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Attitude of Women Towards Conservation of Natural Resources

Neeta Khandelwal[1], V. P.Sharma[2] and K. L.Dangi[3]

ABSTRACT

A study on attitude of women towards conservation of natural resources was conducted with 200 women respondents (100 tribal and 100 non-tribal women) from two panchayat samiti in Udaipur district, Rajasthan. A standardized interview schedule was used to assess their attitude regarding conservation of natural resources. The findings of study showed that majority of tribal and non-tribal women had moderately favourable attitude towards conservation of natural resources. Simirily, both tribal and non-tribal women expressed their positive attitude to half of the statements included in schedule i.e. villagers' participation in soil and water harvesting structure, raising plants at the boundaries, artificial insemination for breeding the animals. However, for some practices like indigenous technology of water harvesting, raising plants at the village common land, tribal women showed their negative and neutral attitude. Therefore, it is recommended to create awareness among women about benefits of natural resource conservation, and recognition and reward be further made for the women who showed their keen interest in conservation activities. Further, no significant difference in attitude of tribal and non-tribal women towards conservation of natural resources was found. It can be concluded that output and advantages of natural resource conservation practices might be the basic motive for similar attitude of tribal and non-tribal women.

Attitude as defined by Thurston (1946) is "the degree of positive or negative feelings associated with some psychological object". Attitude of a person plays an important role in adoption or rejection of an innovation. The attitude of an individual towards any programme exerts a significant influence upon her/his participation in the activity. Experiences drawn from different studies have demonstrated that the people having favourable attitude towards an object reflect a cumulative positive effect in the form of favourable reactions. In social research, attitude of a person or group toward social or psychological object is of prime importance.

It has been found that people generally accept all those ideas, which boost their ego and this form a highly favourable attitude towards the same. Whereas, they simply abandon the idea which is tortuous to them and thus form a relatively negative attitude toward the same. It is needless to mention that the success or failure of any programme or activity, to a large extent, depends upon the attitude of its clientele system towards the proposed programme or any other innovation. Keeping in view the crucial importance of attitude in the success of conservation of natural resources, an attempt was made to find out the attitude of women towards conservation of natural resources.

MATERIAL AND METHODS

In order to determine the attitude of women towards conservation of natural resources i.e. soil, water, forest and livestock, this study was conducted in purposively selected Udaipur district of southern Rajasthan as large number of non-government organizations and other environmental agencies were working for the conservation of natural resources. Udaipur district consists of eleven panchyat samiti; out of them two panchyat samiti viz., Girwa (tribal as more than 50 per cent of their total population is tribal), and Badgaon (non-tribal as more than 50 per cent of their total population is non-tribal) were selected based on plenteous natural resources. Thus, in all, eight villages; four each from Girwa and Badgaon panchyat samiti were selected for the study. A proportionate random sample of 200 respondents was drawn from these eight villages which constituted 100 tribal and 100 non-tribal women respondents.

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Data were collected with the help of structured and standardized interview schedule. Attitude of respondents was measured using "Likert's Attitude Scale" developed for this study. To measure each item, attitude scale was constructed with five response categories viz; strongly agree, agree, neutral, disagree and strongly disagree by assigning a numerical score 5,4,3,2 and 1 for positive statements, whereas reverse scoring was followed for negative statements. Collected data were analyzed and subjected to frequency, percentage and Mean score. 'Z' test was applied to see the difference between attitude of tribal and non-tribal women towards conservation of natural resources.

RESULTS AND DISCUSSION

So as to obtain the profile of the women depicting their attitude toward conservation of natural resources, they were grouped into three categories i.e., least favourable, moderately favourable and most favourable on the basis of mean and standard deviation of the attitude scores obtained by the respondents. The results of attitude of overall women respondents have been presented in Table 1. It is observed that 23 per cent women had most favourable attitude and supported conservation of natural resources. The percentage of women in moderately favourable category (56.5 %) was higher than the percentage of least favourable category of attitude (20.5 %).

A further glance at in Table 1 unfold that 8 per cent of tribal women and 38 per cent of non-tribal women possessed most favourable attitude towards conservation of natural resources, while majority of respondents i.e., 58 per cent of tribal women and 55 per cent of non-tribal women found to be in moderately favourable category. Moreover, it is seen that 34 per cent of tribal women and 7 per cent of non-tribal women had least favourable attitude towards conservation of natural resources.

It could be, therefore, concluded that majority of women (tribal and non-tribal) considered that conservation of natural resources are viable and lucrative for their livelihood.

Statement wise attitude of the respondents towards conservation of natural resources: Table 2 visualizes the attitude of tribal and non-tribal women towards conservation of natural resources. For easy interpretation and investigator's convenience, all negative statements had been converted into positive statements. Mean score was calculated and on the basis of mean score, response of each statement given by respondents was categorized under response groups. The categorization could find only three response groups viz; agree, neutral and disagree. The mean value did not find rest two groups of responses ie. strongly agree and strongly disagree. Thus, the results depicted under three categories of responses (Table 2). The result shows that both tribal and non-tribal women had agreed with near half (11) items out of 20 items of attitude i.e. item no. 4, 7, 8, 12, 13, 14, 15, 16, 17, 18 and 19. It showed that respondents became aware and knew the benefits of conservation of natural resources as well as both groups in the study area had almost similar attitude towards conservation of natural resources.

Table 2 further expressed that tribal women had disopined with the statement entitled technical guidance is available for proper utilization of natural resources while non-tribal women had neutral attitude for the same statement. The statement followed this like there is no harm of water harvesting structure because of proper care and maintenance, which were positively agreed by the non-tribal women but disagreed by tribal women. This might due to the less interest of tribal women related to

Table 1: Distribution of respondents on the basis of their attitude towards conservation of natural resources

n= 200

S. N.	Attitude category	Tribal(n_1 =100)%	Non-tribal (n_2=100)%	Total f	Total %
1.	Least favourable(Up to 55.87)	34	7	41	20.5
2.	Moderately favourable(55.88 to 74.81)	58	55	113	56.5
3.	Most favourable(Above 74.81)	8	38	46	23.0

f=Frequency, n_1 + n_2 = Sample size, % = Per cent

Table 2 : Statement wise level of attitude of women towards conservation of natural resources

S. N.	Statement	M.S.	Level of attitude Tribal	M.S.	Level of attitude Non-tribal
1	Conservation of natural resources is merely wastage of time and labour	2.86	Neutral	3.46	Agree
2	Technical guidance is available for proper utilization of natural resources	1.49	Disagree	2.97	Neutral
3	Conservation of natural resources is popularized among the villagers	3.00	Neutral	3.28	Agree
4	Soil and water harvesting structure can be effectively operated by ensuring villagers' participation	3.59	Agree	3.53	Agree
5	There is no harm of water harvesting structure because of proper care and maintenance	1.79	Disagree	3.48	Agree
6	Indigenous technology of water harvesting or low cost innovation structure should be given priority	2.11	Neutral	3.59	Agree
7	The grass production has increased due to the improved grass seeding	3.3	Agree	3.76	Agree
8	Raising plants at the boundaries of a farm positively effected the crop production	3.21	Agree	3.8	Agree
9	Raising plants at the village common land is feasible and economically viable	2.93	Neutral	3.72	Agree
10.	Pits are comparatively sufficient for afforestation than soil and water conservation measures	2.79	Neutral	3.48	Agree
11	Raising fruit plants in field is beneficial	3.4	Agree	3.56	Agree
12	Changes in cropping pattern have increased the crop yield	3.03	Agree	3.81	Agree
13	Artificial insemination is the best way for breeding the animal	3.39	Agree	3.77	Agree
14	Cross bred animals are preferable over *Deshi* breeds	3.21	Agree	4.00	Agree
15	Keeping cattle is worth while with utilization of time and labour	3.14	Agree	3.81	Agree
16	Land conservation practices are area specific	3.33	Agree	3.72	Agree
17	Small timber provided by farm forest is sufficient for agricultural purpose	3.33	Agree	3.69	Agree
18	Output in terms of income is adequate as compared to input in dairy and livestock conservation practices	3.44	Agree	3.78	Agree
19	Livestock conservation practices helped in solving unemployment problems in the area	3.19	Agree	3.43	Agree
20	Livestock conservation practices are more preferable even in the paucity of fodder	1.97	Disagree	2.84	Neutral

Mean score 3.03 to 3.81 refers agree Mean score 2.11 to 3.00 refers neutral
Mean score 1.49 to 1.97 refers disagree

maintenance and care of water harvesting structure and they expected that the state and concerned agencies should maintain them. This finding is in concordance with Ramanna (1992) who found that farmer showed little or no concern regarding erosion control structure built on arable land.

Table 3 : Overall attitude of women towards conservation of natural resources

Item	Tribal(MPS) (n_1 =100)	Non-tribal(MPS) (n_2 =100)	Total(MPS) (n = 200)	Z-value
Attitude	63.1	71.5	67.2	0.90^{NS}

MPS = Mean per cent score, n_1 + n_2 = Sample size, NS = Not significant

Similarly, non-tribal women agreed with 1, 3, 6, 8 and 10th items where as tribal women had neutral attitude towards same items (Table 2). To sequel this tribal women disagreed with the statements that technical guidance is available for proper utilization of natural resources and livestock conservation practices are more preferable even in the paucity of fodder. However, non-tribal women had neutral attitude for both the statements. Thus women of both tribal and non-tribal villages had favourable attitude towards conservation of natural resources except livestock conservation. Although tribal women played important role in rearing of cattle but they agreed that villagers took less interest in livestock conservation practices because lack of fodder and feed and lot of expenditure incurred for their maintenance. However, they were agreed with statements crossbred animals are preferable over *Deshi* breeds and livestock conservation practices helped in solving unemployment problems.

Overall attitude of women towards conservation of natural resources: The sum up of the scores of attitude of tribal and non-tribal women has been presented in Table 3. It is apparent from the Table 3 that attitude of tribal and non-tribal women were favourable towards conservation of natural resources with 67.2 mean per cent score which was relatively greater than average.

It can be observed that calculated 'Z' value was less than the tabulated value (1.98) at 5 per cent level of significance. The research hypothesis was rejected and null hypothesis was accepted. This confirms that there was no difference in the attitude of tribal and non-tribal women towards conservation of natural resources. This might have happened because output and advantage of natural resources conservation practices have brought a new awakening in women of non-tribal and tribal. This might be basic motive for holding their similar attitude towards conservation practices.

The overall results indicated that majority of the women showed moderately favourable attitude towards conservation of natural resources. Similar attitude of tribal and non-tribal women was found in half of the practices of natural resources conservation. Gathering fuel wood, fodder, small timber and medicinal roots and plants directly from the forest, utilization of harvested rainwater for human and livestock drinking, domestic consumption and life-saving irrigation for high value crops, high milk producing capacity of crossbreds and free bio-mass goods might have possibly led the women to possess favourable attitude towards conservation of natural resources. Although for some practices such as importance of pits for afforestation, raising plants at the village common land, livestock conservation practices tribal women expressed their negative and neutral attitude rather non-tribal women. Therefore, it is an urgent need that conservational agencies, concerned NGo and local leader try to put an effort for change the negative attitude of women by creating awareness among them about programmes and promote involvement in different natural resources conservational activities. Women worker who devoted more time in care and safeguarding of natural resources should be rewarded for the motivation of other women beneficiaries.

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Impact of Self Help Group on Women Members in Terms of Their Socio-Economic Development

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ABSTRACT

The present study was conducted in Akola Panchayat Samiti of Akola district in Maharashtra state with sample size of 150 Self Help Group (SHG) women members to ascertain the impact of Self Help Group on socio-economic development on them. It was observed that SHG had moderate impact on its women members in term of change in income, spending pattern material possession, thrift habit and employment generation. It was concluded that women members could succeed to change in their income, change in their spending pattern , change in their material possession, change in their thrift habit and also change in their employment due to participation in SHGs.

In our country, Self Help Groups (SHGs) are being recognized by financial institution and central government as a potent tool for empowerment of rural women. The grouping of women for economic empowerment is of great importance from the point of view of elevating them above poverty line. SHGs encourage the rural women to form thrift group, build up self confidence and make them economically independent. Women economic independence is highly important because money in the hand of men is spent quite differently from the money in the hands of women .It has been estimated that man spends 60 per cent of his income in his home and remaining 40 per cent on himself, whereas a woman spends 90 per cent of her income on her family and 10 per cent on herself (Anandharajkumar, 1995). This tends to imply that organizing women on the basis of common interest to improve their social and economic condition is the need of hour, SHGs are the means to achieve this purpose SHG is a group of people coming together voluntarily for attaining a common goal like saving habit, meeting emergent credit need, etc. SHGs are the organizations whose members unite together on the basis of common interest to improve their economic and social condition in order to be better able to pursue their paramount long term aim (Ahemed, 1999).

It is being increasingly realised that women income in a family is very important for socio - economic development of the family. An attempt has been made in this study to assess the impact of SHGs on its members in terms of their socio - economic development. The study was carried out with the specific objective : To study the impact of SHG on its members in terms of their socio - economic development.

MATERIAL AND METHODS

The present study was carried out in Akola Panchayat Samiti of Akola district in Maharashtra State. A sample of 150 women members as respondents was drawn randomly from 6 villages having SHGs functioning quite well. Data were collected with the help of pretested structured interview schedule consisting the information about selected characteristics and impact of SHGs on socio -economic development of women. Impact was studied on five dimensions, namely change in income, change in spending pattern, change in material possession, change in thrift behaviour and change in employment.

RESULTS AND DISCUSSION

Impact of Self Help Group:

The impact of SHGs on socio - economic development of its women members was assessed on five dimensions individually, as below

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Table 1 : Distribution of respondents according their to change in income , change in spending pattern , change in material possession , change in thrift behavior and change in employment

S.N.	Category	Change in income		Change in spending pattern		Change in material possession		Change in thrift habit		Change in employment	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1	No change	36	24.00	00	00.00	36	24.00	00	00.00	36	24.00
2	Low (upto 33 %)	71	47.33	20	13.33	06	04.00	00	00.00	20	13.33
3	Medium (34 to 66%)	12	08.00	19	06.00	26	17.33	18	12.00	40	26.67
4	High (above 66 %)	31	20.67	121	80.67	82	54.67	132	88.00	54	36.00
	Total	150	100.00	150	100.00	150	100.00	150	100.00	150	100.00

1. Change in income of the women members

It was observed (Table 1) that majority of the respondents (47.33%) had a change in their income due to participation in SHG, as a result, they had started their occupation like tailoring, poultry, goat rearing and dairying, and earned additional income to the extent of 33 per cent, followed by about one fifth of them (20.67.%) appearing in high level of change i.e. above 66 per cent in their annual income.

2. Change in spending pattern of women members

It was observed (Table 1) that majority of the respondents (80.67%) had high change in their spending pattern (above 66 %) due to participation in SHGs. The percentage of respondents appearing either in low or medium level of change was relatively meager (13.33 & 6.00%, respectively).

The data in Table 2 further reveal that over 62 per cent o f the respondents had changed their food habit and spent little more on vegetables and fruits in their daily diet, followed by 58.67 per cent of them spending more on clothes of family and garments for their children. Over half of the respondents (52.67%) made some improvements in their dwelling houses by fixing tiles and painting walls of houses and 50.67 per cent of them committed for social obligations by donating amount to the community festivals and temples. A little less than half of the respondents (48.67%) did spend more on educational aspects of their school going children by buying uniform, note books, books and schoolbag with shoes, etc. All these they could do due to additional income they generated through participation in SHGs.

3. Change in material possession of women members

The Table 1 reveal that over half of the respondents (54.67%) had above 66 per cent change in their material possession due to additional income they earned after participation in SHGs, where as, 24.00 per cent of the respondents did not have change in their material possession. Near about one fifth of respondents (17.33%) appeared in medium category of change, i.e. 34 to 66 per cent change in material possession. Quite a few respondents (4%) had a change in their material possession to the extent of 33 per cent. It may thus be inferred that a substantial impact of SHG was noticed on their women members as far as the material possession was concerned which facilitated them to earn additional income and buy the household needy material.

Table 2 : Distribution of respondents according to their spending pattern

S.N..	Change in spending pattern	Frequency (n=150)	Percentage *
1	Food habit of family	93	62.00
2	Clothing of family	88	58.67
3	Improvement in dwelling house	79	52.67
4	Education of children	73	48.67
5.	Social obligation of family	76	50.67

* The sum of total is more than 100 due to multiple responses.

Table 3: Distribution of respondents according to the impact of SHG as a whole

S.N.	Category	Frequency	Percentage
1	Low	61	40.67
2	Medium	69	46.00
3	High	20	13.33
	Total	150	100.00

4. Change in thrift behaviour of women members

From Table 1, it was noticed that 88.00 per cent of the respondents had a change in their thrift habit due to participation in SHGs to the highest level i.e. above 66 per cent change, followed by 12.00 per cent of them having change in their thrift habit to the extent of 34 to 66 per cent but none of them appeared in the category up to 33 per cent change in thrift habit.

5. Change in employment of women members

The data in Table 1 indicate that over one third of the respondents (36 %) had a change above 66 per cent in their employment due to participation in SHG, followed by over one fourth (26.67%) of them having change in their employment in the range of 34 to 66 per cent. A few respondents (13.33%) also had the change in their employment up to 33 per cent, whereas 24.00 per cent of them did not have any change in their employment after participation in SHGs. It is thus inferred that the SHGs had a gainful impact on their women members in generating employment opportunities for their family members and thus contributed to the family income additionally for the welfare of their families.

6. Overall impact of Self Help Groups

It is apparent from Table 3 that majority of women members (46.00 %) had moderate impact of SHGs, followed by 40.67 per cent of them appearing in low category of impact. The percentage of respondents appearing in high category of impact of SHGs was found to be meager (13.33%). By and large, it could thus be inferred that the SHGs had a moderate impact on its women members in terms of change in income, spending pattern, material possession, thrift habit and employment generation.

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Role Perception of Woman Members of *Grampanchayat*

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ABSTRACT

The study was conducted in Parbhani District of Marathawada region of Maharashtra state with a view to know the role perception of *Grampanchayat* women member and its relation with their profile. Keeping above objectives in mind, 20 *Grampanchayat* from Parbhani taluka and 60 *Grampanchayat* women member from the selected *Grampanchayat* were chosen randomly. From the study it was found that majority of women member had medium overall role perception and in that most of them had high role perception about agriculture while education, leadership experience, knowledge and value orientation were the crucial variables which influenced the role perception of elected women member of *Grampanchayat*.

Panchayat Raj system is an age old concept of local self government or democracy practiced in the history of civilization in India. It has roots in the word "Panch" representing a group of five elder individuals of the soft, who were given the power of decision making by the people of the land. *Panchayat Raj* institution (PRI) after 50 years of its service to the country are still in the process of evaluation after undergoing a series of mythological changes. One among those changes is 23rd amendment. Participation of women in PRIs by reservation policy which help the women to participate more in the Panchayat. This has first time given the share to women in village administration, hence here was an opportunity to study the participation of women members in Grampanchayat whether they are aware about their role as member of Grampanchayat. These questions need the answer. Therefore, keeping this in view, the present study was undertaken with following specific objectives.

1. To study the role perception of *Grampanchayat* women member.
2. To find out the relationship between personal, socio-economic characteristics and role perception of women member.

MATERIAL AND METHODS

The study was conducted in Parbhani District of Marathawada region of Maharashtra state. For the study, 20 Grampanchayat from parbhani Taluka were selected randomly. Sixty women member of Grampanchayat were selected as respondents for the study. All these respondents were personally interviewed with the help of structured and pre-tested interview schedule. Statistical tools like frequency, percentage and Pearson's co-relation co-efficients were used for analyzing the data.

RESULTS AND DISCUSSION

I. Overall role perception of women member of *Grampanchayat*

Table 1. Distribution of the respondents according to their overall role perception

Category	Frequency	Percentage
Low	18	30.00
Medium	24	40.00
High	18	30.00
Total	60	100.00

The data presented in Table 1 reveal that 40.00 per cent of women member in Grampanchayat had medium overall role perception. It was further observed that about one-third (30.00%) women member had low overall role perception in *Grampanchayat*. Similar findings were also reported by Lohiya (2000).

II. Item wise role perception of women member of *Grampanchayat*

The data in Table 2 show that the three-fourth of woman members of *Grampanchayat* had high role

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perception about agriculture, whereas 36.66 per cent of them had high role perception regarding education, followed by 33.34 per cent of them in same group regarding the health and sanitation. But 8.34 per cent of the women member of *Grampanchayat* had high role perception regarding development schemes to be implemented by *Grampanchayat*. The women member showed low role perception in social forestry (66.68 %), whereas they had medium role perception regarding the various developmental schemes to be implemented by

Table 2 ; Distribution of the respondents according to their item wise role perception.

S.N.	Role Perception	Low	Medium	High	Total
1	Development scheme	16 (26.66%)	39 (65.00%)	5 (8.34%)	60 (100%)
2	Administration	40 (66.68%)	10 (16.66%)	10(16.66%)	60 (100%)
3	Agriculture	0.0 (0.0%)	15 (25.00%)	45 (75.00%)	60(100%)
4	Education	13(21.67%)	25 (41.67%)	22 (36.66%)	60 (100%)
5	Social welfare	16 (26.66%)	24 (40.00%)	20 (33.34%)	60 (100%)
6	Health and sanitation	10(16.66%)	30 (50.00%)	20 (33.34%)	60 (100%)
7	Social forestry	40 (66.68%)	10 (16.66%)	10(16.66%)	60(100%)
8	Other	7(11.67%)	36 (60.00%)	17 (28. 33%)	60 (100%)
	1. To organize trainings for artisans.				
	2. To implements gramin gharkul programme.				
	3. To build godowns.				
	4. To build Grampanchyat office.				
	5. To establish community library.				
	6. To collect the taxes.				
	7. To search and seize encroachment				

(The figures in parentheses indicate percentage)

Table 3. Co-relation and multiple regression analysis

S.N.	Characteristics	Correlation coefficient ('r' value)	Regression co-efficient(bi)	't' value
1	Age	0.149	0.568	1.176
2	Education	0.438**	4.900	2.173*
3	Caste	0.125	2.598	1.087
4	Annual income	0.460**	0.005	1.126
5	Land holding	0.513**	6.475	1.153
6	Occupation	0.540**	5.518	1.375
7	Socio-economic status	0.470**	0.000	0.007
8	Social participation	0.138	3.208	1.054
9	Leadership experience	0.684**	7.719	3.132**
10	Knowledge	0.491**	0.284	3.372**
11	Cosmopoliteness	0.491**	1.569	0.744
12	Value orientation	0.631**	3.120	2.478**

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

$R^2 = 0.723$, 'F' value = 10.24**

the *Grampanchayat*, followed by education (41.67 %) and social welfare (40.00 %) where as half of the woman members had also medium role perception as regard to health and sanitation.

3. Relationship between personal, socio-economic characteristics and role perception

A) Correlation analysis

It was observed from Table 3 that the education, annual income, land holding, occupation, socio-economic status, leadership experience, knowledge, cosmopoliteness and value orientation had positive and significant relationship with role perception, whereas age, caste and social participation did not show any relationship with role perception. These findings are in agreement with Pimparikar (1979), Patil (1984) and Wankhede (1994).

B) Multiple regression

Partial regression coefficients were estimated on data on independent variables. It was found that 72.30 per cent variation in role perception of women members was explained by a set of 12 independent variables. Partial regression coefficients were significant at 0.01 level of probability. It was also revealed that education, leadership experience, knowledge and value orientation were significant contributors in explaining variation in role perception of elected women member in *Grampanchayat*.

CONCLUSION

It can be concluded that three-fourth of woman members of *Grampanchayat* had high perception about the role in agriculture whereas two-third of them had low role perception about *Grampanchayat* administration and social forestry. This might be due to the fact that most of woman members of *Grampanchayat* came from agricultural families or rural background. Hence they might have some interest in agriculture, whereas administration was difficult to them and had less interest in it.

The relational analysis indicates that education, leadership experience, knowledge and value-orientation were significant contributors towards role perception. These are the crucial variables, which influence the role perception of women member of *Grampanchayat*.

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Knowledge and Adoption of Agricultural Technologies Recommended by Marathawada Agriculture University, Parbhani

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ABSTRACT

The study was conducted in purposively selected two districts of Marathwada region viz. Parbhani and Nanded during 2004-05 in order to know the adoption of 54 technologies recommended by MAU Parbhani during 1999-2000 , 2000-2001 and 2001-2002 .Results of study revealed that majority of the respondents (97.92 %) belonged to the low level of knowledge and 81.94 per cent fell under low level of adoption. More than half number of respondents gave constraints like costliness of seed, lack of information regarding seed cost, place of sale and proper guidance

Acceptance and continuous use of agricultural technologies are prerequisite of agricultural development. State Agriculture Universities (SAUs) developed new technologies as per demand and requirement of the farmers of that jurisdiction. The transfer of improved technology and their effective adoption are influenced by the method for its transfer to the farmers in accordance to their need. Keeping this in view, the present study was undertaken to appraise knowledge level and rate of adoption of agricultural technology recommended by MAU, Parbhani by the farmers with the following specific objectives.

OBJECTIVES

1. To appraise knowledge level and extent of adoption of technology recommended by MAU, Parbhani.
2. To find out the constraints faced by the farmers in use agricultural technology.

MATERIAL AND METHODS

The study was conducted in purposively selected two districts of Marathwada region viz. Parbhani and Nanded during 2004-05 in order to know the adoption of 54 technologies recommended by MAU during 1999-2000 , 2000-2001 and 2001-2002 . Two villages were selected by random sampling method from each taluka of respective district. Then, 96 farmers were selected from small, medium and big categories .Thus, the study comprised total sample of 288 respondents .The data were collected by personally interviewing the selected respondents with the help of specially designed structured interview schedule. The statistical methods like percentage and frequency were employed for the analysis of data.

RESULTS AND DISCUSSION

Knowledge and adoption of recommended technologies

Variety: It was observed from Table 1 that in case of released varieties of *jowar* Parbhani *Moti* (SPV 1411) was known to 16.31 per cent of the respondents, while in case of adoption of this variety 4.51 per cent respondents had adopted it on their farm (Gharule, 1998). Next to *jowar*, knowledge of cotton PHH 316 variety was possessed by 5.23 per cent but the adoption was nil.

Crops and farming system : About 10 per cent respondents had the knowledge of sowing cotton + tur intercrop in the ratio of 8:2 or 6:2 in medium and high soil, whereas 4.86 per cent respondents adopted this type of technology. Further 5.20 per cent respondents had the knowledge regarding integrated nutrient supply method under Cotton-*Jowar* alternate cropping system as required 1/2 quantity of nutrient should be provided through chemical fertilizers and 1/2 quantity through organic fertilizer only, whereas 2.43 per cent of the respondents had adopted this practice. Similar 3.47 per

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Table 1. Knowledge and adoption of technologies recommended by MAU.

n=288

S. N.	Recommended technology	Knowledge		Adoption	
		No.	Per cent	No	Pe rcent
A.	**Released varieties of crop**				
1.	Jowar PVK 801	10	3.47	0	0
2.	Jowar PVK 809 (SPV 1474)	9	3.13	0	0
3.	Jowar Parbhani Moti (SPV 1411)	47	16.31	13	4.51
4.	Cotton PHH 316	15	5.230	0	0
5.	American cotton NH 454	11	3.81	0	0
B.	**Crops and farming system**				
1.	INM is recommended for cultivation of Jowar after rained cotton, with application of dose in split through fertilizers and remaining half dose through organic fertilizers along with use of biofertilizers	15	5.20	7	2.43
2.	Improved cotton varieties PA 183 (Savata) and PA 255 (Turab) are recommended in assured rainfall area of Marathwada by applying spacing of 45 x 30 cm with maintaining plant population of 34076, the application 50:25:25 NPK/ha is recommended for optimum yields	10	3.47	3	1.04
3.	Adoption of vertical and horizontal hoeing are recommended in cotton after germination in 3, 6 and 9 week. Further spray of Dioran 0.50 l/ha is recommended before germination of seed and weed in cotton	9	3.13	4	1.39
4.	Inter cropping of cotton + tur (8:2) or (6:2) is recommended for more benefit rather than cultivating sole crop of cotton	30	10.42	14	4.86
5.	Cultivation of jowar PVK 809 as sole crop is recommended for more grain and fodder yield	6	2.08	3	1.04
6.	Cultivation of Parbhani Moti variety of jowar is recommended to get more yield (16.6 %) as compared to Maldandi jowar M 35-1	8	2.78	0	0
7.	In Marathwada region for getting higher germination cotton seed be soaked in water for 6 to 12 hrs	8	2.78	1	0.35
8.	For integrated pest management of rainfed cotton :	107	37.15	34	11.81

cent respondents had knowledge of the improved variety of cotton PA 183 and PA 255 be planted at 45 x 30 cm distance and for maximum cotton yield application of 50:25:25 NPK per ha. whereas only 1.04 per cent respondents had adopted this technology (Darekar 2002).

Most of the respondents (37.15 %) had knowledge of integrated pest management in cotton crop, whereas 11.81 per cent respondents had adopted this technology. Further 2.78 per cent respondents had the knowledge regarding soaking cotton seed in water for 6 to 12 hours for getting higher germination, whereas 0.35 per cent respondent had adopted this technology. Only 2.08 per cent respondent had the knowledge of control of bacterial disease in cotton by applying 5 per cent *nimboli ark* spray after every 10 days but adoption of this technology was nil.

Level of Knowledge of farmers about agricultural technologies

The Table 2 indicates that majority of the respondents (97.92 %) belonged to low level of knowledge, while only 2.08 per cent respondents had high level of knowledge, but none found in medium level of knowledge.

Extent of adoption of recommended technologies

Table 3 revealed that most of the respondents i.e. 81.94 per cent fell under low adoption level, while remainder respondents i.e. 9.38 and 8.68 per cent had high and medium adoption level, respectively.

Constraints faced by the respondents

The constraints namely, lack of information about variety released and agricultural technologies recommended by MAU were expressed by 62.5 per cent, while 56.94 per cent respondents expressed other constraints like seed was costly, lack of information regarding seed cost, place of sale and proper guidance. As much as 52.77 per cent respondents expressed non-availability of seed, travelling over long distance for seed purchase, and lack of availability of seed in time as constraints.

Most of the respondents (31.94 %) expressed that MAU seed was not of much importance because they got seed available from other agencies. Only 17.01 per cent of the respondents clearly expressed that they were using other improved variety seeds from local market. Findings of Kadam (2003) are in line with the findings of this study.

Table 2. Distribution of respondents according to knowledge

S.N.	Category	No.	Per cent
1.	Low (upto 13)	282	97.92
2.	Medium (14-25)	0	0.00
3.	High (26 and above)	6	2.08

Table 3. Distribution of respondents according to adoption

S.N.	Category	No.	Per cent
1.	Low (0)	236	81.94
2.	Medium (1-6)	25	8.68
3.	High (7 and above)	27	9.38

Table 4. Distribution of respondents according to the constraints faced by them

S. N.	Category	No.	Per cent*
1.	No information	180	62.50
2.	Non-availability of seed	152	52.77
3.	Not much important	92	31.94
4.	Other improved variety used	49	17.01
5.	Others (Costly seed, too affordable to reach at Parbhani for seed purchase, transportation problem)	164	56.94

* The sum of percentage is more than 100 due to multiple response

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Effect of Land Configuration and Addition of Weed Biomass on Moisture Content, Fertility Status and Yield of Cotton

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ABSTRACT

A field experiment was conducted on PKV Hy-4 cotton during *Kharif* 2002-03 to 2005-06 at Agriculture College Farm, Nagpur to study the effect of land configuration and addition of weed biomass on moisture content , fertility status and yield of rainfed cotton. Opening of furrow in alternate row or every row + addition of weed biomass @ 5 t ha^{-1} + spray of 2 per cent urea and 2 per cent SSP on weed biomass recorded 31.6 per cent (10.50 q ha^{-1}) and 27.1 per cent (10.14 q ha^{-1}) more seed cotton yield over control. Results indicated that 4.7 per cent increased in seed cotton yield by opening furrow in cotton row, 4.2 per cent increased yield with addition of weed biomass in furrow over furrow opening and 10.7 per cent and 18.5 per cent extra seed cotton yield by application of bio-decomposer and 2 per cent urea and 2 per cent SSP, respectively. Opening of furrow in alternate or every row + addition of weed-biomass + spray of 2 per cent urea and 2 per cent SSP on weed biomass also recorded higher gross monetary returns, B:C ratio, improved soil fertility status and conserved more soil moisture as compared to other treatments .

Productivity of rainfed cotton in Maharashtra state is low mainly due to erratic behaviour of monsoon and moisture stress at critical stages of the crop. Therefore, it is necessary to reduce the water loss from soil. There are several mechanical and cultural practices to over come this problem. Cultural practices, land configuration and mulching are the important practices suitable in rainfed condition to conserve moisture. Land configuration i.e. opening of furrow in between rows of cotton conserves moisture and also act as a drainage during heavy rainy days. Mulching are also useful in reducing soil water loss. Instead of destroying weed biomass obtained from weedings if added in furrows can act as a mulch and after decomposition it get converted in to organic manure and enrich the soil. Use of biodecomposing agent and nutrients force for faster decomposition of organic matter by providing suitable condition for increasing microbial activity, and thus increasing organic manure content in soil and increase the productivity of the crop, like *Tricoderma spp.* having maximum cellulolytic activity of 18.8 to 45.5 per cent (Mallikarjunaiah and Bhide , 1983). More *et al.* (1980) also reported that *Tricoderma spp.* is most efficient and rapid decomposing fungal culture. With view of the above experiment was conducted.

MATERIAL AND METHODS

A field experiment was conducted during *Kharif* 2003-2006 at Agriculture College Farm, Nagpur to study the effect of land configuration and addition of weed biomass on growth and yield of rainfed cotton. The experimental soil was vertisol with 7.6 pH. The initial soil organic carbon 6.13 g kg^{-1}, available N,P and K were 263.4, 28.38 and 399.9 kg ha^{-1}, respectively. The experiment was conducted in Randomized block design and replicated thrice. The treatments consisted were control (T_1), furrow opening in every row (T_2), furrow opening in alternate row (T_3), furrow opening in every row + addition of weed biomass (T_4), furrow opening in alternate row + addition of weed biomass (T_5), furrow opening in every row + addition of weed biomass + bio-decomposer application (T_6), furrow opening in alternate row + addition of weed biomass + bio-decomposer application (T_7), furrow opening in every row + addition of weed biomass + spraying of 2 per cent urea and 2 per cent SSP on weed biomass (T_8) and furrow opening in alternate row + addition of weed biomass + spraying of 2 per cent urea and 2 per cent SSP on weed biomass (T_9).

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Table 1: Seed cotton yield ,yield parameters and economics as influenced by various treatments

Treatments		Seed cotton yield (q ha^{-1})				Seed cotton yield plant^{-1} (g)	No. of bolls plant^{-1}	GMR Rs.ha^{-1}	Cost of production Rs.ha^{-1}	NMR Rs.ha^{-1}	B:C ratio
		03-04	04-05	05-06	Pooled Mean						
T_1	Control	7.70	9.32	6.91	7.98	49.39	17.02	19258	10658	8600	1.81
T_2	Furrow opening in every row	7.83	9.67	7.20	8.23	50.74	17.52	19883	10904	8979	1.82
T_3	Furrow opening in alternate row	7.99	10.06	7.40	8.48	52.59	18.15	20493	10856	9637	1.88
T_4	Furrow opening in every row + addition of weed biomass	8.06	10.17	7.65	8.63	54.33	18.89	20743	11181	9562	1.86
T_5	Furrow opening in alternate row + addition of weed biomass	8.15	10.44	7.78	8.79	55.03	19.13	20891	11116	9775	1.88
T_6	Furrow opening in every row + addition of weed biomass + bio-decomposer application	8.41	11.84	8.17	9.48	56.48	19.58	22874	12936	9938	1.76
T_7	Furrow opening in alternate row + addition of weed biomass+ bio-decomposer application	8.47	12.68	8.26	9.80	57.62	19.94	23519	12891	10628	1.81
T_8	Furrow opening in every row + addition of weed biomass + spray of 2% Urea and 2% SSP on weed biomass	8.59	13.41	8.43	10.14	58.92	20.32	24949	11694	13255	2.13
T_9	Furrow opening in alternate row + addition of weed biomass + spray of 2% Urea and 2% SSP on weed biomass	8.63	14.28	8.60	10.50	59.61	20.57	25755	11662	14093	2.21
	SE (m) ±	0.32	0.85	0.22	0.45	1.42	0.46	1207	-	1131	-
	C.D. at 5%	N.S.	2.47	0.64	1.33	4.27	1.38	3618	-	3390	-

Market rates

Particulars	
1. Seed cotton(Rs.q^{-1})	2258
2. Cotton stalk (Rs.q^{-1})	50
3. Biodecomposer (Rs.kg^{-1})	100
4. Urea (Rs.kg^{-1})	5.02
5. SSP (Rs.kg^{-1})	3.22

The furrows were opened in every as well as in alternate row to a depth of 30 cm at 45 days after sowing by ridger . Weed biomass @ 5 t ha^{-1} was applied from same field and other sources. Bio-decomposer was applied @ 3 kg t^{-1} of weed biomass. Spraying of 2 per cent urea and 2 per cent SSP was undertaken by using 1000 liter water ha^{-1}. After addition of weed biomass and bio-decomposer furrows were covered with soil. PKV Hy-4 cotton was sown at 90x60 cm spacing on 28-6-2003, 30-6-2004 and 2-7-2005. Recommended fertilizer dose of 50:25:25 kg NPK ha^{-1} was applied to all treatments including control. Half N and full dose of P and K was applied at sowing and remaining half dose of nitrogen was applied at square initiation.

The soil samples were taken every year to analyze initial and after harvest to study the effect of addition of weed biomass and application of bio-decomposer on weed biomass on nutrient deposition/ balancing and uptake of nutrients by the crop. Observations on growth and yield contributing parameters were taken on 5 randomly selected plants. B:C ratio was calculated according to prevailing market rates.

RESULTS AND DISCUSSION

Seed cotton yield : Individual year as well as pooled data from Table 1 indicated that treatment of furrow opening in alternate and every row + addition of weed biomass + spray of 2 per cent urea and 2 per cent SSP on weed bio-mass recorded significantly higher seed cotton yield of 10.50 and 10.14 q ha^{-1}, respectively than all other treatments except treatment furrow opening in alternate and every row + addition of weed biomass + bio-decomposer application. On an average 31.6 per cent and 27.1 per cent increase in seed cotton yield was noticed

Table 2 : Mean moisture content (%) at depth (30 and 45 cm) as influenced by Various treatments

Tr. No.	Treatments	Days after sowing							
		40		70		100		130	
		Depth		Depth		Depth		Depth	
		30	45	30	45	30	45	30	45
T_1	Control	24.8	25.2	22.5	23.3	19.7	20.2	17.5	18.2
T_2	Furrow opening in every row	25.4	25.4	23.3	24.0	20.2	20.6	18.2	18.9
T_3	Furrow opening in alternate row	25.4	25.5	23.6	24.2	20.3	20.8	18.5	19.2
T_4	Furrow opening in every row + addition of weed biomass	25.6	25.6	23.8	24.4	21.1	21.6	18.7	19.4
T_5	Furrow opening in alternate row + addition of weed biomass	25.8	25.7	24.1	24.5	21.4	21.8	18.8	19.6
T_6	Furrow opening in every row + addition of weed biomass + bio-decomposer application.	25.9	26.1	24.3	24.6	21.7	22.0	19.0	19.8
T_7	Furrow opening in alternate row + addition of weed biomass + bio-decomposer application	26.0	26.3	24.4	24.8	21.8	22.2	19.2	20.0
T_8	Furrow opening in every row + addition of weed biomass + spray of 2% Urea and 2% SSP on weed biomass	26.0	26.4	24.6	24.9	21.9	22.4	19.2	20.1
T_9	Furrow opening in alternate row + addition of weed biomass + spray of 2% Urea and 2% SSP on weed biomass	26.1	26.6	24.7	25.0	22.1	22.6	19.4	20.2

Table 3 : Fertility status of soil as influenced by different treatments

Treatments		pH	Organic carbon (g kg^{-1})	Available N (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})
Fertility status after harvest						
T_1	Control	7.7	6.22	269.70	28.58	416.64
T_2	Furrow opening in every row	7.7	6.38	272.83	28.90	433.30
T_3	Furrow opening in alternate row	7.7	6.38	274.56	29.26	436.60
T_4	Furrow opening in every row+ addition of weed biomass	7.8	6.54	275.66	29.48	438.97
T_5	Furrow opening in alternate row + addition of weed biomass	7.7	6.58	278.66	29.53	440.06
T_6	Furrow opening in every row+ addition of weed biomass + bio-decomposer application.	7.8	6.70	282.24	29.60	450.52
T_7	Furrow opening in alternate row + addition of weed biomass+ bio-decomposer application.	7.7	6.72	289.10	29.77	456.64
T_8	Furrow opening in every row+ addition of weed biomass+ spray of 2% Urea and 2% SSP on weed biomass	7.8	6.86	297.92	29.88	465.32
T_9	Furrow opening in alternate row + addition of weed biomass+ spray of 2% Urea and 2% SSP on weed biomass	7.7	6.86	307.33	29.96	470.84
	Initial Fertility status of soil	**7.6**	**6.13**	**263.42**	**28.38**	**399.97**

in treatment of furrow opening in alternate row + addition of weed biomass + spraying of 2 per cent urea and 2 per cent SSP (T_9) and furrow opening in every row + addition of weed biomass + spraying of 2 per cent urea and 2 per cent SSP (T_8), respectively over control. Hajara and Kole (1998) stated that addition of 1 per cent urea + 2 per cent SSP was found effective for decomposting as a starter. In general, it was observed that opening of furrow increased the yield by 4.7 per cent, addition of weed biomass increased the yield by 4.2 per cent, application of bio-decomposer on weed bio-mass recorded 10.7 per cent increased yield and application of spray of 2 per cent urea and 2 per cent SSP on weed biomass increased yield by 18.5 per cent over no furrow opening (control). Thus, on the basis of increased seed cotton yield and nutrient status of soil (Table 3) indicated the faster decomposition of weed biomass and resulted in more nutrient content in soil.

Number of bolls and seed cotton yield $plant^{-1}$ were significantly higher in treatments of furrow opening both at every and alternate row + addition of weed biomass + spray of 2 per cent urea and 2 per cent SSP over control and opening of furrow only. Remaining treatments recorded similar values. Similar results were also reported by Hullihalli and Patil (2004).

Economics : Furrow opening in alternate row and every row + addition of weed biomass + spray of 2 per cent urea and 2 per cent SSP on weed biomass (T_9 and T_8) recorded significantly more GMR , NMR and B:C ratio than all other treatments except treatments of application of bio-decomposer (T_7 and T_6). Application of bio-decomposer (T_7 and T_6) recorded comparatively less B:C

ratio due to high cost of decomposer though the seed cotton yield was at par with 2 per cent urea and 2 per cent SSP spray treatment.

Moisture status : Data presented in Table 2 indicated that land configuration + addition of weed biomass with spraying of 2 per cent urea and 2 per cent SSP showed higher values of moisture content at various depth and growth stages of crop as compared to control. Results are inconformity with the findings of Hullihali and Patil (2004).

Fertility status : Fertility status of soil after three years experimentation in respect of organic carbon, available NPK was increased as compared to initial status due to land configuration, addition of weed biomass and use of bio-decomposer and chemical decomposer. However, land configuration + addition of weed biomass + spraying of 2 per cent urea and 2 per cent SSP recorded higher values of nutrient deposition as compared to other treatments. Similar results were also reported by Nagmani *et al.*(1990).

Furrow opening either in every row or alternate row at 45 days after sowing + addition of 5 t ha^{-1} weed biomass + spray of 2 per cent urea and 2 per cent SSP on weed biomass is beneficial to get higher yield, higher monetary returns as well as to conserve soil moisture and improve the soil fertility.

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Studies on Efficiency of Composting Methods Using Dry Grass

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ABSTRACT

The recovery of compost was more in all aerobic composting methods than anaerobic methods. On the contrary significantly maximum gross, net monetary return and B:C ratio were recorded by Nagpur and Middle aeration compost method over all other composting methods. The significantly maximum B:C ratio was recorded by Nagpur (1.740) and Middle aeration (1.708) compost method, respectively. The Middle aeration method of composting proved the best for composting of dry grass based on initial cost of production of compost. The initial cost of construction and cost of production of a compost the Ma compost method recorded lowest cost Rs.551 tonne^{-1}, followed by Trench compost method (Rs.617), Pit (Rs.638) and Local compost method (Rs.810). The Nadep compost method recorded maximum initial cost for production of a tonne compost (Rs.2801), followed by Nagpur compost method (Rs.2319).

Composting offers a solution for both urban and rural solid waste problems and also for organic residues available on farm. The dry grass considered as weed which is largely available and mostly get burned or thrown away offers great scope as substrate for composting. Thus, the present investigation was carried out to study the recovery and B:C ratio for cheapest method of composting easily adaptable by the farmers.

MATERIAL AND METHODS

The present investigation was carried out in randomized block design with three replications at Department of Animal Husbandry and Dairy Science, College of Agriculture, Nagpur during 2005-2006. The dry grass compost was prepared by seven different composting methods viz. aerobic methods like T_1 - Nadep (Narayan Deorao Pandharipande), T_2 - Nagpur, T_3 - Ma (Middle aeration), T_6 – Heap and anacrobic methods like T_4 - Trench, T_5 - Pit and T_7 - Local compost method. The collected dry grass was directly used for composting by different regularly adapted and newly introduced composting methods by adding small quantity of starter like cow dung @ 75 kg t^{-1} on wet basis (12.20 kg t^{-1} on dry basis) with gypsum 1per cent (10 kg t^{-1}) to control loss of nutrient through leaching and develop the microbial activities.The cow dung and gypsum were mixed thoroughly in water and volume made 750 liters. Then approximately 10 per cent of slurry in each compost method was added on the basis of organic material noted i.e. Nadep (214 L), Nagpur (184 L), Ma (184L), Trench (88 L), Pit (33 L), Heap (14 L) and Local (33 L) was sprinkled evenly on each layer of dry grass. Before sprinkling slurry, dry grass was made wet by sprinkling about 40 per cent of water over it. The pits were filled 1 ft. above top level and covered completely with soil + cow dung slurry.

The compost produced from a tonne of dry grass and cost of its production was worked out by considering the cost of materials used for composting. Similarly, the gross monetary return was worked out by considering the local market price of the compost and accordingly the net monetary returns and benefit: cost ratio was worked out. The data thus, obtained were statistically analyzed and presented in respective tables.

RESULTS AND DISCUSSION

Compost produced from different methods of composting using dry grass was significantly influenced by moisture and temperature during composting which reflected in recovery and B: C ratio of composting.

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Table 1 : Effect of composting methods on moisture content (%) and temperature (°C) during composting of dry grass (pavana) .

Methods of composting	Moisture content (%)				Temperature (°C)									
	At 75 days	At 100 days	At 125 days	At 150 days	16Sept.	1Oct.	16Oct.	31Oct.	15 Nov.	30 Nov.	15 Dec.	14Jan.	29Jan.	9Nov
T_1- Nadep	54.33	62.00	57.00	47.67	56.60	51.00	49.00	48.40	46.16	46.27	44.16	42.30	40.33	40.33
T_2- Nagpur	71.33	72.67	66.00	54.33	57.50	57.00	56.06	54.00	53.33	48.50	48.50	48.36	45.66	43.33
T_3- Ma	75.33	76.33	66.00	52.67	52.46	54.16	52.00	51.33	48.13	46.07	45.83	44.66	42.67	38.83
T_4-Trench	71.33	73.67	63.00	57.33	53.00	51.63	49.50	48.00	46.06	47.00	42.73	42.00	40.00	39.60
T_5- Pit	67.67	71.00	60.67	53.00	54.60	49.93	48.73	47.76	46.00	45.60	43.96	41.96	36.67	36.00
T_6- Heap	73.67	74.00	68.67	58.00	58.50	51.16	51.03	50.27	48.33	48.03	44.83	44.00	43.10	41.16
T_7- Local	86.33	88.67	78.33	72.33	47.03	44.53	44.43	43.20	42.00	41.10	40.00	39.00	39.00	35.77
F- test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
S. E. (m) ±	0.36	0.56	0.50	0.53	0.13	0.22	0.27	0.17	0.15	0.21	0.40	0.25	0.20	0.24
C. D. (0.05)	1.11	1.71	1.54	1.63	0.41	0.68	0.84	0.55	0.46	0.65	1.24	0.78	0.62	0.75

Table 2 . Initial cost of construction, cost of production (Rs. t^{-1}) and weight loss of dry grass during composting as influenced by different composting methods.

Methods of composting	Area of construction Cubic feet	Initial cost of construction (Rs.)	Material taken (Kg)	Production of compost (Kg)	Initial costof production (Rs.t^{-1})	Material takenKg t^{-1}	Decomposed material at 150 days Kg t^{-1}	Loss in weight(%)	Undecomposed material Kg t^{-1}	Loss in weight(%)	Balance weight(%)
T_1- Nadep	540	10000	6366	3570	2801	2122.5	1190.09	37.59	134.57	6.34	56.07
T_2- Nagpur	540	6170	5481	2661	2319	1827.0	337.00	48.14	57.55	3.31	48.55
T_3- Ma	540	1440	2631	2613	551	1827.0	371.00	47.28	90.98	4.98	47.74
T_4-Trench	216	648	987	1050	617	877.0	348.84	45.08	132.34	15.09	39.89
T_5- Pit	81	243	384	381	638	329.0	126.60	46.04	50.93	15.48	38.48
T_6- Heap	-	-	-	153	-	128.0	50.61	42.29	19.42	15.17	39.54
T_7- Local	81	243	987	300	810	329.0	113.11	46.04	62.31	22.94	30.66

Factors affecting composting process

The moisture and temperature were significantly influenced due to incubation period and methods of composting. The data depicted in Table 1.

There was reduction in moisture content of compost from initial day to maturity of compost (150 days). As compared to anaerobic composting methods, aerobic composting methods required more moisture. Therefore maintenance of moisture up to 100 to 120 days was essential for hastening the composting rate. The requirement of moisture in aerobic composting method was more as compared to anaerobic. Significantly maximum moisture was retained in local compost method (86.33 and 72.33 %, respectively.) The lowest moisture content was recorded in Nadep compost method (54.33 and 47.67 %) followed by Nagpur compost (71.33 and 54.33 %) and Ma compost method (75.33 and 52.67 %) at 75th and 150th days, respectively. It indicates that the requirement of moisture in aerobic methods of composting was more as compared to other methods. The findings are in conformity to Bell and Pos. (1971).

During composting of dry grass significant fluctuation in temperature was recorded due to different methods of composting (Table 1). The temperature of decomposing dry grass was initially higher and thereafter reduction in it was recorded in all composting methods till maturity. Similar results were reported by Beckmann and Schriefer (1989).

The higher temperature range during composting period was from 58.50 to 43.33°C in aerobic composting methods and lower temperature during composting was recorded from 47.03 to 35.77 °C in anaerobic composting methods. The higher temperatures were recorded in heap composting method (58.50°C) at 16 days of composting and lowest in local composting method (47.03°C).

Cost of compost production (Rs t^{-1}) on the basis of initial cost of construction.

