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CONTENT

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RESEARCH NOTES

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Influence of Mulberry Cultivars on Performance of Pure Mysore Race of *Bombyx mori* L.

S.K. Aherkar[1], S.A. Nimbalkar[2], S.D. Deshmukh[3], P.B. Deshmukh[4] and R.N. Jane[5]

ABSTRACT

The studies condcuted on "Influence of mulberry cultivars on perfornamce of Pure mysore race of *Bombyx mori* L." was undertaken on seven cultivars, revaled that on cultivar S-34, minimum larval duration (36.68 days), higher cocoon yield (191.25 g per dfl), maximum cocoon (0.647 g), pupa (0.559 g) and shell weight (0.087 g), was recorded. Less disease incidence (15.10 per cent) was recorded due to feeding of DD cultivar. Highest weight of larvae (6.750 g / 5 larvae) was recorded with S-1635 cultivar. M-5 cultivars evidenced 39.37 days larvae duration, 4.337 g/ five larvae weight, 110.0 g cocoon yield per dfl and 5.88 per cent disease incidence.

Vidarbha occupies 484.56 ha of land under mulberry cultivation engaging 1162 farming families in silkworm rearing (Patil 1999). Mulberry silkworm is monophagous and feed only on mulberry leaves. In Vidarbha region they are reared on M-5 (kanva-2) cultivar. Mulberry cultivars also affects the performance of silkworm, which ultimately influenced the cocoon yield. The present studies were therefore aimed to evaluate the performance of multivitine race pure mysore of silkworm on different cultivars of mulberry.

MATERIAL AND METHODS

Seven mulberry cultivars viz. S-799, S-1635, DD, M-5, S-13, S-36 and S-34 received from Central Silk Board Banglore under minikit trial were utilized for the present study. The experiment was conducted during 2001-2002. Pure mysore silkworm dfl's were procured from Amravati Grainage, Amravati. Rearing of silkworm was under taken as suggested by Ullal and Narasimhanna (1987) and Datta *et. al.*, (1996). The experiment was conducted in CRD with four replications. Three hundred fifty larvae were reared in each treatment. Observations were recorded on larval duration, weight of full-grown larvae, cocoon, pupa, shell weight, cocoon yield per dfl and disease incidence.

RESULTS AND DISCUSSION

Effect of mulberry cultivar on larvae duration

Significant minimum larval duration (36.68 days) was observed due to rearing of Pure mysore silkworm on S-34 followed by S-1635 (36.70 days), S-13 (36.81 days) and DD (37.56 days) and all these cultivars were found at par. Maximum larval duration of 39.37 days was noticed due to rearing on M-5 and it was at par with S-36 (38.75 days).

Effect of cultivars on weight of full-grown larvae :

Maximum weight of full-grown larvae was recorded in treatment S-1635 (6.750 g/5 larvae), followed by S-34 (6.556 g/ 5 larvae). The latter treatments was also at par with S-13 (6.312 g / 5 larvae). Minimum larvae weight of 4.337 g / 5 larvae was observed due to rearing of silkworm on M-5.

Effect of mulberry cultivars on cocoon weight:

Significntly maximum cocoon weight 0.647 g was recorded due to rearing of Pure Mysore on S-34 and this cultivars was observed at par with S-1635 (0.630 g) and S-13 (0.629 g). Significantly minimum cocoon weight of 0.467 g was recorded due to M-5 cultivar.

Effect of mulberry cultivars on pupal weight :

Maximum pupal weight (0.559 g) was recorded when Pure Mysore larvae were reared on S-34 feeding, followed by S-13 (0.548 g), S-1635 (0.546 g), S-799 (0.532 g) and all these cultivars were found at par with each other. Significantly minimum pupal weight amongst all the cultivars was observed due to M-5 (0.411 g).

Effect of mulberry cultivars on shell weight :

Significantly maximum shell weight was recorded when Pure Silkworm larvae were reared on S-34 (0.087g) and it was at par with S-1635 (0.086 g) and S-13 (0.081 g). Significantly least shell weight of 0.055 g was observed due to feeding on M-5.

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Table 1. Performance of pure mysore race of silkworm on different cultivars of mulberry

Treatments	Larval duration (h)	Weight of 5 full grown larvae	Cocoon weight (g)	Pupal weight (g)	Shell weight (g)	Cocoon yield dfls^{-1} (g)	Fecundity	Disease incidence (%)
S-799	(38.00)** 913.5 bcd	5.525 d	0.613 b	0.532 a	0.080 bc	161.25 cd	367.75 a	25.42 (5.04)*c
S-1635	(36.70) 881.0 a$	6.750 a	0.630 ab	0.546 a	0.086 ab	187.50 a	345.75 a	15.84 (3.98) ab
DD	(37.56) 901.5 abc	5.850 c	0.565 c	0.490 b	0.075 c	170.00 bc	358.75 a	15.10 (3.88) a
M-5	(39.37) 945.0 d	4.337 f	0.467 d	0.411 c	0.055 e	110.00 e	216.00 b	34.28 (5.88) d
S-13	(36.81) 883.5 ab	6.312 b	0.629 ab	0.548 a	0.081 abc	180.00 ab	373.75 a	19.50 (4.41) ab
S-36	(38.75) 930.0 cd	4.662 e	0.535 c	0.470 b	0.065 d	151.25 d	214.25 b	19.89 (4.46) bc
S-34	(36.68) 880.5 a	6.556 ab	0.647 a	0.559 a	0.087 a	191.25 a	398.50 a	16.17 (4.02) ab
'F' test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m)±	10.62	0.106	0.010	0.010	0.002	4.54	21.39	0.19
CD at 5%	31.53	0.315	0.030	0.030	0.006	13.49	62.55	0.56
CV%	2.34	3.719	3.562	4.088	5.496	5.52	13.16	8.33

* Square root transformed values $ Figure followed by same letter is at par ** hr converted to days

Effect of mulberry cultivars on cocoon yield :

Maximum cocoon yield 191.25 g, 187.50 g and 180.00 g dfl^{-1} was recorded with culvitars viz. S-34, S-1635 and S-13, respectively and they were at par with each other. The latter cultivar was also found at par with DD which recorded 170.00 g cocoon yield. Significantly minimum cocoon yield recorded due to rearing of silkworm on M-5 (110 g dfl^{-1}).

Effect of mulberry cultivars on fecundity :

Maximum fecundity was recorded due to rearing of Pure Mysore silkworm on S-34 (398.50 eggs dfl^{-1}), followed by S-13 (373.75 eggs dfl^{-1}), S-799 (367.75 eggs dfl^{-1}), DD (358.75 eggs dfl^{-1}) and S-1635 (345.75 eggs dfl^{-1}). All these treatments were at par with each other and were siginificantly superior over S-36 and M-5 which exhibited significantly minimum fecundity of 214.25 and 216.00 egg dfl^{-1} respectively.

Effect of mulberry cultivars on disease incidence

Significantly least disease incidencne was observed when silkworm larvae were reared on DD (15.10 %), S-1635 (15.84%), S-34 (16.17%) and S-13 (19.50%) and all these cultivars were at par with each other. Significantly maximum disease incidence of 34.28 per cent was observed when reared on M-5 cultivars.

Comparison of improved cultivars with widely adopted M-5 cultivars indicated increase larval weight (33.84 %), cocoon weight (27.82%), pupal weight (26.47%), shell weight (36.78%) cocoon yield (42.48 %) fecundity (45.79%) and reduction in larval duration (7.32 %) and disease incidence (18.11 %) when Pure Mysore silkworms were reared on S-34 mulbery cultivar. Kale (2002) also reported that rearing of PM x NB4D2 hybrid race of silkworm on S-34 recorded increase in cocoon yield, cocoon, pupa and shell weight by 22.15, 9.15, 9.46, 11.66 per cet, respectively and reduction in larval duration by 1.01 per cent over M-5 cultivar is in confirmation with the present investigation.

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Population Build Up of Pod Borers in Mid-Late Pigeonpea, *Cajanus cajan* (L) Millspaugh

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ABSTRACT

Population build up of pod borers comprising of *Helicoverpa armigera* (Hubner) Hardwick and Exelastis atomosa (Walsh) were studied in mid-late pigeonpea, *Cajanus cajan* (L) Millsp., var Maruti (ICP - 8863) during 2002-03 and 2003-04 *Kharif* seasons. Eggs and larval population of *H. armigera* and larval and pupal population of *E. atomosa* were recorded in the field of five randomly selected predetermined plants. An increasing trend in their population was noticed from middle of October to the end of November, showing their peak activity in the second fortnight of November, and thereafter it started declining gradually till the crop attained maturity. Thus, crop found to the most vulnerable to the attack of both the borers from the second to last week of November in both years. During the peak of activity of these pests, the mean maximum and minimum temperature, morning and evening relative himidity and rainfall were 31.2°C, 14.8°C, 73 per cent, 36 per cent and 0.00 mm, respectively.

Mid-late maturing varieties of pigeonpea offer a good alternative to the traditionally grown crops such as cotton, jowar (sorghum), maize etc., and also fit well in the pigeonpea-wheat/ chickpea crops rotation in the Vidarbha (Maharashtra). These varieties are attacked more severely by insect-pests than the long duration ones, since they escape major onslaught is the direct damage caused to buds, flowers and pods with developing grains by insect pests. Over 250 species of insects belonging to 8 orders and 61 families have been found to attack pigeonpea. Of these, *Helicoverpa armigera* (Hub.) Hardwick, *Exelastis atomosa* (Walsh) and *Melanagromyza obtusa* (Malloch) are the important feeders of pigeonpea which are collectively referred to as the "Pod borer complex" (Lal and katti, 1998). With the introduction of early and mid-late high yielding varieties of pigeonpea and changing cropping systems, there is a gradual change in insect-pest conplex which requires greater efforts and proper planning by crop entomologist. The present investigation was, therefore, carried out to study population buildup of lepidopterous pod borers in pigeonpea, particularly under the agroclimatic conditions in Vidarbha.

MATERIAL AND METHODS

Mid-late pigeonpea, *Cajanus cajan* (L) Millsp., variety, Maruti (ICP - 8863) was grown in the field of Deparment of Entomology, Dr. PDKV, Akola (M.S.) during the two consecutive *Kharif* seasons i.e. 2002-2003 and 2003-2004 by adopting the recommended agronomic practices. The crop was grown in an unreplicated plot (10 x 10 m) with row to row and plant to plant spacing of 60 cm and 30 cm, respectively and kept free from pesticidal contamination. The weekly observations on five ramdomly selected predetermined plants for the eggs and larval counts of *Helicoverpa armigera* (Hub.) Hardwick and larval and pupal counts of *Exelastis atomosa* (Walsh) were recorded right from the bud initiation stage to maturity stage during both crop seasons. The trend of population build up of pod borers was determined by working out the mean number of pest population per five plants in relation to the seasonal changes during respectie years. A record of weather parameters viz., maximum and minimum temperature, morning and evening relative himidity and rainfall were maintained to see their effect on pest abundance.

RESULTS AND DISCUSSION

The pest population fluctuations in the field during 2002-2003 and 2003-04 are presented in Table 1 and depicted graphically in Figure 1 and 2. The results are as under.

H. armigera

The oviposition of *H. armigera* started from the second week of October in both seasons i.e. in

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Table 1. Population build-up of pod borer in mid-late pigeonpea var. Maruti (ICP-8863) in relation to seasonal changes during 2002-2003 and 2003-04

Month	MW	Crop season	Pest Population per five plants (Mean)				Temperature		Relative Humidity		Rainfall (mm)
			H. armigera		*E. atomosa*		(°C)		(%)		
			Eggs	Larvae	Larvae	Pupae	Max.	Min.	Morn.	Even	
October	41	A	0.6	0.4	0.4	0.0	35.2	21.3	70	38	0.0
		B	0.4	0.0	0.0	0.0	33.3	19.6	76	38	0.0
		C	0.5	0.2	0.2	0.0	34.3	20.5	73	38	0.0
	42	A	0.2	0.4	0.6	0.2	32.3	19.0	88	51	35.2
		B	0.8	0.2	0.2	0.0	33.6	18.3	87	42	0.0
		C	0.5	0.3	0.4	0.1	33.0	18.7	87.5	46.5	17.6
	43	A	0.4	0.2	0.8	0.4	34.1	15.8	70	29	0.0
		B	1.4	0.2	0.4	0.2	31.9	15.8	73	30	0.0
		C	0.9	0.2	0.6	0.3	33.0	15.8	71.5	29.5	0.0
November	44	A	0.4	0.4	1.0	0.4	33.1	14.1	65	36	0.0
		B	1.4	0.4	0.8	0.2	32.9	20.2	85	57	0.5
		C	0.9	0.4	0.9	0.3	33.0	17.2	75	46.5	0.3
	45	A	1.0	0.6	1.2	0.6	32.3	16.2	72	47	0.0
		B	1.6	0.4	1.2	0.6	33.0	16.0	65	32	0.0
		C	1.3	0.5	1.2	0.6	32.7	16.1	68.5	39.5	0.0
	46	A	0.8	1.0	1.0	0.8	30.8	14.9	76	42	2.3
		B	1.0	1.0	1.4	0.6	31.6	14.6	70	30	0.0
		C	0.9	1.0	1.2	0.7	31.2	14.8	73	36	1.2
	47	A	0.4	1.2	0.8	0.6	31.3	11.3	72	41	0.0
		B	0.8	0.8	1.8	0.8	32.3	15.7	71	29	0.0
		C	0.5	1.0	1.3	0.7	31.8	13.5	71.5	35	0.0
December	48	A	0.0	1.0	0.8	0.8	32.5	13.0	74	49	0.0
		B	0.6	1.2	1.6	0.4	32.2	16.5	71	33	0.0
		C	0.4	1.1	1.2	0.6	32.4	14.8	72.5	41	0.0
	49	A	0.0	0.6	0.6	0.8	31.6	13.0	85	60	0.0
		B	0.4	0.8	1.0	0.4	31.2	11.9	64	21	0.0
		C	0.2	0.7	0.8	0.6	31.4	12.5	75	41	0.0

A = 2002-03 B = 2002-04 C = Pooled mean of A and B

2002-03 and 2003-04 with its mean population density of 0.6 and 0.4 eggs 5 plants^{-1}, respectively, which gradually reached its peak i.e. 1.0 and 1.6 egg 5 plant^{-1} during the second week of November 2002-2003 and 2003-04, respectively. Thereafter, it started declining and became almost traceless with the start of December in 2002-03 and 0.6 eggs and 0.4 egg 5 plants^{-1} in the first and second week of December respectively, in 2003-04 (Table 1 and Fig. 1). This funds in support with the findings of Anonymous (2003), who reported that *H. armigera* eggs were observed from september to Octorber with its peak during October.

The larval incidence of *H. armigera* started from the second week of October in 2002-03 with its mean population density of 0.4 larvae 5 plant^{-1} which gradually increased to the maximum 1.2 larvae 5 plant^{-1} by the last week of November which is in confirmity with the findings by Akhauri *et. al.*, (1994) who noticed the highest larval population of *H. armigera* in the last week of November. Thereafter, it started declining, thus touching its lowest density i.e. 0.6 larvae 5 plants $^{-1}$ in the second week of December, when the crop reached its maturity. More or less similar trend was observed during 2003-04. Patel and Koshiya (1999) reported that *H. armigera*

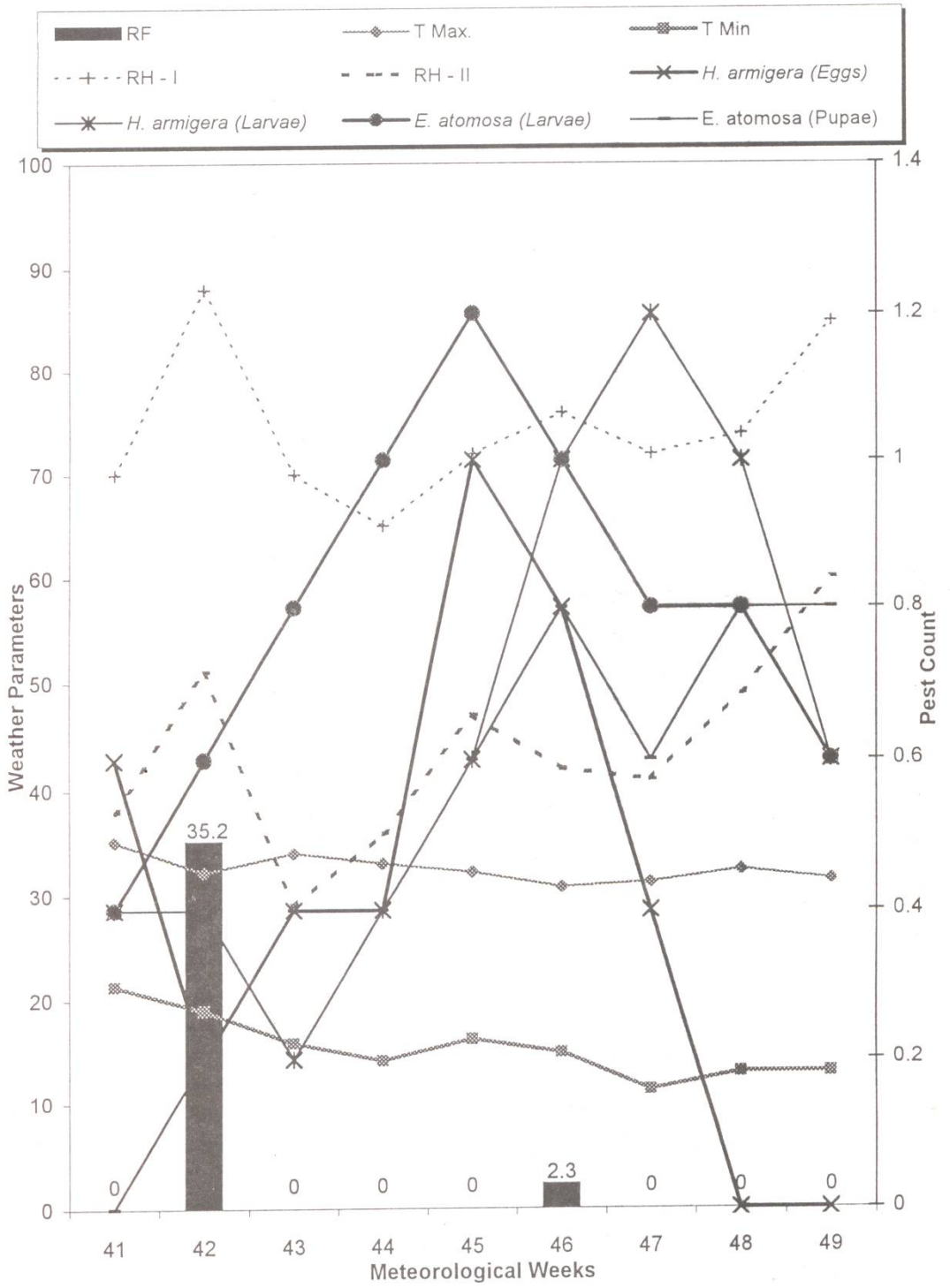

Fig. 1. Population build up of pod borere in mid-late pigeonpea in relation to weather parameters during 2002-03

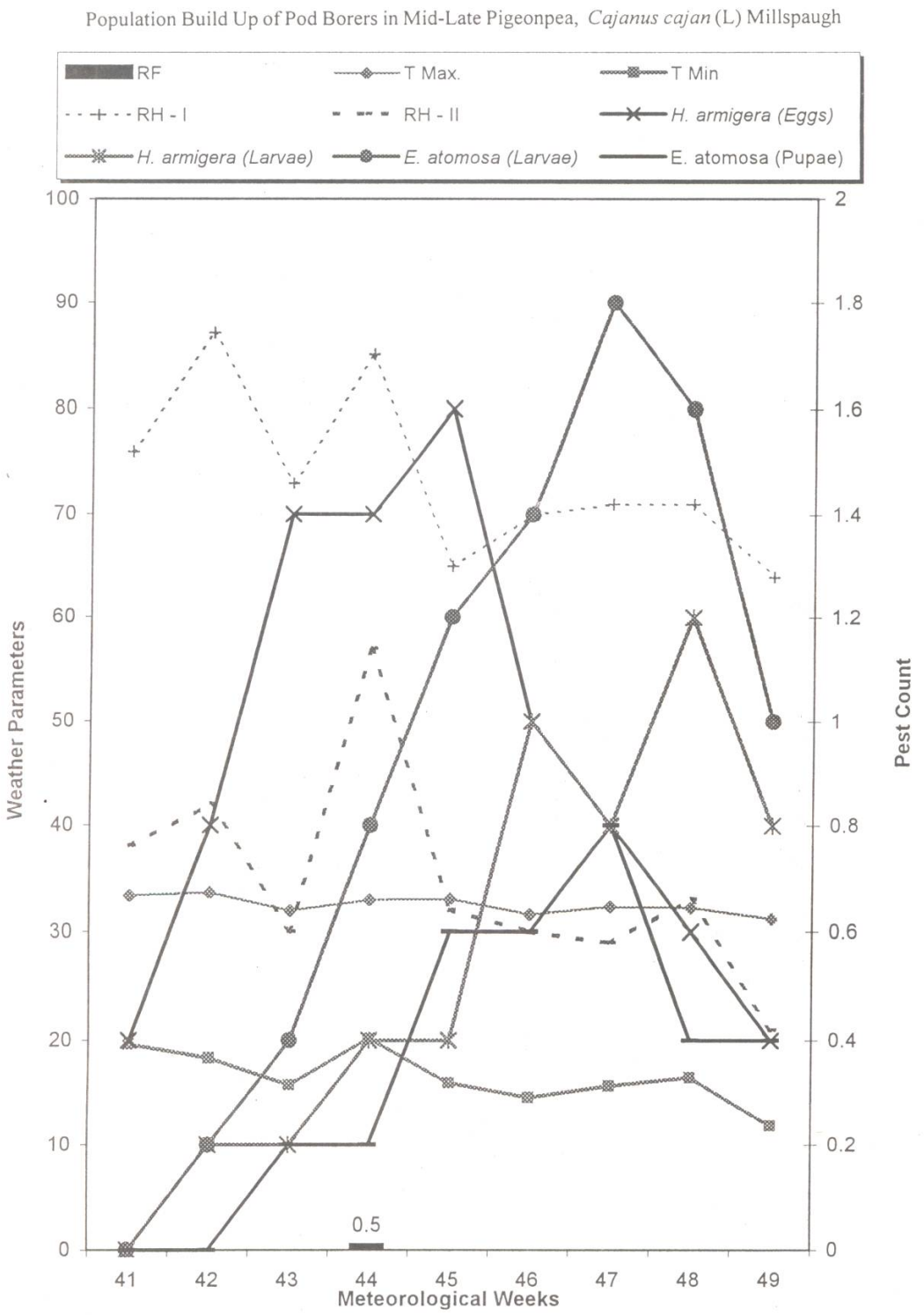

Fig. 1. Population build up of pod borere in mid-late pigeonpea in relation to weather parameters during 2003-04

was active from the first week of October to the last week of November. While, Raut *et. al.*, (1993) noticed the incidence of *H. armigera* at its peak in the third week of November.

E. atomosa

In case of E. atomosa, during the first year i.e. 2002-03, the larval population was initially recorded in the second week of October but in the next year i.e. 2003-04, its incidence was first noticed about one week later i.e. third week of Nobember during 2002-03 with a maximum of 1.2 larvae 5 plant^{-1}, but in 2003-04, it attained its peak (1.8 larvae 5 plants^{-1}) after two weeks i.e. the last week of November (Table 1 and Fig. 2). Similars observations were recorded earlier by Patil (1981) who reported that the two peaks of *E. atomosa* were observed in the second and the last week of November. It stated declining thereafter in both years. November was the most favourable period for the larval activity of *E. antomosa* on mid-late pigeonpea.

Similar trend was noticed in case of pupae, in both the years. In 2002-03, the pupal population of *E. atomosa* appeared in the second week of Obctober (0.2 pupae 5 plants^{-1}) while, in 2003-04, it appeared one wek late i.e. third week of October (0.2 pupae 5 plants^{-1}). The heighest peak of 0.98 pupae 5 plants^{-1} were observed in the third and fourth week of November in 2002-03 and 2003-04, respectively. Pathak and Shriram (2000), earlier, reported taht the active period of *E. atomosa* was September to November.

To sum up the mean collective population of both the pod borers based on pooled data showed a rising trend from middle of October to the end of November and a declining trend from December onwards, with their peak during the last three quarters of November. The data in Table 1, thus clearly revealed that the mid-late pigeonpea crop experiences the sufficient biotic pressure of both the species of pod borers.

The present findings provided the comprehensive account on the population build-up of pod complex in the mid late pigeonpea with particular reference to the agroclimatic conditions of the Vidarbha (Maharashtra).

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Field Evaluation of Bt Transgenic Cotton Hybrids Against Sucking Pests with Need Based Plant Protection Measures Under Rainfed Condition

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ABSTRACT

Population of aphids, thrips and whiteflies observed non-significant differences amongst various Bt, non-Bt and check hybrids. Maximum population of jassids was observed on MECH-12 Bt in spite of maximum number of spray. 3 to 9 sprays were required on Bt, 4 to 7 on non-Bt and three on check hybrids for control of sucking pests during crop season. Minimum sprays were required on MECH-184 Bt, PKV Hy-2 and NHH-44 and maximum on MECH-12 Bt.

Bt cotton is genetically modified cotton plant in which Cry 1 AC gene from *Bacillus thuringiensis,* a common soil bacterium, is introduced through genetic engineering (Rawat, 2002). Three Bt transgenic cotton hybrids i.e. MECH-12 Bt., MECH-162 Bt. and MECH-184 Bt developed by Mahyco in collaboration with monsanto have been released for commercial cultivation in India by Govt. of India (GEAC) in the month of March2002, initially for three years. These three Bt transgenic cotton hybrids along with their non-Bt counterparts and two check hybrids were evaluated for their performance against sucking pests with ETL based plant protection under rainfed condition.

MATERIAL AND METHODS

To study the effect of three Bt transagenic cotton hybrids against sucking pest, a field experiment was conducted in randomised block design with three replications and sowing was done of all cotton hybrids on 6 July, 2002 with the spacing of 90 cm x 60 cm. The weekly observations were recorded onthe population ofr sucking pests onrandomly selected five plants per plot on three leaves (top, middle and bottom starting from fifteen days after emergence of the crop and as and when the populationof sucking pest reached to ETL insecticidal sprays were undertaken to control these pests. The ETL for aphids, jassids, trhrips and whiteflies was considered as 10 aphids leaf^{-1}, 2 jassids leaf^{-1}, 10 thrips leafl^{-1} 8 to 10 whiteflies leaf^{-1} or 20 nymps leaf^{-1}, respectively under this study the observation on population of sucking pests i.e. aphid (*Aphis gossypii*), jassid (*Amarasca biguttula biguttula*) thrips (*Scirtothrips dorsalis*) and whiteflies (*bemisia tabacci*) were recorded at fornightly interval from 15 to 60 DAG and from this average popultion was worked out and transformed. The data obtained were subjected to statistical analysis and are presented in Table 1.

RESULTS AND DISCUSSION

The effect of various cotton hybrids on the population of sucking pests

1) Aphids : During the present investigation it was observed that there were no significant differences amongst the Bt transgenic cotton hybrids, non- Bt cotton hybrids and check hybrids NHH-44 and PKV Hy-2 as regards the population of aphids. Equal number of sprays (three) were required to be undertaken for control of aphids during the crop season on all the cotton hybrids irrespectively of Bt, non-Bt and check hybrids. Similar findings were reported by Anonymous (2002 c and 2002 b) in the respect of the population of aphid on Bt cotton hybrids, non-Bt, and check hybrids and that umber of sprays were required for Bt cotton and non-bt varieties.

2) Jassids - The results on average population of jassids presented in Table 1 revealed that maximum population of jassids nymphs was recorded o MECH-12 Bt (1.20 leaf^{-1}) which was at par with MECH-12

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Table 1. Effect of various cotton hybrids on average population of sucking pests under ETL based protection

S.N	.Cotton hybrids	Average population of sucking pests leaf^{-1}				No. sprays for sucking pests
		Aphids (*)	Jassids (**)	Thrips (**)	White flies (**)	
1.	MECH-12 Bt	21.79	1.20	1.00	0.18	9
		(4.67)	(1.29)	(1.22)	(0.82)	
2.	MECH-12NBt	21.59	0.80	1.06	0.48	7
		(4.64)	(1.14)	(1.24)	(0.96)	
3.	MECH-162 Bt	20.29	0.50	1.69	0.13	4
		(4.51)	(1.00)	(1.47)	(0.79)	
4.	MECH-162 NBt	17.99	0.32	1.47	0.88	4
		(4.24)	(0.90)	(1.40)	(0.76)	
5.	MECH-184 Bt	17.99	0.46	0.68	0.29	3
		(4.23)	(0.98)	(1.09)	(0.88)	
6.	MECH-184 NBt	18.98	0.39	0.64	0.17	4
		(4.35)	(0.94)	(1.06)	(0.82)	
7.	NHH-44	13.30	0.26	0.82	0.22	3
	(National check)	(3.58)	(0.87)	(1.11)	(0.85)	
8.	PKV Hy-2	22.78	0.52	0.93	0.23	3
	(Local check)	(4.74)	(1.01)	(1.19)	(0.86)	
	'F' test	N.S.	Sig	N.S.	N.S.	
	SE (m)±	0.24	0.06	0.104	0.06	
	CD at 5 %	-	0.19	-	-	

(*) Square root value, (**) $\sqrt{x + 0.5}$ transformed values

NBt (0.80 leaf^{-1}), in spite of maximum number of sprays on MECH-12 Bt (7) and MECH-12 NBt (4). Minimum population of jassids was recorded on national check NHH-44 (0.26 leaf^{-1}) and it was found at par with MECH 162 Bt, MECH-184Bt, MECH184 NbBt, MECH-162 NBt and PKV Hy-2. No sprays were required to be nudertaken for control of jassids on NHH-44, PKV Hy-2 and MECH-184 Bt. From these results MECH- 12 Bt and MECH-12NBt were found highly susceptible to jassids. Anonymous (2002 a) also reported similar type of results that MECH - 12 Bt and MECH - 12 NBt were more susceptible to jassids at all location in South Zone and required more number of sprays for sucking pests. Anonymous (2002 c) observed lowest population of jassids on PKV Hy-2 (8.75 on15 laves 5 plants^{-1} and maximum on MECH-12 Bt followed by MECH-12 NBt.

3) Thrips : The results in Table 1 revealed no significant differences amongst all the Bt, non-Bt and check hybrids as regards the population of thrips. However, one spray each on MECH-12 Bt, MECH-12 NBt, MECH-162 Bt, MECH-162NBt was required to be given for control of thrips, whereas no insecticidal sprays were required on MECH-184Bt, MECH-184NBt and check hybrids NHH-44 and PKV Hy-2 for control of thrips. Anonymous (2002 a) reported that in Central Zone Bt cotton hybrids (MECH-12, MECH-162 and MECH-184) recorded low population of thrips.

4) Whiteflies - The results presented in Table 1 revealed non-significantly differences among the Bt, Non-Bt and check hybrids as regards the population of whitefly and population was below ETL through out crop season on all the cotton hybrids. Anonymous (2002 c) observed minimum population of whitefly on MECH-12 Bt which was at par with MECH-12 NBt. Thus the per cent findings corroborate with the results of earlier workers.

5) Overall Population of Sucking Pests : The data on overall population of sucking pest i.e. aphids, thrips and whiteflies were non significant, whereas the data on population of jassids was significant and maximum population of jassids was recorded on MECH-12 Bt followed by MECH- NBt. However 3 to 9 sprays were required to be undertaken on Bt cotton hybrids for control of sucking pest during crop season whereas 4 to 7 on non-Bt and three on check hybrids as an dwhen the population reached to ETL.

These findings were supported by Anonymous (2002 a) who also reported that MECH- 12 Bt, MECH-12MBt were found more susceptible to jassids and required more number of sprays for sucking pests. Badrinarayana (2002) reported that Bt cotton still need control of other (non-lepidopteran) pests like sucking insects attacking the crop in early stage. Anomymous (2003) from findings of Matin Quim and David Zilbermann reported that since Bt gene did not protect against sucking pest the sprays were same for Bt and non-Bt varieties. The findings of rpesent investigation corroborate with earlier workers.

