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Soybean Seed Quality as Influenced by Stacking Height and Transportation

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ABSTRACT

An experiment was conducted to see the effect of stacking height of soybean seed bags and transportation on seed quality of soybean. There was significant effect of stacking height on mechanical damage and seed quality parameters of var. JS-335 during storage. The mechanical damage due to the seeds stacked at 8th layer was significantly higher than the seeds stacked at 2nd and 4th layers. The germination, RS length, vigour index, dry matter content and viability as tested by TZ test was found significantly lower, whereas the moisture content, electrical conductivity, leaching of sugars and seed mycoflora were found significantly higher of seed stacked at 8th layer. There was no significant effect of loading, unloading and transportation of seeds of variety JS-335 when transported by truck upto 40 km distance by road only.

Seeds are in storage from the date of their physiological maturity until they are planted (Harrington, 1972). Thus, the seeds in transit are in fact in storage. "In transit" includes not only the time the seed are being moved from one location to another but also the time they are awaiting in a warehouse, rail road, etc. While in transit the seeds are subjected to the same storage principles as seed in warehouse. The principal difference between warehouse storage and in transit storage are the relatively fast changing in the seed environment that can result from transportation and failure of personnel to predict all the hazardous conditions to which seeds may be subjected. Similarly during transportation, loading and unloading the seed may get bruises, small cracks and internal cracks which might deepening at stacking during storage. In view of the above an experiment was planned to the effect of stacking height and transportation of seed on seed quality of soybean.

MATERIAL AND METHODS

Effect of stacking height

The effect of stacking height during storage on seed quality of soybean was studied with variety JS-335 harvested from Central Farms, MPKV, Rahuri during *Kharif* 1999. The seeds were stored in 30 kg bags and with 8 stacking layers for two months in Breeders Seed Store of the University for two months. The layers were counted from top to bottom (1st layer- at top and 8th layer at bottom). The seed samples were drawn in five replications at monthly interval from the bags stacked at 8, 6, 4 and 2nd layer.

Effect of loading, transportation and unloading

The study on effect of loading transportation and unloading on seed quality of soybean was carried out in collaboration with MSSC Ltd. on seeds which were used for stacking height studies. The seed samples of JS-335 in five replications were drawn before loading, after loading, before unloading (after transportation) and after unloading. The transportation was done from MPKV, Rahuri to Shrirampur located approximately 40 km away from place of study.

The observations on germination (%), moisture content (%), Seed mycoflora (%) (Anonymous,1999), Vigour index (Abdul-Baki and Anderson, 1973), Leaching of sugars (mg $100g^{-1}$) (Dubois *et al.* 1956), Electrical conductivity (mmhos cm^{-1} g^{-1}) (Loeffler *et al.*, 1988), TZ test (%)(Pasha and Das, 1982), were recorded. For mechanical damage, three replications each of hundred seeds from each treatment was observed under polorioscope/ magnifying lens. The seeds having breakages, cracks were counted and the average and percentage were worked out. The data generated were analyzed by Completely Randomized Design in accordance with Snedecar and Cochran (1967).

RESULTS AND DISCUSSION

The data pertaining to effect of stacking height on different seed quality parameters of soybean var. JS-335 have been presented in Table 1. There was significant difference in all the seed quality parameters of soybean var. JS-335 under study due to stacking height during storage.

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Mechanical Damage

The mechanical damage of seed was found to be increased as the stacking layers (height) increased. The mechanical damage of seed stacked at 8th layer (bottom layer) was significantly higher but was at par with mechanical damage of seed stacked at 6th layer at both the periods of storage. There was further increase in mechanical damage at 6th and 8th layer with the advancement in storage period. There was no significant difference in mechanical damage of seed stacked at 2nd and 4th layers at 30 and 60 days of storage.

Germination

The germination percentage was found to be decreased as stacking layer increased. Further, it was also decreased at 60 days of storage as compared to 30 days. The decrease was more as the stacking level increased. The highest germination percentage was observed in seed stacked at 2nd layer during both periods of storage. The significantly lower germination was observed in seed stacked at 8th layer.

Moisture content

The moisture content of the seed was found to be decreased at 60 days of storage as compared to 30 days of storage. The significantly higher moisture content (7.60%) was recorded in seed stacked at 8th layer at 30 days of storage. At 60 days of storage, the moisture content of seed stacked at 4th, 6th and 8th layers was same (7.56%). At 60 days of storage, the moisture content of seed at 2nd layer was (7.36%) significantly lower than the seed stacked at 4th, 6th and 8th layers (7.56%).