The composting was made by preparing different composting methods, therefore, it was important to work out the initial cost of production of compost, hence the cost of construction and digging of the pit were considered and the initial cost of compost production was worked out and presented in Table 2.

The results reveled that the Ma compost method recorded lowest cost Rs.551 t^{-1} for production of compost, followed by Trench compost, method (Rs.617), Pit (Rs.638) and Local compost method (Rs.810). The Nadep compost method recorded maximum initial cost for production of compost (Rs.2801), followed by Nagpur compost method (Rs.2319).

Loss in Weight

At maturity of compost by different methods of composting, total per cent loss in weight including decomposed and undecomosed material (Table 2) was recorded and maximum loss in weight was observed in Nagpur method (48.14 %), followed by Ma method (47.28 %), Local method (46.40 %), Pit method (46.04 per cent), Trench method (47.02 %), Heap method (42.29 %) and Nadep method (37.59 %).

Maximum weight loss was associated with the higher mineralization of organic matter. However in Local compost method includes percentage of undecomposed material 22.41 per cent as compared to Nagpur compost method (3.31%), Ma compost method (4.98%) and Nadep compost method (6.34 %).

Recovery of compost.

The recovery of compost was worked out at complete maturity of compost i.e. at 150 days of incubation of dry grass. The results were statistically significant on recovery of decomposed and undecomposed dry grass (Table 3). The recovery of compost was more in all aerobic composting methods than anaerobic methods. Significantly maximum recovery of compost in Nadep compost method (56.07 %) was recorded over all other composting methods followed by Nagpur compost (48.57 %), Ma compost (47.57 %) and Heap compost (39.89 %) which were higher over anaerobic methods i.e. Trench compost (39.54 %), Pit compost (38.48 %) and local method (30.38 %). Similar results were reported by Sharma *et al.* (1980).

Table 3. Effect of methods of composting on recovery of the compost at maturity(at 150 days), cost of production, gross (GMR) and net (NMR) monetary return and Benefit : Cost (B : C) ratio of the dry grass compost.

Methods of composting	Decomposed dry grass kg t^{-1}	Undecomposed dry grass kg t^{-1}	Recovery of compost (%)	Undecomposed dry grass (%)	Cost of production Rs.	Production of compost kg t^{-1}	G. M .R. Rs.	N. M. R. Rs.	B:C ratio
T_1- Nadep	560.7	63.4	56.07	6.34	818	560.7	841.05	23.05	1.028
T_2- Nagpur	485.5	31.5	48.55	3.15	689	485.5	1214.25	516.25	1.740
T_3- Ma	477.0	49.8	47.70	4.98	689	477.0	1192.5	494.33	1.708
T_4-Trench	398.9	150.9	39.89	15.09	689	395.4	988.5	290.50	1.416
T_5- Pit	384.8	154.8	38.48	15.48	689	384.8	962.0	264.00	1.378
T_6- Heap	395.4	151.7	39.54	15.17	689	398.9	997.25	299.25	1.429
T_7- Local	303.8	229.4	30.38	22.94	638	303.8	759.5	121.50	1.190
F- test	Sig.	Sig.	Sig.	Sig.	-	Sig.	Sig.	Sig.	Sig.
S. E. (m) ±	4.96	3.39	0.418	0.339	-	4.96	11.34	16.79	0.034
C. D. (0.05)	15.27	10.43	1.288	1.043	-	15.272	34.95	51.73	0.115

The significant results were also recorded on undecomposed dry grass. The significantly maximum undecomposed dry grass was recorded in anaerobic condition i.e. local compost method (229.4 kg t^{-1}, 22.94 per cent), followed by Trench and Pit compost method. Whereas, lowest undecomposed dry grass was recorded in Nagpur compost method (31.5 kg t^{-1}, 3.15 %) followed by Ma compost (49.8 kg t^{-1}, 4.98 %)and Nadeep compost method (63.4 kg t^{-1}, 6.34 %). This indicated that the maximum recovery of compost was recorded in Nagpur and Ma compost method than all other compost methods. The maximum recovery of compost might be attributed to aeration from outside and through the center of composting pit.

Cost of production, gross and net monetary return and benefit : cost ratio of the compost.

The results were found statistically significant and the data are presented are Table 3. The quantity of compost produced was significantly influenced by the methods of composting. Significantly maximum production of compost for a tonne of dry grass was recorded by Nadep compost method over all other composting methods. The maximum production of compost in the Nadep method was associated with the addition of soil in it. However, followed to Nadep compost, significantly maximum compost produced by Nagpur and Ma compost over Trench, Pit, Heap and Local methods of composting. On the contrary significantly maximum gross and net monetary return and B : C ratio was recorded by Nagpur compost method (Rs.1214.25, 516.25 and 1.740) and Ma compost method (Rs.1192.5, 494.33 and 1.708), respectively over all other methods of composting. In this method, we got additional benefit of Rs.471 to 494 over the Nadep compost method.

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Growth Performance of Teak Clones in Akola Conditions

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ABSTRACT

Teak being the most important commercial timber, its improvement was initiated in the early sixties with selections, provenance testing and seed orchard establishment. The performance of the clones according to the site matching could ascertain the maximum advantage for mass multiplication and large scale plantations. From study, it becomes clear that for Akola condition Clone B-29 is the best in terms of growth for the volume production in Teak, followed by APT-4, APT-20, MHAL-A4, MHAL-P6 and TNT-17 clones.

Teak (*Tectona grandis*) is the most durable and valuable timber species. It is native to Indo Malayan region and occurs naturally in parts of the country. About 700 plus trees of Teak have been identified in all teak growing areas of the country for establishment of clonal seed orchards. To meet the interim needs for reasonably good seed quality for raising plantations, sufficient seed production area have also been identified. The clones from their original site of adaptation when introduced in to a new location, could not perform up to mark probably due to low acclimatization capacity and due to genotype and site conditions (Anonymous, 1990). The objective of tree improvement programme in teak is to produce by selection and breeding superior verities suitable for growing teak in the moist, semi moist and dry areas. (Kedarnath, 1986).

Plus tree selection for inclusion in the seed orchard must be superior to the average in growth rate, habit of growth, resistance to diseases and pest, timber characters and seed production. The superiority of each tree is assessed in relation to five or more adjacent dominant trees and selection is based on the following characters (Kedarnath and Mathew, 1962).

a. Superior growth in height and diameter.
b. Straight growth, free from spiral grains and excessive fluting.
c. Resistance to frost and drought.
d. Resistance to leaf defoliators and skeletonisers.
e. Ability to produce regular crop and wood with favorable strength.

The study was made to delinete the best clones suitable for the region. The selection of the best performing clones according to site matching could be ascertained to derive maximum advantage. Clonal evaluation of twenty three *Dalbergia sissoo* clones in the clonal seed orchard is reported by Dogra *et al.* (2006) in Punjab. The best performing clones in the region were recommended for the mass clonal multiplication on the basis of growth performance and heritability estimates.

Rao *et al.* (2002) studied the performance of teak clones of Andhra Pradesh. The performance of teak bud wood grafts taken from 27 plus trees of Andhra Pradesh were evaluated for stand volume, PAI and MAI for the period of 25 years. Similarly teak provenances evaluation and progeny testing is reported by many workers (Suri, 1984, Sharma et al. 1996,

MATERIAL AND METHODS

The study was initiated in the year 1992 at Akola conditions with the objective to test the performance of 18 clones in Akola condition with local check. Akola is situated between 19°51' and 21°16' North latitudes and 76°30' and 77°44' East longitudes, in the western central part of Vidarbha in Central India.

The seedlings were planted at the distance of 6x6 m with quincunx planting method. The clonal seed orchard of teak was established at College of Forestry, Akola in the year 1992 by patch budding and cleft grafting method. The scion were taken from selected plus trees collected from the Seedling seed orchard raised at

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Maharashtra Van Sanshodan Sanstha (MVSS), Chandrapur (MS). Eighteen clones were selected for the evaluation purpose (Table 1) with clone B-29 as local selection. Each clone was represented by 3 ramets.

Ancillary observations on teak clonal orchard were recorded for flower initiation, forking in the stem, buttress character, appearance of leaf, self pruning ability, branch angle, average leaf length and breadth and defects, if any. The ancillary data was recorded by grouping the clones into two categories. Growth observations were recorded for the height and girth at dbh in the year 2000, 2004 and 2006. The total volume was estimated by using the formula given by Laurie and Bakhshi (1940).

$$V=0.19601\ K + 0.25659\ D2H - 0.10787$$

(t value for respective regression coefficient: 7.996, 147.350 multiple correlation coefficient $R^2 = 0.989$

Where V= Volume of Trees (m^3), H = Height of trees (m), D= dbh (m) and K was assumed as 1 for the trees with branches with timber value.

RESULTS AND DISCUSSION

The observations recorded are given in Table 2. It is evident that the clone TNT-17 was the first to initiate the flowering in June-July 1996., followed by APT-20, MHAL-A8 and MHAL-P6 in June-July 1997. While four clones KLK-2, ORPB-15, TNT-6 and TNT-17 were the late in the initiation of flowering (Table 2). Seven clones exhibited the unforked straight growing stem at the age of 10 years in 2002. Two clones APJNB-1 and TNT-18 were observed to develop the buttressed characters. The self pruning ability in the clones was observed except for APJNB-1, APMN-4, MHAL-P6, MHAL-P8, MHSC-A4 and B29. The Branch angle recorded ranged between 80 to 65°, with an average angle of 73.15°. The maximum leaf length and breadth recorded was 46 cm and 34 cm, respectively. The average leaf length recorded was 32.94 cm and the leaf breadth was 22.84 cm.

The results for height, diameter at breast height and volume estimates are given in Table 3. The

Table 1. Teak Clones used for growth evaluation.

S.N.	Clone	State	Forest Division (Compartment Number)
1	APJNB-1	Andhra Pradesh	
2	APMN-4	Andhra Pradesh	Mancherial- Neelavai Compartment
3	APT-4	Andhra Pradesh	Not Available
4	APT-20	Andhra Pradesh	Not Available
5	APT-17	Andhra Pradesh	Not Available
6	MHAL-A4	Maharashtra	Allapalli - Allapalli (80)
7	MHAL-A8	Maharashtra	Allapalli - Allapalli (65-B)
8	MHAL-P6	Maharashtra	Pedigundam- Allapalli (102)
9	MHAL-P8	Maharashtra	Pedigundam-Allapalli (99)
10	MHSC-A4	Maharashtra	Asarali – Sironcha (296)
11	MHSC-J2	Maharashtra	Jimalgatta – Sironcha (58)
12	KLK-2	Kerela	Karuli - Nilambur
13	ORAN-P7	Orissa	Not Available
14	ORPB-18	Orissa	Not Available
15	TNT-6	Tamil Nadu	Topslip
16	TNT-11	Tamil Nadu	Topslip
17	TNT-17	Tamil Nadu	Not Available
18	TNT-18	Tamil Nadu	Not Available
19	B-29	Maharashtra	Akola

Table 2. Ancillary data for the teak clones raised through vegetative methods

S.N.	Clone	Flower Initiation	Stem Forked / unforked	Buttressed	Leaves shining /rough	Pruning ability	Defect	Branch angle	Leaf length (cm)	Leaf breadth (cm)
1	APJNB-1	Jul-03	F	B	R	N	Fluting Knots	80	44	21
2	APMN-4	Jul-03	F	UB	R	N	Fork Knot	70	40	27
3	APT-4	Jul-98	UNF	UB	S	Yes	Straight	80	46	24
4	APT-20	Jun-97	F	UB	R	Yes	Straight	70	42	34
5	APT-17	Jul-02	F	UB	R	Yes	Fork	65	24	26
6	MHAL-A4	Jul-02	F	UB	R	Yes	Crack	75	34	22
7	MHAL-A8	Jun-97	UNF	UB	R	Yes	Knot	65	33	23
8	MHAL-P6	Jun-97	UNF	UB	R	N	Knot	75	36	31
9	MHAL-P8	Jul-98	UNF	UB	R	N	Knot	65	26	21
10	MHSC-A4	Jul-03	F	UB	S	N	Fork	70	27	17
11	MHSC-J2	Jul-03	F	UB	R	Yes	Fork Knot	80	29	19
12	KLK-2	Jul-04	UNF	UB	S	Yes	Straight	70	26	15
13	ORAN-P7	Jul-03	F	UB	R	Yes	Fork	75	23	19
14	ORPB-15	Jul-04	F	UB	S	Yes	Fork	80	19	13
15	TNT-6	Jul-04	UNF	UB	R	Yes	Straight	80	31	24
16	TNT-11	Jul-04	F	UB	S	Yes	Fork	80	33	22
17	TNT-17	Jul-96	UNF	UB	R	Yes	Straight	65	38	26
18	TNT-18	Jul-01	F	B	S	Yes	Fluting Fork	75	38	26
19	B-29	Jul-01	F	UB	S	N	Fork	70	37	24

F- Forked Stem, UNF- Unforked stem, B- Buttressed, UB- Unbuttressed, R- Rough, S-Shining Smooth

observations recorded for height growth was statistically non significant. The maximum growth was recorded in APT-4 (7.33m), followed by B-29 (7.17m). The non significant growth for height of clones is partially under the control of the genetic characters but is comparable to site quality as reported in the literature for Indian Teak (Champion and Seth, 1968). The diameter at breast height was maximum in B-29 (0.255 m) and was observed to be stastically significant, followed by MHAL-A4, APT-4 and APT-20. The difference in the diameter growth could be attributed to the genetic differences of the clones. The non significant observations for diameter growth in the early stages of growth is reported by Rao et al. (2001) in teak. The volume estimated on the basis if regression equations was observed to be maximum in B-29 (0.219 m^3) at the age of 14 years after grafting, while Clones APT-4, APT-20, MHAL-A4, MHAL-P6 and TNT-17 were stastically at per with each other. The standard volume table equation gives the prediction of volume at the respective ages. The Clone B-29 was above the predicted line, while the clones APT-4, APT-20, MHAL-A4, MHAL-P6 and TNT-17 were observed to be more or less near to the predicted values of volume.

The variability in the growth performance of the different provenances of teak was studied and several published reports are available for the evaluation of growth performance. (Rao et al., 2002, Sharma *et al.* 1996, and Singh, 1981). The performance of the clones according to the site matching could ascertain the maximum advantage for mass multiplication and large scale plantations. From this it becomes clear that for the Akola condition Clone B-29 is the best in terms of growth for the volume production in teak, followed by APT-4, APT-20, MHAL-A4, MHAL-P6 and TNT-17 clones.

Table 3. Growth performance of teak clones at the age of 14 years.

S.N.	Clone	Height (m)	Diameter (m)	Volume (m3)
1	APJNB-1	7.00	0.153	0.142
2	APMN-4	6.17	0.143	0.123
3	APT-4	7.33	0.195	0.159
4	APT-20	7.00	0.188	0.161
5	APT-17	7.00	0.128	0.120
6	MHAL-A4	6.20	0.196	0.168
7	MHAL-A8	5.60	0.132	0.116
8	MHAL-P6	7.00	0.18	0.149
9	MHAL-P8	5.93	0.104	0.106
10	MHSC-A4	4.40	0.050	0.093
11	MHSC-J2	5.50	0.107	0.104
12	KLK-2	5.60	0.102	0.104
13	ORAN-P7	4.93	0.112	0.106
14	ORPB-15	6.17	0.168	0.141
15	TNT-6	6.17	0.105	0.106
16	TNT-11	5.17	0.121	0.111
17	TNT-17	6.77	0.181	0.162
18	TNT-18	6.73	0.160	0.139
19	B-29	7.17	0.255	0.219
	Significance	NS	S	S
	CD	3.424	0.0754	0.07253
	SE	1.688	0.03722	0.03576

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Seed Source Variability Studies in *Jatropha curcas*

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ABSTRACT

Jatropha curcas is an important biofuel tree species, which has got the focus of the world in the last few years. Jatropha is distributed through out the country and its variability studies are in the initial stages. To select the high yielding seed sources with more oil content, candidate plus trees survey was carried out in the state of Maharashtra and 60 samples were collected. The seed samples were analyzed for its variability and the oil percent was estimated. It was observed that the correlation coefficient was highest for No. of bunches plant^{-1}, where as it was minimum for male : female flower ratio. The maximum variation was recorded for the plant girth, followed by number of bunches plant^{-1}. The minimum variability recorded was for 100 seed weight. The path correlation estimates showed that the number of bunches plant^{-1} and number of capsules bunch^{-1} has the maximum effect on seed yield, followed by male to female flower ratio. The plant growth parameters like height and girth do not have any effect on seed yield.

Jatropha curcas is an important biofuel tree species, which has got the focus of the world in the last few years. The Indian Institute of Petroleum Products, Dehradun, had identified *Jatropha curcas* as potential energy crop. Jatropha seed yields fifty per cent by weight a slow drying oil known as Curcas oil. The Indian Institute of Chemical Technology, Hyderabad advocated that the diesel can be obtained at low cost from *Jatropha curcas* seed. Since Jatropha was introduced into India over 500 years ago by Portuguese sailors, hundreds of sub-species have developed through cross-fertilisation and adaptation to the subcontinent's very varied climatic conditions. As a result, Jatropha oil yields and growing characteristics vary from region to region. The study was carried out with the aim of studying the variation in Jatropha occurring in wild, so that the high yielding sources can be identified.

Since the species got the attention of the world in the recent years the seed source variability studies initiated are in the preliminary state. In many other species like *Acacia nilotica, Azadirachta indica, Quercus* seed source variability has been reported. Results of a seed source evaluation trial of *Jatropha curcas* Linn. laid out in 1996 at Jabalpur (M.P.), a semi arid region of India are reported and discussed by Ginwal *et al.* 2004. They observed the significant differences for seed sources at age 27 months were observed for height, collar diameter, number of branches leaf area and field survival. Seeds collected from different sources also varied significantly in respect of seed and kernel weight and oil content in seed/kernel.

Aker, 1997 studied the growth and reproduction of *Jatropha curcas* in Nicaragua. An exploratory study to detect patterns of variation in flower, fruit and seed production in one-year-old plants of *Jatropha curcas* (Euphorbiaceae) in response to variation in soil moisture and fertility was conducted during a 12-month period in Nicaragua.

Jain *et al.* (2003) has studied the 13 provenances of Neem collected from different agroclimatic zones of MP. Seed thickness and seed weight exhibited the large variation and significant relationship with germination behavior of seeds under nursery condition.

Sukarin *et al.* (1987) did not observe any morphological differences in the clones originated from different location in Thialand and planted in a provenance trial. The differences in vegetative development and first seed yield were not reported. Heller (1992) tested a collection of 13 provenances in multilocation field trial during 1987 and 1988 and found significant differences in the vegetative development among all the provenances at all location in *Jatropha curcas*. A highly significant positive relationship between 100 seed weight, crude fat and crude fibre content was observed amongst provenances by Ferrao, and Ferrao (1984).

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Table 1. Details of Seed Sources and variability of parameters recorded.

S.N	CPT Code	District	Latitude North	Longitude East	Plant height (m)	Average Plant age (Yr)	Plant girth (cm)	Plant Canopy spread (m)	Flowring (once/ twice)	Time of fruit maturity	No. of Bunches plant^{-1}	Average no. of Capsule bunch^{-1}	Male : Female Flower ratio
1	PDKV-D-1	Amravati	20.49	78.04	4.0	10	70	5.0	Once	Oct.-Nov	19	9	0.056
2	PDKV-D-2	Amravati	21.09	75.41	4.5	8-10	50	3.5	Once	Oct.-Nov	17	11	0.032
3	PDKV-D-3	Amravati	21.11	75.54	4.0	8-9	60	4.5	Once	Oct.-Nov	20	11	0.034
4	PDKV-D-4	Amravati	21.28	78.16	3.0	8-10	65	4.0	Once	Oct.-Nov	17	11	0.033
5	PDKV-D-5	Amravati	20.52	77.46	3.5	7-8	70	3.5	Once	Oct.-Nov	22	9	0.045
6	PDKV-D-6	Akola	20.46	77.21	2.5	7	50	3.0	Once	Oct.-Nov	26	7	0.056
7	PDKV-D-7	Amravati	21.28	78.06	3.2	8-7	55	3.0	Once	Oct.-Nov	19	9	0.048
8	PDKV-D-8	Nagpur	21.10	78.38	4.0	12-15	90	4.0	Once	Oct.-Nov	28	9	0.050
9	PDKV-D-9	Akola	21.07	76.45	3.5	10	55	3.0	Once	Oct.-Nov	19	9	0.045
10	PDKV-D-10	Bulbhana	20.49	76.40	4.0	12	86	5.0	Twice	Oct.-Nov	29	9	0.042
11	PDKV-D-11	Amravati	21.18	77.33	3.2	8	70	3.5	Once	Oct.-Nov	18	11	0.037
12	PDKV-D-12	Aurangabad	20.20	75.37	5.0	12	80	4.5	Once	Oct.-Nov	23	9	0.043
13	PDKV-D-13	Nagpur	21.09	79.01	4.0	8	60	3.0	Once	Oct.-Nov	30	9	0.043
14	PDKV-D-14	Washim	20.08	77.09	4.0	10	70	3.5	Once	Oct.-Nov	18	11	0.036
15	PDKV-D-15	Washim	20.04	77.00	4.0	10	80	4.0	Once	Oct.-Nov	21	11	0.032
16	PDKV-D-16	Buldhana	20.31	76.00	3.0	12	80	3.5	Twice	Oct.-Nov	36	9	0.045
17	PDKV-D-17	Buldhana	20.31	76.11	3.8	17	75	4.0	Once	Oct.-Nov	28	9	0.048
18	PDKV-D-18	Aurangadab	20.16	75.42	4.0	10-12	110	4.5	Once	Oct.-Nov	23	11	0.036
19	PDKV-D-19	Aurangadbad	20.11	75.33	2.5	7-8	60	3.0	Once	Oct.-Nov	15	11	0.034
20	PDKV-D-20	Aurangabad	20.30	75.44	4.5	12	95	5.0	Once	Oct.-Nov	26	9	0.053
21	PDKV-D-21	Aurangabad	20.24	75.41	4.0	12	55	3.0	Once	Oct.-Nov	18	11	0.036
22	PDKV-D-22	Buldhana	20.20	76.15	3.0	6-7	50	2.5	Once	Oct.-Nov	23	9	0.048
23	PDKV-D-23	Buldhana	20.10	76.21	2.7	11-12	80	3.0	Twice	Oct.-Nov	33	10	0.042
24	PDKV-D-24	Buldhana	20.09	76.28	2.5	10-12	75	2.5	Once	Oct.-Nov	36	7	0.059
25	PDKV-D-25	Jalgaon	20.39	75.13	2.5	5-7	40	3.0	Once	Oct.-Nov	25	10	0.037
26	PDKV-D-26	Jalgaon	20.39	75.20	3.5	13-15	100	6.0	Once	Oct.-Nov	15	14	0.040
27	PDKV-D-27	Jalgaon	20.27	75.00	3.0	8-10	45	3.0	Once	Oct.-Nov	18	11	0.036
28	PDKV-D-28	Jalgaon	20.52	75.39	4.0	6-7	40	3.0	Twice	Oct.-Nov	37	9	0.033
29	PDKV-D-29	Jalgaon	20.46	75.39	3.8	12-14	110	5.0	Twice	Oct.-Nov	42	12	0.040

30	PDKV-D-30	Jalgaon	20.33	75.10	3.5	6-7	40	2.5	Twice	Oct.-Nov	29	10	0.036	1.8	68	36.97
31	PDKV-D-31	Jalgaon	20.33	75.10	2.0	3	23	2.5	Once	Oct.-Nov	15	11	0.033	1.0	67	36.85
32	PDKV-D-32	Akola	20.42	77.02	2.5	3	25	3.0	Once	Oct.-Nov	28	9	0.045	1.5	65	35.96
33	PDKV-D-33	Akola	20.42	77.02	3.0	3	28	2.8	Once	Oct.-Nov	21	8	0.033	1.0	66	36.02
34	PDKV-D-34	Washim	20.07	77.07	4.0	4	40	4.0	Once	Oct-Nov	18	10	0.045	1.1	68	23.42
35	PDKV-D-35	Hingoli	19.42	77.08	5.0	7	55	4.5	Once	Oct-Nov	23	10	0.043	1.4	84	35.15
36	PDKV-D-36	Hingoli	19.40	77.18	4.0	4	35	4.0	Once	Oct-Nov	17	10	0.038	1.0	74	34.20
37	PDKV-D-37	Hingoli	19.32	77.02	5.0	6	50	5.0	Once	Oct-Nov	15	10	0.050	0.9	66	35.67
38	PDKV-D-38	Parbhani	18.53	77.54	5.0	7	60	5.0	Twice	Oct-Nov	23	13	0.026	1.8	70	33.17
39	PDKV-D-39	Beed	18.43	76.23	5.0	5	65	5.0	Twice	Oct-Nov	18	17	0.026	1.8	74	32.99
40	PDKV-D-40	Beed	18.29	75.56	4.0	5	50	5.0	Once	Oct-Nov	19	13	0.029	1.5	72	23.48
41	PDKV-D-41	Latur	18.17	76.31	3.5	4	30	4.0	Once	Oct-Nov	15	11	0.033	1.0	69	29.85
42	PDKV-D-42	Latur	18.12	76.35	4.0	4	40	3.5	Once	Oct-Nov	15	10	0.037	0.9	65	29.95
43	PDKV-D-43	Latur	18.07	76.42	4.0	5	65	5.0	Twice	Oct-Nov	19	16	0.030	1.8	65	24.17
44	PDKV-D-44	Latur	18.14	76.29	5.0	8	65	5.0	Once	Oct-Nov	15	13	0.029	1.2	73	30.99
45	PDKV-D-45	Osmanabad	18.00	76.03	5.0	6	80	6.0	Once	Oct-Nov	11	15	0.029	1.0	64	22.16
46	PDKV-D-46	Osmanabad	17.52	75.58	4.5	5	50	4.5	Once	Oct-Nov	15	12	0.032	1.1	70	28.56
47	PDKV-D-47	Solapur	17.48	75.38	2.0	2	20	2.0	Once	Oct-Nov	6	14	0.029	0.5	50	19.11
48	PDKV-D-48	Solapur	17.43	75.29	5.0	4	45	4.0	Once	Oct-Nov	12	15	0.036	1.1	65	19.12
49	PDKV-D-49	Solapur	18.13	75.41	6.5	7	55	4.5	Once	Oct-Nov	17	15	0.040	1.5	75	25.84
50	PDKV-D-50	Solapur	18.18	75.47	5.0	6	55	4.0	Once	Oct-Nov	14	16	0.033	1.3	75	38.23
51	PDKV-D-51	Osmanabad	18.23	75.51	3.5	4	40	4.0	Once	Oct-Nov	17	12	0.032	1.2	67	32.85
52	PDKV-D-52	Osmanabad	18.18	75.56	7.0	8	65	5.0	Twice	Oct-Nov	19	17	0.028	1.9	72	35.11
53	PDKV-D-53	Beed	18.42	75.41	5.0	5	50	5.0	Once	Oct-Nov	13	15	0.029	1.2	68	34.51
54	PDKV-D-54	Beed	18.50	75.43	5.0	4	45	4.0	Once	Oct-Nov	17	12	0.031	1.2	70	30.01
55	PDKV-D-55	Beed	18.54	75.44	6.0	7	80	5.0	Once	Oct-Nov	13	15	0.028	1.2	70	32.97
56	PDKV-D-56	Beed	18.57	75.45	7.0	8	19	5.5	Once	Oct-Nov	21	14	0.029	1.8	71	32.88
57	PDKV-D-57	Beed	19.06	75.44	4.0	4	30	3.0	Once	Oct-Nov	20	14	0.037	1.7	60	36.16
58	PDKV-D-58	Beed	19.12	75.45	6.0	12	100	5.0	Once	Oct-Nov	22	13	0.034	1.7	62	35.13
59	PDKV-D-59	Jalna	19.36	75.47	4.5	5	40	4.0	Once	Oct-Nov	25	10	0.042	1.5	68	33.17
60	PDKV-D-60	Jalna	19.44	75.49	5.0	6	50	4.0	Once	Oct-Nov	22	12	0.034	1.6	70	31.93

Table 2. Path analysis and variability estimates of seed sources in *Jatropha curcas*

	Plant ht. (m)	Plant girth (cm)	Plant Canopy (m)	No. of Bunches plant^{-1}	Average no. of Capsule bunch $^{-1}$	Male : Female Flower ratio	100 seed weight (g)	Oil per cent in seed	Fruit Yield plant^{-1} (kg)
Mean	4.061667	58.68333	3.971667	20.91944	11.31667	0.037994655	67.6	33.2095	1.367167
Standard Error	0.144408	2.813456	0.123098	0.884957	0.318446	0.001018473	0.978065	0.610746	0.049432
Standard Deviation	1.118578	21.79293	0.953511	6.854849	2.46667	0.007889055	7.576055	4.73082	0.382902
Phenotypic Variance	1.251218	474.9319	0.909184	46.98896	6.084463	0.00006.2237	57.39661	22.38066	0.146614
Coefficient of Variation	27.30944	36.82573	23.8069	32.65135	21.61439	20.86293	11.11341	14.12614	27.79587
Correlation coefficient	0.20945	0.38162	0.2072	0.753095	0.120426	0.037248	0.076688	0.247164	1
Direct Effect on Yield	0.002947	0.028424	0.086309	1.13986	0.630889	0.101394	0.032988	0.050755	1

Afforestation on the basis of provenance trial alone can improve productivity up 50 percent (Zobel *et al*. 1998). Systematic provenance trials of different location have not been carried out with the Jatropha to the desire extent.

MATERIAL AND METHODS

The survey for the selection of candidate plus trees was carried out during 2004-2006. The CPTs were selected on the basis of Plant age, girth, canopy size, fruiting behavior, number of fruits per bunch, no. of bunches per plant and 100 seed weight. The 60 seed sources were selected from districts Akola, Buldhana, Washim, Amravati, Nagpur, Jalgaon, Dhule, Jalna and Aurangabad, Beed, Solapur, Hingoli. Parbhani, Latur, Osmanabad, Ahmadnagar, Pune and Satara in Maharashtra state. The seed sources were selected having minimum isolation distance of 5 km between two sources. The Latitude and longitude of each location was recorded with the help of GPS.

The CPTs selected were planted in the field of College of Forestry, Akola in RBD Design at 3x3m spacing with five plants CPTs^{-1} for progeny evaluation. The oil content was estimated for all the CPTs by solvent extraction method.

To study the variability in seed sources the observations recorded were subjected to path analysis and the variability was estimated.

RESULTS AND DISCUSSION

Sixty seed sources as Candidate Plus Tree of *Jatropha curcas* were collected from the state of Maharashtra from different agroclimatic zones. The growth character, seed yield and post harvest observations of individual CPTs is given in table 1. The plant height recorded ranged between 2 to 5 m, with the average height of 4.06m. The CPTs selected were of different ages from2 to 15 years. The average basal collar girth of the plants was observed to be 3.97 cm. The fruit yield ranged from 500 g to 3 kg plant^{-1}. However, the variation in fruit yield was largely due to age differences. The number of bunches per plant ranged from 6 to 42. The average number of capsules bunch^{-1} recorded was 11.31. It was also observed that the ratio of male and female flowers has the significant effect on the seed yield. The Male to female flower ration ranged between 0.030 to 0.060. The average 100 seed weight recorded was 67.6 g, The 100 seed weigh varied from 45 to 85 g.

The seed samples were analyzed for oil content. The oil content varying from 19.11 to 38.9 percent was recorded.

The correlation coefficient was worked out for all the CPT, with fruit yield as constant variable (Table 2). It was observed that the correlation coefficient was highest for No. of bunches per plant (0.753), where as it was minimum for male : female flower ratio (0.0372). The maximum variation was recorded for the paltn girth (36.82), followed by No. of bunches plant^{-1} (32.65), plant height (27.30). The minimum variability recorded was for 100 seed weight (11.11).

Variability estimates for the seed sources was calculated. The sample variance was estimated to be lowest for Male to female flower ratio (0.0000622), where as for plant girth it was maximum (474.931). The path analysis for effect of different attributes on yield recorded shows that the effect of number of bunches plant^{-1} had direct effect on seed yield, followed by Male : Female Flower ratio (Table 2).

Similar seed source variability was reported and discussed by Ginwal *et al.* 2004 for *Jatropha curcas* for germination and seedling growth characters. The variations observed are due to the genotype and environment interactions. In Neem large scale variation was reported by Jain *et al.* (2003). They reported that the variation is due the fact that the species grows over a wide range of latitude and longitude. The variability in seed sources is largely attributed to the heterogeneity of the genotypes and the genotype x environment interactions (Thompson, 1973)

The lack of seed source variability studies in the species is the major hindrance in selection of promising seed source as well to correlated the yield and seed source variability estimates.

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Effect of Chemicals and Growth Regulators on Fruit Set and Fruit Retention of Parbhani Bhushan Mango

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ABSTRACT

Investigation was carried out on Parbhani Bhushan mango in mango orchard located at village Paralgavan near Parbhani city during 2005-2006. Mango trees of age 10 years spaced at 10m x 10m were selected and sprayed with chemicals like KNO_3 (2.0 %, 4.0 % and 6.0 %) urea (1.0 %, 1.5 % and 2.0 %) and growth regulators like NAA (40 ppm, 60 ppm and 80 ppm) and triacontanol (300 ppm, 500 ppm and 700 ppm) at flowering stage and when fruits were of pea and marble size. The treatment of triacontanol 700 ppm showed better fruit retention after flowering stage, pea, marble, half grown and full grown stages of fruit, followed by triacontanol 500 ppm and NAA 40 ppm.

Mango (*Mangifera indica* L.) is the king of fruits and occupies a unique position in Indian Horticulture as it has great adaptability and thrives in a wide range of climatic and soil conditions. It is rich in vitamins A and C and also a good source of calcium and phosphorus. In India, the area under mango crop is about 12.83 lakh ha with a production about of 108.10 lakh tonnes (Salaria, 1999). In Maharashtra, the area under mango fruit is about 42540 ha and production is about 6,847 metric tonnes (Anonymous, 2000). The mango varieties like Ratna, Neelum, Totapuri, Pairi, Parbhani Bhushan are cultivated in Marathwada. Among these varieties, Parbhani Bhushan is quite popular because it is free from spongy tissue, has a good taste, abundant juice, good flavour and is a regular bearer. This variety is developed by Marathwada Agriculture University, Parbhani (M.S.) by selection method from local plantation and released in the year 1995. In this variety, fruit setting and fruit retention can be improved by spraying chemicals and growth regulators at flowering, pea and marble stages and hence, the present study regarding effect of chemicals and growth regulators on fruit set and fruit retention of Parbhani Bhushan mango was undertaken.

MATERIAL AND METHODS

The experiment was conducted during 2005-2006 on grafted Parbhani Bhushan mango in mango orchard at Paralgavan village near Parbhani in Maharashtra.

An experiment was laid out in randomized block design (RBD) with three replication on Cv. Parbhani Bhushan along with 13 treatments of chemicals and growth regulators. For recording the observations on various parameters like fruit set and fruit retention, four uniform bearing panicles on the North, South, East and West side of the tree were selected during peak period of flowering randomly on each tree and tagged with lables. The chemicals and growth regulators as per the treatments were applied as a foliar spray to the panicles at flowering, pea and marble stages of fruit growth. The chemical treatment consisted of NAA (40 ppm, 60 ppm, 80 ppm), KNO_3 (2.0 %, 4.0 % and 6.0 %), urea (1.0 %, 1.5 %, 2.0 %), triacontanol (300 ppm, 500 ppm and 700 ppm) and a control. The observations of fruit setting at flowering and fruit retention stages like pea, marble, half grown and full grown stages were taken. Data were analysed as per Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Fruit set at flowering and fruit retention of Parbhani Bhushan mango at different stages were recorded and data are presented in Table-1. Immediately after flowering stage, triacontanol 700 ppm showed the highest (91.63 %) fruit retention, followed by triacontanol 500 ppm (87.66 %) and NAA 40 ppm (85.61 %) and the later two were at par with one another but significantly superior over rest of the treatments. At pea stage of fruits, triacontanol 700 ppm showed the highest (45.64 %) fruit

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Table 1 :Effect of chemicals and growth regulators on fruit set and fruit retention of Parbhani Bhushan mango.

S. N.	Treatments	Per cent fruit set after flowering stage	Per cent fruit retention			
			Pea stage	Marble stage	Half grown stage	Full grown stage
1	Control	62.30	31.11	12.38	2.29	1.95
		(52.11)	(33.89)	(20.59)	(8.69)	(8.01)
2	NAA 40 ppm	85.61	43.37	18.00	3.56	3.55
		(67.70)	(40.60)	(25.09)	(10.87)	(10.86)
3	NAA 60 ppm	82.78	40.84	17.07	3.51	2.88
		(65.47)	(39.71)	(24.39)	(10.79)	(9.77)
4	NAA 80 ppm	71.00	38.48	16.65	2.91	2.25
		(57.41)	(38.33)	(24.07)	(9.82)	(8.62)
5	KNO_3 2.0%	81.79	36.09	15.31	3.26	2.58
		(64.75)	(36.92)	(25.03)	(10.39)	(9.24)
6	KNO_3 4.0%	70.40	37.90	16.73	3.36	2.79
		(57.03)	(37.99)	(24.13)	(10.54)	(9.60)
7	KNO_3 6.0%	80.09	37.28	13.57	3.12	2.77
		(63.50)	(37.62)	(21.59)	(10.14)	(9.56)
8	Urea 1.0%	68.00	36.37	14.12	3.00	2.50
		(55.53)	(37.08)	(22.05)	(9.96)	(9.08)
9	Urea 1.5%	70.55	36.75	12.79	2.94	2.60
		(57.13)	(37.31)	(20.94)	(9.83)	(9.27)
10	Urea 2.0%	74.83	33.76	14.89	3.15	2.73
		(59.88)	(35.51)	(22.66)	(10.17)	(9.49)
11	Triacontanol 300 ppm	73.51	39.62	14.92	2.92	2.64
		(59.02)	(39.00)	(22.70)	(9.83)	(9.33)
12	Triacontanol 500 ppm	87.66	43.87	18.72	3.65	3.62
		(69.43)	(41.47)	(25.63)	(11.01)	(10.96)
13	Triacontanol 700 ppm	91.63	45.64	19.70	4.48	3.78
		(73.18)	(42.49)	(26.33)	(12.21)	(11.21)
	SE (m) ±	1.83	1.20	0.78	0.40	0.33
	C.D. at 5%	5.34	3.51	2.27	1.18	0.96

*Figures in parentheses are angular transformed values

retention, followed by triacontanol 500 ppm (43.87 %) and NAA 40 ppm (43.37 %) and the later two were at par with one another and significantly superior over rest of the treatments. At marble stage triacontanol 700 ppm led to 19.70 per cent of fruit retention which was significantly more than other treatments except triacontanol 500 ppm and NAA 40 ppm (18.72 % and 18.00 % of fruit retention, respectively).

Mane (1999) concluded that maximum fruit set was found in treatment NAA at 50 ppm, followed by NAA 20 ppm and KNO_3 2 per cent significantly increased the fruit retention in Ratna variety of mango. Behra *et al.* (1994) observed that the application of 10 ppm NAA + 2 per cent urea as a foliar spray just before fruit set was the most effective treatment for increasing fruit retention in mango variety Totapuri. Sharma *et al* (1990) found that urea (1.5 to 3 %) and KNO_3 (2 to 4 %) and NAA 40 ppm significantly increased fruit set in mango Cv. Langra.

At half grown stage of fruit, triacontanol 700 ppm was found significantly superior giving 4.48 per cent retention over rest of the treatments. In the order, NAA 40 ppm gave 3.56 per cent fruit retention except urea 1.0 per cent, NAA 80 ppm and control. It was important to note that fruit retention in Parbhani Bhushan at full grown stage was the highest (3.78 %) due to triacontanol 700 ppm application and this treatment was at par with triacontanol 500 ppm (3.62 %) and NAA 40 ppm (3.55 %).

From the above results, it is concluded, that only triacontanol 700 ppm spray at various stages of fruit development of Parbhani Bhushan mango resulted in increased fruit retention and reduced the extent of fruit drop than all other treatments. The other chemical treatments i.e. NAA, KNO_3 and urea at various concentrations also played an important role in maximum retention of fruits.

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Suitability of Amaranthus Varieties for Staggered Planting

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ABSTRACT

An experiment entitled "Suitability of amaranthus varieties for staggered planting" was carried out during summer season of 2005-06 at College of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The treatments comprised of four planting time i.e. 2nd January, 17th January, 2nd February and 17th February and four varieties viz., Local, Pusa Kirti, Pusa Kiran and Chhoti chaulai. The experiment was laid out in split plot design with three replications. The results of the investigation indicated that the minimum days required for first, second and third cutting was recorded in fourth planting time (17th February) and variety Chhoti chaulai, and total yield ha^{-1} was found maximum in third planting time (2nd February) and variety Pusa Kiran.

Vegetable plays an important role in human nutrition. India is the second largest producer of vegetable next to China. Amaranthus, spinach, fenugreek, coriander, baserla, agathi and celery are the important leafy vegetables grown in India. Only a few leafy vegetables can be grown in summer season i.e. amaranthus, spinach and portuluca so that for the continuous supply of leafy vegetables in summer season, amaranthus plays an important role. It is said to be native of India. Amaranthus belongs to the family *Amaranthaceae* and genus *Amaranthus*. It is mainly cultivated as a summer crop and also grown well in rainy season. The leaves and tender stem of amaranthus are rich in protein, minerals, carbohydrates, vitamin 'A' and 'C'. It is also a rich source of magnesium, phosphorus, sodium, riboflavin, potassium, sulphur and nicotinic acid. There are two varieties based on leaf colour green leaf and red leaf. The improved varieties are Co-1 (*A. dubius*), Co-2 (*A. tricolor*), Co-3 (*A. tristis*), Chhoti chaulai (*A. blitum*). The most common leafy amaranthus varieties popular in India are *A. tricolor, A. dubius* and *A. blitum*. Leaves of amaranthus are nutritionally significant source of beta-carotene.

It is a very quick growing crop; the fresh leaf yield is so high. Vegetable amaranthus has received significantly less research attention and it is a short duration crop hence it is felt necessary to have stragger planting for continuous supply of fresh vegetable in the market.

MATERIAL AND METHODS

The present investigation was conducted at College of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during year 2005-06 in summer season. The experiment was laid out in split plot design with sixteen treatment combinations having four planting time i.e. P_1 (2nd January), P_2 (17th January), P_3 (2nd February) and P_4 (17th February) and four varieties V_1 (Local), V_2 (Pusa Kirti), V_3 (Pusa Kiran) and V_4 (Chhoti chaulai) and three replications. The seeds were sown in line sowing with 20 cm row to row spacing. Recommended dose of fertilizer i.e. complete FYM was applied at the time of final harrowing, half dose of N and full dose of P_2O_5 and K_2O was applied at the time of sowing and remaining 1/4 N was applied after first cutting and 1/4 N after second cutting.

Observations on days required for first, second and third cutting and total yield ha^{-1} were recorded.

RESULTS AND DISCUSSION

Days required for cutting as influenced by planting time

The data presented in Table 1 revealed that the data in respect of days required for cutting showed that the effect of planting time on days required for first, second and third cutting was found to be significant and days required for first, second and third cutting was reduced by delayed planting time from first planting time

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to fourth planting time. Days required for the first cutting (30.41 days) and second cutting (45.66 days) and third cutting (63.91 days) were recorded significantly minimum number of days in fourth planting time (17th February), whereas significantly maximum number of days required in first planting time (2nd January) i.e. first cutting (38.58 days), second cutting (54.66 days) and third cutting (72.91 days). This might be due to the fact that the temperature increases from first planting time to fourth planting time and amaranthus is a summer season vegetable crop and also it grows well in high temperature than the low temperature. The results obtained in this investigation are in close agreement with Sant *et al.* (2003) in fenugreek, Gill *et al.* (2001) in fenugreek.

Days required for cutting as influenced by different varieties

Varieties of amaranthus were significantly influenced on the days required for first, second and third cutting. Variety Chhoti chaulai required the minimum number of days for first cutting (32.75 cm), second cutting (48.00 cm) and third cutting (66.00 cm), whereas variety local required maximum number of days for first cutting (34.16 cm) and third cutting (67.50 days) and variety Pusa Kirti (49.41 days) required maximum for second cutting. The results obtained in this investigation are in close agreement with Singh *et al.* (2000) in coriander,

Table 1: Days required for cutting as influenced by planting time and varieties

Treatments	Days required for cutting		
Planting time	First	Second	Third
P_1 (2nd January)	38.58	54.66	72.91
P_2 (17th January)	33.83	48.83	66.83
P_3 (2nd February)	30.91	45.91	64.00
P_4 (17th February)	30.41	45.66	63.91
'F' test	Sig.	Sig.	Sig.
S.E.(m)±	0.19	0.19	0.17
CD at 5%	0.66	0.68	0.61
Varieties			
V_1 (Local)	34.16	49.25	67.50
V_2 (Pusa Kirti)	33.83	49.41	67.50
V_3 (Pusa Kiran)	33.00	48.41	66.58
V_4 (Chhoti Chaulai)	32.75	48.00	66.00
'F' test	Sig.	Sig.	Sig.
S.E.(m)±	0.14	0.12	0.13
CD at 5%	0.41	0.35	0.37
Interaction effect (P x V)			
'F' test	NS	NS	NS
SE (m)±	0.29	0.24	0.26
CD at 5%	-	-	-

Sant *et al.* (2003) in fenugreek and Gill *et al.* (2001) in fenugreek.

An interaction effect due to planting time and varieties on number of days required for cutting were found to be non-significant at first, second and third cutting.

Yield of amaranthus as influenced by planting time (q ha^{-1})

The data presented in Table 2 revealed that the effect of planting time on yield ha^{-1} at first, second and third cutting and total yield were found to be significant.

The maximum yield ha^{-1} at first cutting (81.10 q ha^{-1}) and second cutting (62.52 q ha^{-1}) was recorded in third planting time (2nd January) and at the stage of third cutting (41.94 q ha^{-1}) in fourth planting time (17th February).

The third planting time was found significantly superior and recorded the maximum total yield ha^{-1} (185.41 q ha^{-1}), followed by fourth planting time i.e. 17th February (174.27 q ha^{-1}) which were at par with each other and hence it is indicated that the planting of amaranthus from second fortnight of January at fortnight interval found suitable for staggered planting for continuous supply of green leafy vegetable during summer season. The first planting time (2nd January) recorded significantly minimum yield per hectare (146.31 q ha^{-1}). The results obtained in this investigation are in close agreement with Singh *et al.* (2000) in coriander and Sant *et al.* (2003) in fenugreek.

Table 2: Yield of amaranthus as influenced by planting time and varieties

Treatments	Yield (q ha^{-1})			
Planting time	First cutting	Second cutting	Third cutting	Total yield
P_1 (2nd January)	58.25	51.64	39.16	146.31
P_2 (17th January)	69.6	57.08	39.28	165.96
P_3 (2nd February)	81.10	62.52	41.66	185.41
P_4 (17th February)	73.19	59.09	41.94	174.27
'F' test	Sig.	Sig.	NS	Sig.
S.E.(m)±	2.78	1.28	1.45	4.22
CD at 5%	9.61	4.42	-	14.60
Varieties				
V_1 (Local)	64.11	51.24	35.55	150.93
V_2 (Pusa Kirti)	67.52	54.74	36.59	158.95
V_3 (Pusa Kiran)	78.67	64.23	45.46	188.39
V_4 (Chhoti chaulai)	71.87	60.11	44.44	173.67
'F' test	Sig.	Sig.	Sig.	Sig.
S.E.(m)±	3.00	1.99	1.27	5.56
CD at 5%	8.75	5.82	3.69	16.22
Interaction effect (P x V)				
'F' test	NS	NS	NS	NS
S.E.(m)±	6.00	3.99	2.54	11.12
CD at 5%	-	-	-	-

Yield of amaranthus as influenced by different varieties (q ha^{-1})

Varieties of the amaranthus were significantly influenced on the yield ha^{-1} at first, second and third cutting and total yield ha^{-1} (Table 2). The variety Pusa Kiran was found significantly superior and recorded the maximum yield at first cutting (78.67q ha^{-1}), second cutting (64.23 q ha^{-1}), third cutting (45.46 cm) and total yield ha^{-1} (188.39 q ha^{-1}) followed by variety Chhoti chaulai. Whereas, minimum yield per hectare at first cutting (64.11 q ha^{-1}), second cutting (51.24 q ha^{-1}), third cutting (35.55 q ha^{-1}) and also the total yield per hectare (150.93 q ha^{-1}). It is clearly indicated that amaranthus variety Pusa kiran and Chhoti chaulai found suitable for commercial production under Vidarbha conditions. The results obtained in this investigation are in close agreement with Baswana and Pandita (1989) Singh *et al.*, (2000) in coriander, Sant *et al.* (2003) in fenugreek and Gill *et al.* (2001) and Satish *et al.*, (2002) in fenugreek.

An interaction effect due to planting time and varieties on yield per hectare were found to be non-significant at first, second and third cutting.

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Effect of Bio-inoculants With Graded Doses of NPK on Growth and Yield of Annual Chrysanthemum

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ABSTRACT

An experiment was carried out at Horticulture Section, College of Agriculture, Nagpur during *Rabi* season 2005-2006 to study the effect of bio-innoculants with graded doses of NPK on growth and yield of annual chrysanthemum. The results revealed that the application of 80 per cent NPK with Azospirillium + Azotobacter + PSB 5 kg each ha^{-1} (T_8) produced significantly maximum vegetative growth viz. plant height, diameter of main stem, number of leaves, spread of plant, fresh and dry weight of shoot and root, dry matter production and flower yield ha^{-1}.

Annual chrysanthemum (*Chrysanthemum coronorium*) is one of the popular, winter season, easy growing flowering annual. It is also known as crown daisy, garland chrysanthemum or *Bijli*. The flowers assumed economic importance on account of their varied use such as cut flower for flower decoration, loose flower for garlands and religious functions. It has a long flowering period. To meet the great demand, it is necessary to develop the suitable agro techniques to enhance the growth and production of flowers. For successful cultivation, nutrient management is of prime importance to obtain good quality flower, dry matter production and yield of flowers through the combined use of inorganic and biological sources of plant nutrient. Keeping this in view, an experiment was conducted to study the effect of bio-innoculant along with graded doses of NPK on growth and yield of annual chrysanthemum.