From the present investigation it can be concluded that no significant differences are found in the population of aphids, thrips and whiteflies on various Bt, non-Bt and check hybrids. Maximum population of jassids was observed on MECH-12 Bt in spite of maximum number of sprays. 3 to 9 sprays were required on Bt, 4 to 7 on non-Bt and three on check hybrids for control of sucking pests during crop season. Mimimum sprays were required on MECH-184 Bt, PKV Hy-2 and NHH-44 and maximum on MECH-12 Bt.

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Studies on Effect of Mulberry Cultivars on the Economical Parameters of *Bombyx mori* L.

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ABSTRACT

Mulberry silkworm race NB_4D_2 were reared on six different cultivars viz. S-799, S-1635 DD, M-5, S-13, S-36 and S-34 twice during September - Octobr and December - January 1999-2000 at Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

The results indicated that amongst the various mulberry cultivars S-13 was found most suitable for rearing of silkworms. Minimum larval period 26.39 days maximum weight of fullgrown larvae 2.974 (g), highest cocoon yield (408.94 g dfl^{-1}), minimum rendita 9.272 kg, fecundity 423.50 eggs and least larval mortality of 6.88 per cent was recorded due to rearing of mulberry silkworm NB4D2 on S-13, cultivar of mulberry.

Mulberry silkworm *Bombyx mori* L. is exclusively reared on the leaves of mulberry. The cocoon yield and its quality is reported to be affected by the mulberry cultivars as well as quality of leaves (Ullal and Narasimhanna 1987). Maharashtra being the non-traditional region in sericulture, the screening of mulberry cultivars for assessing their effect on silkworm is most important. Therefore the present investigations were made to assess the performance of bivoltine race NB_4D_2 on different mulberry cultivars in order to identify the suitable one or cultivars and identify the suitable one for rearing of silkworm in Vidarbha.

MATERIAL AND METHODS

Mulberry cultivars received from Central Silk Board, Bangalore, were grown as per the recommended agronomic packages (Krishnaswami, 1986) in the field of Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola and National Sericulture Seed Project Grainage, Bangolare. Rearing of silk worm was carried out as suggested by Datta, *et. al.*, (1996). The experiment was conducted with four replications and hundred larvae in each treatment. Observations were recorded on larval duration, Weight of fullgrown larvae, weight of cocoon, pupa, shell, cocoon yield dfl^{-1}, shell per cent, rendita. fecundity and mortality of worms when reared on different mulberry cultivars. For recording larval, pupal, shell per cent and cocoon weight 10 larvae and cocoons were randomly selected from each treatment. The observatons on larval mortality were recorded at each cleaning and after transfer on mountage. The data of two rearing was subjectd to statistical analysis after appropriate transformation.

RESULTS AND DISCUSSION

Larval duration : Mulberry silkworm NB_4D_2 reared on different cultivars had indicted their significant effect on larval duration. Larvae reared on S-13 cultivar took significantly minimum larval duration of 633.50 h (26.39 days) and it was at par with S-36 cultivars on which larval period was of 644.50 h (26.85 days). Maximum larval duration of 678.00, 682.80 and 686.50 h (i.e. 28.25, 28.45 and 28.60 days) was noticed due to rearing of worms on S-1635, M-5 and S-799 and all these mulberry cultivars were observed at par with each other.

Weight of fullgrown larvae : The pooled data of two rearing indicated that silkworm reared on S-13 cultivars recorded maximum 2.974 g weight of full grown larva and was a par with S-799 (2.804 g). Minimum larval weight was recorded due to feeding on DD cultivar (2.527 g) followe by muberry cultivars viz. S-36, M-5 and S-34 which recorded 2.622, 2.705 and 2.537 g larval weight, respectively, and were at par with each other.

Cocoon weight : There was significant effect of mulberry cultivar on cocoon weight. Larvae reared on S-36 cultivar spun significantly heavier cocoons (1.304 g $cocoon^{-1}$). Significantly minimum weight of cocoon was observed on DD (1.087g $cocoon^{-1}$),

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Table 1. Effect of mulberry cultivars on economical parameters of *Bombyx mori* L.

S.N.	Cultivar	Larval duration (days)	Larval weight (g)	Cocoon weight (g)	Pupal weight (g)	Shell weight (g)	Cocoon yield (dfl^{-1})	Shell per cent	Rendita kg	Fecundity	Mortality (%)
1.	S-799	686.50d	2.804	1.130	0.948	0.181	351.50	16.02	8.155	335.00	12.63
		(28.60)$	ab	cd	cd	d	c	(3.988)** c	a	d	(3.55) * d
2.	S-1635	678.00 cd	2.740	1.210	0.894	0.316	348.88	26.1	8.026	348.37	11.63
		(28.25)	bc	b	de	a	cd	(5.167) a	a	d	(3.44) cd
3	DD	666.50 b	2.527	1.087	0.853	0.234	340.06	21.17	9.100	373.25	10.63
		(27.77)	c	d	e	b	d	(4.599) b	ab	cd	(3.25) c
4	M-5	682.80 d	2.705	1.192	0.999	0.193	397.46	16.16	11.004	403.50	11.00
		(28.45)	bc	bc	bc	cd	d	(4.016) c	cd	abc	(3.31) cd
5	S-13	633.50 a	2.974	1.184	0.973	0.211	408.94	17.94	9.272	423.50	6.88
		(26.39)	a	bc	bc	bcd	a	(4.24) c	abc	ab	(2.62) a
6	S-36	644.50 a	2.622	1.304	1.080	0.224	392.80	17.18	11.489	446.12	8.63
		(26.85)	bc	a	a	bc	b	(4.14) c	d	a	(2.93) b
7	S-34	669.00 bc	2.537	1.231	1.013	0.218	358.29	17.70	10.534	381.65	7.88
		(27.87)	c	b	b	bc	c	(4.207) c	bcd	bcd	(2.80) ab
	F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	SE (m)±	3.35	0.071	0.023	0.018	0.012	3.78	0.010	0.606	16.78	0.08
	CD at 5%	9.96	0.213	0.069	0.055	0.036	11.30	0.311	1.800	49.87	0.24

* Figure followed by same letter are at par

** Figures in parentheses are square root transformation.

$ Figures are of hours converted to days

followed by S-799 (1.130 g) and both these cultivars were found at par with each other. Moderate cocoon weight of 1.231, 1.210, 1.192 and 1.184 g cocoon^{-1} was recorded due to feeding on S-34, S-1635, M-5, S-13 cultivar, respectively.

Pupal weight : Significantly maximum pupal weight of 1.080 g was recorded due to rearing of silkworm larvae on S-36 cultivar. The next better cultivar which recorded higher pupal weight were S-34, M-5 and S-13 where 1.013, 0.999 and 0.973 g pupal weight was recorded, respectively. Least pupal weight was observed due to rearing on mulberry cultivar DD.

Shell weight : Significantly maximum shell of 0.316 g was observed due to rearing of silkworms on S-1635. The other cultivar which recorded higher shell weight as compared to M-5 (0.193 g) and S-799 (0.181g) were DD (0.234 g), S-36 (0.224 g) and S-34 (0.218 g). However, cultivars S-13 was found at par with all these cultivars recording 0.211 g shell weight.

Cocoon yield : Significanlty maximum cocoon yield was obtained from S-13 cultivar (408.94 g cocoon dfl^{-1}). The next cultivars which recorded higher cocoon yield were M-5 (397.46 g dfl^{-1}) and S-36 (392.80 g dfl^{-1}). Significantly minimum cocoon yield dfl^{-1} was recorded due to rearing of silkworm on DD (340.06 g) and S-1635 (348.88 g) and were at par with each other.

Shell per cent :Maximum shell per cent was observed due to feeding of cultivar S-1635 (26.15 %) and it was significanlty more than other cultivars. Cocoons harvested from DD recorded 21.17 shell pe cent and was significantly more than S-13, S-34, S-36, M-5 and S-799 where 17.94, 17.70, 17.18, 16.16 and 16.02 shell per cent was recorded, respectively.

Rendita : Minimum rendita of 8.026 kg was observed due to rearing of silkworm with mulberry cultivar S-1635 followed by S-799, DD and S-13 which recorded 8.155, 9.100 and 9.272 kg rendita, respectively and they were at par with each other. Maximum rendita 11.489, 11.004, 10.534 kg was evidenced when the larvae were rearing on S-36, M-5 and S-34 cultivar of mulberry, respectively.

Fecundity : Significantly maximum fecundity of 446.12 was found due to feeding of S-36 cultivar and was at par with S-13 (423.50) and M-5 (403.50). Minimum fecundity of 335.00, 348.37, 373.25 and 381.62 was noticed with S-799, S-1635, DD and S-34 mulberry cultivars, respectively.

Mortality : Significantly minimum mortality was recorded due to feeding on S-13 cultivars 6.88 per cent and was at par with S-34 (7.88 %). Maximum mortality (12.63%) was recorded due to rearing of silkworm with S-799 followed by S-1635 (11.63%) and M-5 (11.00%). All these cultivars were at par with each other.

The present studies revealed that for rearing of NB_4D_2 race of silkworm in Vidarbha climatic condition S-13 cultivar of mulberry is found to be most suitable one than the existing recommended.

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Performance of Liquid Pheromone Against *Helicoverpa armigera* (Hubner) Hardwick on Cotton

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ABSTRACT

A study was undertaken to assess the performance of liquid pheromone alone and in combinations with botanicals and biopesticide in population suppression of *Helicoverpa armigera* on cotton alongwith conventional insecticides. *Helicoverpa* pheromone 7.5 ml ha^{-1} + HaNPV 250 LE ha^{-1} recorded superior result in reducing the per cent infestation of *Helicoverpa armigera* on green fruiting bodies with minimum per cent damage of bolls, 7 and 10 days after treatment, followed by *Helicoverpa pheromone* 7.5 ml ha^{-1} + NSE 5 per cent and *Helicoverpa pheromone* 7.5 ml ha^{-1} + Neem oil 3 ml lit^{-1} and the alone treatment of *Helicoverpa pheromone* 15 ml ha^{-1} . The botanicals viz. NSE 5 per cent and neem oil 3 ml lit^{-1} were found better than the control plot. Similar trend was found in reducing per cent of bad *Kapas* with higher yield of seed cotton. Thus, addition of HaNPV 250 LE ha^{-1} to *Helicoverpa pheromone* and mixing of NSE and Neem oil with *Helicoverpa pheromone* caused deorientation of *Helicoverpa armigera* males and brought about reduction in the per cent infestation and ultimately increased yield of seed cotton.

Cotton (*Gossypium* spp.) is one of the most important cash crop in India. There is an increasing trend of growing cotton crop, but the production level of the crop is far from satisfaction. The attack on insect pests is one of the limiting factor for low production. American bollworm, *Helicoverpa armigera* (Hubner), Hardwick (Lepidoptera : Noctuidae) is one of the most serious and alrming pest of this crop in India. The year 1997-98 was dominated due to the attack of *H. armigera* (Sarode, 1999). Although, various insecticides have been recommended, the excessive and indiscriminate use of insecticides to control *H. armigera* led to many complex and diversified problems like development of resistance in insect to insecticides (Lande and Sarode, 1995), pest resurgence, toxicity hazards to mammals, adverse effect on bio-agent and environment (Annonymous, 2001). The efforts were being made to search upon not only effective but safe and eco-friendly alternative measures to insecticides for management of Ameraican bollworm on cotton.

Now a days, utility of pheromone in IPM programme is considered to be an essential component as a direct pest supression measure (Yadva, 1999) and Tamhankar *et. al.*, 2001). The pheromones cause the deorientation of male insect which make disruption in mating. Worlds of Sarode (1989), regarding pheromone status in India as 'conception of idea is completed but delivery action is awaited hold still good today.' Botanicals significantly affect the growth and development of *H. armigera* on cotton (Morale, *et al.*, 2000) and offer a reliable, economic and eco-friendly solution against the pests (Gahukar, 1998). Among the bio-agent, Nuclear Polyhedrosis virus (NPV) is a miraculous bio-agent, most extremely studied for its virulence (Fuxa and Ritcher, 1992).

The present study was undertaken to test the performance of *Helicoverpa* pheromone, as a liquid formulation alone and in combination with botanicals and biopesticide to resolve the problem of *H. armigera* on cotton.

MATERIAL AND METHODS

An investigation on the performance of liquid pheromone against *Helicoverpa armigera* on cotton was conducted in the experimental field on Department of Entomology, College of Agriculture, Nagpur (M.S.) during the *Kharif* season 2002-2003. The experiment was conducted with nine treatments viz. *H. pheromone* 15 ml ha^{-1} , 7.5 ml ha^{-1} + Neem oil 3 ml lit. of water *H. pheromone* 7.5 ml ha^{-1} + Neem Seed Extract (NSE) 5 per cent, Neem oil 3 ml $lit.^{-1}$, NSE 5 per cent, *H. Pheromone* 7.5 ml ha^{-1} + HaNPV 250 LE

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ha^{-1}, HaNPV 250 LE ha^{-1} , Endosulphan 35 EC 0.07 per cent and control (Water spray) replicated thrice in randomized block design (RBD) on cotton crop (Variety : PKV Hy-4) which was sown on 1st July 2002. HaNPV and Neem seed extract were prepared in the laboratory of Entomology section, College of Agriculture, Nagpur for experimentation, while the liquid pheromone, Neem oil and endosulfan were obtained from different sources.

Periodical observations were made for incidence of American bollworm prior to first application on green fruiting bodies and as soon as the level of infestation reached economic threshold, the first application was made. However, the subsequent treatments were given at 15 days interval. For recording observations, five plant were selected randomly from each plot and labelled. The pre-treatment observations were recorded 24 hours before and post-treatment observation at 7 and 10 days after the application of each treatment. Requistic observations were recorded at different growth periods of cotton crop to generate the data on per cent infestation on green fruiting bodies and per cent damage of bolls (Cut-open method). The observations were further pooled together for computing cumulative per cent infestation. Similarly, the per cent of bad *Kapas* (Bad Seed Cotton) and the yield of seed cotton was noted from the net plot, treatments and replicationwise. The data thus obtained parameterwise were subjected to statistical analysis.

RESULTS AND DISCUSSION

Persual of the data, 7 days after all three spray (Table 1) revealed that, the lowest per cent infestation 4.47 per cent was recorded in endosulfan (0.07%). Next to endosulphan, the combination treatment *H.* pheromone 7.5 ml ha^{-1} + HaNPV 250 LE ha^{-1} which was found significantly superior over all the remaining treatments recorded 6.61 per cent infestation followed by HaNPV 250 LE ha^{-1} alone, combination treatments *H.* pheromone 7.5 ml ha^{-1} + NSE 5 per cent and *H.* pheromone 7.5 ml ha^{-1} + Neem oil 3 ml lit^{-1} and *H.* pheromone 15 ml ha^{-1} alone which were found effective in reducing the per cent infestation of *H. armigera* on green fruiting bodies and were found at par with each other. Other treatments, NSE 5 per cent and Neem oil 3 ml lit^{-1} were found significantly superior over control and recorded 13.91 per cent infestation. More or less similar trend was noticed on cumulative per cent infestation on green fruiting bodies, 10 days after all three sprays. Gupta and Shrivastava (1998) observed promising results of combination of insecticide with pheromone over control in minimizing bollworm infestation. Sarode *et. al.*, (1996) also recorded superior efficacy of biopesticides over botanical which was in agreement with present findings.

The data on per cent damage of bolls (Cut-open method) examined 7 DAT revealed that, the boll damage was lowest in the treatment endosulfan 0.07% (i.e. 14.51%) followed by combination treatment *H.* pheromone 7.5 ml ha^{-1} + HaNPV 250 LE ha^{-1} (17.18%). Next effective treatments were HaNPV alone, combination of *H. pheromone* with NSE and Neem oil. The similar results were observed 10 days after treatment on per cent damage of bolls. Sreenivas and Patil (2001) also reported superiority of endosulfan over botanicals in reducing per cent boll damage and increased yield of seed cotton.

Average per cent of bad *Kapas* (Bad seed cotton) presented in Table 1 revealed that, application of endosulphan 0.07 per cent was found effective then other treatments. The combination treatment *H.* pheromone 7.5 ml ha^{-1} + HaNPV 250 LE ha^{-1} was found effective in minimizing the percentage of bad *Kapas* to the extent of 16.22 per cent as against 26.24 in the control plot.

The yield of seed cotton was significantly highest in the treatment endosulphan 0.05 per cent (14.46 q ha^{-1}) and combination treatment *H.* pheromone 7.5 ml ha^{-1} + HaNPV 250 LE ha^{-1} (12.82 q ha^{-1}) followed by HaNPV (12.30 q ha^{-1}), combination treatments *H.* pheromone + NSE (11.71 q ha^{-1}) and *H.* pheromone + Neem oil (10.96 q ha^{-1}) and *H.* pheromone alone (10.29 q ha^{-1}). The other alone treatments , NSE and Neem oil also produced significantly higher yield than control plot (7.84 q ha^{-1}). The findings of combination treatments are comparable with the result of Sanga Reddy and Patil (1995) who used combination of pheromone and insecticides against pink bollworm.

The combination of liquid pheromone and insecticides treatments conducted by Srinivasan and venugopal (1999) supported the present findings in reducing per cent infestation and ultimately increased yield of seed cotton. The alone application of liquid pheromone treatment was supported by the observation of Frerot, *et. al.*, (1997) who used liquid

Table 1. Performance of liquid pheromone against *H. armigera* infestation and yield of seed cotton

S.N.	Treatments	Cumulative per cent infestation on green fruiting bodies		Per cent damage of bolls (Cut open method)		per cent bad kapas (Bad seed cotton)	Yield of seed cotton (q ha^{-1})
		7 DAT	10 DAT	7 DAT	10 DAT		
T_1	*Helicoverpa pheromone* 15 ml ha^{-1}	8.71 (2.95)	9.08 (3.00)	19.95 (4.46)	21.86 (4.67)	20.29 (4.50)	10.29
T_2	*Helicoverpa pheromone* 7.5 ml ha^{-1} + Neem oil 3 ml lit^{-1}	7.98 (2.82)	8.51 (2.91)	19.05 (4.36)	20.92 (4.57)	19.61 (4.43)	10.96
T_3	*Helicoverpa pheromone* 7.5 ml ha^{-1} + NSE 5%	7.46 (2.72)	7.72 (2.77)	18.60 (4.31)	19.78 (4.45)	18.52 (4.28)	11.71
T_4	Neem oil 3 ml lit^{-1}	10.40 (3.22)	10.50 (3.23)	21.86 (4.67)	23.26 (8.82)	23.14 (4.80)	9.76
T_5	NSE 5%	8.98 (2.98)	9.56 (3.09)	21.11 (4.59)	22.28 (4.72)	20.92 (4.57)	10.18
T_6	*Helicoverpa pheromone* 7.5 ml ha^{-1} + HaNPV 250 LE ha^{-1}	6.61 (2.56)	6.94 (2.62)	17.18 (4.14)	18.44 (4.29)	16.22 (4.02)	12.82
T^7	HaNPV 250 LE ha^{-1}	7.21 (2.66)	7.48 (2.72)	18.08 (4.25)	18.98 (4.35)	17.12 (4.13)	12.30
T_8	Endosulfan 35 EC 0.07%	4.47 (2.01)	4.76 (2.15)	14.51 (3.81)	15.57 (3.94)	13.86 (3.71)	14.46
T_9	Control (Water spray)	13.91 (3.71)	14.29 (3.77)	25.26 (5.02)	26.68 (5.16)	26.34 (5.13)	7.84
	'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	SE (m) ±	0.047	0.053	0.094	0.103	0.097	0.52
	CD at 5%	0.13	0.16	0.28	0.31	0.29	1.56

Note : Figures in parentheses are the corrosponding square root trasformation values.

pheromone for mating disruption in controlling the *Sesamia nanagrioidas* on maize.

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Fertility Restorers Isolated From Germplasm For Cytoplasmic Male Sterility in Pigeonpea

K.B. Wanjari[1] and M.C. Patel[2]

ABSTRACT

Fertility restorers were investigated for two sources of cytoplasmic male sterile (CMS) lines. CMSGT-288A derived from wild Cytoplasm of *Cajanus scarabaeoides* and AKCMS-1 derived with the cytoplasm of *C. volubilis* were used to develop hybrids with 535 different pollinators. The hybrids were tested for pollen fertility using 1 per cent potassium iodide-iodine (KII) Stain.Seven hybrids were partially fertile. Their pollinators viz., AKT 8811, AKT 9221, AKT 9227, AKT 9620, ICP 10875, ICP 8863 and TAT 9402 were suspected to have source of genes for fertility restorer. The six of the partialy fertile hybrids had few complete sterile plants and some with less than 10 per cent pollen fertility and smaller size of pollen grains. A single hybrid of ICP 10875 had few highly fertile plants with normal size pollen as that of cultivated varieties. Thus, ICP 10875 was expected to be a better source of fertility restorer.

Stable cytoplasmic male sterility has been established in pigeonpea using wild cytoplasmic sources from *C. scarabaeoides* (Tikka *et. al.*, 1997) and *C. volubilis* (Wanjari *et. al.*, 1999). The cytoplasmic male sterility needs fertility restorer to promote its use in heterosis breeding in grain crops like pigeonpea. Hence, search was made to identify effective fertility restorer lines from the germplasm as well from the various recombinat lines available from the breeding programme. They included the derivatives from intervarietal crosses as well as interspecfic crosses involving *C. scarabaeoides, C. sericeus* and *C. volubilis* as one of the parents in their ancestral pedigree records. Present report given few observations regarding search of the fertility restores for two sources of cytoplasmic male sterility in pigeonpea.

MATERIAL AND METHODS

CMSGT-288A established with the wild cytoplasmic background of Cajanus scarabaeoides (Tikka *et. al.* 1997) and AKCMS-1 developed with the cytoplasm of C. volubilis (Wanjari *et. al.*, 1999) were used as the female parents with different 166 lines from cultivated germplasm and 157 from derivates of intervarietal crosses and 212 from interspecific crosses (Table 1) available from breeding materials. They were used as male pollinators. Approximately 5 to 10 hybrid seeds produced in each cross were used to raise the crop in the next season. These hybrids were then tested for pllen fertility using 1 per cent potassium iodide-iodine (KII) stain, prepared in 70 per cent ethyl alcohol. The pollinators producing partial fertile to fertile hybrids were identified. They were marked as a source of fertility restorers for respective cytoplasmic male sterility. Such testing was repeatedly done each year during 1998 to 2001 using new set of genotypes as the pollinators.

RESULTS AND DISCUSSION

Number of pollen parents used as pollinators of the hybrids raised during 1999 to 2002 on each of the two cytoplasmic male sterile sources is given in Table 1 and the fertility status of the hybrids recorded in each year is presented in Table 2. Test of 535 pollinaors were conducted during three years from 1999 to 2001. All the hybrids on AKCMS-1 were complete sterile indicating lack of restorer for this CMS. Among the hybrids on CMSGT-288A, nine lines produced partial fertile hybrids. The sterile hybrid plants showed dimorphism with while or yellow colour of anthers. Yellow anthers further expressed variation in terms of dehiscence. The pollen grains dehisced, however, were complete sterile. It was generally observed that the sterile pollen grains varied in staining ability with potassium iodide iodine (KII) stain. Some of them were hollow without any staining irrespective of time lapse after smearing them

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Table 1. Test of pollinators as fertility restorers on CMS GT-288 and AKCMS-1

S.N.	Pollinators used from	Number of hybrids tested in each year			
		1999	2000	2001	Total
1.	Germplasm of cultivated pigeonpea	61	52	53	166
2.	Derivatives from breeding programme based on				
2 a	Variety x Variety crosses of *C. cajan*	112	23	22	157
2 b	Involving wilt species as one of the parents in their ancestry				
	C. sericeus	74	14	12	100
	C. scarabaeoides	40	3	3	46
	C. volubilis	54	6	6	66

Table 2. Pollen fertility status of the hybrids tested

S.N.	Fertility status	Number of hybrids observed during			
		1999	2000	2001	Total
A.	**Hybrids of CMSGT 288A (Cytoplasm sources *C. Scarabaeoides*)**				
1.	Complete fertile (100% hybrid plants were fertile)	0	0	0	0
2.	Partial fertile (Some hybrids plants having fertile pollen and some with sterile pollens)	0	04	3	7
3.	Complete sterile pollen grains @	341	94	93	528
B.	**Hybrids on AKCMS-1 (Cytoplasmic source *C. volubilis*)**				
1.	Complete fertile or partial fertile	0	0	0	0
2.	Complete sterile	341	98	96	535

@ 100 per cent hybrid plants were sterile

Table 3. Pollen fertility percentage in the partial fertile hybrids on CMS GT 288 A

Year of obser-vation	Pollinator parent @	No. of plants tested	Pollen fertility %	Average size of fertile pollun μ (± SE)
2000	AKT 8811	7	2.33 to 7.67	26.30 ± 12.07
	AKT 9221	9	4.05 to 7.00	24.55 ± 12.10
	AKT 9227	10	0.00 to 8.37	26.66 ± 6.03
	AKT 9620	9	0.00 to 6.67	25.15 ± 9.91
2001	ICP 10875	6	0.00 to 90.47	43.70 ± 11.30
	ICP 8863	4	0.50 to 7.28	27.10 ± 9.11
	TAT 9402	3	0.00 to 8.85	26.90 ± 8.93

@ Origin of all was from cultivated *C. cajan*.

in the stain on glass slide. But some sterile pollen grains turned yellow to orange in colour after 20 to 100 seconds. However, they failed to turn dark blue even after the staining time of about 3 minutes. Normally the fertile pollen in cultivated types turned dark blue within 20 to 30 seconds after smearing in the stain. The sterile pollen grains varied in shape. Some of them were round, triangular or irregular in

shape. They were also much smaller in size in the range of 20 to 35 μ as against 40 to 70 μ in cultivated genotypes.

The hybrids having fertile pollen grains also expressed variation in terms of anther colour, anther dehiscence and also in staining of the pollen in 1 per cent KII stain. Under present investigations the fertility scored was strictly based on the dark blue stained pollen grains in relation to total number, observed in 10 to 20 microscopic fields.

The partial fertile hybrids (Table 3) had some sterile plants with white or yellow anthers without pollen grains or with partially dehiscent yellow anthers but with complete sterile pollen grains. It is interesting to note that the hybrids CMSGT 288T x ICP10875 had high amount of fertility with considerably bigger averge size of fertile pollen size (43.70 + 11.20 μ) as compared to other hybrids. All other six hybrids had smaller pollen grains in the range of 24.55 to 27.10μ. The seven pollinators producing partially fertility hybrids orginated from cultivated pigeonpea. ICP 10875 is a germplasm line collected from Taiwan, as indicated by the available passport data (Ramanandan and mangesh, 1988).

The fertility restores are rare in the cultivated pigeonpea germplasm, as reported earlier by Patel (2000) and Sanena *et. al.*, (2002). Thus, ICP 10875 may be a better source of fertility restorer, which needed confirmation with larger number of hybrid plants developed through CMS.

In next season 18 hybrids based on 18 pollinator plants of ICP 10875 were grown. Each of them had 3 to 17 hybrid plants. Even of them had less than 10 plants which could be tested for pollen fertility at flowering. These Plants however, were not uniform in terms of anther colour and anther dehiscence. One of the them however, had all the plants (4 in number) with while transclucent sterile anthers. Four hybrids had all plants with yellow anthers with good amount of pollen dehiscence. With limited number of plants, it is tentatively concluded that the parental line ICP 10875 is not genetically uniform and homozygous for the genes responsible for fertility restoration in the hybrids on cytoplasmic male sterility. The extreme expression of complete sterile hybrid with all plants having translucent white anthers, suspects about such genetic heterozygosity in some of the plants in female parent as well. Another possibility is of complexities of interaction of regular, modifier genes for the white vs yellow anther colour and their dehiscence. The fertility restoration in hybrid should necessarily express yellow anthers, high amount of pollen dehiscence from anthers, high pollen fertility and normal pollen size as that of cultivated genotypes which finally must result into high amount of pod setting in the hybrids. Heredity of these characters may be studied and unveiled individually. Systematic studies of the genetics of each of these fertility restoration traits responsible to produce highly fertility hybrids are needed. Good and stable fertility restorer must govern the fertility in the hybrid with minimum influence of environment.

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Optimisation of Control Locations of Tractor Operator Workplace

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ABSTRACT

The study was undertaken to optimise control locations with respect to seat reference point (SRP) on the tractor operator's workplace under laboratory conditions. Non-uniformity in the placement of clutch, brake and hydraulic control lever from SRP in the tractor workplace of different tractor models were observed. The optimum forward horizontal distance and vertical distance of clutch and brake pedal from SRP was found to be 65 cm and 36 cm respectively. While the lateral location of the hydraulic control lever was 34 cm from SRP. The energy expenditure rate corresponding to the optimum locations was 12.3 KJ min^{-1} and 75 beats min^{-1} . A comparison of most suitable control location with the existing control locations of Indian tractors indicated that the existing locations need to be shifted from their present positions to more comfortable position.

A successful tractor development makes technical progress profitable for both the farmers and the tractor manufacturers. Plenty of design improvements have been carried out in tractors in past dacades. Since 1970 much more emphasis is placed on the operator's comfort and safety. The design of the modern tractors includes human factors consideration. To achieve better efficiency of performance and human comfort it is necessary to design the equipment keeping in consideration the operator's capabilities and limitations (Gite and Yadav, 1989).

The driving platform of the modern tractor forms a complex arrangement of seat, controls and instrumentation. The placement of these controls is a complex task for the designers who must take into account the anthropometrical characteristics of the target population and biomechanical properties of human limb and trunk (Pheasant and Harris, 1982). Each tractor manufacture tries to find out the best technical solution of the problem of assembling of different parts to the smallest space without paying much attention to the fatigue and strain the product may cause to the operator (Lehman, 1958).

The location of the main controls such as clutch, brake, steering wheel and hydraulic control lever varies widely in the different models of the tractor. Operating a tractor vehicle imposes definite levels of physical and mental performance stresses upon the operator. If the operator's controls are not properly adapted to his anatomy, the demanded performance of him may quickly reach and even sometimes exceeds the limits of tolerance. As a result of excessive stress, premature fatigue and impaired health, the possibilities of accident will increase (Henrich Dupis, 1959).

Therefore the lcoation of the control should be such that these are easily accessible to the operator. The energy spent by the operator is dependent upon the frequency of operation of the controls and their respective locations. Hence uniformity in the placement of these controls is extremely important for putting identical metabolic demand on the subject in all tractors (Henrich Dupuis, 1959).

In India, substantial efforts have not been done on this aspect (Rajvir, 1995). Hence in the present study attempt has been made to find out the optimum locations of the controls with respect to the seat reference point (SRP) under laboratory conditions on the workplace simulator.

MATERIAL AND METHODS

The tracor workplace simulator designed by earlier research workers was used to evaluate the optimum locations of the controls such as brake, clutch and hydraulic control lever in laboratory conditions. Figure 1 shows the schematic diagram of the Tractor workplace Simulator. The simulator was equipped with suitable brake, clutch, hydraulic control lever, seat and steering unit. Provisions were made on the simulator to vary the locations of the controls with respect to seat reference point (SRP).

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Gibrated tensile springs were attached to the pedals to provide equivalent force needed to operate brake and clutch. The positions of the pedals could be adjusted in vertical as well as in horizontal direction to match the required configuration of the workplace. The seat vibrations could be varied by adjusing the amplitude and the frequency of the simulator. The amplitude adjusting mechanism was drived by electric motor (5 hp), through speed controlling unit.

The effects of various workplace parameters were studied at desired vibration level, which was the representative of those obtained in the field test. The other field activities of the operator like frequency of backward views, operation of brake, clutch and hydraulic control level were simulated in the laboratory. The subject was exposed to a predetermined period and a predetermined level of the parameter under study.

