evaluation. 1: 955.

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Effect of Long Term Integrated Nutrient Management System on Physical Properties of Soil Under Cotton + Greengram Intercropping

The practice of intercropping of greengram in cotton is very popular with farmers and many dry land farmers are adopting it. The large-scale production of food grains through application of chemical fertilizers is the base of green revolution but fertilizers are becoming very expensive. So it becomes necessary to minimize the expenses on fertilizers and at the same time sustain the crop yield and soil productivity by adopting integrated nutrient management approach, this practice not only increase the crop yield, but also improves physical, chemical and biological properties of soil (Shashidhar *et al.*, 1995).

Among the organic manure, FYM is the most important source. Now a days availability of FYM has become scarce, therefore, it is essential to find out alternative to FYM which should be equally effective, like compost, vermicompost, green manure, crop residue, etc. In All India co-ordinated Research Project on Dry land Agriculture, possibilities of Leucaena lopping as a source of organic manure have been seen and it is found that Leucaena can be used as an alternative to FYM. The tender green lopping of Leucaena leucocephala contain 3.29 to 3.92 per cent N, 0.139 to 0.167 per cent P_2O_5 and 0.124 to 0.148 per cent K_2O on oven dry basis.

The present investigation was undertaken during the year 2005-06 on effect of long term integrated nutrient management system on physical properties of soil under cotton + greengram intercropping. It was long term experiment conducted on the same site and same randomization from last 18th years in randomized block design during *Kharif* season having eight treatments using organic materials FYM was applied one month before sowing and was thoroughly mixed with the soil. Leucaena loppings were applied at 35 DAS of cotton + greengram on the basis of their N contents. The recommended doses 50 kg N, 25 kg P_2O_5 ha^{-1} was applied to cotton + greengram intercrop. Full recommended dose of phosphorus was applied as a basal dose through SSP. Nitrogen was applied through urea in two split applications, half at the time of sowing and half at 35 DAS to cotton + greengram.

The soil of experimental site was fine montmorillonitic hyperthermic family of Vertic Haplustepts, slightly alkaline in reaction, medium in organic matter and in available phosphorus and with low in available nitrogen and potassium. The soil was analysed for physical properties such as bulk density (Black, 1965), moisture content in soil (Jackson, 1967), saturated hydraualic conductivity by constant head method, infiltration rate using double ring infiltrometer, water stable aggregation (Singh, 1980), and maximum water holding capacity (Sankaram, 1996)

The results indicated that maximum and significant decrease in bulk density was found in the treatment of 50 per cent RDF (25 kg N ha^{-1}) and 100 per cent RDF (25 kg P_2O_5 ha^{-1}) through fertilizers and 50 per cent (25 kg) N ha^{-1} through FYM (T_7), followed by the treatment T_6 i.e. 25 kg N + 25 kg P_2O_5 ha^{-1} through fertilizer and 25 kg organic N ha^{-1} through leucaena lopping. The bulk density increased with depth which may be due to compact nature of soil in the subsurface horizon and low organic matter content reported by Virmani *et al.* (1982).

The data indicated the higher values of hydraulic conductivity at surface layer which might be due to porous nature of surface soil as a result of continuous tillage and comparatively higher organic matter status. The significantly highest values of hydraulic conductivity was recorded by the treatment T_7 receiving 25 kg N + 25 kg P_2O_5 ha^{-1} through fertilizer and 25 kg N ha^{-1} through FYM was found at par with treatment T_6 i.e. 25 kg N + 25 kg P_2O_5 ha^{-1} through fertilizer and 25 kg N ha^{-1} through leucaena lopping over control (T_1). Similar results were observed by Belekar (1995).

The data regarding maximum water holding capacity of experimental soil was measured after harvesting of crops and significantly highest in the treatment T_7 receiving 25 kg N + 25 P_2O_5 ha^{-1} through fertilizer and 25 kg N ha^{-1} through FYM and it was found statistically at par with the treatment T_4, T_6 and T_8 over control (T_1). The inorganic fertilizer alone and in combination with FYM at different levels significantly improved maximum water holding capacity of soil, reported by Acharya *et al.* (1988).

Data pertaining to per cent water stable aggregation > 0.25 mm presented under different treatments were found statistically significant and found

Table 1 . Effect of term INM on physical properties of soil

Treatments	Inorganic fert.		Organic N (kg ha^{-1})	Bulk density (Mg m^{-3})		Hydraulic conductivity (cm hr^{-1})		Maximum water holding capacity (%)		Water stable aggregates >0.25 m m (%)		Infiltration rates (cm hr^{-1})
	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	
T_1	0	0	0	1.35	1.39	0.93	0.89	68.89	71.03	73.89	69.53	1.19
T_2	50	25	0	1.36	1.39	0.95	0.90	69.42	71.81	80.22	77.62	1.51
T_3	25	12.5	0	1.32	1.33	1.08	1.00	69.29	72.22	80.48	76.29	1.65
T_4	0	0	25 LL	1.31	1.37	1.18	1.09	70.05	73.08	84.17	84.24	1.85
T_5	0	0	25 FYM	1.28	1.31	1.20	1.10	68.92	73.77	84.50	81.40	2.15
T_6	25	25	25 LL	1.27	1.32	1.23	1.13	70.54	74.26	85.86	84.31	1.76
T_7	25	25	25 FYM	1.27	1.29	1.28	1.22	71.25	73.99	88.99	82.99	2.92
T_8	0	25	50 LL	1.29	1.32	1.21	1.16	70.91	73.46	84.16	84.31	1.94
SE (m) ±				0.006	0.008	0.016	0.014	0.57	0.54	2.89	2.44	0.03
CD at 5%				0.018	0.023	0.047	0.041	1.60	1.52	8.13	6.88	0.10

higher in surface (0-15 cm) as compared to (15-30 cm) subsurface soil. Chakraborthy *et al.* (1981) reported that the increased soil aggregates was due to the cementing effect of humic substance produced from the organic matter in to the soil, which added stability to the aggregates.The data further indicated that the per cent water stable aggregates size > 0.25 mm increased significantly in the treatment T_7 receiving 25 kg N + 25 kg P_2O_5 ha^{-1} through fertilizer and 25 kg N ha^{-1} through FYM, which was found at par with the treatment T_4, T_5, T_6 and T_8, respectively.

Data pertaining to infiltration rate under all treatments was found higher initially at 10 minutes and it decreased with time.The infiltration values ranged from 1.19 to 2.92 $cmhr^{-1}$. Data further indicated that the highest infiltration rate was recorded under treatment T_7 i.e. 25 kg N + 25 kg P_2O_5 ha^{-1} through fertilizer and 25 kg N ha^{-1} through FYM than control, indicating increase infiltration due to FYM, over control and 100 per cent NP through fertilizers. Bellakki and Badanur (1997) reported that infiltration rate of soil increased significantly with sunhemp or FYM application either alone or in combination with 50 per cent RDF over control and fertilizer alone.

LITERATURE CITED

Acharya, LL., S.K. Bishnoi and H.S. Yaduvanshi. 1988. Effect of long term application of fertilizer and organic and inorganic amendments under continuous cropping on soil physical and chemical properties in an alfisols, J. Indian Soc., 58 (7) : 50-56.

Belekar, D.C., 1995. Long term effect of fertilizer and manure on physical properties of black soil under sorghum wheat cropping system, M.Sc. (Agri.) Thesis (unpub.) Dr. PDKV, Akola.

Bellakki, M.A. and V. P. Badanur. 1997. Long term effect of integrated nutrient management on properties of vertisol under Dryland Agriculture, J. Indian Soc.Soil Sci., 45 (3): 438-442.

Black, C.A. (Ed.)., 1965. Methods of soil analysis. Part I, American Soc. Agron., Inc. No. 9, Modison USA : 770.

Chakraborty, G., S.K. Gupta and S. K. Banerjee. 1981. Distribution of water stable aggregates in some soils of West Bengal in relation to organic and inorganic constituents., J. Indian Soc.Soil Sci., 29 (1): 17-24.

Jackson, M.L. 1967. Soil chemical analysis prentice Hall of India. Pvt. Ltd. New Delhi : 498.

Sankaram, A. 1996. A laboratory mnual of Agricultural Chemistry., Central Rice Research Institute, Cuttak - 6, Orissa.

Shashidhar, B.C., M.D. Kachapur, B.M. Chitapur and Ravi Hunje. 1995. Effect of crop residues on physical, chemical and biological properties of soil in sorghum based cropping systems, An abstract of seminar on conservation of natural resources for sustained production. Nov. 16-17, UAS (Dharwad), India.

Singh, R.A. 1980. Soil physical analysis (Eds.) : 52-78.

Virmani, S.M., K.L. Sushant and J. R. Burford. 1982. Physical and chemical properties of Vertisols and their management. "In Vertisols and Rice Soils of the Tropics." Trans. 12th Intern. Congress Soil Sci. New Delhi. 3 : 80 – 83.