MATERIAL AND METHODS

A field experiment on "effect of bio-innoculants along with graded doses of NPK on annual chrysanthemum was carried out at Bhajiwadi, Horticulture Section, College of Agriculture, Nagpur during *Rabi* season 2005-2006 by adopting Randomzed Block Design with three replications. The experiment comprising ten treatments were

T_1 - RDF (150 : 50 : 50 NPK ha^{-1})

T_2 - 80 per cent RDF + Azosprillium + PSB 5kg each ha^{-1}

T_3- 60 per cent RDF + Azosprillium + PSB 5 kg each ha^{-1}

T_4 - 40 per cent RDF + Azosprillium + PSB 5 kg each ha-1

T_5 - 80 per cent RDF +Azotobacter + PSB 5 kg each ha^{-1}

T_6 - 60 per cent RDF + Azotobacter + PSB 5 kg each ha^{-1}

T_7 - 40 per cent RDF + Azotobacter + PSB 5 kg each ha^{-1}

T_8 - 80 per cent RDF + Azospirillium +Azotobacter + PSB 5kg each ha^{-1}

T_9 - 60 per cent RDF + Azospirillium + Azotobacter + PSB 5kg each ha^{-1}

T_{10} - 40 per cent RDF+ Azospirillium + Azotobacter PSB 5 kg each ha^{-1}

Well decomposed farm yard manure @ 20 t ha^{-1} was applied at the time of land preparation. Biofertilizers viz., Azospirillium, Azotobacter and PSB were applied @ of 5 kg ha^{-1} in the soil at the time of transplanting. Annual Chrysanthemum var. Local was transplanted at 45 x 30 cm spacing in flat bed on 17/10/2005. The inorganic chemical fertilizers as per treatment were applied through urea, single super phosphate and murate of potash. The observations on growth parameters, dry matter production and yield of flowers were recorded

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Table 1. Effect of bio-inoculants with graded doses of NPK on growth, dry matter production and yield of flower.

Treatments	Height of plant (cm)	Basal Diameter of main stem (cm)	No. of primary branches plant^{-1}	No. of leaves plant^{-1}	Spread of plant (cm)	Fresh Weight		Dry weight		Dry matter	Yield qt. ha^{-1}
						Shoot (g)	Root (g)	Shoot (g)	Root (g)	(g)	
T1	97.97	2.49	25.22	576.72	59.29	1003.5	114.83	319.50	32.70	352.2	115.08
T2	99.83	2.54	25.16	578.25	59.59	1008.7	118.47	323.20	35.50	358.7	121.11
T3	97.13	2.39	23.90	574.85	58.36	992.6	105.07	302.90	30.30	331.47	110.62
T4	93.96	2.14	21.49	570.99	56.47	977.35	96.40	285.40	24.70	310.10	95.23
T5	97.30	2.41	24.17	575.65	58.93	995.50	106.43	309.50	31.90	341.40	113.82
T6	96.20	2.27	22.93	573.65	57.68	985.30	101.27	294.90	26.50	321.40	101.11
T7	94.67	2.16	22.10	571.92	57.35	980.40	97.43	287.10	25.90	313.00	96.05
T8	100.70	2.69	26.86	578.99	59.91	1011.50	120.0	335.70	45.00	380.70	125.18
T9	96.23	2.29	23.41	573.89	58.31	988.75	103.23	297.70	28.90	326.43	106.79
T10	94.90	2.19	22.73	572.42	57.35	982.30	98.30	291.50	26.95	318.45	96.91
F Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
S.E. ± (m)	0.221	0.033	0.290	0.681	0.081	0.941	0.507	0.727	0.788	1.404	3.191
C. D. at 5%	0.657	0.098	0.861	2.024	0.242	2.797	1.507	2.162	2.341	4.171	9.482

and presented in Table 1. The presented data were analysed statistically for representing the results.

RESULTS AND DISCUSSION

Growth parameters

The data on vegetative growth viz., height of plant, diameter of main stem, number of primary branches plant^{-1}, number of leaves plant^{-1}, spread of plant are presented in Table 1. The results indicated that combined application of inorganic chemical fertilizers with bio-innoculats significantly influenced the vegetative growth parameters. Significantly the maximum plant height (100.70 cm) and diameter of main stem (2.69 cm) were recorded by application of 80 per cent RDF + Azospirillium + Azotobacter + PSB 5 kg each ha^{-1} (T_8), closely followed by treatments T_2 (99.83cm and 2.54 cm respectively) and T_1 (97.97 cm and 2.49 cm, respectively). However, significantly the minimum plant height (93.96 cm) and diameter of main stem (2.14 cm) were recorded by the application of treatment 40 per cent RDF + Azospirillium + PSB 5 kg each ha^{-1} (T_4). Similar results were reported by Kulkarni (1990) and Swaminathan *et al.* (1999). Significantly maximum number of branches plant^{-1} (26.86) and maximum number of leaves plant^{-1} (578.99) were produced by treatment receiving 80 per cent RDF + Azospirillum + Azotobacter + PSB 5 kg each ha^{-1}(T_8), but they were found to be statistically at par with treatments T_2 and T_1. However, significantly minimum number of branches (21.49) plant^{-1} and minimum number of leaves (570.99) plant^{-1} were noted by treatment receiving 40 per cent NPK + Azospirillium + PSB 5 kg each ha^{-1} (T_4). As regards to the spread of plant, significantly the maximum spread of plant (59.91cm) was recorded in treatment T_8, closely followed by treatments T_1 (59.29) and T_2. The data clearly indicated that biofertilizers along with graded doses of NPK has positive role on growth parameters. This might be due to nitrogen fixing ability of *Azospirillium* and *Azotobacter* and ability of PSB to mobilize phosphorus, making these elements available for plant growth and development. Similar results under different treatments were reported by Chandrikapure *et al.* (1999) in Marigold and Rathod *et al.*(2002) in Gaillardia.

Fresh and dry weight of shoot and root: Data in respect of fresh weight of shoots and root plant^{-1} were found to be significantly influenced by bio-innoculant along with graded doses of NPK. Significantly the maximum fresh weight of shoot (1011.50g) and fresh weight of root (120.0 g) were recorded by the treatment T_8 followed by treatments T_2 (1008.7 g) and T_1 (1003.5 g). Significantly the maximum dry weight of shoot (335.70 g) and dry weight of root (45.00 g) were obtained by treatment T_8 followed by treatments T_2 and T_1. This might be due to the facts that, plants receiving 80 per cent RDF + Azospirillium + PSB 5 kg each ha^{-1} had produced more vegetative growth due to an increase in nitrogen application through inorganic fertilizer and biofertilizers. More the vegetative growth, more will be the fresh weight and dry weight of shoot and root plant^{-1}. Similar results under combination of different fertilizer and biofertilizer treatments were reported by Prabhu *et al.* (2002).

Total dry matter production: The total dry matter production plant^{-1} was influenced significantly by the different treatments (Table-1). Significantly the maximum total dry matter plant^{-1} (380.70 g) had recorded in treatment T_8, followed by treatments T_2 (358.7 g) and T_1 (352.2 g). This might be due to the fact that the adequate supply of nutrients would have resulted into an increase in vegetative growth and thus had produced maximum total dry matter of the plants. The results are in close agreement with the findings of Anuradha *et al.*(1988) and Gadagi *et al.* (2004) in Gaillardia.

Flower yield: An application of nutrients through biofertilizers and inorganic fertilizers showed significant results on ha^{-1} yield of flowers (Table 1). Significantly the maximum ha^{-1} yield of flower (125.18 q) was obtained from treatment T_8 (80 per cent RDF+ Azospirillium + Azotobacter + PSB 5 kg each ha^{-1}), which was closely followed by the treatments T_2 (121.11 q) and T_1 (115.08 q). This might be due to adequate supply of nutrients through bio-innoculants with graded doses of inorganic fertilizers. An increased vegetative growth might have been helpful in increasing number and weight of flowers plant^{-1} These findings are in agreement with Rathod *et al.* (2002) in Gaillardia, Wange and Patil (1994) in Tuberose and Chandrikapure *et al.* (1999) in Marigold.

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Assessment of Biotic Key Mortality Factors in the Various Larval Stages of *Helicoverpa armigera* on Cotton

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ABSTRACT

The study of key biotic mortality factors in different larval stages of *H. armigera* under field conditions were conducted by collection and rearing of different larval stages, weekly, started from 30 days after germination of cotton crop. The mortality of I age group i.e. I to III instar larvae due to biotic factors was in the range of 7.69 to 26.6 per cent and it includes four parasitoids viz., *Tachnids* (7.69 -13.33 %); *Ichneumonids* (10 - 16.6 %); *Apanteles* sp. (5-1.11 %) and *Eriorus* sp. (13. 31 %). There were two peaks of parasitoids i.e. in 37th and 40th M.W. (10 - 16 Sept. and 1 - 7 Oct.) This I age group was found to be most preferred by parasitiods. However, only one parasitoid i.e. *Tachnid* sp. was found active to cause mortality in II age group (IV and V instar) larvae to the extent of 7.69 to 11.76 per cent during 39th to 41st Mw (24 Sept, to 14 Oct.). The average mortality rate was 0.30 in I age group and 0.09 in II age group *of H. armigera* larvae. From these studies it may be concluded that, the I to III instar larvae (I age group) was preferred by parasitoid than IV and V instar larvae.

Cotton, the well known 'White gold', occupies place of pride amongst the cash crop of Indian Agriculture, in general, and Vidarbha, in particular. Among the causes of low productivity of cotton in India, the damage caused by *H. armigera* is most threatening to the cultivation of the cotton crop. Till now chemical insecticides "i are mainly used for the control of this pest. Hence, substitute for chemicals in pest management is a time need.

Some work on its biological management is carried out by various workers and noticed that this pest is naturally killed by number of parasitoid on cotton viz., *Campoletis chloridae, Carcelia illota, Trichogramma chilonis* Ishii, *Apanteles* sp., *Eriborus argentiopilosus* etc.; (Sivaprakasan *et. al.*, 1986, Nikam 1990, Mishra *et al.* (1992). Hence, the present study was undertaken with the objective^ to study the different biotic key mortality factors in larvae stages *of H. armigera* under field condition.

MATERIAL AND METHODS

The research work was carried out during 2003 - 04 on the experimental field of Cotton Research Station and in the Biotechnology Laboratory of Department of Entomology, Dr. PDKV, Akola. The material required for the study were made available by the Department of Entomology, Dr. PDKV, Akola.

Observations on larval count and its per cent parasitization was recorded regularly at weekly interval from 30 days after germination of the crop sown unreplicated. For the purpose of sampling I, II and III larval instars were considered as I age group and 4th and 5th instars were considered as II group.

The larvae belong to I age group i.e. I to III instars and II age group i.e. IV and V instars were counted and collected from 25 plants. Collection was done by taking more than 20 larvae in each age group. Each larvae was kept in the glass tube having moist soil in laboratory till their pupation. Number of larvae died during was recorded and the cause of death was ascertained.

RESULTS AND DISCUSSION

A. Study of biotic key mortality factors in I age group (I to III instar) larvae of *H. armigera*

The data presented in Table 1 indicated that the incidence of *H. armigera* larvae was observed on cotton crop from 36 to 43 MW (3 Sept. to 28 Oct.). However, the highest population of larvae i.e. 47 larvae 25 plants^{-1} were observed in 38th MW (17-23 Sept.) and lowest i.e. 11

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Table 1: Life stages study: Survival and Mortality in I" to III[rd] instar larvae

X	Met. Week	Period of Week	(TL1)	Lx	dx	dxf	100qx	Sx	Remark
Larvae	33	13-19 Aug.	—	—	—	—	—	—	—
	34	20-26 Aug	—	—	—	—	—	—	—
	35	27-2 Sept	—	—	—	—	—	—	—
	36	3-9 Sept.	15	8	1	Tachinid(l)	12.5	0.88	12.5% par
	37	10-16 Sept	17	15	7	Tachinid (2)	46.66	0.53	13.3% par
						Eriborus(2)			13. 3% par
						Other reason (3)			20% by other reason
	38	17-23 Sept.	47	20	8	Tachinid (2)	40.00	0.60	10% par
						Ichneumonides(2)			10% par
						Apanteles (1)			5% par
						Other reason (3)			15% by other reason
	39	24-30 Sept.	27	20	6	Ichneumpnides(3)	30.00	0.70	15% par
						Apanteles (1)			5% par
						Other reason (2)			10 %by other reason
	40	1-7 Oct.	16	12	5	Tachinid (1)	41.66	0.58	8.33%par
						Ichneumonides(2)			16.6% par
						Other reason (3)			16.6% by other reason
	41	8-14 Oct.	11	9	3	Tachinid (1)	33.33	0.67	11. 11% par
						Apanteles (1)			11. 11% par
						Other reason (3)			11. 11% par by other reason
	42	15-21 Oct.	24	20	3	Ichneumonides(2)	15	0.85	10% par
						Other reason (3)			5% by other reason
	43	22-28 Oct.	17	13	2	Tachinid (1)	15.38	0.85	7.69% par
						Other reason (3)			7.69% by other reason
	44	29-4 Nov.	—	—	—'	—	...	—	--
	45	5-1 1 Nov.		~	—	—	—	—	--
	46	12-1 8 Nov	—	~	—	..	—	—	--
		Subtotal		117	35		29.90	0.70	

X - Age interval

TL1 - Total number of larvae recorded on 25 plants

Lx - Number of individuals alive at the beginning of age interval X

dx - Number of individuals died during age interval X

dxf - Mortality factor for dx

l00qx - % Mortality in X

Sx - Survival rate within X

Par – Parasitization

larvae per 25 plants was noticed in 41st MW (8 - 14 Oct.). No larvae of this age group was noticed during 33rd to 35th MW (13 Aug. to 2 Sept.) and 44th to 46th MW (29 Oct. to 18 Nov.).

However, regarding the mortality of I to III instar larvae of *H. armigera,* it is found that the larvae of this I age group, collected from field and reared in laboratory were parasitized by four different types of parasitoids viz., *Tachnids, Eriborus* sp., *Ichneumonid* sp. and *Apanteles* sp. the highest parasitization was found in the 37th MW (26.66 %), followed by 25 per cent in 38th MW; 24.93 per cent in 40th MW; 22.22 per cent in 41st MW; 20 per cent in 39th MW; 12.5 per cent in 36th MW; 10 per cent in 42 MW and lowest 7.69 per cent in 43rd MW. While the average mortality noticed in I age group larvae was 29.90 per cent with 0.70 survival rate.

The *Tachinid* was found prominently active and effective throughout the larval period i.e. from 36th MW to 43rd MW except 39th and 42nd MW, recording the larval mortality to the tune of 7.69 to 13.33 per cent.

The second prominent parasitoid found was *Ichneumonid,* which was found effective during 38th, 39th, 40th and 42nd MW, recording 10 to 16.66 per cent mortality. The highest mortality (16.6 %) was recorded in the 40th MW while lowest (10%) in 38th and 42nd MW.

The forth parasitoid recorded was *Eriborus* sp. and was active in 37th MW recording as high as 13.33 per cent larval parasitization.

Whereas, the mortality due to other unknown reasons was in the range of 5 to 20 per cent and was recorded during 37th to 43rd MW.

More or less similar results were also obtained by Bilapate *et al.* (1988), Tripathi and Sharma (1984)T Koshiya and Patel (1987)' which conforms the present results.

B. Study of biotic key mortality factors in II age group (IV and V Hnstars) larvae of *H. armigera*

The data presented in Table 2 indicated that the IV and V instar of *H. armigera* larvae was observed On cotton from 39th MW to 42nd MW (24 Sept. to 21 Oct.). However, the highest population i.e.19larvae 25 plants^{-1} was noticed in 41st MW (8 - 14 Oct.) and lowest (13 larvae 25 plant^{-1}) in 39th MW (24 - 30 Sept.).

The II age group of *H. armigera* larvae collected from cotton field was found parasitized by only one parasitoid i.e. *Tachinid* in the range of 7.69 to 11.76 per cent when reared in the laboratory.

However, maximum parasitization of field collected *H. armigera* larvae due to *Tachinid was* observed during 41st MW (8-14 Oct.) i.e. 11.76 per cent, followed by 9.09 per cent in 39th MW (24 - 30 Sept.) and 7.69 per cent in 40th MW (1-7 Oct.).

The larval mortality due to unknown factors was 7.14 per cent in 42nd MW (15 - 21 Oct.) might be due to some weather parameters. The average mortality noticed during the period was 9.09 per cent with a survival rate of 0.91 as against the value of'x'.

From this study, it can be concluded that I and III instar i.e. first age group of larvae of *H. armigera* was found to be more preferred by parasitoids of four groups causing as high as 26.6 per cent mortality during 37th MW (10-16 Sept.) and continued till 43rd MW (22-28 Oct.) with an reduced rate of mortality. Hence, the I to III instar larvae is the weak link of the life cycle *of H. armigera* so far as parasitoids are concerned. Therefore, this information is very important while planning biological management of *H. armigera.*

Mortality of *H. armigera* to the extent of 5 to 7.69 per cent by *Tachnids* is reported (Anonymous, 2003). Tripathi and Sharma (1984) noticed *Tachnidperiseae* as a main larval parasite of *H. armigera* recording 15-20 per cent parasitization, which justify the results of the present findings.

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Table 2: Life stages study: Survival and Mortality in IVth and Vth insUr larvae

X	Met. Week	Period of Week	(TL1)	Lx	dx	dxf	100qx	Sx	Remark
Pre-pupae	33	13-19 Aug	--	--	--	--	---	--	--
	34	20-26 Aug.	--	--	--	--	---	--	--
	35	27-2 Sept.	--	--	--	--	---	--	--
	36	3-9 Sept.	--	--	--	--	---	--	--
	37	10-16 Sept.	--	--	--	--	---	--	--
	38	17-23 Sept.	--	--	--	--	---	--	--
	39	24-30 Sept.	13	11	1	Tachinid	9.09	0.91	9.09% par
	40	1-7 Oct.	17	13	1	Tachinid	7.69	0.92	7.69% par
	41	8-14 Oct.	19	17	2	Tachinid	11.76	0.88	11.76 par
	42	15-21 Oct.	19	14	1	Unknown	7.14	0.93	7.14% by other reason
	43	22-28 Oct.	--	--	--	--	--	--	--
	44	29-4 Nov.	--	--	--	--	--	--	--
	45	5-11 Nov.	--	--	--	--	--	--	--
	46.	12-18 Nov.	--	--	--	--	--	--	--
		Subtotal		55	5		9.09	0.91	

X - Age interval
TL1 - Total number of larvae recorded on 25 plants
Lx - Number of individuals alive at the beginning of age interval X
dx - Number of individuals died during age interval X
dxf - Mortality factor for dx
100qx - % Mortality in X
Sx - Survival rate within X
Par – Parasitization

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Dual Resistance Against Pests and Diseases in Pigeonpea

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ABSTRACT

The study on dual resistance against pests i.e. pod borer, *Heliocoverpa armigera* (Hubner) , tur plume moth, *Exelatis atomosa* (Walshinghum) and tur pod fly, *Melanagromyza obtusa* (Malloch) and diseases i.e. *Fusarium* wilt and sterility mosaic virus in pigeonpea was undertaken during 2003-04 to 2005-06. The results indicated that the genotypes PT-8208-1 and PT-9230 had dual resistance against the pests and diseases.

Pigeonpea (*Cajanus cajan* (L.) Millsp.) is one of the pulse crop grown in India. In Maharashtra, it is cultivated on 8.30 lakh ha area and production of 4.66 lakh tones with productivity 562 kg ha^{-1} (Anonymous, 2005). Among the biotic factors responsible for lower yield of pigeonpea, incidence of pests and diseases are considered to be the most important. Pod borers comprise lepidopteran borers i.e. pod borer, *Heliocoverpa armigera* (Hubner) and tur plume moth, *Exelatis atomosa* (Walshinghum) and tur pod fly, *Melanagromyza obtusa* (Malloch) and diseases like *Fusarium* wilt and sterility mosaic virus are the major yield reducing factors in pigeonpea. In India, the total pod damage due to pest borer complex has been reported 33.8 to 49.9 per cent (Vishwa Dhar *et al.*, 2005). In Maharashtra, *F.udum* causes 15 to 20 per cent grain yield losses (Nene *et al.*, 1989) , Sterility mosaic is reported to be virus spread by *Eriophyd* mites, *Aceria cajani* and causes yield losses up to 95 per cent in South India (Reddy and Nene, 1981). Zote *et al.*, (2002) reported 47 per cent incidence of sterility mosaic on farmer's field in Ahmednagar district of Maharashtra. Host plant resistance as a major component of IPM, it is chief, non-polluting and compatible with other methods of pest control (Sachan, 1990). While reviewing the literature, no information available on dual resistance against pests and diseases infesting on pigeonpea. Therefore, considering the severity of pests and diseases on this crop, the study was undertaken.

MATERIAL AND METHODS

Pigeonpea genotypes were screened for their reaction to pests (10 genotypes) and diseases (12 genotypes) during *Kharif* 2003-2004 to 2005-2006 at Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra). The genotypes which was initially exhibited resistance/ moderately resistance against pests i.e.lepidopteran borers and pod fly and diseases *viz*., wilt and sterility mosaic were grown in a two row of 4 m length with two replications.The check ICPL-87 was grown for confirmatory test against these pests under natural field conditions for conducive infestation against pod borers. For assessment of borer damage was recorded on five randomly sampled plants at the time of harvest by counting the total number of healthy and damaged pods. From which per cent pod damage was calculated and these percentage were further converted into pest susceptibility rating (PSR). Similarly, pest susceptibility rating (1-9 scale) for individual genotypes has been worked out based on the formula suggested by Abbott (1925).

$$\text{Pest Susceptibility Rating} = \frac{\text{Pod damage in check - pod damage in genotypes}}{\text{Pod damage in check}} \times 100$$

The same genotypes were screened for *Fusarium* wilt in artificially wilt sick plot and for sterility mosaic disease used infector row technique having plot

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size 5x3 m with two replications at the spacing 45x15cm during *Kharif* season of 2003-04 to 2005-06 at above project. All the cultural practices except plant protection measures carried out to raise the crop. The wilt susceptible check ICP-2376 was sown intermittently after every two test entries. Similarly, the sterility mosaic susceptible check ICP-8863 (Maruti) was sown as an infector, alternatively after every two test entries to ensure high disease pressure and monitor the disease on various test entries. The observations on number of plants wilted in each line were recorded from 45 days after sowing upto harvesting. The incidence of sterility mosaic disease was recorded before flowering; at flowering and physiological maturity of the crop (Nene and Reddy,1976). The per cent incidence of the disease was calculated and the genotypes were graded on the basis of disease reaction categories. The disease reaction categories are of resistant (0 to 10%), moderately resistant (10.1 to 20.0%), susceptible (20.1 to 50.0%) and highly susceptible (50.1 to 100%).

RESULTS AND DISCUSSION

Pod damage

The lepidopteran pod borers damage data (Table 1) revealed that the pod damage among the test genotypes was ranged from 18.04 per cent in PT-9230 to 32.75 per cent in ICPL-87. From the pest susceptibility rating, the genotypes PT-1037, PT-8208-1, PT-9230, BSMR-736, and BSMR-853 recorded PSR 4 and were most promising against lepidopteran pod borers, whereas, remaining genotypes found to be promising as against check ICPL-87 and scored PSR-5.

The pod fly damage was ranged between 23.24 per cent in PT-9230 to 41.95 per cent in BSMR-853. On the basis of pest susceptibility rating, only two genotypes of PT-8208-1 and PT-9230 are most promising against pod fly and scored under PSR 4. Rests of the genotypes had PSR above 6 and are more susceptible than check ICPL-87.

Disease reaction

The genotypes *viz*, PT-1037, PT-8208-1, PT-25-6, PT-9230 and BSMR- 853 were resistant whereas BDN-2070, BSMR-736 and ICPL-87119 were moderately resistant to *Fusarium* wilt.The genotypes *viz*., PT-1037,PT-8208-1, BDN-2010, BSMR-736, BSMR-853 and ICPL-87119 were resistant while PT 25-6 and PT-9230 are moderately resistant to sterility mosaic. The genotypes i.e. PT-1037, PT-8208-1 and BSMR-853 had combine resistance against *Fusarium* wilt and sterility

Table 1: Field reaction of pigeonpea genotypes against pests and diseases (2003-04 to 2005-06).

S. N.	Genotypes	*Pod damage (%)		PSR		Disease incidence (%)	
		Pod Borers	Pod fly	Pod Borers	Pod fly	Wilt	Sterility mosaic
1	PT-1037	18.06	30.22	4	6	8.12	7.22
2	PT-8208-1	22.47	23.91	4	4	9.63	6.91
3	PT-25-6	25.04	31.34	5	6	8.66	15.54
4	PT-9230	24.14	23.24	4	4	8.49	14.14
5	BDN-2010	27.54	37.75	5	7	12.41	5.53
6	BSMR-736	24.19	35.08	4	6	19.51	8.04
7	BSMR-853	21.71	41.95	4	8	7.72	7.23
8	ICPL-87119	26.47	36.83	5	7	15.65	9.66
9	AKT-8811	28.23	37.22	5	7	75.92	54.67
10	ICPL-87 (Pod borers check)	32.75	31.99	6	6	60.40	54.64
11	ICP-2376(Wilt check)	-	-	-	-	100.00	42.02
12	ICP-8863 (SM check)	-	-	-	-	27.62	100.00

* - Mean of three years PSR - Pest Susceptibility Rating

mosaic disease. Similar results were reported by Zote and Dhatraj (2002) showing BSMR 853 cultivar of pigeonpea had multiple disease resistance against *Fusarium* wilt and sterility mosaic.

The per cent incidence of *Fusarium* wilt and sterility mosaic virus on ICP-2376 and ICP-8863 was 100 per cent, respectively during the study.

The results clearly indicated that the pigeonpea genotypes PT-8208-1 and PT-9230 had dual resistance and had high degree of resistance against pests i.e. pod borer complex and diseases i.e. wilt and sterility mosaic virus. Therefore, these genotypes can be used for further pigeonpea breeding programme.

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Evaluation of *Trichogramma* Spp. Against Eggs of *Papilio demoleus* Linn.

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ABSTRACT

Laboratory study was carried out at Project Directorate of Biological Control during the month of November, 2003. Out of four *Trichogramma* species screened viz., *T. chilonis, T. evanescens, T. pretiosum T. brasiliense* against eggs of *Papilio demoleus*, *T. chilonis*(73.33%) and *T. evanescens* (69.63%) had maximum egg parasitising efficacy irrespective of the egg density in comparison to *T. brasiliense* (51.11%) and *T. pretiosum* (45.18%). All the four Trichogramma species parasitised 100 per cent eggs when a single egg of *P. demoleus* was exposed per female. However, decreased parasitizing trend was noticed with increased density of eggs. Emergence period was more in *T. chilonis* (8.3days) and lowest in *T. brasiliense* (7.8 days). *T. evanescens* produced maximum (13.1) adults, followed by *T. chilonis* (12.4 adults). Higher per cent female progeny was from *T. brasiliense*(78.05%), followed by *T. chilonis* (72.04%). Significantly more longevity noticed in *T. chilonis* (8.4 days) when fed with 40 per cent honey streak.

Citrus is one of the important horticultural crops of India and area under citrus plantation is increasing year after year. However, problem of citrus decline has been associated with this crop since its interception. Pest incidence is one of the major factors for this syndrome. Among *Papilio* spp. *Papilio demoleus* and *P. polytes* Linn. are known to be widely distributed through out India, while *P. polymnester* and *P. helenus* are confined to sub mountain areas with milder climate. Out of these *P. demoleus* is a key pest of citrus in India, caterpillars of this butterfly feed on the foliage and cause extensive damage in citrus nurseries, young plants and tender flushes of the grown up plant. Serious out breaks of *P. demoleus* have been recorded in Madhya Pradesh in 1940 and 1941 (Sontakay, 1943) and in 1969 on Bhera, *Chloroxylon sweetenia* in Vidarbha region of Maharashtra (Thakare and Borle, 1974). The pest is active throughout the year except during severe winter. Peak activity coincides with emergence of new flush. In the case of severe infestation the entire tree gets defoliated.

A number of natural enemies namely, *Trichogramma chilonis, Telenomus* spp., *Ooencyrtus* spp. etc., were recorded by earlier workers (Pruthi and Mani, 1945; Singh, 1980, 1985, 1991; Krishnamoorthy and Singh, 1986; Krishnamoorthy, 1987 and Jalali and Singh, 1990)in India. Moreover, earlier research has been confined to recording natural parasitism and associated parasitoids only. However, no efforts have been made to evaluate different species of *Trichogramma* against this pest.

Various egg parasitoids of *Papilio* spp. viz., *Trichogramma chilonis*, *Telenomus* sp., *Ooencyrtus papilionis* (Jalali and Singh,1990) are playing an important role in suppression of the pest in the nature, but effectiveness of different *Trichogramma* spp., which is a dominant parasitoid has not been tested so far, under laboratory conditions. Taking into consideration the above finding, a need to study parasitizing efficacy of different *Trichogramma* species, present investigations were carried out at PDBC, Bangalore.

MATERIAL AND METHODS

Following species of *Trichogramma* were procured from *Trichogramma* mass production unit, PDBC, Bangalore for conducting the experiment.

1. *Trichogramm chilonis*
2. *Trichogramma evanescens*
3. *Trichogramma pretiosum*
4. *Trichogramma brasiliense*

Methodology and Observations

Experiment was conducted by following split plot experimental design.

Experimental design	:	FCRD
Replications	:	Three
Treatments	:	Main treatments - Four
		Sub treatments - Three

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Main treatments	Sub treatments (No. of eggs exposed female^{-1})		
T_1- *T. chilonis*	1 egg	3 eggs	5 eggs
T_2- *T. evanescens*	1 egg	3 eggs	5 eggs
T_3- *T. pretiosum*	1 egg	3 eggs	5 eggs
T_4- *T. brasiliense*	1 egg	3 eggs	5 eggs

Fresh eggs of *Papilio demoleus* were obtained from butterfly rearing unit, GKVK (UAS), Bangalore. Egg cards were prepared and kept in glass tubes (15x2.00 cm) with providing 40 per cent honey streak. A single mated female was released into the tube containing egg cards for parasitisation. Each treatment was replicated thrice. After exposing the eggs upto 24 h. for oviposition the eggs were removed out and kept individually in small vials (5.00x1.2cm) and the following observations were recorded.

1. Per cent parasitisation
2. No. of adults emerged egg^{-1}
3. Sex ratio (per cent female progeny)
4. Days to adult emergence
5. Adult longevity

RESULTS AND DISCUSSION

1. Per cent egg parasitisation

Data presented in Table 1 revealed that irrespective of the egg density, *Trichogramma chilonis* (73.33%) and *T. evaescens* (69.63%) had maximum egg parasitizing efficacy and they were on par. The parasitism by these two species was significantly different from the other two parasitoids viz., *T. brasiliense* (51.11%) and *T. pretiosum* (45.18%).

Krishnammoorthy and Singh (1986) and Mani (2001) have already described the efficacy of *T. chilonis*. Beside this *T. evanescens* emerged as a next promising egg parasitoid of *Papilio demoleus* as regards to per cent parasitisation during the present study. All the *Trichogramma* species tested parasitised 100 per cent eggs when a single egg of *Papilio demoleus* was exposed female^{-1}. However, decreased parasitizing trend was noticed with increased density of eggs and parasitism was at par (44.44 and 34.99%), when 3 eggs and 5 eggs were exposed female^{-1}, respectively.

Interaction between *Trichogramma* species and egg density indicated that all the parasitoids gave 100 per cent parasitisation when a single egg was exposed, whereas *T. chilonis* (66.67 and 53.33%) and *T. evanescens* (55.56 and 53.33%) parasitised significantly more in comparison to *T. pretiosum* (22.22 and 13.33%) and *T. brasiliense* (33.33 and 20.00%).

2. Average emergence period (Days)

Data presented in Table 2 revealed that developmental period (egg laying to adults emergence) was significantly more in *T. chilonis* (8.3 days) and *T. evanescens* (8.1days) as compared to other two species *T. pretiosum* and *T. brasiliense* (7.8 days). The developmental period was significantly more (8.2 days)

Table 1: Per cent egg parasitisation as influenced by *Trichogramma* spp. and egg density of *P. demoleus*

Trichogramma spp	Number of eggs exposed for parasitisation			
	1 egg female^{-1}	3 eggs female^{-1}	5 eggs female^{-1}	Mean
T. chilonis	100	66.67	53.33	73.33
	(90.00)^{a}	(54.74)^{b}	(46.92)^{bc}	(63.89)^{a}
T. evanescens	100	55.56	53.33	69.63
	(90.00)^{a}	(48.25)^{bc}	(46.92)^{bc}	(61.72)^{a}
T. pretiosum	100	22.22	13.33	45.18
	(90.00)^{a}	(23.51)^{de}	(17.71)^{e}	(43.74)^{b}
T. brasiliense	100	33.33	20.00	51.11
	(90.00)^{a}	(35.26)^{cd}	(26.57)^{de}	(50.61)^{b}
Mean	100	44.44	34.99	
	(90.00)^{a}	(40.44)^{b}	(34.53)^{b}	
	Trichogramma spp.	Egg numbers	Interaction	
SE (m) ±	2.82	2.45	4.90	
CD at 5%	8.26	7.15	14.30	

Table 2: Average emergence period (days) as influenced by *Trichogramma* spp. and egg density of *P. demoleus*

Trichogramma spp	Number of eggs exposed for parasitisation			
	1 egg female^{-1}	3 eggs female^{-1}	5 eggs female^{-1}	Mean
T. chilonis	8.5	8.2	8.3	8.3^{a}
T. evanescens	8.2	7.3	7.8	8.1^{ab}
T. pretiosum	7.5	7.7	8.2	7.8^{ab}
T. brasiliense	7.5	7.5	8.5	7.8^{ab}
Mean	7.9^{ab}	7.7^{ab}	8.2^{a}	
	Trichogramma spp.	Egg numbers	Interaction	
S E (m) ±	0.14	0.12	-	
CD at 5%	0.40	0.35	NS	

Table 3: Number of adult emergence from a single egg as influenced by *Trichogramma* spp. and egg density of *P. demoleus*

Trichogramma spp	Number of eggs exposed for parasitisation			
	1 egg female^{-1}	3 eggs female^{-1}	5 eggs female^{-1}	Mean
T. chilonis	13.7	12.3	11.3	12.4^{a}
T. evanescens	14.0	13.7	11.7	13.1^{a}
T. pretiosum	10.0	6.3	6.0	7.4^{b}
T. brasiliense	10.7	10.3	10.0	10.3^{a}
Mean	12.1	10.6	9.7	
	Trichogramma spp.	Egg numbers	Interaction	
SE (m) ±	0.89			
CD at 5%	2.57	NS	NS	

when 5 eggs were exposed per female in comparison to 7.9 days when single egg was exposed per female.

3. Average number of adult emerged

Data presented in Table 3 indicated that *T. evanescens* (13.1 adults) and *T. chilonis* (12.4 adults) and *T. brasiliense* (10.3 adults) produced significantly more adults egg^{-1} of *Papilio demoleus* in comparison to *T. pretiosum*. However, there was no significant difference amongst density of eggs when exposed to parasitoids, ranged from 12.1 adults in case of 1egg female^{-1} and 9.7 adults in case of 5 eggs female parasitoid. Krishnamoorthy and Singh (1986) recorded 8-27 adults of *T. chilonis* from a single parasitized egg of *Papilio* spp.

4. Per cent female progeny of parasitoids

Data presented in Table 4 revealed that significantly higher per cent female progeny was observed in *T. brasiliense* (78.05%), followed by *T. chilonis* (72.04%) and *T. evanescens* (69.83%) than *T. pretiosum* (52.08%). However, density of eggs of *Papilio demoleus* did not show significant effect on per cent female progeny of parasitoids ranged, which from 65.11-72.93 per cent. The sex ratio (Male:Female) was found to be 1:7.06 which equal to 87.59 per cent female progeny in case of *T. chilonis*. Krishnamoorthy and Singh (1986) reported 87.59 per cent female progeny in case of *Trichogramma chilonis* which is more or less in the tune of present investigation.

5.Adult longevity

Data presented in Table 5 revealed that adult of *T. chilonis* survived significantly for about 8.4 days, when fed with 40 per cent honey streak than *T. evanescens* (7.8 days), *T. pretiosum* (7.3 days). Lowest longevity was observed in *T. brasiliense* (7.1 days) but it was on par with longevity of *T. pretiosum*. Irrespective of species, significantly higher longevity was noticed (8.1days) when a single egg was exposed for parasitisation than 3 eggs female^{-1} (7.6 days) and 5eggs female^{-1} (7.2 days). Krishnamoorthy and Singh (1986) reported 6.9 days of longevity in *T. chilonis* when fed with 40 per cent honey diet.

Table 4: Per cent female progeny as influenced by *Trichogramma* spp. and egg density of *P. demoleus*

Trichogramma spp	Number of eggs exposed for parasitisation			
	1 egg female^{-1}	3 eggs female^{-1}	5 eggs female^{-1}	Mean
T. chilonis	72.49	71.82	71.82	72.04
	(58.37)	(57.95)	(57.95)	(58.09)^a
T. evanescens	71.89	69.35	68.25	69.83
	(58.00)	(56.40)	(55.72)	(56.71)^a
T. pretiosum	66.23	46.15	44.45	52.28
	(54.53)	(37.54)	(36.49)	(42.85)^b
T. brasiliense	81.11	77.12	75.92	78.05
	(64.39)	(61.44)	(60.66)	(62.16)^a
Mean	72.93	66.11	65.11	
	(58.82)	(53.33)	(52.10)	
	Trichogramma spp.	Egg numbers	Interaction	
SE (m) ±	4.39			
CD at 5%	12.84	NS	NS	

Table 5: Adult longevity (Days) as influenced by *Trichogramma* spp. and egg density of *P. demoleus*

Trichogramma spp	Number of eggs exposed for parasitisation			
	1 egg female^{-1}	3 eggs female^{-1}	5 eggs female^{-1}	Mean
T. chilonis	9.0	8.5	7.7	8.4a
T. evanescens	8.5	7.5	7.3	7.8b
T. pretiosum	7.5	7.3	7.0	7.3c
T. brasiliense	7.3	7.2	6.8	7.1c
Mean	8.1a	7.6bc	7.2bc	
	Trichogramma spp.	Egg numbers	Interaction	
S E (m) ±	0.16	0.14		
CD at 5%	0.48	0.42	NS	

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Efficacy of Newer Insecticide Lepimectin Against Cotton Bollworm Complex

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ABSTRACT

The experiment was conducted in *Kharif* 2004-2005 at Cotton Research Station, Nanded under jurisdiction of Marathwada Agriculture University, Parbhani (M.S.) on well drained black cotton soil to evaluate the efficacy of bio-rational insecticide E-237 (Lepimectin) with different doses against cotton bollworm complex. In field testing of E-237 (Lepimectin), Lepimectin 1 per cent EC 60 g a.i. ha^{-1} was found most effective in reducing larval population infestation of bollworm in square and boll damage. The lowest infestation in locule was observed in Lepimectin 1per cent EC 60 g a.i. ha^{-1}, which was at par with Lepimectin 1per cent EC 30 g a.i. ha^{-1}. The significantly lowest bad kapas was recorded in Lepimectin 1per cent EC 60 g a.i. ha^{-1}, followed by Lepimectin 1per cent EC 30 g a.i. ha^{-1}. The highest seed cotton yield (810 kg/ha) was obtained from plots sprayed with Lepimectin 1per cent EC 60 g a.i. ha^{-1} and was at par with Lepimectin 1per cent EC 30 g a.i. ha^{-1} (802 kg ha^{-1}).

Insect pests play a major role in the low productivity of cotton in India. Important insect pests of cotton crop causing serious losses are sucking pests and bollworm complex. Sucking pests attack the crops in early vegetative stage of the crop, while cotton bollworms, viz., American bollworm, spotted bollworm and pink bollworm are most serious pests of cotton in reproductive stage (Sharma and Jalan, 1997). The cotton bollworms are very serious and destructive insect pest causing damage to the extent of 36.2 per cent and also affect fiber and seed quality (Singh and Lakra, 1992). The present strategy of controlling bollworms includs use of chemical insecticides which are poured every year in enormous quantity on cotton crop have not yet proved successful in controlling the menace of the bollworms in an ecofriendly manner and hence it is obligatory for the scientists to develop environmentally sound pest control techniques for management of cotton bollworms and to overcome the resistance. As well the use of biopesticides may be solace for the control of bollworms as these biopesticides would be safer to the soil, air and water sources.

MATERIAL AND METHODS

The experiment was conducted in *Kharif* season (2004-2005) at experimental field of Cotton Research Station, Nanded under jurisdiction of Marathwada Agriculture University, Parbhani (M.S.) on well drained black cotton soil to evaluate the efficacy of newer insecticide E-237 (Lepimectin) against cotton bollworm complex. The experiment was laid out in Randomised Block Design with seven treatments and three replications. The plot size was 6.0 x 4.8 m with row to row and plant to plant spacing of 60 cm. Hybrid variety of cotton NHH-44 was used for experiment. Total seven treatments including one antibiotic insecticide E-237 (Lepimectin) with five different doses i.e. 10 g, 12 g, 15 gm, 30 g and 60 g a.i. ha^{-1}, one chemical insecticide Profenofos 50 per cent EC 1000 gm a.i. ha^{-1} and untreated control were tested. The observations regarding the effect of Lepimectin on larval population of *H. armigera* were taken one day before and 3, 7, 14 days after each spraying. The observations regarding the effect of Lepimectin on per cent infestation of bollworm in squares and bolls were taken one day before and 7, 14 days after each spraying. In all two sprayings were undertaken.

RESULTS AND DISCUSSION

Larval population of *Helicoverpa armigera*

The results presented in Table 1 in respect of effect of bio-rational insecticide Lepimectin on larval population of *H. armigera* 3 days, after first spraying revealed that

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Table 1 Effect of newer insecticide lepimectin on larval population of *Helicoverpa armigera*.

S. N.	Treatments	Dose g a.i. ha^{-1}	Larval count plant^{-1}							
			After I spray				After II spray			
			1 DBS	3 DAS	7 DAS	14 DAS	1 DBS	3 DAS	7 DAS	14 DAS
1.	Lepimectin 1 per cent EC	10	7.33	2.20	2.66	3.00	3.00	2.00	2.66	2.21
			(2.79)*	(1.61)	(1.77)	(1.85)	(1.85)	(1.58)	(1.77)	(1.64)
2.	Lepimectin 1 per cent EC	12	7.00	1.73	2.33	2.33	3.00	1.72	2.33	1.96
			(2.73)	(1.48)	(1.67)	(1.65)	(1.87)	(1.46)	(1.68)	(1.56)
3.	Lepimectin 1 per cent EC	15	6.66	1.43	1.66	2.33	3.33	1.66	1.46	1.51
			(2.67)	(1.38)	(1.46)	(1.67)	(1.93)	(1.46)	(1.40)	(1.41)
4.	Lepimectin 1 per cent EC	30	7.33	1.60	1.33	2.00	3.00	1.37	1.38	1.42
			(2.79)	(1.50)	(1.34)	(1.55)	(1.85)	(1.35)	(1.37)	(1.38)
5.	Lepimectin 1 per cent EC	60	7.66	1.40	1.33	1.66	2.66	1.33	1.34	1.38
			(2.84)	(1.36)	(1.34)	(1.46)	(1.76)	(1.35)	(1.35)	(1.37)
6.	Profenofos 50 per cent EC	1000	7.33	2.33	2.33	2.66	2.66	2.10	2.76	2.33
			(2.79)	(1.63)	(1.67)	(1.73)	(1.73)	(1.61)	(1.80)	(1.68)
7.	Untreated control	--	7.33	7.00	8.00	5.33	3.00	3.00	3.66	3.33
			(2.79)	(2.73)	(2.91)	(2.41)	(1.76)	(2.11)	(2.03)	(1.95)
	SE (m) $\pm$	--	0.30	0.14	0.11	0.14	0.18	0.05	0.03	0.03
	CD at 5per cent	--	NS	0.44	0.35	0.45	NS	0.17	0.09	0.09

* Figures in parentheses are Poisson ($\sqrt{x + 0.5}$) values.

Table 2 Effect of bio-rational insecticide lapimectin on per cent infestation of bollworms in squares.

S. N.	Treatments	Dose g a.i. ha^{-1}	Per cent square damage					
			After I spray			After II spray		
			1 DBS	7 DAS	14 DAS	1 DBS	7 DAS	14 DAS
1.	Lepimectin 1per cent EC	10	8.91	5.66	8.57	16.38	14.26	15.95
			(17.35)*	(13.76)	(17.02)	(23.86)	(22.18)	(23.53)
2.	Lepimectin 1per cent EC	12	8.20	4.58	7.84	15.37	13.10	14.85
			(16.62)	(12.36)	(16.25)	(23.07)	(21.21)	(22.66)
3.	Lepimectin 1per cent EC	15	8.00	4.53	7.04	16.44	9.81	11.33
			(16.42)	(12.26)	(15.74)	(23.91)	(18.25)	(19.66)
4.	Lepimectin 1per cent EC	30	8.27	4.04	6.40	15.37	9.74	11.22
			(16.71)	(11.59)	(14.73)	(23.07)	(18.13)	(19.56)
5.	Lepimectin 1per cent EC	60	8.67	2.44	5.46	16.68	9.60	11.15
			(17.10)	(8.98)	(13.51)	(24.10)	(18.04)	(19.50)
6.	Profenofos 50per cent EC	1000	8.04	5.96	10.00	16.71	14.46	16.11
			(16.47)	(14.12)	(18.35)	(24.11)	(22.34)	(23.66)
7.	Untreated control	--	8.48	12.68	15.99	16.97	22.00	24.30
			(16.90)	(20.85)	(23.56)	(24.32)	(27.96)	(29.53)
	SE (m) ±	--	0.43	0.04	0.25	0.56	0.05	0.05
	CD at 5per cent	--	NS	0.14	0.77	NS	0.16	0.17

* Figures in parentheses are angular transformed values.

Table 3 Effect of bio-rational insecticide lepimectin on per cent infestation of bollworm in boll

S. N.	Treatments	Dose g a.i. ha^{-1}	Per cent boll damage					
			After I spray			After II spray		
			1 DBS	7 DAS	14 DAS	1 DBS	7 DAS	14 DAS
1.	Lepimectin 1per cent EC	10	6.51	5.96	6.28	7.52	10.60	10.98
			(14.78)*	(14.05)	(14.51)	(15.91)	(18.99)	(19.34)
2.	Lepimectin 1per cent EC	12	5.94	5.15	6.08	7.35	8.34	9.65
			(14.10)	(13.11)	(14.27)	(15.31)	(16.78)	(18.09)
3.	Lepimectin 1per cent EC	15	6.61	4.98	5.22	7.35	7.20	7.85
			(14.89)	(12.89)	(13.20)	(15.70)	(15.56)	(16.26)
4.	Lepimectin 1per cent EC	30	6.06	4.76	5.12	7.45	7.12	7.76
			(14.21)	(12.60)	(13.07)	(15.83)	(15.47)	(16.17)
5.	Lepimectin 1per cent EC	60	6.89	3.02	4.55	7.78	6.95	7.65
			(15.21)	(10.06)	(12.31)	(16.17)	(15.28)	(16.05)
6.	Profenofos 50per cent EC	1000	6.92	6.03	6.85	7.96	10.72	11.04
			(15.23)	(14.21)	(15.17)	(16.38)	(19.10)	(19.40)
7.	Untreated control	--	6.06	11.53	13.00	7.49	15.05	16.95
			(14.21)	(19.83)	(21.26)	(15.87)	(22.82)	(24.30)
	SE (m) ±	--	0.42	0.19	0.16	0.34	0.15	0.04
	CD at 5per cent	--	NS	0.60	0.50	NS	0.45	0.14

* Figures in parentheses are angular transformed values.

Table 4 Effect of bio-rational insecticide lepimectin against cotton bollworm complex

S. N.	Treatments	Dose g a.i. ha^{-1}	Per cent infestation of bollworms at different stages		Yield kg ha^{-1}
			In locules at harvest	Per cent bad Kapas	
1.	Lepimectin 1per cent EC	10	20.24 (26.73)*	12.98 (21.24)	640
2.	Lepimectin 1per cent EC	12	19.12 (25.92)	12.09 (20.34)	690
3.	Lepimectin 1per cent EC	15	18.24 (25.27)	11.32 (19.65)	796
4.	Lepimectin 1per cent EC	30	17.33 (24.59)	10.11 (18.52)	802
5.	Lepimectin 1per cent EC	60	16.77 (24.16)	9.42 (17.87)	810
6.	Profenofos 50per cent EC	1000	21.17 (27.38)	13.22 (21.31)	628
7.	Untreated control	--	26.66 (31.08)	16.45 (23.92)	465
	SE (m) ±	--	0.38	0.32	4.05
	CD at 5per cent	--	1.17	0.98	12.46

* Figures in parentheses are angular transformed values.

the lowest larval population of *H. armigera* was recorded in the treatment Lepimectin 60 g a.i. ha^{-1} (T_5), followed by treatment Lepimectin 15 g a.i. ha^{-1} (T_3) and Lepimectin 30 g a.i. ha^{-1} (T_4). All the treatments were significantly superior over untreated control. Effect of Lepimectin on larval population of *H. armigera* 7 days and 14 days after first spray and 3 days, 7 days and 14 days after second spray revealed that the lowest population was observed in treatment Lepimectin 60 g a.i. ha^{-1} (T_5) followed by Lepimectin 30 g a.i. ha^{-1} (T_4) and Lepimectin 15 g a.i. ha^{-1} (T_3) treatments.

Per cent infestation of bollworm in square

The data incorporated in Table 2 regarding per cent infestation of bollworm in squares 7 and 14 days after first spraying revealed that all the treatments were significantly superior over untreated control. The lowest infestation was observed in plots treated with Lepimectin 1per cent EC 60 g a.i. ha^{-1}, followed by Lepimectin 1per cent EC 30 g a.i. ha^{-1}, 15 g a.i. ha^{-1}, 12 g a.i. $ha^{-1}$and 10 g a.i. ha^{-1}, respectively. Similar trend of results was obtained after second spraying.

Per cent infestation of bollworm in boll

Data presented in Table 3 regarding per cent infestation of bollworm in bolls 7 and 14 days after first spraying revealed that the lowest infestation of bollworm in bolls was found in plots treated with Lepimectin 1per cent EC 60 g a.i. ha^{-1} (T_5). The next treatment was Lepimectin 1per cent EC 30 g a.i. ha^{-1} and it was at par with Lepimectin 1per cent EC 15 g a.i. ha^{-1}. The highest bollworm infestation was found in untreated control. The data in respect of effect of bio-rational insecticide Lepimectin on per cent infestation of bollworm in boll 7 days and 14 days after second spray revealed that the lowest infestation was observed in treatment Lepimectin 60 g a.i. ha^{-1}, followed by Lepimectin 1per cent EC 30 g a.i. $ha^{-1}$and 15 g a.i. ha^{-1}.

Infestation in locules at harvest

The data regarding per cent infestation in locules at harvest due to bollworm in Table 4 revealed that Lepimectin 1per cent EC 60 g a.i. ha^{-1} was the best treatment recording lowest per cent locule infestation (24.16 %), however, it was at par with Lepimectin 1per

cent EC 30 g a.i. ha^{-1}and Lepimectin 1per cent EC 15 g a.i. ha^{-1}. Rest of the treatments were also found effective when compared with untreated control.

Percentage of bad *Kapas*

The data showed in Table 4 in respect of percentage of bad kapas revealed that Lepimectin 1per cent EC 60 g a.i. ha^{-1} recorded lowest percentage of bad kapas (17.87 %) and was at par with Lepimectin 1per cent EC 30 g a.i. ha^{-1} (18.52 %). These treatments were followed by Lepimectin 15 g a.i. ha^{-1}, 12 g a.i. ha^{-1}, 10 g a.i. ha^{-1}and Profenofos 50 per cent EC 1000 g a.i. ha^{-1}. The highest per cent bad kapas (23.92 %) was recorded in untreated control.