Factorial randomized block design was used in conducting the experiment. The design parameters selected for the study were the forward horizontal distance (Sf) and vertical distance (Sv) of clutch and brake pedal from SRP and the lateral horizontal distance of hydraulic control lever (L) from SRP. In all, 27 combinations of control locations were studied. Three levels of forward horizontal distance were Sf_1(55 cm), Sf_2 (65cm), and Sf_3 (75 cm). The levels of vertical distance for clutch and brake pedal were Sv_1 (36 cm), Sv_2 (40 cm) and Sv_3 (44 cm). Similarly the lateral locations of hydraulic control lever were kept at L_1 (29 cm), L_2 (31.5 cm) and L_3 (34 cm) from SRP. the physioloical response (heart rate) of the operator was considered as dependent variable. Each combintion was replicated three times.

The 50th percentile subject was selected who represents the average Indian tractor operator population. The tractor operator's task on the simulator involves operation of foot pedals, hydraulic control lever and tractor driver's activities to make him adopt a sitting posture similar to driving the tractor in the field and was also subjected to the constant level of acceleration of 3.5 m/sec^2 through amplitude adjusting mechanisms. The heart rate of the subject was monitored by the telemetry and cardiomin before and immediately after the end of each individual task. A task set in each case of the combination was of 12 minute duration. The different activities in a task of operation were predetermined and allotted randomly to the opertor during the course of single task duration on the vibrating simulator. These activities were simulated with the help of a control level task simulation-indicating panel. The indicating panel had the different colour electric bulbs (each of 25 watt) and a buzzer bell signal. Indications were given to the operator by glowing of a particular bulb and by sounding a buzzer bell. The allotment of task activities during simulation were random. The operator was asked to perate clutch, brake and hydraulic control lever 1, 2 and 3 times min^{-1} during the given individual task. These activities of the tractor operator were found inthe field and it was simulated in the laboratory conditions on the workplace simulator. The tractor operator was allowed to take sufficient rest between the individual tasks. This procedure was followed for each of the control location combination under study.

The data obtained was analysed to obtain ANOVA, energy expenditure rate and regression model.

RESULTS AND DISCUSSION

Table 1 shows the observed data of the physiological response (heart rate) of the subject while working at different control location combinations. The analysis of variance indicated that the replications were insignificant. The brake and clutch pedal locations both vertical and horizontal had significant effect on the heart rate of the subject. Lateral locations of hydraulic control lever had significant effect on heart rate at 1 per cent level. The interactions of the vertical and horizontal locations of breake and clutch pedal had significant effect on the heart rate of the subject. The interactions of Sf x L and Sv x L had significant effect on heart rate of the subject. However the interactions of Sf x Sv x L were found insignificant. There was decrease in heart rate with increase in forward horizontal distace (Sf), which started increasing at 65 cm in all three levels of verticl distance of pedals (Sv). The heart values were minimum at vertical pedal location of 36 cm and at this location heart rate values were ranged from 79.66 to 80.85 beats min^{-1} (Fig 2). With increase in Sf, heart rate decrease initially and started increasing further after a distance of 65 cm for all three levels of L (Fig. 3). But marginal variation was observed in heart rate at different values of L. The minimum values of heart rate were obtained at L_1. There was increase in heart values with increase in vertical pedal locations at different levels of Sf (Fig. 4). The

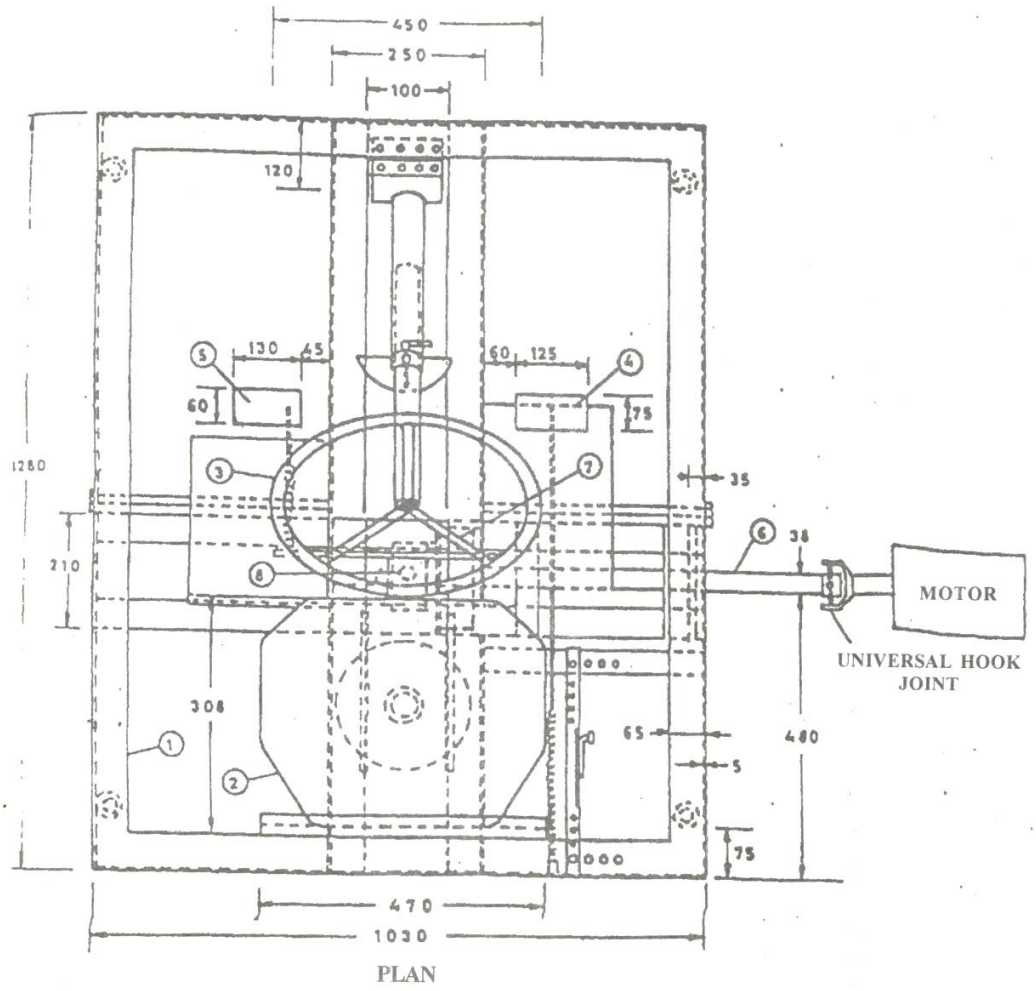
Table 1. Heart rate, energy expenditure rate (EER) and oxygen consumption rate at different control locations combinations on workplace simulator

Control lcoation combination	Heart rate (beat min^{-1})	Oxygen Consumption rate (lit min^{-1})	Energy expenditure rate (KJ min^{-1})
$Sf_1Sv_1L_1$	82.87	0.798	16.20
$Sf_1Sv_1L_2$	81.00	0.765	15.54
$Sf_1Sv_1L_3$	78.76	0.726	14.74
$Sf_1Sv_2L_1$	88.40	0.896	18.19
$Sf_1Sv_2L_2$	85.14	0.838	17.01
$Sf_1Sv_2L_3$	82.87	0.798	16.20
$Sf_1Sv_3L_1$	90.10	0.926	18.80
$Sf_1Sv_3L_2$	87.42	0.879	17.84
$Sf_1Sv_3L_3$	85.72	0.873	17.00
$Sf_2Sv_1L_1$	72.83	0.621	12.61
$Sf_2Sv_1L_2$	83.86	0.639	12.97
$Sf_2Sv_1L_3$	75.00	0.656	12.33
$Sf_2Sv_2L_1$	75.10	0.661	13.42
$Sf_2Sv_2L_2$	75.90	0.675	13.75
$Sf_2Sv_2L_3$	77.58	0.705	14.31
$Sf_2Sv_3L_1$	79.22	0.734	14.90
$Sf_2Sv_3L_2$	80.21	0.751	15.26
$Sf_2Sv_3L_1$	81.51	0.774	15.73
$Sf_3Sv_1L_1$	80.57	0.758	15.39
$Sf_3Sv_1L_2$	80.00	0.748	15.19
$Sf_3Sv_1L_3$	78.70	0.724	14.72
$Sf_3Sv_2L_1$	82.71	0.795	16.16
$Sf_3Sv_2L_2$	80.57	0.758	15.39
$Sf_3Sv_2L_3$	78.53	0.721	14.65
$Sf_3Sv_3L_1$	84.97	0.835	16.97
$Sf_3Sv_2L_2$	82.61	0.800	16.24
$Sf_3Sv_2L_3$	80.72	0.760	15.43

minimum values were obtained at Sf_2 location with increasing Sv. At Sf_1 location the nature of the curve is different than the other, it might be the fact that, the operator was not in a position to stretch his legs fully while operating the controls.

The effect of Sv at different levels of L on the heart rate is shown in Fig. 5. Heart rate values were found to increase more rapidly with increase in Sv. At L_3 location the minimum heart rate values were obtained ranging from 77.36 to 82.65 beats min^{-1}.

The effect of L on heart rate of subjects at different levels of Sf is shown in Fig. 6. Decrease in heart rate was observed with increase in L at the same level of Sf but with an exception of Sf_2. The minimum values at Sf2 were observed in the range of 75.72 to 78.03 beats min^{-1}.



1. FRAME
2. SEAT
3. STTERING
4. FOOT PEDAL
5. DRAFT CONTROL LEVER
6. AMPLITUDE ADJUSTMENT MECHANISM
7. POWER TRANSMISSION UNIT
8. CONNECTINGROD

Fig. 1. Tractor operator work place simulator - Top view

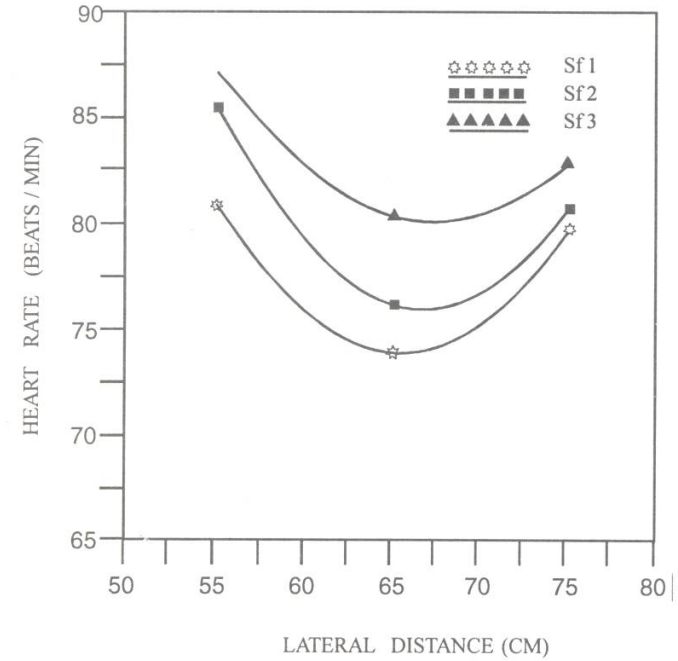


Fig. 2. Effect of horizontal distance of clutch and brake pedal on heart rate

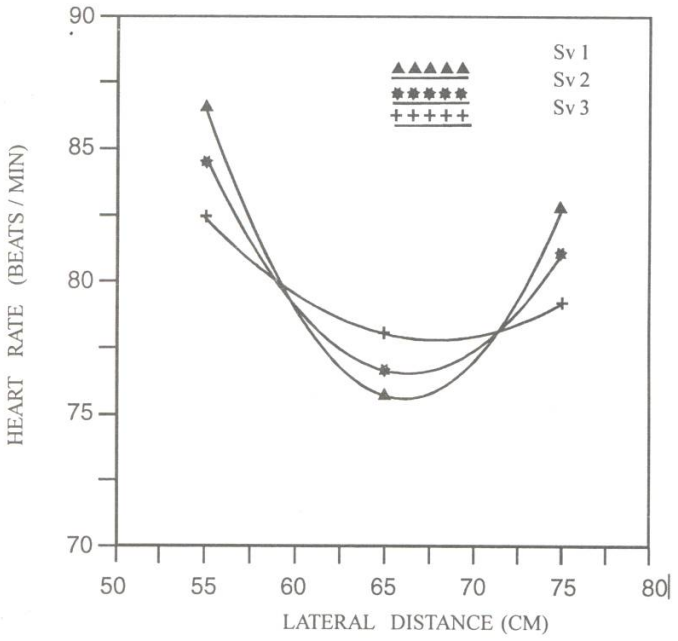


Fig. 3. Effect of horizontal distance of clutch and break pedal on heart rate

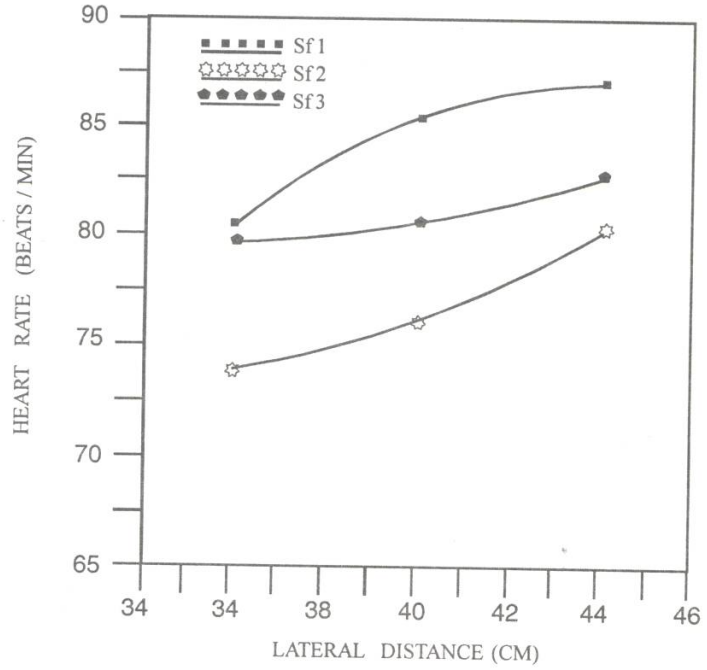


Fig. 4. Effect of vertical distance of brake and clutch pedal on heart rate

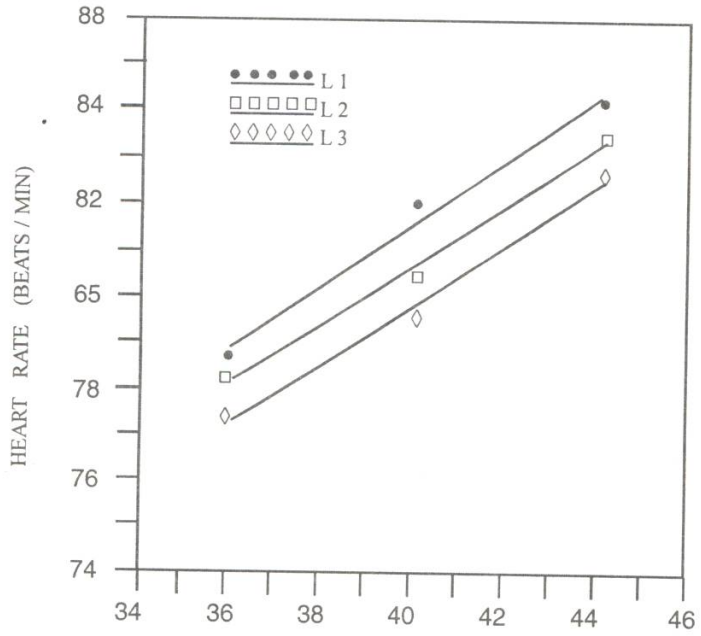


Fig. 5. Effect of vertical distance of clutch and brake pedal on heart rate

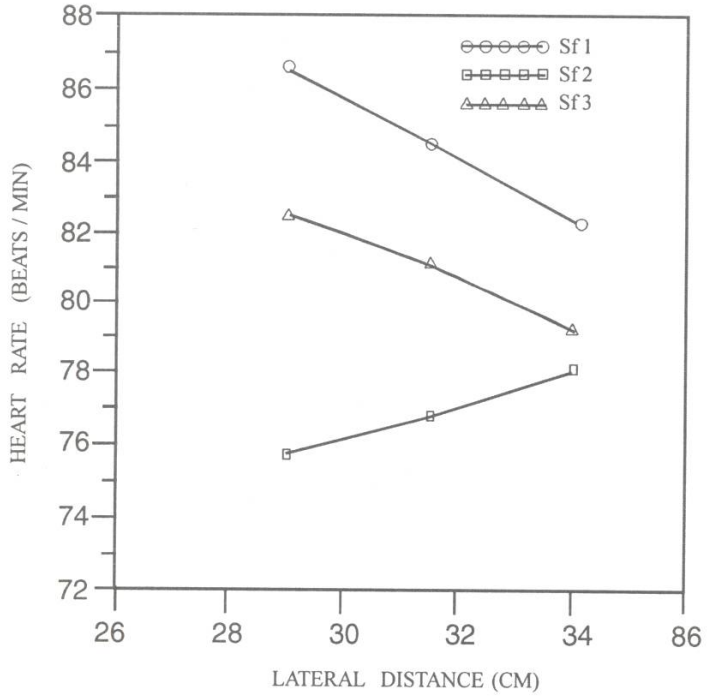


Fig. 6. Effect of lateral distance of hydraulic control lever on heart rate

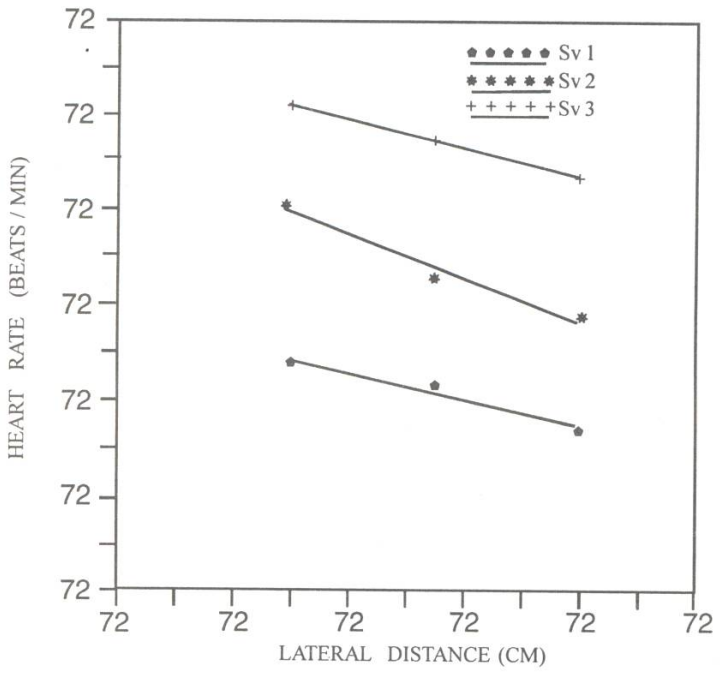


Fig. 7. Effect of lateral distance of hydraulic control lever on heart rate

Table 2. Existing control location on few Indian Tractor Models (Unit cm)

Parameters	Indian tractor model				
	T_1	T_2	T_3	T_4	T_5
Forward horizontal distance of brake pedal	65.5	43.3	72.0	60.5	76.4
Forward horizontal distance of clutch pedal	76.5	43.3	72.0	60.5	76.4
Vertical distance of brake pedal	36.8	43.2	41.9	40.5	43.2
Vertical distance of clutch pedal	34.1	43.2	41.9	43.0	43.2
Lateral horizonrtal distance of hydraulic control lever	30.0	31.5	29.0	30.0	32.0

Table 3. Comparision of optimum control location to the existing control location (Unit cm)

Parameters	Indian tractor model				
	T_1	T_2	T_3	T_4	T_5
Forward horizontal distance of brake pedal	-0.5	+21.7	-7.0	+4.5	-11.4
Forward horizontal distance of clutch pedal	-11.5	+21.7	-7.0	+4.5	-11.4
Vertical distance of brake pedal	-0.8	-7.2	-5.9	-4.5	-7.2
Vertical distance of clutch pedal	+1.9	-7.2	-5.9	-7.0	-7.2
Lateral horizontal distance of hydraulic control lever	+4.0	+2.5	+5.0	+4.0	+2.0

Fig. 7 depicts the effect of increase in value of L at three levels of Sv. It was seen that the heart rate values were decreased with increasing L at constant Sv. The minimum values were obtained at Sv_1 location.

Regression Analysis

Multiple regression analysis was performed to obained the influence of locations on the heart rate of the subjects. The following empirical model was developed.

$HR = 255.2174 - 7.1079Sf + 2.5539Sv + 0.06069\ Sf^2 - 0.02413\ Sf.Sv - 0.000873Sv.L$

Where HR = Heart rate of the subject, beats min^{-1}

The correlation coefficient was found to be 0.946. The high value of correlation coefficient indicated that the model could predict the heart rate with great accuracy.

The optimum locations are based on minimum energy expenditure requirement and minimum heart rate to operate controls. The study of all these combinations resulted in an optimum forward horizontal distance of 65 cm, vertical distance of 36 cm for both the pedals. The laterial location of hydraulic control lever was found optimum at 34 cm from SRP. The energy expenditure rate at optimum location was 12.3 KJ min^{-1} (Table1).

Optimum and Existing Control Locations

The existing locations of the selected controls and the selected parameters, from SRP in few Indian tractor models are given in Table 2. Uniformity was not observed in the location of these controls on the different Indian tractor models. The existing locations need to be shifted from their original position to more comfortable position suiting to the anatomy of the operator. The values in the Table 3 along with sign are to be added to the existing locations values to arrive at an optimum location. According to Pheasant and Harris, 1982, the pedal locations can be well defined by the percentage of the individual subject stature. They concluded that most suitable pedal positions from SRP ranged from 40 to 50 per cent of stature. In the present study the most efficient locations worked out to be 35 to 40 per cent of mean stature of Indian subjects.

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Estimation of Agricultural Land Drainage Coefficient through Rainfall Analysis

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ABSTRACT

Drainage coefficient of agricultural land were estimated for agricultural watershed at Central Research Station (CRS), Dr. PDKV, Akola. For this purpose the daily rainfall data of 25 years was used for its depth-duration-frequency analysis to find one to four consecutive days rainfall values for 2,5,10 and 20 years return period (R.P.). Estimated drainage coefficients indicated that the soil at CRS having basic infiltration rate above 3, 5, 7 and 8 mm hr^{-1}, may not need surface drainage system for one day period rainfall of 2, 5, 10 and 20 years R.P., respectively. The corresponding values in case of two conecutive days rainfall are 2, 3, 3 and 4 mm hr^{-1}, for three consecutive days these values are 1, 2, 2 and 3 mm hr^{-1} and for four consecutive days rainfall values are 1, 1, 2 and 2 mm hr^{-1}. Study further revealed that soils at CRS having predominantly clayey with infiltration rate 1 to 3 mm hr^{-1} may necessarily have to be provided with agricultural land drainage for its major existing crops. For 5 years return period drainage coefficient suggested for vegetable are 112.14, 88.14, 64.14 mm and for oil seed crop values are 55.81, 31.81 and 7.81 mm for soil having basic infiltration rate 1, 2, and 3 mm hr^{-1}. For cotton, jowar, bajra, maize and other similar crops drainage coefficients are 32.55 and 8.55 mm for soils having basic infiltration rate 1 and 2 mm hr^{-1}, respectively.

Drainage discharge is a key factor for decided the design capacity of a drainage system. If the rate of drainage is not assessable by direct measurement, indirect method of its estimation such as analysis of rainfall is used. Kesslar and De Radd (1974) described the design rainfall as a function of return period, duration and area under the study for different kinds of drainage problems. Bhattacharya and Sarkar (1982) stated that for estimating drainage rate for agricultural crops one need to know the total rainfall over duration of crop tolerance period.

Rainfall is a stochastic variable and large number of years rainfall data is needed for its depth-duration-frequency analysis. Particularly, for flat land with slopes ranging between 0-0.05 per cent the design rate removal of excess surface water is decided by the interaction of the chances of crop loss due to water logging. The design drainage rate for surface drainage is commonly taken as approximately 9.3 mm day^{-1} for agricultural watershed of various command areas of the country, irrespective of the agrometerrological conditions such as type of crops grown, type of soil or rainfall pattern. Keeping in view above facts, study was planned to evaluate drainage coefficient through rainfall analysis.

MATERIAL AND METHODS

Central Research Station is situated about 4 km east of Akola city. It is located at 20°40′ North latitude and 77°2′ East longitude. The textural class of soil is clay with clay per cent varying between 45.11 and 54.51%. Basic infiltration rate of soil is approximately 1 to 3 mm hr^{-1}.

Daily rainfall data of 25 years (1974-1998) collected from the observatory situated within the research farm was subjected to depth-duration-frequency analysis to work out one to four consecutive days rainfall. The expected values were found out by three well known probability distributions viz. Gumbel, Lognormal and Log Pearson type III distribution. Among these three distribution methods the best fit distribution was decided by chi-square test for goodness of fit. The drainge coefficient for different return period 2, 5, 10 and 20 years were determined by subtracting basis infiltration rate from estimated consecutive days rainfall. The drainage coefficient for different return period were estimated by considering the fact that soils are saturated and evapotranspiration, surface retention and raindrop interception are negligible as far as land drainage is concerned.

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RESULTS AND DISCUSSION

Maximum rainfall in one, two, three and four consecutive days were observed from daily rainfall and are shown in Table 1.

Rainfall analysis by three distribution methods viz. Gumbel, Lognormal, Log Pearson type III were carried out. Statistical parameters were compared for one to four consecutive days rainfall (Table 2). Value of chi-square were found to be 11.1, 6.52 and 63.27 for Gumbel, Lognormal and Log pearson type III distribution of one day maximum rainfall respectively. Corresponding values for two consecutive days rainfall were 3.64, 2.29 and 4.78 respectively. For three consecutive days rainfall values were 8.83, 7.50 and 9.07 and for four consecutive days maixmum rainfall chi-square values were 3.51, 3.012 and 3.42, respectively. From this analysis Lognormal distribution found to be best in predicting one to four consecutive days maximum rainfall, because of low chi-square value.

Consecutive days rainfall values were found our for return period of 2, 5, 10 and 20 days (Table 3).

The drainage coefficients (DC) were calculated by substracting basic infiltration rate (Ib) from consecutive days rainfall for return period of 2,5, 10 and 20 years. It is observed from Table 4 tht soils of agricultural watershed at CRS having basic infiltration rate above 3, 5, 7 an 8 mm hr^{-1} may not need drainage system for one day period maximum rainfall for return period, 2, 5, 10 and 20 years respectively and for four days rainfall these values are 1, 1, 2 and 2 mm hr^{-1} respectively. When one day period is considered as permissible for estimation of drainage coefficient and similarly in case of two, three and four days period of crop tolerance two, three

Table 1. Year wise maximum one, two, three and four consecutive days rainfall

Year	Rainfall				Probability
	One day (mm)	Two day (mm)	Three day (mm)	Four day (mm)	(p)
1986	217.2	247.0	249.8	250.8	3.84
1988	184.4	223.0	230.4	238.5	7.692
1979	171.2	182.2	189.6	192.2	11.53
1978	134.6	176.4	185.6	189.6	15.38
1997	131.0	171.2	183.8	187.4	19.23
1981	131.0	149.4	167.8	177.8	23.07
1992	113.0	148.4	159.6	170.3	26.92
1977	107.0	131.0	156.8	156.8	30.76
1985	105.6	131.0	149.4	149.4	34.61
1995	104.4	121.6	131.0	133.4	38.46
1990	103.0	120.6	131.0	131.0	42.30
1994	99.6	118.2	128.0	131.0	46.15
1975	98.2	117.0	122.7	128.0	50.00
1984	94.2	110.9	121.6	126.4	53.84
1980	93.0	108.0	118.6	124.4	57.69
1982	86.6	104.0	112.2	121.1	61.53
1987	81.4	96.2	110.6	118.2	65.38
1996	79.8	95.6	110.6	113.2	69.23
1983	76.0	94.4	96.2	110.0	73.07
1991	73.4	88.6	95.0	96.2	76.92
1989	69.0	84.6	93.2	94.5	80.76
1974	61.2	83.2	87.4	89.0	84.61
1998	57.2	76.0	85.6	86.2	88.46
1987	56.8	69.0	80.2	85.6	92.30
1993	18.5	36.5	53.7	71.5	96.15

Table 2. Statistical parameters for comparison of one to four consecutive days annual maximum rainfall by frequency distribution

Days	Parameters	Gumbel	Lognormal	Logpearson
	ΣX	2547.7	2547.7	2547.4
	x	101.908	101.908	101.908
	δy	0.4297	0.4198	0.208
One day	Cv	0.4503	0.4380	-
	Cs	1.4423	1.3980	-1.4
	χ^2	11.14	6.52	63.27
	ΣX	3048.2	3048.2	3048.2
	x	123.368	123.368	123.368
	δy	0.4807	0.4028	0.1748
Two day	Cv	0.509	0.4197	-
	Cs	1.6624	1.332	-0.57533
	χ^2	3.64	2.29	4.784
	ΣX	3350.4	3350.4	3350.4
	x	134.016	134.016	134.016
	δy	0.4748	0.3553	0.1540
Three days	Cv	0.5028	0.3668	-
	Cs	1.6357	1.1500	-0.1532
	χ^2	8.83	7.50	9.07
	ΣX	3427.7	3427.7	3427.7
	x	138.908	138.908	138.908
	δy	0.4675	0.3267	0.1416
Four day	Cv	0.4942	0.3357	-
	Cs	1.6035	1.0449	-0.1928
	χ^2	3.51	3.012	3.42

Table 3. Consecutive day rainfall values for different return periods (years)

S.N.	Return period	Rainfall (mm) for consecutive days			
	(Year)	1	2	3	4
1.	2	90.75	113.78	125.90	131.68
2.	5	136.14	159.62	169.66	173.41
3.	10	174.06	189.16	195.33	206.28
4.	20	199.94	220.73	225.71	225.41

and four consecutive days maixmum rainfall is used.

In case of one day period the estimated drainage coefficient varied between 64.14 mm day^{-1} to 112.14 mm day^{-1} for 5 years R.P. and 102.06 nd 150.06 m day^{-1} for 10 years R.P. having basic infiltration rate between 1 to 3 mm hr^{-1}. However in case of two consecutive days maximum rainfall the estimated values of drainage coefficient varied between 7.81 and 55.81 mm day^{-1} for 5 years R.P. and 22.58 to 70.58 mm day^{-1} for 10 years R.P. for same type of black cotton soil. For three consecutive days rainfall these values were 8.55 to 32.55 mm day^{-1} for 5 years R.P. and 17.11 to 41.11 mm day^{-1} for 10 years R.P. having basic infiltration rate between 1 to 2 mm day^{-1}.

Crop wise drainage coefficient are given in Table 5. It is evident from Table 5 that drainage coefficient for vegetable crops were 112.14, 88.14, 64.14, 40.14 and 16.14 for soil having basic infiltration reate 1, 2, 3, 4 and 5 mm hr^{-1}, respectively. For oilseed

Table 4. Estimated drainage coefficient, DC (mm day^{-1})

S.N.	Ib mm hr^{-1}	DC for one day rainfall (mm) for return periods (years)				DC for two consecutive days rainfall (mm) for return periods (years)				DC for three consecutive days rainfall (mm) for return periods (years)				DC for four consecutive days rainfall (mm) for return periods (years)			
		2	5	10	20	2	5	10	20	2	5	10	20	2	5	10	20
1.	1	66.75	112.14	150.06	175.94	32.89	55.81	70.58	86.36	17.67	32.55	41.11	51.24	8.92	19.35	27.52	32.35
2.	2	42.75	88.14	126.06	151.94	8.89	31.81	46.58	62.36	–	8.55	17.11	27.24	–	–	3.57	8.35
3	3	18.75	64.14	102.06	127.94	–	7.81	22.58	38.36	–	–	–	3.24				
4	4	–	40.14	78.06	103.94	–	–	–	14.36								
5.	5	–	16.14	54.06	79.94												
6.	6	–	–	30.06	55.94												
7.	7	–	–	6.06	31.94												
8.	8	–	–	–	7.94												

-- Indicate there is no necessity to provide drainage.