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Evaluation for Resistance Against Pulse Beetle in Stored Green Gram

The pulses have an important role in Indian agriculture and form an essential component of the Indian diet. Pulses have highly nutritive food value being rich in protein. Green gram *(Vigna radiata L.* Wilczek) is one of the major pulses aiding to meet the requirement of the country but suffer severe infection by pulse beetle *(Callosobruchus chinensis)* in storage. Host plant resistance has become one of the important non-chemical methods of integrated pest management (IPM). Breeding for resistant varieties against insect pest can be made feasible by identifying various factors that elicit sur.h resistance. Therefore, in the present study an attempt has been made to evaluate relative susceptibility of green gram to pulse beetle with certain vital seed parameters.

Seeds of five promising genotypes of green gram were obtained from Pulse Breeder, M.P.K.V., Rahuri. Seeds of five genotypes *viz.*, PM-2, PM-9339, AKM-8802, TARM-18 and Kopargaon were cleaned and sterilized by exposing to sunlight for four days and fumigated with aluminium phosphate in order to eliminate any existing infestation of pest. Four replication of 100 g healthy seed of each five genotypes were kept in 1 kg capacity plastic jars used for susceptibility test alongwith eight pairs of freshly emerged beetles from a uniparental culture raised in laboratory as per the procedure described by Strong *et al.* (1968). The fourth replication (without beetle) was kept for each genotype as check to observe any beetle emergence (control). The jars were covered with muslin cloth to avoid the escape of beetles and the jars were kept in ambient laboratory condition. After 10 days the number of eggs laid in each jar were counted on randomly selected 50 seeds and the dead beetles were also removed. On commencement of 25th days after setting the experiment, the freshly emerged adults were counted and removed daily for another 15 days to prevent their further breeding The susceptibility parameters such as, number of adults emerged, per cent loss in seed weight and number of resistant seeds were studied. Correlation among various parameters like oviposition, number of adults emerged, seed hardness, loss in seed weight and 100 seed weight alongwith number of resistant seeds were taken as an indicator for varietal resistance.

All the genotypes included in present investigation ware released varieties. The varietal response was measured on the basis of different parameters after 40 days of inoculation. The results obtained with reference (to different criteria *viz.*, number of adult emerged, per cent loss in seed weight, per cent number of resistant seeds, seed hardness, 100 seed weight and oviposition alongwith correlation studies. The genotype Kopargaon (4.66 g) and AKM-8802 (4.15 g) having maximum seed weight and bold seeds favoured the insects for oviposition, followed by PM-9339; whereas minimum in TARM-18. The genotype Kopargaon was observed to be the most preferred for oviposition (Choudhary *et. al.*, 1989). This may be due to the fact that the seed size might have influenced the amount of seed surface available to bruchid for oviposition as revealed in horse gram (Ramamangudar and Viswanatha, 1989). Maximum number of adults emerged and loss in seed weight was recorded in genotype Kopargaon; whereas in TARM-18, it was appeared to be the least. On the other hand maximum number of resistant seeds (60.75) and seed hardness (3.4 kg/cm^2) were recorded in genotype TARM-18; while it was minimum in bruchid susceptible genotype Kopargaon.

Coefficient of correlation was worked out for different parameters to measure resistance in green gram varieties against *Callosobruchus chinensis.* The interaction among different parameters (Table 2) showed negative association with number of resistant seeds except seed hardness. Seed hardness exhibited highly significant positive correlation with resistance; whereas number of adults emerged, per cent loss in seed weight, 100 seed weight and oviposition had significant association with number of resistant seeds, number of adults emerged had highly significant positive correlation with loss in seed weight and 100 seed weight.

Significant positive correlation of 100 seed weight with number of adults emerged and loss in seed weight was reported in mung bean (Muhammad *et al.*, 1997). High positive correlation between loss in seed weight and number of adults emerged in green gram (Chakraborty *et al.*, 2004). The significant positive correlation between susceptibility parameters *viz.*, per cent of affected seeds, number of eggs laid, number of adults emerged and per cent weight loss was reported in green gram. Highly significant positive correlation between number of adults emerged with weight loss and number of damaged seeds in mung bean was earlier reported by Khattak *et. al.*, (1987). Positive association between number of adult emerged with loss in seed weight revealed that the higher number of the adults emerged, more was the loss in seed weight; while when seed hardness was more, higher number of resistant seeds were observed.

Table 1 : Mean performance of different parameters for evaluating resistance in green gram genotype.

S.N.	Genotypes	Oviposition	Number of adult emerged	Loss in seed weight (%)	Seed hardness (kg cm^2)$^{-1}$	100 seed weight (g)	Number of resistant seed
1	PM-2	40.75	261.75	22.00	4.22	3.30	76.50 (61.03)
2	PM-9339	47.00	281.75	23.68	4.30	3.66	73.25 (58.87)
3	AKM-8802	52.75	300.00	25.10	3.82	4.15	71.25 (57.91)
4	TARM-18	37.50	87.00	11.26	4.80	3.91	87.00 (68.95)
5	Kopargaon	56.50	429.50	28.15	3.40	4.66	60.75 (51.21)
	SE±	2.18	3.27	0.90	0.15	0.03	0.90
	CD at 5%	6.58	9.86	2.71	0.45	0.11	2.71

Figures in parentheses are arcsine values

Table 2: Correlation coefficient between various parameters and number of resistant seeds to bruchid.

Characters	Number of adults emerged	Seed hardness weight	Loss in seed resistant seed	100 seed weight	Number of
Oviposition	0.427	-0.552*	0.384	0.014	-0.486*
Number of adults emerged		-0.953**	-0.774**	0.902**	0.652**
Seed hardness			-0.656**	-0.242	0.757**
Loss in seed weight				0.507**	0.874**
100 seed weight					-0.632**

** Significant at 1 % level of probability * Significant at 5 % level of probability

LITERATURE CITED

Chakraborty, S., S.N. Choudhari and S.K. Senapati, 2004. Correlation between seed parameters and relative susceptibility of mung bean *(Vigna radiata* L. Wilczek) genotypes to *Collosobruchus chinensis* (L.) during storage, Ann. PI. Protection. Sci., 12(1): 48-50.

Choudhary, B.S., R.R. Rawat and S.C. Pathak, 1989. Relative preference of *Callosobruchus chinensis* (L.) for different varieties of green gram. Bull. Grain Tech., 27(2): 107-112.

Khattak, S.U.K., M. Hameed, R. Khatoon and T. Mahammad, 1987. Relative susceptibility of different mung bean varieties to *Callosobruchus maculates* F, J. Stored Prod. Res., 23(3): 139-142.

Muhammad, H., G.C. Ray and M. Husain, 1997. Laboratory evaluation of 'some mung bean strains for susceptibility to pulse beetle *Callosobruchus chinensis* (L), Bangladesh J. Entomol, 7(1-2): 21-26.

Ramamangudar, H. and K.P. Viswanatha, 1989. Correlation between seed parameters and relative susceptibility of some horse gram genotypes to pulse beetle *Callosobruchus chinensis* (L.) during storage. Pestol. 22(10): 55-59.

Strong, R.G., G. J. Patria and D.N. Warner, 1968. Rearing store product insect for laboratory studies, bean and cowpea weevil. J. Econ. Entomol, 61 : 747-751

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Biosafety of Systemic Insecticides Through Seed Treatment and Stem Smearing to Some Predators

Insecticides being an inevitable component of pest management, insecticides comparatively safer to bioagents need to be included in the plant protection programme. As such systemic insecti-cides, in general, and systemic seed dresses in par-ticular, become the cause of concern (Mizell and sconyer, 1992). Thiamethoxam 70 WS, imidacloprid 70 WS, acetamiprid 20 SP, thicloprid 21.7 SC and monocrotophos as per treatments were field evaluated for their safety against three predators viz, LBB, chrysopa and spiders on cotton.

Field experiment was conducted in ran-domized, block design with ten treatments and three replications at experimentation field of entomology Dr. PDKV, Akola during *Kharif* 2006-07. Thiamethoxam 70 WS, imidacloprid 70 WS, acetamiprid 20 SP, thicloprid 21.7 SC and monocrotophos 36 WSC were tested through seed treatment and stem smearing technique for their biosafety to lady bird beetle, chrysopa and spiders on cotton van PKV-Rajat. The observations on number of LBB, chrysopa, spiders per plant on whole plant were recorded at weekly interval from21 to 77, 42 to 77 DAE, respectively. The data of each observation were consolidated and are pre-sented in table 1.

Table 1 shows that maximum population of LBBs (2.55 plant^{-1}) was observed in untreated control and being on par with stem smearing of thicloprid 1:20 dilution (2.55) and imidacloprid 1:20 dilution (2.24). In remaining treatments significantly lower population of LBBs were recorded than untreated control. In untreated control plot highest population of chrysopa was recorded (1.94 plant^{-1}) and it was significantly superior over all other treatments except thiamethoxam 70 WS, 1:20 dilution (SS) and acetamiprid 20 SP, 1:20 dilution (SS).