Root shoot length

The RS length was found to be decreased at 60 days of storage as compared to 30 days of storage. The decrease in RS length was more sharp with increase in stacking layer. The significantly higher RS length was observed in seedling of seed stacked at 2nd layer than 6th and 8th layers during 30 and 60 DAS. The RS length of seedlings of seed stacked at 8th layer was significantly lower than the seedlings of seed stacked at 2nd, 4th and 6th layers at 30 and 60 days of storage.

Vigour index

The vigour of seed was found to be decreased as storage period increased. The significantly higher vigour was recorded in seed stacked at 2nd layer than vigour of seed stacked at 8th layer. The significantly lower vigour was noted in seed stacked at 8th layer as compared to vigour of seed stacked at 2nd, 4th and 6th layers.

Dry matter content

The dry matter content was found to be decreased as stacking layer increased, it was also further decreased at 60 days of storage as compared to 30 days of storage. The significantly higher dry matter content of seedlings was noticed in seeds stacked at 2nd layer than the seeds stacked at 4th, 6th and 8th layers at 30 and 60 days of storage.

Electrical conductivity

The electrical conductivity was found to be increased as stacking layer increased. It was further increased as the storage period advanced. The electrical conductivity of the seed stacked at 2nd layer was significantly lower than that of seed stacked at 6th and 8th layers The electrical conductivity of the seed stacked at 8th layer was significantly higher than the seed stacked at 2nd and 4th layers at both the period of storage.

Leaching of sugar

The leaching of sugars from seeds was found to be increased as the stacking layer increased. The leaching of sugars further increased as storage period advanced. The leaching of sugar from seeds stacked at 2nd layer was found to be significantly lower as compared to 4th, 6th and 8th layers at 30 days of storage. The leaching of sugar from seeds was significantly increased at each increasing stacking layer.

Seed mycoflora

The mycoflora of seed increased as the level of stacking layer increased, further it increased as storage period advanced. At 30 days of storage, there was significant difference in seed mycoflora at each stacking level. The mycoflora was significantly lower in seed stacked at 2nd layer and higher at 8th layer. At 60 days of storage, the mycoflora of seed stacked at 2nd and 4th layers was same, however, it was significantly lower than mycoflora of seeds stacked at 6th and 8th layers, whereas the mycoflora of seeds stacked at 8th layer was significantly higher than that of seed stacked at 2nd, 4th and 6th layers.

TZ test

The viability was found to be decreased as stacking layer increased and decreased further with advancement of storage period. The viability of seeds

Table1. Effect of stacking height on different seed quality parameters of soybean during storage

Treatments	Mechanical Damage		Germination%		Moisture Content		TZ viability		Seed Mycoflora	
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
2nd layer	19.20 (25.99)	19.60 (26.28)	82.80 (65.50)	81.00 (64.16)	7.44	7.36	83.20 (62.80)	82.40 (65.20)	50.00 (45.00)	58.00 (49.60)
4th Layer	21.60 (27.69)	21.60 (27.69)	78.80 (62.58)	77.00 (61.34)	7.52	7.56	80.80 (64.01)	80.60 (63.87)	56.00 (48.45)	58.00 (49.60)
6th Layer	24.80 (29.87)	26.80 (31.18)	78.20 (62.17)	76.00 (60.67)	7.56	7.56	80.00 (63.44)	79.12 (62.80)	66.00 (50.77)	64.00 (53.13)
8th Layer	27.60 (31.69)	28.67 (32.39)	76.00 (60.67)	73.20 (58.69)	7.60	7.56	78.40 (62.31)	77.60 (62.44)	66.00 (54.33)	70.00 (56.80)
Mean	23.30 (28.86)	24.16 (29.47)	79.20 (62.87)	78.80 (62.58)	7.53	7.51	80.10 (63.50)	80.40 (63.72)	58.50 (49.89)	59.50 (50.48)
Sig	*	*	*	*	*	*	*	*	*	*
SE (m) ±	0.980	0.880	0.740	0.780	0.041	0.040	0.431	0.511	0.291	0.337
CD at 5%	2.950	2.630	2.200	2.300	0.102	0.120	1.181	1.417	0.512	0.878