Yield of seed cotton

The data presented in Table 4 regarding yield of seed cotton revealed that highest seed cotton yield (810 kg ha^{-1}) was obtained in the plots treated with Lepimectin 1per cent EC 60 g a.i. ha^{-1}was at par with Lepimectin 1per cent EC 30 g a.i. ha^{-1}. The lowest yield (465 kg ha^{-1}) was obtained in treatment untreated control.

The results in the present experiment are in conformity with those of Patil *et al.* (1999) who reported that Spinosad 48 SC @ 100 gm a.i ha^{-1} recorded minimum per cent bollworm incidence and at par with its lower dose 75 gm a.i. ha^{-1}. Dandale *et al.* (2001a) recorded Spinosad 48 SC 75 and 50 gm a.i. ha^{-1} was most effective in controlling the infestation of *H. armigera* in green fruiting bodies on plant 14 days after treatment was followed by Decamethrin 2.8 EC 10 and 12.5 gm a.i. ha^{-1} and Bulldock 2.5 EC 12.5 and 18 gm a.i. ha^{-1}. Bheemanna *et al.* (2004b) reported that Emamectin benzoate (Proclaim) @ 11 g a.i. ha^{-1} was most effective causing lower fruiting bodies damage and higher seed cotton yield and was at par with other new molecules Spinosad 45 SC and Indoxycarb 14.5 SC @ 75 g a.i. ha^{-1} dose. The above studies indicate that Lepimectin was found effective in reducing the bollworm damage and increasing the seed cotton yield.

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Evaluation of Chlorpyrifos and Chlorpyrifos-Methyl Against Beneficial Insects, Earthworms and Soil Microbes

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ABSTRACT

The influence of chlorpyrifos and chlorpyrifos-methyl was tested against honeybees, earthworms and soil microbes. The LC50 worked out for chlorpyrifos was 0.0046 per cent and for chlorpyrifos-methyl 0.025 per cent. There was no any adverse effect noticed on the activity of soil microbial organisms (based on CO_2) at the fortification levels of 10 to 40 ppm. Similarly, development of earthworms were not influenced due to contamination of soil at the level of 5 to 20 ppm.

Chlorpyrifos is an organophosforus insecticide (O,O-Diethyl-O-3,5,6-trichloro-2-pyridyl phosphorothiate). It has broad range of insecticidal activity and is effective by contact, ingestion and vapour action. It is non-systemic, used for the control of mosquitoes, flies, various soil and many foliar crop pests and household pests. Chlorpyrifos-methyl also belongs to organophosphorus group of pesticides and chemically known as O,O-Dimethyl-O-3,5,6-trichloro-2-pyridyl phosphorodithioate. It is an insecticide with a broad range of activity, effective by contact, ingestion and vapor action but it is non-systemic. It is used to control pests of stored grains and various foliar crop pests. It is non persistent in soil.

These two compounds were used by farmers for control of many pests on various crops and also for soil drenching. The effect of these compounds was investigated on honey bees, earthworms and microbial activity in the present investigation.

MATERIAL AND METHODS

The influence of these compounds was evaluated as per the test protocol to beneficial insects, earthworms and soil microbes. The technical grade pesticides supplied by M/S. D-nocil, Mumbai were diluted in acetone and preliminary range finding experiments were conducted by taking a wide range of test concentrations.

Contact toxicity test using filter paper as outlined by Regupathy *et al.* (1996) was adopted. Filter paper of 7 cm diameter was impregnated with chemical solution (in water), dried and placed in same size perforated plastic petridishes to provide ventilation to the bees. Each treatment was replicated four times and water alone was used as control. Honey bees maintained in the field hives were collected and anesthetized with CO_2 and bees were quickly transferred into petridishes. The petridishes were then covered with black cloth in order to minimize flying or bailing so as to bring about maximum contact with the treated surface of filter paper. The bees were kept in contact with the treated surface for 10 minutes, after which the bees were transferred into cages (40x40x40 cm) made of muslin cloth cover in a iron frame and were provided with cotton soaked in 40 per cent sucrose solution as sucrose of food. The bees were observed for mortality after 24 hours. Moribund honey bees were counted as dead. Mortality in all treatments was corrected by Abbott's formula. The data were analyzed by Probit analysis for calculating the LC50 (Finney, 1952).

Soil from cultivated field was used for testing the influence of toxicant on the microbial respiration, as the activity of soil microbes is directly related to mineralization of and the evolution of carbon dioxide. To conduct the test, incubation chamber was prepared using a 500 ml capacity Erlenmeyer flask with tightly stoppered rubber cork. Glass vial (25 ml) was kept suspending in flask with the help of thread hooked on bottom surface of the cork. In each set of apparatus, 50 g soil was kept at the bottom and vial was filled with 10 ml of NaOH (0.5 N). Soil was maintained at field capacity by adding appropriate quantity of water uniformly to all

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sets. At the specified intervals, vial from chamber was replaced immediately by another vial containing fresh 10ml NaOH solution (0.5 N). The content of separated vial was titrated with 0.7 N HCl using 10 ml of 1 N $BaCl_2$ to phenolphthalein end point. Blank was recorded by titration of fresh 10 ml solution of 0.5 N NaOH with HCl in a similar manner. The amount of carbon dioxide present as carbonate in soil was calculated using following formula and expressed in mg per gram of soil.

$$C = (B-A) \times 2.2 \times 1/0.1 \times H$$

Where : C = CO_2 evolved in mg from 50 g soil

B = Volume of 0.7 N HCl in ml as a blank reading

A = Volume of 0.7 N HCl in ml required to neutralize NaOH in vial

H = Normality of acid (1 ml 0.1 N HCl is Equivalent to 2.2 mg CO_2)

The laboratory experiment was conducted on treated soil in plastic container to test the toxicity of chlorpyrifos and chlorpyrifos-methyl to earthworm. Soil (3 kg) was maintained at field capacity by adding appropriate quantity of chemical solution of specific concentration and known number of earthworms were released in each treatment container. The content was maintained over a period of six weeks by providing equal quantity of food and water in each container. The total count of earthworms in each container was counted and influence of each treatment was compared with the population in untreated soil container.

RESULTS AND DISCUSSION

Toxicity to honey bees

Bioassay tests were carried out to assess the toxicity of chlorpyrifos and chlorpyrifos-methyl against foraging honey bees (*Apis cerana indica*). The data on toxicity test of chlorpyrifos and chlorpyrifos-methyl are given in Table 1 and 2, respectively. The median lethal concentration (LC50) worked out for chlorpyrifos was 0.0046 per cent with the fiducial limits of 0.0039 (lower) and 0.0051 per cent (upper). The LC90 derived from the regression equation was 0.0092 per cent which appeared to be much less than the spray concentrations of 0.05 to 0.1 per cent normally recommended by the manufacturer for the control of crop pests. Hence, chlorpyrifos should be classed as highly toxic pesticide to honey bees. In case of chlorpyrifos-methyl, the LC50 value was 0.025 per cent with the upper and lower fiducial limits of 0.02 and 0.03 per cent, respectively. The LC90 value worked out from the regression equation was 0.051 per cent. Keeping in view the normal concentrations of 0.05 to 0.1 per cent chlorpyrifos-methyl specified for plant protection, the LC90 value was more closer to the lower concentration of 0.05 per cent. Nevertheless, this pesticide can be classed as toxic to foraging bees. If the LC50 values are compared to the recommended spray concentrations range of 0.05 to 0.1 for both the evaluated pesticides, the chlorpyrifos should be considered more toxic than chlorpyrifos-methyl. Similarly, Mishra and Verma, 1982; and Thomas and Phadke, 1994 reported chlorpyrifos as most toxic to *A. cerana indica*. Keeping in view these results, chlorpyrifos and chlorpyrifos-methyl should be cautiously used taking into consideration parallel activities of honey bees in the concerned crops.

Influence on soil microbial activity

Soil microbial activity is directly related to the carbon dioxide gas evolved from the incubated soil. Hence, the CO_2 evolved in each test container was measured periodically at 10, 20, 30 and 40 days. Chlorpyrifos and chlorpyrifos-methyl was separately used for the fortification of soil in incubation chamber at the toxicant levels of 0, 10, 20, 30, 40 and 50 ppm. The data on the evolved CO_2 in test sets of chlorpyrifos and chlorpyrifos-methyl are presented in Table 3 and 4, respectively. In experiment with chlorpyrifos the CO_2 evolved over a period of 40 days was in the range of 5.84 to 6.14 $mg^{-1}g$ of soil. At the same time the quantity of CO_2 in untreated chamber was 6.02 mg g^{-1}. In case of chlorpyrifos-methyl the quantity of CO_2 evolved in treated soil ranged between 5.50 to 5.91 mg g^{-1} as against the quantity of 5.90 mg g^{-1} in untreated soil.

In case of both the pesticides, the difference in the CO_2 evolved in treated and untreated soil were negligible. Hence, both pesticides at the fortification levels of 10 to 50 ppm could not show any adverse effect on the soil microbial activity. In fact the levels of pesticide tested in the present study (10 to 50 ppm) can not be attained due

Table 1: Toxicity of chlorpyrifos against honey bees

Dose (%)	Mortality	Log (dose x 1000)	Emp. probit	Exp.probit	y
0.0070	99.88	0.85	8.06	7.98	8.01
0.0065	79.88	0.81	5.83	7.20	1.92
0.0060	69.88	0.78	5.52	6.10	5.34
0.0050	19.89	0.70	4.16	5.50	4.10
0.0020	9.99	0.30	3.72	2.74	5.85

Reg.equation : y=5.4078+(-0.6184)x LC50 : 0.0046 %
Fiducial limit Upper : 0.0089 % Lower : 0.0051 %
LC90 : 0.0092 %

Table 2: Toxicity of chlorpyrifos-methyl against honey bees

Dose (%)	Mortality	Log (dose x 1000)	Emp. probit	Exp.probit	y
0.040	99.88	1.60	7.87	8.06	8.03
0.035	89.10	1.54	6.23	7.78	5.65
0.030	79.88	1.48	5.80	6.45	5.46
0.025	39.99	1.40	4.74	4.74	4.75
0.020	2989	1.30	4.47	3.30	6.01
0.010	19.89	1.00	4.15	1.80	4.93

Reg.equation : y=73.5836+(48.5287)x LC50 : 0.025 %
Fiducial limit Upper : 0.020 % Lower : 0.030 %
LC90 : 0.051 %

Table 3 : Influence of chlorpyrifos on CO_2 evolution from soil

Level of fortification	Evolved CO_2 from soil in mg/g				Total
	Incubation interval in days				
	0-10	11-20	21-30	31-40	
0	1.27	1.65	1.67	1.43	6.02
10	1.39	1.58	1.77	1.40	6.14
20	1.20	1.70	1.68	1.34	5.92
30	1.22	1.60	1.55	1.59	5.96
40	1.30	1.65	1.59	1.38	5.92
50	1.18	1.72	1.53	1.41	5.84

Table 4 : Influence of chlorpyrifos-methyl on CO_2 evolution from soil

Level of fortification	Evolved CO_2 from soil in mg/g				Total
	Incubation interval in days				
	0-10	11-20	21-30	31-40	
0	1.74	1.56	1.32	1.38	5.90
10	1.52	1.35	1.28	1.44	5.59
20	1.38	1.75	1.34	1.29	5.76
30	1.80	1.38	1.42	1.31	5.91
40	1.69	1.42	1.20	1.19	5.50
50	1.35	1.72	1.30	1.41	5.78

to use of pesticides, which were used for the crop protection in the field. In general, pesticides at the recommended doses used for pest control work in agriculture are considered harmless to beneficial activities of soil microbes (Hill and Wright, 1978).

Effect on earthworm development

Effect of chlorpyrifos and chlorpyrifos-methyl on earthworms was studied in soil fortified at the toxicant levels of 0, 5, 10 and 20 ppm. Influence of treatment was judged on the basis of surviving population of earthworms after release of 20 earthworms in each test container. The data on the number of earthworms present in each treatment container for the exposure period of 5 weeks are presented in Table 5. In untreated soil the mean count of earthworms was 18.3. The earthworm count in treatments of chlorpyrifos and chlorpyrifos-methyl were in the range of 16.0 to 17.0 and 16.3 to 17.0, respectively.

Table 5: Effect of test insecticides on development of earthworms

Treatments	Conc.ppm	Number of earthworms			
		RI	RII	RIII	Mean
Chlorpyrifos	5	18.00	16.00	15.00	16.33
Chlorpyrifos	10	17.00	18.00	16.00	17.00
Chlorpyrifos	20	16.00	15.00	17.00	16.00
Chlorpyrifos-methyl	5	18.00	17.00	16.00	17.00
Chlorpyrifos-methyl	10	17.00	18.00	15.00	16.67
Chlorpyrifos-methyl	20	15.00	16.00	18.00	16.33
Untreated control	-	18.00	18.00	19.00	18.33
S. E. (m) ±					0.33
C.D. at 5%					N.S.

N.S. = Not significant

Statistically, the difference between the counts of treated and untreated soil containers was not significant. This clearly indicate that both the pesticides at the toxicant levels of 5, 10 and 20 ppm in soil did not show any adverse effect on the population of earthworms. However, in direct exposure test conducted by Tzeng and Kao (1996) and Mostart *et al.*, (2000) chlorpyrifos was classed as moderately harmful pesticide. Nevertheless, high level of contamination of soil due to pesticides should be always avoided to conserve the population of earthworms in the cultivated fields.

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Screening of F_1 Hybrids of Brinjal Against Shoot and Fruit Borer

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ABSTRACT

Intraspecific crossability was found more successful than the Inter specific crossing in brinjal. Highly resistant cultivar PPC identified during the investigation was used as resistant male parent in crossing programme to transfer resistant characters into susceptible cultivars and showed its potentiality. Amongst all F1 hybrids developed during the investigation Aruna x PPC and Suruchi-10 x PPC were observed to be highly resistant and high yielder as compared to their female parents and remaining F1 screened viz., Adoni local x Malkapur local, Kanheri local x Shekta local, PDKV x Shekta local, Puneri kateri x PPC, Gudadhi local x *S. incanum* and Chaitanya x PK against *L. orbonalis*.

Brinjal has been a staple vegetable in our diet since ancient times. Egg plant has wide spectrum of uses for maintaining the human health and essentially a source for building economic treading for farmers. Among the major constraints in economic cultivation of brinjal, pest infestation cause heavy losses. Among the major insect pest of brinjal shoot and fruit borer, *Lucinodes orbonalis* is the most destructive one (Agnihotri, 1999) distributed all over India and the pest is active throughout the year (Butani and Jotwani, 1984).

Due to indiscriminate use of insecticides and internal feeding behaviour of the pest recently interest in development of resistance in egg plant to this pest has been increased. Egg plants grown for the table or seed purposes receive blanket sprays of chemicals to protect it throughout its growth. Breeder generally considered the varietal development for yield and appearance for consumers preference and neglect its tolerance to borer attack. Moreover, brinjal being an indigenous plant, there is a great genotypic diversity for selection of tolerant genotype in developing desirable variety and hybrids. In view of this, present investigations were carried out at Department of Agriculture Entomology, Dr, PDKV., Akola.

MATERIAL AND METHODS

Breeding for resistance

In order to develop F_1 hybrids, a crossing programme was carried out in the field of Department of Agril. Entomology during *Kharif* season 2001.

Cultivation of genotypes for crossing programme

Genotypes, already identified as immune, highly resistant, fairly resistant, tolerant and susceptible during the field screening in 2000-2001, were used for breeding programme. Agronomical superiority and consumers' choice were also taken into consideration. Hybrid seed production techniques suggested by Kale and Wankhede (1996) were adopted.

Emasculation

Anthers were removed from the flower buds of female parent which were supposed to open in next day with the help of forcep and covered with butter paper perforated bags.

Pollination

Pollens in the next morning were separated from anthers and collected in container (Black container of photo film roll). Pollen collected were transferred from the male line to the stigmatic surface of the emasculated flowers of female line with the help of fine brush. Bud pollination were attempted between 7.30 to 10.30 a.m. The pollinated buds were covered with perforated butter paper bags with label. The fruits obtained from successful crossing were harvested after their full maturity, when they riped and attained yellow colour. The seeds from the crossed fruits were extracted, shade dried and used for F_1 screening during late *Rabi* season, 2001-02.

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Testing of F_1 hybrids against *Leucinodes orbonalis* Guen

F_1 screening trial was conducted in the field of Department of Agricultural Entomology during late *Rabi* season 2001-2002. Possible efforts were made to maintain the crop growth through protective irrigation.

An experiment was conducted in randomised block design with three replications. For field screening, following 14 entries were transplanted in the field with the spacing of 60x60cm.

All the agronomical practices were followed as per recommendations. Due care was taken to maintain proper growth of plant and no spraying was given. Observations regarding shoot infestation, fruit infestation (both number and weight basis) and yield per plant were recorded and analysed by transforming the data using suitable transformation. The different genotype / hybrids and their source are given below

RESULTS AND DISCUSSION

Breeding for resistance

Various intra and interspecific crosses (Table 1) were developed during the present investigations by using the resistant sources identified during the screening programme. 'PPC' was used in general as a male parent beside 'Pusa Kranti'. The other male parents used in the crossing were Arka Mahima, *S. incanum*, *S. viarum* and *S. indicum*. However, no crossability of *Solanum melongena* and derivatives of *S. khasianum* (Arka Mahima) was observed.

Crosses between Gudadhi Local and *S. incanum* proved successful. However, cross between Aruna and *S. viarum* yielded the seed which had poor germination. Similarly, the F_1 seed from the cross between Gudadhi Local and *S. indicum* did not germinate. Rao (1981) successfully crossed *S. melongena* Cv. Nurki baingan x

Treatments	F_1 cross/Genotypes	Sources
V_1	Morvi	GAU, Anand
V_2	PPC	National Seed corporation, New Delhi
V_3	Puneri Kateri	Damani seeds, Pune
V_4	Manjari Gota	Pocha seeds Pvt. Ltd., Pune
V_5	Gudadhi Local	Gudadhi village, Dist. Akola
V_6	Aruna	Chilli and Vegetable Research unit, Dr. PDKV, Akola
V_7	PDKV x Shekta local (F_1)	MSSC Ltd, Akola
V_8	Kanheri Local x Shekta Local (F_1)	MSSC Ltd, Akola
V_9	Adoni Local x Malkapur Local (F_1)	MSSC, Ltd, Akola
V_{10}	Suruchi x PPC (F_1)	Department of Agril. Entomology, Dr. PDKV, Akola developed during present investigations
V_{11}	Gudadhi Local x *S. incanum* (F_1)	Department of Agril. Entomology, Dr. PDKV, Akola developed during present investigations
V_{12}	Puneri kateri x PPC (F_1)	Department of Agril. Entomology, Dr. PDKV, Akola developed during present investigations
V_{13}	Chaitanya x PK (F_1)	Department of Agril. Entomology, Dr. PDKV, Akola developed during present investigations
V_{14}	Aruna x PPC (F_1)	Department of Agril. Entomology, Dr. PDKV, Akola developed during present investigations

Table 1 : Inter and Intra specific crossability in brinjal

S. N.	Parents	Remarks (Successful / unsuccessful)
1	Suruchi Sel.–10 x PPC	Successful
2	Local x *S. incanum*	Successful
3	Puneri Kateri x PPC	Successful
4	Chaitanya Sel.-5 x PK	Successful
5	Aruna x PPC	Successful
6	Suruchi Sel.-10 x Arka Mahima	Crossability not observed
7	Puneri Kateri x Arka Mahima	Cossability not observed
8	Gudadhi Local x Arka Mahima	Crossability not observed
9	Aruna x Arka Mahima	Crossability not observed
10	Manjari Gota x Arka Mahima	Crossability not observed
11	Aruna x *S. viarum*	Crossability observed (Poor germination and growth)
12	Gudadhi Local x *S. indicum*	Crossability was observed but F_1 did not germinate

S. incanum. Thus the present investigation is in the tune of previous findings in terms of crossability of Gudadhi local cross.

Screening of F_1 hybrids against *L. orbonalis* Guen.

A. Shoot infestation

Data in table 2 revealed that, resistance source, Pusa Purple Cluster had significantly lowest shoot infestation (0.95%), however, it was at par with F1 cross, Aruna X PPC (1.11%). where in the resistant source PPC was used as male parent. Next F1 hybrid suruchi-10 x PPC was also found to be superiour by resisting lower shoot infeststion (1.33) and categories as tolerant F1 hybrid. Rest of the genotypes and crosses did not express resistance / tolerence against the shoot borer of brinjal. Significantly highest shoot infestation (11.14%) was noticed in highly susceptible variety "Puneri kateri" followed by "Manjari Gota" (9.37%) and Gudadhi local (7.17%).

From above mentioned results, it can be inferred that PPC, the identified highly resistsnt source could enhance the level of resistance in susceptible cultivar. While indicating the similar trend, Sharma *et. al.* (2001) reported that the crosses of SM-141 x PPC and DBLV x PPC gave resistant F_1 hybrid by using PPC as male parent which are in agreement with the present findings.

B. Fruit infestation

The perusal of the data (Table 2) revealed that there were negligible differences in the infestation recorded on number and weight basis of fruits. However, the results are discussed hereafter on the number basis of fruit infestation. 'PPC' had significantly lowest infestation than other cultivars and F1 hybrids screend during the investigation.. The F_1 obtained from Aruna x PPC had low fruit infestation (7.04 %), followed by the F_1 obtained from Suruchi–10 x PPC (8.42 %)and were found to be at par with each other. It means that the highly resistant cultivar 'PPC' when crossed with the susceptible cultivar enhanced the level of resistance against the fruit borer. F_1 obtained from Gudadhi Local x *S. incanum* had least (14.26 %) fruit infestation as compared to the female parent Gudadhi Local (23.16 %). It is, therefore, indicated that the wild brinjal species if crossed with the susceptible cultivars, could give the F_1 hybrid with improved level of resistance.

Similar views have also been expressed by Sharma *et al.* (2001). They have reported that the F_1 obtained from the crosses of SM-141 x PPC, and DBLV x PPC were found to be resistant. The F_1 from other crosses namely Adoni Local x Malkapur Local, Kanheri Local x Shekta Local and PDKV x Shekta Local showed fairly resistant reaction against BSFB. The infestation

Table 2 : Performance in respect of BSFB infestation, yield obtained from F_1 crosses and their parents (summer 2002)

Treatment No.	Cultivar/ F_1 crosses	Shoot Infestation (%)	Per cent fruit infestation (No. basis)	Per cent fruit infestation (Wt. basis)	Yield of marketable fruits (kg/plant)	Damage category (%) Shoots	Damage category (%) Fruits Number basis	Damage category (%) Fruits Weight basis
V_1	Morvi	2.67 (1.65)	18.41 (25.30)	18.89 (25.71)	0.920	M	FR	FR
V_2	Pusa Purple Cluster	0.95 (1.08)	2.90 (9.73)	3.11 (10.12)	0.928	T	HR	HR
V_3	Puneri Kateri	11.14 (3.41)	30.55 (33.52)	31.24 (33.96)	0.676	HS	S	S
V_4	Manjari Gota	9.37 (3.14)	24.47 (29.60)	24.96 (29.93)	0.750	HS	T	T
V_5	Gudadhi Local	7.17 (2.76)	23.16 (28.72)	23.62 (29.04)	0.720	HS	T	T
V_6	Aruna	2.86 (1.82)	11.17 (19.94)	12.27 (20.95)	0.855	M	FR	FR
V_7	Adoni Local x Malkapur Local	5.90 (2.66)	18.17 (25.21)	18.18 (25.30)	0.791	M	FR	FR
V_8	Kanheri Local x Shekta Local	8.00 (2.90)	18.92 (25.73)	20.16 (26.65)	0.738	HS	FR	T
V_9	PDKV x Shekta Local	5.14 (2.36)	18.90 (25.73)	19.12 (25.86)	0.730	HS	FR	FR
V_{10}	Suruchi-10 x PPC	1.33 (1.18)	8.42 (16.81)	9.79 (18.53)	0.918	T	HR	HR
V_{11}	Gudadhi Local x *S. incanum*	4.28 (2.23)	14.26 (22.16)	14.41 (22.26)	0.905	S	FR	FR
V_{12}	Puneri Kateri x PPC	4.19 (2.14)	16.52 (23.93)	17.00 (24.28)	0.693	S	FR	FR
V_{13}	Chaitanya x PK	2.85 (1.82)	11.58 (19.88)	12.11 (20.35)	0.846	M	FR	FR
V_{14}	Aruna x PPC	1.11 (1.12)	7.04 (15.35)	7.52 (15.94)	0.940	T	HR	FR
	'F' test	Sig.	Sig.	Sig.	Sig.			
	SE ± m	0.09	0.96	0.99	0.025			
	CD at 5 %	0.24	2.71	2.79	0.071			
	CV %	6.94 %	7.27 %	7.32 %	5.37 %			

Figures in parentheses are arc sine transformed values

HR- Highly Resistant FR – Fairly Resistant T – Tolerant M – Moderately Tolerant S – Susceptible HS – Highly Susceptible

ranged between 18.17 to 18.92 per cent which was comparatively higher than the F_1 described earlier. It can be inferred from these results that the highly resistant sources were not utilized in this crossing programme due to which the superior F_1 could not be developed.

Yield of marketable fruits

The data on marketable yield of fruits (Table 2) indicated that the F_1 obtained from the crosses of Aruna x PPC gave significantly better yield (0.940 kg plant^{-1}) and found to be at par with PPC (0.928 kg plant^{-1}), Morvi (0.920 kg plant^{-1}), F_1 from Suruchi-10 x PPC (0.918 kg plant^{-1}) and F_1 from Gudadhi Local x *S. incanum* (0.905 kg plant^{-1}).

The F_1 hybrid obtained from MSSC, Ltd. Akola viz., Adoni local x Malkapur Local (0.791 kg plant^{-1}), Kanheri Local x Shekta Local (0.738 kg plant^{-1}) and PDKV x Shekta Local (0.730 kg plant^{-1}) showed intermediate performance in terms of marketable fruit yield which may be attributed due to use of agronomically and genetically inferior cultivars in crossing programme. Significantly lowest yield (0.676 kg plant^{-1}) was obtained from susceptible cultivar Puneri Kateri.

The overall results have shown that the F_1 developed from the promising parents were superior in respect of pest infestation and yield of marketable fruits. There is a tremendous scope to identify the genotypes which are agronomically superior and can be crossed with the immune or highly resistant cultivars to obtain promising F_1 in future. The F_1 developed during the present studies have been therefore incorporated in the regular crop improvement programme.

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Studies on Parasitoids Associated with Cabbage Aphids and Diamond Back Moth Infesting Cauliflower

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ABSTRACT

Field experiments were conducted at Department of Horticulture M.A.U., Parbhani (M.S.) for consecutive two years i.e. 2002-03 and 2003-04 to study the parasitoids associated with cabbage aphid *Brevicoryne brassicae*, Diamond back moth *Plutella xylostella* and their extent of parsitisation in Marathwada region. The important parasitoids recorded were *Aphidius spp.* from cabbage aphids with maximum parasitisation of 76.43 and 82.33 per cent in 2002-03 and 2003-04 respectively. The parasitoids of *P. xylostella* include a larval parasite *Cotesia plutellae* and a larval pupal parasite *Oomyzus sokolowskii*. The extent of larval and pupal parasitisation was 10.80 and 26.83 per cent respectively, in 2002-03 while it was 11.33 and 28.38 in 2003-04.

Cauliflower (*Brassica oleracea*) var. Botrytis Linn. is an important vegetable crop mainly grown in winter season on an area of 0.28 million hectares with an annual production of 4.80 million tonnes (Anonymous, 2003). Cauliflower is mostly used for culinary purpose in curries, pickles, etc. From nutritional point of view it is an important source of minerals, vitamins, protein, carbohydrate and dietary fibres (Chatfield, 1984).

The crop however suffers from various insect pests during different growth stages. The predominant pest species attacking the crop are cabbage aphid *Brevicoryne brassicae* Linn., diamond back moth, *Plutella xylostella* Linn., cabbage borer, *Hellula undalis* Fab., cabbage looper *Trichoplusia ni* Hub. and tobacco caterpillar *Spodoptera litura* (Narsimhamurthy et al., 1998). In India, at least 52 per cent loss in marketable yield occurs due to DBM alone and more than 80 per cent when attack is severe (Chelliah and Srinivasan, 1986). Reports on natural enemies of cabbage pests are well documented. A number of potent parasitoids and predators have been found to exert influence on pest populations (Rana et al., 1995). Investigations in India and abroad have positively indicated usefulness of bioagents and botanicals against cabbage pests (Tambe et al., 1997). The effectiveness of natural enemies in controlling cauliflower pests were also reported by earlier workers (Morallo et al., 1990; Talekar and Hu 1996).Therefore present studies were undertaken to study the important natural enemies associated with the major pest of cauliflower.

MATERIAL AND METHODS

The studies comprised of field experiments conducted at the Department of Horticulture and Laboratory experiments at the Department of Entomology, Marathwada Agricultural University, Parbhani. The material used and methods adopted during the present investigations are outlined as under.

To study the parasitoids associated with diamondback moth, *P. xylostella* and aphid *B. brassicae* four quadrates each of 10 x 10 m² were maintained free from plant protection operation and the regular agronomic practices were done as per protocol.

Parasitoids of *B. brassicae*

The known number of mummified aphids were collected and reared in laboratory upto emergence of parasitoids and percent parasitization was worked out.

Parasitoids of diamond back moth *P. xylostella.*

The known number of larvae and pupae were collected from field and reared in a plastic container in laboratory and fed with cauliflower upto the emergence of parasitoids and percent parasitization were worked out.

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RESULTS AND DISCUSSION

Natural enemies associated with *Brevicoryne brassicae* and *Plutella xylostella*

a) Parasitization of aphid by *Aphidius spp.* during 2002-03 and 2003-04

The data pertaining to aphid parasitisation are presented in Table 1.

During 2002-03 aphid parasitisation was first observed 1.07 per cent in 47th meteorological week (3rd December) and was found to be increasing steadily from 48th meteorological week to 3rd MW and it become more pronounced in 4th MW (66.96 %) and declined steadily thereafter upto 6th MW and again reached it peak in 7th MW (76.43 %).

During 2003-04, aphid parasite activity was first noticed (1.14 %). In 48th MW to 1st MW (53.19 per cent), it decreased in 2nd MW upto (24.86 %) and fluctuated upto 8th meteorological week where it reached its peak 82.33 per cent and declined thereafter upto 10th MW. In both the years when climatic conditions were optimum for the multiplication of the pest and the parasite activity was meagre. The incidence started increasing from December and reached its peak at the end of January although the parasite activity was more but it could not reduce the population due to profound increasing rate of its host. Frueler et al. (2001) reported that *D. rapae, Aphidius matricariae, Aphidius ervi* and *Bracon sp.* clearly dominated *B. brassicae* with generally more than 90 per cent of individual. Biradar (1999) also reported that *Aphidius spp.* was predominant parasitoid with 95 per cent parasitisation in the moth of February in Marathwada region.

Vaz *et al.*, (2004) also reported parasitisation of *B. brassicae* by *Aphidius celomei* under field studies. However, *Aphidius sp.* was only the predominant parasitoid of *B. brassicae* in both the seasons. It is therefore, necessary to explore the possibility of utilisation of this parasite in the management schedule of aphid. Further work on mass multiplication technique, time of release and number to be released per unit area needs to be initiated.

In earlier literature pertaining to the work on percent parasitisation of aphid infesting cauliflower from Marathwada has not been reported. However, the finding of the earlier workers gave some support to the present findings.

b) Parasitisation of DBM during 2002-03 and 2003-04

The data on percent parasitisation of DBM i.e. larval parasitisation by *Cotesia plutellae* and pupal parasitisation by *Oomyzus sokolowskii* and total parasitisation are presented in Table 2.

During both the years *C. plutellae* and *O. sokolowskii* were found the major natural enemies of DBM.

i) Larval parasitisation of DBM by *Cotesia plutellae* during 2002-03 and 2003- 04

In 2002-03 parasitioid activity of DBM was first noted in 50th MW with 0.50 per cent larval parasitisation and it fluctuated upto 2nd MW and then increased steadily upto 8th MW (10.80 per cent) and later it started to decline upto 10th MW.

In 2003-04, parasitoid activity of DBM was first noted in 52nd MW (3.58 %) and it fluctuated upto 5th MW and increased upto 7th MW where it reached it peaks and later it starts declining upto 10th MW.

ii) Pupal parasitisation of DBM by *Oomyzus sokolowaskii* during 2002-03 and 2003-04

The pupal parasitisation of DBM pupae were recorded in 52nd MW (2.13 %) during 2002-03 from 52nd MW. It starts increasing upto 4th MW (12.48 %) and later it decreases upto 7th MW week (8.26 %) and then started increasing and reaches its peak during 9th MW (20.83 %) and later it starts decreasing upto 10th MW.

During 2003-04, the pupal parasitoid activity was first noticed in 52nd MW (4.93 %) and it fluctuates upto 5th MW and later it starts increasing upto 8th MW and reaches its maximum population in the same week (28.38 %) and later it starts decline upto 10th MW.

iii) Total parasitisation of DBM during 2002-03 and 2003-04

During 2002-03, the parasitisation of DBM larvae and pupae was first noticed during 50th MW (0.50 %) and it fluctuated upto 6th MW and later started

increasing upto 9th MW where it recorded maximum parasitisation of 35.90 % and later it decreases.

During 2003-04 the parasitoid activity of both the parasitoids was first recorded in 52nd MW (8.51 %) and it fluctuated upto 5th MW and later it starts increasing and reaches its peak during 8th MW (39.44 %) and later it start decreasing upto 10th MW.

The larval parasitoid *Cotesia plutellae* Kurdj and pupal parasitoids *Oomyzus sokolowskii* Kurdj were the predominant parasitoids of DBM in this region. More over natural enemies of *P. xylostella* were reported by Yadav et al. (1975) from Anand (Gujarat). Jayrathnam (1977) from Karnataka in India. In world natural enemies of DBM were recorded by earlier workers like Noda *et al.*, (1996), Talekar and Hu (1996) and Wang et al. (1998) from different areas.

Cock (1985) reported 89 to 100 per cent pupal parasitisation of DBM. Similar observations were also recorded by Liu et al. (2000) also reported that *O. sokolwoskii* parasitoides 3.1, 13.2 and 6.8 larvae of DBM at different temperatures. He *et al.*, (2000) reported that *O. sokolowskii* and *C. plutellae* were the key factors in control of natural population of DBM.

Santos et al. (2000) reported that *O. sokolaowskii, D. insulare* and *Conura petioleventris* were the most common parasites emerges from parasitised larvae and pupae of *P. xylostella*. Chellian and Srinivasan (1986) observed 72 per cent larval parasitisation, Oh *et al.*, (1997) reported 9.8 % parasitism in different season. Reddy and Singh (1998) reported 13.13 to 36.17 per cent parasitisation in different generations for first instar and 18.33 to 43.33 in second instar. In the present investigation the percentage of parasitisation by both the parasitoid differed from the report by earlier workers that may be due to host density, season and climatic conditions which are different at different places but the work done by the earlier scientists brings conformity in findings of present investigation.

Table 1. Parasitisation of aphid during 2002-03 and 2003-04 by *Aphidius spp.*

Meteorological week	Aphids/3 leaves			
	2002-03		2003-04	
	Population	Parasitisation	Population	Parasitisation
46	1.32	0.00	0.00	0.00
47	8.7	1.07	1.22	0.00
48	22.3	3.14	3.15	1.14
49	20.20	2.98	23.17	3.48
50	60.15	4.27	80.17	16.13
51	72.80	15.18	51.4	12.29
52	8.477	16.15	76.42	15.33
1	110.85	35.17	161.67	53.19
2	140.92	50.38	82.07	24.86
3	131.05	48.62	219.22	71.53
4	164.85	66.96	150.5	60.21
5	97.70	41.73	145.35	52.76
6	90.35	40.83	286.17	80.83
7	273.12	76.43	317.05	80.73
8	192.22	50.16	319.15	82.33
9	85.27	25.28	74.07	31.19
10	120.32	18.36	31.32	10.03

Table 2. Parasitisation of *Plutella xylostella* during 2002-03 and 2003-04 by *Cotesia plutellae* and *Oomyzus sokolowaskii*

MW	DBM population per 10 plants		Per cent parasitization					
			Larval		Pupal		Total larval + pupal	
	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	1.17	1.2	0.00	0.00	0.00	0.00	0.00	0.00
48	2.42	3.3	0.00	0.00	0.00	0.00	0.00	0.00
49	1.28	2.95	0.00	0.00	0.00	0.00	0.00	0.00
50	8.12	3.17	0.50	0.00	0.00	0.00	0.00	0.00
51	14.80	8.97	1.00	0.00	0.00	0.00	0.50	0.00
52	19.32	23.17	1.13	3.58	2.13	4.93	3.26	8.51
1	13.05	88.12	0.90	8.85	2.00	9.18	2.90	18.03
2	38.70	30.20	4.16	5.28	6.32	5.13	10.48	10.41
3	70.75	81.12	7.40	8.31	9.29	10.12	16.69	18.43
4	98.55	106.12	8.12	9.21	12.48	14.46	20.60	23.67
5	35.22	93.17	8.11	9.14	9.31	13.29	17.42	22.43
6	30.70	111.15	8.23	10.12	8.26	19.26	16.49	29.38
7	119.77	129.22	9.19	11.33	18.21	27.89	27.40	39.22
8	102.02	103.15	10.80	11.06	24.13	28.38	34.93	39.44
9	73.17	65.22	9.07	8.79	26.83	25.18	35.90	33.97
10	45.12	30.12	5.80	4.18	12.81	10.77	18.61	22.79

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Credit Utilization and Repayment by Members of Primary Agricultural Credit Society

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ABSTRACT

The present study was conducted in Akola Panchayat Samiti of Akola district in Maharashtra State with sample size of 150 cotton growers to study the crop loan utilization and its repayment by the cotton growers. It revealed that 35.34 per cent of cotton growers had spent money partially on farm inputs and partially on family consumptions, followed by purchase of farm inputs such as seeds, fertilizer, pesticides, biofertilizer and bio-agents. It was also revealed that 46.67 per cent of cotton growers had low repayment behaviour.

It is quite obvious that in India most of the farmers do not have sufficient funds with them to meet their farming needs. They are very much dependent on the borrowed money from one or the other source of finance to manage farm inputs such as, seeds of high yielding varieties, new package of practices, fertilizers, pesticides, farm implements, etc. The success of credit co-operatives as far as recovery of crop loan is concerned, largely depends on productive utilization of agricultural credit by the borrowers. Hence, it is essential for co-operative society to know the credit utilization and repayment behaviour of farmer borrowers. Keeping this in view, the study was undertaken with the specific objective: To study the crop loan utilization and its repayment by cotton growers.

MATERIAL AND METHODS

The present study was conducted in Akola Panchayat Samiti of Akola district in Maharashtra State. The Primary Agricultural Credit Society (PACS) has been considered as the main Credit Co-operative Agency for financing crop loan to the farmers in the co-operative sector. There are 74 PACS in Akola Panchayat Samiti. Out of which 15 PACS were selected purposively on the basis of maximum turnover. The farmers growing cotton crop i.e. cotton growers who borrowed the crop loan from PACS were considered for the purpose of study. A sample of 150 such cotton growers was drawn from 15 PACS by resorting to proportionate random sampling method. Data were collected with the help of pre-tested structured interview schedule by personally interviewing the respondents.

RESULTS AND DISCUSSION

I. Utilization of crop loan by the cotton growers

Crop loans are advanced to facilitate the borrowers to buy the needed farm inputs for crop production. In the context of the present study, the utilization of crop loan has been conceptualized as to whether the borrower had utilized the amount of crop loan for the purpose of crop production or otherwise, as the loan was advanced in terms of cash only. A query was made as to whether the respondents had spent the amount of crop loan for the purchase of farm inputs such as seeds, fertilizer, pesticide, etc. or spent towards meeting the family expenses, etc. The data, thus obtained, have been furnished in Table 1.

It is observed from Table 1 that over one third of the respondents (35.34%) who had borrowed the crop loan for cultivation of cotton crop but found utilizing partially for buying the farm inputs and partial amount on family consumptions. In other words, it could be stated that these one third cotton growers did not utilize fully the crop loan for growing cotton crop for which it was advanced by the credit co-operative. However, there were one fifth of the cotton growers (21.33%) who had borrowed the crop loan and utilized for the purpose for which it was borrowed. These respondents spent the amount of crop loan for productive purpose through buying the inputs required for cultivation of cotton crop. Further, it was disheartening to note that 18.00 per cent of the respondents had utilized the crop loan for celebrating religious functions, ceremonies and attending marriage ceremonies despite spending on productive

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Table 1: Distribution of respondents according to the utilization of crop loan amount

S. N.	Aspects of utilization	Respondents (n=150)	
		Frequency	Percentage
1	Purchase of farm inputs like seed, fertilizer, pesticide, biofertilizer and bioagents	32	21.33
2	Spending partially on farm inputs and partially on family consumptions	53	35.34
3	Spending on books, note books and school bags of children.	18	12.00
4	Spending on marriage ceremony of relatives and friends, religious ceremonies and functions	27	18.00
5	Spending on repayment of debt borrowed from private money lenders	20	13.33

purpose. This was followed by 13.33 per cent of respondents who had utilized the amount of crop loan for clearing off their old debts borrowed from private money lenders. Further, it was also noted that a few respondents (12.00%) diverted their crop loan on educational aspects of their children, that is, on buying books, note books, school bags, etc. Thus, it could be inferred that there was a complete misutilization of crop loan by majority of the respondents. Chauhan and Swarnkar (1993) reported similar findings stating that small and marginal farmers were better utilizers of the loan as compared to big farmers. Kumar (1997) also found that majority of the farmers (64.00) had diverted crop loan for repayment of old debts and for meeting the consumption needs of their families.

II. Credit repayment by cotton growers

Credit repayment was studied in terms of amount of crop loan repaid by the cotton growers to the financing agency. The data in this regard have been furnished in Table 2.

Table 2: Distribution of respondents according to their repayment of crop loan

S. N.	Category	Respondents (n=150)	
		Frequency	Percentage
1	Low	70	46.67
2	Medium	34	22.67
3	High	46	30.66

A perusal of the data in Table 2 reveal that majority of the respondents were in low to medium category of repayment behaviour (69.34%). The respondents to a tune of 30.66 per cent could be observed in high repayment category. It meant that majority of the respondents found to be defaulters as far as crop loan repayment is concerned. The plausible reason for this finding might be the misutilization of crop loan for the unproductive purpose, that is, other than the purpose for which it was borrowed. These findings are in accordance with the findings of Anand (1994) who reported that majority of borrowers had exhibited medium level of loan repayment behaviour.

CONCLUSION

On the basis of findings, it could be concluded that the recovery of crop loan by the co-operative sector was low from majority of the cotton growers, obviously because of the fact that the cotton growers, in majority borrowed the crop loan for cultivation of cotton crop but did not utilize for the productive purpose i.e. for buying agricultural inputs, however spent on unproductive aspects. This tends to imply that there is a need to monitor the utilization of crop loan by the borrowers. For this purpose, the credit co-operative / co-operative banks may constitute a cell called as "monitoring cell" and motivate the farmers towards proper utilization of crop loan which in turn facilitate the adequate recovery of crop loan and may prevent the co-operative financing agency from being bankrupt.

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Adoption of Vermicompost Technology by Farmers

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ABSTRACT

The present study was conducted in Akola district of Maharashtra State to investigate the profile of farmers, their knowledge and adoption about vermicompost technology with sample size of 140 farmers. Findings revealed that cent per cent farmers had knowledge about vermicompost technology, such as use of organic materials and farm residues namely, stubbles, sugarcane trash, litter, garbage from home and urban cities, use of raised bed, digging the soil up to 2 to 3", width 2.5' to 3' and height 3' to 4', use of gunny bags or grass for covering vermicompost bed , application of water with the help of water spray can, spraying water every day in summer and at an interval of 2 to 3 days in winter on bed and application to soil within 40 to 45 days, whereas majority of farmers had completely adopted the vermicompost technologies such as use of raised bed, digging the soil up to 2 to 3", width 2.5' to 3' and height 3' to 4' (99.28%), use of gunny bags or grass for covering vermicompost bed (98.57%), application of water with the help of water spray can, spraying water every day in summer and at an interval of 2 to 3 days in winter on bed (98.57%) and use of organic materials and farm residues namely, stubbles, sugarcane trash, litter, garbage from home and urban cities (87.14%). Thus, education, knowledge and socio-economic status of farmers showed positive and significant relationship with adoption of vermicompost technologies by them.

In the international market, the produce which are produced by the use of natural resources have more value, so the use of organic fertilizer have increased our hopes to compete in the international market. In organic manures, vermicompost is the highly efficient manure which is made from the farm waste and involves the advantages of increase in production and improve the quality of agricultural produce. Vermicompost contains various amino acids, minerals and microorganisms, which humidify the organic matter in the surrounding soil, and acts as a bio-fertilizer for plants. Vermicompost is the production of blackish, light weighted and granular material after the metabolic process of earthworm which contains plants nutrients like N, P, K, Ca, Mg, Mo, etc. (Raut and Malewar, 1995). Vermicomposting is the technique of producing compost reproducing organic matter through earthworm. Earthworms take organic matter from the soil surface into the soil, grind the organic matter together with soil profile. Earthworms through burrowing, increase water holding capacity of the soil and also provide ideal aerobic condition for bacteria as well as plant roots (Vaishali Shanbhag, 1999). The present investigation was an attempt to find out as to what extent the farmers are aware about the vermicompost technology and its use by them.

Keeping this in view, the present investigation was carried out with the specific objectives, as follows :

1. To study the profile of farmers
2. To study the knowledge possessed by the farmers about vermicompost technology and its adoption by them
3. To study the relationship between the profile of farmers and adoption of vermicompost technology by them

MATERIAL AND METHODS

The present investigation was carried out in Akola district of Maharashtra state. The State Department of Agriculture has imparted the training on vermicompost technology at their polyclinics located at Taluka Seed Farms. There were 140 farmers who had undergone such training. These farmers constituted the population for the present investigation and, therefore, all these 140 trained farmers were considered as respondents. The data were collected from them and the results thus obtained have been interpreted.

RESULTS AND DISCUSSION

I. Profile of farmers

Data revealed that majority of respondents were middle aged, educated up to college level, big farmers

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having land more than 10 ha., had their annual income above Rs. 1,00,000, occupying upper middle level of socio-economic status, had moderate orientation towards scientific farming and farm management, and had medium level of input available with them.

II. Knowledge and Adoption of vermicompost technology

It is noticed from Table 1 that cent per cent farmers had knowledge about use of organic materials and farm residues such as stubbles, sugarcane trash, litter, garbage from home and urban cities, followed by its adoption by great majority of farmers (87.14 %). Cent per cent farmers had knowledge about use of raised bed required for preparation of vermicompost and almost all the respondents also had its complete adoption (99.28 %). The practices like use of gunny bags or grass for covering vermicompost bed, application of water with the help of water spray can, application of soil within 40-45 days and separation of earthworms from vermicompost with the help of sieve, were also known to cent per cent farmers. However, the adoption of these practices by the farmers varied from practice to practice. Almost all the farmers had adoption of the practice of covering vermicompost bed with the help of gunny bag/ grass and application of water on bed, as recommended (98.57 % each). Two third of farmers had adoption of the practices namely, application to soil within 40-45 days and separation of earthworms from vermicompost with the help of sieve (65.72 & 68.57 %, respectively), although its knowledge was possessed by almost all the farmers. Further, it was observed that the knowledge about use of mixture of cow dung and organic material in the ratio of 1:1 was possessed by 60 per cent of the farmers only, whereas 90.00 per cent of them adopted this practice partially. Over one fourth of the farmers

Table 1 : Distribution of respondents according to practicewise knowledge and adoption of vermicompost technology.

S.N.	Practices	Knowledge		Adoption			
				Complete		Partial	
		F	%	F	%	F	%
1	Use of organic materials and farm residues such as stubbles, sugarcane trash, litter, garbage from home and urban cities.	140	100.00	122	87.14	18	12.86
2	Use of raised bed, digging the soil up to 2" to 3", width 2.5' to 3' and height 3 to 4'	140	100.00	139	99.28	1	0.72
3	Use of mixture of cow dung and organic material in ratio of 1:1.	83	60.00	14	10.00	126	90.00
4	Spreading feed mixture over the bed in direction of length by using *ghamela*. Lying two heap of mixture a side and place third *ghamela* on the top of two aside heap.	41	29.28	6	4.28	134	95.72
5	Use of earthworm species viz. *Esenia foetida* and *eudrituseugenine*.	46	32.85	7	5.00	133	95.00
6	Use of 100 earthworm or one kg of vermicompost (with eggs) over every five *ghamelas* of mixture.	35	25.00	14	10.00	126	90.00
7	Use of gunny bags or grass for covering vermicompost bed .	140	100.00	138	98.57	2	1.43
8	Application of water with the help of water spray can, spray water every day in summer and at an interval of 2 to 3 days in winter on bed.	140	100.00	138	98.57	2	1.43
9	Application to soil within 40 to 45 days.	140	100.00	92	65.72	48	34.28
10	Separation of earthworm from vermicompost with the help of sieve.	139	99.28	96	68.57	44	31.43

had knowledge of the practices like spreading feed mixture over bed (29.28 %) and use of earthworm species and its number (32.85 & 25.00%, respectively). However, the percentage of farmers adopting these practices as per recommendation was negligible and thus all these practices were adopted partially by the farmers in majority (95.72, 95.00 & 90.00 %, respectively)

III. Association between profile of farmers and their adoption of vermicompost technology

The data in Table 2 reveal that the variables namely education and knowledge had positive and significant association with adoption of vermicompost technology at 0.01 level of probability, whereas socio-economic status showed positive and significant association with adoption of vermicompost technology at 0.05 level of probability. However, the remainder variables namely, age, land holding, annual income, sources of information, extension contact, scientific orientation, management orientation and input availability did not show any significant association with adoption of vermicompost technology.

The plausible reasons behind significant correlation of education, socio-economic status and knowledge with adoption of vermicompost technology might be that education opens mental faculty of an individual and leads to seek enough knowledge which is prerequisite for adoption of technology. Individuals with better socio-economic status can afford to get exposed themselves for seeking first hand knowledge from natural settings ultimately leading to behave in a positive manner towards adoption of technology. The plausible reason behind non significant association of age, land holding, annual income, sources of information, extension contact, scientific orientation, management orientation and input availability with the adoption of vermicompost technology might be that the respondents were trained in vermicompost technology at Taluka Seed Farms of State Department of Agriculture and thus could not influence the their behaviour and therefore, irrespective of their characteristics, they adopted the vermicompost technology.