Data on population of spiders presented in table 1 revealed that, the treatment thiamethoxam 70 WS @ 5g kg^{-1} seed was found most safer to spiders (2.01), followed by thiamethoxam 70 WS, 1:20 dilution (1.16). Both these treatments signifi-cantly differ from each other and superior over all other treatments including control. The next safer treatments were acetamiprid 20 SP @ 20 g kg^{-1} (ST), followed by acetamiprid 20 SP, 1:20 dilution (SS) and on par with untreated control. Rest of the treatments were least safer to spiders.

Figures in parenthesis are square root values

Mizell and Sconyer (1992), studied effect of imidacloprid and thiamethoxam on population of lady bird beetle and found that imidacloprid had little impact on beneficial insects.

Satpute (1999), concluded that^ seed treat-ment with imidacloprid and thiamethoxam only conservative to bioagents, but also attracted more population of LBB adults and chrysopa eggs. Seed treatment was safer than foliar sprays. Imidacloprid @ 10g kg^{-1} seed treatment

Table 1 : Effect of different treatments on population of predators.

Treatments		Average number of LBB, Chrysopa and Spiders /plant		
Tl -	Thiamethoxam 70 WS @ 5g/kg	1.24 (1-11)	1.48 (1-22)	2.01 (1.42)
T2 -	Imidacloprid 70 WS @ 10 g/kg	1.62 (1.27)	1.13 (1.06)	0.88 (0.94)
T3 -	Acetamiprid 20 SP @ 20 g/kg	0.92 (0.96)	1.42 (1.19)	1.29 (1.14)
T4 -	Thicloprid 21.7 SC @ 10 ml/kg	2.19 (1.48)	1.02(1.01)	0.90 (0.95)
T5 -	Thiamethoxam 70 WS 1 :20 dilution.	2.15 (1-47)	1.77 (1.33)	1.61 (1.27)
T6 -	Imidacloprid 70 WS 1:20 dilution	2.24 (1.49)	1.57 (1.25)	0.97 (0.98)
T7 -	Acetamiprid 20 SP 1 :20 dilution.	1.87 (1.36)	1.70 (1.30)	1.07 (1.03)
T8 -	Monocrotophos 36 WSC 1 : 1 dilution	1.01(1.01)	1.13 (1.06)	0.93 (0.96)
T9 -	Thicloprid 21. 7 SC 1:20 dilution	2.55 (1.60)	1.28 (1.13)	0.76 (0.87)
T10 -	Untreated control	2.55 (1.60)	1.94 (1.39)	1.18 (1.09)
'F' Test		Sig-	Sig.	Sig.
SE (m)±		0.039	0.038	0.030
CD at 5%		0.11	0.08	

allowed maximum Lady bird beetle adults and thiamethoxam 4g kg^{-1} allowed maximum oviposition of chrysopa and were at par with untreated control on cotton (Katole and Patil,2000).

LITERATURE CITED

Katole, S.R. and P.T. Patil, 2000. Bioassay of imidacloprid and thiamethoxam as seed treatment and foliar spray to some predators, Pestol, 24, (11) : 11-13.

Mizell, R.F. and M.C. Sconyer, 1992. Toxicity of inidacloprid to selected arthropod predators in the laboratory, Florida Entomol., 75 (2) : 227-280.

Satpute N.S., 1999. Effect of seed treatment of some insecticides in the management of suking pests of cotton, M.Sc. (Agril.) Thesis (Unpub.), Dr. PDKV Akola

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Evaluation of Herbal Extracts and HaNPV in Combination with Endosulfan Against *Helicoverpa armigera* (Hubner) on Cotton

Cotton (*Gossypium* spp.) is one of the important commercial crops named to as "White Gold of Black Soil" in Maharashtra, serves as a source of natural fibre, oil and provides raw material to the textile and oil industry. The pest menace is limiting factor responsible for its low production and American bollworm, *Helicoverpa armigera* (Hubner) emerged as a key pest all over the country causing a high as 66 per cent yield loss in cotton (Banerjee, 1998). Indiscriminate and excessive use of insecticides against this pest resulted in several problems. The plants are rich source of bio-active chemicals and about 10 per cent plant species of the estimated 5,00,000 different plant species in world have been reported to possess pest control properties (Dhaliwal *et al.*, 1996). Among them, *Beshram* (*Ipomea carnea*), *Nirgudi* (*Vitex negunda*) and *Neem* (*Azadirachta indica*) possess broad spectrum activity against insect pests. Moreover among biopesticides, Nuclear Polyhedrosis Virus (NPV) is a miraculous bio-agent and possesses self-perpetuating, safety and host-specificity property. Taking these into considerations, present study on evaluation of herbal extracts and HaNPV in combination with endosulfan against *H. armigera* on cotton was formulated.

The experiment was conducted at the experimental field of Entomology section (Insectory), College of Agriculture, Nagpur during the *Kharif* season of 2005-06. The experiment was conducted with nine treatments and three replications in randomized block design. Initiation of application was made as soon as the infestation of *H. armigera* was noticed. In all, three applications were given at 15 days interval. The pre-treatment observations were recorded 24 h. before the application of treatment and post-treatment observations were recorded at 2, 7 and 10 days after spraying from randomly selected five plants of each plot. Requisite observations were recorded at different growth periods of cotton crop to generate the data on per cent infestation in squares, flowers and green bolls and the observations were further pooled. Similarly, the per cent of bad kapas and the yield of seed cotton were noted from the net plot treatment and replication wise. The data thus obtained were subjected to statistical analysis.

The data at 2 days after all three spray (Table 1) revealed the lowest per cent infestation (3.34 %) in treatment of endosulfan 35 EC 0.07 per cent. Next to this, combination treatment of NSE 5 per cent + endosulfan 35 EC 0.035 per cent recorded 5.54 per cent infestation, which was found superior over all the remaining combination treatment. In alone treatments, HaNPV 250 LE ha^{-1} recorded 6.69 per cent damage, followed by 5 per cent extract application of NSE, *Beshram* leaf and *Nirgudi* leaf, which were found to be significantly superior over control. More or less similar trend was noticed on cumulative per cent infestation on square, flowers and green bolls at 7 and 10 days after all three sprays. The effectiveness of endosulfan over alone and combination

Table 1: Effect of herbal extracts and HaNPV in combination with endosulfan against *H. armigera* on cotton

S.N.	Treatments	Cumulative per cent infestation on squares, flowers and green bolls			Per cent bad kapas	Yield of seed cotton (q ha^{-1})
		2 DAT	7 DAT	10 DAT		
T1	Neem Seed Extract (NSE) 5 per cent	7.29	7.62	7.85	16.22	10.32
		(2.69)	(2.75)	(2.79)	(4.02)	
T2	Beshram Leaf Extract 5 per cent	7.83	8.08	8.26	16.88	10.19
		(2.78)	(2.83)	(2.86)	(4.10)	
T3	Nirgudi Leaf Extract 5 per cent	8.88	9.18	9.35	18.10	9.72
		(2.97)	(2.85)	(3.05)	(4.25)	
T4	Neem Seed Extract (NSE) 5 per cent +	5.54	5.71	5.89	12.09	12.50
	Endosulfan 35 EC 0.035 per cent	(2.32)	(2.38)	(2.42)	(3.47)	
T5	Beshram Leaf Extract 5 per cent +	5.85	6.14	6.31	13.46	12.29
	Endosulfan 35 EC 0.035 per cent	(2.41)	(2.47)	(2.50)	(3.66)	
T6	Nirgudi Leaf Extract 5 per cent +	6.41	6.71	6.88	14.62	12.00
	Endosulfan 35 EC 0.035 per cent	(2.52)	(2.58)	(2.61)	(3.82)	
T7	HaNPV 250 LE ha^{-1}	6.69	6.92	7.08	15.55	11.72
		(2.58)	(2.55)	(2.66)	(3.94)	
T8	Endosulfan 35 EC 0.07 per cent	3.34	3.52	3.71	10.54	14.10
		(1.81)	(1.87)	(1.92)	(3.24)	
T9	Control (Water spray)	11.59	12.04	12.30	20.71	8.09
		(3.40)	(3.46)	(2.50)	(4.55)	
	'F' test	Sig.	Sig.	Sig.	Sig.	Sig.
	S. E. (m) ±	0.046	0.043	0.042	0.084	0.45
	CD at 5 %	0.13	0.13	0.12	0.25	1.35

Note: Figure in parentheses are the corresponding square-root transformation values.

treatment is comparable with the results of Shirbhate (1998) and Paul and Kadam (2003). The superiority of alone treatments of botanicals over control of this investigation are corresponding with the findings of Murugan, *et al.* (1997) and Morale, *et al.* (2000).

Average per cent bad kapas presented in Table 1 depicted that endosulfan 35 EC 0.07 per cent was found effective in minimizing the per cent of bad kapas to the extent of 10.54 as against 20.71 per cent in the control plot. It was followed by the treatment of NSE 5 per cent + endosulfan 35 EC 0.035 per cent (12.09 per cent), which was found effective than other treatments. Remaining all the treatments were found effective in minimizing the per cent bad kapas over control treatment.