Treatment	RS length		Vigour Index		Dry Matter		Electrical Conductivity		Leaching of Sugar	
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS		30 DAS	60 DAS	30 DAS	60 DAS
2nd layer	30.30	27.28	2450.60	2182.84	1.11	1.09	0.88	1.00	516.75	524.19
4th Layer	29.66	26.16	2350.64	2081.48	1.05	1.04	1.00	1.09	536.45	538.60
6th Layer	28.54	24.94	2250.40	1944.24	1.06	1.04	1.07	1.18	546.82	556.98
8th Layer	26.90	22.90	2109.44	1769.24	0.99	0.87	1.16	1.23	577.72	589.90
Mean	28.85	25.32	2290.27	1994.45	1.05	1.02	1.03	1.12	544.43	552.42
Sig	*	*	*	*	*	*	*	*	*	*
SE (m)±	0.483	0.606	67.085	52.477	0.073	0.081	0.043	0.036	4.505	3.238
CD at 5%	1.447	1.818	201.132	157.334	0.021	0.022	0.128	0.109	13.508	9.709

DAS- Days after storage

Table2. Effect of loading, unloading and transportation on different seed quality parameters of soybean

Treatments	Mechanical damage(%)	Germination (%)	Root-shoot length(cm)	Vigour index	Dry matter content (g)	Moisture content	EC	TZ test (%)	Seed mycoflor (%)
Main effect	25.000	80.800	27.870	2253.800	1.066	7.500	1.032	81.800	52.000
BL	(29.981)	(64.047)						(64.789)	(46.179)
AL	30.200	77.600	26.990	2101.680	0.975	7.600	1.177	79.600	59.000
	(33.285)	(61.781)						(63.174)	(50.242)
Sig	NS	NS	NS	NS	NS	NS	*	NS	NS
BUL	26.200	80.000	27.610	2211.000	1.045	7.560	1.049	81.400	54.000
	(30.757)	(63.468)						(64.496)	(47.333)
AUL	29.000	78.400	27.250	2144.480	0.996	7.540	1.160	80.000	57.000
	(32.509)	(62.360)						(63.468)	(49.089)
Sig.	NS	NS	NS	NS	NS	NS	NS	NS	NS
SE (m) ±	1.685	1.048	0.536	66.9111	0.0343	0.035	0.041	0.989	4.183
C.D. at%5	5.052	3.1444	NS	NS	NS	NS	0.124	NS	NS
Interaction	24.000	81.200	27.940	2271.360	1.080	7.520	0.981	82.800	50.000
BL x BUL	(29.318)	(64.335)						(65.535)	(45.000)
BL x AUL	26.000	80.400	27.800	2236.240	1.052	7.480	1.084	80.800	54.000
	(30.644)	(63.758)						(64.043)	(47.358)
AL x BUL	28.400	78.800	27.280	2150.640	1.010	7.600	1.117	80.000	58.000
	(32.195)	(62.600)						(63.457)	(49.665)
AL x AUL	32.000	76.400	26.700	2052.720	0.940	7.600	1.237	79.200	60.000
	(34.374)	(60.963)						(62.892)	(50.819)
Mean	27.600	79.200	27.430	2177.740	1.020	7.550	1.105	80.700	55.500
	(31.633)	(62.914)						(63.982)	(48.211)
Sig.	NS	NS	NS	NS	NS	NS	NS	NS	NS
SE (m) ±	2.383	1.483	0.758	94.627	0.0485	0.0490	0.058	1.399	5.916
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

BL : Before Loading
AL : After Loading
BUL : Before Unloading
AUL : After Unloading

stacked at 2nd layer was significantly higher than the seeds stacked at 4th, 6th and 8th layers.

The mechanical damage was found to be higher to the seeds stacked at 8th layer. There was slight increase (1-2 %)in mechanical damage in 2nd month of storage. The increased mechanical damage could be ascribed to weight of the bags in the stacks at 1 to 7 layers. Looking to the fragile nature of soybean seed coat, the seeds which already had received bruises, small cracks and internal cracks might have resulted in deepening of the same. The lower germination of the seed stacked at 8th layer and at 2nd month of storage than seed stacked at 1 to 7 layers could be ascribed to higher mechanical damage to the seeds stacked at 8th layer. Further, the reduction in germination might be the cause of senescence or ageing of the seed. In addition to this, the cracks of mechanically damaged seeds permit early entry of mycoflora which reduces the viability of seed. Ultimately, the RS length, vigour index and dry matter content of seedlings of seed was reduced. The EC, LS and mycoflora increased which is negatively correlated with the viability. There was higher fluctuation in moisture content of seed stacked at 2nd layer which could be ascribed to more exposure of upper layer (2nd) to atmosphere than the 8th layer. Since the temperature was higher and relative humidity was lower during the period of storage, the moisture content had reduced in 2nd month of storage after stacking. However, there was no much difference in moisture content of seed stacked at different layers. The results are in conformity with those reported by Cabrera and Lansakara (1995) who observed greater fluctuations in moisture content of seed at the top than at the middle or bottom of the stack of bags. Germination of seeds at the top of the stack was significantly higher than that of seed from either middle or bottom of the stack.