Table 2 : Correlation coefficients of adoption of vermicompost technology by the farmers

S. N.	Characteristics	Coefficient of correlation'r'
1	Age	- 0.047
2	Education	0.286**
3	Land holding	0.036
4	Annual income	0.036
5	Socio-economic status	0.178*
6	Sources of information	- 0.001
7	Extension contact	- 0.102
8	Scientific orientation	- 0.076
9	Management orientation	- 0.019
10	Knowledge	0.461**
11	Input availability	0.018

** significant at 0.01 level of probability

* significant at 0.05 level of probability

CONCLUSION

On the basis of findings, it could be concluded that the farmers in majority were aware about the various practices of vermicompost technology. However, the adoption of some of the practices was partial by the respondents. These includes the important practices of vermicompost technology i.e. use of mixture of cow dung and organic material in proper ratio, spreading mixture over bed as recommended, use of species of earth worm and quantity of earth worms. This tends to imply that the emphasis needs to be paid on these aspects during training by the trainer. Secondly, the farmers with better level of education and socio-economic status need to be selected for training with a view to use them as opinion leader / contact farmer for further promotion of vermicompost technology among their peers through them. Systematic efforts on the part of State Department of Agriculture are required to properly organize the training at Taluka Seed Farms with proper selection of trainee farmers, and on the part of extension agency, these trained farmers be utilized for farmer to farmer extension of vermicompost technology.

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Information Processing Behaviour of Dairy Farmers

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ABSTRACT

The study was conducted in Akhnoor and R.S. Pura blocks of district Jammu of Jammu and Kashmir state to find out the information processing behaviour of dairy farmers. The findings revealed that majority of the respondents were found to have discussed the information received by them with the family members, friends, fellow farmers, progressive farmers and neighbours. Almost all the respondents stored information received by them by way of conveying to family members and asking them to remember. Majority of the respondents had followed the technique of transferring the information to their friends, fellow farmers, progressive farmers and neighbours.

The rapid strides that has taken place in recent years in the field of information technology has paved the way for revolutionary change in higher education and the new technologies have provided access to a vast volume of information and helped in their processing more competently. Thus, improving both quality as well as quantity of production system. The transfer of technology from the seat of its generation to the point of its utilization is widely dependent upon the efficiency of extension and client system. The last component is most important for dairy modernization. Keeping this point in view, the present investigation was undertaken with the specific objective to study the information processing behaviour of dairy farmers .

MATERIAL AND METHODS

The present study was conducted in purposively selected Jammu district of Jammu and Kashmir state as it had maximum milch bovine population. Jammu district consists of eleven blocks, out of which two blocks *viz.*, R.S. Pura and Akhnoor were selected based on maximum milch bovine population. Then from each of the selected block, five villages which fatll within the radius of 15 km from the block headquarters were selected on the basis of possessing highest milch bovine population. Thus in all, 10 villages were taken for the study. After knowing the number of dairy farmers in each village, a proportionate sample of 200 respondents was selected from these villages. Further, on the basis of number of milch animals (bovine) possessed by the dairy farmers, they were divided into three categories of small, medium and large dairy farmers. Thus, there were 80, 68 and 52 small, medium and large dairy farmers, respectively. The data were collected through personally interviewing the respondents with the help of a pre-tested structured interview schedule. Thereafter, data were analysed, tabulated and interpreted in the light of objective of the study. The information processing behaviour of dairy farmers has been analysed in terms of evaluation of information received, storage of information received and transfer of information received. The responses obtained from the respondents were recorded on three respectively. Total score obtained by each respondent as well as for each statement was calculated. Further, to determine the information processing behaviour of the respondents, mean per cent score (MPS) for each statement was calculated and ranked accordingly. Mean per cent score (MPS) was calculated by using following formula :

$$\text{Mean per cent score (MPS)} = \frac{\text{Total score obtained}}{\text{Maximum obtainable score}} \times 100$$

RESULTS AND DISCUSSION

Information evaluation methods used by the respondent:

The data incorporated in Table 1 vividly corroborate that majority of the respondents (MPS 89.71) were found to have discussed the information received by them with the family members, friends, fellow farmers, progressive farmers and neighbours which was placed at

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Table 1: Information evaluation methods used by the respondents n = 200

Information evaluation methods	Small dairy farmers		Medium dairy farmers		Large dairy farmers		Total	
	MPS	Rank	MPS	Rank	MPS	Rank	MPS	Rank
Discussion with officials of State Department of Animal husbandry	70.62	III	90.35	II	59.61	IV	73.52	III
Acceptance of received information with modifications	58.50	IV	78.02	IV	45.07	V	60.53	V
Judging on the basis of economic feasibility	82.00	II	85.14	III	93.26	I	86.79	II
Accepted information as it is	10.62	VIII	18.82	VIII	7.69	VIII	12.37	VIII
Discussion with family members, friends, fellow farmers, progressive farmers and neighbours	90.50	I	96.11	I	82.53	II	89.71	I
Judging in the light of climatic conditions	25.62	VII	49.76	VII	25.96	VII	33.76	VII
Judgement based on technical feasibility	38.75	VI	60.47	VI	38.46	VI	45.89	VI
Weigh the merit of an innovation in the light of past experience	53.12	V	70.02	V	79.80	III	67.64	IV

MPS = Mean per cent score

Table 2 : Information storage methods used by the respondents

n = 200

Information evaluation methods	Small dairy farmers		Medium dairy farmers		Large dairy farmers		Total	
	MPS	Rank	MPS	Rank	MPS	Rank	MPS	Rank
By conveying to family members and asking them to remember	93.75	I	96.17	I	97.11	I	95.67	I
By maintaining classified notebooks/ diary	50.00	III	55.94	III	40.38	III	48.77	III
Preserve in the form of printed literature like leaflets, folders, clippings appeared in newspapers etc.	13.12	V	15.29	V	10.57	V	12.99	V
By maintaining a subject matter file	25.00	IV	25.32	IV	19.23	IV	23.18	IV
By memorizing	83.75	II	86.88	II	86.53	II	85.72	II

MPS = Mean per cent score

first position in the rank hierarchy of information evaluation methods. Most of them were found to have judged the information received by them on the basis of its economic feasibility (MPS 86.79) and accorded second position to this information evaluation method. A fair proportion of dairy farmers (MPS 73.52) were found to have evaluated the received information after consultation with officials of State Department of Animal Husbandry. Processing by weighing the merit of an innovation in the light of past experience (MPS 67.64) was accorded fourth rank by the respondents followed by acceptance of received information with modifications (MPS 60.53), judgement based on technical feasibility (MPS 45.89) and judging in the light of climatic conditions (MPS 33.76) which were assigned fifth, sixth and seventh ranks, respectively by the respondents. However, it is interesting to note that small proportion of respondents (MPS 12.37) accepted the dairy information as it is received without deletion or addition.

A deep glance at the data incorporated in Table 1 divulge that discussion with family members. friends, fellow farmers, progressive farmers and neighbours was assigned first rank by small (MPS 90.50) and medium (MPS 96.11) dairy farmers. Whereas, the same information evaluation method was assigned second rank by large dairy farmers with MPS 82.53. Judging on the basis of economic feasibility was placed at second position by small (MPS 82.00), third position by medium (MPS 85.14) and first position by large dairy farmers (MPS 93.26). Likewise, discussion with officials of State Department of Animal Husbandry was accorded third rank by small (MPS 70.62), second rank by medium (MPS 90.35) and fourth rank by large dairy farmers (MPS 59.61). In case of weigh the merit of an innovation in the light oi past experience, small and medium dairy farmers assigned fifth rank with MPS 53.12 and 70.02. respectively, whereas large dairy farmers assigned third rank with MPS 79.80. Similarly, acceptance ol received information with modifications was accorded fourth rank by small and medium dairy farmers with MPS 58.50 and 78.02, respectively, while large dairy farmers assigned fifth position to this aspec! with MPS 45.07. In rest of the methods, all the categories of dairy farmers assigned similar ranks.

The frequent interpersonal communication might be responsible for majority having evaluated the information by discussion with family members, friends, fellow farmers, progressive farmers and neighbours. Besides, costly nature of dairy vocation might be responsible for majority having judged the received information on the basis of economic feasibility. Further, majority of the respondents were founc to evaluate the

Table 3 : Information transfer methods used by the respondents **n = 200**

Information evaluation methods	Small dairy farmers		Medium dairy farmers		Large dairy farmers		Total	
	MPS	Rank	MPS	Rank	MPS	Rank	MPS	Rank
To those who come and seek	73.75	II	65.76	III	42.30	IV	60.60	III
To my friends, fellow farmers, progressive farmers and neighbours	90	I	96.91	I	90.38	I	92.43	I
To my relatives	50.62	IV	50.79	IV	56.73	III	52.71	IV
To those who cultivate my land on lease	33.12	V	31.61	V	23.07	V	29.26	V
Speaking in local meetings	63.12	III	80.67	II	76.92	II	73.57	II
By conducting demonstrations to show the practical aspects of received information	7.5	VII	11.76	VII	9.61	VII	9.62	VII
Lending printed literature to others	16.25	VI	17.64	VI	15.38	VI	16.42	VI

MPS = Mean per cent score

information by way of discussion with officials of State Department of Animal Husbandry. Veterinary Attendants were considered as the reliable sources of communication by the respondents to check with. Similar findings were reported by Balasubramanian (1976), Kadian and Kumar (2002) and Ganesan *et al.* (2004).

Information storage methods used by the

The data incorporated in Table 2 reveal that almost all the respondents stored information received by them by way of conveying to family members and asking them to remember (MPS 95.67) closely followed by the method of memorization (MPS 85.72), which were placed at first and second positions in the rank hierarchy of information storage methods. Nearly half of the respondents (MPS 48.77) maintained classified note books/diary to store the information. However, by maintaining a subject matter file (MPS 23.18) and preserving the form of printed literature like leaflets, folders, clippings appeared in newspapers, etc., (MPS 12.99) got very minimal response, which were accorded fourth and fifth ranks, respectively by the respondents. A further perusal of data reveals that all the categories of dairy farmers had similar pattern of ranking with respect to use of information storage methods for processing information relevant to their vocation. Similar findings were reported by Pramella (1992) and Kadian and Kumar (2002).

Information transfer methods used by the respondents

The data given in Table 3 vividly corroborate that majority of the respondents (MPS 92.43) had followed the technique of transferring the information to their friends, fellow farmers, progressive farmers and neighbours. Nearly three-fourth of the respondents (MPS 73.57) transferred the received information by speaking in local meetings. A fair proportion of dairy farmers (MPS 60.60) gave information to those who come and seek. More than half of the respondents (MPS 52.71) transferred the received information to their relatives. More than one-fourth of the respondents (MPS 29.26) gave the information to those who cultivate their land on lease. However, it is discouraging to note that a small proportion of respondents had the habit of lending printed literature to others (MPS 16.42) and conducting demonstrations to show the practical aspects of the received information (MPS 9.62).

A deep glance of the data incorporated in Table 3 show that the method of speaking in local meetings was accorded third rank by small dairy farmers (MPS 63.12), whereas the same method was assigned second rank by medium (MPS 80.67) and large dairy farmers (MPS 76.92). The method of giving information to those who come and seek was assigned second rank by small (MPS 73.75), third rank by medium (MPS 65.76) and fourth rank by large dairy farmers (MPS 42.30), respectively. However, in case of method, passing on information to their relatives, both small and medium dairy farmers accorded fourth position with MPS 50.62 and 50.79, respectively, whereas the same method was assigned third position by large dairy farmers with MPS 56.73. Rest of the items were accorded similar ranks by all the categories of respondents. It was observed during the period of data collection that majority of the respondents had regular contact with their friends, fellow farmers, progressive farmers and neighbours. This might be the plausible reason that majority of them transferred the received information to their friends, fellow farmers, progressive farmers and neighbours. Similar findings were reported by Ramasubramanian and Manohar in (2003)[1x]

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RESULTS AND DISCUSSION

A) Adoption level of respondents about Cotton + Green gram/Black gram intercropping practices (1:1)

Out of 150 respondents studied, only 122 respondents followed cotton + Green gram/ Black gram intercropping. Adoption level of these respondents have been studied and the data are presented in Table 1.

Table 1 : Distribution of respondents according to their adoption level about Cotton + Green gram/ Black gram intercropping practices.

S. N.	Adoption level Respondents (n=122)	
	Frequency	Percentage
1. Low	22	18.03
2. Medium	89	72.95
3. High	11	9.02

From the data presented in Table 1, it was observed that about three fourth of respondents (72.95 %) had medium level of adoption of intercropping of Cotton + Green gram/ Black gram. The percentage of respondents having low level of adoption was 18.03 per cent, whereas only 9.02 per cent of them had high adoption level. Thus, it could be inferred that majority of the respondents had medium level of adoption about intercropping of Cotton + Green gram/ Black gram.

B) Adoption level of respondents about Cotton + Sorghum + Pigeon pea + Sorghum (6:1:2:1)

Out of 150 respondents studied, only 11 respondents followed Cotton + Sorghum + Pigeon pea + Sorghum intercropping practices. Adoption level of these respondents have been studied and the data are presented in Table 2.

Table 2 : Distribution of respondents according to adoption level about Cotton + Sorghum + Pigeon pea + Sorghum intercropping practices.

S.N. Adoption level	Respondents (n=11)	
	Frequency	Percentage
1. Low	4	36.37
2. Medium	5	45.45
3. High	2	18.18

The data in Table 2 revealed that majority of the respondents (45.45 %) had medium level of adoption of intercropping of Cotton + Sorghum + Pigeon pea + Sorghum, followed by 36.37 per cent of them in low adoption level. Only 18.18 per cent of respondents were in high adoption level. Thus, it could be inferred that majority of respondents had medium level of adoption about intercropping of Cotton + Sorghum + Pigeon pea + Sorghum practice.

C) Adoption level of respondents about Sorghum + Pigeon pea /Green gram (3:3).

Out of 150 respondents studied, 79 respondents adopted Sorghum + Pigeon pea/ Green gram intercropping. Adoption level of these respondents have been studied and the data are presented in Table 3.

Table 3 : Distribution of respondents according to adoption level about Sorghum + Pigeon pea /Green gram intercropping practices.

S.N. Adoption level	Respondents (n=79)	
	Frequency	Percentage
1. Low	20	25.32
2. Medium	44	55.69
3. High	15	18.99

The data in Table 3 revealed that majority of the respondents (55.69 %) had medium level of adoption of intercropping of Sorghum + Pigeon pea /Green gram. The percentage of respondents in low adoption level was 25.32 per cent, where as only 18.99 per cent of them had high adoption level. Thus, it could be inferred that majority of the respondents had medium level of adoption about intercropping of Sorghum + Pigeon pea/ Green gram. Similar finding was observed by Kude *et al.* (1991).

Practice wise adoption of different intercropping practices by the farmers :

The data with regards to the practicewise adoption of recommended intercropping practices under three different intercropping pattern have been presented in Table 4.

A) Cotton + Green gram /Black gram (1:1)

Out of 150 respondents studied, 122

Table 4 : Distribution of respondents according to their practicewise adoption about the recommended intercropping practices

S. N.	Practice	Cotton + Green gram / Black gram n=122			Cotton+Sorghum+ Pigeon pea + Sorghum n=11			Jowar + Pigeon pea / Green gram n=79		
		Complete	Partial	Non adopters	Complete	Partial	Non adopters	Complete	Partial	Non adopters
1.	Ratio of intercropping (1 : 1),(6: 1 :2: 1), (3: 3)	88 (72.13)	16 (13.11)	18 (14.28)	0 (0.00)	0 (0.00)	11 (100.00)	15 (18.98)	10 (12.67)	54 (68.35)
2.	Soil type	86 (70.49)	15 (12.29)	21 (17.22)	8 (72.72)	1 (9.10)	2 (18.18)	60 (75.94)	9 (11.39)	10 (12.67)
3.	Fertilizer dose for main crop	11 (9.01)	68 (55.73)	43 (35.24)	0 (0.00)	4 (36.36)	7 (63.64)	12 (15.20)	32 (40.50)	35 (44.30)
4.	Fertilizer dose for intercrop	104 (85.24)	0 (0.00)	18 (14.75)	9 (81.81)	0 (0.00)	2 (18.19)	65 (82.27)	0 (0.00)	14 (17.73)
5.	Basal dose of fertilizer for main crop	11 (9.01)	68 (55.73)	43 (35.24)	0 (0.00)	4 (36.36)	7 (63.64)	12 (15.20)	32 (40.50)	35 (44.30)
6	Second dose of fertilizer for main crop	11 (9.01)	68 (55.73)	43 (35.24)	0 (0.00)	4 (36.36)	7 (63.64)	12 (15.20)	32 (40.50)	35 (44.30)
7.	Spacing between two rows of main crop	12 (9.84)	55 (45.08)	55 (45.08)	0 (0.00)	2 (18.19)	9 (81.81)	8 (10.12)	36 (45.56)	35 (44.30)
8.	Spacing between two plants of main crop	9 (7.38)	23 (18.85)	90 (73.77)	0 (0.00)	1 (9.10)	10 (90.90)	5 (6.33)	19 (24.05)	55 (69.62)
9.	Seed rate of main crop	25 (20.49)	60 (49.18)	37 (30.93)	4 (36.36)	3 (27.28)	4 (36.36)	25 (31.64)	37 (46.84)	17 (21.22)

Figure in parenthesis indicate percentage

respondents found to adopt intercropping of Cotton + Green gram /Black gram.

The practicewise adoption of the intercropping pattern by the respondents presented in Table 4 revealed that a great majority of the respondents had complete adoption with regard to fertilizer dose for intercrop i.e. no need of fertilizer application for intercrops (85.24 %), ratio of intercropping in Cotton + Green gram / Black gram (72.13 %), soil type required for main crop (70.49 %).

Further, it is seen that 55.73 per cent of respondents had partially adopted the fertilizer application for main crop, spacing between two rows of main crop (45.08 %) and seed rate of main crop (49.18 %). However, 73.77 per cent of respondents did not adopt spacing between two plants of main crop, followed by 45.08 per cent of them who did not adopt the spacing between two rows of main crop.

From the above findings, it could be concluded that respondents had adopted cotton based intercropping practices, such as: no fertilizer application, ratio for intercropping, and soil type required for main crop.

B) Cotton + Sorghum + Pigeon pea + Sorghum (6:1:2:1)

Out of 150 respondents studied, only 11 respondents had adopted Cotton + Sorghum + Pigeon pea + Sorghum intercropping practices.

The practicewise adoption of the said intercropping (Table 4) revealed that majority of respondents had complete adoption with regards to fertilizer dose for intercrop i.e. no need of fertilizer application for intercrop (81.81 %), soil type required for main crop (72.72 %) and seed rate of main crop (36.36 %).

As regards to partial adoption, it is further noted that 36.36 per cent of respondents each had partially adopted the fertilizer application for main crop, basal dose of fertilizer for main crop and second dose of fertilizer for main crop, whereas seed rate for main crop was partially adopted by 27.28 per cent of respondents.

From the Table 4, it is inferred that cent per cent respondents did not adopt ratio for intercropping, followed by fertilizer application for main crop (63.64 %) , spacing between two rows of main crop (81.81 %) and spacing between two plants of main crop (90.90 %).

From the above findings, it could be concluded that respondents did not adopt the ratio of intercropping in Cotton + Sorghum + Pigeon pea + Sorghum, spacing between two plants of main crop, spacing between two rows of main crop and fertilizer application for main crop. The logical reason behind this might be that the farmers might hve felt that this type of intercropping was difficult for sowing.

C) Sorghum + Pigeon pea/ Green gram (3:3)

Out of 150 respondents studied, 79 respondents adopted Sorghum + Pigeon pea / Green gram intercropping.

The practice wise adoption by the respondents (Table 4) revealed that a majority of respondents had complete adoption with regards to fertilizer dose for intercrop i.e. no need of fertilizer application for intercrop (82.27 %) and soil type required for main crop (75.94%). However, the practices like spacing between two plants of main crop and ratio between main crop and intercrop were not adopted by majority of the respondents (69.62 % & 68.35 %, respectively).

It is further noted that a sizeable percentage of respondents had partially adopted seed rate of main crop and spacing between two rows of main crop (46.84 % & 45.56 %, respectively).

From the above findings, it could be concluded that respondents adopted intercropping practices related to no fertilizer application for intercrop, soil type required for main crop, followed by respondents not adopting the ratio for intercropping.

Extent of Adoption :

The data with regards to the extent of adoption of recommended intercropping practices have been presented in Table 5.

Table 5 : Distribution of respondents according to their adoption level about recommended intercropping practices

S.N.	Adoption level	Respondents (n=150)	
		Frequency	Percentage
1.	Low	24	16.00
2.	Medium	103	68.67
3.	High	23	15.33

A cursory look at the data in Table 5 revealed that majority of respondents (68.67 %) had medium adoption level of intercropping, followed by 16.00 per cent of them having low level of adoption, where as 15.33 per cent of respondents had high level of adoption. Thus, it could be inferred that majority of the respondents had medium level of adoption about recommended intercropping practices.

The above results revealed that majority of the respondents had medium level of adoption of recommended intercropping practices by Dr. PDKV, Akola in dryland farming. Majority of the farmers did not adopt ratio of intercropping in cotton + sorghum + pigeon pea + sorghum, and spacing between two plants of main crop in cotton + green gram/black gram and sorghum + pigeon pea/green gram intercropping. Thus, it is suggested that the farmers should be given training on dryland farming to impart skill in them. Extension personnel should try to make the farmers aware about advantages of intercropping and about benefits of adoption of recommended intercropping practices, so that it would be helpful to increase the area and productivity in dryland farming.

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Constraints Faced by the Farmers in Adoption of Summer Groundnut Technology

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ABSTRACT

A study on level of technological gap in summer groundnut technology and the constraints faced by the respondents in its adoption was conducted in Parbhani block of Parbhani district. 120 summer groundnut growers were selected randomly as sample for the study. Information was collected by personal interview schedule. Results reveal that majority of the respondents had medium level of technological gap in adoption of summer groundnut technology. High level of technological gap was observed in application of gypsum followed by seeds and sowing technique, seed treatment, utilization of irrigation water, soil type and preparatory tillage, use of plant protection measures, use of chemical fertilizers and intercultural operation. As reported by majority of farmers, the constraints in adoption of summer groundnut technology includes lack of scientific knowledge about recommendations, high cost in adoption and non-availability of inputs at proper time.

India plays a prime role in the world market of protein oilseed. It occupies first place in the production of groundnut, second in sesame and castor and third in rapeseed and mustard. India is the largest groundnut growing country accounting for 40.00 per cent of the world's groundnut area and 34.00 per cent of the world's production. However, the yield levels in the country are low and have remained stagnant at around 900 kg ha^{-1} for the past few decades. In the irrigated area, majority of farmers is cultivating groundnut in summer season because of high average yield and low attack of insects, pests and diseases as compared to *Rabi* and *Kharif* season but its productivity was not good enough. This was only due to less adoption of improved summer groundnut production technology.

Hence, the present study was undertaken with the following objectives:

1. To study the level of technological gap of summer groundnut technology.
2. To study the constraints faced by farmers in adoption of summer groundnut technology.

MATERIAL AND METHODS

The present study was confined to the Parbhani block of Parbhani district of Maharashtra state. The Parbhani block was purposively selected as it has sufficient area under summer groundnut crop. Six villages were selected purposively keeping in view the villages having more area under the summer groundnut crop and from each village, only 20 farmers were selected randomly. Thus a total 120 respondents were selected from these villages constituted the sample for the study. The data were collected from the respondents by personal interview schedule.

The technological gap in eight recommended practices viz. soil and preparatory tillage, seed and sowing technique, seed treatment, use of chemical fertilizers, application of gypsum, intercultural operations, use of plant protection measures and utilization of irrigation water in summer groundnut cultivation were considered. Composite technological gap was also worked out by considering together selected eight recommended practices of summer groundnut technology. The technological gap in selected recommended practices was calculated by following formula and expressed in terms of percentage.

$$\text{Gap index (\%)} = \frac{R - A}{A} \times 100$$

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Where,

R = Use as per recommendations (Maximum possible score)

A = Actual use (Acquired score)

The constraints faced by farmers while adopting summer groundnut technology were measured in terms of percentage.

RESULTS AND DISCUSSION

Level of technological gap

Data in Table 1 revealed that high level of technological gap in application of gypsum (39.17%) followed by seeds and sowing technique (30.00%), use of seed treatment (29.17%), utilization of irrigation water (28.33%), use of soil type and preparatory tillage (25.00%), use of plant protection measures and use of chemical fertilizers (22.50%) and intercultural operations (21.67%).

In medium level of technological gap, highest percentage of respondents were observed in use of chemical fertilizers (61.67%) followed by utilization of irrigation water (57.50%), use of soil type and preparatory tillage and plant protection measures (42.50%), seed treatments (35.83%), application of gypsum and intercultural operations (25.83%) and seeds and sowing technique (17.50%).

Similarly, low level of technological gap was noted in the highest percentage of respondents in seeds and sowing technique and in intercultural operations (52.50%) followed by seed treatments and application of gypsum (35.00 %), plant protection measures (34.17%), use of soil type and preparatory tillage (32.50%), use of chemical fertilizers (15.83%) and utilization of irrigation water (14.17%).

In case of composite technological gap, data in Table 2 indicated that majority of the respondent belonged to medium level of technological gap (53.33%), followed by high level (25.00%) and low level (21.67%) of technological gap.

Constraints faced by respondents in adoption of summer groundnut technology

The data presented in Table 3 indicated that 64.17 per cent respondents expressed that sufficient quantity of FYM or compost did not produce on their own farm due to less number of animals. While 59.17 per cent respondents perceived that they did not get FYM/ compost in time and 35.83 per cent of the respondents did not have technical knowledge about preparation of FYM or compost. High cost of FYM/compost is also a major constraint expressed by 32.50 per cent of the respondents.

Table 2. Distribution of the respondents according to their level of composite technological gap of summer groundnut technology

(n=120)

Level of technological gap	Frequency	Per cent
Low (5.45 and below)	26	21.67
Medium (5.46 to 45.08)	64	53.33
High (45.09 and above)	30	25.00

Table 1. Level of technological gap of summer groundnut technology

S. N.	Package of practices	Level of technological gap					
		Low		Medium		High	
		Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
1	Use of soil type and preparatory tillage	39	32.50	51	42.50	30	25.00
2	Seeds and sowing technique	63	52.50	21	17.50	36	30.00
3	Use of seed treatment	42	35.00	43	35.83	35	29.17
4	Use of chemical fertilizers	19	15.83	74	61.67	27	22.50
5	Application of gypsum	42	35.00	31	25.83	47	39.17
6	Intercultural operations	63	52.50	31	25.83	26	21.67
7	Plant protection measures	41	34.17	51	42.50	27	22.50
8	Utilization of irrigation water	17	14.17	69	57.50	34	28.33

Table 3. Constraints faced by respondents in adoption of summer groundnut technology

(N=120)

S.N.	Constraints in adoption of recommended technology	Frequency	Per cent*
1	**Constraints in use of FYM or compost**		
	1) Lack of technical knowledge	43	35.83
	2) Non availability	71	59.17
	3) Costly	39	32.50
	4) Not possible to produce FYM due to less number of animals	77	64.17
2	**Constraints in use of improved varieties**		
	1) Lack of knowledge	20	16.67
	2) Non-availability	97	80.83
	3) Costly	53	44.17
3	**Constraints in use of seed treatment**		
	1) Lack of technical knowledge	67	55.83
	2) Non-availability of fungicide or rhizobium culture	88	73.33
	3) Costly	102	85.00
4	**Constraints in seed and sowing technique**		
	1) Lack of scientific knowledge	39	32.50
	2) Non-possibility of timely sowing due to lack of finance	43	35.83
	3) Non-possibility of timely sowing due to late harvesting of previous crop	49	40.83
5	**Constraints in use of chemical fertilizers**		
	1) Lack of scientific knowledge	54	45.00
	2) Costly	102	85.00
6	**Constraints in application of gypsum**		
	1) Lack of knowledge about application of gypsum	48	40.00
	2) Non availability	101	84.17
	3) Costly	73	60.83
7	**Constraints in use of plant protection measures**		
	1) Lack of scientific knowledge	33	27.50
	2) Non availability of duster and sprayer	57	47.50
	3) Costly	67	55.83
	4) Complexity in use of plant protection measures	59	49.17
8	**Constraints in utilization of irrigation water**		
	1) Lack of knowledge about proper stages of irrigation	47	39.17
	2) Scarcity of water for irrigation	63	52.50
	3) Non-availability of canal irrigation at proper time	75	62.50
9	**Constraints in use of ICRISAT groundnut technology**		
	1) Lack of scientific knowledge	91	75.83
	2) Non-availability of skilled labour	107	89.17
	3) Complexity in ICRISAT technology	105	85.83
	4) Lack of time and money for ICRISAT technology	89	81.67
	5) Lack of proper levelled land for ICRISAT technology	95	79.17

* The sum of percentage is more than 100 due to multiple responses.

The constraints with regards to use of improved varieties, non-availability of improved varieties at proper time was major constraints faced by 80.83 per cent of the respondents, followed by high cost of seeds of improved varieties (44.17%) and lack of knowledge (16.67%).

So far as seed treatment is concerned, high cost of fungicide or rhizobium culture (85.00%), non-availability of fungicide or rhizobium culture (73.33%) and lack of scientific knowledge about seed treatment (55.83%) were the major problems faced by the respondents.

With regards to seed and sowing technique, the problem of late sowing due to late harvesting of previous crop and lack of finance were faced by 40.83 and 35.83 per cent of the respondents, respectively. Whereas 32.50 per cent of the respondents did not have scientific knowledge about seed and sowing technique.

In case of application of chemical fertilizers, 45.00 per cent of the respondents faced the problem of lack of scientific knowledge while 85.00 per cent of the respondents faced the problem of high cost of fertilizers.

In the respect of plant protection measures, 55.83 per cent of the respondents faced the problem of high cost of insecticides/pesticides, followed by complexity of plant protection measures (49.17%) and non-availability of duster and sprayer (47.50%). Whereas 27.50 per cent farmers did not have scientific knowledge about plant protection measures.

In case of utilization of irrigation water, the scarcity of water and non-availability of canal irrigation at proper time were major constraints faced by 52.50 and 62.50 per cent of the respondents while 39.17 per cent respondents faced the problem of lack of knowledge about proper stages of irrigation for summer groundnut. Similar findings were observed by Jaiswal and Sharma (1990) and Naiknaware (1991), Raval *et al.* (1997) and Dubolia and Jaiswal (2000).

In the present investigation was also identified constraints faced by the farmers in adoption of ICRISAT technology for summer groundnut cultivation. It was reveal that 89.17 per cent respondents faced the problem of non-availability of skilled labour while 85.83 per cent respondents expressed that ICRISAT technology was complex in nature are major problem. Whereas lack of time and money for adopting ICRISAT technology faced the problem by 81.67 per cent respondents. Lack of proper-levelled land for ICRISAT technology is also a major constraint of 79.17 per cent respondents, whereas 75.83 per cent respondents did not have scientific knowledge about ICRISAT technology.

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Effect of Different Dates of Sowing and Spacings on Seed Production of Cowpea cv. Konkan Sadabahar

S. S. Patil[1], S.G. Rajput[2], P. B. Sable[3] and S. G. Vedpathak[4]

ABSTRACT

An experiment was conducted during *Kharif* season of 2004 involving five dates of sowing i.e. 20th, 30th June, 10th, 20th and 30th July 2004 symbolized as D_1, D_2, D_3, D_4 and D_5 with three spacings i.e. 30 cm x 30 cm, 30cm x 45cm and 30 cm x 60 cm symbolized as S_1, S_2 and S_3. Of all the treatment combinations, the best was sowing on 20th June 2004 at 30 cm x 30 cm spacing which showed significant increase in weight of dry pods plot^{-1} (2.15 kg), weight of seed plot^{-1} (1.40 kg) and seed yield ha^{-1} (18.54 q). However, significantly highest average weight of dry pods plant^{-1} (40.89 g), average weight of seeds plant^{-1} (24.53 g) and narrow seed to husk ratio (1 : 1.62 and 1: 1.5) were recorded in treatment in which sowing was done on 20th June 2004 at 30cm x 60cm spacing. Thus for getting the economic yield, the sowing of cowpea Cv. Kokan sadabahar for seed production should be done in June at 30 cm x 30 cm spacing.

Cow pea (*Vigna sinesis*) is an important leguminous vegetable crop grown both for its tender pods and also for its dry seed used as pulse for culinary purpose. It is also grown for foliage as vegetable and fodder. It can be grown successfully both in summer and rainy season in the plains. According to Ravinderkumar and Singh (1998), the green pod yield of cowpea cv. Pusa komal and its attributes were maximum when the crop sown at 23rd June and continuously decreased with the delay in sowing dates. The spacing or area available plant^{-1} in the field is of a considerable importance which is decided by the nutrient status of soil and growing habit of the plant. Mascarenhas (1996) stated that bean yields were highest with closet spacing. Many workers have shown the effect of time of sowing on the production of cowpea. The yields plant^{-1} were significantly more at wider spacing 45cm x 15 cm in cowpea. (Parihar *et. al.*, 1996). Availability of quality seed is of almost importance for increasing the vegetable production and productivity.

Hence, keeping in view these facts, the present investigation was undertaken to explore the effect of different dates of sowing and spacing on seed production of cowpea.

MATERIAL AND METHODS

The experiment was undertaken at Horticultural Research Station, Subcampus, Marathwada Agricultural University, Parbhani in split plot design having three replications. There were main treatments as dates of sowing i.e. 20th June, 30th June, 10th, 20th and 30th July 2004 and subtreatments as 30 cm x 30cm, 30cm x 45 cm, 30cm x 60cm. Flat beds were prepared for sowing and on them seed sowing of cowpea cv. Kokan sadabahar was done on following dates. The dibbling was done at 10 days interval from 20th June 2004 to 30th July 2004 by keeping 30cm, 45 cm and 60cm spacing between two plants as per treatment. The plot had a gross area of 3.60m x 5.40m and net area of 2.1m x 3.6m. Recommended dose of fertilizer i.e. 50 kg N + 50 kg P_2O_5 + 50 kg K_2O per ha was applied to the crop through the mix fertilizer of 15 : 15 : 15 NPK bag^{-1} @ 650 gm plot^{-1} at the time of sowing by ring method. The ring was prepared 6 cm away and 6 cm deep from plant with the help of *Khurpi*. Gap filling and two times hand weeding were undertaken. Irrigation was given as per requirement at an interval of 8-10 days. Two sprayings of each insecticide i.e. Endosulfan + Bavistin and Thiodon + Fitalon were taken. Experimental plots were harvested by hand picking when colour of pods changed from green to yellow. Threshing was done by gentle beating with wooden ladle without injury to seeds. Observations on seed yield were recorded.

RESULTS AND DISCUSSION

1. Effect of sowing dates :

The data on seed production of cowpea as influenced by different sowing dates are presented in Table 1. Significantly maximum average weight of dry pods plant^{-1} (33.48 g), plot^{-1} (1.92 kg), weight of seeds

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Table 1 : Effect of different dates of sowing and spacings on seed production of cowpea Cv. Kokan Sadabahar.

Treatments	Weight of dry pods plant^{-1} (g)	Weight of seeds plant^{-1} (g)	Weight of dry pods plot^{-1} (kg)	Weight of seeds plot^{-1} (kg)	Seed yield (q ha^{-1})	Seed to husk ratio
D_1S_1	25.66	16.68	2.15	1.40	18.54	-
D_1S_2	33.89	21.01	1.89	1.19	15.83	-
D_1S_3	40.89	24.53	1.71	1.03	13.64	-
D_2S_1	22.53	14.64	1.89	1.23	16.28	-
D_2S_2	29.58	18.86	1.67	1.05	13.98	-
D_2S_3	34.62	20.56	1.45	0.87	11.55	-
D_3S_1	19.91	12.94	1.67	1.08	14.40	-
D_3S_2	27.10	17.26	1.51	0.96	12.80	-
D_3S_3	30.60	18.25	1.28	0.77	10.21	-
D_4S_1	17.80	11.58	1.49	0.97	12.87	-
D_4S_2	21.32	13.44	1.19	0.75	9.96	-
D_4S_3	25.04	15.18	1.05	0.63	8.36	-
D_5S_1	12.94	8.41	1.08	0.70	9.36	-
D_5S_2	16.01	10.00	0.89	0.56	7.48	-
D_5S_3	20.55	12.69	0.86	0.51	6.86	-
Sowing Dates						
D_1	33.48	20.74	1.92	1.200	16.00	1:1.62
D_2	28.91	18.02	1.67	1.050	13.94	1:1.65
D_3	25.87	16.15	1.49	0.940	12.47	1:1.66
D_4	21.39	13.40	1.24	0.780	10.40	1:1.67
D_5	16.50	10.40	0.94	0.590	7.90	1:1.70
SE (m) ±	0.33	0.21	0.016	0.009	0.13	—
CD at 5%	0.99	0.63	0.047	0.029	0.38	—
Spacings						
S_1	19.77	12.85	1.66	1.080	14.29	1:1.85
S_2	25.58	16.13	1.43	0.900	12.01	1:1.7
S_3	30.34	18.24	1.27	0.760	10.12	1:1.5
SE (m) ±	0.25	0.15	0.012	0.008	0.10	—
CD at 5%	0.74	0.46	0.038	0.023	0.31	—
Interaction (D x S)						
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	—
SE (m) ±	0.56	0.36	0.028	0.017	0.23	—
CD at 5%	1.67	1.03	0.085	0.052	0.69	—

plant^{-1} (20.74 g), plot^{-1} (1.20 kg), seed yield ha^{-1} (16.00 kg) and narrow seed to husk ratio i.e. ratio between seed weight dry pods to husk weight (1 : 1.62) were recorded in early date of sowing D_1 (20th June, 2004). This was followed by D_1, D_3 and D_4 treatments. As the date of sowing delayed, there was significant decrease in the average weight of seed plant^{-1}, plot^{-1} and ha^{-1}. Similar type of results were obtained by Ravinderkumar and Singh (1998) and Shrimati and Malarkodi (2000) in cowpea.

2. Effect of spacings :

It can be seen from Table 1 that different spacings had significant effect on seed production of cowpea. Maximum weight of dry pods plant^{-1} (30.34 g) and weight of seeds plant^{-1} (18.24 g) were recorded in treatment S_3 (30cm x 60 cm). Also the treatment S_1 (30cm x 30cm) recorded significantly highest average weight (1.66 kg) of dry pods plot^{-1}, weight of seed plot^{-1} (1.080 kg), seed yield ha^{-1} (14.51 q) and narrow seed to husk ratio plot^{-1} (1 : 1.85). This might be due to closer spacing which increased the number of plants plot^{-1} and ha^{-1} and increased the seed yield plot^{-1} as well as ha^{-1} of cowpea. The results are similar to the results obtained by Kudmulwar (1983) in cluster bean and Mascarenhas *et. al.*, (1996) in beans.

3. Effect of interaction :

Interaction effects between different dates of sowing and spacings were found to be significant in respect of weight of dry pods plant^{-1}, plot^{-1} also weight of seeds plant^{-1}, plot^{-1} and seed yield quintal ha^{-1}. By reviewing the data, it was found that treatment combination D_1S_3 (20th June at 30 cm x 30cm) was superior in producing maximum weight of dry pods plant^{-1} (40.89 g), weight of seeds plant^{-1} (24.53 g). Also significantly highest average weight of dry pods plot^{-1} (2.15 kg), seeds plot^{-1} (1.40 kg) and seed yield ha^{-1} (18.54 q) were recorded in D_1S_1 combination (20th June at 30cm x 30cm). Jain *et. al.*, (1984) studied rainfed cowpea and concluded that yield in rows of 45 cm apart were higher than in rows of 30 cm or 60 cm apart.

From the above results, it is concluded that the sowing of cowpea cv. Kokan sadabahar for seed production should be done in June at 30 cm x 30 cm spacing for economic yield.

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Correlation and Path Analysis in Sesamum

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ABSTRACT

Correlation and Path Analysis in 36 genotypes of sesamum were worked out at the field of Department of Agricultural Botany, Dr. Panjabrao Deshmukh, Krishi Vidyapeeth Akola during *Kharif* season of 2001, for 2001, for 7 characters. Genotypic coefficient of correlations were greater in magnitude than the corresponding phenotypic in most of cases indicating that there was inherent association among various characters and phenotypic expression o correlation was lessened under the influence of environment. The correlation studies revealed the importance of characters viz, height of plant at maturity, reproductive dry matter and number of branches plant^{-1} because of their strong genotypic correlation with fruit yield^{-m1}, plant height and biomass increase till maturity including indeterminate growth habit. Yield^{-m2} exhibited significant positive association with plant height, number of branches plant^{-1} and height at maturity were the reliable and effective characters to be considered while selection in crop improvement programme when high yield is the main objective.

Sesamum (*Sesamum indicum* L.) plays vital role in Indian agriculture. It is one of the most important and ancient oilseed crops cultivated in India. It is the first oilseed crop cultivated by man. Sesamum is mostly used as source of edible oil. In last 25 years attention has been paid to study variability in sesamum. In such studies quality aspects and physiological factors were not included, while in such studies greater stress was given on inheritance of morphological characters of planning breeding programmes. Therefore, the prime objective of breeding programme was to evolve varieties having high yield potential to break existing plateau of productivity and it requires information on genetic variability and relationship among characters. The main aim of present studyn was therefore to work out correlations and path analysis between the yield and its components to initiate effective breeding programmes.

MATERIAL AND METHODS

Thirty-six genotypes of sesamum were raised in a randomized complete block design with three replications at the field of Department of Agricultural Botany, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during *Kharif* 2001. Observations were recorded on five randomly selected plants from each plot for 7 characters viz number of branches plant^{-1}, number of leaves plant^{-1}, stem dry matter, leaves dry matter, reproductive dry matter, height t harvest and seed yield^{-m2}. The data obtained were subjected to analysis as per the method suggested by Panse and Sukhatme (1954). The correlations were calculated as per formula given by Johnson *et. al.*, (1955). The path analysis of expected Genetic Advance Heritability was carried as per the method given by Johnson *et.al.*, (1955).

RESULTS AND DISCUSSIONS

Estimates of Genotypic and Phenotypic Coefficients of Variation, Heritability and Genetic advance are presented in Table 1. All the characters differed significantly. The character Genotypic and Phenotypic coefficient of variations was high for seed yield^{-m2}, and number of branches plant^{-1}. The phenotypic coefficient of variation had high magnitude than genotypic coefficient of variation in all the characters.

Height at harvest showed highest genetic advance (30.90), followed by seed yield^{-m2}(29.92). These findings are in accordance with the finding of Raut *et. al.*, (1990). Phenotypic and Genotypic correlations are presented in Table 2. Genotypic ones in most of the cases indicating that there was inherent association among various characters. The results of correlation coefficients revealed that the positive and significant correlation existed for yield with number of branches plant^{-1} (0.657) similar results were quoted by Singh and Singh (2000),

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Table 1. Estimates of Genotypic Coefficient of Variation, Heritability and expected Genetic Advance over mean

S.N.	Characters	Range	Heritability	Genetic Advance	Coefficient of Variation	
					Genotypic	Phenotypic
1.	Number of branches plant^{-1}	2.73 to 12.53	0.944	1.69	27.31	28.11
2.	Number of leaves plant^{-1}	1.80 to 6.40	0.987	6.89	24.31	28.11
3.	Stem dry matter	9. 13 to _ 13.83	0.994	2.51	10.96	10.99
4.	Leaves dry matter	1.40 to 3.80	0.995	2.29	18.37	18.42
5.	Reproductive dry matter	5.2 to 9.13	0.994	2.61	18.32	18.38
6.	Height at harvest	47.8 to 105.2	0.999	30.91	19.91	19.92
7.	Seed yield	12.39 to71.44	1.000	29.92	42.51	42.51

Table 2. Genotypic (G) and Phenotypic (P) correlation coefficient among different pairs of morphological characters and yield in sesamum.

Characters	No. of branches plant^{-1} (X_1)	No.of leaves plant^{-1} (X_2)	Stem dry matter (X_3)	Leaves dry matter (X_4)	Reproductive dry matter (X_5)	Height at harvest (X_6)	Seed Yield^{m2} (X_7)
No. of branches plant^{-1} (X_1)	1.00	0.265	0.288	0.036	0.444**	0.610	0.657*
	1.00	0.257	0.281	0.035	0.432**	0.593	0.638*
No. of leaves plant^{-1} (X_2)		1.00	0.114	0.046	0.347**	0.350**	0.275
		1.00	0.113	0.044	0.344**	0.347**	0.273
Stem dry matter (X_3)			1.00	0.129	0.144	0.275	-0.048
			1.00	0.129	0.143	0.274	-0.048
Leaves dry matter (X_4)				1.00	0.258	-0.245	-0.014
				1.00	0.256	-0.244	-0.014
Reproductive dry matter (X_5)					1.00	0.469*	0.538*
					1.00	0.469	0.538*
Height at harvest(X_6)						1.00	0.582*
						1.00	0.582*
Seed Yield^{-m2}(X_7)							1.00
							1.00

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

followed by height at harvest (0.582) and reproductive dry matter (0.538), similar findings was also recorded by Gupta (1975). This is an indication of importance of these three characters. The highest genotypic correlation coefficient was recorded for the association between number of branches plant^{-1} (0.657) with seed yield followed by height at harvest (0.610) and reproductive dry matter (0.444). Then positive and significant association was observed between height at harvest with seed yield^{-m2} (0.582), followed by reproductive dry matter with seed yield^{-m2} (0.538) as well as height at harvest (0.469). These findings go to corroborate the findings of Sheelavantar *et al.* (1978), and Saha and Bhargava (1980). Positive and significant association was also observed between number of leaves plant^{-1} with height at harvest (0.350) as well as with reproductive dry matter (0.347). Similar results were conformed by Osman and Khidir (1974). The intercorrelation between the yield and morphological characters is an useful study to find out the individual character which have a strong influence on the yield.

Table 3. Path analysis studies related to morphological characters and yield in sesamum lines.

Characters	No.of branches plant^{-1} (X_1)	No.of leaves plant^{-1} (X_2)	Stem dry matter (X_3)	Leaves dry matter (X_4)	Reproductive dry matter (X_5)	Height at harvest (X_6)
No. of Branches plant^{-1} (XO	0.193	0.010	-0.026	0.03	-0.017	0.107
No. of leaves plant^{-1} (X_2)	0.051	0.038	-0.010	0.004	-0.013	0.061
Stem dry matter (X_3)	0.056	0.004	-0.092	0.011	-0.005	0.048
Leaves dry matter(X_4)	0.007	0.002	-0.012	0.086	-0.010	-0.043
Reproductive dry matter (X_5)	0.086	0.013	-0.013	0.022	-0.037	0.082
Height at harvest(X_6)	0.118	0.013	-0.025	-0.021	-0.018	0.175
Residual = 0.043						

Diagonal and bold values indicate direct effect and values above and below the diagonal indicate indirect effect.

Negative association was observed between stem dry matter with yield^{-m2} (-0.048) as well as leaves dry matter with yield^{-m2} (0.014). Similar results were obtained by Radhika *et.al.,* (1999).

The results of path coefficient analysis (Table 3) revealed that number of branches plant-1 and height at harvest were direct and positive contributing characters to seed yield^{-m2} to their high direct effect (0.193) and (0.175), respectively. It is an indication of importance of these characters in improvement programme. The results of similar nature were observed by Raut *et.al.,* (1990) and Deokar *et.al.,* (1989). The character reproductive dry matter exhibited high negative direct effect.

The analysis of data for heritability and genetic advance also exhibited high values of heritable and genetic advance for above characters indicating scope of improvement of selection and usefulness of above character as the selection indices.

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Genetic Divergence Studies with Morphological Characters in Cotton

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ABSTRACT

The genetic diversity was assessed in a set of 30 genotypes of 4 species of cotton with objective to identify genetically diveregent parents for the exploitation in hybridization programme and to determine the relative contribution of each component character towards total divergence. All genotypes were grouped into five clusters using Mahalanobis D^2 statistics Cluster I and II were largest with eight genotypes each followed by cluster III and cluster IV with four genotypes. The maximum inter-cluster distance was observed between cluster I and IV, followed by cluster I and II; while the lowest average inter cluster distance was between cluster IV and V. BSoll weight, span length at 2.5 percent, seed index had contributed considerably towards divergence. On the basis of inter-cluster distance, cluster means and per se performance a hybridization programme involving genotypes AK-32, AKH-07R, PKV Rajat, CAK-02R from the cluster I and GAK-423B, KWA-8, G-27 and Jaydhar from cluster III showing maximum inter cluster distance may be utilized in hybridization programme in order to exploit the heterosis.

MATERIAL AND METHODS

Thirty genotypes of cotton were grown during *Kharif* 2004-05 in three replications under RBD design. The field experiment was conducted at All India Coordinanted Cotton Improvement Project, Research Station, Dr. PDKV, Akola. Each entry was represented by single row of 4.5m length by keeping 45cm spacing between plants. Recommended agronomic practice was followed to raise a normal crop.

Observations were recorded on 5 randomly selected competitive plants from each replication for 9 characters viz. days to 50 percent flowering, plant height (cm), number of sympodia plant^{-1}, number of bolls plant^{-1}, boll weight (g), ginning percentage, seed cotton yield plant^{-1}, seed index (g) and staple length (mm). Mahalanobis D^2 statastics (1936) was used to assess the genetic divergence. The genotypes were grouped into different clusters as described by Rao (1952).

RESULTS AND DISSCUSSION

The analysis of variance showed significant differences among 30 genotypes for all the nine traits indicating the presence of genetic variability among 30 genotypes (Table 2). It indicated wide diversity among 30 genotypes of cotton. The cluster II and I were largest clusters each containing eight genotypes, followed by cluster III and V with five genotypes and cluster IV with four genotypes.

On the basis of magnitude of D^2 values, all 30 genotypes were grouped into 5 clusters(Table 3). The maximum inter cluster distance was observed between cluster I and III(12.07), followed by between cluster I and IV (10.09) and between cluster I and II (9.49). thus the crosses can be made between the genotypes belonging to widely diversed clusters to exploit the heterosis and for obtaining transgressive segregants in subsequent generation.

The inter and intra cluster D^2 and D values were worked from average analysis and presented in Table 4. The highest intra cluster was observed in cluster II (D=8.99) and it was followed by cluster III (D=8.75), cluster IV and I with D=7.46 and D=6.97 respectively indicating that genotypes included in these clusters may have genetic architecture. The genotypes from these clusters can be used as parent in hybridization programme to develop early maturing and high yielding varieties. The highest inter cluster distance was observed between cluster I and III (D = 12.07) followed by cluster I and IV (11.37) followed by cluster II and III (D =10.46), and cluster II and IV (D=10.09), suggesting that genetic

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makeup of genotypes included in these clusters may be entirely different from one another whereas lowest inter cluster distance was observed between cluster IV and V (D = 6.68) indicating that the genetic constitution of these genotypes in one cluster were in close proximity with the genotypes in other cluster. The existence of ample genetic diversity among the genotypes as seen from inter cluster distances was adequate for improvement by hybridization and selection for different combination of characters Kals and Garg (1996).

In order to study the contribution of individual character toward divergence among nine characters boll weight (23.90%), contribution is maximum followed by 2.5 percent span length (20.22%), seed index (16.32%), plant height (12.64%) and number of bolls plant^{-1} (9.19%) thereby indecating that these characters were considerably responsible for total divergence. These findings were similar to the findings of Rajaruthinam and Subramanian (1994). Among these characters Sambhamurty *et al.* (1995) found plant height no. of bolls plant^{-1} and ginning percentage were most important characters in deciding diversity in cotton improvement.

In variance of cluster means for all the characters indicated that maximum variation accounted

Table 1. List of Cotton genotypes included in study.