The yield of seed cotton was significantly highest in the treatment of endosulfan 35 EC 0.07 per cent (14.10 q ha^{-1}). The next better treatments were NSE 5 per cent + endosulfan 35 EC 0.035 per cent (12.50 q ha^{-1}) found superior over other botanical combinations. In alone treatments, HaNPV 250 LE ha^{-1} found superior over alone botanicals and all these produced significantly higher yield over control plot (8.09 q ha^{-1}). These findings of combination treatment are supported with the findings of Shirbhate (1998) and Sarode, *et al.* (2000).

It could be abstracted from the result that the botanicals in combinations with insecticide and HaNPV alone against *H. armigera* found superior in reducing damage and by increasing yield of seed cotton indicating safety to ecosystem.

LITERATURE CITED

Banerjee, S.K. 1998. Assessment of losses due to major pest of cotton. Annual report, 1997-98. Central Institute for Cotton Research, Nagpur.

Dhaliwal, G.S.; R. Arora and V.K. Dilawari 1996. Botanical pesticide in insect pest management: Emerging trends and future strategies. Allelopathy in Pest Management for Sustainable Agriculture, Himalaya Publication, New Delhi : 93-119.

Morale, R.S., D.N. Sarnaik, U.S. Satpute and A.K. Sadawarte 2000. Effect of plant products on growth and development of *Helicoverpa armigera* (Hubner) on cotton., Pestol., 24(1): 26-28.

Murugan, K.; S. Sivaramakrishanan; N.S. Kumar and D. Jeyabalan 1997. Synergistic interaction of botanicals and biocides Nuclear Polyhedrosis Virus on pest control., J. Sci. Industrial Res., 57(10/11): 732-739.

Paul, A.M. and B.S. Kadam 2003. Efficacy of some biopesticide and bioagent against cotton bollworms. State Level Seminar on "Pest Management for Sustainable Agriculture" held at MAU, Parbahni (M.S.), Feb. 6-7:116-118.

Sarode, S.V.; A.E. Chaudhary and V.U. Sonalkar 2000. Evaluation of neem products against cotton bollworm complex. J. Entomol. Res., 24(4): 319–324.

Shirbhate, V.S. 1998. Efficacy of herbal and biopesticide against cotton bollworm. M.Sc. (Agri.) Thesis (Unpub.), Dr. PDKV, Akola.

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Bio-Efficacy of Systemic Insecticides Against Aphids and Jassids on Cotton Through Seed Treatment and Stem Smearing

Cotton is an important fibre and oil seed crop in India and contributes 1/3 of total foreign exchange earning of the country, providing 65 per cent 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 270 lakh bales and productivity 503 kg lint ha^{-1}. How-ever, Maharashtra state occupies an area of about 31.24 lakh ha. under cotton crop with the produc-tion of 55 lakh, bales and productivity of 299 kg lint ha^{-1} as against India's average productivity of 503 kg lint ha^{-1}.

Among the 25 pests reported on cotton, in Maharashtra, the sucking pests especially aphids "Aphis gossypii" (Glover) and Jassids" Amrasca biguttula (Ishida) attained a 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 aphids and jassids, so that these insecticides can reach specifically to the target sites.

Field experiment was conducted in randomized block design with ten treatments and three replications on the field of department of Entomol-ogy Dr. PDKV, Akola during *Kharif* 2006 -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 aphids and jassids on cotton, var. PKV-Rajat. Seed treatment done before sow-ing and stem smearing twice at 20 and 40 days after emergence (DAE), weekly observations were recorded on the number of aphids and jassids start-ing from 21 to 70 DAE by randomly selecting five plants from each treatment plot. Three leaves each from top, middle and bottom canopy of selected plants were observed for aphids and jassids count. Data of all the observations were consolidated and subjected to statistical analysis.

There was heavy incidence of aphids during the period of study. All the treatments were significantly superior over control in reducing aphid population and presented in table 1. Seed treat-ment of imidacloprid 70 WS @ 10 g kg^{-1} was most effective against aphids (30.68 $plant^{-1}$) and signifi-cantly superior over rest of the treatments. Next effective treatment was monocrotophos

Table 1. Effect of different treatments on population of aphids and jassids

Treatments			Average number of aphids and jassids/3 leaves/plant	
Tl	-	Thiamethoxam 70 WS @ 5g kg^{-1}	57.16 (7.56)	2.22 (1.49)
T2	-	Imidacloprid '70WS @10'g kg^{-1}	30.68(5.54)	4.53 (2.13)
T3	-	Acetamiprid 20 SP @ 20 g kg^{-1}	61.26 (7.83)	3.16 (1.78)
T4	-	Thicloprid 2 1.7 SC@ 10 ml kg^{-1}	135.96 (11.66)	5.01 (2.23)
T5	-	Thiamethoxam 70 WS 1:20 dilution.	92.74 (9.63)	3.52, (1.87)
T6	-	Imidacloprid 70 WS 1:20 dilution	82.16 (9.06)	6.27 (2.50)
T7	-	Acetamiprid 20 SP 1:20 dilution.	69.77 (8.35)	4.17 (2.04)
T8	-	Monocrotophos 36 WSC 1:1 dilution	56.18 (7.50)	3.73 (1.93)
T9	-	Thicloprid 2 1.7 SC 1:20 dilution	85.72 (9.26)	5.47 (2.34)
T10	-	Untreated control	150.24 (12.26)	8.70 (2.95)
		'F' Test	Sig.	Sig.
		SE (m) ±	0.048	0.036
		CD at 5%	0.13	0.10

Figure in parentheses are square root values.

3 6 WSC, 1:1 dilution (SS) 56.18 $plant^{-1}$ and this treatment was on par with thiamethoxam 70 WS @ 5 kg^{-1} (ST), 57.16 $plant^{-1}$ Acetamiprid 20 SP @ 20 g kg^{-1} ranked 3rd in order of efficacy, followed by acetamiprid 20 SP, 1:20 dilution (SS), imidacloprid 1:20 dilution (SS) thicloprid 1:20 dilution (SS); thiamethoxam 70 WS @ 1:20 dilution (SS) and thicloprid 21.7SC @ 10 ml kg^{-1} (ST).

The data on jassid counts (Table 1) revealed that all the treatments were significantly superior over control however, treatment thiamethoxam 70 WS @ 5g kg^{-1} (ST) recorded least population of (2.22 $plant^{-1}$) jassids and proved most effective treatment. Acetamiprid 20 SP, 20 g kg^{-1} was next effective treatment and being on par with thiamethoxam 1:20 dilution (SS), Monocrotophos 36 WSC, 1:1 dilution (SS) stood 3rd in order of efficacy. Acetamiprid 20 SP @ 1:20 dilution ranked 4th in reducing population of jassids and this treat-ment was found at par with imidacloprid 70 WS @ l0g kg^{-1} seed treatment. Remaining treatments effective in descend-ing order were thicloprid 21.7SC @ 10 ml kg^{-1} (ST), thicloprid 1:20 dilution (SS) and imidacloprid 70 WS, 1:20 dilution (SS).

The results of imidacloprid, thiamethoxam and monocrotophos are in agreement with the earlier reporters. Venilla (1998) suggested that aphids and jassids are the key sucking pests in cotton eco-system and they occur in early growth stages, their heavy infestation ultimately reduced the yield of seed cotton. Barkhede and Nimbalkar (2000), evolved a new technique "Stem smearing and new appli-ance TAGO (Treat and Go)" for field application of systemic insecticide. It was found that monocrotophos 36 WSC 1ml + water 1 ml, 2ml and 3ml recorded 100 per cent reduction in the population of aphids. Seed treatment of imidacloprid 70 WS @ l0g/kg seed was most effective upto 56 days in controlling aphids and jassids population and it was found at par with thiamethoxam 70 WS @ 4.28 g kg^{-1} seed (Satpute *et. al, 2003).*

LITERATURE CITED

Barkhede, U.P. and S.A. Nimbalkar, 2000. Control of sap sucking pests AICCP, Annual report 2005-06 : 203.

Mayee, C.D. and M.R.K. Rao, 2002. Current cotton production and protection scenarios including G.M. cotton, Agrolook. April-June : 14-20.

Satpute, U.S., S.R. Katole, V.K. Dere and P.H. Mane, 2003. Effect of seed dresser insecticides on early season sucking pests, plant growth and yield, J. Cotton Res. Dev., 17 (1) : 111-113.

Venilla, S., 1998. Relationship between sucking pests and their predators on cotton cultivars, J. Entomol,. Res., 22 (4) : 349-353.

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Economics of Farm Business Activities in Akola District

The farm business is concerned with organization of farm resources in such a way as to assist the family in meeting their family and business goals. Good management requires sound knowledge of economic principles because they are framework for farm operations and organization. Good management also requires knowledge of farm practices, which suits to the situation considering the new developments in the field.