Table 5. Suggested drainage coefficient for different crops

Name of crop	Tolerance to waterlogging (days)	Return Period (years)	Basic infiltration rate (mm hr^{-1})	Drainage coefficients (mm day^{-1})
Vegetable	1	5	1	112.14
			2	88.14
			3	64.14
			4	40.14
			5	16.14
Oil seed crops	2	5	1	55.81
			2	31.81
			3	7.81
Cotton, Jawar, Maixe, Bajara & Other similar crops	3	5	1	32.55
			2	8.55

crops values were 55.81, 31.81 and 7.81 for soils having basic infiltration rate 1, 2 and 3 mm hr^{-1}, respectively. For crop like cotton, jawar, maize, bajara and other similar crops drainage coefficient were 32.55 and 8.55 mm day^{-1} for soil having basic infiltration rate 1 and 2 mm hr^{-1} respectively.

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Effect Of Irrigation Frequency on Depth of Water and Yield of Wheat Crop Under Border Irrigation

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ABSTRACT

The project was undertaken to evaluate the effect of irrigation frequency on depth of water applied and yield of wheat crop in border irrigation under command area by considering the limited water supply from the irrigation source. The borders are laid on 0.5 per cent slope, having 20 m length and 1.75 m width. The average depth of irrigation was found maximum in 4 irrigations treatments to be 6.28 cm irrigation^{-1} followed by 2 irrigations and 3 irrigations treatments. The minimum average depth of irrigation was recorded in 5 irrigation treatments. The minimum average followed by 2 irrigation was recorded in 5 irrigations treatments (4.44 cm irrigation^{-1}) followed by 6 irrigations treatment (4.54 cm irrigation^{-1}), however, 6 irrigations treatments gave the maximum grain yield of wheat crop (2528.33 kg ha^{-1}). The crop yield was decreasing with the missing number of irrigation. For shortage of irrigation water in the source, 5 irrigations could be considered better for wheat crop under border since it recorded the maximum field water use efficiency and minimum average depth of water.

Wheat is one of the important cereal crop grown extensively in the north and west of India with supplemental irrigation. Judicious management of water supply is very important for crop growth and yield. The extent of the yield reduction depends not only on the magnitude of water deficit but also on the stages of plant growth at which it develops. Often, rainfall is inadequate and insufficient and water sources may fail to meet the requirements of the crop resulting to crop failure. For such situation the effect of irrigation on the crop yield and the depth of irrigation are to be evaluated for wheat crop. Irrigation schedules based on physiological stages have been worked out by Cheema *et. al.*, (1973). Earlier work revealed that five irrigations applied at crown root initiation (CRI), tillering, jointing, flowering and milk stage were essential for maximization of wheat production (Sharma and Bhardwaj, 1983). Sharma *et. al.*, (1969) and Singh and Singh (1973) showed that the first irrigation at CRI was a must, the subsequent irrigations need to be applied depending upon the availability of water. Irrigation before CRI stage and delaying irrigation after CRI stage or less than five irrigations affected the yield and net return adversely. Data on depth of irrigation water as an effect of irrigation frequency under Border irrigation for wheat crop is meagerly available so keeping these in view, present investigation was undertaken.

MATERIAL AND METHODS

Field experiments were conducted during *Rabi* season for three consecutive years namely 1999-2000, 2000-01 and 2001-02 at Shivar block, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experiment was laid out in 5 treatments with 4 replications under randomized block design. The experimental soil was deep black vertisol having 1.30 g cc^{-1} bulk density, 33.50 per cent field capacity, 17.50 per cent permanent wilting point, 50.94 per cent prorosity and $0.57t^{0.53}$ cm hr^{-1} as infiltration rate respectively. The borders laid on 0.5 per cent slope with 20 m length and 1.75 m width were prepared. The wheat cv. AKW-381 was sown in the borders.

Treatment Details

Treatments -	Stages of Irrigation					
No. of Irrigations	CRI	Tillering	Jointing	Flowering	Milking	Dough
T_1 - 6 irrigation	*	*	*	*	*	*
T_2 - 5 irrigation	*	*	*	*	*	-
T_3 - 4 irrigation	*	-	*	*	-	*
T_4 - 3 irrigation	*	-	*	*	-	-
T_5 - 2 irrigation	*	-	*	-	-	-

* - Indicates irrigation scheduled, - Indicates no irrigation

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All recommended agronomic practices were followed. The crop was irrigated with 3.5 lps discharge and the time of advance of water front to irrigate the border was recorded for each irrigation in all treatments to find out the depth of water required. The crop yield was monitored and the field water used efficiency was determined.

RESULTS AND DISCUSSION

From the three years data, it is revealed that the total depth of irrigation was more for 6 irrigations treatment (27.24 cm). It is followed significantly by 4 irrigations and 5 irrigations treatments (25.14 and 22.18 cm respectively). The treatment of 2 irrigations

Table 1. Total depth of water for different treatments, cm

Treatments / No. of irrigation	Depth of water, cm				Average depth of water, cm
	1999-00	2000-01	2001-02	Pooled mean	
T_1 - 6 irrigations	26.80	28.30	26.61	27.24	4.54
T_2 - 5 irrigations	21.66	23.20	21.69	22.18	4.44
T_3 - 4 irrigations	24.84	25.15	25.43	25.14	6.28
T_4 - 3 irrigations	16.20	17.40	16.35	16.65	5.55
T_5 - 2 irrigations	11.70	11.90	11.16	11.59	5.79
'F' test	Sig	Sig	Sig	Sig	
SE (m)±	0.53	0.66	0.28	0.50	
CD at 5%	1.50	1.87	0.79	1.42	
CV,%	5.27	6.30	2.77	4.92	

Table 2. Grain yield, kg ha^{-1} and per cent increase in yield under different treatments

Treatments / No. of irrigation	Depth of water, cm				Increase in yield over 2 irrigations, %
	1999-00	2000-01	2001-02	Pooled mean	
T_1 - 6 irrigations	2520	2380	2685	2528.33	302.60
T_2 - 5 irrigations	2212	2175	2405	2264.00	260.51
T_3 - 4 irrigations	1748	1612	2044	1801.33	186.83
T_4 - 3 irrigations	1260	964	988	1070.66	70.49
T_5 - 2 irrigations	694	572	618	628.00	–
'F' test	Sig	Sig	Sig	Sig	
SE (m)±	63.77	33.48	69.90	57.28	
CD at 5%	179.12	94.04	196.33	160.88	
CV,%	7.56	4.34	7.99	6.90	

Table 3. Field water use efficiency (FWUE), kg ha^{-1}-cm as influenced by different treatments

Treatments / No. of irrigation	FWUE, kg ha^{-1}- cm			
	1999-00	2000-01	2001-02	Pooled mean
T_1 - 6 irrigations	94.18	84.25	101.02	93.15
T_2 - 5 irrigations	102.27	93.78	110.88	102.31
T_3 - 4 irrigations	70.49	64.26	80.32	71.69
T_4 - 3 irrigations	78.04	55.44	60.43	64.64
T_5 - 2 irrigations	60.10	48.44	55.61	54.72
'F' test	Sig	Sig	Sig	Sig
SE (m)±	5.38	2.39	3.69	4.00
CD at 5%	15.10	6.73	10.37	11.22
CV,%	13.27	6.92	9.04	10.33

recorded the minimum depth of irrigation i.e. 11.59 cm (Table 1). But on the basis of average depth of irrigation (depth of water required for each irrigation), it is observed that 5 irrigations treatment recorded the minimum average depth of water i.e. 4.44 cm irrigation^{-1} that was slightly lower than 6 irrigations treatment i.e. 4.54 cm irrigation^{-1}. The maximum average depth of irrigation was found in 4 irrigations treatment (6.28 cm irrigation^{-1}) followed by 2 irrigations and 3 irrigations treatments.

Table 2 revealed that the yield recorded in all treatments was significantly varied with each other. The maximum yield was observed in 6 irrigations treatment (2528.33 kg ha^{-1}) and significantly superior over all other treatments. The minimum yield was recorded in 2 irrigations treatment i.e. 628 kg ha^{-1}. The percentage increse in grain yield was recorded as 302.60, 260.51, 186.83 and 70.49 per cent over 2 irrigations treatment by 6 irrigations, 5 irrigtions, 4 irrigations and 3 irrigations treatments respectively.

From Table 3, it is found that the maximum field water use efficiency was recorded in 5 irrigations treatment (102.31 kg ha^{-1}-cm) and it was at par with 6 irrigations treatments (93.15 kg ha^{-1} -cm). The minimum field water used efficiency was recorded in 2 irrigations treatment (54.72 kg ha^{-1} -c) and at par with 3 irrigations treatment.

The results of pooled data of 3 years indicates that the maximum yield of wheat crop was obtained by applying 6 irrigations under border irrigation method. However, in case of inadequate water supply or limited availability of water in the source, 5 irrigations could be applied for wheat crop under border method of irrigation, since it recorded the maximum field water use efficiency and required the minimum averae depth of water.

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Channel Supplement - New Technology in Border Irrigation

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ABSTRACT

Since the water resources are limited, the channel supplement technology is proposed over stream cutoff in border irrigation. The study was conducted on wheat borders with 75, 80, 85, 90, 95 and 100 per cent cutoff. It is revealed that 75 per cent cutoff is not adoptable. The channel supplement method is superior over stream cutoff method since it saved 14.58 per cent irrigation water withut significant reduction in crop yield. The highest yield and minimum depth of water is recorded in 85 per cent cutoff. The farmer's pratice i.e. 100 per cent cutoff required maximum water and recorded the minimum crop yield.

In earlier design of border irrigation the stream was allowed to advance upto the downstream end of border, which resulted, into deep percolation at the upstream end and excess impounding at the downstream end of the border (Michael and Pandya, 1971) To overcome these losses the stream cutoff technology was introduced in which stream was allowed to reach the prefixed cutoff point and then discountinued (Anjaneyulu and Mishra, 1971, Gawande *et. al.*, 1992). Since the water resources are limited, economic and efficient utilization of water is highly essential, that demands further superior irrigation technology than the stream cutoff. Therefore, the new concept of channel supplement is proposed. In this method, channel is prepared between every two consecutive borders along their lengths. The stream is fed at the upstream side of borders and allow it to advance upto the channel supplement point. The channel supplement point or length is proposed to define as the 50 per cent length of stream cutoff point in the respective border. It means, if the border of 40 m length is to be irrigated by 90 per cent stream cutoff treatment, then the flow of water should allow upto 36 m length (strea cutoff point) and later on stream should be discountinued, while in channel supplement the stream is to be allowed to pass to the channel supplement point (18 m) i.e. 50 per cent of cutoff length and then discoutinued at the upstream end of border but the same irrigation stream is to be fed in the constructed channel between two consecutive border and supplied again to the same border at the channel supplement point. As soon as the stream reaches to cutoff point (36 m), it should be stopped from channel.

The study was undertaken to evaluate the effect of proposed channel supplement technology on depth of water and crop yield, in comparison with stream cutoff technology.

MATERIAL AND METHODS

The field experiment were conducted on clay soil during 1993-94 and 1994-95 at NARP, Dr. PDKV, Akola. The field capacity and wilting point of the experimental soil were 35.0 and 16.5 per cent, respectively. The borders laid on 0.5 per cent slope having 1.75 m width and 40 m length were prepared. These borders are irrigated by irrigation stream of 3.5 lps i.e. 2 lps m^{-1} width of border. The treatments details are given below

Treatment details

S.N.	Particulars	Number	Details
1.	Stream cutoff	6	100, 95, 90, 85, 80 and 75 % length of border
2.	Channel supplement	6	As Above
3.	Replication	4	
4.	Design		Factorial Randomized Block Design

All the recommended packages of agronomical practices were followed for wheat crop, var. HD-2189. The data on length of impounded water and dry length at the downstream end of the borders were measured (Table 1). The data on total time of

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Table 1. Length of impounded water and dry length for stream cutoff and channel supplement, m (average of 1993-94 and 1994-95)

Cutoff, %	Stream cutoff					Channel supplement				
	Irrigation number					Irrigation number				
	1	2	3	4	5	1	2	3	4	5
A) Length of impounded water, m										
100	7.05	8.41	8.35	8.20	8.15	6.05	6.81	6.65	6.53	6.41
95	6.25	7.00	6.84	6.66	6.45	4.26	5.10	4.93	4.81	4.77
90	4.10	4.74	4.65	4.45	4.41	3.38	3.51	3.32	3.30	3.21
85	3.03	3.12	3.00	2.92	2.80	2.12	2.35	2.15	2.06	1.95
80	2.10	2.20	2.10	2.07	2.00	2.02	1.55	1.50	1.43	1.38
B) Dry length, m										
75	1.66	1.54	1.61	1.70	1.74	1.79	1.67	1.77	1.90	1.94

Table 2. Total depth of water applied, cm and percentage saving of water

Cutoff, %	Technology						Pooled mean of cutoff %	% saving in water by channel supplement over stream cutoff
	Stream cutoff			Channel supplement				
	93-94	94-95	Mean	93-94	94-95	Mean		
100	34.38	32.37	33.52	26.86	27.37	27.11	30.32	19.12
95	31.32	29.64	30.48	25.22	24.80	25.01	27.74	17.95
90	28.56	27.42	27.99	24.03	23.60	23.81	25.90	14.93
85	25.92	25.49	25.70	22.22	22.52	22.37	24.03	12.96
80	23.67	23.57	23.62	20.98	21.00	20.99	22.30	11.13
75	20.80	21.68	21.24	19.34	19.72	19.53	20.38	8.05
Pooled mean	27.49	26.70	27.09	23.10	23.17	23.14	25.11	14.58

Pooled data	**Technology**	**Cutoff**	**Interaction**	
'F' test	Sig	Sig	Sig	-
SE (m) ±	0.477	0.826	1.168	
CD at 5%	1.322	2.29	3.24	-
CV%	13.32	13.50	-	-

advance of water front for all irrigations were collected and converted into the depth of water (Table 2). The percentages saving of water by channel supplement over stream cutoff was also determined and presented in Table 2. The crop yield was measured and presented in Table 3.

RESULTS AND DISCUSSION

From Table 1 it is revealed that the maximum length of impounded water was observed in 100 per cent cutoff showing the excess impounding and wastage of water. On the contrary, the minimum impounding was recorded in 80 per cent cutoff treatment without showing wastage of water, since this impounding was essential to get nearly required depth of irrigation. The similar result was also observed by Goyal *et. al.*, (1991). Negligible decrease in impounding was noticed with successive irrigation except first. More length of impounded water was recorded in stream cutoff method over channel supplement in all treatments. Thus it was evident that due to channel supplement irrigation, wastage of water could be avoided.

The drylength was observed in 75 per cent cutoff treatment both in stream cutoff and channel

Table 3. Mean net yield, kg ha^{-1}

Cutoff, %	Technology						Poolded mean of cutoff
	Stream cutoff			Channel supplement			
	93-94	94-95	Mean	93-94	94-95	Mean	
100	1894.25	3297.82	2596.03	1917.75	3321.20	2619.47	2607.75
95	1953.00	3358.01	2755.50	1964.75	3578.48	2771.61	2763.55
90	1970.50	3672.04	2821.27	2011.50	3788.98	2900.24	2860.75
85	2105.00	3929.31	3017.15	2079.75	3592.51	2836.13	2926.64
80	2081.05	3765.59	2923.32	1949.50	3426.45	2687.97	2805.64
75	1824.25	2958.68	2391.46	1767.50	2694.37	2230.94	2311.20
Pooled mean	1971.41	3530.24	2750.79	1948.45	3400.33	2674.39	2712.58

Pooled data	**Technology**	**Cutoff**	**Ineraction**
'F' test	N.S.	Sig	Sig
SE (m) ±	29.22	50.61	71.58
CD at 5%	–	140.33	198.41
CV%	7.45	8.49	–

supplement hence this treatment is not to be advise to the farmers.

The data presented in Table 2, showed that the significantly less amount of water was required in channel supplement method (23.14 cm) as compared to the stream cutoff (27.0 cm) i.e. 14.85 per cent less. The data also revealed that the result was significant for different cutoffs. The 100 per cent cutoff needed the maximum depth of water (30.32 cm) and the depth of water consistently decreased with the decreasing cutoff per cents. 95 per cent coutoff required significantly more water than the rest of treatments but at par with 90 per cent cutoff. The 90 per cent cutoff was required more water than 80 per cent and 75 per cent cutoffs but at par with 85 per cent treatment, which were at par with each other and erquired the minimum depth of water after rejecting the 75 per cent cutoff.

From Table 2, it is observed that per cent saving of water by channel supplement over stream cutovff was rangnig from 19.12 to 8.05 per cent with average of 14.58 per cent. The per cent saving was found more in higher cutoff treatment.

The data recorded in Table 3 revealed that the yield response was non significant for both the technologies i.e. stream cutoff and channel supplement. 85 per cent cutoff treatment gave the highest yield (2926.64 kg ha^{-1}) and significantly superior over 75 per cent, 95 per cent and 100 per cent cutoff treatments (2311.20, 2763.55 and 2607.75 kg ha^{-1}, respectively), but it was at par with 80 per cent and 90 per cent treatments (2805.64 and 2860.75 kg ha^{-1} respectively). 95 per cent cutoff (2763.55 kg ha^{-1}) was statistically superior over 100 per cent and 75 per cent cutoff treatments. Further, 75 per cent treatment was found significantly inferior to 100 per cent cutoff treatment and recorded lowest yield.

The yield of 2540 kg ha^{-1} was obtained from the channels prepared for channel supplement technology that showed the area under channel could also be put under crop production (20 sq.m. area/ channel).

CONCLUSIONS

From this study, the following conclusions are drawn"

1. Channel supplement method is superior over stream cutoff under wheat borders since it saved 14.58 per cent irrigation water without significant reduction in crop yield.
2. 85 per cent cutoff gave the highest yield as well as requried minimum depth of water
3. 100 per cent (farmer's practice) requried the maximum depth of water and recorded the minimum crop yield.
4. 75 per cent cutoff could not irrigate the complete border ultimately resulted in low crop yield, hence it should not be advised to the farmers.

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On Farm Response of Soybean-Wheat Sequence to N, P and K in Central Vidarbha Zone

B.N. Dahatonde[1] and J.T. Kamdi[2]

ABSTRACT

On farm trials to study the response of recommended doses of N, P and K alone and in combination, on soybean-wheat crop sequence, were conducted at six, eight and ten locations during 1999-2000, 2000-2001 and 2001-2002, respectively in Nagpur district of central Vidarbha zone. The highest yields of both soybean and wheat were recorded with the application of recommended doses of NPK with combination to both the crops. The highest total as well as increased benefits were obtained with the combined application of NPK at recommended levels.

Central Vidarbha zone comprises of Nagpur, Wardha and Yavatmal district of Vidarbha region of Maharashtra state. The zone characterized by semi-arid ecosystem with hot and dry summer and mild to cool winter. Average rainfall is 1133 mm received in 43 rainy days. The soil are vertisols and associated ones derived from basalt rock, black in colour with varying depth, predominantly rich in sujectite type of clay, at many places high in lime reserves with high base saturation of the exchange complex. Average fertilizer consumption is 45.60 kg N, 16.19 kg P_2O_5 and 3.43 kg K_2O ha^{-1}, which is quite inadequate considering requirement of mono or double crop in a year. Farmers hesitate to supply recommended dose to the crop because of various problems and therefore imbalance application of NPK is also commonly observed. Keeping this in view, the present investigation entitled "On farm response of soybean-wheat sequence to N, P and K" was conducted.

MATERIAL AND METHODS

Field experiments were conducted at six, eight and ten locations (villages) during 1999-00, 00-01 and 01-02 respectively with five treatments, treating locations as replications. Villages were selected in Katol, Saoner and Hingna tahasils of Nagpur district. Treatments consisted of no NPK (control), recommended dose of N alone, NP alone, NK alone and NPK (30:75:30 and 100:50:50 kg NPK ha^{-1} for soybean and wheat respectively) applied to both the crops on a plot size of 20 m x 5 m.

The soils of the experimental sites were shallow to deep, fairly high in clay, black to reddish in colour, rich in lime reserve and sodic in reaction with high base saturation of exchange complex (Table 1). Well distributed rainfall ranged between 980 to 1150 mm was received during the crop growth period. Soybean (JS 335) was sown from 15th to 20th June and wheat (Ak 1071) from 5th to 10th November. Both the crops were raised with recommended package of practices except fertilization. NPK were supplied through straight fertilizers at recommended timings. Life saving irrigations were given to soybean.

RESULTS AND DISCUSSION

Grain yield

Grain yield of soybean and succeeding wheat (Table 2) was significantly high due to applciation of recommended dose of N alone over control during first two years but at par in third year. Recommended doses of NP and NK alone, being at par, yielded significantly more than control and N alone while NPK application yielded significantly highest during all the three years. Pooled data indicated highest yield of soybean with NPK, which was at par with NP and NK alone, but significantly superior that no NPK and N aone. Significantly highest yield of succeeding wheat was obtained with NPK application. NP and NK alone, being at par with N alone were significantly superior than control. Similar results were recorded by Pramila Rani and

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Table 1. Initial soil fertility status of experimental sites

Parameters	1999-2000		2000-2001		2001-2002	
	Max.	Min.	Max.	Min.	Max.	Min.
Available N (kg ha^{-1})	288.5	197.6	257.6	232.0	493.9	225.1
Available P (kg ha^{-1})	20.2	12.3	19.5	11.2	19.0	10.0
Available K (kg ha^{-1})	604.8	515.2	408.5	349.7	496.2	278.9
O.C., %	0.71	0.44	0.52	0.32	0.69	0.35
pH	8.00	7.60	7.56	6.30	8.01	7.56
EC (dSm^{-1})	0.25	0.10	0.20	0.11	0.50	0.16

Table 2. Grain yield (q ha^{-1}) of soybean and wheat

Treatments	1999-2000		2000-2001		2001-2002		Pooled	
	Soybean	Wheat	Soybean	Wheat	Soybean	Wheat	Soybean	Wheat
No NPK	13.46	21.77	9.82	11.36	11.98	19.40	11.15	17.31
Rec. N	14.74	26.13	13.54	19.90	15.26	22.15	14.50	21.89
Rec. NP	16.97	29.55	16.61	26.57	18.60	25.95	17.56	26.73
Rec NK	16.15	30.73	16.11	24.72	18.70	26.97	17.20	27.16
Rec NPK	18.64	37.17	20.12	32.22	21.55	32.53	20.35	33.59
SE (m)±	0.30	0.66	0.53	0.82	1.63	2.21	1.30	2.09
CD at 5%	0.87	1.92	1.58	2.42	3.30	4.49	3.60	5.79

Table 3. Economic analysis of the treatment effect

Treatments	Increase yield due to treatment (q ha^{-1})		Value of increased yield (Rs. ha^{-1})	Expenditure due to treatment (Rs. ha^{-1}) for both crops	Total benefit due to treatment (Rs. ha^{-1})
	Soybean	Wheat			
No. NPK	–	–	–	–	–
Rec. N	2.74	5.22	6616	1753	4862
Rec NP	5.64	8.85	6824	4253	7944
Rec. NK	5.24	9.96	12687	2519	10333
Rec. NPK	8.36	16.47	20688	4852	15835

Table 4. Crop response to applied N, P and N (Kg soybean equivalent yield kg^{-1} nutrient)

Nutrient	1999-2000		2000-2001		2001-2002	
	Max.	Min.	Max.	Min.	Max.	Min
N	5.41	2.58	12.08	4.06	8.14	2.13
P	8.84	5.58	11.62	3.70	8.78	2.03
K	14.03	5.50	18.68	5.15	15.59	3.30

Kondandaramaiah (1997) and Singh *et. al.*, (1996) for soybean and wheat, respectively.

Economic analysis

Data on economics of soybean- wheat sequence as affected by fertilizer application (Table 3) indicated that the total ha^{-1} monetary benefit was augmented by Rs. 4862, 7944, 10,333 and Rs. 15,835 due to fertilization with only N, NP, NK and NPK respectively over control. The increased total benefit due to NPK application was 222 per cent higher than N application alone, 99 per cent higher than NP application laone and 53 per cent higher than NK

application alone. This confirms the findings of Rao *et. al.* (1996).

Response of N, P and K

The data on response to N, P and K in terms of soybean equivalent yield (Table 4) indicated that the response to N was within the range of 2.13 to 12.08 for P_2O_5 it was 2.03 to 11.62 while that for K_2O, the same was between 3.30 to 18.68. Soybean and wheat, in a sequence cropping, should be fertilized with 30:75:30 and 100:50:50 Kg NPK ha^{-1}, respectively for maximum production.

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Yield and Yield Attributes of Rice and Mustard as Influenced by FYM, Nitrogen and Phosphorus in Rice-Mustard Sequence

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ABSTRACT

A field experiment was conducted during 2001-02 and 2002-03 to study the effect of varied levels of N and P2O5 alongwith FYM @ 10 t ha^{-1} on transplanted *Kharif* rice and subsequently their residual effect on the mustard in vertisols. Application of 100 kg N alongwith FYM @ 10 t ha^{-1}, irrespectively phosphorus levels recorded maximum grain and straw yields and yield attributes in rice. There were no significant response to phosphorus application. The residual effect of FYM @ 10 t ha^{-1} plus 100 kg N ha^{-1} irrespective of phoshporus levels to preceding rice was more pronounced which reflected in terms of high grain and stover yields of succeeding mustard.

Presently, it is being increasingly realized that when crops are grown in system, the fertilizer need of the individual crop cannot be precisely determined without taking into account the cropping system as a whole which should include, the nature of preceeding crop, its yield level and residual effect of fertilizer application to sustain high levels of yield and profitability. Information generated so far shows that less than 30 per cent of nitrogen and small fraction of phosphorus and potash contained in organic manure may become available to mmediate crop and rest to subsequent crop (Gaur *et. al.*, 1984) in sequence. Since the information on residual effect of integrated nutrient supply system on mustard grown after rice is lacking for agro-climatic region of south Gujarat, the present investigation was conducted to assess the effecrtive of residual effect of FYM and fertilizer on mustard.

MATERIAL AND METHODS

An experiment was conducted during *Kharif* and *Rabi* season of 2001-02 and 2002-03 at N.M. College of Agriculture, Navsari Agricultural University, Navsari. The soil was clay in texture, having organic carbon of 0.42 per cent, available nitrogen 219.80 kg ha^{-1}, available phosphorous 39.60 kg ha^{-1} and available potassium 320.12 kg ha^{-1}. The experiment was conducted in Randomized Block Design with twelve treatments replicated thrice. The treatments comprised of twelve combination of two leavels of FYM (0 to 10 t ha^{-1}), four levels of N (0, 50, 75 and 100 kg ha^{-1}) and four levels of P_2O_5 (0, 25, 37.5 ad 50 kg ha^{-1}) (Treatment detail given in Table 1). A uniform dose of 50 kg each of nitrogen and phosphorous ha^{-1} was applied to mustard.

Twenty-five days old seedings of Jaya rice were transplanted at 20 x 15 cm spacing with 2-3 seedings $hill^{-1}$ during third week of July and mustard cv. Gujarat mustard-2 was sown at 45 x 15 cm spacing with seed rate of 4 kg ha^{-1} during 1st week of November, in both the years. The rice was harvested during last week of October and mustard during last week of February in both the years. The total rainfall received during the cropping sequence (June to Feb.) was 1787.6 and 1085.7 mm in 78 and 64 rainy days, during and second year, respectively, as against average rainfall of 1454.23 mm (12 years). Maximum rainfall was precipitated during July to Aug. during both the years.

RESULTS AND DISCUSSION

Direct effect on rice

Application of FYM @ 10 t ha^{-1} in combintion with 100 kg N irrespective of phosphorus levels brought about significant improvement in the yield attributes, grain and straw yield over the application of 50 kg N ha^{-1} alongwith FYM @ 10 t ha^{-1} with respective phosphorous levels (Table 1). However, application of 75 kg N ha^{-1} alongwith FYM @ 10 t ha^{-1}, with respective phosphorous levels found statistically at par with higher and lower levels of ntrogen. The increased grain yield might be due to

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Table 1. Effect of different treatments on yield and yield attributes of rice

Treatments	Grain yield (t ha^{-1})		Straw yield (t ha^{-1})		No. of panicles		Length of panicle (cm)		No. of filled spikelets panicle^{-1}		Test weight (g)		HI (%)	
	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
$F_0N_0P_0$	3.91	3.10	4.73	4.20	214.86	190.03	20.86	19.44	78.41	76.48	27.09	27.18	45.31	42.17
$F_{10}N_0P_0$	4.03	3.70	5.50	5.00	224.50	209.30	20.99	20.48	80.53	77.21	27.28	27.33	42.42	42.53
$F_{10}N_0P_{50}$	4.61	4.42	5.60	5.23	233.34	218.62	21.73	20.67	84.85	81.36	28.50	28.40	45.20	45.80
$F_{10}N_{50}P_{25}$	5.62	5.31	6.90	6.53	263.58	246.22	22.27	21.11	90.90	85.39	28.87	28.70	44.96	44.85
$F_{10}N_{50}P_{50}$	5.53	5.30	6.84	6.63	264.90	245.99	22.12	21.17	89.17	86.76	28.80	28.80	45.89	44.43
$F_{10}N_{75}P_{37.5}$	6.30	6.05	7.52	7.00	282.70	257.14	22.45	21.47	98.80	95.64	29.27	29.10	45.38	46.36
$F_{10}N_{75}P_{50}$	6.23	6.00	7.53	6.93	281.74	255.45	22.43	21.44	98.57	95.72	29.27	29.20	45.38	46.40
$F_{10}N_{100}P_0$	6.60	6.42	7.80	7.60	287.93	265.16	22.55	21.86	103.65	101.29	29.56	29.37	45.83	45.79
$F_{10}N_{100}P_{25}$	6.63	6.41	7.82	7.63	288.28	263.25	22.67	22.63	103.66	100.78	29.79	29.40	45.88	45.66
$F_{10}N_{100}P_{37.5}$	6.72	6.33	7.93	7.57	290.50	261.56	22.89	21.56	105.40	99.26	30.14	29.63	45.87	45.41
$F_{10}N_{100}P_{50}$	6.81	6.62	8.10	7.83	291.69	267.32	23.99	21.78	105.58	101.18	30.24	29.83	45.67	44.81
$F_0N_{100}P_{50}$	6.50	6.21	7.77	7.45	287.61	264.42	22.88	21.78	103.72	99.03	29.88	29.40	45.55	45.50
CD at 5%	0.82	0.82	0.85	0.89	20.16	20.21	1.15	1.42	7.49	6.12	0.76	0.60	NS	NS

Table 2. Residual effect of different treatments on yield and yield attributes of succeeding mustard

Treatments	Seed yield (t ha^{-1})		Stover yield (t ha^{-1})		No. of siliquae plant^{-1}		No. of seeds siliquae^{-1}		1000 seed weight (g)	
	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03
$F_0N_0P_0$	0.78	0.60	2.36	1.72	116.67	73.67	10.03	9.74	3.93	4.22
$F_{10}N_0P_0$	1.37	1.05	3.26	2.77	187.19	144.17	11.73	11.45	4.99	4.82
$F_{10}N_0P_{50}$	1.38	1.10	3.28	2.87	188.81	145.18	12.06	11.45	5.06	4.85
$F_{10}N_{50}P_{25}$	1.44	1.13	3.71	3.14	190.27	148.94	12.23	11.50	5.14	4.92
$F_{10}N_{50}P_{50}$	1.43	1.15	3.65	3.19	189.81	147.86	12.11	11.34	5.05	4.87
$F_{10}N_{75}P_{37.5}$	1.47	1.19	4.00	3.51	193.47	150.00	12.37	12.05	5.19	5.17
$F_{10}N_{75}P_{50}$	1.47	1.18	3.83	3.49	192.80	149.67	12.44	11.92	5.17	5.11
$F_{10}N_{100}P_0$	1.51	1.21	4.04	3.65	197.00	154.01	12.48	12.16	5.18	5.12
$F_{10}N_{100}P_{25}$	1.52	1.21	4.05	3.62	198.53	155.64	12.65	12.37	5.20	5.14
$F_{10}N_{100}P_{37.5}$	1.54	1.22	4.17	3.70	201.87	157.87	12.59	12.23	5.18	5.15
$F_{10}N_{100}P_{50}$	1.56	1.24	4.22	3.77	203.88	158.60	12.89	12.47	5.22	5.20
$F_0N_{100}P_{50}$	1.24	0.96	3.21	2.70	173.81	132.30	11.27	11.19	4.94	4.78
CD at 5%	0.21	0.19	0.48	0.52	17.18	15.33	NS	NS	2.2	2.2

increase in number of panicles m^{-2}, length of panicle and test weight of 1000-grain as a result of adequate availability and transformation of organic nitrogen during reproductive and grain filling stages coupled with increased rate of photosynthesis and better availability and translocation of nutrients and photosynthates from source to sink.