S.N.	*G. arboreum*	*G. herbaceum*	*G. barbadense*	*G. hirsutum*
1	GAK-423 B	Jayadhar	ERB – 4488	AK – 32
2	GAK – 8615 B	Sarvottam	PBN - 10350	DHY. 286-1
3	HD.110-115	GBHV-825		CAK – 023B
4	KWA – 8	G.Cot - 23		AKH- 07R
5	HD.110-115			CAK – 053B
6	G-27			AKH – 073 R
7	Arvinda			AKH – 859
8	AKA-5			AKH – 004 ypca
9	AKA-7			PKV – Rajat
10	AKA-8			CAK – 081 B
11				AKH – 31 R
12				AKH – 1174 R
13				AKH – 969 R
14				AKH – 02 R

Table 3. cluster constellation based on D^2 statistics in cotton

Cluster No	No. of genotypes included in cluster	Genotypes included
I	8	AK-32, AKH-07R, PKV Rajat, CAK–081 B, AKH -31R, AKH-1174R, AKH-969R, AKH-02R
II	8	ERB-4488, PBN-10350, DHY.286-1, CAK-023B, CAK-053B, AKH-073R, AKH-859R, AKH-004ypca
III	5	GAK-423B, KWA-8, G-27, Jaydhar, Sarvottam
IV	5	G.Cot-23, HD-162, AKA-7, AKA-8, GAK-8615B
V	4	HD.110-115, Arvinda, AKA-5, GBHV-824

Table 2. Analysis of variance for nine characters in 30 genotypes of cotton.

S.N.	Source of variation	D.F	Mean Sum of squares								
			Days to 50 % flowering	Plant height	Number of sympodia plant^{-1}	No. of bolls plant^{-1}	Boll Wt. (g)	Ginning percentage	Seed Index (g)	Span length 2.5 percent (mm)	Seed cotton yield plant^{-1}
1	Replication	2	27.03	350.68**	116.34**	8.01**	0.83 x 10 $^{-2}$	17.23**	0.46	0.52	74.03
2	Genotype	29	67.86*	579.32**	15.80**	42.23**	0.61**	15.37**	4.14**	8.48**	359.0**
3	Error	58	31.24	308.03	7.70	3.56	0.032	17.23	0.28	0.28	28.09

Table 6. Cluster means for different characters

Source of variation	Days to 50 % flowering	Plant height	Number of sympodia plant^{-1}	No. of bolls plant^{-1}	Boll Wt. (g)	Ginning percentage	Seed Index (g)	Span length 2.5 percent (mm)	Seed cotton yield plant^{-1}
I	61.30	70.93	8.78	14.59	2.88	38.26	7.15	24.24	41.04
II	66.19	61.67	7.07	10.22	2.36	35.78	6.96	22.27	24.02
III	67.22	92.00	11.00	10.33	1.98	38.62	5.33	20.68	20.27
IV	70.92	87.83	11.08	11.75	2.70	36.52	5.42	21.89	31.51
V	65.47	83.00	12.67	16.00	2.31	37.2	5.65	22.60	37.32
S.D	4.76	13.90	2.29	3.80	0.45	2.26	1.17	1.68	10.94
Variance	22.65	193.21	5.25	14.44	0.21	5.11	1.37	2.83	119.61

Table 4. Average intra and inter cluster D^2 and D values of genotypes.

Cluster	I	II	III	IV	V
I	6.97	9.49	12.07	11.37	9.40
II		8.99	10.46	10.09	8.59
III			8.75	8.01	7.77
IV				7.46	6.68
V					4.34

Table 5 Contribution of each character towards genetic divergence.

S.N.	Character	Contribution (%)
1.	Days to 50% flowering	0.45
2.	Plant height (cm)	12.64
3.	Number of sympodia plant^{-1}	0.22
4.	No. of bolls plant^{-1}	9.19
5.	Boll weight (g)	23.90
6.	Ginning percentage	8.73
7.	Seed Index (g)	16.32
8.	Span length 2.5 percent (mm)	20.22
9.	Seed cotton yield plant^{-1}	8.27

by plant height (193.21), followed by seed cotton yield plant^{-1} (119.6g), days to 50 percent flowering (22.65) and number of bolls plant^{-1} (14.44). According to Carvaltho *et al* (1995) above characters are important factors of diversity in the present material.

These characters should be given priority in breeding programme. Thus this study helps to identify genetically divergent parents for initiating hybridization programme and to decide the important character contributing towards total genetic divergence.

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Exploitation of Heterosis in Interspecific Derivatives of Sunflower

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ABSTRACT

Combining ability and heterosis were studied in sunflower using 8 CMS lines mated with 5 testers in Line x Tester design. The cross CMS 240A x ID 5016 exhibited highest heterosis, heterobeltiosis and standard heterosis for seed yield plant $^{-1}$ and yield attributing characters namely head diameter, percentage of filled seeds head^{-1}, harvest index and oil content. CMS 336A and CMS 240A were identified as good general combiner for seed yield and other traits. The testers ID 5020 and ID 1020 were proved good general combiner for seed yield and other traits. Crosses CMS 240A x ID 5016, CMS 60A x ID 5020, CMS 336A x ID 1020 were the best specific combinations for yield and yield contributing characters. Present study indicated possibility of evolving production of interspecific derivatives with desirable characters in sunflower.

Genetic architecture of the parents and their crosses necessitates the assessments of parents in hybrid combination through systematic genetic studies of the parents for general and specific combining ability effects. Hence, the present investigation was undertaken to determine the heterosis and combining ability for various economic traits in sunflower.

MATERIAL AND METHODS

The experimental material comprised of eight CMS lines and five testers crossed in line x tester fashion. The 40 F_1's and their parents were grown in randomized block design with three replications during rabi 2004 at Oilseed Research Unit, Dr. PDKV, Akola. The observations were recorded on five randomly selected plants per line for days to maturity, head diameter, percentage of filled seeds head^{-1}, hundred seed weight, harvest index, seed yield plant^{-1}, oil content and hull content. The interspecific derivatives were obtained from Project Director (Oilseeds), Directorate of Oilseed Research Hyderabad. Heterosis, heterobeltiosis and standard heterosis were calculated following the standard procedure. The data was also subjected to combining ability analysis as Kempthorne (1957). The suggestions of Arunachalam (1974) were also kept in view.

RESULTS AND DISCUSSION

The analysis of variance for combining ability (Table 1) indicated that variance due to females were highly significant for seed yield and yield traits. Similarly the variances due to males were highly significant for all the traits except days to maturity. However, parents vs crosses exhibited significant differences for all the characters except days to maturity which indicates the presence of substantial amount of genetic variability among the parents.

The phenomenon of heterosis was of general occurrence for all the characters. Top ranking cross combinations for different traits have been listed in table 2, along with per se performance, sca effects, gca status of parents with all three types of heterosis, Sca effects and per se performance were not always in consistency. Superior crosses involve high and low combiners as parents. CMS 240A x ID 5016 was highest yielding (47.24g) cross combination on the basis of per se performance and standard heterosis.this cross also had highest significant positive heterosis and heterobeltiosis for head diameter, percentage of filled seeds heads^{-1} and harvest index.

Another cross viz. CMS 336A x ID 1020 exhibited better parent heterosis for seed yield plant^{-1}, though it was second on the basis of per se performance and standard heterosis. This cross also showed significant standard heterosis for head diameter and harvest index. High extent of heterosis coupled with high sca effects for seed yield presented bright prospect for developing commercial hybrid in sunflower. The significant levels of all three types of heterosis along with gca, sca effects for seed yield and yeld attributing characters in sunflower

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Table 1: Analysis of variance for combining ability

Source of variation	D.F.	Days to maturity	Head diameter (cm)	Percentage of filled seeds head-1 (%)	Hundred seed weight (g)	Harvest index (%)	Seed yield palnt^{-1} (g)	Oil content (%)	Hull content (%)
		1	2	3	4	5	6	7	8
Replications	2	27.967	1.341	61.475	0.136	10.931	13.281*	0.954	7.433
Females (lines)	7	78.908*	2.166	227.065**	2.226**	258.730**	307.411**	21.717**	34.091**
Males (lines)	4	58.115	4.352**	229.172**	0.343*	141.139**	188.339**	48.763**	27.217**
Female Vs Males	28	8.053	1.937*	80.841*	0.141	103.245**	83.532**	4.202	21.96
Error	78	26.608	1.168	42.526	0.109	4.86	3.77	3.437	5.45

*, ** Significant at 5% and 1% respectively

Table 2: Superior cross combinations selected on the basis of perse performance along with respective sca effect, gca status and heterosis.

Crosses	Seed yield plant-1 (g)	Heterosis (%)			Sca effects	Gca effects with type of parents	Significant gca effects for other characters	Significant sca effects for other characters	Significant heterosis for other characters		
		H1	H2	H3					H1	H2	H3
CMS 240A x ID 5016	47.24**	154.28**	91.32**	76.85**	8.59**	8.41** (H) x –0.24 (L)	P1 = 3,4,8 P2= 3,8	7,8	2,3,5,7	2,3,5	2,4,5
CMS 336 x ID 1020	44.01**	78.60**	36.28**	64.75**	7.56**	3.34** (H) x 2.63** (H)	P1 = 2,3, P2= 2,5	3,5	2,3,5	2,5	2
CMS 240A x ID 1020	42.80**	91.28**	32.55**	60.24**	1.28	8.41** (H) x 2.63** (H)	P1 = 3,4,5,8 P2= 2,5	5	2,3,4,5,7	4,5,8	2,4,5
CMS 147A x ID 5020	42.26**	98.54**	30.90**	58.20**	6.59**	1.76** (H) x 3.07** (H)	P1 = 7,8 P2=3,4,5,7,8	-	2,4,8	2,7	2,7,8
CMS 336A x ID 3030	37.97**	75.89**	44.81**	42.15**	6.86**	3.34** (H) x -2.70** (H)	P1 = 2,3 P2=2	5	2,5,7	2	2

Table 3 : General combining ability effects of parents in sunflower

S. N.	Parents	Days to maturity	Head diameter (cm)	Percentage of filled seeds head^{-1} (%)	Hundred seed weight (g)	Harvest index (%)	Seed yield plant^{-1} (g)	Oil content (%)	Hull Content (%)
	Females lines	1	2	3	4	5	6	7	8
1	CMS 60A	0.57	-0.18	-3.92	0.49	3.52	-6.47	0.72	0.25
2	CMS 103A	2.43	-0.22	-5.89	0.37	-0.21	-1.88	1.99	1.62
3	CMS 145A	2.84	-0.55	-0.18	-0.33	3.12	-2.27	-1.25	0.65
4	CMS 147A	-1.56	0.17	1.96	-0.11	-0.05	1.76	1.35	-1.35
5	CMS 148A	3.44	-0.16	1.05	-0.01	-4.86	-2.79	0.48	-1.48
6	CMS 237A	-2.76	0.23	-2.46	0.28	-1	-0.11	-0.81	0.12
7	CMS 240A	-0.62	-0.01	5.18	0.60	8.39	8.41	-1.16	2.92
8	CMS 336A	0.51	0.72	4.26	-0.33	-1.87	3.34	0.13	0.52
	SE (gi)	1.08	0.23	1.37	0.07	0.46	0.41	0.39	0.49
	CD at 5%	2.1492	0.4577	2.7263	0.1393	0.9145	0.8159	0.7761	0.9751
	CD at 1%	2.8501	0.607	3.6154	0.1847	1.1239	1.082	1.0292	1.2931
	Male (Testers)								
9	ID 1020	1.32	0.38	-1	-0.04	2.26	2.63	-0.05	0.53
10	ID 1078	-0.77	-0.62	-4.66	0.14	-1.87	2.76	-1.04	1.38
11	ID3030	1.98	0.40	0.1	-0.14	-3.26	-2.7	-0.17	0.7
12	ID 5016	-1.6	-0.2	2.90	-0.07	1.12	-0.24	-1.14	0.88
13	ID 5020	-0.93	0.03	2.66	0.10	1.74	3.07	2.39	-1.03
	SE (gi)	0.82	0.17	1.03	0.05	0.35	0.31	0.29	0.37
	CD at 5%	1.6318	0.3383	2.0497	0.0995	0.6965	0.6169	0.5771	0.7363
	CD at 1%	2.164	0.4486	2.7182	0.132	0.9237	0.8181	0.7653	0.9764

were alsoreported by Jagdeshwar *et al.* (2001), Radhika *et al.* (2001) and Phad *et al.* (2002).

The gca effects of the parents are presented in Table 3. CMS 240 A exhibited highest significant gca effects (8.41) for seed yield plant^{-1} followed by CMS 336A and CMS 147A. The CMS 240A also showed significant gca effect for other characters like percentage of filled seed head $^{-1}$, hundred seed weight and harvest index. Among the testers, ID 5020 and ID 1020 showed maximum significant positive gca effects 3.07 and 2.63 simultaneously for seed yield plant^{-1}. ID 5020 also showed significant gca effect for percentage of filled seeds head^{-1}, hundred seed weight, harvest index, oil content and hull content and proved to be good general combiner. Sixteen (Out of 40) promising specific cross combinations have been presented in Table 4. The cross CMS 240A x ID 5016 showed highly significant sca effects (8.59) for seed yield plant^{-1} and moderate for oil content (1.76) and hull content (-3.42). The crosses CMS 60A x ID 5020, CMS 336A x ID 1020, CMS 103A x ID 1078 and CMS 237A x ID 5020 also showed significant sca effects for seed yield plant^{-1} and yield attributing characters. Similar results for gca, sca, effects were also reported earlier by Khurana and Bhatia (1996); and Halaswamy (2004).

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Effect of Integrated Nutrient Levels on Yield and Juice Quality of Sweet Sorghum

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ABSTRACT

A field experiment was conducted during *Kharif* (2004-05) at Sorghum Research Unit, Akola to study the response of three sweet sorghum genotypes viz., SSV-84, AKSSV-15, AKSSV-22 to different levels of N, P,K with FYM @ 5 t ha^{-1} and biofertilizers. The experimental results revealed that varietal differences were found significant in respect of juice yield and quality parameters. Genotype AKSSV-15 was found significantly superior in respect of grain yield (23.39 q ha^{-1}), whereas maximum green cane yield (61.77 t ha^{-1}) was recorded by genotype SSV-84. Genotype SSV-84 recorded maximum juice yield (11969 *l.* ha^{-1}) with highest brix (17.37 %) and non reducing sugar (9.23%) and lowest pH (4.97). 100 per cent RDF (80:40:40 kg NPK ha^{-1}) recorded highest grain and fodder yield (23.79 q ha^{-1} and 135.73 q ha^{-1}, respectively). However, application of 75 per cent RDF (60:30:30 kg NPK ha^{-1}) with FYM and biofertilizer was optimum for getting superior quality parameters.

Sweet sorghum (*Sorghum biocolor* (L.) Moench) is an important crop for food, fodder, fuel, jaggery, and syrup production and most important for the fuel ethanol. Sweet sorghum is potential, particularly under conditions of poor resources base against sugarcane because it requires less water and fertilizers than sugarcane. Sweet sorghum harvested at particular physiological maturity, for sweet juice from stalks and grains from earheads. The study was undertaken to study the effect of different levels of N, P, K with FYM and biofertilizers on grain and fodder yield and juice quality of sweet sorghum.

MATERIAL AND METHODS

A field experiment was conducted during 2004-05 *Kharif* season on black soils at Sorghum Research Unit, Dr.P.D.K.V., Akola in a Factorial Randomized Block Design with nine treatments. Sowing was done on 26th July 2004 with plot size 1.8 x 3 m (Net) and spacing 45 x 15 cm. Three sweet sorghum genotypes viz., SSV-84 (Check), AKSSV-15 and AKSSV-22 were tested against different treatments with three replications. The requisite quantities of N, P and K were applied through Urea, SSP & MOP, respectively. As per treatments details FYM @ 5 t ha^{-1} was applied uniformly 15 days before sowing. Seeds of all three different genotypes were inoculated with mix culture of PSB and *Azospirillum* @ 25 g each per kg seed. The crop was harvested on 15th November 2004, at physiological maturity. Grain and fodder yields were recorded. Juice yield was recorded in litre, TSS by hand refractometer, pH by pH-meter, total sugar and reducing sugar by Dubois and Somogyi method, respectively (Sadasivan and Manickam, 1996), CCS (%), total sugar index (TSQ), juice extractability calculated by using respective formulae.

RESULTS AND DISCUSSION

Grain and fodder yield

Grain and fodder yields of sweet sorghum as influenced by different treatments (Table 1) indicated that genotype AKSSV-15 recorded highest grain yield (23.39 q ha^{-1}) and fodder yield (135.87 q ha^{-1}) also. The genotypes AKSSV-15 and AKSSV-22 were found to be superior over check SSV-84 in respect of grain as well as fodder yields. Increasing levels of fertilizer showed significantly increase in grain and fodder yields, the highest grain yield (23.79 q ha^{-1}) and highest fodder yield (135.73 q ha^{-1}) were recorded with application of 80:40:40 kg NPK ha^{-1} (100% RDF). The fodder yield increased progressively with NPK from 112.96 q ha^{-1} with 50 per cent RDF + 5 t FYM/ha + Biofertilizers to 127.74 q ha^{-1} with 75 per cent RDF + 5 t FYM/ha + Biofertilizers. Kachapur and Hunje (1996) found that the maximum fodder yield 13.34 t ha^{-1} was noticed with 120 kg N ha^{-1} and 13.72 t ha^{-1} with 60 kg P ha^{-1}.

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Table 1: Grain and fodder yield (q/ha) of sweet sorghum as influenced by different treatments

Treatments		Grain yield (q ha^{-1})	Fodder yield (q ha^{-1})
Genotypes			
G_1 – SSV-84		17.44	112.86
G_2 –AKSSV-15		23.39	135.87
G_3 –AKSSV-22		21.29	127.71
'F' test		Sig.	Sig.
Fertilizer levels			
F_1 (100% RDF)		23.79	135.73
F_2 (75% RDF + 5t FYM/ha + biofertilizers)		21.97	127.74
F_3 (50% RDF + 5t FYM/ha + biofertilizers)		16.36	112.96
'F' test		Sig.	Sig.
SE (m) ±		0.85	0.92
CD at 5%		2.56	2.75
Interaction (Genotypes x Fertilizers)			
G1	F1	19.91	123.81
	F2	18.15	115.00
	F3	14.26	99.76
G2	F1	26.66	144.18
	F2	25.37	137.86
	F3	18.14	125.58
G3	F1	24.81	139.20
	F2	22.40	130.37
	F3	16.67	113.55
'F' test		Sig.	Sig.
SE (m) ±		1.48	1.59
CD at 5%		4.43	4.76

Interactive effect of genotypes with fertilizer levels on grain and fodder was significant and treatment G_2F_1 recorded highest grain 26.66 q ha^{-1} and fodder yield 144.18 q ha^{-1}.

Green cane and juice yield

The maximum green cane yield (61.77 t ha^{-1}) was obtained from var. SSV-84, and was significantly superior over AKSSV-15 and AKSSV-22. Application of higher doses of NPK recorded highest green cane yield (61.61 t ha^{-1}) but it was found at par with treatment F_2 (75% RDF + 5 t FYM + biofertilizer) (Table 2). Significant increase in green stalk yield with successive increase in N level upto 120 kg and phosphorus level upto 60 kg ha^{-1}, also reported by Wanjari *et al.* (1996). The interaction was also found to be significant and recorded the superiority of G_1F_1 in respect of given cane yield of sweet sorghum.

Among the tested genotypes, the check var.SSV-84 recorded maximum juice yield (11969 *l* ha^{-1}) and found at par with var.AKSSV-22 (11043 lit ha^{-1}). However, juice yield did not show any significant difference due to various fertilizer levels. It was maximum (11629 lit.ha^{-1}) in treatment consisting 100 per cent RDF. An application of N, P and K dose recorded numerically higher value, due to combined effect of higher level of N, P and K. The interaction effect between genotypes and fertilizer levels was also found non significant (Table 2).

Table 2: Green cane and juice yield of sweet sorghum as influenced by various treatments

Treatments		Green cane yield (t ha^{-1})	Juice yield(lit ha^{-1})
Genotypes			
G_1 – SSV-84		61.77	11969
G_2 –AKSSV-15		55.45	10673
G_3 –AKSSV-22		58.90	11043
'F' test		Sig.	Sig.
Fertilizer levels			
F_1 (100% RDF)		61.61	11629
F_2 (75% RDF + 5t FYM/ha + biofertilizers)		59.86	11247
F_3 (50% RDF + 5t FYM/ha + biofertilizers)		54.65	10809
'F' test		Sig.	N.S.
SE (m) ±		0.75	310.41
CD at 5%		2.26	931.24
Interaction (Genotypes x Fertilizers)			
G1	F1	65.24	12368
	F2	63.07	11982
	F3	57.00	11556
G2	F1	58.30	11056
	F2	55.91	10648
	F3	52.15	10315
G3	F1	61.30	11463
	F2	60.59	1111
	F3	54.81	10556
'F' test		Sig.	N.S.
SE (m) ±		1.31	537.66
CD at 5%		3.92	-

Quality of Juice:

The pH of juice ranged from 4.97 to 5.36. Maximum pH value was observed by genotype AKSSV-15 (5.36) and lowest by SSV-84 (4.97) Bapat *et al.* (1996) reported that the pH of juice of all sweet sorghum varieties ranged from 4.9 to 5.3 with respect to fertilizer levels, the maximum pH value was recorded at 100 per cent RDF. The pH of juice decreased numerically with decrease in fertilizer levels (Table 3). Similar results were reported by Kachapur and Hunje (1996). Genotype AKSSV-15 recorded significantly highest pH value (5.44) with 80:40:40 kg NPK and was found at par with 50 per cent RDF + 5 t FYM ha^{-1} + Biofertilizer.

The results of Table 3 indicated that, the varietal differences were found significant for the brix, reducing sugar and non reducing sugar. The highest brix per cent (17.37) and non reducing per cent (9.23) recorded in the juice of genotype SSV-84, whereas, the highest per cent of reducing sugar was observed with genotype AKSSV-15. However, with respect to fertilizer treatments, the brix value as well as non reducing sugar increased with decrease in NPK levels. Maximum brix (17.50%) and non reducing sugar (9.12%) were noticed with 40:20:20 kg NPK ha^{-1} + 5 t FYM ha^{-1} + Biofertilizer treament, while lowest brix value (15.60 %) and non reducing sugar (8.45%) were found with 100 per cent RDF (80:40:40

Table 3: Brix, pH, reducing and non reducing sugar content of sweet sorghum juice as influenced by different treatments

Treatments	Brixper cent	pH	Reducing sugar	Non-reducing sugar
Genotypes				
G_1 – SSV-84	17.37	4.97	2.15	9.23
G_2 – AKSSV-15	16.50	5.36	3.10	8.73
G_3 – AKSSV-22	16.10	5.20	2.16	8.49
'F' test	Sig.	Sig.	Sig.	Sig.
SE (m) ±	0.17	0.042	0.046	0.15
CD at 5%	0.52	0.13	0.133	0.45
Fertilizer levels				
F_1 (100% RDF)	15.60	5.27	2.70	8.45
F_2 (75% RDF + 5t FYM/ha + biofertilizers)	16.87	5.12	2.52	8.88
F_3 (50% RDF + 5t FYM/ha + biofertilizers)	17.50	5.15	2.20	9.12
'F' test	Sig.	Sig.	Sig.	Sig.
SE (m) ±	0.17	0.042	0.04	0.15
CD at 5%	0.52	0.13	0.13	0.45
Interaction (Genotypes x Fertilizers)				
G1 F1	16.7	5.07	2.28	8.79
F2	17.4	4.92	2.19	9.22
F3	18.0	4.92	1.97	9.69
G2 F1	15.4	5.44	3.34	8.32
F2	16.6	5.31	3.09	8.79
F3	17.5	5.34	2.87	9.09
G3 F1	14.7	5.29	2.47	8.24
F2	16.6	5.13	2.27	8.65
F3	17.0	5.18	1.76	8.59
'F' test	Sig.	Sig.	Sig.	N.S.
SE (m) ±	0.30	0.073	0.07	0.26
CD at 5%	0.91	0.22	0.23	-

kg NPK ha^{-1}). Highest reducing sugar per cent was observed with higher doses of NPK, it increased significantly (from 2.20 – 2.70%) with increase in nutrient levels. Similar result was also reported by Kachapur and Hunje (1996). Teli (1993) have also observed that the application of 40 kg N ha^{-1} was found optimum for most of the juice quality parameters like brix, reducing sugar, non reducing sugar and pH. The interaction effect with respect to brix and reducing sugar was found significant, whereas in respect of non reducing sugar it was found non significant.

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Land Evaluation for Land Use Planning of Warkhed Microwatershed

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ABSTRACT

Fourteen pedons of Warkhed watershed in Akola district of Vidarbha region of Maharashtra were studied during the year 2002-03, to assess and evaluate the soils for suitability of different rainfed crops. The soils were non to slightly eroded to severely eroded, well to moderately well drained, clay to clay loam, neutral to slightly alkaline in reaction with low to medium organic carbon, nitrogen & phosphorus and moderate to high in potassium contents. These soils were classified as Typic Haplusterts, Vertic Haplustepts, Typic Haplustepts and Typic Ustorthents. Qualitative and quantitative methods of land evaluation were used for interpretation of data. The qualitative methods included USDA land capability classification and FAO land suitability classification while the quantitative methods include Storie index rating and Riquier's productivity index rating. The land suitability classification indicated tha\ the soils of Typic Haplusterts and Vertic Haplustepts were found to be suitable to moderately suitable for cotton, sorghum, pigeonpea, soybean, green gram, and pearlmillet. Soils of Typic Haplustepts and Typic Ustorthents were marginally suitable to unsuitable. The FAO land suitability evaluation revealed the suitability of soils for sorghum, cotton, pigeonpea, soybean, green gram and pearlmillet with the degree of limitations of lands for specific use. Riquier's parametric approach was found to be a good indicator of production potential of soils. The results obtained in the present study may be useful to evaluate the suitability and capability of soils for important rainfed crops viz. sorghum, cotton, pigeonpea, soybean, green gram, and pearlmillet and thereby also help in soil based agrotechnolgy transfer for better harvest of these crops on similar soils occurring in the same agroclimatic region elsewhere.

The increasing need for food to support the growing population demands, systematic appraisal of soil and water resources. For increasing agricultural production on sustainable basis the importance of rational use of soil and water resources with minimum soil and water loss is needed. The need of the hour therefore should be to suggest the proper land use according to capability or suitability of land by identifying the constraints of the top production of available land. In order to use the land resources optimally on sustainable basis, it is necessary to have an up to date and precise information on existing natural resources. This can be best achieved by adopting the most scientific and efficient^ watershed based land use planning approach. There is extreme inadequacy of basic data or resources for preparation of scientifically sound watershed development plans with specific reference to land use planning. Keeping in view the importance, the present study was carried out in Warkhed microwatershed by evaluating the soil-site characteristics and various evaluation methods with respect to crop production and suggest proper land use plan for the watershed.

MATERIAL AND METHODS

The present study was undertaken during the year 2002-03 in Warkhed microwatershed in Barshitakli Tahsil of Akola district, 32 km South-East of Akola, located between 20 ° 32' 30" to 20 ° 35' 00" N latitudes and 77 ° 07' 00" to 77° l0'00" E longitudes covering an area of about 198 ha. Survey of the watershed, area was carried out with the help of Survey of India Toposheet (1:50,000) and a cadastral map (1:10,000). After traversing the watershed area, based on variations in soil-site characteristics, fourteen profile sites were selected and described (Soil Survey Staff, 1951 & 1998). Soil samples(< 2 mm) were analysed for various physico-chemical properties following standard methods(Black, 1965 and Jackson, 1967).

The data were interpreted using qualitative and quantitative methods of land evaluation. The qualitative methods included USDA land capability classification and FAO land suitability classification (FAO , 1976) while the quantitative evaluation included Storie index rating (Storie, 1978) and Riquier's parametric approach (Riquir *et al.*, 1970).

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RESULTS AND DISCUSSION

Among the fourteen typifying pedons studied, shallow soil pedons 1 to 6 and 11 were classified as Typic Ustorthents, pedons 13 and 14 as Typic Haplustepts, pedons 8 and 9 as Vertic Haplustepts and pedons 7,10 and 12 as Typic Haplusterts.

The morphological study of the soils indicated that the soils were shallow to very deep with very dark grayish brown to very dark gray colour. The surface horizons had subangular blocky structure while the subsoil horizons of Vertisols had angular blocky structure with well developed intersecting slickensides and wedge shaped structural peds. The data pertaining to physical characteristics of the soils (Table 1) showed considerable variations. Bulk density and hydraulic conductivity ranged between 1.38 to 1.57 Mg m^{-3} and 0.40 to 1.47 cm hr^{-1} respectively. The soils were clay and clay loam in texture with clay content ranging between 52.2 to 67.2 per cent which increased with depth, the silt content ranged between 7.4 to 17.0 per cent. The available water capacity varied from 8.57 to 19.57 per cent. In general, subsurface horizons retained more moisture than the surface horizons.

The chemical characteristics (Table 2) of the soils indicated that the soil reaction was slightly acidic to moderately alkaline with pH values varying from 6.51-8.03and the to eve. electrical conductivity (EC) varied from 0.13 to 0.47 dSm , indicating that the soils am-free from sodicity and salinity. The organic carbon content ranged between 0.25 to 0.67 per cent, which was low to medium. The surface layers high amount of organic carbon,which was mainly due to the accumulation of crop residues and addition of bulky organic manures. The study of exchangeable cations showed that the calcium was the dominant cation, followed by magnesium, sodium, and potassium. The content of calcium and magnesium ranged between 29.70 to 43.56 and 10.89 to 18.81 cmol (P) kg respectively, the exchangeable sodium and potassium content varied from 0.30 to 0.42 and 0.14 to 0.31 cmol (P^+) kg^{-1}, respectively. The Ca/Mg ratio varied between 1.77 to 3.54. The exchangeable sodium percentage (ESP) was recorded from 0.53 to 0.77 percent. The CEC of the soil ranged between 48.61 to 61.84 cmol (P +) kg^{-1}. The base saturation varied from 91.00 to 98.52 per cent. The available N, P and K content of the soils indicated the decreasing trend with depth and soils were found to be low in nitrogen and phosphorus content (119.6 to 216.38 and 13.23 to 26.47 kg ha^{-1}, respectively). The soils had high to very high content of potassium (263.20 to 482.72 kg ha^{-1}).

The data on capability classification of soils (Table 3) revealed that the pedons 1 to 6 are classified as IVes as these have major limitations which include shallow soil depth and erosion. These soils are shallow, clay to clay loam, well drained, low water retentive and moderately eroded. Pedons 8 and 13 have erosional limitation and roots zone limitation and hence classified as III es. These soils are clay textured, well drained and slightly eroded. The remaining pedons are classified as He as these have erosional limitation. These soils have moderate to poor drainage to high swell-shrink potential, higher moisture retentivity and unfavorable tilth.

The land suitability classification for studied soils has been done based on number and intensity of limitations. The crop requirement tables were compared with climatic and soil-site characteristics and the final land class was determined by the combination of number and degree of constraints according to the scale suggested by FAO (1976).

In the present study, important climatic and soil-site characteristics were evaluated to determine the suitability of the studied soils for sorghum, cotton and pigeonpea, soybean, greengram and pearlmillet. The crop requirements as given by Sys (1985) and compiled by NBSS and LUP (1994) were used.

It is inferred from the land suitability evaluation (Table 4) that generally, the soils of Typic Haplusterts and Vertic Haplustepts are moderately suitable for sorghum, cotton, pigeonpea, and very suitable for soybean, greengram and pearlmillet. Soils of Typic Haplustepts and Typic Ustorthents are marginally suitable to not suitable for cotton and pigeonpea.

The data (Table 5) showed that the values for the Storie index fall between very poor to fair for crop production. The very poor values of the Storie index might be the result of the integration of the various factors used for calculating the Storie index. It is observed that if a individual factor is considered the soils exhibits good rank but when the ratings for the various factors are multiplied and pooled together; the soils qualify for very

Table 1. Physical characteristics of the soils (weighted means)

Pedon	Solum depth (cm)	Particle size distribution			Bulk density ($Mgirf^3$)	HC (cm hr^{-1})	Water retention		AWC(%)
		Sand (%)	Silt (%)	Clay (%)			33kPa (%)	1500kPa (%)	
PI	13	27.7	32.5	38.9	1.39	1.07	32.88	21.73	11.15
P2	16	15.0	28.6	56.4	1.38	1.02	38.52	28.44	10.07
P3	19	17.0	28.5	54.5	1.38	0.94	30.0	19.79	10.20
P4	8	29.7	31.2	39.1	1.40	0.95	33.04	22.04	10.98
P5	11	31.8	29.3	38.9	1.49	1.03	38.09	27.05	10.98
P6	19	13.8	26.6	59.6	1.54	0.97	34.32	23.19	11.13
P7	140	11.0	28.7	60.2	1.48	0.67	38.11	20.63	17.54
P8	47	8.8	29.7	61.4	1.47	0.86	37.12	22.09	15.02
P9	58	11.8	28.3	59.8	1.49	0.75	37.19	20.98	16.19
P10	140	1.8	29.2	61.3	1.50	0.82	38.21	19.86	18.44
Pll	64	13.1	27.8	59.0	1.47	1.18	33.66	22.11	11.54
P12	115	8.7	26.5	64.7	1.48	0.82	36.74	19.73	17.01
P13	67	10.7	25.0	63.9	1.44	0.71	27.17	17.85	9.32
P14	93	12.2	23.6	64.2	1.45	0.73	36.90	24.89	11.59

Table 2. Chemical characteristics of the soils (weighted means)

Pedon	Solum depth (cm)	PH (1:2:5)	EC (dsm^{-1})	OC (%)	C_aCo_3 (%)	Exchangeable Bases				Sum bases	CEC	BS (%)	ESP
						Ca	Mg	Na	K				
						(cmol (P^+) kg^{-1})							
PI	13	7.24	0.47	0.43	3.00	38.16	12.87	0.40	0.21	52.10	55.62	93.67	0.73
P2	16	7.05	0.18	0.44	1.50	35.64	14.85	0.36	0.25	51.10	53.89	94.82	0.67
P3	19	6.70	0.23	0.45	3.25	36.55	14.85	0.35	0.21	52.06	53.11	98.02	0.65
P4	8	6.51	0.16	0.40	2.25	37.54	13.86	0.39	0.30	52.09	53.52	97.32	0.72
P5	11	7.02	0.33	0.38	2.25	29.70	15.84	0.38	0.17	46.09	49.52	93.07	0.77
P6	19	7.75	0.19	0.42	13.00	34.55	13.82	0.40	0.29	49.06	50.17	97.78	0.79
P7	140	7.73	0.26	0.48	12.2	39.42	11.91	0.39	0.25	51.98	54.42	95.50	0.71
P8	47	7.65	0.25	0.45	10.38	36.40	16.42	0.39	0.17	53.40	56.00	95.34	0.69
P9	58	7.79	0.21	0.28	18.46	41.76	15.33	0.37	0.18	57.66	59.19	97.34	0.64
P10	140	7.95	0.20	0.52	12.96	36.41	15.39	0.38	0.26	52.46	54.73	95.84	0.70
Pll	64	7.65	0.17	0.34	12.85	32.19	15.86	0.36	0.25	48.69	50.31	96.79	0.72
P12	115	7.77	0.17	0.56	19.28	37.24	17.25	0.34	0.28	55.12	57.85	95.15	0.59
P13	67	7.87	0.27	0.49	9.20	36.47	17.02	0.33	0.28	54.11	57.52	94.13	0.57
P14	93	7.91	0.14	0.35	17.98	34.05	17.41	0.32	0.23	52.03	55.43	93.84	0.58

poor to fair category. Therefore, it appears that Storie index ratings are not appropriate for ranking the soils of this area when fairly good yields of crops are obtained.

Riquier *et al.* (1970) has suggested productivity index for evaluating soils for the commonly grown crops in the area. Accordingly productivity index for the soils under study was calculated by considering nine factors which are related to soil productivity. The data (Table 6) showed that the studied soils have productivity index ranging between 9.52 to 42.84. The lowest productivity index was observed in pedons 2 and 6 (9.52) and the highest value of productivity index was observed in pedons 7,10 and 12(42.84). The productivity class was worked out from the productivity index as suggested by Riquier *et al.* (1970). Pedons 1 to 6 were classified as poor, pedons 8 and 9 were classified as average and remaining pedons were classified as good. Typic Haplusterts and Vertic Haplustepts have average to good

Table 3. Capability classification of the soils.

Pedon	Unit	Description	LCC
PI	Pl-Cl-d2-D5 B-e2	Clay loam, shallow, well drained soil, 1-3% slope, moderate erosion.	IVes
P2	P2-C-d2-D5 B-e2	Clay, shallow, well drained soil 1-3% slope, moderate erosion.	IVes
P3	P3-C-d2-D5 B-e2	Clay, shallow, well drained soil, 1-3% slope with moderate erosion.	IVes
P4	P4-Cl-d2-D5C-e3	Clay loam, shallow, well drained soil with slope 3-5%, sever erosion	Vies
P5	P5-Cl-d2-D5 B-e2	Clay loam, shallow, well drained, 1-3% slope, moderate erosion.	IVes
P6	P6-C-d2-D5 B-e2	Clay, shallow, well drained soil 1-3% slope, moderate erosion	IVes
P7	P7-C-d5-D4 A-el	Clay soil, very deep, moderately well drained, nearly leveled (0- 1 %) slope slight erosion	IIe
P8	P8-C-d3-D5 A-el	Clay soil, moderately deep, well drained, nearly leveled slight erosion	IIIe
P9	P9-C-d4-D5 A-el	Clay soil, deep, moderately well drained, nearly leveled, slight erosion	IIe
P10	P10-C-d5-D4 A-el	Clay, very deep soil, moderately well drained, nearly leveled, slight erosion	IIe
Pll	Pll-C-d4-D5 A-el	Clay soil, deep, well drained, nearly leveled, slight erosion.	IIe
P12	P12-C-d5-D4 A-el	Clay soil, very deep, moderately well drained, nearly leveled, slight erosion.	IIe
P13	P13-C-d3-D5 A-el	Clay soil, moderately deep, well drained nearly leveled, slight erosion.	III es
P14	P14-C-d5-D4 A-el	Clay, very deep soil, moderately well drained, nearly leveled, slight erosion	II e

Table 4. Suitability of some important rainfed crops

S.N.	Crop	Pedon													
		P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_7	P_9	P_{10}	P_{11}	P_{12}	P_{13}	P_{14}
1	Cotton	N_1	N_1	N_1	N_1	N_1	N_1	S_3	S_3	S_2	S_2	S_2	S_2	S_3	S_3
2	Sorghum	S_3	S_3	S_3	S_3	S_3	S_3	S_2	S_2	S_2	S_2	S_2	S_2	S_2	S_2
3	Pigeonpea	N_1	N_1	N_1	N_1	N_1	N_1	S_2	N,	S_2	s,	S_2	S_2	S_2	S_2
4	Soybean	S_3	S_3	S_3	S_3	S_3	S_3	S_2	S_3	S_2	S,	S_2	S,	S_2	S_2
5	Greengram	S_3	S_3	S_3	S_3	S_3	S_3	S_2	S_2	S_2	S_2	S_2	S_2	S_2	S_2
6	Pearlmillet	S_3	S_3	S3	N_1	S_3	S_3	S_2	S_2	S_2	S_2	S_2	S_2	S_2	S_2

productivity and Typic Haplustepts and Typic Ustorthents have poor to very poor productivity.

The Riquier's productivity index appears to be more appropriate as compared to the Storie index, where in both the cases the soil factors are considered for rating the soil productivity without considering the climatic characteristics. Thus it may be stated that Riquier's productivity index lead to the semiquantitative assessment of the soil characteristics related to crop performance.

The results obtained in present investigation may be useful to suggest the suitability and capability of soils for sorghum, cotton, pigeonpea, soybean, greengram and pearlmillet, and thereby also useful to suggest the soil based agrotechnolgy transfer for better harvest of these crops on similar soils occurring in the same agroclimatic region elsewhere.

Table 5. Storie Index Rating

Pedon	Factor A (Depth)	Factor B (Texture)	Factor C (Slope)	Factor X (Drainage)	Alkali	Nutrient level	Erosion	Storie Index	Rating
P_1	40	85	95	100	100	95	90	27.61	Very poor
P_2	40	60	95	100	100	95	90	19.49	Very poor
P_3	40	60	95	100	100	95	90	19.49	Very poor
P_4	40	85	95	100	100	95	90	24.54	Very poor
P_5	40	60	95	100	100	95	90	27.61	Very poor
P_6	40	60	95	100	100	95	90	19.49	Very poor
P_7	90	60	100	90	100	95	100	46.17	Fair
P_8	40	60	100	100	100	95	100	22.80	Poor
P_9	60	60	100	90	100	95	100	30.78	Poor
P_{10}	90	60	100	90	100	95	100	46.17	Fair
P_{11}	60	60	100	100	100	95	100	24.20	Poor
P_{12}	90	60	100	90	100	95	100	46.17	Fair
P_{13}	60	60	100	100	100	95	100	24.20	Poor
P_{14}	80	60	100	90	100	95	100	41.04	Fair

Table 6. Productivity index and productivity class of soils (Riquier etal, 1970)

Pedon	Soil moisture (H)	Drainage (D)	Depth (P)	Texture structure (T)	Base saturation (N)	Soluble salts (S)	Organic matter (O)	Nature of Clay (A)	Mineral reserves (M)	Producti -vity Index	Producti-. vity class
Pi	H_3C (70)	D_4 (100)	P_2 (20)	T_6b (90)	N_5 (100)	S, (100)	0, (85)	A_3(100)	X_3 (100)	10.71	Poor
P_2	H_3C (70)	D_4 (100)	Pi (20)	T_5b (80)	N_5(100)	S, (100)	0, (85)	A_3 (100)	X_3(100)	9.52	Poor
P_3	H_3C (70)	D_4(100)	P_2 (20)	T_5b (80)	N_5(100)	S, (100)	0_2 (90)	A_3 (100)	X_3(100)	10.08	Poor
P4	H_3C (70)	D_4(100)	P_2 (20)	T_6b (90)	N_5(100)	S,(100)	0, (85)	A, (100)	X_3(100)	10.71	Poor
P_5	H_3C (70)	D_4(100)	P_2 (20)	T_6b (90)	N_5(100)	S, (100)	0, (85)	A_3 (100)	X_3(100)	11.90	Poor
P_6	H_3C (70)	D_4(100)	P_2 (20)	T_5b (80)	N_4(100)	S, (100)	0, (85)	A_3(100)	X,(100)	9.52	Poor
P_7	H_3C (70)	D_3 (85)	P6(100)	T_5b (80)	N_5(100)	S, (100)	0_2 (90)	A_3(100)	X, (100)	42.84	Good
P_8	H_3C (70)	D_4(100)	P_3 (50)	T_5b (80)	N_5 (100)	S, (100)	0_2 (90)	A, (100)	Xj(lOO)	25.20	Average
P_9	H_3C (70)	D, (85)	P_3 (50)	T,b (80)	N_5 (100)	S,(100)	0, (85)	A, (100)	X_3(100)	20.23	Average
P.o	H_3C (70)	D_3 (85)	P_6(100)	T_5b (80)	N, (100)	S,(!00)	0_2 (90)	A, (100)	X_3(100)	42.84	Good
Pn	H_3C (70)	D_4(100)	P_4 (80)	T_5b (80)	N_5 (100)	S, (100)	0, (85)	A_3(100)	X_3(100)	38.08	Good
PI2	H_3C (70)	D_3 (85)	P_5(100)	T,b (80)	N_5 (100)	S, (100)	0_2 (90)	A_3(100)	X, (100)	42.84	Good
P,3	H_3C (70)	D_4(100)	P_4 (80)	T_5b (80)	N_5 (100)	Si (100)	0_2 (90)	A_2 (100)	X_3(100)	40.32	Good
PI4	H_3C (70)	D_4(100)	P_5 (100)	T_5b (80)	N_5(100)	S, (100)	0, (85)	A_3(100)	X_3(100)	40.46	Good

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Seasonal Variation in Milk Production

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ABSTRACT

The amount of milk production varied for different seasons of study. Rainy and winter season recorded maximum milk production as compared to summer season indicating the effect of high atmospheric temperature and low humidity during summer and also the scarcity of green forages. The morning and evening milking did not indicate any irregularity for different months and seasons of study.

The index of prosperity of any nation is counted on the consumption of milk and milk products. From the vedic period, it is mentioned that milk has become an important article of human diet and universally it is regarded as natures most complete food.

India has described as a land flowing with milk. However as compared with other advanced dairy countries it is lacking much behind.

India possesses 1/5th of world cattle population (219 million) with 30 distinct cattle breeds and 1/2th of buffalo with 6 distinct breeds population since last couple of years. India is occupying the first rank in milk production but per head milk production is very less (FAO,2004).

The present milk production for the year 2004-05 is about 91.9 million tones of milk production. India is the top most country of the world. The average annual growth rate is about 5.6 per cent in milk production. The per capita milk availability is about 214 gms per day as against the recommended requirements of 250 gms.

Seasonal variation in milk production is mostly due to fluctuations in climate and availability of fodder, climatic influence prevails even after supplying adequate nutrients (Sharma *et al.* 1988)

Significant increase in milk production in the country reflects to the combine effect of genetic improvement and managemental approach of dairy animals (Kumar,1999).

MATERIAL AND METHODS

The study was conducted at livestock instructional farm Dr. PDKV, Akola is located at the district place. It is situated outside of the city on National Highway No. 6

Akola is situated on the latitude of 22.42° north and longitude of 77.02° east with height of 307.4 m above sea level. Akola is located under hot climatic area of the tropical region weather during summer is hot in day time and pleasant during night hours. On the basis of rainfall this region is classified under "assured rainfall zone"

The required data was collected from the livestock instructional farm at Dr. PDKV, Akola during the April,05 to March,06.

RESULTS AND DISCUSSION

In summer the higher milk production in the month of March 2287.25 kg. (SD 85.65) and lower milk production is in month of April 292.75 kg. (SD 21.58). Also the per cow per month milk production in summer is higher in the month of May 115.88 kg at 8 cows in milking and the lower milk production in April 32.52 kg at 9 cows in milking. The per cow month^{-1} milk production higher in the month of May 3.86 kg and lower in the month of April 1.08 kg.

In rainy season the higher milk production was observed in October 2606.50 kg. (SD 135.24) and lower in the month of July 1488.25 kg. (SD 47.51). And the per cow month^{-1} milk production in rainy is higher in the

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Season wise morning milk production from April 05 to March 06

S.N.	Seasons	Month	No. of cows in milking	Per cow day^{-1} milk production (kg)	Per cow month^{-1} milk) production (kg)	Total milk production for cows (kg)	S.D.	C.V. (%)
1.	Summer	March06	26	2.93	87.97	2287.25	85.65	18.72
		April 05	9	1.08	32.52	292.75	21.52	36.76
		May 05	8	3.86	115.88	927.10	83.32	44.93
		June 05	12	2.80	84.29	1011.50	72.57	35.87
2.	Rainy	July 05	11	4.50	135.29	1488.25	47.51	15.96
		Aug. 05	20	3.47	104.37	2087.50	98.73	23.65
		Sept. 05	24	3.58	107.43	2578.50	141.75	27.48
		Oct. 05	26	3.62	108.64	2606.50	135.24	25.94
3.	Winter	Nov. 05	29	2.56	76.86	2229.15	156.07	35.00
		Dec. 05	27	2.68	80.62	2177.00	120.67	27.71
		Jan. 06	28	2.57	77.27	2163.75	92.07	21.27
		Feb. 06	30	2.41	72.44	2173.25	219.18	50.42

month of July 135.29 kg and total no. of cows in milking are 11 and lower in the month of August 104.37 kg and total no. of cows in milking are 20. The per cow day^{-1} milk production in rainy season higher in the month of July 4.50 kg and lower in August 3.47 kg.

In winter at morning the higher milk production was in the month of November i.e. 2229.15 kg. (SD 156.07) and the lower milk production was in the month of Jan. i.e. 2163.75 kg. (SD 92.07). The per cow month^{-1} milk production in winter higher per cow month^{-1} milk production was observed in the month of December i.e. 27 cows are in milking and milk production is 80.62 kg and lower milk production is in the month of February and the total number of cows in milking are 30 and production was 72.44 kg. The per cow day^{-1} milk production higher in winter in the month of December i.e., 2.68 kg and lower in February 2.41 kg.

Seasonal variation in milk production of evening

The total milk production at evening is compared season wise for different months in following table.

Season wise evening milk production from April 05 to March 06

S.N.	Seasons	Month	No. of cows in milking	Per cow day^{-1} milk production (kg)	Per cow month^{-1} milk) production (kg)	Total milk production for cows (kg)	S.D.	C.V. (%)
1.	Summer	March06	26	2.24	67.48	1754.50	72.46	20.64
		April 05	9	1.00	24.02	216.25	14.32	33.12
		May 05	8	3.17	95.20	761.60	68.96	45.27
		June 05	12	2.33	69.93	839.25	58.90	35.09
2.	Rainy	July 05	11	5.27	158.38	1742.25	196.62	56.42
		Aug. 05	20	2.97	89.30	1786.05	82.53	23.10
		Sept. 05	24	2.81	84.47	2027.35	116.10	28.63
		Oct. 05	26	2.64	79.49	2066.75	109.70	26.54
3.	Winter	Nov. 05	29	1.93	57.90	1679.75	112.14	33.38
		Dec. 05	27	2.02	60.73	1639.90	86.74	26.44
		Jan. 06	28	1.98	59.44	1664.45	79.21	23.79
		Feb. 06	30	2.26	67.86	2036.00	207.76	51.02

It can be seen from above table, in summer season the higher milk production is observed in the month of March i.e. 1754.5 kg. SD 72.46 and the lower milk production found in the month of April i.e. 216.25 kg. (SD 14.32) and per cow month^{-1} milk production is higher in the month of May i.e. 95.20 kg and number of cows in milking 8 and the lower milk production per cow month^{-1} is in the month of April i.e. 24.02 kg and 9 cows are in milking in this month. The per cow day^{-1} milk production higher in the month of May 3.17 kg and lower in April 1.00 kg.

In rainy season, the higher milk production is observed in the month of October i.e. 2066.75 kg. (SD 109.70) and lower milk production in the month of July 1742.25 kg, 196.62. And per cow month^{-1} milk production is higher in rainy season in the month of July i.e. 158.38 kg and in this month number of cows in milking are 11 and lower in the month of October i.e. 79.49 kg and number of cows in milking are 26.The per cow day^{-1} milk production higher in the month of July 5.27 kg and lower in the month of October i.e., 2.64 kg.

In winter season higher milk production at evening is in the month of February i.e. 2036 kg. (SD 3207.76) and lower milk production at evening in the month of December 1639.9 kg. (SD 86.74). When per cow month^{-1} milk production in winter is compared the results show that the higher milk production is in the month of February 67.86 kg and total number of cows in milking is 30 and in another side lower milk production per cow per month is observed in the month of November i.e. 57.90 kg and total number of cows in milking are 29.The per cow day^{-1} milk production in winter higher in the month of February i.e., 2.26 kg and lower in November i.e., 1.93 kg.