Recent development in production technology have increased the choice of alternatives to which scarce farm resources can be put for achieving the economic goal of maximizing the stream of farm profit. The present study was undertaken in Akola district for the year 2005-06. The data were collected from 120 farmers randomly selected and were stratified into four groups i.e. Marginal (upto 1.00 ha) , Small (1.01 to 2.00 ha) Medium (2.01 to 4.00 ha) and Large (above 4.01 ha) for the study. Standard Cost Concept for Crop activities and dairy activities were used. The paper deals with the farm business analysis and efficiency of farms having different levels of resource base.

1. Economics of Agriculture and dairy activities of selected farmers in Akola district

Per hectare costs and returns from crop activities and per animal cost and returns from dairy were calculated and presented in table-1

The economic returns of different crop and dairy activity revealed that the net return at cost A in soybean and sunflower were higher as compared to other crops i.e. Rs. 15188.01 and Rs. 11984.21, respectively. While the same trend was observed for the net return at cost C. The B:C ratio of the soybean and sunflower was 1.61 and 1.55, respectively. Though the cotton is contributing highest area in gross cropped area the returns at working as well as total expenses (Cost 'A' and Cost 'C') were lowest among the all activities on the farm. The net returns per dairy animal was 8311.64 at cost A and Rs. 7203.64 at cost C on the selected farms. The results exhibited the same as the results obtained by Dhaka and Jain(2000)

Among the *Rabi* crops gram observed profitable both at cost A and cost C i.e. Rs. 6045.61 and Rs. 3303.49, respectively.

2. The aggregate measures of selected farms in Akola district

The aggregate measures calculated are gross income, gross expenses, net returns, net farm income, family labour earnings and farm business income of different farms. The net returns of different farms are presented in Table 2.

At overall level the gross income was Rs. 67107.33 and gross expenses was Rs. 34951.37 (53.12%) and net return was Rs. 32155.96 (46.88%). In comparison of different size groups it is observed that the percentage of net returns to gross return at large farm was highest. The net returns of marginal, small, medium and large size group was Rs. 6391.96 (47.31%), Rs. 17114.16 (43.29%), Rs. 32529.63 (46.90%) and Rs. 72588.10 (49.72%), respectively.

At overall level the change in inventory was Rs. 1866.37 while the computed value of family labour was Rs. 4876.26. The net farm income included net cash income and the value of change in inventory was resulted in Rs. 34022.33 (48.04%) per farm. Family labour earning was Rs. 31590.83 (44.54%), which is net farm income less interest on farm capital. The results exhibited the same as the results obtained by the Veerkar and Kamble(2002). The most important farm business income was Rs. 26714.57 (37.50%) per farm. This farm business income was Rs. 5130.96 (37.97%), Rs. 31776.18 (34.84%), Rs. 26085.38 (37.60%) and Rs. 57865.72 (39.62%) on marginal, small, medium and large farm, respectively.

It is concluded that, among the different crop activities, the net return of soybean was higher (Rs. 9252.99) followed by sunflower i.e. Rs. 7171.00. Per animal net return from dairy activity at cost A was Rs. 8311.64 per animal. From the calculated aggregate measures observed that financial efficiency on large farm was highest. At overall level, the net income was 37.50 per cent of the gross income. The area under soybean and sunflower may be increased, as these crops are most profitable. Farmers should undertake the dairy activity for increasing the net returns of the farms, it being complementary to crop production.

Table 1. Economics of different activities of selected farmers

S. N.	Crops	Gross returns	Cost(Rs ha^{-1})			Net returns at cost(Rs ha^{-1})			B:C ratio at cost		
		(Rs ha^{-1})	A	B	C	A	B	C	A	B	C
A)	**Crop activities (per ha)**										
1.	Cotton	14,968.95	9385.17	12596.85	14259.00	5583.24	2372.10	709.95	1.59	1.18	1.04
2.	Jowar	13723.72	8070.00	10945.20	11950.41	5653.72	2778.52	1773.31	1.70	1.25	1.15
3.	Soybean	24414.13	9226.08	14240.17	15161.13	15188.01	10173.95	9252.99	2.65	2.05	1.61
4.	Tur	18910.34	10135.66	13625.80	15507.10	8774.68	5284.54	3403.24	1.94	1.38	1.21
5.	Mung	17683.13	6968.29	10214.46	11601.36	10214.90	6968.62	551.71	2.51	1.73	1.5
6.	Sunflower	20183.00	8204.79	12420.36	13018.00	11984.21	7768.64	7171.00	2.46	1.62	1.55
7.	Wheat	9162.17	6114.22	7895.39	8704.75	3047.95	126.78	457.42	1.50	1.16	1.05
8.	Gram	11491.61	5446.61	7454.1	8188.12	6045.61	4037.51	3303.49	2.10	1.54	1.40
B)	**Dairy activity (per animal)**	16190	7878.36	8986.36	8986.36	8311.64	7203.64	7203.64	2.05	1.94	1.94

Table 2 .Aggregate measures of selected farmers in Akola district (Rs/farm)

S. N.	Measures	Size group				Overall
		Marginal	Small	Medium	Large	
I)	**Gross income**					
1.	Crops	10,274.83	24,424,64	50474.48	1,21,733.42	51,726.84
2.	Dairy activity	3238.00	15110.66	18888.33	24285.00	15380.49
	Sub total	13512.83	39535.3	69362.81	146018.42	67107.33
		(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
II)	**Gross expenses**					
1.	Crops	5323.60	14033.88	26349.10	5995078	26414.34
2.	Dairy activities	1797.27	8387.26	10484.08	13479.54	8537.03
	Sub total	7120.87	22421.14	36833.18	73430.32	34951.37
		(52.69)	(56.71)	(53.10)	(50.28)	(53.12)
III)	**Net income**					
1.	Crops	4951.23	10390.76	24125.38	61782.64	25312.5
2.	Diary activity	1440.73	6723.4	8404.25	10805.46	6843.46
	Sub total	6391.96	17114.16	32529.63	72588.10	32155.96
		(47.31)	(43.29)	(46.90)	(49.72)	(46.88)
IV)	Change in inventory	172.5	460.18	111.5	2021.3	1866.37
		(1.27)	(1.16)	(1.13)	(1.38)	(1.25)
V)	Interest charges @ 10% on farm capital	518.09	1266.48	2073.43	5868.04	2431.5
		(3.88)	(3.21)	(2.98)	(4.01)	(3.5)
VI)	Imputed value of family labour	915.40	2531.68	5182.32	10875.64	4876.26
		(6.77)	(6.40)	(7.47)	(7.44)	(7.02)
a.	Net cash income (I-II)	6391.96	17114.16	32529.63	72588.10	32155.96
		(47.31)	(43.29)	(46.90)	(49.72)	(46.80)
b.	Net farm income (A+III) / Farm Earning	6564.46	17574.34	33341.13	74609.4	34022.33
		(48.57)	(44.45)	(48.07)	(51.09)	(48.04)
c.	Family labour farming (B-IV)	6046.37	16307.86	31267.7	68741.36	31590.83
		(44.77)	(41.24)	(45.08)	(47.08)	(44.54)
d.	Farm business income (C-V)	5130.97	13776.18	26085.38	57865.72	26714.57
		(37.97)	(34.84)	(37.60)	(39.62)	(37.50)

Figures in parentheses indicates the percentage to gross income

LITERATURE CITED

Dhaka, J. P. and D. K. Jain (2000). Economic analysis of dairy and crop farming systems in Haryana. Annual Reports, NDRI Karnal, **49**(3) : 32.

Veerkar, P. D. and S. H. Kamble (2002). Economics of crop + dairy farming in Chiplun block of Maharashtra. *Indian J. Agri. Econ.*, **57**(3) : 414-415.

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Economics of Custard Apple Production

Custard apple is one of the important dryland fruit crops which gives high return as compared to other crops in dryland area. The soil and climatic condition in Vidarbha favouring the production of fruit crop like custard apple. There is no specific information available on physical inputs use, per hectare cost and return from custard apple. Taking into consideration the above points, an attempt has been made to study per hectare cost and return of custard apple.