Effect of loading, unloading and transportation

The data pertaining to the effect of loading, unloading and transportation of soybean seed on seed quality parameters have been presented in Table 2. From data, it is seen that there was no significant effect of loading, unloading and transportation on any seed quality parameters of soybean, except the electrical conductivity. The germination percentage, root shoot length, vigour index, dry matter content, and viability as tested by TZ test was found to be decreasing, whereas the moisture content, seed myoflora, and mechanical damage due to loading, unloading and transportation was found to be increasing but the difference was non-significant. There was significant difference in electrical conductivity of soybean seed due to loading, unloading and transportation. The electrical conductivity of seed was found to be increased significantly after loading but it was at par with that of the seed before unloading i.e. after transportation. Again it significantly increased after unloading. It could be ascribed to less traveling distance (40 km) of the seed. However, utmost care should be taken while transporting of soybean seed for long distance in bulk quantity.

Thus it is concluded that, the stacking of soybean seed bags should be done up to six layer only to avoid deterioration in seed quality due to mechanical damage during storage.

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Assessment of Soil Erosion in Akola District of Vidarbha Region

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ABSTRACT

Universal Soil Loss Equation was used to estimate soil erosion for Akola district of Maharashtra. Various parameters of USLE were computed using rainfall, soil, topography, management practices and land use information. The maximum value of erodibility factor was observed for Balapur tahasil of Akola district, which was 0.65 and minimum of 0.52 for Malegaon tahsil. The maximum area under Akola tahasil falls under very severe soil erosion (18.26t ha^{-1} $year^{-1}$). Similarly Murtizapur, Malegaon and Patur tahasil come under moderate to severe soil erosion with average soil loss of 12.55t ha^{-1} $year^{-1}$. From results shows that Akola tahasil requires immediate attention for soil conservation planning followed by Murtizapur, Malegaon and Patur. This information can be used as a tool for identifying erosion susceptible areas and execution of soil conservation programme on priority.

As a consequence of increasing pressure on land, the natural balance between soil forming and soil conserving process has been affected leading to serous problem of erosion, in which soil slips and slides away at an alarming rate under the action of wind and running water. This process of erosion increases by leaps and bounds when natural protection of the soil is lost. The splashing of soil particles form one place to another through raindrop impact beat up the bare soil surface into flowing mud which splashes as much as 60cm high and 150cm away resulting in enormous soil loss.

Knowledge on the extent of land degradation due to water erosion is important for advocating the conservation measures properly. Quantitative estimations using USLE were attempted by Narain, *et al.* (1993) for West Bengal and Kurothe, *et al.* (1997) for Gujarat State. As per recent soil survey conducted by NBSS & LUP, 42.5 per cent area in the State is suffering from different degrees of soil degradation. Out of which, 38 per cent degradation was due to water erosion only. This is a matter of serious concern and needs immediate attention (Mahalle and Wankhede, 1997).

Quantitative estimates precisely defined the priority areas where conservation strategies are to be adopted urgently. It also helps in selection of land use and conservation practices to reduce the soil loss from a higher level to a permissible limit. By keeping in view the above facts, the present work was taken up to assess erosion status of Akola district which can be useful for prioritization and planning of soil conservation work in the region.