It is observed that the production is highest in winter season followed by rainy season and lowest in summer season. This seasonal variation can be attributed with climatic conditions as well as availability of better nutrition during winter season. In rainy season ample green fodder is available to the animals and the chlorophyll contain enhances the physiology of milk production. On the contrary such conditions and nutrition are not available during summer season hence there is decline in production level.

Kulkarni *et al.,* (1998) reported that maximum humidity had highly negative non significant effect on average daily milk yield.

Pal (1969) also reported that scarcity of climatic condition and scarcity of fodder and green resulted in decrease milk yield.

The results of this investigation are also in agreement with Hassan *et al.,* (1979) they concluded that the milk yield and milk composition decrease significantly during hot season of the year in crossbred cows.

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Quantity of Milk Obtained in Association with Time Requirement of Milking

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ABSTRACT

The time required for pre harvesting operation of milk was highest in winter and lower in April. This seasonal variation in pre harvesting time might be due to amount of milk produced. The results of actual milking time did not differ with that of pre harvesting time morning and evening milking. The difference in actual milking time for different months and season might be attributed to wards the quantum of milk harvested.

From the vedic period, it is mentioned that milk has become an important article of human diet and universally it is regarded as natures most complete food. It has an important place in the diet of human beings because of its composition, high nutritive value and digestibility.

Milk is the almost complete food to preserve health and environment. The people of the world now a days prefer a vegetarian diet with a touch of milk in it as an essential component (Ganguli, 1997).

The secretion of milk is continuous process and the flow is ceaseless in a lactating cows. The milk secreted is collected in the alveoli with in consequences become distended. The rate of milk secretion therefore, decrease with the increase in milking interval and also explains why the milk yield is generally increases with the frequency of milk yield. The let down at milking time is due to the release of milk by alveoli.

MATERIAL AND METHODS

The study was conducted at livestock instructional farm Dr. PDKV, Akola is located at the district place. It is situated outside of the city on National Highway No. 6

Akola is situated on the latitude of 22.42° north and longitude of 77.02° east with height of 307.4 m above sea level. Akola is located under hot climatic area of the tropical region weather during summer is hot in day time and pleasant during night hours. On the basis of rainfall this region is classified under "assured rainfall zone"

The required data was collected from the livestock instructional farm at Dr. PDKV, Akola during the April,05 to March,06. Time requirement for hand milking per cow was recorded with the help of "Stop watch" pertaining to the time requirement for actual milking and pre harvesting milking operation on dairy farm and separately noted the for morning and evening milk recorded is done after the suckling of calf.

RESULTS AND DISCUSSION:

Pre-harvesting time for milking at morning

Pre-harvesting time is contain the time required for the various operation like tie the legs of cow and massage it is shown in the Table.

From above table the time required for the pre-harvesting operation also compared season to season and month to month.

In summer season higher time (min.) required in the month of March 4574.5 min (SD 171.30) and lower time required in the month of April 569 min (SD 49.52). Also per cow month^{-1} time required higher in the May i.e. 231.77 min and number of cows are 8 and lower time in the month of April 63.22 min and number of cows are 9. The per cow day^{-1} time require higher in the month of May 7.72 min. and lower in the month of April 2.10 min.

In rainy season higher time required in the September i.e. 5714.5 min (SD 300.480) and lower time is required on the July i.e. 2976.5 min (SD 95.03). Also per cow time required higher in the July i.e. 270.59 min

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Season wise pre-harvest time required at morning, for milking from April - 05 to March -06

S.N.	Seasons	Month	No. of cows in milking	Per cow day^{-1} milk production (kg)	Per cow month^{-1} milk) production (kg)	Total milk production for cows (kg)	S.D.	C.V. (%)
1.	Summer	March06	26	5.86	175.94	4574.5	171.30	18.72
		April 05	9	2.10	63.22	569.00	49.52	43.57
		May 05	8	7.72	231.77	1854.2	166.65	44.93
		June 05	12	5.36	160.95	1931.50	151.91	39.32
2.	Rainy	July 05	11	9.01	270.59	2976.50	95.03	15.96
		Aug. 05	20	6.95	208.75	4175.00	197.47	23.65
		Sept. 05	24	7.10	213.10	5714.50	300.48	29.37
		Oct. 05	26	6.68	200.50	5213.00	270.49	25.94
3.	Winter	Nov. 05	29	5.12	153.73	4458.30	312.14	35.00
		Dec. 05	27	5.37	161.24	4353.50	241.28	27.11
		Jan. 06	28	5.15	154.55	4327.50	184.14	21.27
		Feb. 06	30	4.13	123.97	3719.25	375.16	50.43

and number of cows 11 and lower time required is in the October i.e. 2005 min. and number of cows are 26 cow in milking and per cow day^{-1} time require for rainy season higher in the month of July 9.01 min. and lower in the month of October 6.68 min.

In winter season higher time is required in the month of November i.e. 4458.3 min (SD 312.14) and lower time is required in the month of February i.e. 3719.25 min (SD 375.16). Also per cow month^{-1} time required is higher in December i.e. 161.24 min and total cows in milking are 27 as well as lower time required is in winter in February 123.975 min and total cows in milking are 30. The per cow day^{-1} time require is higher in the month December 5.37 min. and lower in February 4.13 min.

Pre-harvesting time for milking at evening

Pre-harvesting time for milking at evening is shown in Table.

Season wise Pre harvest time required for milking at evening from April – 05 to March-06

S.N.	Season	Month	No. of cows in milking	Per cow day^{-1} milk production (kg)	Per cow month^{-1} milk) production (kg)	Total milk production for cows (kg)	S.D.	C.V. (%)
1.	**Summer**	March06	26	4.48	134.57	3499.00	144.10	20.59
		April 05	9	1.62	48.77	439.00	29.68	33.80
		May 05	8	6.34	190.40	1523.20	137.93	45.27
		June 05	12	4.66	139.84	1678.50	117.80	35.09
2.	**Rainy**	July 05	11	10.5	316.77	3484.51	393.24	56.42
		Aug. 05	20	5.95	178.60	3572.10	165.06	23.10
		Sept. 05	24	5.63	168.94	4054.70	232.20	28.63
		Oct. 05	26	5.29	158.98	4133.50	219.41	26.54
3.	**Winter**	Nov. 05	29	3.86	115.84	3359.50	224.28	33.38
		Dec. 05	27	4.04	121.47	3279.80	173.48	26.44
		Jan. 06	28	3.90	117.13	3328.90	158.42	23.79
		Feb. 06	30	5.03	150.96	4529.00	456.50	50.39

From above Table it can seen that. In the summer the higher pre harvesting time is required in the March i.e. 3499 min (SD 144.10) and lower in April is 439 min (SD 29.68). Also per cow month^{-1} time required at evening is higher for summer in May i.e. 190.4 min for 8 cows and lower for April. i.e. 48.77 min for 9 cows. Per cow day^{-1} pre harvesting time required higher in the month of May 6.34 min. and lower in April 1.62 min.

In the rainy the higher pre harvesting time is required in the October i.e. 4133.5 min (SD 219.45) and lower in the July i.e. 3484.51 min, (SD 393.244). Also per cow per month pre harvesting time required at evening is higher for rainy in July. 316.77 min for 11 cow and is lower in October i.e. 158.98 min for 26 cows. Per cow day^{-1} pre harvesting time higher in July 10.5 min. and lower in October 5.29 min.

In the winter the higher pre harvesting time required in the February at evening i.e. 4529.0 min, (SD 456.50) and lower time is required evening in December i.e. 3279.8, (SD 173.48). And per cow month^{-1} time required for month at evening is higher in the month of February i.e. 150.96 min for 30 cows and is lower in November i.e. 115.84 min for 29 cows. Per cow day^{-1} time required higher in the month of February 5.03 min. and lower in November 3.86 min.

The pre-harvesting time required in this investigation indicated that the morning pre-harvesting time is more as compared to evening pre-harvesting time. This might be due to the time required for cleaning of animals and udder before milking. It is general practice that dung is collected throughout the day so that the animals are cleaned after evening milking such practice is stopped which resulted in dung deposition near the body of animal is specially udder portion. The another reason for such difference is watering of animals, the drinking water is made available in day time as compared to night hours.

The pre-harvesting time of milk is also associated with grooming of animals and early in the morning, the time required for grooming is more as compared to evening hours.

Shrialkar *et al.*, (1975) reported that preparation and milking time during different months the time required for preparation was lower in July and August as compared to other months. In this investigation, the results are slightly different because of availability of greens which are more in late rainy season and early winter season, this resulted in cleaning mangers for concentrate feeding.

Actual time required for milking at morning

The actual time required for milking at morning i.e. for flow of milk is shown in the Table.

From above Table it is seen that, in summer the actual time requirement for milking at morning is higher the month of March i.e. 2808.0 min, (SD 150.78) and lower in the month of April 388.8 min, (SD 17.28). Per

Season wise Actual time required at morning for milking from April – 05 to March - 06

S.N.	Seasons	Month	No. of cows in milking	Per cow day^{-1} milk production (kg)	Per cow month^{-1} milk) production (kg)	Total milk production for cows (kg)	S.D.	C.V. (%)
1.	**Summer**	March06	26	3.6	108	2808	150.78	26.84
		April 05	9	1.4	43.2	388.8	17.28	22.23
		May 05	8	3.3	100	800	57.27	35.79
		June 05	12	3.6	110	1320	54.57	20.67
2.	**Rainy**	July 05	11	3.3	100	1100	83.18	37.81
		Aug. 05	20	4.3	130	2600	118.82	22.85
		Sept. 05	24	4.0	120	2880	143.73	24.95
		Oct. 05	26	3.5	106	2756	142.44	25.84
3.	**Winter**	Nov. 05	29	3.4	102.4	2969.6	67.20	11.31
		Dec. 05	27	3.3	100	2700	149.93	27.76
		Jan. 06	28	3.4	102.5	2870	161.92	28.21
		Feb. 06	30	4.51	135.3	4059.0	522.68	64.38

cow per month time required for actual milking is higher in summer for the month of June i.e. 110.0 min. for 12 cows and lower in April i.e. 43.2 for 9 cows. Per cow day^{-1} time required for actual milking is higher in the month of June 3.6 min. and lower in April 1.4 min.

In rainy the higher actual time requirement at morning milking in the month of September 2880 min, (SD 143.73) and lower for July 1100 min, (SD 83.18). Per cow month^{-1} time required for actual milking is higher in August i.e. 130.0min for 20 cows and lower for July i.e. 100.0 min for 11cows . Per cow day^{-1} time required for actual milking is higher in the month of August 4.3 min. and lower for July 3.3 min.

In winter actual time required for milking at morning is higher in February 4059.00 min, (SD 522.68) and lower in December i.e. 2700.0 min, (SD 149.93). Per cow month^{-1} time required for actual milking in winter at morning is higher in February i.e. 135.3 min for 30 cows and lower in December 100.0 min. for 27 cows. Per cow day^{-1} time required for actual milking higher in the month of February 4.51 min. and lower in December 3.3 min.

Actual time required for milking at evening

From above table it is observed that, actual time required for milking at evening.

During in summer the higher time is required for the actual milking is in March 1752.1 min. (SD 184.29) and lower in April 218.7 min (SD 110.52). And per cow month^{-1} time required for actual milking at evening in summer is higher in May 95.2 min for 8 cows and lower in April 24.3 min for 9 cows. Per cow day^{-1} time required for actual milking higher in the month of May 3.17 min. and lower in April 0.81 min.

In rainy season the higher time required for actual milking in October 2064.4 min. (SD 103.17) and lower in July 1100 min.(SD 78.70). Per cow month^{-1} time required for actual milking at evening in rainy is higher in the month of July 100.0 min for 11 cows and lower in the month of Oct. 79.4 for 26 cows. Per cow day^{-1} time required for actual milking in higher in the month of July 3.3 min. and lower in October 2.64 min.

In winter higher time is required for actual milking in the month of February i.e. 3018 min. (SD 380.38) and lower in the month of December i.e. 1638.9 min. (SD 51.60) and per cow month^{-1} time required for actual milking at evening is higher in February i.e. 100.6 min for 30 cow and lower in November 57.9 min for 29 cow. Per cow day^{-1} higher time required for actual milking in the month of February 3.35 min. and lower for month of November 1.93 min

Season wise actual time required at evening for milking from April 2005 to March 2006

S.N.	Seasons	Month	No. of cows in milking	Per cow day^{-1} milk production (kg)	Per cow per month milk) production (kg)	Total milk production for cows (kg)	S.D.	C.V. (%)
1.	Summer	March06	26	2.24	67.4	1752.1	184.39	52.61
		April 05	9	0.81	24.3	218.7	110.52	25.26
		May 05	8	3.17	95.2	761.6	30.38	19.94
		June 05	12	2.33	69.9	838.8	23.47	13.99
2.	Rainy	July 05	11	3.3	100	1100	78.70	35.77
		Aug. 05	20	2.97	89.3	1786	67.81	18.98
		Sept. 05	24	2.81	84.4	2025.6	102.07	25.19
		Oct. 05	26	2.64	79.4	2064.4	103.17	24.98
3.	Winter	Nov. 05	29	1.93	57.9	1679.1	104.78	31.20
		Dec. 05	27	2.02	60.7	1638.9	51.60	15.74
		Jan. 06	28	1.98	59.4	1663.2	75.49	22.69
		Feb. 06	30	3.35	100.6	3018	380.38	63.02

It is observed that the actual milking time required during morning milking was lower is compare to evening milking this was associated with the milk production and also the interval between two milkings. In present study the interval between two milkings was not exactly 12 hours duration of the time between evening milking and morning milking was more and the milk production was lower during evening milking.

Shrialkar *et al.,* (1975) reported higher milking time during the month of July and lower milking time during the month of November The results of the present investigation are not in agreement which might be due to higher production level in the month of October as compared to July.

Kuber Ram and Kulwant Singh (1979) reported more labour cost as compared to other component except feed, the time required for milking in the present investigation also indicated the same type of results.

Aulakh *et al.,* (1974) studied the requirement of labour for milking the cows by hand milking and they reported that, seasons, time of milking and the milkers had significant effect on total milking time. In the present investigation such seasonal variation and time of milking had shown the changes in the milking time.

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Studies on Air Sleeve Boom Sprayer

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ABSTRACT

Air sleeve boom sprayer was modified to improve the effectiveness of pesticides application. The laboratory test results of air velocity trajectories at sleeve outlets with exiting blower diffuser and modified diffuser showed almost even and uniform. The sprayer was tested at total nine combination of travel speed (2, 3 and 4 kmh^{-1}) and system pressure (15,20 and 25 $kgcm^{-2}$) in the field for its performance evaluation in terms of droplet size distribution. The droplets size distribution analysis showed that the spraying treatment with 3 kmh^{-1} travel speed and 25 $kgcm^{-2}$ system pressure was found best amongst the nine treatments for effective spraying with average droplet density ranged between 32 to 23 droplets cm^{-2} and uniformity coefficient of variation was found to be 3.54 to 3.10.

Plant protection is only solution to save not only crops but also the valuable inputs like seeds, fertilizer and irrigation. Precise and uniform application and distribution of pesticide as well as correct application rate are vital for pest control at minimum cost and without damage to the crop and environment (Andrew and Michael, 2001). Presently spraying is carried out by manually or by boom sprayer but they are not effective to deposit spray droplets uniformly.

The air sleeve boom sprayer brings about a major improvement in the spraying process by alleviating the drawbacks of the conventional sprayers. The spraying with air sleeve improves coverage, boosts chemical effectiveness and makes every spraying job easier and faster. The air sleeve boom sprayer was modified at Department of Farm Power and Machinery, Dr. PDKV, Akola with the collaboration of Aspee Research Institute, Mumbai to evaluate its performance.

MATERIAL AND METHODS

Air sleeve boom sprayer was modified for applying herbicides, insecticides, fungicides and other compounds to field crops like vegetables crops, tobacco, cotton etc. A schematic view of an air sleeve boom sprayer is shown in Fig.1. It consisted pesticides tank HTP pump (horizontal triplex pump), control panel assembly, oil tank, hydraulics meter, PVC sleeves, boom nozzles and axial flow blower. A tank of 400 liter capacity of high density poly-ethylene (HDPE) was used for air sleeve boom sprayer. A horizontal triplex pump was used to generate the pressure on spray fluid for pesticide application. It was equipped with pressure control valve to stabilize the system pressure. The pressure control valve was provided on the tank to regulate the pressure in the system. The hydraulic oil pump was provided on sprayer and was operated by a gearbox with gear ratio 1:3.6. The oil pump supplied, pressurized oil to the hydraulic motor, fold and unfold piston cylinder unit and lift piston cylinder unit. All these operations were controlled electrically by 12 V DC tractor battery. Three boom made of M.S. bar were fitted with the sprayer and on which 25 nozzles were spaced at 450 mm apart.

The air sleeve boom sprayer was equipped with hydraulic and air system. Hydraulic system comprising of HTP pump, discharges high-pressure liquid while air system comprising of blower and air sleeve, supplied air required for shuffling of crop leaves. The air sleeve boom sprayer was a trailed type unit and operated by PTO of 40 hp tractor. The propeller shaft of tractor was connected with gearbox and the hydraulic pump unit was operated by shaft of gearbox. The HTP was operated by belt pulley drive from gearbox. The chemical from the tank was supplied to booms through three hosepipes via control panel assembly by HTP pump. The axial flow blower of the sprayer consisted of blower impeller, blower casing and blower diffuser. Specifications of modified aluminium blower are shown in Table 1. The blower casing with existing and modified diffuser is shown in Fig.2. The blower generates air stream and which passes air to the sleeve and spread chemical through nozzles.

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The blowers were operated at four different speeds viz., 1800, 2000, 2200, and 2400 rpm and air velocity trajectories were recorded by digital anemometer.

RESULTS AND DISCUSSION

The modified air sleeve boom sprayer was tested in laboratory and field by Air Movement and Control Association test code (AMCA). Existing M.S. blower and modified aluminum blower were tested at various blower speeds viz., 1800, 2000, 2200 and 2400 rpm. Static and dynamic pressure heads were measured at blower exits for every blower speed. The variation of air velocity and air discharge in aluminum blower at exist was found 16.60 to 19.64 ms^{-1} and 5.68 to 6.72 m^3s^{-1}, respectively at blower speed of 1800 and 2400 rpm (Table 2). Air velocity and air discharge increases with increasing blower speed. The mean static pressure was varied from 325.35 to 467.00 Nm^{-2} and mean dynamic pressure was varied from 109.70 to 151.69 Nm^{-2}. The variation of static and dynamic pressure heads was found linear with increasing blower speed. The input power given to blower was varied from 8.71 to 12.15 kW, whereas output power was varied from 2.47 to 4.15 kW. It is clear from Table 2 that as the speed of rotation increased the power output was also increased. But it was found less at test section than that of the blower exist

Table1. Specifications of modified blower

S.N.	Particulars	Modified blower
1	Material of construction	Aluminum
2	Hub diameter, cm	36.0
3	Tip diameter, cm	64.0
4	Hub to tip ratio	0.56
5	No. of blades	10
6	Length of blade, cm	14.0
7	Width of blade at hub, cm	11.0
8	Width of blade at tip, cm	9.0
9	Spacing between two blades at hub, cm	11.5
10	Spacing between two blades at hub, cm	20.0
11	Blade inlet angle at hub, degree	30
12	Blade inlet angle at tip, degree	25
13	Blade inlet angle at hub, degree	60
14	Blade inlet angle at hub, degree	50

Table 2. Performance of existing and modified aluminum blower

S.N.	Particulars	Blower speed, rpm							
		1800		2000		2200		2400	
		E	M	E	M	E	M	E	M
1	Air velocity, ms^{-1}	16.66	16.60	17.30	17.25	18.94	19.12	19.46	19.64
2	Air discharge, m^3s^{-1}	5.70	5.68	5.92	5.90	6.48	6.54	6.66	6.72
3	Mean static pressure, Nm^{-2}	335.09	325.35	370.93	359.89	438.20	435.77	465.54	467.00
4	Mean dynamic pressure, Nm^{-2}	109.82	109.70	119.08	118.36	140.88	143.40	149.17	151.69
5	Input power to blower, kW	11.30	8.71	12.15	9.10	14.52	11.30	15.39	12.15
6	Output power of blower, kW	2.53	2.47	2.90	2.82	3.75	3.78	4.09	4.15
9	Blower efficiency, %	22.38	28.35	23.87	30.98	25.84	33.45	26.57	34.16

E- Existing blower, M- Modified blower

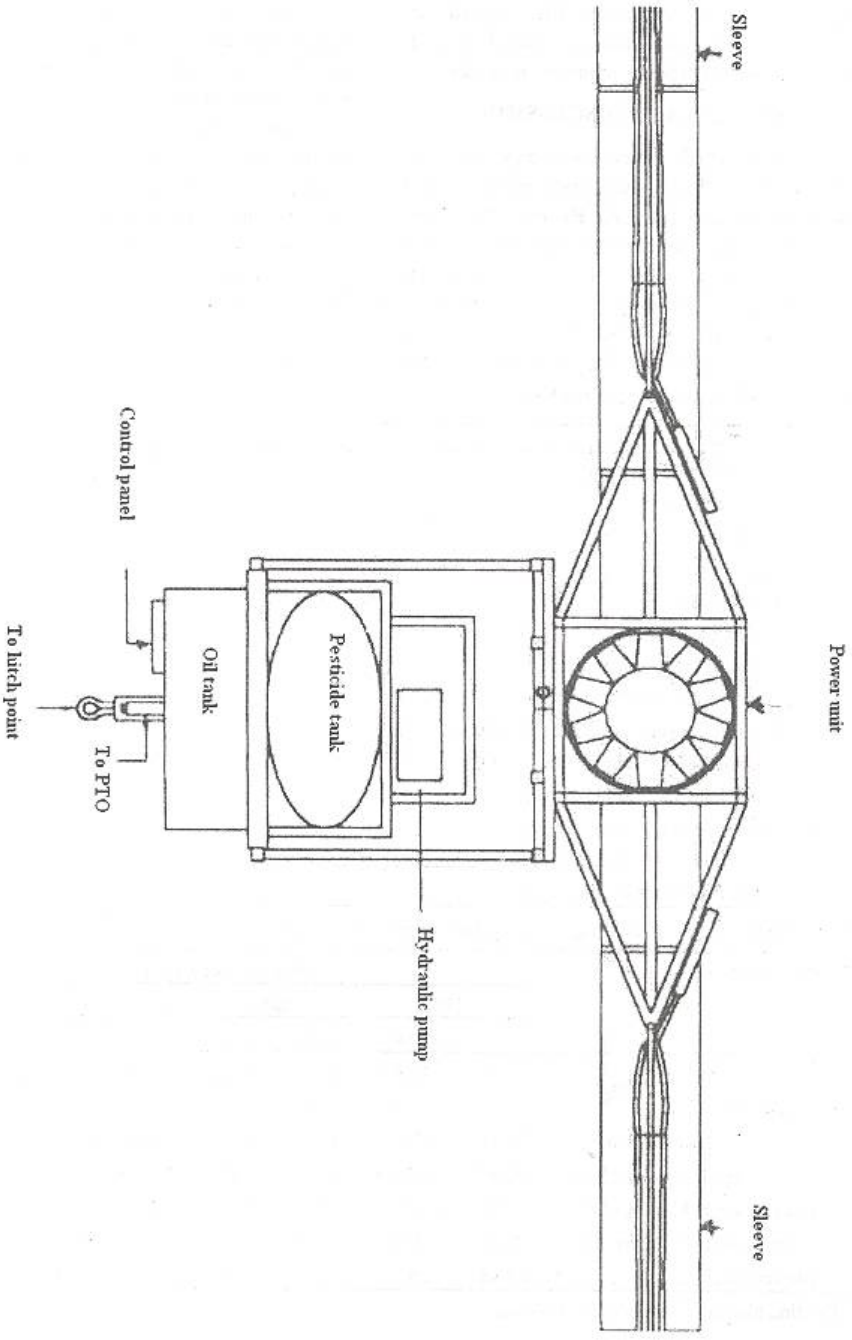
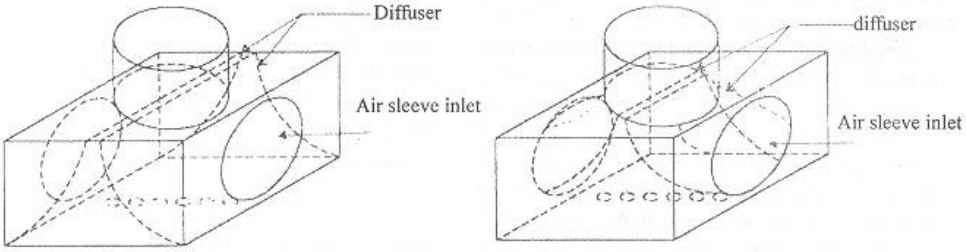


Fig. 1 Top View of air sleeve boom sprayer

Table 3. Velocity trajectories at sleeve outlet with existing and modified blower diffuser

S.N.	Particulars	Velocity, ms^{-1}	
	Blower speed:	Existing blower	Modified blower
1.	At 1800 rpm	10.74 – 13.28	11.42 – 12.00
2	At 2000 rpm	11.30 – 13.92	12.32 – 12.88
3	At 2200 rpm	11.96 – 14.14	12.86 – 13.76
4	At 2400 rpm	12.54 – 15.58	14.00 – 14.68



(a) Blower casing with existing diffuser (b) Blower casing with modified

Fig. 2. Blower casing with diffuser

Fig. 3. Testing of air sleeve boom sprayer in brinjal field

because of various losses in the wind tunnel in aluminum blower. The blower efficiency was found in the range of 22.38 to 26.57 per cent in M.S. blower and 28.35 to 34.16 per cent in aluminum blower. The aluminum blower was light in weight and the input power requirement of this blower was less than that of M.S. blower and hence the efficiency of aluminum blower was found to be more than that of M.S. blower. The velocity trajectories at PVC sleeve outlets and blower casing outlet with existing and modified diffuser for different blower speed were measured and tabulated in Table 3. The velocity variation with modified diffuser was seen almost even and uniform throughout all sleeve outlets due to proper diversion of air stream from blower exist to sleeve outlets provided with the M.S. sheet curved guide vanes. In existing diffuser, the air coming from blower outlet, strike and bounced at four corners of sleeve inlets. Due to this air bouncing turbulence was created in the air stream and thus there was random velocity variation. Whereas in modified diffuser the four corners were avoided by providing vanes of M.S. sheet for proper diversion of air from blower outlets to sleeve inlets due to which the velocity variation at sleeve outlets was seen almost even and uniform.

The modified air sleeve boom sprayer was tested in brinjal field (Fig. 3) at different conditions of travel speed (2, 3 and 4 kmh^{-1}) and system pressure (15, 20 and 25 $kgcm^{-2}$). The nozzles sprayed the fluid on the air curtain formed by the air discharge from all outlets of sleeve. Thus the air discharged from sleeve outlets caused the shuffling of leaves and projected the spray droplets on upper and lower sides of the crop canopy. The glossy papers were collected from field and analyzed for droplet size distribution with the help of computerized droplet size analyzer. The combination of 3 kmh^{-1} travel speed and 25 $kgcm^{-2}$ system pressure was found significant amongst the treatments. The average droplet density was found in the range of 32 to 23 droplets cm^{-1} and uniformity coefficient of variation was found 3.54 to 3.10. The combination of 3 kmh^{-1} travel speed and 25 $kgcm^{-2}$ system pressure was found significant amongst the treatments (Sonar, 2002).

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Modification and Testing of Paddy Disc Plough

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ABSTRACT

A tractor operated disc plough was modified incorporating the notches on the periphery of disc for land preparation in hard paddy fields. The field trials were conducted as per RNAM test code to determine the performance of modified plough as compared to conventional disc plough. The mean weight diameter of soil aggregates, effective field capacity, field efficiency and cost of operation of modified disc plough was found to be 41.97 mm, 0.106 hah^{-1}, 53.33 per cent and 234.07 Rsh^{-1}, respectively.

The farmers of rice growing area have raised the problem of land preparation after harvest of paddy often. Due to the non-availability of proper implement, land cannot be prepared well in time for the next crop. The mulching of soil during planting of paddy and allowing water to stagnate over these fields are the basic requirements for the production of paddy crop. This conditions and the soil characteristics are responsible to make the crust of soil hard. After harvesting the paddy crop soil crust becomes harder and harder progressively due to loss of moisture and it becomes very difficult to till the land with the conventionally used bullock drawn implements, like *Deshi* plough and harrow, etc. It is also reported that even tractor operated mould board plough could not be operated in this condition and therefore needed to evolve some strategy for land preparation in paddy for *Rabi* crop (Bokade, 2003). Hence, this problem was attempted to solve using notch type paddy disc plough. The main objective of this investigation was to compare the performance of conventional disc plough with notched type disc plough for land preparation in *Rabi* season after harvest of paddy crop.

In the view of above aspects notched disc plough was developed at department of Farm Power & Machinery, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola for hard paddy land preparation.

MATERIAL AND METHODS

Tractor drawn two bottom disc plough developed providing notches on disc periphery for land preparation in paddy (Fig.1). The plough consisted two discs and weighs 236 kg. It was attached to the three-point linkage, and lifted and lowered by the hydraulic system of the tractor. The disc plough consisted of concave notched disc, disc bearing, disc scraper, frame, cross shaft and furrow wheel. The size of disc in terms of diameter and thickness was 660 mm and 1.87 mm, respectively and concavity of the disc was 80 mm. The disc was made up of high carbon steel. The overall dimensions of the plough and disc specification are given in Table1 and Fig. 2.

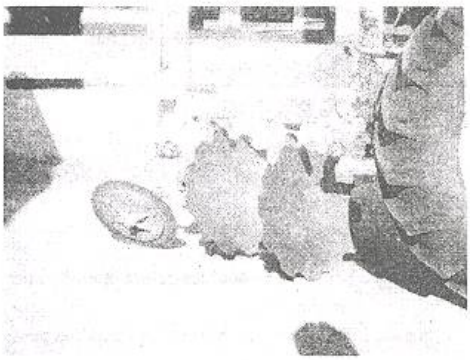

Fig .1. Modified Disc Plough

The disc plough mounted on Mahindra 575 DI tractor and testing was carried out as per RNAM test codes (Anonymous, 1983), on University field at National Agricultural Research Project (NARP), Sindewahi, Dist. Chandrapur (M.S.) The field tests were carried out to study the performance of notched disc plough viz., field capacity, field efficiency, soil inversion and MWD of soil aggregates (Fig. 3). Soil inversion was calculated by using the formula, as below

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Table 1. Overall dimensions of notched disc plough and disc specification

S.N.	Particulars	Dimensions
1	Overall dimensions of plough:	
	i Length, mm	1295
	ii Width, mm	991
	iii Height, mm	1118
	iv Weight, kg	236
2	Disc specification:	
	i Diameter, mm	660
	ii Length of cutting edge, mm	69.1
	iii Length of notch(blade edge),mm	103.6
	iv Height of notch, mm	55

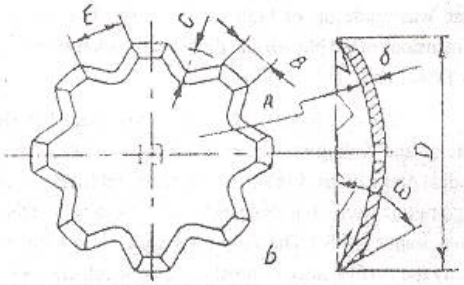
$$F = \frac{(Wp - We)}{Wp} X\ 100$$

Where,

F - Soil inversion (%)
Wp - No. of crop stubbles before operation per unit area.
We - No. of crop stubbles after operation per unit area.

Soil pulverization was evaluated by using a set of sieves 100, 80, 40, 20, 10, 4.75, 1 mm size of mesh using the formula by Van Bavel, as below

$$MWD = \sum_{n=i} \frac{Wi\ di}{W}$$



Diameter of disc (D) = 660 mm
Length of cutting edge (B) = 69.1 mm
Length of notch (E) = 103.6mm
Height of notch (C) = 55 mm
Thickness of disc (ä) = 1.87 mm

Fig. 2 Notched Disc

Where,

MWD - Mean Weight Diameter of soil aggregate, mm
Wi - Weight of soil sample retained over the i^{th} sieve, mm,
di - Class of mean size for i^{th} sieve, mm,
W - Total weight of soil samples, kg.

RESULTS AND DISCUSSION

The modified disc plough was evaluated and compared with conventional disc plough for its performance at NARP, Sindewahi, Dist. Chandrapur. The field conditions during trials are presented in Table2. The field trials were conducted as per RNAM test code. The results obtained are tabulated and presented in Table 3 with comparative performance of notched disc and plane disc plough. Notched disc plough gave highest reduction in the value of 35.22 mm MWD because of notches on the disc produce grip on soil thus it reduce slippage and decrease contact area and break the furrow slice into the pieces. In case of conventional disc plough it gave higher value of pulverization of 51.85 mm MWD, this was due to the conventional disc plough cuts and turns the complete furrow slice without breaking it into the pieces. It was also observed that, using notched disc plough the average tilling depth was found to be 12.1cm, which was satisfactory in paddy growing area. Whereas in conventional disc plough the average tilling depth was observed to be 8.3 cm. The depth of operation achieved by modified plough was noticed more as compared to conventional plough. It was also noticed that the

Table 2. Field conditions of trial field.

S.N.	Particulars	Conditions
1	Location of the field	NARP, Sindewahi, Distt. Chandrapur
2	Type of soil	Sandy clay loam
3	Average soil moisture content	13.95%
4	Crop before land preparation	Paddy
5	Stubble height	12 cm
6	Name of the implement used for testing	i) Modified disc plough ii) Conventional disc plough
7	Bulk density	1.35 g/cc
8	Cone index	511.33 kPa

Table 3. Field observations of the disc plough used in paddy land

Sr. No.	Particulars	Modified disc plough	Conventional disc plough
1	Average tilling depth obtained, cm	12.5	8.3
2	Average width of operation, cm	58	57
3	Gear select	2 nd low	2 nd low
4	Speed of operation, kmh^{-1}	3.3	3.05
5	Effective field capacity, hah^{-1}	0.116	0.095
6	Theoretical field capacity, hah^{-1}	0.191	0.173
7	Field efficiency, %	60.65	54.48
8	Soil inversion, %	91.10	84.48
9	Fuel consumption $lit.h^{-1}$	3.6	3.4
10	MWD, mm	41.97	60.18
11	Cost of operation, $Rsha^{-1}$	2208.20	2721.76

Fig3. Field testing of notched disc plough

maximum soil inversion was obtained 91.10 per cent by notched disc plough as compared to 84.48 per cent in conventional disc plough. The field coverage that would be obtained if the plough was operating continuously without interruptions i.e. theoretical field capacity and it is depend on speed of operation and theoretical width covered by the plough. The theoretical field capacity of the modified plough at average speed of 3.3 kmh^{-1} was found 0.191 and for conventional disc plough it was 0.173 hah^{-1} at average speed of 3.05 kmh^{-1}. The notched disc and plane disc plough operated in the field of 0.06 ha separately. The time required to cover the area by notched disc and plane disc was 31 min. and 38 min., respectively. Thus the effective field capacity was found to be 0.116 hah^{-1} for notched disc plough and 0.095 ha h^{-1} for plane disc plough with field efficiency was 60.65 and 54.48 per cent, respectively. The fuel consumed during ploughing was found more by 0.2 liter in notched disc plough as compared to conventional plough. The cost of operation of ploughing by notched disc and plane disc plough was calculated to be Rs.2185.87 and Rs.2651.10 ha^{-1}, respectively.

This study highlighted the highest field capacity, field efficiency, better soil inversion and pulverization which was observed in modified notched disc plough. The performance of notched disc plough was superior as compared to conventional disc plough and also found successful for land preparation in paddy.

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RESEARCH NOTE

Influence of Moisture Conservation Practices on Growth and Yield of Soybean

Soybean holds top position in international trade as oil seed crop. In Vidarbha, soybean grown under rainfed condition which suffers due to prolonged drought during the important crop growth stages like flowering, pod filling and seed development stages resulting into poor yields. On the contrary, excess and continuous rains during early growth stages may create bad drainage and affect the growth of crop. Because of waterlogging and inadequate oxygen diffusion rate sinking below the critical value. Hence, it is necessary to conserve rain water in soil and remove excess water from field for better aeration and growth of crop under rainfed agriculture.

Field experiment was conducted at Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth; Akola (M.S.) during *Kharif* seasons 2005 to asses the effect of moisture conservation practices on growth and yield of soybean.. The experiment was laid out in Randomized Block Design with seven treatments viz; T_1 Normal planting, T_2 Key line furrow after every row at 30 DAS, T_3 Key line furrow after 2nd row at 30 DAS, T_4 Key line furrow after 4th row at 30 DAS, T_5 Weed biomass mulch @ 5 t ha^{-1} (Uprooted weed biomass from the same plot) at 30 DAS, T_6 Use of soybean straw mulch @ 5 t ha^{-1} and T_7 Green gram mulch @ 6.7 t ha^{-1} (Green gram was sown between the two rows of soybean) and replicated thrice. The soil of experiment field was clay loam in texture and moderately alkaline in reaction (pH: 8.34), medium in organic carbon, lower in available nitrogen, medium in available phosphorous and fairly rich in available potassium. Variety TAMS-38 (75 kg ha^{-1}) was sown plot^{-1} by drilling method at 45 cm row spacing on 6th July 2005 with fertilizer dose of 30:75:0 kg NPK ha^{-1}.

The soybean plant height was significantly influenced by various treatments. Use of soybean straw mulch @ 5 t ha^{-1} (T_6) recorded highest plant height (45.54 cm) which was at par with mulching of weed biomass (T_5), but these treatments were significantly superior than normal planting (T_1). Highest dry matter accumulation was observed with soybean straw mulch treatment (T_6), but differences between various treatments were not significant. Opening of furrows after two rows (T_3) produced significantly more number of pods plant^{-1} than all other treatments. Significantly highest number of seeds pod^{-1} was recorded with treatment T_4 in which furrows were opened after 4th row of soybean than all other treatments except T_2 and T_5 treatments. Whereas, treatment where furrows were opened after 2nd row (T_3) yielded significantly highest seed yield plant^{-1} than all other treatments except T_2, T_6 and T_7 treatments. These

Table 1: Growth, yield attributes and seed yield of soybean as influenced by various treatments.

Treatments	Plant population ha^{-1} (Lakh)	Plan height at harvest (cm)	Dry matter accumulation Plant^{-1} (g)	No. of pods plant^{-1}	No. of seeds pod^{-1}	Seed yield plant^{-1}	Seed yield (kg ha^{-1})
π: Normal sowing	4.22	39.39	17.93	34.80	2.22	4.87	1046
T2i Furrow after every row	4.28	43.43	18.80	37.37	2.26	5.27	1256
T_3: Furrow after 2nd row	4.27	43.79	19.56	41.33	2.20	5.47	1361
14: Furrow after 4th row	4.26	44.00	18.25	35.97	2.36	5.18	1152
T_5: Weed biomass mulch	4.24	44.59	19.00	35.67	2.31	5.08	1100
T&: Soybean straw mulch	4.33	45.54	19.98	36.57	2.08	5.29	1218
Ty: Green gram mulch	4.23	43.72	19.40	37.20	2.17	5.36	1253
SE(m) ±	NS	0.42	0.57	1.03	0.04	0.07	40.55
CD at 5%	—	1.18	NS	2.89	0.13	0.21	114.44

Table 2: Moisture content in soil (%) as influenced by various treatments.

Treatments	45 DAS		60DAS 7		5 DAS		At harvest	
	0-30 cm	30-60 cm	0-30 cm	30-60 cm	0-30 cm	30-60 cm	0-30 cm	30-60 cm
T1: Normal sowing	24.24	25.41	22.91	21.21	20.99	21.21	17.17	17.41
T_2 : Furrow after every row	26.52	27.52	23.31	24.59	22.11	22.28	20.00	20.41
T_3: Furrow after 2nd row	30.38	28.95	24.57	26.27	23.87	24.15	22.32	22.41
T_4: Furrow after 4th row	24.31	25.88	23.08	22.20	21.44	21.55	17.38	17.91
T_5: Weed biomass mulch	25.08	26.41	24.12	25.34	22.91	22.68	20.99	21.39
T_6 : Soybean straw mulch	32.27	31.31	25.91	27.27	24.88	25.25	22.78	23.08
T_7: Green gram mulch	31.41	30.84	24.98	26.81	24.32	24.56	20.09	21.90
SE(m) ±	1.01	0.86	0.95	0.86	1.06	1.06	1.12	1.13
CD at 5%	2.84	2.42	2.67	2.42	2.99	2.99	3.14	3.17

results are in accordance with the findings of Shrivastava and Pahalwan (1972) and Muniappa *et al.* (1975).

Opening of furrows after 2nd row (T_3) recorded significantly highest seed yield (1361 kg ha^{-1}) than other treatments except opening of furrows after every row (T_2) and green gram mulch treatment (T_7). Similar findings were reported by Sakai and Munemura (1990) and Jain and Dubey (1996).

At 45 DAS highest moisture content was observed with soybean straw mulch treatment (T_6) which was at par with $T_3$and T_7 treatments but significantly superior to rest of the treatments with 0 to 30 and 30 to 60 cm soil depth. Similar results were observed at 60 and 75 DAS. At harvest soybean straw mulch treatment (T_6) contained maximum soil moisture at both the depth which was significantly superior to normal planting (T_1) and opening of furrows after 4th row (T_4) treatments, however the differences between remaining treatments could not reach to the level of significance. These results are supported with the work of Gupta and Rao (1989).

For obtaining maximum seed yield, moisture conservation and better growth of soybean opening of furrows at 30 days after sowing either every row or after second row was found better under rainfed condition.

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Effect of Farm Yard Manure Levels on Growth and Yield of Turmeric

Turmeric (*Curcuma longa* L.) is an important cash crop and has a great depend as a spice in most of the countries in the world. India is the leading producer and exporter of turmeric in the world. Turmeric plays an important role in earning foreign exchange for the country. Out of the total area under spices and condiment crops in India, turmeric occupies six per cent of the total area. In all, 11 districts of Vidarbha, 1,409 hectares of land is under cultivation of turmeric crop producing 11,091 tonnes of dried turmeric yield year^{-1}. In Vidarbha, highest area and production comes from Chandrapur district i.e. 435 hectares of land under turmeric cultivation producing 1,784 tonnes of dried turmeric per year (Anonymous, 2004). In order to fulfill the increasing demand of the people for the turmeric and improved quality, it is essential to increase the production of turmeric considerably. This can be achieved by bringing more area under cultivation and increasing productivity per unit area. Lack of suitable doses of Farm Yard Manure (FYM) is one of the constraints for low productivity. However, other factors like low yield variety, nutrition, layout, planting material, spacing and time of planting that influences the productivity. The present study on "Effect of FYM levels on growth and yield of turmeric" was carried out at Main Garden, department of Horticulture, Dr. PDKV, Akola during *Kharif*, 2004. The experiment was laid out in randomized block design with four replications and six FYM levels viz., 15 FYM ha^{-1}, 20 t FYM ha^{-1}, 25 t FYM ha^{-1}, 30 t FYM ha^{-1}, 35 t FYM ha^{-1}, and control. Different doses of FYM levels from 15 t ha^{-1} to 35 t FYM ha^{-1} were applied randomly to selected plots and replications-wise and incorporated well after bed prepared before planting. Mother rhizomes were used as planting material. The planting of mother rhizomes was carried out on 4th June 2004. Recommended package of practices were followed during experimentation to raise the crop successfully.

The different levels of FYM significantly influenced different growth parameters viz. height, number of leaves and tillers, leaf area and girth of psuedostem in turmeric plant (Table 1). The plant height at 180 days after planting was significantly maximum in 35 t FYM ha^{-1} (109.98 cm) and was significantly minimum in control treatment (93.17 cm). Similar results were also found by Vishwanath *et. al.*, (2004). At 180 days, significantly maximum number of leaves and leaf area plant^{-1} was observed in 35 t FYM ha^{-1} (109.98 cm) and was significantly minimum in control treatment (93.17 cm). Similar results were also found by Vishwanath *et. al.*, (2004). At 180 days, significantly maximum number of leaves and leaf area per plant was observed in 35 t FYM ha^{-1} (13.95 and 572.60 cm), followed by 30 t FYM ha^{-1}, whereas minimum number of leaves and leaf area was recorded in control treatment(12.02 and 483.49 cm^2). Similar results were also reported by Vadiraj *et. al.*, (1998) and Vishwanath *et. al.*, (2004). At 180 days, application of 35 t FYM ha^{-1} revealed significantly maximum girth of psuedostem (9.14 cm) whereas, significantly minimum girth was found in control treatment (7.56 cm). In general application of FYM levels found significant results at every stages of growth. These findings are in line with Poinkar, (2004). The number of tillers plant^{-1} were significantly maximum in 35 t FYM ha^{-1} (3.95) while significantly minimum number of tillers was recorded in control treatment (3.05). The results were conformatory with the results obtained by Gill *et. al.*, (1999) and Vishwanath (2004). Data in respect of yield parameters viz., number, length and girth (cm) of fresh fingers plant^{-1} , yield of fresh and dry fingers (Table 2), number and yield of mother rhizomes (Table 3) revealed that the number of fresh finger plant^{-1} was significantly influenced by different levels of FYM. The significantly maximum number of fresh finger was recorded in 35 t FYM ha^{-1} (14.12), followed by 30 t FYM ha^{-1} (14.12). However, significantly minimum number of fingers recorded in control treatment (12.57). These results are in close agreement with Gill *et. al.*, (1999) and Poinkar (2004). Significantly maximum length and girth of fresh finger was found significantly maximum in 35 t FYM ha^{-1} (14.98 cm and 9.94 cm), followed by 30 t FYM ha^{-1} which were superior over all other remaining treatments. However, minimum length and girth of fingers was recorded in control treatment (12.15 cm and 8.02 cm). Similar conformatory results were reported by Poinkar (2004). Application of 35 t FYM ha^{-1} showed significantly

Table 1: Growth parameters as influenced by different levels of Fym

FYM levels (T ha^{-1})	Height of Plant (cm)	Number of leaves $plant^{-1}$	Leaf area (cm^2)	Girth of psuedostem (cm)	Number of tillers $plant^{-1}$
T1-15	13.28	12.82	8.57	258.74	14.72
T2 – 20	13.74	13.31	8.79	273.14	17.90
T3 – 25	14.12	13.72	9.02	324.78	19.85
T4 – 30	14.38	14.34	9.51	352.10	22.53
T5-35	14.84	14.98	9.94	392.04	26.18
T6- control	12.57	12.15	8.02	211.18	10.36
SE (m)±	0.16	0.24	0.08	7.38	0.31
CD at 5%	0.54	0.66	0.22	20.71	0.86

Table 2 : Yield parameters as influenced by different levels of FYM

FYM Levels (t ha^{-1})	Number of fresh fingers $plant^{-1}$	Length of fresh fingers (cm)	Girth of fresh fingers (cm)	Yield of fresh fingers (g $plant^{-1}$)	Yield of fresh fingers (q ha^{-1})	Dry yield of of finger (q ha^{-1})
T1-15	13.28	13.82	8.57	258.74	189.20	54.24
T2-20	13.74	13.31	8.79	273.14	230.07	57.71
T3 – 25	14.12	13.72	9.02	324.78	255.14	62.98
T4 – 30	14.38	14.34	9.51	352.10	289.58	67.60
T5 – 35	14.84	14.98	9.94	392.04	336.50	71.97
T6 – control	12.57	12.15	8.02	211.18	133.16	50.38
SE (m) ±	0.16	0.24	0.08	7.38	0.89	0.39
CD at 5%	0.54	0.66	0.22	20.71	2.51	1.09

Table 3. Yield of mother rhizomes as influenced by FYM levels

FYM levels (t ha^{-1})	Number of mother rhizome $plant^{-1}$	Yield of mother Rhizomes (g $plant^{-1}$)	Yield of mother rhizomes (kg $plot^{-1}$)	Yield of mother rhizomes (q ha^{-1})
T1-15	2.17	62.45	3.11	39.97
T2 – 20	2.30	64.28	3.18	40.87
T3 – 25	2.30	66.14	3.27	42.02
T4 – 30	2.50	67.34	3.81	48.97
T5 – 35	2.55	68.24	4.18	53.72
T6 – Control	1.95	58.24	2.74	35.21
SE (m) ±	0.03	0.62	0.22	0.48
CD at 5%	0.08	1.74	0.63	1.35

Development of Sorghum Breeding Materials for Shoot fly Resistance

Sorghum is one of the most important cereal crops in the semi arid tropics, and it is damaged by more than 150 insect species from sowing to crop harvest (Sheshu reddy, 1983). Shoot fly is one of the most important pests of late *Kharif* and *Rabi* season in Vidarbha region of Maharashtra. Host plant resistance is the most important component of integrated pest management in sorghum, it does not involves any extra costs nor require application skills in pest control techniques. Therefore, the advance generation breeding material were screened against sorghum shoot fly.

About 1237 progenies of advance generation breeding material received from ICRISAT Patencheru Hyderabad to Sorghum Breeder, Dr. PDKV Akola were planted in *Rabi* season of 1999 and screened for shoot fly resistance, alongwith resistant and susceptible checks IS 18551 and CSH 1, respectively. The sowing was undertaken by dibbling method on dated 24-10-1999 and 26-10-1999, in a non-replicated design with the plot size of 3.00 x 0.90 m (two rows). The spacing was adopted 45 x 15 cm. The recommended package of practices was adopted to raise good crop without plant protection measures. The observations on shoot fly dead hearts are

Table 1: ICRISAT Promising Sorghum Breeding materials to shoot fly.

S. N.	Entry No.	Stage and generation of progeny	Promising progenies (0-25 % dead hearts)
1	7001-7069 (69 Nos.)	B x R, F6 materials	7001,7003, 7007, 7009, 7010, 7011,7012, 7019, 7028 (9 Nos.)
2	7101-7396 (296 Nos.)	B x B, F4 materials	7121, 7124, 7127, 7130, 7158, 7162, 7173, 7179, 7187, 7193, 7196, 7202, 7256, 7260, 7069, 7179, 7354, 7364, 7365, 7366, 7367, 7369, 7370, 7371, 7372 (25 Nos.)
3	7401-8041 (641 Nos.)	B x B, TWC F3 & F4 materials	7403, 7411, 7449, 7453, 7455, 7456, 7476, 7477, 7482, 7489, 7490, 7491, 7492, 7493, 7494, 7495, 7496, 7501, 7505, 7508, 7509, 7510, 7538, 7539, 7547, 7553, 7555, 7557, 7559, 7581, 7582, 7584, 7592, 7602, 7609, 7610, 7614, 7615, 7616, 7626, 7640, 7641, 7656, 7667, 7668, 7671, 7681, 7689, 7697, 7702, 7709, 7718, 7722, 7728, 7730, 7734, 7735, 7742, 7747, 7748, 7751, 7752, 7753, 7757, 7770, 7771, 7772, 7773, 7774, 7777, 7778, 7779, 7782, 7790, 7791, 7803, 7811, 7828, 7830, 7831, 7832, 7835, 7836, 7840, 7847, 7849, 7859, 7866, 7878, 7880, 7890, 7893, 7960, 7989, 8006 (95 Nos.)
4	8101-8162 (62 Nos.)	B x B, SC F4 materials	8105, 8108, 8110, 8112, 8118, 8120, 8121, 8124, 8128, 8133, 8136, 8137, 8138,8140, 8145, 8146, 8147, 8151, 8152, 8154, 8155, 8159 (22Nos.)
5	8201-8282 (82 Nos.)	296B selections	8236, 8273, 8274, 8279 (4 Nos.)
6	8301-8387 (87 Nos.)	ICSP, B population S5 materials	8304, 8305, 8315, 8342 (4 Nos.)
7	IS 18551 (25 Nos.)	Resistant check	13.63 % dead hearts.
8	CSH 1 (25 Nos.)	Susceptible check	53.35 % dead hearts.

recorded on 28th days after germination of crop by counting total plants and plants showing dead hearts symptoms in each entry and per cent incidence of shoot fly was worked out. The data thus collected were given in table 1.