Table 1. Economics of custard apple production

(Figures in Rs ha^{-1})

Sr. No.	Particulars	Group-I	Group-II	Group-III	Overall
A.	**Cost of establishment**				
1.	Labour cost	11793	—	—	11793
					(29.77)
2.	Material cost	22887	—	—	22887
					(57.78)
3.	Land revenue	375	—	—	375
					(0.94)
4.	Interest on working capital @ 13%	4560	—	—	4560
					(11.52)
	Total cost of establishment	39615	—	—	39615
					(100)
B.	**Cost of cultivation**				
1.	Human labours	—	10790	11834	11089
			(43.61)	(45.55)	(44.81)
2.	Bullock labours	—	820	830	840
			(3.31)	(3.43)	(3.39)
3.	Material cost	—	5368	5736	5402
			(21.70)	(22.08)	(21.83)
4.	Land revenue	—	75	75	75
			(0.030	(0.29)	(0.30)
5.	Depreciation	—	318	318	318
			(1.28)	(1.23)	(1.29)
6.	Interest on working capital	—	498	489	487
			(2.01)	(1.88)	(1.97)
7.	Rental value of land	—	1296	2312	1588
			(5.24)	(8.90)	(6.42)
8.	Interest on fixed capital	—	838	863	845
			(3.39)	(3.32)	(3.42)
9.	Amortization value	—	4740	3462	4101
			(19.16)	(13.32)	(16.57)
	Total cost of cultivation		24743	25979	24745
			(100)	(100)	(100)
10.	Production (q ha^{-1})	—	53.33	92.95	64.71
11.	Gross income	—	38884	69352	47630
12.	Net income	—	14141	43673	22884
13.	Input-output ratio	—	1.57	2.67	1.92

(Figure in parentheses indicate percentage to total cost)

For study multistage sampling method was adopted. On the basis of concentration of area under custard apple, about 60 growers from nine tehasils of Akola, Buldhana and Washim districts were selected randomly and grouped into three groups on the basis of age of orchard viz., Group-I (upto 5 years), Group-II (5 to 10 years) and Group-III (Above 10 years). The proportionate numbers of growers were 34, 18 and 8, with average area of orchard about 0.74 ha, 0.84 ha and 0.76 ha for Group-I, II and III, respectively. Collection of data done by personal interview method with the help of well designed schedule for reference year 2004-05 and analysed with simple statistical tools like mean and percentage for meaningful results. The average annual cost of cultivation was worked out by using standard cost concepts while the amortization value obtained by using compounding cost formulae considering economic life of orchard to be 25 years.

The results showed that (Table 1), the total cost of establishment (upto 5th year) of custard apple orchard was worked out to Rs. 39615 ha^{-1}. In establishment of orchard highst share of expenditure was on account of material cost (57.78 %), followed by labour cost (29.77 %). The cost of cultivation of custard apple was worked out to Rs. 24745 ha^{-1} at overall level, while it was Rs. 24743 ha^{-1} and Rs. 25949 ha^{-1} for Group-II and III, respectively. This indicate that per hectare cost of cultivation showed increasing trend with age of orchard. In cost of cultivation highest share of expenditure was on account of human labour (44.81%), followed by material cost (21.83 %).

The average yield obtained was 64.71 quintals ha^{-1}. The highest gross income, net income and input-output ratio was worked out to Rs. 69352 ha^{-1}, Rs. 43673 ha^{-1} and 2.67 ha^{-1} in Group III, respectively. At overall level input-output ratio was 1.92 ha^{-1}.

From the study, it is concluded that in establishment of custard apple orchard, the material cost had highest share of expenditure while in cost of cultivation the human labour cost was maximum. With age of orchard the cost of cultivation and net income rises. But the highest input output ratio, upto 2.67 ha^{-1}, obtained when the age of orchard was above 10 years.

LITERATURE CITED

Chitra, Parayil and I. Narender, 2002. Adoption of sweet orange technology in and around Hyderabad : A profitability study, Agric. Econ. Res. Review., 15(1):66-73.

Khunt, K.A., H.M. Gajipara, B.K. Gadhavi and S.B. Venkariya. 2003. Economics of production and marketing of pomegranate, Indian J. Agric. Econ., 17(1):100-107.

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Farm Efficiency on Different Size of Farms in Akola District

Efficiency is the ratio of output to input. The concept is important as it shows profitability of the farming business. Farm efficiency can be defined as the capacity or ability of the farm business, as a complete unit or any single enterprise, to reach the desired goal. Therefore, the study was undertaken with an objective to estimate the farm efficiency of different farms.

The present study was undertaken in Akola district for the year 2005-06. The data were collected from 120 randomly selected farmers. The farmers were stratified on the basis of size of holding into four groups i.e. Marginal (upto 1.00 ha), Small (1.01 to 2.00 ha) Medium (2.01 to 4.00 ha) and Large (above 4.01 ha). The various farm efficiency measures used in the farm business analysis i.e. crop yield index, cropping intensity, crop hecterage man^{-1} equivalent, productive man equivalent, input-output ratio and cost ratios were calculated. The efficiency of the marginal, small, medium and large farm was worked out, by estimating technical and financial efficiency, as fallows.

1. Technical efficiency measures

The crop yield index of different crops grown on selected farms is given in Table-1. The crop yield index indicates that the yield of different crops was higher on medium and large farms as compared to and the average yield of the Akola district.

Table 1. Crop yield index of different crops of selected farmers

S. N.	Crops	Crop yield index				Overall
		Marginal	Small	Medium	Large	
1.	Cotton	94.8	98.7	106.9	104.4	101.23
2.	Jowar	103.4	98.3	106.1	125.9	108.43
3.	Soybean	—	108.4	108.4	117.7	110.90
4.	Tur	112.13	111.46	115.8	122.2	115.42
5.	Mung	109.8	107.6	103.2	115.16	109.01
6.	Sunflower	—	—	112.25	124.75	118.50
7.	Wheat	109.74	102.8	112.6	120.9	111.55
8.	Gram	—	98.59	100	105.21	101.26

Cropping intensity on different farms

Cropping intensity of different farms in Akola district is given in Table 2.

Table 2. Cropping intensity of different farms

S.N.	Size groups	Gross cropped area (ha)	Cultivable area (ha)	Intensity of cropping
1.	Marginal	0.75	0.72	104.16
2.	Small	1.70	1.60	106.77
3.	Medium	3.17	2.83	107.09
4.	Large	6.97	5.81	108.77
5.	Overall	3.140	2.74	106.77

The cropping intensity indicates potential of farm to take of crop activities during a given year on the selected farms. At overall level, the cropping intensity was 106.43 per cent, while cropping intensity on large farm was 108.77 per cent, followed by medium farms (107.09 %). It was observed that the cropping intensity increased with the increase in size of holding.

Labour efficiency measures on different farms

By comparing the labour efficiency, it is known whether the labour use on a farm is more or less than what is required. We can also find out whether the labour is relatively more or less efficient. It includes following measures.

Labour efficiency by crop hectareage man^{-1} equivalent on different farms.

The significance of this measure is influenced by the varying proportion of crops with high or low labour requirements. Labour requirement can be judged by comparing crop hectareage man^{-1} equivalent. The results obtained are presented in Table 3.

Crop hectereage per man equivalent was calculated for the crops like cotton, jowar, soybean, tur, mung, sunflower, wheat and gram. Cropwise and groupwise crop hectarege per man equivalent is given in Table 3. Crop hectarege man^{-1} equivalent was calculated was lowest (0.01) in tur and highest in case of gram(0.031). The range of crop hectareage per man equivalent in

Table 3. Labor efficiency by crop hecterage per man equivalent on different farms.

S. N.	Crop	Size group				Overall
		Marginal	Small	Medium	Large	
1.	Cotton	0.015	0.012	0.012	0.013	0.013
2.	Jowar	0.016	0.015	0.014	0.016	0.015
3.	Soybean	—	0.02	0.016	0.014	0.016
4.	Tur	0.01	0.01	0.012	0.01	0.01
5.	Mung	0.02	0.02	0.019	0.019	0.019
6.	Sunflower	—	—	0.015	0.014	0.014
7.	Wheat	0.026	0.027	0.023	0.024	0.025
8.	Gram	—	0.03	0.033	0.032	0.031

different size group was more or less same for particular crop. The results revealed the same trend obtained by Kahlon and Kapur (1969).

Labour efficiency by productive man work unit per man equivalent on different farms.

The total productive man work units from a given farm represent the number of 8 hour days required under average conditions and abilities to do all the work necessary on the production of crops. The results obtained are presented in Table 4.

Table 4. Labour efficiency by productive man work unit man^{-1} equivalent on different farms.

S.N.	Size group	Total cropped area (ha)	Total productive man workout (days)	Total man equivalent (days)	Ratio
1.	Marginal	22.5	1916.26	1470.37	1.30
2.	Small	51.0	4948.92	3791.30	1.30
3.	Medium	95.1	8434.65	6563.10	1.28
4.	Large	209.1	17731.27	13948.49	1.27
	Overall	94.65	8257.77	6443.31	1.28

Productive man work unit per man equivalent on different farms is presented in Table 4. At overall level the productive man work unit man^{-1} equivalent were 1.28 while the productive man work unit per man equivalent on marginal size of farms and small size farms were 1.30, whereas the productive man work unit per man equivalent on medium size of farms were 1.28. The lowest productive man work unit man^{-1} equivalent was observed on large farms.

2. Financial Efficiency Measures

Input-Output ratio of different farms in Akola district

Input-output ratios at Cost A, B and C were considered important tools for estimation investment in crop production. The results obtained are presented in Table 5.