Grain yield of rice was not significantly affected due to varied phosphorus levels. This might be due to increase in available phosphorus of the native and added phosphorus by addition of organic matter. Reduction in phosphorus fixation by the solubilizing effects of organic acids produced during their decomposition has been reported by Singh and Pati Ram (1977). As there was no significantly response of rice to phosphorus application its substitution with FYM could not be ascertained.

Residual effect

Integrated nutrient management treatments given to preceding rice influenced significantly the yield attributes and yield of mustard (Table 2). The highest seed yield of mustard was recorded with the residual effect of application of recommended dose of NP alongwith 10 t ha^{-1} of FYM to preceding rice. However, it was at par with the application of 50, 75 and 100 kg N ha^{-1} alongwith FYM @ 10 t ha^{-1} irrespective of phosphorus application. This might be due to boosting of yield attributes such as number of siliquae $plant^{-1}$ and test weight. The beneficial effects of FYM with nitrogen and phosphorus on succeeding crop following rice have been reported by Dhurandher *et. al.*, (1999) and Puste *et. al.*, (2002).

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On Farm Response of Rice - Wheat Cropping System to N, P and K in Central Vidarbha Zone

J.T. Kamdi[1], B.N. Dahatonde[2] and S.N. Potkile[3]

ABSTRACT

On farm trial to sutdy the response of recommended doses of N, P and K alone and in combination, on rice-wheat sequence were conducted during 1999-00, 2000-01 and 2001-02 at three, four and ten locations, respectively in Nagpur district of Central Vidarbha region of Maharashtra state. Application of recomended dose of NPK to both the crops recorded their highest yields and total as well as incresed benefits.

Central Vidarbha comprises of Nagpur, Wardha and Yavatmal districts of Vidarbha region of M.S. The zone has semi-arid ecosystem with hot and dry summer and mild to cool winter. The soils are vertisol having varying depth, derivated from basalt rock and contains montmorillonite clay. On an average, the zoe has 17.35 per cent heavy, 33.0 per cent medium and 49.7 per cent light soils. The zone receives on an average, 1133 mm rainfall in 43 rainy days from June to September. Average fertilizer consumption is 45.60, 16.19 and 3.43 kg NPK ha^{-1}, which is quite inadequate considering requirement of single or double cropping in a year. Imbalance application of NPK to the crops is also a common phenomenon. Keeping this view, on farm trials were conducted to study.the response of N, P and K alone and in combination, in rice-wheat, a commonly adopted crop sequence.

MATERIAL AND METHODS

Field experiments were conducted at three, four and ten lcoations (villages) during 1999-00, 2000-01 and 2001-02, respectively with five treatments, treating the locations as replictions. Villages were identified in Parshivani and Umred tahasils of Nagpur district. Treatments consisted of control (no. NPK), recommended dose of N alone, NP alone, NK alone and NPK @ 100:50:50 kg ha^{-1}, each for rice and wheat grown on a plot size of 20 x 5 m^2.

The soils of the experimental site ranged between black to reddish in colour with shallow to moderately deep and deep, high in clay with slightly alkaline in reaction (Table 1). Well distributed rainfall between 1200 to 1240 mm was recieved during the crop growth period. Rice (PKV HMT) was transplanted from 24th July to 8th August and subsequenlty, wheat (AKW 1071) from 2nd to 5th December. Crops were raised with recommended package of pratices except fertilizer treatments. NPK were supplied through straight fertilizers, as per recommendations. Life saving irrigation was given to rice and wheat, as per recommended practice.

RESULTS AND DISCUSSION

Grain yield

Grain yield of rice and succeeding wheat (Table 2) revealed that the application of recommended dose of N alone has recorded

Table 1. Initial soil fertility status of experimental site

Parameters	1999-2000		2000-2001		2001-2002	
	Max.	Min.	Max.	Min.	Max.	Min.
Available N (kg ha^{-1})	288.5	197.6	257.6	232.0	493.9	255.1
Available P (kg ha^{-1})	20.2	12.3	19.5	11.2	19.0	10.0
Available K (kg ha^{-1})	604.8	515.2	408.5	349.7	496.2	278.9
O.C %	0.71	0.44	0.52	0.32	0.69	0.35
pH	8.00	7.60	7.56	6.30	8.01	7.56
EC (dSm^{-1})	0.25	0.10	0.20	0.11	0.50	0.16

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Table 2. Grain yield of rice and wheat (q ha^{-1})

Treatments	1999-2000		2000-2001		2001-2002		Pooled	
	Rice	Wheat	Rice	Wheat	Rice	Wheat	Rice	Wheat
No NPK	13.46	21.77	9.82	11.36	11.98	19.40	11.15	17.31
Rec. N	14.74	26.13	13.54	19.90	15.26	22.15	14.50	21.89
Rec. NP	16.97	29.55	16.61	26.57	18.60	25.95	17.56	26.73
Rec NK	16.15	30.73	16.11	24.72	18.70	26.97	17.20	27.16
Rec NPK	18.64	37.17	20.12	32.22	21.55	32.53	20.35	33.59
SE (m)±	0.30	0.66	0.53	0.82	1.63	2.21	1.30	2.09
CD at 5%	0.87	1.92	1.58	2.42	3.30	4.49	3.60	5.79

Table 3. Economic analysis of treatment effect

Treatments	Increase in yield due to treatment (q ha^{-1})		Value of increased yield with crops (Rs. ha^{-1})	Expenditure due to treatment for both crops (Rs. ha^{-1})	Total benefit due to treatment (Rs. ha^{-1})	B:C ratio
	Rice	Wheat				
No NPK	-	-	-	-	-	-
Rec. N.	13.34	4.65	12429	2018	4081	1:2.02
Rec. NP	20.62	10.17	21616	4657	16959	1:3.64
Rec. NP	18.71	6.93	17731	3407	14324	1:4.20
Rec. NPK	23.87	13.96	26499	5407	21092	1:3.90

Table 4. Crop response to applied N, P and K (Kg soybean equivalent yield kg^{-1} nutrient)

Nutrients	1999-2000		2000-2001		2001-2002	
	Max.	Min.	Max.	Min.	Max.	Min.
N	9.65	2.91	17.86	12.36	7.93	3.62
P	23.74	15.98	17.32	8.16	20.68	7.16
K	13.15	9.35	9.72	3.08	10.32	2.04

significantly higher yield over control (No. NPK), during all the three years. Application of NP alone or NK alone, increased the grain yield significantly over control by remaining at par. Significantly highest grain yields were recorded with the application of recommended dose of NPK, during all three years.

Pooled data indicated that recommended dose of NPK recorded significantly higher yields of rice over control and N alone but it was at par with recommended dose of NP and NPK alone. Patra *et. al.* (2000) and Rawat *et. al.*, (2000) recorded highest yields of rice and wheat in a sequence due to application of highest and recommended dose of NPK, respectively. Wheat yields were significantly highest with the application of recommended dose of NPK. Application of NP and NK, both alone, yielded at par but were significantly superior than control.

Total monetary benefit :

Data on economic of rice- wheat crop sequence, as affected by fertilizer application (Table 3) indicated that the total monetary benefit per hectare was enchanced by Rs. 4081, 16959, 14324 and Rs. 21092 due to fertilizeation with only N, NP, NK and NPK, respectively over control. The increased total benefit due to NPK application was 417 per cent of N application alone, 24 per cent over NP application

alone and 47 per cent of over NP applciation in rice-wheat system.

Benefit cost ratio :

Higher benefit cost ratio was recorded with application of recommended NK, followed by recommended NPK, NP and N.

Response to N, P and K :

The response in terms kg of grains, per kg of applied nutrients (N, P and K), calculated on the basis of rice equivalent, are shown in (Table 4). The data indicated that the response per kg of applied nitrogen ranged between 5.56 to 16.17 kg, 11.56 to 19.90 kg for phosphate and 6.12 to 11.24 kg for potash. Therefore, it is concuded that rice and wheat in a sequence cropping should be fertilized each with 100:50:50 kg NPK ha^{-1} for maximum production as wellas benefits.

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Effect of Cropping Systems and Nutrient Management on Microbial Population in Vertisols

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ABSTRACT

Effect of irrigation and rainfed cropping systems on microbial population was studied at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Maximum fungal, actinomycetes and bacterial population were recorded under irrigated condition during summer season. In all cropping sequences highest population was observed at grand growth stage of crops. Higher count was observed under sorghum-chickpea-groundnut sequence and under monocropping and intercropping with legumes. Application of FYM, wheat straw and green manuring greatly boosted the fungal population. While FYM in combination with NPK fertilizer was found to be most promising in enhancing actinomycetes and bacterial population.

The production and turnover of the microbes is pivotal to our understanding of organic matter dynamics and nutrients cycling. The prospects for improved management of microbial population, thereby improved nutrient turnover will lead to a more cost-effective, efficient agriculture (Lowrance *et. al.*, 1984) which is more organically oriented. Soil harbours a dynamic population of microorganisms which is affected by the intensive cropping systems. The application of organic material favourably augmented beneficial microbial population and their activities such as organic matter decomposition, biological nitrogen fixation and availability of plant nutrients. Microbiota is responsible for the turnover of nutrient under various cropping systems and influencing the dynamics of available plant nutrient.

Soil microbial population, a living phase of soil is predominantly influenced by the magnitude of soil organic matter in soil and hence quantification of their abundance determines the over all biological processes and soil health at large.

MATERIAL AND METHODS

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

Soil samples were taken before sowing of first crop, at grand growth and harvest of each crop in sequence. In case of intercropping, grand growth state value considered as an average value of both crops. While at harvest, soil samples were collected after completion of the cropping cycles. Soil sample were ground and sieved through 2 mm sieve. Fresh samples were used for determining the microbial population. Nutrient management details are given in Table 1. In the treatments organics were applied before sowing of the crop and N was applied in two splits (half at sowing and remaining 30 DAS). Full dose of P and K was applied at the time of sowing. In case of pigeonpea full dose of N and P was given at the time of sowing.

Isolation and enumeration of soil borne fungi, actinomycetes and bacteria were done by using Dilution Plate Techinique as described by Dhingra and Sinclair (1993).

RESULTS AND DISCUSSION

Fungal population

Results pertaining to fungal population (Table 20 indicate that maximum count was recorded under irrigated condition during summer season. Highest fungal count was noted under Sorghum-Chickpea-groundnut followed by Sorghum-Wheat-

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

Cropping systems			Nutrient management		
Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Irrigated					
1. Sorghum	Wheat	Greengram	100 : 40 : 40	120 : 60 : 60	20 : 40 : 40
2. Sorghum	Chickpea	Groundnut	100 : 40 : 40	25 : 50 : 00	25 : 50 : 00
3. Sorghum	Wheat		100 : 50 : 40	120 : 60 : 60	
4. Soybean	Wheat		30 : 75 : 00	120 : 60 : 60	
Rainfed					
5 Sorghum	+ Pigeonpea		80 : 40 : 00	+20:40:00	
6. Cotton	+ Greengram		50 : 25 : 00	+ 00 : 00 : 00	
7. Sorghum			100 : 40 : 40		
8. Cotton			50 : 25 : 00		
9. Greengram			20 : 40 : 00		
10. Groundnut			25 : 50 : 00		

Table 2. Fungal population (x 10^4 g^{-1} soil) influenced by cropping systems and nutrient management

Cropping systems	Initial	*Kharif*		*Rabi*		Summer	
		GG	AH	GG	AH	GG	AH
		Irrigated					
1. Sorghum - wheat - greengram	6.00	13.65	10.35	16.00	12.65	17.00	13.85
2. Sorghum- chickpea- groundnut	6.15	16.50	12.85	19.15	15.35	20.50	16.00
3. Sorghum- wheat							
I Control	3.15	6.00	3.65	7.65	4.65		
II 100 % NPK	6.0	14.85	11.15	17.50	12.85		
III 100% NPK + FYM 10 t	6.65	16.50	13.00	-	-		
4. Soybean- wheat							
I Control	4.00	8.65	6.15	9.85	6.85		
II 100% NPK	6.35	18.50	15.35	21.65	17.00		
III N through FYM, WS and GM	7.15	21.85	18.15	-	-		
		Rainfed					
5 Sorghum + Pigeonpea	6.00	17.65	13.35				
6. Cotton + Greengram	5.35	18.65	14.50				
7. Sorghum	3.65	12.00	9.15				
8. Cotton	3.00	11.65	8.00				
9. Greengram	5.00	14.35	11.35				
10. Groundnut	4.85	16.00	12.15				

Note : GG - Grand growth, AH - At harvest

greengram. However, at harvest of sorghum in both the sequences, the count increased over its initial count. Similar trend was reported by Patil and Varade (1998), while studying the microbial population in vertisols subjected high inputs. At the end of both the sequences, the fungal population was increased over their initial status. Bhore, *et. al.*, (1988) opined that multiple cropping systems influenced the soil microflora specially with legumes which stimulate the fungal count. Legume in crop sequence specially groundnut under which fungi reproduced faster due to the higher availability of nitrogen. In soybean-whet crop sequence, higher population under wheat might be due to the favourable effect of previously grown leguminous crop which provided good amount of N besides organic matter. Moisture regime in soil significantly modified the conditions such as availability of moisture, aeration, nutrient and decomposability of organic matter in soil. In this context microbial dynamics will vary from irrigated and rainfed situations. Among monocrops studied, the maximum population was noticed under ground followed by greengram. While, cotton + greengram intercropping showed the highest fungal count over sorghum + pigeonpea. Fungal population increased from planting to flowering in all crop sequences and at harvest it tended to decrease but was higher than initial level.

Comparing the sources of nutrient applied to sorghum-wheat crop sequences, the maximum fungal population was observed in the treatment receiving 100 percent NPK + FYM. Sharma *et. al.*, (1998) also reported the highest count of fungi with NPK + FYM. Application of 100 per cent NPK and FYM alone was proliferated the fungal count over control. As soon as the favourable substrates are added into the soil, fungi, rapidly grow and are almost doubled in their population. In soybean-whet sequence, application of N through FYM + Wheat straw + Green manuring increased the fungal count.

Table 3. Actinomycetes popultion (x 10^6 g^{-1} soil) as influenced by cropping systems and nutrient management

	Cropping systems	Initial	*Kharif*		*Rabi*		Summer	
			GG	AH	GG	AH	GG	AH
			Irrigated					
1.	Sorghum - wheat - greengram	8.85	16.00	12.15	17.85	14.35	19.65	16.15
2.	Sorghum- chickpea- groundnut	10.65	18.00	14.85	20.50	17.00	22.65	18.15
3.	Sorghum- wheat							
	I Control	6.00	9.50	7.15	11.35	8.15		
	II 100 % NPK	7.85	16.15	12.50	18.85	14.85		
	III 100% NPK + FYM 10 t	11.00	20.00	15.65	-	-		
4.	Soybean- wheat							
	I Control	7.85	11.85	8.00	14.15	10.15		
	II 100% NPK	10.65	22.15	17.85	25.15	19.50		
	III N through FYM, WS and GM	12.50	26.50	20.85	-	-		
			Rainfed					
5	Sorghum + Pigeonpea	8.85	18.65	15.00				
6.	Cotton + Greengram	9.00	19.15	15.15				
7.	Sorghum	6.35	13.35	10.35				
8.	Cotton	5.00	12.65	9.50				
9.	Greengram	7.15	15.85	12.35				
10.	Groundnut	7.65	16.65	13.15				

Note : GG - Grand growth, AH - At harvest

Table 4. Bacterial population (x 10^7 g^{-1} soil) as influenced by cropping systems and nutrient management

	Cropping systems	Initial	*Kharif*		*Rabi*		Summer	
			GG	AH	GG	AH	GG	AH
			Irrigated					
1.	Sorghum - wheat - greengram	10.85	17.15	13.0	19.35	15.00	20.5	16.85
2.	Sorghum- chickpea- groundnut	11.50	19.65	15.65	22.15	18.15	24.65	19.15
3.	Sorghum- wheat							
	I Control	7.85	10.85	8.85	12.65	9.15		
	II 100 % NPK	9.85	17.0	13.65	19.50	15.15		
	III 100% NPK + FYM 10 t	12.15	21.15	16.85	-	-		
4.	Soybean- wheat							
	I Control	9.0	13.65	9.15	15.50	11.0		
	II 100% NPK	11.85	23.35	18.5	26.15	20.35		
	III N through FYM, WS and GM	12.0	27.15	22.15	-	-		
			Rainfed					
5	Sorghum + Pigeonpea	11.35	19.50	15.65				
6.	Cotton + Greengram	10.50	20.35	16.35				
7.	Sorghum	7.50	14.0	11.15				
8.	Cotton	6.85	13.35	10.15				
9.	Greengram	8.50	16.50	13.35				
10.	Groundnut	9.65	17.65	14.15				

Note : GG - Grand growth, AH - At harvest

Actinomycetes population

Actinomycetes population was higher under irrigated conditions as compared to rainfed (Table 3). It increased from initial stage to grand growth stage and again dropped down at harvest in all cropping systems. Actinomycetes population was found to be higher in sorghum-chickpea-groundnut sequence than sorghum-wheat-greengram sequence. Maximum count was recorded at grand growth stage of ground nut crop. In rainfed condition, highest count was recorded under the cotton + greengram intercropping. Beneficial effect of legumes grown in intercropping was perceived. Monocropping with sorghum and cotton has been increased the count but was less than that of legumes. Better performance of legumes can be ascribed can be ascribed to N riched crop residues added besides optimum soil moisture.

In sorghum-wheat sequence, highest population was noted in treatment receiving 100 per cent NPK + FYM with highest count at grand growth stage of sorghum crop and was higher by 23.84 per cent over the count observed in fertilizer alone treatment. Thus, the data clearly denotes the superiority of FYM in increasing the actinomycetes population. The results are in agreement with Kanazawa *et. al.*, (1988). Wheat crop also showed the higher population with treatments. This may be attributed to the effect of residues added by the previous crop and fertilization programme. While, in soybean-wheat sequence, maximum count was observed with the application of N through FYM + WS + GM. Microbial population was more in soils where organics have been applied (Martyniuk and Wagner, 1978). Fertilizer application also enhanced the count over control. Similar observations were

reported by Singh and Sarkar (1988). In this context, it may be construed that intensive cropping and continuous addition of fertilizer and crop residues may have proliferated the microbial count during the growing seasons. Multiple cropping systems specially with legumes edged over the systems and increased the population of organisms.

Bacterial population

Bacterial population increased under irrigated conditions as compared to rainfed (Table 4). In sorghum-chickpea-groundnut crop sequence, bactrial count was higher than sorghum-wheat-greengram. Judicious use of NPK as well as cereal crop residue resulted in triggering the bacterial population. Results are in consonance with Ghate *et. al.*, (1994). The highest bacterial count was recorded at grand growth stage of groundnut and green gram during summer season. Rainy and summer season samples had maximum bacterial populaion. Similar trend was observed by Ram and Singh (1981). Soybean-wheat sequence showed higher count as compared to sorghum-whet. In rainfed situation soil water being the limiting factor controls the biological activity and biochemical transformation in soil. Cotton + greengram intercropping recorded the maximum bacterial count. Inclusion of legumes enriched the soil N status and improved the rhizophere environment favourable for boosting the bacterial population. Among the scale crops, the highest count ws recorded with groundnut followed by greengram. Sorghum and cotton cropping although supported the higher population, but was lower than that of legumes. At harvest of these monocrops, the bacterial colonies were higher as compared to their initial population.

While comparing the sources of nutrients applied to sorghum-wheat sequence, maximum bacterial population was noticed with the application of 100 per cent NPK + FYM. In soybean-wheat crop sequence, higher bacterial count during growing period of sorghum was observed with application of N through FYM + wheat straw + green manuring. The data clearly evinced that balance use of fertilizer did not cause any damage to microbial flora.

Overall scrutiny of the results indicate that bacteria of any time of the year was more than that of actionomycetes and fungi under identical condition. Nanda *et. al.*, (1988) revealed persistance of dominant bacterial flora followed by actinomuycetes and fungi. Microbial population was almost doubled with the balanced and integrated use of chemical fertilizer and organics.

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Carbon and Nitrogen Turnover as Influenced by Cropping Systems and Nutrient Management

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ABSTRACT

Effect of irrigated and rainfed cropping systems on carbon and nitrogen turnover was studied at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during year 2000. Maximum C and N turnover was observed under irrigated cropping systems than rainfed. Sorghum-chickpea-groundnut showed highest turnover under irrigated condition. While monocropping and intercropping with legumes enhance the rate of turnover under rainfed situation. Highest turnover was observed at grand growth stage of crops. Application of integrated nutrient supply increased C and N turnover as compared to their individual application. The FYM + wheat straw + green manuring application augmented the turnover under soybean-wheat crop sequence.

Carbon and nitrogen turnover is provided to our understanding of availability of plant nutrients. Seasonal changes in moisture, microbial population and C input from crop roots and crop remain seem to have a large effect on C and N turnover in Vertisol under irrigated and rainfed situation (Schimel, 1986). The dynamics of C and N turnover is dependent on the cropping and nutrient management. Due to continuous use of manures, fertilizers and other organic sources, the organic C and N status and thereby availability of nutrients are favourably enhanced. The assessment of potential mineralization of C and N in soil will throw light on the extent of their turnover and availability of N to plants. Although, nutrient turnover is microbial dependent process, it is greatly influenced by the cultivation. In the present studies, attempt was therefore, made to obain C and N turnover information under various cropping systems in semi-arid region wherein limited literture on this aspect is available.

MATERIAL AND METHODS

The laboratory study was carried out in the Department of Agricultual Chemistry and Soil Science, Dr. PDKV, Akola during year 2000. For this purpose surface soil samples. (0-30 cm) were collected from the different experimental fields of Central Research Station of University under irrigated and dryland cropping system viz., multiple sequence cropping systems, intercropping and monocropping. The soil was clayey in texture, alkaline in reaction (pH 7.9), medium in available N (180 kg ha^{-1}), low in available P (11.38 kg ha^{-1}), high in available K (340 kg ha^{-1}) and medium in organic C (0.46%).

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

C and N turnover rate was estimated as suggested by Schimel (1986) with the help of following equation.

N turnover (% d^{-1}) = (N mineralized/organic N) x 100

C turnover (% d^{-1}) = (C mineralized/organic C) x 100

For C and N mineralization, place 250 g soil (passed through 2 mm sieve) in 500 ml flask. Moist it with water. Place test tube containing 10 ml of 1 N NaOH in flask in a suspended manner. Wrap the flask with paper. Incubate the flask at 25°C for 30 days. The mouth of the flask completely sealed during the period of incubation. At the end of incubation period, amount of CO_2 trapped in NaOH solution was estimated by titrating the excess of alkali with 1 N HCl, in presence of the Std. $BaCl_2$ solution (Pramer

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and Schimidt, 1965). While the available N ($NH4^+$ + $NO3^-N$) was estimated as per the procedure of Black (1965) by distillation. Organic C and N was determined by the standard procedure (Jackson, 1967).

RESULTS AND DISCUSSION

Carbon turnover

Higher C turnover was recorded under irrigated condition as compared to rainfed (Table 2), probably due to favourable soil environment, leading to greater microbial activity. Highest C turnover was recorded in sorghum-chickepea-groundnut sequence followed by sorghum-wheat-green gram under irrigated condition. Higher C turnover followed by sorghum-wheat-green gram under irrigated condition. Higher C turnover under Sorghum-chickpea-groundnut is due to the inclusion of two legumes in sequence which seems to have altered the dynamic of C turnover rate. At the end of these sequences C turnover in the soil was increased over its initial status due to higher cropping intensity. Soybean-wheat sequence also showed the higher C turnover. This can be attributed to the growing of legumes prior to cereal crop and leaving more crop residues in soil which enhanced microbial activities and ultimately the turnover of nutrients. However, under rainfed condition, C turnover was less under sorghum and cotton monocropping even to its initial level, but under legumes, it was higher over their initial level. According to Schimel (1986), if carbon quality is restricted, that should slow down carbon turnover by reducing decomposition rates. Intercropping with legumes registered higher C turnover as compared to above monocropping.

C turnover increased from planting to flowering in all cropping systems. At harvest it tended to decrease but was slightly higher than initial level except in monocroping with cereals.

While comparing the sources of nutrients applied to sorghum-wheat crop sequence, maximum C turnover was observed in treatment receiving 100 per cent NPK + FYM. It was higher at grand growth stage of the sorghum crop registering an increase of 25.92 per cent over treatment 100 per cent NPK alone. In soybean-wheat sequence, highest C turnover was recorded with application of N through FYM + wheat straw + green manuring, may be because of organic sources.

Nitrogen turnover

It is pertinent to bring out the fact that higher N turnover was recorded under irrigated condition than rainfed (Table 3). Sorghum-chickpea-groundnut crop sequence recorded the highest N turnover compared to sorghum-wheat-green gram. The data further revealed that N turnover in chickpea and wheat crop was less as compared to their previous crop. Which may be due to the highest rate of N mineralization in *Kharif* because of favourable conditions. The results are in agreement with those of Singh and Singh (1994). Higher values were found under soybean-wheat sequence as compared to sorghum-wheat-sequence, probably be due to the residual effect of preceding soybean crop with narrow C : N residues, besides N fixation. Under rainfed condition, among the monocropping studied, the highest N turnover was noticed under sorghum and cotton crop as compared to legumes. Intercropping consisting of legumes had a notable impact on the dynamics of N. Sorghum + Pigeonpea intercropping showed higher N turnover at all stages of crop growth as compared to cotton + green gram. Beneficial effect of intercropping involving legumes over monocropping was observed at the end of intercropping.

In all cropping systems, N turnover increased steadily from planting to grand growth period and thereafter, gradually declined upto maturity of the crop. It is thus, quite apparent that there exists greater turnover at grand growth period when nutrient assimilation is optimum.

In sorghum-wheat-cropping sequence, maximum N turnover was recorded with the application of 100 per cent NPK + 10 t FYM and was highest (0.075% d^{-1}) at grand growth stage of sorghum crop and was 5.63 per cent more than the values obtained by application of fertilizer alone. It may be deciphered from the foregoing results that the integrated approach of combining organics with fertilizers has greatly favoured in increasing N turnover as compared to other treatments. The results are in agreement with those of Marumoto (1984). Under soybean-wheat-crop sequence, application of N through FYM - wheat straw + green manuring increased the N turnover. Sparrow and Cochran (1988) reported similar effect of organic on N turnover.

Close examination of the results reveals that the requirement of nutrient for different cropping systems under study are variable and thus, they alter

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

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

Table 2. C turnover (% d^{-1}) as influenced by cropping systems and nutrient management.

S.N.	Cropping systems	Initial	*Kharif*		*Rabi*		Summer	
			GG	AH	GG	AH	GG	AH
			Irrigated					
1.	Sorghum-wheat-greengram	0.021	0.025	0.022	0.027	0.022	0.029	0.025
2.	Sorghum-chickpea-groundnut	0.025	0.030	0.027	0.033	0.029	0.036	0.030
3.	Sorghum-wheat							
	I Control	0.018	0.020	0.016	0.022	0.018		
	II 100% NPK	0.022	0.027	0.023	0.030	0.025		
	III 100% NPK + FYM 10 t	0.030	0.034	0.031	-	-		
4	Soybean-wheat							
	I Control	0.020	0.024	0.020	0.026	0.021		
	II 100 % NPK	0.028	0.035	0.031	0.039	0.033		
	III N through FYM, WS and GM	0.036	0.043	0.040	-	-		
			Rainfed					
5.	Sorghum + Pigeonpea	0.034	0.039	0.035				
6.	Cotton + Greengram	0.029	0.032	0.030				
7.	Sorghum	0.019	0.023	0.018				
8.	Cotton	0.015	0.019	0.014				
9.	Green gram	0.024	0.028	0.025				
10.	Groundnut	0.032	0.036	0.033				

Note : GG - Grand growth, AH - at harvest

Table 3. N turnover (% d^{-1}) as influenced by cropping systems and nutrient management.

S.N.	Cropping systems	Initial	*Kharif*		*Rabi*		Summer	
			GG	AH	GG	AH	GG	AH
	Irrigated							
1.	Sorghum-wheat-greengram	0.058	0.073	0.062	0.066	0.060	0.065	0.054
2.	Sorghum-chickpea-groundnut	0.066	0.082	0.070	0.075	0.067	0.071	0.064
3.	Sorghum-wheat							
	I Control	0.023	0.039	0.022	0.030	0.021		
	II 100% NPK	0.049	0.071	0.056	0.062	0.053		
	III 100% NPK + FYM 10 t	0.054	0.075	0.064				
4	Soybean-wheat							
	I Control	0.023	0.039	0.022	0.030	0.021		
	II 100 % NPK	0.049	0.071	0.056	0.062	0.053		
	III N through FYM, WS and GM	0.054	0.075	0.064	-	-		
	Rainfed							
5.	Sorghum + Pigeonpea	0.047	0.066	0.055				
6.	Cotton + Greengram	0.043	0.062	0.050				
7.	Sorghum	0.023	0.040	0.030				
8.	Cotton	0.018	0.031	0.022				
9.	Green gram	0.031	0.051	0.040				
10.	Groundnut	0.040	0.058	0.048				

Note : GG - Grand growth, AH - at harvest

the dynamics of C and N turnover in soil. It is quite evident from the present study that cropping with legumes increased the C and N turnover in soil. Favourable effect of green manuring and FYM was attributed to faster decomposition due to their narrow C : N ratio and thereby resulting in more absorption by crops.

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Correlates of Adoption Gap of Recommended Cotton Technologies Among Small and Big Farmers

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ABSTRACT

A sample 100 each of small and big cotton growers was studied in Jalgaon (Jamod) Panchayat Samiti of Buldhana district to find out the gap in adoption of PKV Hy-2 cotton technologies. The results have shown that there was 29 per cent adoption gap in recommendations and use of PKV Hy-2 cotton technologies by farmers. The adoption gap was found to be more in respect of use of seed rate (36.32%), followed by application of fertilizers (31.04%) and plant protection chemicals (30.03%). It was found to be minimum in case of use of manures (20.39%). From amongst the selected technologies the adoption gap was significantly more only in respect of use of seed rate by small (41.69%) and big (30.95%) cotton growers. It was further noted that the psychological characteristics namely, ceonomic motivation, scientific orientation and risk preference, were found to be negative and significant in relation with adoption gap in use of seed rate, manures, chemical fertilizers and plant protection mesures among small and big cotton growers and were thus consistently influencing the adoption of PKV Hy-2 cotton technologies. The cotton growers therefore, need to be constantly persuaded and convinced about the importance of PKV Hy-2 cotton technologies for getting higher yields.

All sections of farming population are not benefited equally due to differential personality characteristics and resources available. Domen (1976) stated that small peasant did not benefit from Green Revolution as much as the big farmers and agricultural loabours. This is so because the agricultural input made available with the onset of Green Revolution could not be secured by small farmers as their economic resource base was feable. The inequality in availability and availment of opportunity by farmers resulted in disparties. The reasons, for this are social status and their differential degree of sources of information, extension contact and other social and economical factors. Singh (1969) reporte that in the field of agricultural science and technology there is tremendous gap between knowledge production and knowledge utilization.

PKV Hy-2 cotton is the innovation from the University reseach. It is grown on large area in Vidarbha region. A technology package along with the improved seed variety PKV Hy-2 cotton was recommended for getting higher yielding. There is a gap between the technology packages recommended and used by the cotton growers. In this study efforts have been made to ascertain the different characteristics of cotton growing farmers and their relation with adoption gap. The specific objectives of the study were :

i) To findout the adoption gap between recommended and adopted PKV Hy-2 cotton cultivation practices among small and big cotton growers.
ii) To ascertain the relationship between characteristics of small and big cotton growers with adoption gap.