The data in table 1 indicated that out of 69 progenies of the stage of B x R F6 materials, nine progenies were found promising, whereas from 296 progenies of B x B F4 generation, 25 progenies showed resistant reaction to shoot fly. Out of 641 progenies of B x B, TWC F3 and F4 materials, 95 progenies exhibited resistant reaction to shoot fly. Similarly, in B x B SC F4 materials, out of 62 progenies, 22 progenies showed resistant level reaction. In case of 82 progenies of 296B selections only four progenies were found promising, while in ICSP, B population of S5 materials, four progenies exhibited resistant level reaction. All these selections showed resistant reaction to shoot fly in the range of 0 - 25 per cent dead hearts as against 13.63 per cent dead hearts in resistant check IS 18551, while 53.35 per cent dead hearts in susceptible check CSH 1. The results of the findings are similar with the findings of Balikai *et al.* (1999) and Kandalkar *et al.* (2000).

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Efficacy of *Trichoderma* Spp. Against *Alternaria Solani*

Infection of tomato seedlings by *Alternaria solani* (Early blight of tomato) causes low yield and economic losses. Spraying fungicides more frequently leads to residual toxicity. Biological control of the disease is the best alternative to overcome the losses caused by the disease and to avoid the pollution hazards due to fungicides.

An attempt has been made in present study to determine the efficacy of *Trichoderma* spp. *in vitro* and also effect of culture filtrates of *Trichoderma* spp. on the growth of *A. solani in vitro.*

The antagonistic activity on *A. solani* exerted by *T. viride, T. harzianum, T. harmatum, T. koningii* and *T. longiforum* were studied by dual culture technique under *in vitro* condition. To see the effect of culture filtrates of *Trichoderma* spp. on growth of *A. solani* under *in vitro* condition, the preparation of culture filtrates of *Trichoderma* spp. about 600 ml sterilized water was added in three installments in each bottle containing the profuse growth of *Trichoderma* spp. About 200 ml water was first added to the bottle containing cultures of *Trichoderma* spp. and the media was stirred well with glass rod. The culture was decanted. The process was repeated for two or more times and the culture filtrates of three lots were mixed. Entire culture filtrates was filtered through double layered muscline cloth. Five ml culture filtrates of respective *Trichoderma* spp. were

Table 1. Percent inhibition of *A. solani* by T. Spp.

Trichoderma isolates	*A. solani*			
	Colony diameter	% inhibition over control	Size of colony	% inhibition over control
T. viride	14.99	83.34	43.10	52.11
T. harzianum	11.21	87.54	20.12	77.64
T. hamatum	12.88	85.68	22.12	75.42
T. koningii	18.89	79.01	28.39	68.45
T. longiforum	28.22	68.64	45.33	50.16
Control	90	-	90	-

taken and added in petridish along with melted potato dextrose agar and mixed by rotating. Petridish containing potato dextrose agar alone was served as control. Mycelial disc of 7 days old culture of *A. solani* was placed in the centre of the petridish and incubated at temperature (28 ± 1°C). The colony diameter was measured at seventh day after inoculation.

Table 1 indicates that all T. Spp. had efficiency to restrict the growth of *A. solani*. Maximum inhibition (87.54 %) was recorded with *T. harzianum* where the colony diameter was only 11.21 mm followed by *T. hamatum* (85.68 % inhibition) whereas, minimum inhibition was noticed with *T. longiforum* (68.64 %). Culture filtrates of all five *Trichoderma* spp. significantly inhibited the growth of *A. solani*. (Table 1) Maximum inhibition of *A. solani* was noticed with *T. harzianum* (77.64 %) followed by *T. hamatum* (75.42 % inhibition) This was followed by *T. viride* (52.11 % inhibition) Minimum inhibition was recorded with *T. longiforum* with colony diameter 45.33 mm. (Table 1) These results were found similar with the results of Chet (1987) who found that imperfect fungi in the genus *Trichoderma* have a substantial ability to supress a wide range of plant pathogenic fungi by various mechanisms. These results were found similar with other workers like Wells (1988) and De *et al* (1996)

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Response of Wheat Genotypes to Irrigation Levels

In Vidarbha, irrigation resources are limited and more than 87 per cent area is still under rainfed. Wheat is an important food grain crop and there is an urgent need to identify suitable genotypes which can be grown successfully under limited soil moisture conditions. Very meagre information is available on the suitable varieties of wheat under limited irrigation conditions. Several experiments have been conducted on irrigation application at critical stages of plant growth on the yield of dwarf wheat varieties by Deshmukh *et al.,* (1992) and Thakur *et al.,* (2000). Keeping this in view, the present study was undertaken.

A field experiment was carried out at Central Demonstration Farm , Wani-Rambhapur , Dr. PDKV. Akola during *Rabi* 2005 on clayey soil containing low available nitrogen (225 kg ha^{-1}), low available phosphorus (12.00 kg ha^{-1}), rich in available potassium (598 kg ha^{-1}) and the pH was slightly alkaline in reaction (8.08). The experiment was laid out in split plot design with twenty four treatment combination of six genotypes i.e. AKW-381, AKW-1071, AKW-3722, HD-2189, MACS-2846 and MACS- 2496 as main plots and four irrigation levels i.e. one irrigation at 40-42 DAS (I_1), two irrigations at 18 – 20 DAS and 65 – 70 DAS (I_2), three irrigations at 18 – 20 DAS, 40 – 42 DAS and 60 – 65 DAS (I_3) and six irrigations at 18 – 20, 30 – 35, 45 – 50, 60-65, 80 – 85 and 95 – 100 DAS (I_4) as sub plots replicated three times. The fertilizer dose applied was 60 kg N and 30 kg P_2O_5 ha^{-1}. Gross plot size was 2.25 x 6.00 m^2 and net plot size was1.80 x 5.00 m^2. The experimental plot was sown on November 18, 2005.

Genotype AKW-3722 recorded significantly higher plant height, weight of grain, spike $plant^{-1}$, no. of seeds $plant^{-1}$, and spike and test weight than all other genotypes. The genotypes AKW-381 and AKW-1071 produced equal results in respects of plant height and yield attributes. The genotype AKW-1071 was also at par with MACS-2496 in respect of plant height, weight of grain and spike $plant^{-1}$.

Six irrigation (I_4) showed significantly higher plant height, weight of grain and spike $plant^{-1}$, no. of seeds $spike^{-1}$ and $plant^{-1}$ and test weight than I_1, I_2 and I_3 . One and two irrigations recorded similar results in respect of weight of grain and spike $plant^{-1}$. Similar findings were pointed out earlier by Parihar and Tripathi (1990) and Thakur *et al.* (2000).

The interaction effects of wheat genotypes and irrigation levels were not significant in yield and yield attributes.

Genotype AKW-3722 produced significantly higher grain and straw yield over MACS-2846 and HD 2189 genotypes. However, it was at par with the genotype AKW-381, AKW-1071 and MACS-2496 for grain and straw yield. These results are in conformity with the results of Singh *et al.*(1993) .Every higher level of irrigation noted significant increase in grain and straw yield over its lower level of irrigation. Similar results were noted earlier by Deshmukh *et al.* (1992) and pal *et al.,* (1996).

Thus it could be concluded that genotype AKAW-3722 was significantly higher in grain and straw yield over MACS- 2846 and HD-2189. In respect of irrigation levels, sufficient irrigation (six irrigations) noted significant increase in grain and straw yield over lower level of irrigation.

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

Treatments	Plant height (cm)	Weight of grain plant^{-1} (g)	Wt. of spike plant^{-1}	No. of seeds spike^{-1}	No. of seeds plant^{-1}	Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
I. Main Plots Genotypes (G)								
G|AKW-381	87.04	3.70	5.85	41.04	118.20	44.02	15.68	30.63
G_2AKW-1071	85.73	3.51	5.48	40.82	98.20	40.27	17.88	29.22
G_3 AKAW - 3722	92.44	4.16	6.70	43.15	121.97	40.17	19.23	30.88
G_4HD-2189	77.78	3.08	4.41	26.38	79.75	38.42	12.56	23.97
G_5 MACS -2846	81.24	3.25	4.71	30.49	86.42	42.20	15.31	25.74
G_6 MACS -2496	83.38	3.26	5.44	38.49	94.09	34.32	16.41	28.80
SE (m) ±	0.95	0.12	0.22	0.67	1.17	0.45	1.19	0.75
CD at 5%	2.76	0.34	0.63	1.93	3.43	1.31	3.47	2.20
I 1 . Sub plots irrigation levels (I)								
I] One irrigation	75. 18	2.50	4.43	28.44	70.78	40.04	12.32	15.33
I_2 Two irrigation	81.55	2.78	4.50	29.72	76.44	41.56	18.01	24.45
{3 Three irrigation	87.61	3.76	5.78	38.56	112.17	42.69	20.36	30.70
14 Six Irrigations	94.07	4.93	7.04	50.19	139.69	41.67	29.77	42.34
SE±	1.39	0.29	0.31	0.85	1.67	0.38	0.67	1.01
CD at 5%	4.01	0.78	0.19	2.47	4.87	1.11	1.96	2.97

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Genetic Variability Studies for Some Quantitative Traits in Grain Amaranthus

Grain amaranthus *(Amaranthus hypochondriacus* L.) is one of the forgotten food crops and is confined to small pockets during the present century, which has all the potential to become a valuable new crop. Amaranthus began attracting increased research attention recently, because of its high protein content (8-22%), lysine (6%) and sulphur containing amino acids (4.4%), which are deficient in other major grain crops. The knowledge on the nature and magnitude of genetic variation in respect of quantitative characters like yield and its components is essential for effecting crop improvement. The estimates of mean serves as basis for eliminating the undesirable genotypes, whereas genetic variability helps to choose the potential genotypes. Heritability (h^2) along with genetic advance (GA) would be more useful tool in predicting the resultant effect from selection of best genotypes for yield of some of its components. Therefore, the present study was undertaken to estimate variability, heritability and genetic advance in grain amaranthus.

Sixty one grain amaranthus *(Amaranthus hypochondriacus* L.) genotypes were studied for yield and yield contributing characters. The field experiment was laid out in randomized block design with two replications during *Kharif*- 2004 at the Department of Agricultural Botany, Marathwada Agriculture University, Parbhani. The spacing of 45 cm between rows and 15 cm within plants was maintained. Each row represented one entry in each replication with 1.5 m row length. Observations on days to 50 per cent flowering, days to maturity, 50 ml volume seed weight were observed on plot basis, where as plant height, number of spikelets inflorescence^{-1}, inflorescence length, inflorescence girth, stem girth, leaf area plant^{-1}, harvest index and grain yield plant^{-1} observations were recorded on five randomly selected plants in each treatment in each replication and average were worked out. Genotypic and phenotypic coefficients of variation, heritability (in broad sense) and genetic advance were calculated according to Burton (1952), Hanson *et al.*, (1956) and Allard (1960), respectively.

Analysis of variance revealed that the genotypes differed significantly for all characters. Perusal of the data in Table 1 revealed that the magnitude of GCV and PCV were highest for harvest index, grain yield plant^{-1}, inflorescence girth and leaf area plant^{-1} indicating presence of large amount of variation for these characters. Kamble (2000) reported high GCV and PCV values for grain yield plant^{-1} and leaf area plant^{-1}. These results were in consonance with findings of Suryawanshi (2003) for the traits *viz.*, grain yield plant^{-1}, harvest index, inflorescence girth and leaf area plant^{-1}.

Number of spikelets inflorescence^{-1}, stem girth, inflorescence length and plant height showed moderate magnitudes of GCV and PCV indicating that

Table 1. Parameters of Genetic variability for yield and yield contributing characters in grain amaranthus

Character	Mean	Genotypic variance	Phenotypic variance	GCV	PCV	Heritability (bs)	Genetic advance (GA)	Genetic advanceas % of mean
Days to 50% flowering	64.00	5.66	7.733	3.60	4.20	73.20	4.19	6.55
Days to maturity	98.50	32.04	34.07	5.72	5.90	94.00	11.31	11.48
Plant height (cm)	133.51	370.48	372.92	13.47	13.51	99.30	39.52	29.60
No. of spikelets inflorescence^{-1}	45.50	58.74	60.74	16.97	17.26	96.70	15.53	34.13
Inflorescence length (cm)	43.50	42.44	44.44	14.98	15.33	95.50	13.12	30.16
Inflorescence girth (cm)	21.80	24.16	26.06	22.10	22.95	92.70	9.75	44.72
Stem girth (cm)	4.18	0.47	0.74	16.43	20.70	63.00	1.13	27.03
Leaf area plant^{-1} (cm^2)	1185.24	54729.50	65770.50	20.54	22.51	83.20	439.61	37.09
50 ml volume seed weight (g)	39.87	8.14	10.15	6.99	7.81	80.20	5.27	13.22
Harvest index (%)	28.07	68.83	70.89	31.76	32.23	97.10	16.84	59.99
Grain yield plant^{-1} (g)	17.80	21.62	23.66	27.18	28.43	91.40	9.16	51.46

improvement in these characters under selection might be achieved up to a reasonable extent. Similar results were reported by Suryawanshi (2003). Low GCV and PCV were observed for 50 ml volume seed weight, days to maturity and days to 50 per cent flowering, indicating selection for these characters may not be rewarding. These results are in conformity with the observations of Suryawanshi ((2003).

High heritability coupled with high genetic advance as per cent of mean were observed for harvest index, grain yield plant^{-1} and inflorescence girth, leaf area plant^{-1}, number of spikelets inflorescence^{-1}, inflorescence length and plant height indicating that these characters were governed by additive gene action and selection for these traits in the genetically diverse material would be more effective for desired genetic improvement. These results are in accordance with the findings of Suryawanshi (2003).

High heritability coupled with moderate genetic advance as per cent of mean was exhibited by 50 ml volume seed weight and days to maturity. Similar results were reported by Suryawanshi (2003). High heritability coupled with low genetic advance as percent of mean was observed for days to 50 per cent flowering. These results are in conformity with the observations of Suryawanshi (2003).

From the above findings, it can be concluded that the characters *viz.*, harvest index, grain yield plant^{-1}, inflorescence girth and leaf area plant^{-1} exhibited high GCV, PCV, heritability and genetic advance indicating presence of additive gene action and practicing direct selection may be highly effective.

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Testing of Validity of Fertilizer Adjustment Equation for Soybean Under Vertisol at Parbhani Condition

Targeted yield concept is precise meaningful and more quantitative approach in soil test fertilizer recommendation. The main advantage of fertilizer adjustment equation was with high profitability both for high & low levels of fertilizer investment. Balanced fertilizer recommendations done on the basis of soil available nutrient and crop needs using targeted yield concept. Similarly Kausadikar *et al* (2003) developed fertilizer requirement equation for soybean crop to produce maximum yield, but it is necessary to verify their validity under different sets of agro-ecological conditions. Soybean is an important pulse as well as oil seed crop so an attempt was made to test the validity of fertilizer adjustment equation developed for soybean under Parbhani condition.

A field experiment was conducted on medium to deep black soil (Vertisol) at Departmental farm, College of Agriculture, M.A.U., Parbhani during Kharif season of 2000 / 2001 using the soybean variety PK-472.

There were six treatments (Control, Recommended Dose, As per soil test value, 20 q ha^{-1} targeted seed yield, 30 q ha^{-1} targeted seed yield & 40 q ha^{-1} targeted seed yield) which were replicated four times & experiment was laid out in Randomized Block Design.

As per treatments, the fertilizer quantities were calculated of N, P_2O_5 & K_2O & applied through Urea, S.S.P and M.O.P., respectively (Table 1). The fertilizer prescription equation developed by Kausadikar *et al* (2003) for soybean crop on Vertisol of M.A.U., Parbhani are given in Table 2. Standard methods were followed for soil and plant analysis. Yield data were statistically analysed as described by Panse & Sukhatme (1985).

The significant variation in yield of soybean was found due to variation in fertilizers. The highest seed yield of soybean was found under 40 q ha^{-1} targeted seed yield treatment i.e. 26.27 kg ha^{-1} followed by 30 q ha^{-1} targeted seed yield treatment (Table 3). The data further revealed that all yield targets of 20, 30, 40 q ha^{-1} were achieved with $\pm$ 5 to 20 percent variation except 40 q ha^{-1} targeted yield. There was increasing trend in monetary returns with increased fertilizer input. Highest increase over control (Rs ha^{-1}) was found in 40 q ha^{-1} targeted seed yield treatment, it was 17421.

The straw yield of soybean was also varied from control 18.22 kg ha^{-1} to 40 q ha^{-1} targeted yield 32 - 20

Table 1 : Treatments and fertilizer doses calculated for targeted yield experiment.

Treatment	N	P_2O_5	K_2O
Control	—	—	—
R.D.	30	60	00
As per soil test value	38	75	00
20 q ha^{-1} targeted seed yield	15	24	02
30 q ha^{-1} targeted seed yield	55	85	28
40 q ha^{-1} targeted seed yield	96	146	54

Table 2 : Fertilizer adjustment equations used for the investigation.

$FN = 4.10\ T - 0.45\ SN$

$FP_2O_5 = 6.13\ T - 7.02\ SP$

$FK_20 = 2.64\ T - 0.21\ SK$

Where,

FN = Fertilizer nitrogen
FP_2O_5 = Fertilizer Phosphorous
FK_2O = Fertilizer Potassium
SN = Soil nitrogen
SP = Soil phosphorous
SK = Soil potassium
T = Targeted yield

Table 3 : Validity of fertilizer adjustment equation.

Treatments	Fertilizer applied (Kg ha^{-1})			Yield (kg ha^{-1})		Cost of fertilizer (Rs. ha^{-1})	Monetary Returns (Rs. ha^{-1})	Increase over control	Returns/ Rupees invested on fertilizer (Rs. ha^{-1})	Variation (percent) ± (Rs. ha^{-1})
	N	P	K	Grain	Straw					
Control	—	—	—	11.27	18.22	—	14632	—	—	—
R.D.	30	60	00	16.30	22.40	440	20372	5740	13.04	—
As per STV	38	75	00	17.25	24.30	1743	21678	7046	4.74	—
20 q ha^{-1}	15	24	02	19.46	26.12	603	24215	9583	15.89	5
30 q ha^{-1}	55	85	28	24.12	31.34	2269	29785	15153	6.67	20
40 q ha^{-1}	96	146	54	26.27	32.20	3928	32053	17421	4.43	35

kg ha^{-1} Velayathum (1979) emphasized the significance of targeted yield concept, because this concept is based on balanced fertilization. Similar observations were made on targeted yield of cotton by (Khandare *et al* 2002). Application of phosphorous showed increasing trend in straw yield with increased phosphorus, it was in agreement with the finding of Warade *et al* (1992). In nut-shell the fertilizer prescription equation proved its validity for soybean crop under Parbhani condition.

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Effect of Land Treatments on Availability of Major and Micronutrients and Productivity of Soybean on Inceptisol

In India, soybean is cultivated over 74.52 lakh hectares with annual production of 72.07 lakh metric tonnes. Area in Maharashtra under soybean is 21.15 lakh ha with production of 23.66 lakh metric tonnes and Vidarbha accounts for about 13.70 lakh hectares with production of 14.40 lakh metric tonnes (Anonymous, 2004).

The vegetative barriers on contour for in-situ soil and moisture conservation has been preferred to conventional mechanical structure alone on arable and non-arable farming considering the small land holding size and other limitations of farming system.

The study was conducted at Watershed Management Research Unit, Agroecology and Environment Centre, Dr. PDKV, Akola, during 2004-2005 on Inceptisol. The three treatments consisted of sowing along the main slope (T_1), sowing along the graded bund (T_2) and contour cultivation along vetiver hedge (T_3). Plotwise soil samples from upper and lower side of the slope (0-15 cm and 15-30 cm) were collected, processed and analysed for various physical and chemical properties with standard procedures suggested by Black *el* al. (1965) and Jackson, (1967).

The available nitrogen in surface (0-15 cm) and subsurface (15-30 cm) soil varied from 191.23 to 211.68 and I 52. 4 to 194. 7 kg ha^{-1}, respectively. On the basis of soil test rating, the available nitrogen content in most of the soil samples were categorized as medium. The available P in surface and subsurface soil ranged from 10.80 to 14.48 and 9.05 to 10.86 kg ha-1, respectively, indicating that the soils were low to medium in available phosphorus. On the basis of soil test rating, all the soil samples were categorized as high in available potassium content. The available K content of surface and subsurface soil ranged from 306.8 to 348.0 and 288.0 to 324.0 kg ha^{-1}, respectively.

Data presented in Table 1 indicate that the Zn content in surface and subsurface soil ranged from 0.82 to 1.49 and 0.63 to 1.12 ppm respectively. The critical limit for Zn is 0.6 ppm (Katyal, 1985) and hence soils under study were sufficient in Zn status with decreasing trend with depth. Similar observations were also reported by Chavan *et al.*, (1980)

The copper content in 0-15 and 15-30 cm depth varied from 1.96 to 2.84 and 1.7 to 2.66 ppm, respectively. The data clearly indicate that the DTPA Cu decreased with depth.

Table 1. Major and micronutrients status of soil

Treat-ment	Depth (cm)	Avail. N (kg ha^{-1})	Avail. P (kg ha^{-1})	Avail. K (kg ha^{-1})	Zn (ppm)	Cu (ppm)	Mn (ppm)	Fe (ppm)
T1	0-15	200.39	10.86	314.7	1.24	2.67	3.88	6.28
(LS)	15-30	174.98	9.80	307.7	0.99	2.45	3.25	6.00
T1	0-15	21 1.68	14.48	348.0	1.00	2.40	3.79	6.77
(US)	15-30	186.27	10.86	305.4	0.80	2.06	3.21	6.62
T2	0-15	191.23	10.86	31 1.30	1.49	1.96	2.90	6.74
(LS)	15-30	183.45	10.80	300.16	1.12	2.32	3.05	5.62
T3	0-15	197.5	10.86	324.0	0.95	2.84	4.87	6.21
(US)	15-30	152.4	9.05	299.0	1.05	2.66	2.48	6.31
T4	0-15	21 1.68	14.48	306.8	1.03	2.18	3.45	6.40
(LS)	15-30	186.27	10.86	288.0	0.63	1.96	3.16	6.18
T5	0-15	200.39	10.80	326.0	0.82	2.07	3.64	5.47
(US)	15-30	194.7	10.42	324.0	0.76	1.70	3.10	4.63

Table 2. Yield of soybean (q ha ') as influenced by land treatments

Treatments	Grain yield (qha^{-1})	Straw yield (qha^{-1})	Increase in grain yield over T_1 (%)	Increase in straw yield over T_1(%)
T_1	14.49	14.88	-	-
T_2	14.9	15.41	3.45	3.56
T_3	16.03	16.27	10.63	9.34
'F' test	Sig.	Sig.	-	-
CD at 5%	0.51	0.57	-	-

The manganese in surface (0-15 cm) and subsurface (15-30 cm) soil varied from 2.90 to 4.87 and 2.48 to 3.25 ppm, respectively. The data clearly indicate that the DTPA Mn decreased with depth.

The DTPA Fe in 0-15 and 15-30 cm soil ranged from 5.47 to 6.77 and 4.63 to 6.62 ppm, Respectively. The data indicate that the DTPA Fe decreased with depth. Decrease in available Fe in subsurface soil attribute to low organic carbon and higher pH of subsurface soil.

The data in relation to yield of soybean as influenced by various land treatments are presented in Table 2.

Results indicate that the highest grain yield was recorded in contour cultivation along Vetiver barrier (16.02 q ha^{-1}) and minimum grain yield was recorded in treatment (T_1) sowing along the slope (14.49 q ha^{-1}). Highest straw yield was recorded in contour cultivation along vetiver barrier (16.27 q ha^{-1}) and minimum straw yield was recorded in treatment (TO sowing along the slope (14.88 q ha^{-1}). Similar observations were also recorded by Bharad *et al.* (1993).

The increase in grain and straw yield under land treatment + contour cultivation along Vetiver barrier (T_3) was 3.45 and 3.56 per cent and in sowing along the graded bund (T_2) was 10.63 and 9.34 per cent, respectively over sowing along the x main slope (Ti).

Thus from the experimental results, it can be stated that the contour cultivation along the vetiver hedges not only improved the fertility status of soil but also enhanced the productivity of soybean.

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Occurrence of Powdery Mildew on Soybean

Maharashtra contributes18.92 lakh tonnes of soybean from 21.02 lakh ha area (Anonymous ,2005). Several pathogens have been reported to cause diseases in this crop. During *Kharif* (2006-2007) the incidence of powdery mildew was noticed on soybean cultivar JS-335 at research farm of Seed Technology Research Unit (NSP), M.P.K.V., Rahuri. The severity of the disease ranged from 0.00 to 62.2 per cent depending upon the cultivars. The disease was not observed previously on this crop and, therefore, it was decided to undertake the study on the powdery mildew of soybean.

The incidence of powdery mildew was noticed at flowering to pod formation stage. Initially, small patches of white powdery mass developed on both the surface of leaves (Fig. 1). Thereafter the patches grew , covered a large area and affected leaves turn purple. The disease occurred on leaves (65 DAS) in the second week of September. Infection was noticed on young leaves, branches, stem and pods (Fig. -2) At the time of occurrence of disease the maximum temperature was 30.6 °C, minimum temperature 20.7 °C with relative humidity (max. 85 % and min.64 %) with dry climate .The severity of the disease increased thereafter and it was highest during third week of September i.e 47.5 per cent on JS-335 when the maximum temperature of 30.8° C and minimum 21.9 °C with 62 per cent relative humidity.

The oidia usually formed singly rarely in chains (Fig. -3). Oidia were ellipsoid, hyaline, thin walled and measured 25.33 X 15.94 um. Cleistothecia was not observed on infected plant parts . The pathogen was identified as *Erysiphe polygoni* DC on the basis of morphological characteristics of the fungus. Occurrence, development and the spread of the disease was due to prevalence of dry weather and high humidity . The infection of powdery mildew in dry period coupled with high humidity have been reported earlier by Sharma (1992). Mehrotra (1986) reported that conidia of *Erysiphe polygoni* inciting powdery mildew germinated well over range of moisture (0-99 %) at 23 ° C temperature. The pathogenecity of the fungus was performed as per the prescribed method. The inoculated leaves on plants developed characteristic powdery mildew symptoms within 10 days. Lehman (1931) earlier reported powdery mildew of soybean caused by *Erysiphe polygoni* .

Twenty cultivars of soybean were grown in the research field of Seed Technology Research Unit (NSP), MPKV, Rahuri during *Kharif* 2006-2007. The varieties were vigorously screened against powdery mildew. For recording the disease, 10 plants were selected randomly from each plot and variety. Two lower, two middle and two upper leaves were tagged by coloured thread and categorized the leaves by 0-9 scale (Mayee and Datar,1986). The per cent disease intensity was calculated by the formula given below-

$$\text{Per cent disease intensity (\%)} = \frac{\text{Sum of all the numerical ratings}}{\text{No. of plants observed X highest rating}} \times 100$$

The genotypes were categorized into various disease reaction categories. The categories were

Resistant (R)	: 0-10 % powdery mildew
Moderately Resistant (MR)	: 10.1-25 % powdery mildew
Moderately susceptible (MS)	: 25.1-50 % powdery mildew
Susceptible (S)	: 50.1-75 % powdery mildew
Highly susceptible (HS)	: 75.1 % & above powdery mildew

Of the twenty genotypes of soybean screened, the genotypes *viz*., MACS-661, DS-182, JS-7103 and DS-228 (Phule Kalyani) were totally free from powdery mildew infection while MACS-144, MACS-629 and MACS-450 were found resistant showing 9.5,6.5 and 7.5 per cent intensity of powdery mildew. These genotypes were graded as resistant against powdery mildew. The genotypes *viz*., MAUS-2, MACS-518, MACS-515, MACS-13, MACS-659, MACS-58 and MACS-124 were moderately resistant to powdery mildew. The variety JS-335 and MACS-413 were susceptible to powdery mildew.

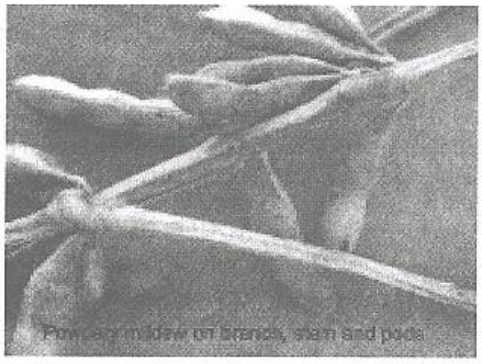

Fig. 1 Powdery mildew on branch, stem and pods

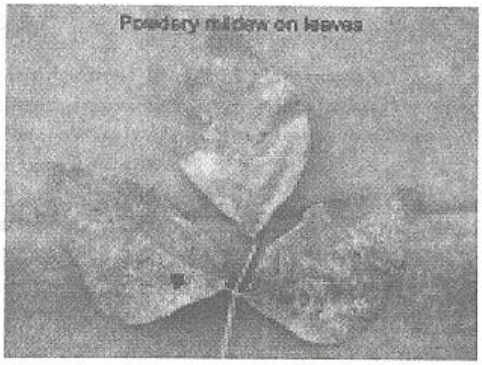

Fig. 2. Powdery mildew on leaves

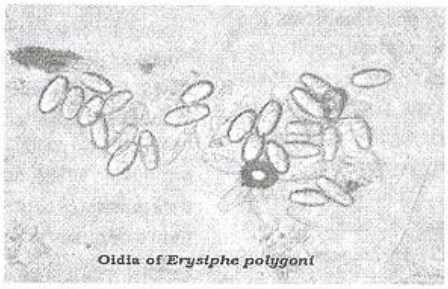

Fig. 3. Oidia of Erysiphe polygoni

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Dual Resistance of Chickpea Genotypes Against *Fusarium* Wilt and Pod Borer

Chickpea (*Cicer arietinum* L.) is an important pulse crop grown in India. It is cultivated over an area of 6.71 million ha with a production of 5.47 million tonnes and average productivity of chickpea is 815 kg ha^{-1} in India (Anonymous,2006). The area under this crop in Maharashtra was 8.30 lakh ha and production of 4.66 lakh tonnes with average productivity of 562 kg ha^{-1} (Anonymous, 2005).The major limiting factor has been the susceptibility of cultivars to several biotic and abiotic stresses that affect yield adversely (Singh *et al.*, 1994). Chickpea wilt caused by *Fusarium oxysporum Schlecht. f.* sp. *ciceri* (Padwick) Snyd. and Hans. is wide spread in almost all the chickpea growing regions in the state. The fungus is soil and seed borne and survives in soil in the absence of host for at least 6 years (Haware *et al.*, 1986) causing losses up to 100 per cent. Gram pod borer, *Helicoverpa armigera* (Hubner) is regular occurrence in the state of Maharashtra from early vegetative to podding stage causing 60-80 per cent losses (Puri *et al.*, 1998).In the present study, 26 genotypes of chickpea were evaluated during 2002-03 to 2005-06 (Four years) to find a donor against wilt and pod borer.

Twenty six genotypes were sown in wilt sick plot with susceptible genotype JG-62 as a check intermittently after every two test entries to ensure high disease pressure in two replications. Each genotype has row length of 4 m with 30x10 cm spacing and recommended package of practices were followed except plant protection measures. The observations on number of plants wilted in each genotype were recorded at 30, 45, 60, 75 and 90 days after sowing and thereafter mean per cent wilt incidence was calculated. Further, the genotypes were graded by adopting 0-9 rating scale (Nene *et al.*, 1981). The same genotypes were screened for gram pod borer. The chickpea genotype Vishal was used as a check in this study. Pod borer infestation was recorded as per cent damaged pods at the end of harvesting. Further, per cent pod borer infestation were converted to pest susceptibility rating (1-9 scale) as suggested by Lateef and Reed (1983).

The wilt susceptible genotype, JG-62 was completely wilted thereby indicating high and uniform level of sickness in the field. All the 26 genotypes showed varying per cent / degree of mortality (Table 1) ranging from 3.28 per cent on Phule G-01103 to 100 per cent on JG-62. From the wilt reaction , it was observed that the genotypes *viz.*, Rajas, Digvijay, Vishal, Phule G-92926, 96006, 9421-1, 9409-1-1, 9426-2, 97030, 97033, 9758-6-2, 00108, 97121, 00109, 97036, 97117, 0110 , 01103 were resistant (<10 per cent) while Phule G-97036, 03302 were moderately resistant (10-20 %) to *Fusarium* wilt.

The pod damage due to pod borer (*Helicoverpa armigera)* among the test genotypes ranged from 11.74 per cent in Phule G-00109 to 27.27 per cent in Phule G-5. From the pest susceptibility rating (PSR), it was noticed that the genotypes *viz.*, Phule G-9409-1-1, 97030, 00109, 01103, 03404, 96325, 03302 were most promising against pod borer had PSR value 4. While Phule G-9426-2, 9758-6-2, 00108, 97121, 97036, 97117, 0110 had PSR of 5 and found to be less susceptible than check Vishal. Rests of the genotypes had PSR above 6 and were more susceptible than check Vishal.

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Table 1. Reactions of chickpea genotypes against *Fusarium* wilt and pod borer, *Helicoverpa armigera* (2002-03 to 2005-06).

Genotypes	Average wilt incidence (%)	Average pod damage (%)	PSR
Vishal	5.26	19.85	-
Rajas	5.64	18.24	6
Digvijay	6.09	18.81	6
Vijay	34.60	22.63	7
Phule G- 5	88.56	27.27	8
Phule G-92926	7.05	24.38	7
Phule G -96006	7.88	21.58	6
Phule G-9421-1	4.89	22.53	7
Phule G-9409-1-1	6.33	12.69	4
Phule G-9426-2	5.41	17.36	5
Phule G-97030	6.88	14.10	4
Phule G-97033	6.47	18.18	6
Phule G-9758-6-2	5.09	15.85	5
Phule G-96005	20.60	18.35	6
Phule G-00108	4.45	14.89	5
Phule G-97121	7.21	15.84	5
Phule G-00109	7.91	11.74	4
Phule G-97036	4.05	15.06	5
Phule G-97117	5.01	16.65	5
Phule G-0110	5.36	16.85	5
Phule G-01103	3.28	14.15	4
Phule G-03404	26.48	12.02	4
Phule G-97306	11.92	22.81	7
Phule G-96325	36.11	14.21	4
Phule G-03302	15.15	13.29	4
JG-62	100	19.23	6
Mean	16.83	17.64	
SD±	24.10	3.96	

PSR= Pest Susceptibility Rating

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Occurrence of Powdery Mildew on Sunflower

Maharashtra contributes 1.20 lakh tones of sunflower from 2.90 lakh ha area with 396 kgha^{-1} yield (Anonymous ,2005).Several pathogens have been reported to cause diseases on this crop. During *Rabi* 2006-2007 the incidence of powdery mildew was noticed at Central Campus, M.P.K.V., Rahuri and Zonal Agril. Research Station, Solapur. The severity of the disease ranged between 18.60 to 30.80 per cent depending upon the cultivars. The disease was not observed previously on this crop in this region and therefore, it was decided to undertake the study on the powdery mildew of sunflower (*Helianthus annus* L.).

The incidence of powdery mildew was noticed at head formation stage. Initially, small patches of white powdery mass developed first on lower surface of leaves and then on upper surface (Fig. 1). Thereafter, the patches grew, covered a large area and affected leaves turned purple. The white area turned gray and small black fruiting bodies (cleistothecia) of powdery mildew appeared in grey areas. Severely infected leaves turned yellow and dry. Lower leaves found heavily infected than the upper leaves. The disease occurred on leaves in the second week of December. The maximum temperature 31 °C, minimum temperature 11 °C with morning relative humidity 91 per cent and evening relative humidity 43 per cent with dry climate found congenial for initiation of powdery mildew. The severity of the disease increased thereafter and it was highest during second and third week of December i.e. 30.80 per cent. During this period the maximum temperature 29.4 °C and minimum 8.9 °C with morning relative humidity 79 per cent and evening relative humidity was 31 per cent, found congenial for development of epidemic of powdery mildew

The oidia usually formed singly, rarely in chains (Fig. 2). Oidia were ellipsoid, hyaline, thin walled and measured 24.09 X 16.83 µm. Cleistothecia, sexual black fruiting bodies were observed on infected leaves. The fungus was identified as *Erysiphe cichoracearum* on the basis of morphological characteristics of the fungus. Occurrence, development and the spread of the disease was due to prevalence of dry weather and high humidity. The pathogenecity of the fungus was performed as per the prescribed method. The inoculated leaves on plants developed characteristic powdery mildew symptoms within 10 days. Salman *et. al.* (1982) earlier

Table 1. Mean Per cent Disease Intensity (PDI) of powdery mildew on sunflower genotypes at STRU, M.P.K.V., Rahuri

Genotypes	PDI of Powdery mildew
Morden	30.80
	(33.71)
SS-56	20.80
	(27.13)
EC-68414	30.80
	(33.71)
PKV-SF-9	22.10
	(28.02)
LS-11 (Siddheshwar)	20.00
	(26.53)
TAS-82	20.00
	(26.53)
DRSF-108	18.60
	(25.52)
TNAUSUF-7	22.00
	(27.95)
KBSH-1	18.96
	(25.76)
LSH-3	16.80
	(24.19)
PKVSH-27	20.00
	(26.57)
KBSH-44	18.60
	(25.54)
SSFH-17	18.60
	(25.54)
PAC-1091	20.00
	(26.57)
SH-416	20.00
	(26.57)
S.E.±C.D C.V%	0.89
	2.69
	4.60

(Figures in parentheses indicate arc sin transformed values)

reported powdery mildew of sunflower caused by *Erysiphe cichoracearum*.

For recording the disease, 10 plants were selected randomly. Two lower, two middle and two upper leaves were tagged by coloured thread and categorized the leaves by 0-9 scale (Mayee and Datar, 1986). The per cent disease intensity was calculated by the formula given below-

$$\text{Per cent disease intensity (\%)} = \frac{\text{Sum of all the numerical ratings}}{\text{No. of plants observed X highest rating}} \times 100$$

Fifteen sunflower genotypes were screened against powdery mildew. The results (Table 1) indicated that the powdery mildew intensity ranged between 16.80 to 30.80 per cent on various genotypes. The genotypes i.e. LSH-3, SSFH-17, KBSH-44, KBSH-1, DRSF-108, LS-11, TAS-82, PKVSH-27, PAC-1091 and SH-416 were tolerant to powdery mildew. These genotypes may be used in further development of sunflower breeding programme. The crops *viz.* red pumpkin, bottle gourd and cucumber were also inoculated with this fungus and found infected. Therefore, these crops act as host for this fungus.

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Natural Epizootic of Entomopathogenic Fungi on Semilooper of Soybean in Akola Vicinity

Soybean is one of the most important proteineous and oil seed crops of 21st Century. In India, area under soybean cultivation increased rapidly due to its very high nutritional value (Bishnoi, 2005). With the extensive rise in area under soybean cultivation the pest problem have also been increased seriously and become one of the reasons for low yield. The luxuriant growth of soybean accompanied by green, soft and succulent foliage provides an unlimited source of food space and shelter to the insects (Jayappa *et al.*, 2003).

Farmers are facing severe problem for control of lepidopteran and other major pests on soybean. They generally use chemical pesticides to combat the pest problem. It gives hazardous effect and create environmental pollution. However, epizootic of fungal pathogen on soybean pests have been reported by various workers. Singh and Singh (1987) showed 100 per cent natural infection of white muscardine disease, *Spicaria rileyi* on green semilooper in soybean. Also during survey, an average 22.2 per cent green semilooper, 8.4 per cent *S. litura* and 2.4 per cent *S. obliqua* larvae were observed dead per meter row length infected by *N. rileyi* in soybean field naturally (Ingale *et al.*, 2004). Hence present survey was carried out to know the natural epizootic of entomopathogenic fungi on lepidopteran pests of soybean in Akola vicinity.

In the present investigation weekly survey was conducted to observe natural infection on lepidopteran pests of soybean on the field of Dr. P. D. K. V., Akola as well as field of research station near by Akola city. From selected field, randomly five plants were selected from each plot. Number of larvae plant^{-1} and number of

infected larvae of green semilooper, *Spodoptera litura* and hairy caterpillar were counted and percentage was worked out.

It is evident from the data in Table 1 that during third week of August (18 Aug. 2005) (33 MW), moderately heavy infection (28.57%) of *B. bassiana* was noticed on green semilooper at Agronomy Farm, Dr. PDKV, Akola. Other pests *viz.*, *Spodoptera litura, Spilosoma obliqua* were observed to be uninfected from fungal attack. During the survey the temperature ranged between 22.8 to 30.8°C and relative humidity 87 per cent.

During fourth week of August (25 August 2005) when survey was conducted at Agronomy Farm it was observed that, the natural epizootics of entomopathogenic fungi was noticed to the extent of 57.14 per cent on green semilooper of soybean. Out of which 75 per cent cadavers were infected due to *N. rileyi* and remaining 25 per cent cadavers were due to *B. bassiana,* when the temperature was ranged between 22.6 to 30.2 °C and relative humidity was 86 to 88 per cent.

During last week of August, (30th August, 05) (35 MW) when survey was conducted at Oil Seed Research Unit, Dr. PDKV, Akola 13.64 per cent infection was noticed on green semilooper larvae. Out of which, 66.67 per cent larvae were found to be infected with *N. rileyi* and remaining 33.33 per cent larvae were infected by *B. bassiana*. During this observation relative humidity observed was 83 per cent with increased maximum temperature of 34 °C.

In first week of September (6 Sept. 05) (36 MW) on field of Department of Botany, 24 per cent infection of entomopathogenic fungi was recorded. Out of which 83.33 per cent larvae were found to be infected by *N. rileyi* and remaining 16.67 per cent larvae by *M. anisopliae*. Relative humidity was found to be very high 93 per cent with temperature of 30.3 °C during this period.

In third week of September (16 Sept. 05) (37 MW) on field of Department of Plant Pathology 38.89 per cent epizootic was recorded. Out of which 85.71 per cent larvae of green semilooper were found to be infected

Table 1 : Natural fungal infection

Date	Temperature (°C)	Relative Humidity (%)	Location	Semilooper			
				L	I	I%	% fungus attack
18/08/05 (MW-33)	22.8-30.8	87	Agronomy farm	7	2	28.57	*B. bassiana*-28.57
25/08/05 (MW-34)	22.6-30.2	86-88	Agronomy farm	7	4	57.14	*N. rileyi* - 75.00 *B. bassiana* -25.00
25/08/05 (MW-34)	23.0-31.1	85-87	Washim Road Farm	30	0	0	-
30/08/05 (MW-35)	34	83	Oilseed farm	22	3	13.64	*N. rileyi* - 66.67 *B. bassiana* -33.33
06/09/05 (MW-36)	30.3	93	Plant breeding	25	6	24	*N. rileyi* - 83.33 *M. anisopliae*-16.67
16/09/05 (MW-37)	33.2	84	Plant pathology	18	7	38.89	*N. rileyi* - 85.71 *M. anisopliae* - 14.29
29/09/05 (MW-38)	30.5	91	Agronomy farm	14	12	85.71	*N. rileyi* - 50.00 *B. bassiana* - 33.33 *M. anisopliae* - 8.33
5/10/05 (MW-39)	34	88	Agronomy farm	17	12	70.59	*N. rileyi* - 58.33 *M. anisopliae* - 25.00 *B. bassiana* - 16.67

L-Larvae per 25 plants, I-No. of Infected larvae, I %-Infected larval percentage

by *N. rileyi* and remaining 14.29 per cent larvae by *B. bassiana*. During this observation relative humidity observed was 84 per cent with temperature of 33.2 °C.

During last week of September (29th Sept. 06) (38 MW) when survey was conducted at Agronomy farm heavy epizootic of entomopathogenic fungi was noticed. During this period all the three fungi played an active role naturally. Out of total fungal infection (85.71%), *N. rileyi* had 50 per cent share. Next efficacious fungus was *B. bassiana* responsible for mortality of 33.33 per cent larvae, followd by *M. anisopliae* (8.33%). During the survey high relative humidity (91%) was noticed with maximum temperature of 30.5 °C.

First week of October (5 Oct. 05) (39 MW) was also found to be the favourable for the activity of entomopathogenic fungi and thus recorded 70.59 per cent epizootic. Out of which 58.33 per cent cadavers were found to be infected due to *N. rileyi* and 25 per cent cadavers by *M. anisopliae. B basiana* contributed 16.67 per cent larval mortality, 88 per cent relative humidity with high temperature 34 °C was observed during the survey.

Overall results showed that all the three entomopathogenic fungi were remained active in Akola vicinity. Out of which *N. rileyi* had more share in terms of natural epizootic on green semilooper of soybean. *B. bassiana* appeared to be the next promising fungus on green semilooper. Further it is observed that entomopathogenic fungi were more active during high per cent of humidity (83-93 %) and temperature ranged between 30.5 °C to 34 °C.

Phadke *et al.* (1978) reported the outbreak of *N. rileyi* during September at high humidity. Ignoffo (1981) suggested the *Nomuraea rileyi* as potential candidate for use as microbial insecticide in soybean agroecosystem due to its extensive epizootic on caterpillar pests. Lingappa *et al.* (2000) reported natural epizootic of *N. rileyi* on lepidopteron pests in traditional Soybean belt of Karnataka in India. Ingale *et al.* (2004) reported on an average 22.20 dead green semilooper per mt. row infected by *N. rileyi* in soybean field. Thus, all these previous findings are in agreement with the present findings.

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Field Evaluation of Tractor Drawn Sugarcane Planter

Sugarcane cultivation requires various operations like land preparation, planting, irrigation, harvesting, interculturing, plant protection, harvesting, transportation that are done by indigenous equipments. Uniform distribution of seed pieces is a key indicator of quality of the planting operation. Inadequate farming techniques, low plant population, poor management, lack of modern and versatile equipment for sugarcane cultivation are the main causes of low yield (Anonymous, 2007). The shortage of timely labourers and exorbitant labourers hiring rates force the farmers to limit their sugarcane acreage. Hence, there is an urgent need to mechanize these operations fully or partially in order to cut down man-h to reduce operational cost. The problem of non-availability of labourers, higher cost of planting, timely operation and drudgery have forced sugarcane growers to think of the use of machines for planting sugarcane. Traditionally, sugarcane has been planted manually. However, to have timelines in planting, planters have been developed. These planters are basically of two types widely known as two-row drum type sugarcane planter (semiautomatic) and two-row whole stick sugarcane cutter planter (automatic). Considering the importance of sugarcane planting, the experiments were conducted at different locations in Akola district on farmers' field to assess the performance of the sugarcane planters.

The field performance tests were conducted on nine farmers' field comprising 5.2 ha area in Akola district. Planting was done using drum type planter available in Department of Farm Power and Machinery and whole stick cutter planter available in the Sugarcane Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The field performance tests were carried out to obtain actual data on overall machine performance, field capacity and cost of operation etc., by following RNAM test code (Bangali baboo and Singh, 1997). Automatic sugarcane planter consists of sturdy frame accommodating seed metering mechanism, seed box, fertilizer box and insecticide tank. One pair of chute was also attached to the main frame for dropping the setts. In automatic planter, the furrow openers opened furrows, setts were dropped continuously one after another mechanically by using cutting blades through chute. Semi-automatic planter consists of sturdy frame accommodating two revolving drums, fertilizer box, seed box, furrow openers, ground wheel and covering devices (Muhammad Farooq and Abdul Majid, 1992). This machine was integrally mounted on the rear of a tractor through three-point linkage. The automatic planter was provided with cutter blades, which cut the whole sugarcane into setts of required length and drops them in the furrow. Whereas the semi-automatic planter required pre cut of desired length of setts (35-40 cm) to be fed to the planter. The performance of semi-automatic drum type and automatic set cutter sugarcane planters were evaluated at farmers' field. Similarly, the conventional method of sugarcane planting was also studied. The results obtained from these planters are compared with conventional planting method and are presented in table 1. The effective field capacity was found to be 0.150 and 0.176 hah^{-1} and the field efficiency was found to be 55.53 and 51.76 per cent in semi-automatic and automatic planter, respectively. The cost of planting operation using semi-automatic and automatic planter was worked out to be Rs ha^{-1} 1687 and Rs ha^{-1} 1491, respectively compared to conventional sugarcane planting of Rs ha^{-1} 1765. It saved Rs. 78 per hectare in semi-automatic and Rs 274 per ha in automatic planter. The number of setts required for 10 m row length was 23 and 24 in semi-automatic and automatic planter, respectively and over lapping of the setts was found to be 9-15 cm in automatic planter, whereas no overlapping was observed in semi-automatic planter. The planters maintained row-to-row spacing of 90 cm. Physical damage to the bud was observed to be 4-5 per cent and it gave lowest seed damage. The labourers requirement for planting operation was 8 and 4 in semi-automatic and automatic planter, respectively and 32 labourers in conventional practice considering, cutting canes, seed treatment, transportation of setts, setts placing in the furrows, pressing setts and watering, refilling of seed box and applying fertilizer. It saved 75.00 and 87.50 per cent labourers in semi automatic and automatic planter, respectively compared to conventional method. The planter was mounted on 45

hp Mahindra tractor and operated in second low gear. The fuel consumption of the tractor, mounted with semi-automatic and automatic planter was measured to be 15.34 lit. ha^{-1} and 12.7 lit. ha^{-1}, respectively. Farmers found the sugarcane planter successful for adaptation and use. It reduces the time, human labour and drudgery involved while sugarcane planting operation. Sugar cane planter accomplishes all the operations involved in sugarcane planting viz., opening of furrows, dropping of setts, placement of fertilizer and covering of setts in single pass. The overall performance of the planters during operation in the field was found satisfactory without break down.

Table1. Field performance test of the planters and conventional planting

SN.	Particulars	Semiautomatic planter	Automatic planter	Conventional planting
1	Overlapping of setts, cm	Nil	9-15	Nil
2	No. of setts required per 10 m row length	23	24	18
3	Effective field capacity, ha h^{-1}	0.150	0.176	-
4	Theoretical field capacity, ha h^{-1}	0.27	0.34	-
5	Field efficiency, %	55.53	51.76	-
6	Labourers requirement			
7	i) for cutting canes	2	-	6
	ii) Seed treatment	2	-	2
	ii) Transportation of setts	-	-	4
	iii) For placing of setts in furrows	-	-	6
	iv) Pressing setts and watering	-	-	12
	v) On machine for setts dropping	2	2	-
	vi) for refilling of seed box	2	2	-
	vii) Applying fertilizer	-	-	2
	Total labourers	8	4	32
8	Germination percentage	65.51	68.20	70.65
9	Cost of planting operation, Rs. ha^{-1}	1687	1491	1765

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Research Notes

CONTENT

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