Table 5. Input-output ratio on selected farmers

S.N.	Farm size group	At cost A	At cost B	At cost C
1.	Marginal	1.91	1.38	1.21
2.	Small	1.96	1.42	1.27
3.	Medium	1.97	1.41	1.27
4.	Large	2.06	1.46	1.35
5.	Overall	1.98	1.41	1.27

The results estimated by input output ratio indicates the returns rupees^{-1} of investment at cost C was higher on large farms i.e. 1.35. It is followed by medium farms (1.27) and small farms (1.27) and the lowest was on marginal farms (1.21).

It is concluded that the crop yield index was higher on medium and large farms as compared to marginal and small farms. The crop yield index of sunflower was highest (118.50%). The labour use efficiency measured by crop hectareage man^{-1} equivalent, indicates the use of labour was higher for tur, cotton and sunflower crops, while the labour use for gram, wheat and mung was lower on selected farms. The input output ratio of large farm was highest at working cost as well as at total cost i.e. 2.06 and 1.35 respectively. At the overall level, the input-output ratio was 1.98 at cost 'A' and 1.27 at cost 'C'

LITERATURE CITED

Kahlon, A. S. and T. R. Kapur (1969): Impact of High Yielding Varieties on Farm Labour Use in I. A. D. P. District Ludhiana:, *Contributions* to Agril. Science and Statistics, New Delhi.

Jol, S. S. and A. S. Kahlon (1966): Labour Utilizaiton Pattern and Employment Potentials of Punjab Farms : A case study. Indian J. Agril. Econ. 21 (1).

Bhatia, S. S. (1967): Spatial variation changes and trends in agricultural efficiency in uttar Preadesh, 1953-63.Indian J. Agric. Econ. : 66-80.

Sapre, S. G. and V. D. Deshpande (1960): Inter district variations in agricultural efficiency in Maharashtra state, Indian J. Agril. Econ., 36 : 296.

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Effect of Magnetic Treatment on Seed Germination on Kalmegh in Polyhouse

The quality of seeds sown below soil surface, soil condition and environment at the time of germination play an important role for proper germination of seeds. We can select the seed material as per requirement and soil condition can be manipulated upto some extent. However, it is not possible to alter the environment in open condition. Greenhouse is a closed inflated structure in which crop can be grown and the environment (microclimate) inside can be controlled partially.

Kalmegh(*Andrographis peniculata*) is one of the most important medicinal plant species on which considerable amount of research has been conducted and its pharmaceutical potential has been well established. *Andrographis peniculata* is self pollinated crop but very rarely 5 to 10 per cent out crossing is expected. The whole plant has astringent, anodyne, anti-inflammatory, immunosuppressive and alexipharmic properties and is useful in dysentery, diorrhea, chollera, fever, diabetes, consumption, influenza, cough, sore throat, tonsillitis, bronchitis, itches, mensual, hypertension, piles and gonorrhea. Decoction of the plant is blood purifier and used for cure of turbit liver, jaundice, dermatological disease.

After germination of seed crop gets matured within 4 to 6 months. Considering the high market value it was felt necessary to undertake an experiment to evaluate the effect of magnetic treatment on germination of Kalmegh seed.

An experiment was conducted at Nagarjuna Medicinal Plant Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in modified Quonset type structure of 17 m x 4 m covered with 50 per cent shade net and polyhouse of fan pad cooling system

Before sowing the seed samples were magnetically treated for 12 hours north and 12 hours south. One sample was rotated in seed treator for 20 minutes and one sample was kept as untreated. The sample of 100 seeds of each treatement was kept in INDOSAW seed germinator. In seed germinator, the temperature was automatically maintained at 28 to 29 °c and relative humidity at 80 per cent. After 7 days the sample was drawn out and observation was taken. Results showed that germination percentage for north treated seed was 56 per cent , south treated seed was 72 per cent and 20 minute magnetic rotated treatment was 75 per cent and for untreated it was 51 per cent.(as shown in graph no 1 and table 1).

After performing seed germination test in germinator, three samples of the magnetically treated seeds and one untreated seed sample were sown in polyhouse. The four beds of size 2m x 2m were prepared manually inside polyhouse for sowing those four samples. Plots were marked with marker for row spacing of 30 cm.

The seeds were sown on 15-10-2006 and environmental parameters inside and outside of polyhouse were measured after sowing up to 23 days as shown in table 2. The plots were irrigated as and when required. No fertilizer treatment was given to field. From the data collected, effects of magnetic treatment on the germination of seeds were evaluated.

The average relative humidity inside and outside the poly house was observed to be 53.5 per cent and 51.6 per cent respectively. It was maximum on first day after planting which is 78 per cent and 71 per cent inside and outside of the polyhouse.

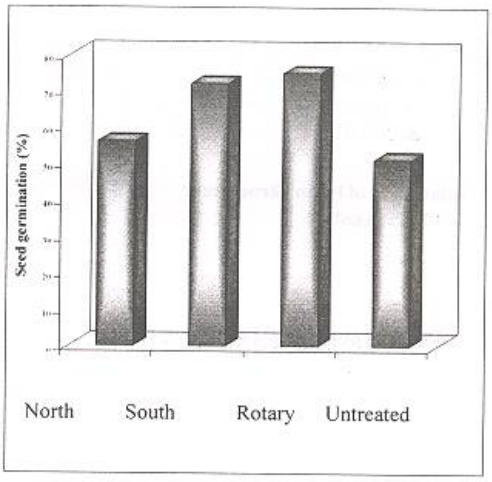

Fig. 1 : Variation of seed germination percentage with respect to treatment

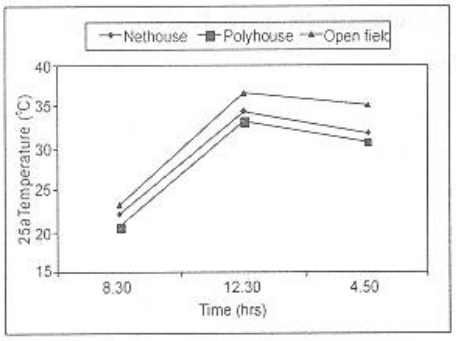

Fig. 2 : Variation of temperature with respect to time

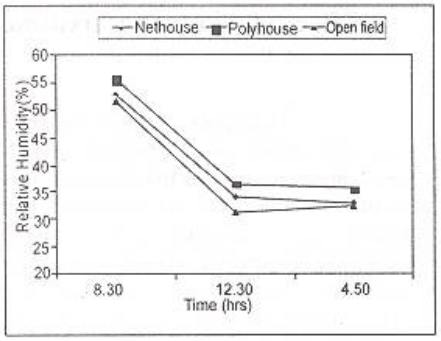

Fig. 3 : Variation of relative humidity with respect to time

The average temperature inside and outside of polyhouse was 35.5 and 36.4 °C, respectively. The first day temperature inside the polyhouse is 32°C at 12.30 and 36.5°C at 12.30 outside condition . In general, outside temperature was observed always higher than inside of polyhouse.

It was observed that 55 per cent of southly treated seeds germinated after 5 days, 55 per cent northly treated seed germinated after 7 days,55 per cent of 20 minute rotated seed germinated after 8 days and untreated seed took 15 days. From above result it was concluded that magnetically treated seeds, germinated earlier than untreated seeds.

Table 1: Variation of seed germination percentage with respect to treatment

Treatment	Seed germination (%)
North	56
South	72
Rotary	75
Untreated	51

LITERATURE CITED

Kawade S. M., K. R. Gajbhiye ,2006. Study of medicinal plant kalmegh (*andrographis paniculata*) in polyhouse, nethouse and open field condition B.Tech. Thesis (Unpub), C.A.E.T., Dr PDKV Akola

Kindelan, M., 1980. Indian Medicinal Plants Second Edition 2039-2041.

Murphy. J. D, 1942. The influence of magnetic field on seed germination American J. Bot. (suppl.) 29: 155

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Use of Solar Photovoltaic System with Tracking Arrangement to Battery Charging and Spraying Operation

The most useful way of harnessing solar energy is by directly converting it into electricity by means of Solar Photovoltaic (PV) cells. In the present situation of energy crunch Photovoltaic (PV) power generation has been receiving considerable attention as one of the more promising energy alternative. A photovoltaic system involves the solar cells, energy storage component, power conditioning unit and control equipment.

Tracking the sun harnesses optimum solar energy by the solar cells. It has been found that after comparing the experiment results of power out put of a sun tracking solar cell with that of a stationary solar cell, the tracking was found to produce 30 per cent more electrical energy in the course of a relatively clear day A Photovoltaic tracking system using operational amplifier, comparator and d c motor components, consumed a power 12 W (Kharche 1997). A use of stepper motor is more proper for discrete rotations, so a study was under taken for performance of solar photovoltaic tracking system with load as battery and sprayer.

The details of the solar photovoltaic system are given below.

1) Solar PV module : Solar PV module type = L 1235, Open Circuit Voltage (Voc) = 21 V, Short Circuit Current (Isc) = 2.4 A, Max. Power = 35W, Number of solar cells = 36.