MATERIAL AND METHODS

The present study was conducted in purposively selected Jalgaon (Jamod) Panchayat Samiti in Buldhana district of Maharashtra State. A sample of 200 cotton growers i.e. 100 each of, small and big cotton growers was selected randomly from 15 randomly selected villages. An interview schedule was prepared to obtain the responses from the selected cotton growers regarding different aspects under study.

Adoption gap of cotton technologies on the part of farmers was studied in respect of use of seed rate, use of manures, fertilizer application and plant protection measures. The adoption gap was determined with the help of following formula.

$$\text{Average Gap Index for } i^{th} \text{ practice} = \frac{R - A}{R} \times 100$$

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Where, R = Recommended package
A = Adopted package

$$\text{Average Adoption Gap} = \frac{\sum_{i=1}^{n} \text{Average gap index}}{n}$$

Where Σ = Summation
n = Number of practices

RESULTS AND DISCUSSION

Extent of adoption gap :

The extent of adoption gap in PKV Hy-2 cotton technologies depicted in Table 1 revaled that on an average there is 29 per cent adoption gap in cotton technologies. It clearly indicates that only about 70 per cent technologies related to PKV Hy-2 cotton in being adopted by cotton growers. It may further be noted that among small (41.69) and big (30.95) cotton growers there exist a difference of 10.75 per cent in adoption gap in respect of seed rate. The small cotton grower seems to be more particular about use of recommended seed rate than big cotton growers. No sitgnificant different was noted in respect of adoption gap pertainig to use of manures, fertilizer application and plant protection measures by small and big cotton growers. The above findings indicate a wider scope for minimization of adoption gap with regard to cotton technologies among the farmers. This has to be achieved through constant persuation and motivation by arranging demonstrations and visits of farmers to research fields.

Characteristics and adoption gap :

Efforts were made to ascertain the relationship between the characterizes of cotton growers and the adoption gap through correlational analysis. The result of the same are presented in Table 2. It is seen that there was a negative and significant correlation between education of small and big cotton grower and adoption gap in case of seed rate. Further, negative significant among big cotton growers. In case of plant protection measures and use of manures, education of small and big farmers was found to be non-significantly related. This has indicated that with the increase in educational achievement there is an increase tedency to use the recommended quantity of seed rate among the farmers. However this does not hold good in respect of application of fertilizers and plant protection chemicals.

The relational analysis between socio-economic status of small cotton growers with adoption gap in respect of selected practices (Table 2) revealed that there was a negative significantly correlation between socio-economic status and adoption gap in respect of seed rate, fertilizers and plant protection chemicals in case of small cotton growers of seed rate, fertilizers and plant protection chemicals in case of small cotton growers and in the group of big cotton growers there were negative and significant relationship in respect of adoption gap of using seed rate and fertilizer application. There was a non significant relationship in use of manures and plant protection measures. This negative significant correlation may be due to the fact that higher socio-economics status easily signifies better educational opportunities, higher socil participation and assured capacity to invert on innovation and their input. All these factors leads to better knowledge and increase in adoption of recommended practices.

In cluster of psychological characteristics all the three factors i.e. economic motivation, scientific orientation and risk preference were found to be negative significantly correlated with adoption gap in respect of all the practices, among small and big cotton growers. The relationship is indicative of the fact that as the score on psychological characteristics increases their is commensurate decrease in adoption gap. In another words, the farmers who are having economic motivation, better scientific outlook and who took more risk in farming adopted more recommended technologies.

Among communicational characteristics i.e. sources of information and extension contact, it is seen that, there was negative significant relationship between communicational variables and adoption gap in respect of using seed rate and fertilizer application among small and big cotton growers. No significant relationship was observed between both the communicational variable and adoption gap in respect of use of manures. In case of plant protection measures negative significant relationship was observed, in case of sources of information and extension contact among small and big cotton growers respectively. From the above result, it may be inferred that sources of information and extension contact play decisive role in reducting the adoption

Table 1. Per cent of adoption gap in respect of recommended PKV Hy-2 cotton technologies among small and big cotton growers

S.N.	Practices	Percentage of adoption gap			Difference
		Small cotton growers	Big cotton growers	Total	
1.	Seed rate	41.69	30.95	36.32	10.75*
2.	Use of manures	20.60	20.17	20.39	00.43
3.	Fertilizer application	30.00	32.07	31.04	02.07
4.	Plant protection measures	30.73	29.32	30.03	01.41
	Average	30.76	28.13	29.45	02.63

* Significant at 0.05 per cent level of probability

Table 2. Coefficient of correlation between characteristics of cotton growers with adoption gap

S.N.	Characteristics of cotton growers	Coefficient of correlation 'r' values			
		Gap in use of seed rate	Gap in use of manures	Gap in fertilizer application	Gap in plant protection manures
1.	Education				
	Small	-0.2199**	-0.0660 NS	-0.0798 NS	-0.0613 NS
	Big	-0.6715*	-0.0828 NS	-0.2366**	-0.1656 NS
2.	Socio-economics status				
	Small	-0.3905*	-0.2572 NS	-0.2057**	-0.2885*
	Big	-0.2218**	-0.0828 NS	-0.2130 **	-0.0157 NS
3.	Economics motivation				
	Small	-0.5368*	-0.4769*	-0.4140*	-0.3598*
	Big	-0.4651*	-0.5583	-0.4042*	-0.3598*
4.	Scientific Orientation				
	Small	-0.5153*	-0.3941*	-0.4290*	-0.3387*
	Big	-0.3872*	-0.3729*	-0.4191*	-0.3162*
5.	Risk preference				
	Small	-0.3938*	-0.3214*	-0.2646*	-0.2997*
	Big	-0.2682*	-0.4127*	-0.2597*	-0.2817*
6.	Sources of information				
	Small	-0.3890*	-0.1109 NS	-0.2689*	-0.2185**
	Big	-0.4048*	-0.0084 NS	-0.1982**	+0.0014 NS
7.	Extension Contact				
	Small	-0.2496**	-0.0926 NS	-0.2468**	-0.1087 NS
	Big	-0.3270*	-0.0951 NS	-0.2235**	-0.2204**

* Significant at 0.01 per cent level of probability
** Significant at 0.05 per cent level of probability
NS - Non Significant

gap in case of seed rate, application of fertilizers and plant protection chemicals. Similar were the inference drawn by Kubde and Kalantri (1986), and Sharma *et. al.*, (1988),

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Farmer's Attitude Towards National Agricultural Insurance Scheme

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ABSTRACT

The studies conducted on farmer's attitude towards National Agricultural Insurance Scheme in Parbhani and Hingoli Districts of Maharashtra state revealed that mojaroty of the farmers had favourable attitude towards National Agricultural Insurance Scheme. It was also observed that the educational qualification, land holding, annual income, socio-economic status, social participation and sources of information were the important characteristics influencing attitude of the farmers and indicated significant and positive correlation

Indian Agriculture is still subjected to the natural calamities and uncertainties in crop yield. Therefore, there is a need to provide relief measure to the farmers in the event of a crop failure arising out of natural hazards, such as hail storms, heavy rainfall, drought etc. In May 1985, Government of India started crop insurance scheme in collaboration with General Insurance Corporation of India. It is restricrted to borroweres of crop loans from co-operative credit societies, commercil banks and Regional Rural Banks and crop insurance security was limited up to Rs. 10,000/-. Due to these drawbacks, this scheme was cancelled and new scheme called as "National Agricultural Insurance Scheme" (Rashtriya Krishi Bima Yojana) was introduced in 1999. The aims of this scheme is to provide social security,help farmers in maintaining dignity, self-helf, encourage them for large investment in agriculture and reduced risk of burden. The present study was planned and carried out with specific objectives.

1) To study the personal, socio-economic, psychological characteristics of the respondent farmers.
2) To study the attitude of the respondent farmes towards National Agricultural Insurance Scheme.
3) To study the association between the selected characteristics of the respondent farmers and their attitude.

MATERIAL AND METHODS

The present study was conducted in Parbhani and Vasmat taluka of Parbhani and Hingoli districts, respetively of Marathwada region. From these two talukas, 10 villages were selected randomly and samples of 120 respondent farmers who insured their crop were selected by using proportionate random sampling method. Keeping in view the objectives of study, a structural interview scheule was developed for data collection. Data were collected by personally interviewing the respondent farmers with the help of structured interview schedule. The data were subjected to the statistical tests, like frequencies, percentage, coefficient of correlation etc.

RESULTS AND DISCUSSION

I) Personal, social, economic and psychological characteristics

A) Age : The present investigation revealed that 47.50 per cent respondents were from middle age group, followed by 35.00 per cent and 17.5 per cent respondent from young age group and old age group respectively.

B) Education : The findings revealed that 33.34 per cent respondents were educated up to high school level, followed by 26.66 per cent up to college level 16.66 per cent up to primary school level. While 15.00 per cent of them were illiterate.

C) Land holding : The present study indicated that the maximum number of respondents (46.66 per cent) possessed medium land holding, while the 27.50 per cent respondent were from small land holding. The percentage of big land holding was found 25.84 per cent.

D) Annual income : The findings showed that 68.33 per cent respondents with medium annual income followed 18.33 per cent with high annual income,

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Table 1. Distribution of the respondents according to their personal, social, economic and psychological characteristics

S.N.	Category	Frequency	Percentage
	Age		
1.	Young age	42	35.00
2.	Middle age	57	47.50
3.	Old age	21	17.50
	Total	**120**	**100.00**
	Education		
1.	Illiterate	18	15.00
2.	Primary school level	20	16.66
3.	Middle school level	10	8.34
4.	High school level	40	33.34
5.	College level	32	26.66
	Total	**120**	**100.00**
	Land holding		
1.	Small farmers	33	27.50
2.	Medium farmers	56	46.66
3.	Big farmers	31	25.84
	Total	**120**	**100.00**
	Annual income		
1	Low annual income	16	13.34
2.	Medium annual income	82	68.33
3.	High annual income	22	18.33
	Total	**120**	**100.00**
	Socio-economic status		
1.	Lower socio-economic status	2	1.67
2.	Lower middle socio-economic status	17	14.17
3.	Middle socio-economic status	41	34.16
4.	Upper middle socio-economic status	42	35.00
5.	Upper socio-economic status	18	15.00
	Total	**120**	**100.00**
	Social participation		
1.	Low social participation	16	13.33
2.	Medium social participation	82	68.34
3.	High social participation	22	18.34
	Total	**120**	**100.00**
	Source of information		
1.	Low	18	15.00
2.	Medium	70	58.34
3.	High	32	26.66
	Total	**120**	**100.00**
	Risk orientation		
1.	Low	27	22.50
2.	Medium	52	43.34
3.	High	41	34.16
	Total	**120**	**100.00**

while 13.34 per cent of the respondents had low annual income.

E) Socio-economic status : It was seen that 35.00 the respondents, were from upper middle socio-economic status group, followed by 34.16 per cent were middle socio-economic status group. It was further noticed that the 15.00 per cent, 14.17 per cent and 1.67 per cent respondents were having upper socio-economic status, lower middle socio-economic status and lower socio-economic status group respectively.

F) Social participation : It was observed that the majority (68.33 %) of the respondents were from medium social participation group, followed by 18.34 per cent from high social participation group only 13.33 per cent of the respondent were from low social participation.

G) Sources of information : It was found that more than half 58.34 per cent of the respondents were making medium use of sources of information, followed by 26.66 per cent respondents who had high exposure to sources of information and only 15.00 per cent of the respondents were found in low category of use of sources of information.

H) Risk orientation : It was noticed that 43.34 per cent of the respondent were found in medium risk orientation category, followed by 34.16 per cent and 22.50 per cent were found high and low risk orientation category, respectively.

II) Attitude : It was observed that the majority (76.66 per cent) of the respondents had favourable attitude towards National Agricultural Insurance Scheme, followed by 15.00 per cent of te respondents ha unfavourable attitude while highly favourable attitude of the respondents was noticed in only 8.35 per cent. The above findings were in line with the findings of Pandey *et. al.*, (1981), Thakur *et. al.*, (1990) and Vijayabhinandana and Suryamani (1999).

A perusal of Table 3 indicated that among the selected characteristics of the farmers, education, land holding, annual income, socio-economic status, social participation and sources of information had positive and significant relationship with attitude about the National Agricultural Insurance Scheme. However, the risk orientation had significant correlation with attitude at 0.01 per cent level of probability. However the correlation with age revealed non significant relationship with attitude. The findings of the present study were in line with the findings reported by Vijayabhinanadana and Suryamani (1999) and Shinde *et. al.*, (2002)

Table 2. Distribution of the respondents according to their attitude

S.N.	Catogory	Frequency	Percentage
1.	Highly favourably	10	8.34
2.	Favourable	92	76.66
3.	Unfavourable	18	15.00
	Total	120	100.00

III) Association with attitude

Table 3. Coefficient of correlation of characteristics of the respondents with their attitude

S.N.	Variables	'r' values
1.	Age	0.063
2.	Education	0.551**
3.	Land holding	0.274**
4.	Annual income	0.244**
5.	Socio-economic status	0.355**
6.	Social participation	0.485**
7.	Sources of information	0.626**
8.	Risk orientation	0.196**

* Significant at 0.01 per cent level of probability, ** Significant at 0.05 per cent level of probability

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Effect of Nitrogen and Spacing Levels on growth and Flower Yield of China Aster

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ABSTRACT

The experiments on nitrogen levels and plant density were carried out during winter seasons of 98-99, 99-2000 and 2000-2001 involving four levels of nitrogen (0, 100, 150 and 200 kg ha^{-1}) with three spacing levels (30 x 30 cm, 45 x 30 cm and 60 x 30 cm). Results showed significant increase in plant height (68.1 cm), branches (14.5 nos), flowers (45.0 nos.) $plant^{-1}$ and flower yield (10.7 tonnes ha^{-1}) with the application of nitrogen 150 kg ha^{-1}. Amongst the various spacing tried, maximum branches (13.0 nos.), flowers (42.4 nos) was obtained under wider spacing (60 x 30 cm) while, maximum flower yield (12.9 tonnes ha^{-1}) was produced under closer spacing (30 x 30 cm). It is therefore recommended for higher flower yield to apply 75 kg nitrogen, 50 kg P_2O_5 and 50 kg K_2O ha^{-1} at planting and there after 75 kg nitrogen at bud initiation of aster under spacing of 30 x 30 cm.

China, Aster (*Callistephus chinensis* L. Ness) flowers are used for garland and decoration purpose. The flowers with long spikes are excellent as cut flower for decoration when arranged in bowls and vases. It is also grown as bedding borders in garden. In view of its large commercial production it is gaining importance. Cultural practices are important factors which determine the crop yield. Nutrients and plant density play major role in plant growth, flower yield and quality of flowers. In view of this, the experiment was undertaken to study the effect of different levels of nitrogen and plant density on growth and flower yield of China aster.

MATERIAL AND METHODS

The experiment on nitrogen levels and plant density was carried out during winter seasons of 98-99, 99-2000 and 2000-2001 at Floriculture Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in Factorial Randomized Block Design. The soil of experiment plot has pH 7.7 and low in nitrogen and phosphorus and high in potassium. Uniform one month old seedlings of China aster variety Ostrich plume mixed were transplanted in first week of October every year as per spacing treatments. The plot size was 3.60 x 1.50 m^2. There were four levels of nitrogen (0, 100, 150 and 200 kg ha^{-1}) and three spacing treatments (30 x 30, 45 x 30 and 60 x 30 cm.). The full common dose of P_2O_5 and K_2O 50 kg ha^{-1} each and half dose of nitrogen as per treatments were applied at the time of transplanting. The remaining nitrogen was applied at the time of flower bud initiation. FYM @ 10 tonnes ha^{-1} was applied at the time of field preparation. The observations on growth, flower quality and yield were recorded.

RESULTS AND DISCUSSION

Effect of nitrogen levels on growth and flower yield of China aster

It is revealed from data presented in Table 1 and 2 that, nitrogen application had significant effect on growth,yield and quality of flowers of aster.Significantly miximum plant height (68.1 cm), branches $plant^{-1}$ (14.5 nos) and spared of plant (47.7 cm) were produced due to application of nitrogen 150 kg ha^{-1} (N_2) as compared to lower level 100 kg ha^{-1} and higher level 200 kg ha^{-1} (N_3). Maximum growth of China aster was reported by Vijay Kumar *et. al.*, (1988) due to application of nitrogen 240 kg ha^{-1} as compared to lower and higher levels of nitrogen. Maheshwar (1978) and Narayana Gowda (1985) have observed increase in growth attributes in China aster due to increase in nitrogen levels. These results are confirmed with the findings of these workers.

Maximum number of flowers $plant^{-1}$ (45), diameter of flower (9.3 cm) and stalk length of flower (28.8 cm) were produced due to application of nitrogen 150 kg ha^{-1} (N_2). Maheswar (1978) and

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Table 1. Effect of different levels of nitrogen and spacing on growth and flower quality of Aster cv. Ostrich plume mixed

(Pooled mean) (Average figures)

Treatments	Height of plant (cm)	No. of branches plant^{-1}	Spread of plant (cm)	No. of floweer plant^{-1}	Diameter of flower (cm)	Length of flower stalk (cm)
Nitrogen levels						
N_0 - O kg ha^{-1}	53.4	6.7	36.5	31.5	5.9	26.7
N_1 - 100 kgha^{-1}	62.8	11.99	43.5	36.4	8.3	26.7
N_2 - 150 ha^{-1}	68.1	14.5	47.7	45.0	9.3	28.8
N_3 - 200 ha^{-1}	66.2	13.3	42.5	41.6	8.6	22.4
F test	Sig	Sig	Sig	Sig	Sig	N.S.
SE (m)±	1.46	0.58	1.27	1.50	0.37	0.95
CD at 5%	4.04	1.60	3.51	4.15	1.02	-
Spacing levels						
S_1 30 x 30 cm	66.0	10.2	36.3	34.9	7.2	28.6
S_2 45 x 30 cm	62.0	11.5	44.0	38.5	8.3	27.5
S_3 60 x 30 cm	59.9	13.0	47.4	42.4	8.6	26.1
F test	Sig	Sig	Sig	Sig	Sig	NS
SE (m)±	1.27	0.50	1.10	1.30	0.32	0.83
CD at 5%	3.51	1.38	3.04	4.68	0.88	-

Table 2. Effect of different levels of nitrogen and spacing on flower yield of Aster cv. Ostrich plume mixed

Treatments	Flower yield (kg)			Pooled	Yield ha^{-1}
	1998-99	1999-00	2000-01	mean (kg)	tonnes
Nitrogen levels					
N_0 - O kg ha^{-1}	1.025	1.199	0.216	1.484	5.9
N_1 - 100 kgha^{-1}	1.783	1.987	2.519	2.096	8.3
N_2 - 150 ha^{-1}	2.167	2.494	3.427	2.696	10.7
N_3 - 200 ha^{-1}	1.863	2.431	2.783	2.359	9.4
F test	Sig	Sig	Sig	Sig	Sig
SE (m)±	0.12	0.083	0.087	0.127	0.50
CD at 5%	0.350	0.250	0.254	0.351	1.33
Spacing levels					
S_1 30 x 30 cm	3.042	3.629	3.784	3.485	12.9
S_2 45 x 30 cm	1.400	1.601	2.561	1.854	7.6
S_3 60 x 30 cm	0.684	0.854	1.882	1.140	5.3
F test	Sig	Sig	Sig	Sig	Sig
SE (m)±	0.10	0.072	0.075	0.110	0.4
CD at 5%	0.31	0.212	0.219	0.304	1.10

Table 3. Interaction effect of nitrogen and spacing levels on flower yield (kg) of Aster cv. Ostrich plume mixed (Pooled mean)

Nitrogen levels	Spacing levels			Mean
	S_1 (30 x 30 cm)	S_2 (45 x 30 cm)	S_3 (60 x 30 cm)	
N_0. 0 kg ha^{-1}	2.297	1.354	0.803	1.484
N_1 100 kg ha^{-1}	3.538	1.739	1.013	2.096
N_2 150 kg ha^{-1}	4.434	2.167	1.489	2.696
N_3 200 kg ha^{-1}	3.667	2.158	1.253	2.359
Mean	3.484	1.854	1.139	

'F' test - Sig.; SE (m) $\pm$ 0.220 ; CD at 5 % level 0.610

Narayana Gowda (1985) have also reported increase in flower quality attributes in China aster due to increase in nitrogen levels.

It is evident form data presented in Table 2 that yield in respect and weight of flowers plot^{-1}(2.696 kg) and hectare^{-1} (10.7 tonnes) were observed maximum in applied nitrogen at 150 kg ha^{-1} (N_2) and was at par with higher level of nitrogen 200 kg ha^{-1} (N_2). Maheswar (1978) and Vijaykumar *et. al.* (1988) reported maximum flower yield due to increase in nitrogen levels in China aster. Sreenivas and Narayana Gowda (1999) have also reported maximum flower yield due to application of recommended dose of NPK and 15 tonnes FYM ha^{-1}.

Effect of plant density on growth and flower yield of China aster

The data on growth and flower yield as influenced by various plant densities adopted are presented in Table 1 and 2. Significantly maximum branches plant^{-1} (13.0 nos) and spread of plant (47.4 cm) were produced in wider spacing (60 x 30 cm), while, tallest plants (66.0 cm) were recorded in closer spacing (30 x 30 cm). Similar type of results were reported by Dhemre *et. al.*, (1998) in aster.

Maximum number of flowers plant^{-1} (42.4) with maximum diameter (8.6 cm) of flower were produced in wider spacing (60 x 30 cm), while, length of flower stalk (28.6 cm) was maximum at closer spacing (30 x 30 cm). These results are in conformity with the results reported by Dhemre *et. al.*, (1998). It is noticed from pooled data presented in Table 2 that, significantly maximum fresh flower yield plot^{-1} (3.485 kg) and ha^{-1} (12.9 tonnes) were produced by plants transplanted at closer spacing 30 x 30 cm (1.11 lakh plants ha^{-1}) and minimum flower yield plot^{-1} 1.140 kg (5.3 tonnes ha^{-1}) was produced under wider sapcing 60 x 30 cm (0.55 lakh plant ha^{-1}). Same trend of results were reported by Patil *et. al.*, (1987) and Vijay Kumar *et. al.*, (1988).

It is revealed from data presented in Table 3 that interaction effects of nitrogen and spacing levels were found significant in respect of flower yield. Maximum flower yield plot^{-1} (4.434 kg) was obtained under interaction N_2S_1 (150 kg nitrogn ha^{-1} at spacing 30 x 30 cm). Same trend of results were reported by Vijay Kumar *et. al.*, (1988).

It is concluded from the above results that, planting of China aster should be done at a spacing of 30 x 30 cm with application of nitrogen 150 kg ha^{-1} for higher flower yield of China aster in Vidarbha region. Half dose of nitrogen should be applied at the time of transplanting and remaining half dose at the time of flower bud initiation.

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Effect of Pesticides Against Different Phyllosphere Bacteria of Chilli

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ABSTRACT

Effect of different pesticides used in management of pest and disease on phyllosphere bacteria collected from Chilli (*Capsicum annum*) was assessed *in vitro* spectrophotometrically at λ 620 mm. Nineteen phyllosphere bacteria were isolated on nitrogen free Jensens medium at monthly interval against the plant protection chemicals adopted in the field. Seven identical distinct vigorous growing bacteria were selected for further study. Most of the pesticides found to be harmless to phyllosphere bacterial isolates except streptocyclin 100 ppm, where as tridemorph 0.1 per cent had synergistic effect on phyllosphere bacteria. Copper oxychloride does not possess harmful or additive effect for supporting the growth of phyllophere bacteria.

It is recognized that leaf surface constitute a distinct microhabitat. The phyllosphere study is useful to certain the role of plant bacteria for same nutrient fixation and in biological control of plant pathogens. Ruinen (1956) first coined the term phyllosphere and stated that many microorganisms are associated with lef surface. Azotobacter and other bacteria liberate antifungal metabolites offered formidable resistance to various fungi. (Lakhsmikumari and Vijaylakshmi 1975).

Most of the cultivators undertaken sprays for management of pests/diseased by use of different chemicals which are harmful to the beneficial bacterial flora and hence keeping in view these factors it is planned to investigate the deleterious effect of pesticides on phyllosphere microorganisms in chilli (*Capsicum annum* L.).

MATERIAL AND METHODS

By using leaf surface washing method, seven isolates of phyllosphere bacteria were collected from chilli (*Capsicum annum* L.) from the experimental farm of Department of Plant Pathology, Dr. PDKV, Akola where the plant protection schedule was applied.

Leaf surface of chilli were washed with 10ml sterilized distilled water and from washing 1 ml suspension was pipetted and spread on surface of Jensens medium in petriplate and incubated. Distinct vigorous colonies were picked up and streaked on fresh sterilized plates, the colonies were examined microscopically for purity and transferred on slants for further studies.

Sensitivity of phyllosphere bacteria was studied by following method.

a) Paper disc method

b) Assaying growth (spectrophotometrically)

Following pesticides were used in this study at recommended does which were used for management of various pests and diseases of chilli crop to assess the effect on phylosphere bacteria.

Pesticide	Recommended doses
Fungicides	
a) Carbendazim	0.1%
b) Copper oxychloride	0.2%
c) Tridemorph	0.1%
Antibiotics	
d) Streptocyclin	100 ppm
Insecticide	
e) Cypermethrin	0.07%
f) Dimethoate 30 EC	0.03%
g) Monocrotophos 36 EC	1.5%

a) Paper disc method :

Calculated quantity of above mentioned pesticides were added in sterilized distilled water at the recommended dose and stirred with glass rod of uniform mixing.

One-ml suspension of different phyllosphere bacteria (10^7 cfu ml^{-1}) incorporated in warm autoclaved liquified NA medium just before

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pouring in Petriplate. Plates were inoculated centrally with 5 mm disc treated with diferent pesticide with three replication. Paper disc dipped in sterilized distilled water served as control. Petriplate were incubated at 27 $\pm$ 2^0 c. After four days of incubation the zones were formed and radial diameter was measured (mm).

b) Assaying the growth of phyllosphere bacteria in pesticide containing medium (Spectrophoto metrically)

One ml of ech phyllopheres isolate (10^7 cfu ml^{-1}) was added to nutrient broth containing requisite concentration of pesticide separately in aseptic condition. The flask were shaked 6-7 times a day. Each treatment was replicated thrice.

At 24 hr. interval, 10 ml samples were withdrawn and absorbance at λ 620 mm was recorded separately using spectrophotometer. The spectrophotometer was adjusted to zero using blank medium. Observations of inoculated and un-inoculated flask were recorded. Control flask were inoculated with a bacterial isolate (standard) alone without addition of pesticide.

RESULTS AND DISCUSSION

Effect of different pesticides used in plant protection practices on phyllosphere bacteria was assessed *in vitro* spectrophoto matrically at λ 620 mm.

The data presented in Table 1 showed that the carbendazine @ 0.1 per cent exhibited maximum inhibitation (11.66 %) with the isolate AII followed by BI (6.71%). Streptocycline @ 100 ppm showed

Table 1. Effect of different pesticides on phyllosphere bacteria of chilli (mm)

Isolate	Carbend azim 0.1% inhibition	Strepto-cycline 100 ppm inhibition %	Dimeth-oate 0.03% inhibition %	Cyperme-thrin 0.07% inhibition %	Tridem-orph 0.1% inhibition %	Copper oxychlo-ride 0.2%	Monocr-otophos 1.5 ml lit^{-1} inhibition %
AII	11.66	51.59	6.19	5.66	11.66	0.00	0.00
BI	6.71	41.17	11.19	16.66	0.00	0.00	0.00
CII	1.18	39.75	6.19	16.66	5.66	5.66	5.66
CIII	0.00	34.72	5.66	5.66	5.66	5.66	11.19
EII	4.39	46.23	6.19	5.66	5.66	4.39	0.00
EIII	6.71	6.19	11.19	10.71	10.87	5.66	5.66
EIV	1.96	46.23	5.66	16.66	5.66	0.00	5.66
Control	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2. Assaying growth of phyllosphere bacteria in pesticide containing medium (spectrophotometrically) after 72 hr. (OD)

Isolate	Carbend azim 0.1%	Strepto-cycline 100 ppm	Dimeth-oate 0.03%	Cyperme-thrin 0.07%	Tridem-orph 0.1%	Copper oxychlo-ride 0.2%	Monocr-otophos 1.5 ml lit^{-1}
AII	2.75	1.87	1.44	1.54	1.72	1.89	1.81
BI	1.57	1.66	1.46	1.54	1.74	1.65	1.70
CII	2.73	1.72	1.45	1.67	1.70	1.64	1.77
CIII	1.27	1.52	1.39	1.75	1.81	1.80	1.56
EII	2.37	1.65	1.43	1.66	1.81	1.77	1.72
EIII	2.64	1.56	1.55	1.69	1.79	1.71	1.63
EIV	2.66	1.54	1.42	1.66	1.76	1.81	1.79
Control	2.98	1.98	1.66	1.79	1.98	1.94	2.35
'F' test	Sig	Sig	NS	Sig	NS	NS	Sig
SE (m) $\pm$	0.038	0.071	0.078	0.045	0.062	0.07	0.135
CD at 5%	1.612	0.298	-	0.189	-	-	0.568

the high degree of effective agaoinst all isolate except (6.19%). Highest inhibition (51.59%) was recorded in isolate AII.

The highest inhibitation of 11.19 per cent mm was observed in dimethoate @ 0.03 per cent against isolate BI and EIII. Dimethoate can be safely used as foliar spray for survival of all the seven phyllosphere bacteria. Cypermethrin @ 0.07 per cent showed highest 16.66 per cent inhibition of isolate BI, CII and EIV. While Tridemorph 0.1 per cent showed max. inhibition (11.66 per cent) of isolate AII.

Copper oxychloride @ 0.2 per cent showed higher inhibition of 5.66 per cent against CII, CIII and EIII, followed by EII (4.39%). And in case of Mondocrotophos 36 EC 1.5 ml $lit.^{-1}$ showed high inhibition per cent (11.19 %) against CIII, followed by CII, EIII and EIV (5.66 mm each)

In general among the pesticides tested tridemorph (Systemic fungicide) and dimethoate (Insecticide) can be used safely. However, most of the chemicals were also found to be harmless for maintaining the phyllosphere bacteria on the plant except streptocycline 100 ppm which act as antibiotic.

The priliminary present investigation with these pesticide brought out the fact that most of the commonly used organic fungicides and insecticides are not harmful to phylosphere bacteria. Besides this some of the chemcials stimulated the growth. Similar findings were reported by Mallikarjunaih (1995) against *Azotobacter*. Agrawal (1990) and Siba Adhikari (1989) stated that most of the chemicals are less harmful to useful microorganisms and further observed that lower concentration increase the growth. Thomson (1976), Pande and Kumar (1990) reported that some antibiotic substances are produced by *phyllosphore azotobacter* that inhibit the growth of pathogenic fungi and bacteria.

It is revealed from Table 2 that the differences are existed among the phyllosphere isolate over control in enhancing the growth. Optical density when observed at 72 hr., Bl (1.57) and CIII (1.27) showed inhibitory effect towards carbendazim while other isolates were observed to grow without harmful effect.

Antibiotic proved to have antibacterial accordingly streptocylline 100 ppm was observed to be inhibitory to all isolates. Isolate AII (1.87) and CII (1.72) attained maximum, growth respectively and the OD was also at par with control.

Isolate CIII (1.75) and EIII (1.69) exhibited higher OD which was at par with the control in cypermethin 0.07 per cent indicating harmless effect of the insecticide. Tridemorph had synergistic effect on phyllosphere bacteria Monocrotophos was observed to be least effective and OD ranged between 1.56 to 2.35. Data indicates that plant protection chemicals does not have any deleterious effect on phyllosphere bacteria of chilli.

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RESEARCH NOTES

Ovicidal Action of Newer Insecticides and Bt Formulations Against *Earias vitella* (Fabricius) on Okra

Amongst the cultivated fruit vegetable grown in country, Okra, (*Abelmoschus esculentus*, L. Moench) is one of the important crops. Successful production of this crop is hampered due to many pests. Shoot and fruit borer, *Earias vitella* (Fab.) (Lepidoptera : Noctuidae) is the most important and serious insect pest causing 88 to 100 per cent fruit damage (Radake and Undirwade, 1981). For the management of *E. vitalla*, farmers are using various types of insecticides indiscriminerly which leads to the development of resistance, resurgence of pest and problem of residual toxicity (Dethe and Kale, 1990). To overcome this selective use of insecticides and ovicides for suppression of the egg stage is highly desirable as a chemical component of IPM technology.

Keeping this in view, laboratory investigations were undertaken to generate useful information on the efficacy of several insecticides including new molecules as ovicides in suppressing *E. vittella* populations.

The studies on the ovicide action of different insecticides against *E. vittella* eggs were carried out during 2002-2003 crop season in the laboratory of Department of Entomology, Dr. PDKV, Akola. The study was conducted on 1, 2, 3 and 4 day old eggs of *E. vittella* under laboratory conditions.

Rearing of *E. vittella* was done on tender fruits of Okra in laboratory. The eggs of *E. vittella* were obtained from laboratory reared population. The fresh laid eggs were kept for 1 - 4 days, according to the treatment, ten eggs of *E. vittella* were pasted on strip of paper with the help of thin smear of gum and replicated thrice for each treatment. The paper strip having eggs pasted was dipped in the insecticides solution for ten seconds and air dried under fan. The treated eggs strips was placed in disinfected plastic vial containing bhendi fruits. Simultaneously, eggs strip was dipped in distilled water and was treated as control. Observations on egg hatching were taken every day till the normal incubation period for eight days. The total number of eggs hatched within a period of eight days was recorded. The eggs those could not be hatched were considered as dead cue to ovicidal effect of the insecticide. In this say ovicidal activity of each insecticide was worked out by dipping eggs of different ages i.e. freshly laid 1 day, 2 day, 3 day and 4 day old eggs in each insecticide solutions. Thereafter, data on per cent egg mortality for each treatment were subjected to appropriate transformation and statistical analysis on CRD was done according to Gomez and Gomez (1984).

The data regarding per cent ovicial activity of insecticides and Bt formulations agaisnt 1 - 4 day old eggs of E. vittella are preented in Table 1. All the treatments were significantly superior over control in all the age group of eggs.

Amongst the treatments, indoxacarb 14.5 SC, 0.0087 per cent recorced maximum egg mortality ranging from 86.66 to 73.33 per cent followed by spinosad 45 SC, 0.012 per cent (83.33 to 70.00 %), diflubenzuron 25 WP, 0.02 per cent (80.00 to 63.33 %) and novaluran 10 EC, 0.002 per cent (76.66 to 60.00 %) in 1 - 4 day old eggs of *E. vittella* respectively while these tretments were at par among themselves. Abamectin 1.8 EC, 0.0027 per cent caused egg mortality ranging from 66.66 to 46.66 per cent and was at par with acetamiprid 20 SP, 0.002 per cent (50.00 to 30.00 %) and Btk (Halt) i.e. 53.33 to 33.33 per cent in 1-4 days ld eggs. In general, it was observed that the 1 day and 2 day old eggs were more susceptible than 3 and 4 day old eggs. The treated eggs turned black, shriveled and dried. Results further revealed that the ovicidal action irrespective of insecticides was gradually decreased with the increased of the eggs up to 4 days. This may probably be due to the development of choria and chitnization of eggs, which is completed in 3 to 4 days.

The finding regarding indoxacarb 14.5 SC and spinosad 45 SC are in conformity with the findings of Ahmed *et. al.*, (2001) who reported 86.60 per cent and 73.33 per cent *S. litura* egg mortality

Table 1. Effect of insecticides on mortality of *E. vitella* eggs

S.N.	Treatments	% conc.	% egg mortality			
			1 Day old	2 Day old	3 Day old	4 Day old
1	Diflubenzuron 25 WP	0.02	80.00 (63.44)	76.66 (61.22)	70.00 (56.79)	63.33 (52.77)
2	Novaluron 10 EC	0.002	76.66 (61.22)	70.00 (57.00)	66.66 (54.78)	60.00 (50.77)
3	Acetamipirid 20 SP	0.002	50.00 (45.00)	43.33 (41.15)	36.66 (37.22)	30.00 (33.00)
4	Imidacloprid 17.8 SL	0.00356	46.66 (43.07)	40.00 (39.14)	33.33 (35.00)	26.66 (30.78)
5	Spinosad 45 SC	0.012	83.33 (66.14)	80.00 (63.44)	73.33 (59.00)	70.00 (57.00)
6	Abamectin 1.8 EC	0.0027	66.66 (54.78)	60.00 (50.77)	53.33 (46.92)	46.66 (43.07)
7	Indoxacarb 14.5 SC	0.0087	86.66 (68.85)	83.33 (66.63)	76.66 (61.22)	73.33 (59.00)
8	Bt var Kurstaki (Dipel 8 L)	0.15	43.33 (41.15)	36.66 (37.22)	30.00 (33.00)	23.33 (28.77)
9.	Bt var Kurstaki (Halt)	0.1	53.33 (46.92)	43.33 (41.15)	40.00 (39.14)	33.33 (35.21)
10.	Control (water spray)		6.66 (10.52)	10.00 (15.83)	3.33 (7.81)	0.00 (2.5)
	'F' Test		Sig	Sig	Sig.	Sig.
	SE m±		3.50	3.39	3.22	2.57
	CD at 5%		10.39	10.09	9.56	7.64

N.B. Figures in parentheses are arc sine values.

due to indoxacrb 14.5 SC and spinosad 45 SC respectively. Likewise the findings regarding diflubenzuron 25 WP applied @ 0.02 per cent are in agreement with finding of Meisner *et. al.*, (1987) and Samraj and Jesudasan (1989) who reported 929 per cent and 91.00 per cent reduction in hatchability of spotted bollworm eggs dipped in 0.1 per cent and 100 ppm of diflubenzuron 25 WP. Singh (2002) reported 60 per cent eggs mortality of *Spilosoma obliqua* with Btk (Halt) @ 2 g lit.$^{-1}$ which support the findings present in investigation regarding activity of Bt. to *E. vittela* eggs.

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Susceptibility of *Bombyx mori* (L) to *Nomuraea rileyi* (Farlow) Samson

In the era of biotic control, use of biotic agents like viruses, bacteria, fungi etc. is accelerating due to the promising results achieved in minimising the pest population. The entomofungal *Nomuraea rileyi* (F) Samson is known to be a naturally occuring fungus effective against many lepidopterous insect pests. Natural occurrence of epizootic of *N. rileyi* has been observed on *Helicoverpa armigera* (Gopalkrishnan and Narayanan, 1988, Men *et. al.*, 1990), *Spodoptera exigua* (Phadke and Rao, 1978). So it was felt necessary to know its safety to beneficial insect. Keeping this point in view the present study "Susceptibility of *Bombyx mori* (L) to *Nomuraea rileyi* (Farlow) Samson" was conducted.

The isolate of *N. rileyi* was obtained from *H. armigera* diseased larvae collected from the field. After reisolation from larval cadavers. the isolate were purified by subculturing on Sabouraud maltose agar containing 1 per cent yeast extract. Rearing of silkworm larvae was undertaken in the sericulture unit of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in confined conditions. Ten Fourth and fifth instar larvae of silkworm were reared on mulberry leaves in the laboratory (24 $\pm$ 1°C). The inoculum containing 3 x 10^7 conidia/ ml in 0.02 per cent Tween 80 in sterile single distilled water was then sprayed with the help of atomizer by pumping twice on the larvae in petriplate over a filter paper. Four replications were maintained along with a control. All the larvae were fed with mulberry leaves. Observations of larval mortality were recorded daily.

The fourth instar larvae were found most susceptible to infection compared to fifth instar. In fourth instar larvae 100 pe cent mortality was recorded on 5th day after inoculation. Larvae were completely covered by the fungus, malchate green sporulation was observed on infected larvae. There was 70 per cent larval mortality observed in 5th instar treated larvae. Pupation and moth emergence was not seen in 5th instar larvae. Where as in control out of forty larvae only one larva died and the adult emergence was normal.

The present study gives an indication that silkworms are highly susceptible to *N. rileyi* and and therefore it's use in biotic control should be restricted to non sericulture areas of India as this fungus is highly effective in normal rearing conditions. (Temperature 24 $\pm$ 1°C and RH 78%) which is essential during silkworm rearing.

Table 1. Infectivity of *N. rileyi*

Larval instar	Number of larvae infected out of 10 larvae				Total infected larvae out of 40 larvae	Average % mortality
	RI	RII	RIII	RIV		
4th instar	10	10	10	10	40	100
5th instar	8	7	7	6	28	70
Control	0	01	0	0	1	2.5

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Heterosis studies for Shoot Fly Resistance in *Rabi* Sorghum (*Sorghum bicolor* (L.) Moench)

Shoot fly is one of the major pests of sorghum, which lowers the productivity. Genetic control of the Shoot fly is practically feasible means than other methods of control. The degree of hybrid vigour provides an ideal about the probable gene action in the determination of a character. Heterotic breeding maintains the heterozygosity and congregates the desirable genes from the diverse parents. Since the heterosis is the function of intra genic interactions at various loci, genetic diversity of the parameters is very important in its expression. On account of this the present study was carried out to identify the best desirable combinations with high degree of heterotic effects for shoot fly resistance.

The material for the present study comprised of six male sterile lines viz. Akms 44 A, Akms 45 A, Akms 47 A, Akms-74 A, Akms 75 A and Akms 80 A and eight restorers viz. AkRb-349, AkRb-352, AkRb-361, AkRb-365, AkRb-369, AkRb-370, AkRb-371 and AkRb-374. The resultant 48 hybrids and 14 parents were sown in randomized block design with three replciations during *Rabi* 2003, at the field of Sorghum Research Unit, Dr. PDKV, Akola. Recommended fertilizer dozes were given. All agronomical and other operations were carried out when ever necessary. Row to raw and plant-to-plant distance was kept 45 and 15 cm respectively. The crop was sown when high shoot fly population had already been build up. The observations were recorded on number of eggs plants^{-1}, Seedling height, Number of trichomes/mm^2 and dead heart percentage at 21st days of sowing. The heterobeltiosis was worked out and tested for its significance by standard method suggested by Kempthorne, O. (1957).

Heterosis over the better parent (heterobeltiosis) was observed in both positive and negative direction for all the characters studied (Table 1).

No. of eggs plant^{-1} : The negative and significant heterobeltiosis for low no of eggs plant^{-1} was observed in following crosses viz. Akms 44 A x AkRb 352 (-35.69 %), Akms 44 A x AkRb 361 (-27.24 %), Akms 45 A x AkRb 352 (-20.39%), and Akms 74 A X AkRb 361 (-16.67%).

Seedling height :24 crosses showed positive and significant heterobeltiosis in desired direction. The crosses viz. 74 A x AkRb 365 (44.77 %) Akms 80 A x AkRb 369 (40.52%), Akms 74 A x AkRb 361 (30.37%), Akms 80 A x AkRb 361 (30 .14 %) and Akms 80 A x AkRb 352 (26.13%) were found promising for faster seedling growth in desired direction towards shoot fly resistance.

No. of Trichomes/mm^2 : Positive and significant heterobeltiosis for more number of trichomes/mm^2 in desired manner recorded by the crosses viz. Akms 45 A x AkRb 371 (186.84%), Akms 75 A x AkRb 352 (127.14%), Akms 74 A x AkRb 371 (76.81%), Akms 45 A x AkRb 370 (72.31%), Akms 44 A x AkRb 349 (18.87%).

Dead heart % : Negative and significant heterobeltiosis for low dead heart percentage was

Table 1. Promising hybrids showing Heterobeltiosis (superiority of the hybrids over better parents) for different contributing traits of Shoot fly resistance.

Characters	No. of Eggs plant^{-1}	Plant height (cm)	Trichomes/mm^2	D.H., %
Akms 44 A x AkRb 361	-27.24**	11.85**	-68.75**	-76.75**
Akms 45 A x AkRb 371	-2.35**	10.00**	186.84**	-53.70**
Akms 74 A x AkRb 352	-9.60	40.32**	-83.06**	-30.68**
Akms 75 A x AkRb 371	3.42	31.33**	-20.00**	-80.10**
Akms 80 A x AkRb 361	-8.29	30.14**	13.73	-58.24**
SE (D)		0.3254	2.7341	2.07
CD 95%		0.6462	5.4287	4.12
CD 99%		0.8556	7.1884	5.17

* Significant at at 5 per cent level, **Significant at 1 per cent level

recorded by the crosses viz. Akms 75 A x AkRb-361 (-80.10%), Akms 80 A x AkRb 374 (-64.51%), Akms 80 A x AkRb 361 (-58.24%), Akms 45 A x AkRb 371 (-53.70%), Akms 44 A x AkRb 361 (-46.28%), Akms 80 A x AkRb 371 (-44.44%), Akms 80 A x AkRb 365 (-40.75%), Akms 80 A x AkRb 370 (-37.37%), Akms 74 A x AkRb 365 (-27.90%) and Akms 74 A x AkRb 365 (-12.19%) in desired direction. Nimbalkar and Bapat (1991) reported significant heterosis in desired manner for low dead heart percentage and no. of eggs plant^{-1}. Starks *et. al.*, (1970) reported 14 per cent heterosis for shoot fly resistance.

In general the crosses viz. Akms 75A x AkRb 371, Akms 80 A x AkRb 361, Akms 44 a x AkRb 361, Akms 45 x AkRb 371 and Akms 74 A x AkRb 352 has exhibited negative and significant heterotic effects forlow dead heart percentage in desired direction. These crosses have also exhibited desired heterotic effects for low no. of eggs plant^{-1}, Seedling height and no. of trichomes/mm^2 hence these crosses were found to be better for shoot fly resistance and can be successfully utilized as commercial hybrids after further testing for grain, fodder yields and with released commercial hybrids.

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Studies on Selection of Indices in Durum Wheat (*Triticum durum* Dest.)

Yield is a complex phenomenon depending on a number of components involved in it. These components are not only associated with yield but also have interdependence. This interdependence of factors often affected their direct relationship with yield. Information on characters association is useful for selection of elite genotypes from diverse genetic populations. Path analysis reveals the direct and indicrect contribution of various characters towards the yield. Hence present investigation was undertaken to know the causes and effect relationship of different variables towards the grain yield of durum wheat.

The eighteen genotypes were grown in a row at 18 cm spacing at Wheat Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Rabi* 2001. Observations on ten quantitative traits (Table 1) were recorded on ramdomly selected 10 plants in each genotype. The F_1 data were used for estimating correlations coefficient the direct and indirect effects as per the procedure given by Dewey and Lu (1959).

Number of earhead m^{-1} (0.577) and number of seeds ear^{-1} (0.471) showed the positive and significant correlation with grain yield, while days to 50 per cent flowering (-0.524) and days to muturity (-0.546) showed significant negative correlation with the grain yield i.e. in desirable direction. This indicated that more number of earhead m^{-1} with more number of seeds ear^{-1} should be perferred while selecting high yielding genotypes. These results are in agreement with those of Dokuyucn and Akkaya (1999).

In order to know the specific forces in building up total correlation, it is prerequisite to report to the path coefficient analysis. Number of earhead m^{-1} exhibited the highest indirect effect via days to 50 per cent flowering (Table 1). Number of seeds ear^{-1} exhbited positive and prominent direct effect towards the grain yield of durum wheat. The direct effect of number of earhead m^{-1} and number of seeds ear^{-1} as well as indirect effect via other traits resulted in significant and positive association with yield. Similar results were also reported by Raut *et. al.*, (1987) and Sharma and Singh (1981).

From these investigation it is inferred that while making selections for high yielding genotypes in durum wheat, the selection pressure should be exercised simultaneously, for more number of earhead m^{-1}, more number of grains per ear, and early maturing genotypes.

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Table 1. Estimates of direct and indirect effects of nine characters on grain yield of durum wheat

Characters	Days to 50 % flowering	Days to maturity	Plant height (cm)	Chlorophyll content (mg g^{-1})	Flag leaf area	Number of earhead (cm^2)	1000 grain weight m^{-1}	Number of seed ear^{-1} (g)	Weight of grain ear^{-1}	Total correlation
Days to 50 % flowering	-0.565	0.048	0.003	-0.018	-0.022	-0.103	0.152	-0.025	0.006	-0.524*
Days to maturity	-0.416	0.065	-0.004	-0.035	0.016	0.092	0.077	-0.139	0.014	-0.546*
Plant height (cm)	0.039	0.005	-0.051	-0.017	0.027	0.060	0.083	-0.009	-0.013	0.338
Chlorophyll content (mg g^{-1})	0.074	-0.016	0.006	0.137	0.016	0.047	-0.018	0.105	0.006	0.357
Flag leaf area (cm^2)	0.103	-0.008	-0.011	0.018	0.122	0.014	-0.088	0.094	0.017	0.227
Number of earhead m^{-1}	0.257	-0.026	-0.013	0.029	0.007	0.227	0.022	0.070	0.004	0.577*
1000 grain weight (g)	-0.181	0.010	-0.009	-0.005	-0.023	0.011	0.473	-0.017	-0.006	0.253
Number of seed ear^{-1}	0.037	-0.023	0.001	0.037	0.030	0.041	-0.021	0.385	-0.016	0.471*
Weight of grain ear^{-1}	0.046	-0.011	-0.008	-0.011	0.025	-0.012	0.035	0.075	-0.080	0.059

Underline figure denotes direct effects, Residual effect = 0.2425

Germination of Safed Musali (*Chlorophytum borvillianum*) Tubers Inside and Outside Greenhouse

The quality of seed or planting material like tubers sown below the soil surface, soil condition and the environment at the time of germination play an important role for proper germination. We can select the seed material as per requirement and soil condition can be manipulated up to some extent. Still it is not possible to alter the environment in the open condition. Hence the concept of greenhouse came in existence. Greenhouse is a closed inflated structure in which crop can be grown and the environment (micro climate) inside can be controlled partially.Garge (2000) and Soman *et. al.* (2001) observed the seed germination up to 30 per cent inside greenhouse as compared to 5 to 7 per cent in open field condition.

Safed musali (*Chlorophytum borvillianum*) is having high medicinal value. It can be used as general tonic and calculus. It is also having high market value and as it a medicine, only quality produce is preferred by the *Vaidya's* or doctors or aurved (herbal) medicine manufacturers. Safed musali can be propagated through seeds as well as through its tubers. But the percentage of seed germination is lower as compared to the tuber germination. When the tubers are sown, the crop gets matured within 7 to 8 months while it takes 18 months to get matured when seeds are sown. Hence the cultivators mostly follow the safed musali propagation through tubers. Considering the high market value, it was felt necessary to undertake an experiment to evaluate the effect of greenhouse on the germination of safed musali tubers. .

The study was conducted at Nagarjuana Medicinal Plant Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) (Dr. PDKV, Akola) to evaluate the effect of greenhouse on the safed musali tuber germination. The experiment was carried out in a north roof truss type semi controlled greenhouse of 16 X 6 m size having the cabin of 2 X 2 m with fan and pad system, foggers and over head sprinklers for controlling the environmental parameters. The shed net was provided at the gutter height for reducing the light intensity inside the greenhouse. The seedbeds inside and outside the greenhouse were prepared manually. Two raised beds of size 6.5 m X 2 m were prepared inside while six beds of size 2.5 m X 1.5 m were prepared outside the greenhouse i.e. controlled conditions. The prepared plots were marked with a marker for the row with the spacing of 30 cm. The soil samples of inside and outside plots were analysed for its chemical content from the Deptt of Agricultural Chemistry and Soil Science, Dr PDKV, Akola (Table 1). The planting material i.e. tubers of safed musali of about 4 cm long and 0.8 to 1 cm thick were obtained from AICRP on Medicinal and Aromatic Plants, Dr PDKV, Akola. The tubers were dipped into copper oxy chloride solution just before sowing. These treated tubers were sown inside and outside the greenhouse at 2-3 cm depth at 30X15 cm spacing on 16/06/2004. Exactly 360 tubers were planted manually inside and outside conditions. The environmental parameters inside and outside the greenhouse were measured from the day of planting to 25 days after planting. Also the occurrence of rains during this period was also recorded (Table 2). Throughout this period, the number of tubers germinated daily were counted manually. The plots were irrigated as and when required. No additional dose of fertilizer was applied to the field. From the data collected, the effect of

Table 1: Analysis of soil before planting safed musali

Soil Properties	Inside greenhouse		Outside greenhouse	
	Content	Remark	Content	Remark
PH	8.13	Normal	8.23	Normal
EC (dsM-1)	0.616	Normal	0.513	Normal
N	0.299%	Low	0.379%	Low
P	27%	Low	27%	Low
K	176%	Low	243%	Low

Table 2. Environmental parameters and tuber germination inside and outside greenhouse

Days after	Temperature, °C		Humidity, %		Soil temperature		Light intensity, lux		Rain,	Tuber germination	
planting	In	Out	In	Out	In	Out	In	Out	mm	In	Out
1	32.08	32.93	60.33	52.67	26.00	26.33	4243.33	15076.67	11.00	—	—
2	26.31	24.93	88.22	92.67	26.00	25.17	470.00	2376.67	—	—	—
3	26.89	27.10	85.89	81.00	24.67	24.33	170.00	854.00	08.30	—	—
4	35.81	37.30	46.78	41.33	27.67	28.83	2547.67	14176.67	—	—	—
5	35.83	37.73	53.00	42.33	28.33	28.67	1961.00	7856.00	—	—	—
6	33.77	37.07	54.67	40.00	27.33	30.00	1095.33	5169.00	—	—	—
7	35.08	37.47	53.89	36.33	28.67	29.67	201.00	808.00	—	167	—
8	34.54	37.47	50.78	37.67	28.00	31.00	169.33	729.00	—	221	—
9	34.51	35.73	51.22	41.33	26.67	27.67	356.00	1121.67	—	251	—
10	36.63	38.20	42.78	36.67	28.00	30.33	239.33	683.67		260	—
11	37.18	37.82	42.67	37.33	29.00	30.33	337.00	846.67	—	272	—
12	38.88	38.53	41.89	36.00	30.33	31.67	222.00	749.67	—	284	—
13	35.68	37.50	51.00	34.67	30.00	29.67	775.00	2440.33	—	290	156
14	34.47	34.97	57.56	45.33	29.33	29.67	181.00	462.00	—	298	162
15	35.78	37.83	53.22	38.00	28.33	27.67	270.67	1116.00	—	298	163
16	34.64	35.73	57.11	51.33	28.00	29.00	2636.67	11336.67	05.00	301	164
17	34.09	35.30	64.67	58.33	27.00	27.67	3450.00	15783.33	09.00	305	165
18	32.56	33.53	67.33	61.33	28.33	28.67	2616.67	12563.33	03.00	307	165
19	34.46	35.30	63.00	52.00	28.33	29.67	4970.00	19656.67	—	310	165
20	34.73	36.03	58.11	49.00	29.00	30.67	1873.33	8673.33	—	314	166
21	35.51	35.67	52.56	44.33	28.83	28.67	2440.00	10013.33	—	315	211
22	35.76	36.60	45.22	41.33	28.00	28.67	2700.00	11416.67	—	315	235
23	35.83	36.37	47.67	37.00	30.33	28.33	3123.33	16703.33	—	315	235
24	34.72	37.47	52.22	41.00	29.00	29.00	526.67	1926.67	—	319	254
25	36.00	37.67	47.89	40.33	29.33	28.67	1026.67	2730.00	—	322	267

greenhouse on the germination of tubers was evaluated.

The average temperature inside and outside the greenhouse was 34.47 and 35.69 °C respectively. The temperature was recorded to the lowest on first day after planting as it rained on the day. On this day the temperature inside the greenhouse was 26.31 °C and that in outside condition it was 24.93 °C. During the next 25 days, the temperature did not drop down. In general the outside temperature was observed always higher than that inside to a tune of 0.15 °C to 3.3 °C throughout the experimentation period.

The average relative humidity inside and outside the greenhouse was observed to be 55.59 per cent and 46.77 per cent respectively. It was maximum on the first day after planting which was 88.82 per cent and 92.67 per cent inside and outside the greenhouse respectively. The lower relative humidity on this day was observed inside the greenhouse as the plots inside the greenhouse were protected from the rain. For other days, the relative humidity inside the greenhouse was always higher than that outside by 3.8 per cent to 17.55 per cent throughout the experimentation.

The light intensity inside the greenhouse was very much lower as compared to the outside conditions. This was because of the use of shed net inside the greenhouse. In general it was observed that due to the shed net and the UV stabilized polysheet, the light intensity controlled approximately to a tune of 75 per cent i.e. only 1/4th of the natural light intensity might reach inside the greenhouse. The minimum and maximum the light intensity difference outside and inside the greenhouse was recorded to be 281 lux and 14686.7 lux, respectively.

The soil temperature was observed lower on the first day after the planting on which the rain was occurred. It was 24.67 °C inside greenhouse and 24.33 °C outside the greenhouse. The maximum soil temperature was recorded to be 30.33 °C and 31.67 °C respectively inside and outside greenhouse throughout the experimentation.

Germination of the safed musali tubers inside the greenhouse was started on 7th day after the planting while in open condition it was commenced on 13th day after planting. About 167 tubers, out of 360 tubers planted, were germinated inside the greenhouse on 7th day after planting while 156 tubers, out of 360 tubers planted, were germinated on 13th day after planting. During 16th to 19th day after planting, the germination of the tubers was stagnated outside the greenhouse while similar situation was observed inside the greenhouse during 21st to 23rd day after planting. This might be because of insufficient water supplied to the crop, higher ambient and soil temperature during the period. Due to the occurrence of rain during 16th to 18th day after planting, increase in the germination of tubers was occurred outside the greenhouse during 21st to 23rd day after planting. On the 25th day, about 89.44 per cent of germination was occurred inside the greenhouse while it was only 74.16 per cent outside the greenhouse. In general the crop inside the greenhouse was observed slightly healthier than that outside the greenhouse. Delay in the germination outside the greenhouse might be because of higher light intensity, soil temperature and ambient temperature as compared that inside the greenhouse.

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Studies on Effect of Levels and Sources of Phosphate on Greengram -Wheat System

An experiment to study the effect of sources and levels of phosphate with and without phosphate solubilizing bacteria on greengram-wheat system was condcuted at Pulse Research Unit, Dr.Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2002-03. The experiment was arranged in RBD with ten treatments, replicated thrice. Treatments consisted of three levels of phosphates (0, 20 and 40 kg ha^{-1}), supplied through two sources (DAP and rock phosphate) with and without phosphate solubilizing bacteria.

The soil of the experimental site was medium deep, black in colour and cleyey loam. It was medium in available N (285 kg ha^{-1}), low in availble P_2O_5 (16.74 kg ha^{-1}), rich in available K_2O (378 kg ha^{-1}) having 0.46 per cent organic carbaon with pH as 8.4 and EC 0.315 dSm^{-1}. The experiment was arranged in RBD with 10 treatments, replicated thrice. Treatments consisted of three levels of phosphate (0, 20 and 40 kg ha^{-1}), two source (DAP and rock phosphate), with and without phosphate solubilizing bacteria (PSB). Green gram (AKM 8802) was drilled sown on 29th June 2002, at 30 cm distance. Seeds were treated with PSB (25 g Kg^{-1} seed) before sowing, as per treatment. The crop was raised with recommended package of practices except fertilizers, which were provided as per the treatment. Except control, all the treatments received N at 25 Kg ha^{-1} and it was adjusted in the treatments where phosphate was supplied through DAP. Green gram was harvested by plucking the pods. Succeeding wheat (AKW 1071) was drilled sown on 13th November 2002, to streamline the residual effect of phosphate, applied to green gram. Wheat was raised with recommended package of practices and harvested on 6th March, 2003.

Grain yield of gram (Table 1) was increased with increase in the level of phosphate. The highest yield was recorded with the supply of 40 kg P_2O_5 ha^{-1} through DAP, in association with PSB seed dressing (T_{10}). It was at par with the yields recorded in case of 40 kg P_2O_5 ha^{-1}, through rock phosphate with PSB (T_9) and 40 kg P_2O_5 ha^{-1} through DAP (T_5) but significantly superior over rest of the treatments. The highests number of pods $plant^{-1}$, number of grains pod^{-1} and grain weight $plant^{-1}$ were recorded in T^{10} treatment which might have resulted in the highest grain yield. Singh *et. al.*, (2001) also recorded the highest grain yield of greem gram with 40 kg P_2O_5 ha^{-1} supplied through rock phosphate or DAP, along with PSB inoculation. Due to seed inoculation with PSB alone, without any fertilizer (T_6), the seed yield was enhanced over absolute control (T_1) but the difference was not significant.

Application of 40 kg P_2O_5 ha^{-1} through rock phosphate to green gram (T_4) recorded significantly highest grain yield of whet, although it was at par

Table 1. Yield attributes and yield of green gram and wheat as influenced by various treatments

S.N.	Treatments	Green gram				Wheat		
		No. of pods $plant^{-1}$	No. of grains pod^{-1}	Wt.of grains $plant^{-1}$	Grain yield (kg ha^{-1})	No. of grains $earhead^{-1}$)	Test weight (g)	Grain yield (kg ha^{-1})
T_1	Absolute control	9.60	8.47	2.82	538	39.40	41.4	3939
T_2	P_{20} Rock Phosphate	10.0	8.66	3.10	579	43.40	41.6	4350
T_3	P_{20} DAP	10.93	8.82	3.30	603	43.06	41.5	4269
T_4	P_{40} R/p	12.06	9.10	3.63	684	46.93	42.2	4814
T_5	P_{40} DAP	12.80	9.55	3.72	706	46.13	42.1	4754
T_6	PSB alone	9.73	8.51	2.86	752	41.06	41.4	4044
T_7	P_{20} R/p + PSB	10.40	8.86	3.25	613	42.20	41.5	4175
T_8	P_{20} DAP + PSB	11.00	8.90	3.41	634	42.00	41.5	4044
T_9	P_{40} R/P + PSB	12.85	9.42	3.68	744	44.20	41.8	4441
T_{10}	P_{40} DAP + PSB	13.06	10.13	3.91	763	44.50	41.7	4592
	CD at 5%	1.05	N.S.	0.37	71	0.56	N.S.	501

with 40 kg P_2O_5 ha^{-1} through rock phosphate or though DAP, coupled with PSB (T_9 and T_{10}) and 20 kg P_2O_5 ha^{-1} through rock phosphate (T_2). This might be due to the high residual effect of rock phosphate as evident from number of grains per earhead, to higher grain yield. This conform the findings of Debnath and Basak (1984).

On the basis of one year data, it has been indicated that for maximum yield of green gram, it should be fertilized with 40 kg P_2O_5 ha^{-1}, through DAP with PSB seed inoculation.

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Effect of Different Layouts and Nitrogen Levels on Growth and Yield of Soybean

Soybean cultivation has taken great strides during the recent years. Among all legumes, soybean is most sensitives to soil moisture. Under situations of high rainfall, waterlogging condition is a common problem in such soils, which affects early growth and root proliferation and consequently nutrient uptake and final yield performance of crop. Besides, the black cotton soil are very poor in nitrogen content and hence optimization of nitrogen fertilizer is also one of the deciding factor for enhancing soybean yield in such soils. With the aforesaid facts under consideration, an experiment was carried out to study the effects of different layouts and nitrogen levels on growth and yield of soybean.

The field experiment was conducted during *Kharif* 1996 at the farm of College of Agriculture, Nagpur. The experiment was laid out in factorial randomized block design with four replications.

Treatments included 3 layout patterns (traditional layout, broad bed and furrow, ridges and furrows) and 4 nitrogen levels (0, 15, 30, 45 kg ha^{-1}) making 12 treatment combinations. Soybean cv. JS-80-21 was sown on 15th July maintaining 45 x 5 cm spacing. Nitrogen as per the treatments and uniform dose of phosphorus @ 60 kg ha-1 was applied at sowing. Crop was harvested on 29th October. Total rainfall during the crop growth period was 726.20 mm.

Growth parameters

Ridges and furrows layout produced significantly taller plants as compared to traditional and, borad bed and furrow layout (Table 1). However, different layouts did not significantly influence the leaf area. Jadhav (1983) had recorded similar observations in respct of plant height in groundnut crop. Significant impact of nitrogen levels was observed on growth parameters. The maximum values of plant height and leaf area plant^{-1} were recorded where higher dose of 45 kg ha^{-1} nitrogen was applied. This could be attributed to the fact that nitrogen is an integral constituent of photosynthetically active pigment, the chlorophyll, by virtue of which plants are able to utilize light energy and enzyme nucleotides, which play an important role in cell development. Majumdar and Behera (1991) also reported similar results in soybean.