2) Supporting unit for module: I) Stand, II) Half Circular Pipe, III) Clamp and IV) Shaft

3) Mechanical power transforming unit: I. Half circular gear, II. Shaft with gear, with one side having splined gear and wind comparator.

4) Electronic and electrical system: I. Stepper motor

II. Printed circuit boards with integrated circuit chips

a) The UA741 CN chips is an operational amplifier

b) 74 LS86 a chip comprised of XOR gates.

c) The NE 555 chip is an a stable multi-vibrator

d) GD 74 LS 74 A is a driving circuit

III. Transistor circuit as driver unit: 2N2222 A and KSP2222A are transistors

5) Battery: Sealed Lead Acid Rechargeable Battery (6V), Nos.=2

6) Sprayer: Motor pump, which is used for cleaning the windscreen of the car or vehicles as wiper pump was used for spraying and spray nozzle.

The mechanical power transforming unit consisted of a gear train (worm and worm wheel and full and half circular gears) having a reduction ratio of 1: 150. The motor used in the tracking system was a 4 pole stepper motor. The stepper motor is a form of synchronous motor, which is designed to rotate a specific number of degrees for each electrical pulse received by its control unit (Fitzgerald *et al.*, 1971). The shaft of the motor used in the present study moved in steps of 2^0. The electrical unit consisted of power supply regulator, stepper motor, comparator and driving unit etc. The function of the power supply regulator was to bring down the voltage of 21 (Voc), which was generated by the PV module, to 12V and 5V.

Testing of the tracking system was done and it was found that a specific setting of the window comparator kept on panel for locating the sun's position was very useful. Using the digital phototype tachometer the rotational speed of the shaft was found to be 95 rpm. The photovoltaic system with tracking arrangement was tested for load as battery and sprayer.

The performance of photovoltaic tracking system with load as battery and sprayer was found out. The readings of voltage, current and solar lux were noted from 9.00 AM to 4.00 PM at one hour intervals. The angle through which the module traveled per hour was also noted down. The angle was read from a graduated scale fixed on the half circular gear and a stationary pointer on the rod that supported the motor and gear assembly.

Load used as a Battery: The open circuit voltage (Voc), varied from 14.0 V to 17.6 V with a maximum of 17.6 V at 12:00 AM and short circuit current (Isc) varied from 0.7 to 1.1 A with a maximum of 1.1 A. The tracking system for it self consumed nearly 6 W (for stepper motor, the rating of stepper motor used in the study was 1.2 A and 5 V.

Load used as Sprayer along with Battery Charging : The open circuit voltage varied from 13.3 V to 18.6 V, with a

maximum of 18.6 V at 12:00 AM (at 61300 lux) and short circuit current varied from 1.1 A to 1.8 A with a maximum of 1.8 A at 12:00 AM .The voltage 12 V and current 2.8 A to the motor of the sprayer is a constant once as it was generated by the batteries, which were also included in the test. The spraying was carried out on small experimental plots of 10 m X 10 m size.

LITERATURE CITED

Fitzgerald A.E.,C.Kingsley and A.Kusko, 1971. Electric Machinery 3rd edition Mc Graw Hill International Book Company.

Kharche S.D. 1997. Design and fabrication of low cost sun tracking system for solar photovoltaic module. B.Tech. Thesis (Unpub), Dr.PDKV, Akola.

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Anthropometric Design of Bullock-drawn Weeder

In this study, features of bullock-drawn weeder important from human comfort point of view have been identified. Dimensions of these features have been obtained considering anthropometric (body dimensions) data of farm workers and bullocks in the region, ergonomic design principles and functional aspects of weeding task.

Human body dimensions and animal body dimensions that correspond various geometric features of bullock-drawn weeder (Figure) were identified. Anthropometric data of 50 farm workers and 32 bullocks from Western Vidarbha region were collected and statistically analysed. Geometric features of weeder having interaction with human body were designed on the basis of anthropometric data,, functional aspects, and available design guidelines/principles in Ergonomics. Some dynamic aspects of this work system were evaluated using drawing and design software AutoCAD. The an,thropometric design criteria and the dimensions of various features of bullock-drawn weeder are presented as below.

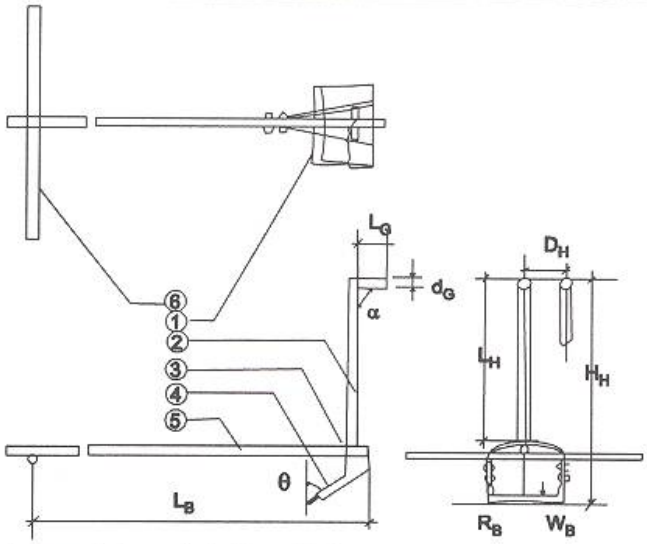
Grip diameter d_G: The grip diameter ranges between 5th percent! le value of internal grip diameter and 95th percentile value of the middle finger-palm grip diameter (Gite and Yadav, 1989 and Helander 1995). Therefore, the handle grip diameter do will range between 33 mm and 34 mm. Considering the narrow gap between two sizes, a grip with fixed diameter 33 mm is recommended.

Grip length l_g: Anthropometric feature related to length of grip is handbreadth across the thumb. It should be designed to accommodate 'large' person i.e. 95th percentile person. Therefore, grip length is found to be 18 mm. (fixed)

Effective length of beam lb: Minimum value of effective length of beam L_{Bm}m corresponds to 5th percentile effective length of bullock and 5th percentile walking length of bullock Maximum value of effective length of beam $L_{B\,max}$ corresponds to 95th percentile effective length of bullock and 95th percentile walking length of bullock. According to this, the range of adjustability for effective length of beam L_B is found to be 2276 mm to 2819 mm.

Position of handle grip dh: The position of the grip is at the center of weeder and in front of operator's navel. Secondly, he is constrained to walk along the rows. Therefore, operator requires twisting his wrist (supination). Muscles of arm twist due to supination resulting into postural discomfort and poor application of vertical force. To avoid supination and twisting of muscle, handle grip should be towards right of center position for right-handed worker and vice versa. It causes unbalanced distribution of vertical force and may affect quality of operation. To overcome this problem it is suggested to put weight on the other side of weeder. Bicromial breadth is found to be the related anthropometric measure to design the position of handle grip. The range of adjustability in the position of handle grip is found to be 139 mm to 157 mm measured from the center of the frame.

for bullock drawn implement is 1.15* (metacarpale III height) (Gite 1991). The handle height H_H ranges between 1.15* (5th percentile metacarpale III height) and 1.15 * (95th percentile metacarpale III height).The range of



1 - Blade. 2 - Handle, 3- Frame, 4 - Tyne assly, 5 - Beam. 6- Yoke
L_B - Effective length of Beam, L_G - Length of grip, d_G - Grip diameter
α - Grip angle θ - Penetration angle, D_H - Distance/Position of handle frip
L_H - Length of handle, H_H - Height of handle, R_B - Radius of blade W_B - Width of blade

Fig. : Geometric features of bullock-drawn weeder

adjustability for handle height hh will be 734 mm to 828 mm.

Length of handle : The handle height h_h has to match (1.15 * metacarpale III height) of operator for minimum postural discomfort (Gite, 1990). To find out adjustability in the length of handle lh, limiting values of shoulder height of bullock and length of beam lb are considered. This dynamic aspect is analysed using AutoCAD. The range of adjustability in the length of handle L_H is found to be 620 mm to 740 mm.

Grip angleα: The hand of operator should always remain in 'neutral position' i.e. the angle between the axis of arm of operator and the axis of the grip should be 100° to 110° (Murrell 1986). To find out adjustability in the grip angle a extreme positions of handle are considered. This dynamic aspect is analysed using AutoCAD. The range of adjustability in grip angle α is found to be 117° to 121°.

LITERATURE CITED

Gite, L. P. and B. G. Yadav, 1989. An Indian Anthropometric survey for agricultural machinery design: An Indian Case Study, Applied Ergonomics, 20 (3): 191-196.

Gite L.P. and B.G.Yadav, 1990. Optimum handle height for push pull type manually operated dry land weeder, Applied Ergonomics 33 (12): 1487-1484

Helander Martin, 1997. A Guide to the Ergonomics of Manufacturing Taylor and Francis, New York.

Murrell K.F.H., 1986. Practical Ergonomics, Chapman and Hall, New York.

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RESEARCH NOTE

CONTENT

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