Yield attributes and yield

Among the yield components number of filled pods plant^{-1} were significantly higher under ridges and furrows, however, it was comparable to broad bed and furrow layout (Table 1). Whereas, grain weight plant^{-1}, seed yield and straw yield were statistically equivalent under different layouts. Yield attributes and yield increased with increasing level

Table 1. Growth and yield attributes as influenced by different treatments

Treatments	Plant height (cm) 90 DAS	Leaf area (cm) 60 DAS	Filled pods plant^{-1}	Grain weight plant^{-1}	Seed yield (q ha^{-1})	Straw yield (q ha^{-1})
Layout pattern						
Traditional	75.25	2090.78	75.87	14.44	19.13	29.75
Broad bed & furrow	75.19	2116.62	79.58	16.21	19.04	30.46
Ridges & furrows	75.90	2093.51	80.95	16.31	19.66	30.07
SE (m)±	0.20	26.75	1.48	1.09	0.40	0.91
CD at 5%	0.57	NS	4.23	NS	NS	NS
Nitrogen levels (kg ha^{-1})						
0	72.81	1981.17	60.75	13.01	15.40	25.26
15	74.74	2105.05	73.53	13.38	18.98	30.30
30	76.86	2124.18	84.04	17.13	20.40	31.48
45	77.77	2190.69	96.87	18.89	21.33	32.84
SE (m)±	0.23	21.84	1.71	0.89	0.31	0.74
CD at 5%	0.66	62.40	4.89	2.55	0.90	2.13

of nitrogen up to 45 kg ha^{-1}. There was no significant difference between 30 and 45 kg N ha^{-1} in respect of grain weight $plant^{-1}$ and straw yield. However, filled pods $plant^{-1}$ and seed yield ha^{-1} were significantly higher with 45 kg N ha^{-1}. Nitrogen fertilization increases photosynthetic activity and translocation of photosynthates, which might have resulted in better partitioning of photosynthates in yield attributes and eventually inreased the yield. Pradhan *et al.*, (1995) reported that positive effect of N application on yield attributes resulted in higher seed yield of soybean.

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Correlates of Characteristics of Agriculture School Students About Knowledge and Skill Possessed by Them

Farming is the biggest avenue of employment for the rural people and will continue to remain so for many years to come. For that we have to confirm overselves to agricultural education. Lower agricultural education is independent education branch working separately in agricultural universities. Since many years Agriculture schools under agricultural universities are offering two years diploma course in agriculture. School students can play a major role in changing scenario of traditional agriculture into a commercial enterprises. To reduce the rural migration and increase the agricultural production, knowlege and skill must be provided to the students to develop their own farms and increase in agricultural production, for this purpose evaluation of knowledge and skill level must be known by policy makers. Since last many years agriculture schools in Maharashtra are imparting agricultural education but the academic performance, gain in knowledge and skill of student has been always a debatable subject. There are various factors, which may determine knowledge and skill of students. The personal, socio-economic, situational and family educational characteristics of the students may greatly influence their knowledge and skill. Hence, this study was planned to know the relationship of these characteristics with the knowledge and skill possessed by agriculture school students.

Presnet investigation was carried out in Buldana district of Maharashtra state. There are seven agriculture schools in this district in the jurisdiction of Dr. PDKV, Akola. Out of these the author selected three agriculture schools namely Agriculture Achool, Sagwan (Buldana), Sharad Pawar Agriculture School, Jalgaon Jamod and Mahatma Phule Agriculture School at Deulgaon Raja. Exploratary design of social research was used to carryout this study. The student from second year were only considered for the study. In all 60 students from each school making 180 students were selected. Out of these 150 could be contacted by the researcher due to absence in class room and hostel.

The questionnaire was prepared with the expert's opinion. All the subjects' tought in agriculture school were taken in to consideration to frame the questions related to knowledge and skill. In all 100 questions were prepared to test the knowledge and skill of the students. The questionnaires was pretested with the nonsample respondents at Agrilculture School, Nimbi district Akola and after necessary modifications was used for the study. The data regarding the characteristics and knowledge were collected with the help of questionnaires and skill was assessed by personal observations. Knowledge and skill was quantified with suitable method of scaling.

Distribution of the respondents according to their characteristics

It is vivid from Table 1 that the age of the respondents varied from 17 to 26 years with meanage 19.44 years. As the course is based on 10th standard the age category. Majority (76.67%) of the respondents were in the category of 18 to 21 years. In case of education majority of the respondents were registered for this course after 10^{th} standard. $1/3^{rd}$ of the student (24.66%) were having eduction above 10^{th} standard. Respondents contacted were from O.B.C. category 44.33 per cent followed by nomadic tribes (24.67%), schedule caste (19.33%), Open (6 %) and Schedule tribes (4.67%). Family education of the respondents were found to be with medium educational level (73.34%) and 14.0 per cent and 12.66 per cent respondents families had low and high educational level respectivley. Most of the respondents were from agriculture as their family occupation, followed by service (12%), labour (6.6%), only one respondent (0.66%) was followed his caste occupation. According to distribution it is clear that 26.00 per cent and 25.33 per cent had annual income of Rs. 10,001 to 20,000 and Rs. 20,001 to 30,000 respectively followed by 24.61 per cent and 20.27 per cent having income above Rs. 40,001 and in between Rs. 30,001 to 40,000 respectively. Only 3.33 per cent of the respondents were having an annual income upto Rs. 10,000.Majority of the respondents (87.33%) did not participate in any organization while 8.67 per cent participarte in one organization followed by 3.33 per cent having membership of more than one organization. Only 0.67 per cent respondent was Chairman/Vice-chairman/Sarpanch or Office holder. Majority (96%) of the respondents were from rural family background and only few (4%) were from urban

Table 1. Distribution of Respondents according to their characteristics

S.N.	Characteristics	Respondents	
		Number	Percentage
Age			
1.	Up to 17	12	8
2.	18-21	115	76.67
3.	About 21	23	15.33
	Total	150	100
Education			
1.	10th standard	113	75.34
2.	Above 10th	37	24.66
	Total	**150**	**100**
Caste			
1.	Schedule Caste	29	19.33
2.	Schedule Tribe	7	4.67
3.	Nomadic tribes	37	24.67
4.	Other Backward Class	68	45.33
5.	Open	9	6
	Total	**150**	**100**
Family Education			
1.	Low	21	14
2.	Medium	110	73.34
3.	High	19	12.66
	Total	**150**	**100**
Father Occupation			
1.	Labour	10	6.67
2.	Caste Occupation	1	0.66
3.	Business	0	0
4.	Agriculture	121	80.67
5.	Service	18	12
	Total	**150**	**100**
Annual income			
1.	Up to 10,000	5	3.33
2.	10,001 to 20,000	39	26
3.	20,001 to 30,000	38	25.33
4.	30,001 to 40,000	31	20.67
5.	Above 40,000	37	24.67
	Total	**150**	**100**
Social Participation			
1.	No participation	131	87.33
2.	Participation in one organization	13	8.67
3.	Participation in more than one organization	5	3.33
4.	Chairman/Vice Chairman/Serpanch or Office holder	1	0.67
	Total	**150**	**100**
Native background			
1.	Urban	6	4
2.	Rural	144	96
	Total	**150**	**100**
Academic performance			
1.	Upto 45	4	2.67
2.	45.01 - 60	67	44.67
3.	60.01 - 75	77	51.33
4.	Above 75	2	1.33
	Total	**150**	**100**

family background. As far as the academic performance of the respondents was concerned, it was observed that more than half of the students secured 1st class in 10th standard (51.33%) followed by (44.67%) in second class and 2.67 per cent securing below 44 per cent makrs in 10th standard, ony 1.33 per cent obtaine ddistinction.

Relationship of independent variable with knowledge and skill possessed by the respondents :

Zero order correlation was computed to know the relationship between selected independent variables and knwoledge and skill possessed by the respondents. The findings are presented in Table 2.

It was observed from Table 2 that only two variable out of nine variables studied, have been found to be highly significant with the knowledge and skill possessed by the respondents. These variables are family educated and academic performance. The variables age, education, caste, fathers occupation, annual income social participation, family background was found to be non-significant.

Findings of the study led the conclusions that majority of the agricultural school students were in the age group of 18 to 21 years and were passed 10th standard only. A large sectionof OBC class was admitted for the diploma course. The present findings are in concurrence with the findings reported by kalantri and Khonde (2003). Farming as occupation with medium level of education and rural background were the characteristics of student coming for diploma course. Social participation was very low. Half of the respondents secured more thn 50 per cent marks in SSC examination. Out of 9 variables under taken inthe study only 2 were found to be highly correlated with knowledge and skill possessed by the students. The multiple regression analysis indicated that the

Table 2. Coefficient of correlation of independent characteristics of respondent with knowledge and skill

S.N.	Independent variables	'r' value for knowledge	'r' value for skill
1.	Age	-0.00906	0.05017
2.	Education	0.0833	0.1093
3.	Caste	0.0013	0.0594
4.	Family education	0.2831**	0.1736*
5.	Father occupation	0.0824	0.0867
6.	Annual Income	0.0694	0.0772
7.	Social participation	-0.0214	-0.0337
8.	Family background	-0.0303	-0.0616
9.	Academic performance	0.17109*	-0.0084

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

students from educated family and having good academic performance were having more knowledge but it did not show any contribution in skill possessed by them.

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Studies on Rooting and Survival of Cuttings and Simultaneous Grafts in Peach (*Prunus persica* L. Batsch)

Effect of different concentrations of IBA at 0, 100 (24 hr soaking), 500, 1000, 1500 and 2000 ppm (30 sec. dip) on the rooting of cutting of cv. Sharbati alone and in combination with simultaneous grafts of peach scion cvs. Florda Prince, EarliGrande and Shan-i-Punjab were studied at different timing. IBA @ 100 ppm during December caused highest rooting and survival of 90.01 per cent in cvs. Earli Grande and Shan-i-Punjab graft, followed by 78.25 per cent success in Sharbati cuttings. During January, IBA at 90.01 per cent each in 2000 ppm gave highest rooting success of cuttings and simultaneous gafts of Sharbati and Shan-i-Punjab. Irrespctive of the time of grafting, cv. Florda Prince exhibited lowest success with different IBA treatments. IBA at 100 ppm produced greater plant height (57.17cm) root length (29.33 cm) and root number (6.08) plant^{-1} in cv. Shan-i-Punjab.

Peach is commercially propagated through budding/grafting on seedling rootstock and it takes about two years in the nursery for the plant to become fit for transplanting in the orchard. Therefore, present studies were planned with the objective to reduce the time of planting by resorting to simultaneous grafting and rootstock cutting of peach with scion cultivars by using Indole butyric acid (IBA) rooting growth regulator.

The study was carried out in the Department of Horticulture, Punjab Agricultural University, Ludhiana during 2001-02. Hardwood cutting of peach rootstock cv. Sharbati taken in 4th week of December and 2nd wek of January were grafted with scions cvs. Florda Prince, Earli Grande and Shan-i-Punjab. After grafting, the 3-4 cm basal portion of the grafts were treated with different concentrations of IBA i.e. 0, 100 (24 hours soaking), 500, 1000 and 1500 ppm (30 sec dip) and were planted in polybags containing a mixture of orchard soil, sand and FYM. Thirty cuttings were used for each treatment. Observations on rooting and survival success, plant height, stem diameter, root number and length were recorded in the 4th week of December, 2003. Data were statistically analysed according to split plot design.

Rooting and survival

Data regarding the rooting and survival in the Table 1 reveal that among the growth regulator

Table 1. Effect of IBA on the rooting and survival of peach plants raised from cuttings and simultaneous grafts

Varieties		Rooting and survival success (%) under IBA treatments (PPM) at different timings						
		Control	100	500	1000	1500	2000	Mean
Sharbati	D*	30.00	78.25	0.00	0.00	30.00	60.01	
(cutting)	J*	30.00	0.00	36.15	0.00	30.00	90.01	
	Mean	**30.00**	**39.13**	**18.07**	**0.00**	**30.00**	**75.01**	**32.04**
Florda Prince	D*	0.00	0.00	15.00	0.00	0.00	30.00	
	J*	0.00	0.00	0.00	0.00	30.00	60.01	
	Mean	**0.00**	**0.00**	**7.50**	**00.00**	**15.00**	**45.00**	**11.25**
Earli Grande	D*	0.00	90.1	0.00	15.00	0.00	0.00	
	J*	0.00	6.15	0.00	6.15	60.01	60.01	
	Mean	**0.00**	**48.08**	**0.00**	**10.57**	**30.00**	**30.00**	**19.78**
Shan-i-Punjab	D*	0.00	90.01	0.00	0.00	30.00	30.00	
	J*	0.00	60.01	0.00	90.01	90.01	90.01	
	Mean	**0.00**	**75.01**	**0.00**	**45.00**	**60.01**	**60.01**	**40.00**
Overall mean		7.50	40.55	6.39	13.89	33.75	52.50	

*D- December, J - January CD at 5%
Var. (A) =14.82, Conc. (B) = 14.27, Time (C) 10.48,
AxB :21.75, AxBxC = 30.76

Table 2. Cumulative (December & January) effect of IBA on the height, root number and length of root from cutting/simultaneous grafts of peach varieties

Plant Characters	Varieties	IBA treatments (ppm)					
		0	100	500	1000	1500	2000
Height (m)	Sharbati	22.42	44.97	20.00	0.00	21.67	43.68
	Florda prince	0.00	0.00	10.25	0.00	7.67	27.67
	Earli grande	0.00	56.27	0.00	37.33	14.83	18.33
	Shan-i-Punjab	0.00	57.17	0.00	33.00	30.17	29.85
Root length (cm)	Sharbati	6.00	22.07	9.03	0.00	13.33	29.92
	Florda prince	0.00	0.00	6.17	0.00	7.50	17.00
	Earli grande	0.00	21.48	0.00	17.67	13.75	16.92
	Shan-i-Punjab	0.00	29.33	0.00	19.42	21.63	16.53
No. of roots plant^{-1}	Sharbati	2.56	3.67	3.17	0.00	2.33	5.67
	Florda prince	0.00	0.00	1.00	0.00	1.17	3.33
	Earli grande	0.00	5.02	0.00	2.17	2.25	2.50
	Shan-i-Punjab	0.00	6.08	0.00	3.50	5.25	4.75

treatments significantly highest rooting and survival of 75.01 per cent each was noted in Sharbati cutting and Shan-i-Punjab grafts treated with IBA 2000 and 100 ppm respectively. This was followed 60.01 per cent success in Shan-i-Punjab grafts treated with 1500 ppm IBA. It is also evident from the data that, among the growth regulator treatments, highest rooting and survival of 52.50 per cent were obtained with 2000 ppm IBA. this was closely followed by 100 ppm IBA (24 hr soaking) where rooting and survival were 40.55 per cent, however, this was at par. Interaction among peach variety, time and IBa treatments regarding the rooting and survival of different peach varieties were also significant. During January, highest rooting and survival of simultaneous grafts (90.01%) were recorded in Shan-i-Punjab at 100 ppm IBA and its higher concentration. However, this was at par with cv. Sharbati (90.01%) at 2000 ppm IBA concentrations. Further, in Earli Grande IBA 1500 ppm and its higher concentrations caused 60.01 per cent success and this was at par with Flora Prince at 2000 ppm IBA and Shan-i-Punjab at 100 ppm IBA.

Plant height

Data regarding the effect of IBA on the height of different peach varieties (Table 2) did not reval specific trend in the height of the grafts. IBA 100 ppm treatment yielded maximum plant height (57.17 cm) in Shan-i-Punjab grafts which was at par with Earli Grande (56.27 cm), followed by Sharbati cutting (44.97 cm). Among the higher concentrations of IBA, maximum plant height was obtained with IBA 2000 ppm (43.68 cm) in Sharbati, followed by Shan-i-Punjab and Earli Grande (37.33 cm and 33.00 cm) with IBA 1000 ppm.

Root length

Data regarding the effect of IBA on the root length (Table 2) reveal that, significantly highest root length of 29.92 cm was noted in Sharbati plants from cutting with 2000 ppm IBA, followed by 29.33 cm root length in Shan-i-Punjab with 100 ppm IBA.

Root number

Data regarding the effect of IBA on number of root (Table 2) did not reveal specific trend in graft combinations. IBA @ 100 ppm treatment produced maximum number of roots (6.08) in Shan-i-Punjab, followed by Earli Grande (5.02). Among the higher concentrations of IBA, maximum number of roots plant^{-1} were produced with IBA @ 2000 ppm (5.67) in cv. Sharbai.

Simultaneous grafting and rooting of hard-wood cutting has also been reported with varied success by Mihnas *et. al.*, 1993, Gill and Chitkara, 1994 in Prunus species and n pear (Sandhu *et. al.*, 1993). The variation of results with present findings might possibly be associated with different matabolic status of varieties at the time of propagation and concentrations of growth regulators under the prevailing agro-climate.

Application of IBA @ 100ppm in December and at 2000 ppm in January appeared to be good for rhizogenesis in cutting and simultaneous grafts of peach cultivars.

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Performance of Sorghum Genotypes for Grain Mold Resistance

With the introduction of high yielding non-photosensitive, early maturing and soft-grained sorghum hybrids and varieties, which lack the built in mold, eacape mechanism. A new problem of grain mold has emerged as a serious threat to sorghum production. High relative humidity and incidental rains at grain formation stage invariably promotes mold on grains in field causes grain deterioration in storage, loss of seed viability and low market value. In order to identify better genotypes for grain mold resistance and grain yield, the study was undertaken.

For the present study, four sorghum strains viz. TNS-299, TNS-586, SPV-1390, SVD-9601, a hybrid NRCSH-1 and two released genotypes CSV-15 (variety) and CSH-16 (hybrid) were evaluated in a Randomized Block Design with three replications for three years viz. 2001, 2002 and 2003. The study was conducted at Sorghum Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The observations were recorded on grain mold rating (field grade) days to 50 per cent flowering, 100 grain weight, grain hardness and grain yield plant^{-1}. On the basis of observations for three years the pooled analysis was carried out and presented in Table 1.

Analysis of variance showed statistically significant differences in all the years for all the characters studied. Pooled anlaysis for three showed statistically significantly difference for days to physiological maturity and seed hardness where as non significant differences were observed for 100 grain weight, grain mold (field grade) and grain yield plant^{-1}.

The hybrid NRCSH-1 (101 days) was found earliest in completing physiological matiruty among all the genotypes studied, followed by the released hybrid CSH-16 (103 days) and SPV-1390 (107 days). These genotypes are statistically at par with each other. As early maturing genotypes can escape grain mold, these genotypes are observed to be promising.

The hybrid NRCSH-1 (9.33 kg cm$^{2-1}$) and TNS-299 (9.21 kg cm$^{2-1}$) . These genotypes are statistically at par with each other. As grain hardness is positively correlated with grain mold resistance mechanism, these genotypes are found to be promising.

For the trait 100-grain weight, pooled analysis showed non-significant differences, might be due to genetic potential. However, the genotypes SPV-1390 (3.11g), TNS-299 (2.92 g) and NRCSH-1(2.87 g) were observed to be relatively superior to rest of the genotypes studied.

Pooled analysis of grain mold rating showed non-significant differences. However, all these genotypes exhibited grain mold rating (field grade) 3.0. Grain mold rating (field grade) below 3.00 is considered better for grain mold resistance.

Pooled analysis for grain yield plant^{-1} , showed non-significant differences. Jambunathan *et. al.*,(1992) reported the positive relationship of grain hardness with grain mold resistance. Narkhede

Table 1. Pooled (2001 to 2003) data on grain mold resistance and grain yield plant^{-1}

Genotypes	Days to physiological maturity	100 grain weight(g)	Grain hardness (kg cm$^{2-1}$)	Grain mold rating (field grade)	Grain yield plant^{-1} (g)
TNS-299	112	2.92	9.21	3.00	59.33
TNS-586	111	2.81	8.00	3.00	68.22
SPV-1390	107	3.11	8.33	3.00	66.33
NRCSH-1	101	2.87	9.33	3.00	62.33
SVD-9601	111	2.39	9.31	3.00	65.00
CSV-15	109	2.52	7.75	3.00	63.22
CSH-16	103	2.75	7.19	3.00	67.33
CD at 5%	4.73	NS	1.55	NS	NS
CV%	2.11	–	8.78	–	–

et. al., (1998) studied seven genotypes during 1998-99 for stability and noted selection 3 and SPV 489 stable for fodder yield.

In general, the new hybrid NRCSH-1 and the new genotypes TNS-299, SVD-9601, SPV-1390 and a released variety CSV-15, exhibited good and stable performance for grain mold resistance. The hybrid NRCSH-1 and the new strains viz. TNS-299, SVD-9601 and SPV-1390 could be successfully used as the sources for grain mold resistance in breeding programme. Similarly TNS-299, SVD-9601, SPV-1390 and a new hybrid NRCSH-1 could be used for commercial cultivation after studying further for its yield performance.

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In Vitro Evaluation of Chemicals and Antagonist Against *Colletotrichum capsici* (Syd.) Butl and Bisby Causing Leaf Spot of Turmeric

Turmeric (*Curcuma longa* L.) is one of the most important ancient spice crops in India. Leaf spot caused by *Colletotrichum capsici* (Syd) Butler and Bisby is an important foliar disease of tumeric in several states of India. The foliage of diseased plant are heavily spotted which later on dry up thus affecting the yield of rhizomes. Loss in yield has been recorded upto 50 to 62.7% (Nair and Ramkrishnan, 1973). Due to extreme variation in the pathogen, stable resistance in cultivars does not maintained for long. Isolate of the fungus specially from different location might differ in their response to fungicides. The pathogen is saprophytic in nature and colonize in leaf sheaths of turmeric and remain in soil for 7 to 8 months (Palarpawar and Ghurde, 1992). Keeping in view the serious problem of leaf spot of turmeric attempt was made to compare the efficacy of five fungicides and antagonist *Trichoderma* spp. against four isolates of *C. capsici.*

The diseased leaf samples of turmeric showing typical symptoms were collected from four different locations viz. Akola, Amravati, Satara and Washim district (M.S.) Isolation and purification of *C. capsici* was done on PDA. All the four isolates were pathogenic to variety Waigaon as proved by three artifical inoculation method viz. spray conidial suspension, sick soil with pathogen and rhizome dip method.

Five fungicides at different concentration viz. carbendazim 0.1 per cent, captaf 50 per cent WP, 0.2 per cent, copperoxychloride 0.25 per cent, mancozeb 0.25 per cent and thiophanate - M 0.2 per cent were evaluated by poison food technique. Desired quantity of fungicide was weighed and mixed with autoclaved PDA at room temp. and poured aseptically in sterilised Petriplates Medium without fungicides served as control. A six mm disc was cut from seven day old culture of *C. capsici* grown on PDA was placed in the center of each Petriplate and replicated thrice. The inoculated Petriplates were incubated at 27 $\pm$ 1°C for 7 days. After 7 days of incubation mycelial colony diameter was recorded and per cent growth inhibition was calculated by using following formula -

$$I = \frac{C - T}{C} \times 100$$

Where = I = Inhibition per cent, C = Colony diameter in control (mm) and T = Colony diameter in fungicide amended medium (mm).

Antagonistic activity of *Trichoderma viride* and *T. harzianum* against *C. capsici* was tested *in vitro* using dual culture method (Morten and Sproube, 1955). Six mm disc of antagonist and the test pathogen was cut separately with the help of sterilized cork borer from the edge of 5 day old culture grown on PDA. The discs of pathogen were placed at center and three discs of antagonist were placed at equidistance around the pathogen were placed apart on solidified PDA. Three replications were kept for each treatment. The plates containing PDA medium was inoculated with pathogen only, served as control. The inoculated petriplates were incubated at 27 $\pm$ 1°C for seven days and observations on antagonist and its ability to colonize the pathogen was recorded by measuring redial mycelial diameter in mm.

The results presented in Table 1 revealed that among all the fungicides tested mancozeb (0.25%) was highly effective causing 100 per cent inhibition of grown of four isolates of *C. capsici*, followed by captaf (0.2%) 90.3 per cent, carbendazim (0.17) 88.51%). Captaf 50 per cent WP (0.2%) also inhibited (100%) mycelial growth of Satara isolate. No much difference against four isolate was observed in inhibition per cent by fungicides, except thiophonate M (0.2%) which was observed less effective 68.67 per cent against Washim isolate. The fungicides observed effective in inhibition of *C. capsici* growth in present study have also been reported as effective by Dakshinamurthi (1986) and Rao and Rao (1987). Copperoxychloride (0.25%) was less effective causing per cent inhibition between range of 65.94 per cent to 74.49 per cent. Kodmelwar *et.al.*, (1973) also found similar result while testing against *C. capsici* causing fruit rot of chilli.

Data from Table 2 revealed that *Trichoderma spp.* inhibited the growth of four isolate

Table 1. Evaluation of fungicides against four isolates of *C. capsici* in vitro (After 7 days).

Fungicides	Conc.	Akola isolates		Amaravati isolates		Satara isolates		Washim isolate		Average	
		Mean colony diameter (mm)	% inhibition	Mean colony diameter (mm)	% inhibition	Mean colony diameter (mm)	% inhibition	Mean colony diameter (mm)	% inhibition	Av. colony diameter (mm)	% inhibition
Carbendazim	0.1%	6.00	90.99	8.83	85.57	8.33	87.86	6.33	89.65	7.37	88.53
Copper oxychloride	0.25%	17.00	74.49	20.66	66.76	22.66	66.99	20.83	65.94	20.28	68.54
Mancozeb	0.25%	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
Captaf 50% Wp	0.2%	7.33	89.00	8.83	85.87	0.00	100.00	8.0	86.91	6.04	90.37
Thiophanate-M	0.2%	11.33	83.00	9.83	84.18	12.66	81.56	19.16	68.67	13.24	79.35
Control		66.66	0.00	62.16	0.00	68.83	0.00	61.16	0.00	64.70	0.00
SE m $\pm$		0.47		0.56		0.45		0.69			
CD at 5%		1.40		1.66		1.34		2.05			

Table 2. Evaluation of Trichoderma spp. against four isolate of *C. capsici in vitro* (7 days incubation)

Treatments	Akola isolate		Amravati isolate		Satara isolate		Washim isolate	
	Mean colony dia (mm)	% mycelial growth inhibition	Mean colony dia (mm)	% mycelial growth inhibition	Mean colony dia (mm)	% mycelial growth inhibition	Mean colony dia (mm)	% mycelial growth inhibition
T. harzianum	18.66	72.00	17.66	71.51	21.33	69.26	19.00	68.85
T. viride	13.66	79.50	12.33	80.11	17.00	75.24	15.33	74.86
Control	66.66	--	62.00	--	68.66	--	68.85	--

of *C. capsici*. The highest inhibition was notied in Amravati isolate, 80.11 per cent by *T. viride* and Akola isolate, 72.00 per cent by *T. harzianum*. The minimum growth inhibition in Washim isolate, 74.86 per cent by *T. viride* and 68.85 per cent by *T. harzianum*. Both the species of *Trichoderma* are effective in reducing the mycelial growth of C. *capsici*. But *T. viride* was highly effective as compared to *T. harzianum* inhibiting growth of *C. capasici*. Similar findings were reported by Ravi *et. al.*, (1999). Inhibition zone in *T. viride* and *T. harzianum* might be due to the production of fungistatic metabolites. From the present studies it is inferred that the application of mancozeb and *T. viride* can be used for the management of leaf spot disease of turmeric.

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Anti-fungal Activity of Phyllosphere Bacteria of Chilli Against *Colletotrichum dematium*

Chilli (*Capsicum annum* L.) is an indispensable condiment in Indian cuisine and is cultivated as one of the important cash crops in India. Fruit rot is most destructive disease causing heavy losses in yield and quality of produce. *Colletotrichum dematium* (Fr.) Groove is one of the major dieback and fruit rotting fungi.

It is recognized that leaf surface constitutes a distinct microhabitat. The phyllosphere study is useful to ascertain the role of plant surface bacteria in biological control of plant pathogens. Ruinen (1956) stated tht many microorganisms are associated with leaf surface, *Azotobacter* and other bacteria liberates anti-fungal metabolites offered formidable resistance to various fungi improving milieu. (Lakshmi Kumar and Vijay Lakshmi, 1975, Singh 1977). With these information the present investigation was planned to study the anti-fungal activity of phyllosphere bacteria.

Seven isolates of bacteria were collected from phyllosophere (Leaf microflora) of chilli (*Capsicum annum* L.) by surface washing method from the field in experimental farm of Department of Plant Pathology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola where the Plant protection schedule was applied.

Leaf surface of chilli leaves were washed with 10 ml. sterilized distilled water and from washing one ml suspension was pipetted and spread on surface of Jensens medium in Petriplate and incubated. Distinct vigorus colonies were picked up and streaked on fresh sterilized plates, the colonies were examined microscopically for purity nd transferred on slants for further studies.

Antifungal activity of phyllosphere bacteria was studied by following methods.

a) Inoculation of fungal pathogen on baterial mass in place by inhibition method.
b) Antifungal activity of phyllosphere bacteria against *Colletotrichum dematium* (in broth)

The suspension of different phyllosphere isolates were (10^7 cfu/ml) poured in to sterile petriplate containing potato Dextrose Agar medium aseptically and then placed for incubation at 28 + 2° C. Disc (5 mm) of *Colletotrichum dematium* was placed at centre of each plate separately and are replciated thrice along with the control by inoculating fungal isolate on plain medium. The observations were recorded after 72 hrs of incubation and percent inhibition was calculated.

Inhibition of pathogen in broth :

Nutrient broth (100 ml) was poured in 250 ml conical flask in which one ml suspension PDA was used to inoculate separately. Appropriate control was maintained without inoculating bacterial suspension.

After 7 days, mycelial mat was separated by passing through pre weighed oven dried, Whatman No. 1 filter papers and dried at 50°C in hot air over, unitl constant weights were obtained.

Table 1. Antifungal activity of Phyllosphere bacteria against *Colletotrichum dematium* in solid media and broth

S.N.	Isolate	Radial diameter (mm) (solid media)	% inhibition	Mycelial dry wt. (mg) (broth)	% inhibition
1	AII	12.00	14.28	596	62.14
2	BI	5.33	61.90	158	89.95
3	CII	8.00	42.85	615	60.98
4	CIII	13.33	4.76	1120	28.92
5	EII	7.33	47.61	194	87.67
6	EIII	10.00	28.57	486	69.12
7.	EIV	14.00	0.00	480	69.58
8.	Control	14.00	-	1576	-
	'F' test	Sig.	-	Sig	
	SE (m) ±	0.04		100	
	CD at 5%	0.17		420	

All the phyllophere isolates are significant except EIV over control for reducing the radial mycelial diameter. Minimum radial 1mycelial growth of *Colletotrichum dematium* was obtained in BI (5.33 mm) which was significantly superior and restrict the fungal growth to the extent of 61.90 per cent followed by EII (47.61 %) and C II (42.85%).

From Table it is clear that all phyllosphere isolates are statistically significant over control in checking the mycelial dry weight of fungus. The least mycelial growth was observed in isolate B1 with 89.95 per cent inhibition, followed by EII 87.67 per cent. The isolate B1 (158), EII (194), EIII (486) and EIV (480) were found to be at par with each other. Minimum antifungal effect was noted in CIII (1120).

Phyllosphere bacterial isolates, possess the antifungal properties that inhibit the growth of phylopathogenic fungi (Suneja and Lakhsminarayan, 1993). Antifungal activities assessed by inhibition zone and the basis of mycelial dry weight. The pathogen causing dieback and fruit rot in chilli *Colletotrichum dematium* was inhibited to the extent of 61.90 per cent by BI isolate followed by EII (47.61 %).

The same siolates B1 and EII were also observed to be highly effective in reducing the mycelial dry weight as 89.95 per cent and 87.67 per cent inhibition was recorded by respective isolates. The present investigations are in agreement with the results reported by Mehetre 2000.

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