MATERIAL AND METHODS

The study was confined to Akola district of Vidarbha region. It covers an area of 10,575sqkm. It lies in between the latitude 20° 42' N and longitude 77° 02' E. Cotton, Sorghum, Green gram and Black gram are predominant crops grown in the region. Akola district comes under assured rainfall zone with rainfall ranging form 650 to 950mm. For assessment of soil erosion in Akola district Universal Soil Loss Equation (Wischmeier & Smith, 1978) has been used. The equation predicts the soil loss by sheet and rill erosion from an area. The equation is expressed as

$$A = R K L S C P \qquad (1)$$

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Where 'A' is average annual soil loss (t ha^{-1} $year^{-1}$), 'R' is the rainfall erosivity factor (hundredth of mt cm ha^{-1} h^{-1}), 'K' is soil erodibility factor (t ha^{-1} of 'R'). 'L' is slope length factor, 'S' is the slope steepness factor, 'C' is the cover and management factor and 'P' is the conservation practice factor.

Rainfall erosivity factor (R)

Rainfall erosivity is the potential ability of rain to cause erosion. The amount of erosion depends upon a combination of kinetic energy of rain to cause erosion and susceptibility of soil to erosion. For computation of rainfall erosivity (R) at different tahasil of Akola district, iso-erodent map of Vidarbha was used (Bhuibhar *et al.*, 1989).

Soil erodibility factor (K)

The susceptibility of soil to erosion is a measure of potential erodibility of the particular soil under a set of conditions. It depends on the inherent properties of the soils. Some of intrinsic soil properties that influence the erodibility are soil texture, stability of soil structure, soil permeability, infiltration, organic matter and soil mineralogy. For computation of soil erodibility at different tahasil of Akola district nomograph was used (Wischmeier *et al.*, 1971). Soils containing less than 70 per cent silt and very fine sand, the soil erodibility factor (K) can be calculated from following equation.

$$K = 1.2917\,[2.1*10\text{-}M\ 1.14\ (12\text{-}a) + 3.256\ (b\text{-}2) + 25\ (c\text{-}3)]/100 \qquad (2)$$

Where, 'M' is per cent of silt (per cent clay), 'a' is per cent organic matter; 'b' is the soil structure code used in classification and 'c' the profile permeability code.

Topographic factor (LS)

Topographic factor includes slope length and steepness of slope factor. The slope length has a direct relation with the soil loss. The steeper slope would cause more soil erosion and a positive linear relation has been observed between steepness of soil and soil loss. The information on degree of slope and length of slope were collected from soil survey report of different locations of Akola district and from NBSS& LUP, Nagpur. The final 'LS' factor then computed using equation given by Wischmeier and Smith (1978).

Crop management factor (C)

Crop management factor (C) indicates not only the land cover by the natural vegetation but also the land use under the crops. It also indicates the status of the land in an area. The cover and management factor for some of the crops were obtained from literature (Singh *et al.*, 1981). The value evaluated at Central Soil and Water Conservation Research and Training Institute, Vasad for different crops were used (Verma *et al.*, 1968; Nema *et al.* and 1978; Kurothe, 1991-92)

Conservation practices factor (P)

It is the ratio of soil loss and a specific supporting practice to the corresponding loss with up and down cultivation. In order to restrict the influence of erosion intensive rain, the crop management practices are to be supported by different conservation practices through land management and shaping.

The main conservation practices viz. field bunding, contour bunding and terracing followed at each tahasil of Akola district were compiled. The 'P' factor for these main conservation practices were computed using data of Singh *et al.* (1990). Similarly ' P' factor for contour cultivation (Kurothe, 1991-92) was also used.

RESULTS AND DISCUSSION

For prediction of soil erosion, USLE was used. Information regarding parameters viz. R, LS, C and P were collected from literature. The soil erodibility factors for different tahasils were worked out using standard procedure and there from soil erodibility values for different tahasils were worked out. Information regarding soil erodibility for each tahasil of Akola district was computed form Wischmeier and Smith (1978) nomograph and presented in Table 1. From table, it is revealed that the maximum soil erodibility for Balapur tahasil was 0.65 and minimum of 0.48 for

Table 1. Soil erodibility factor (K) for Akola district

Tahsils	silt + vfs (%)	Sand (%)	OC (%)	OM (%)	Soil structure	Permeability	Soil erodibility factor (K)
Balapur,	15.4	30.5	0.35	0.80	Sub angular blocky	Slow	0.65
Murtizapur	27.1	54.5	0.49	1.10	Sub angular	Slow	0.64
Akot	13.2	26.7	0.26	0.60	Blocky	Moderate to slow	0.53
Malegaon	26.3	39.0	0.22	0.50	Sub angular.	Moderate to medium slow	0.52
Patur	19.2	35.5	0.31	0.70	Blocky	Moderate slow	0.62
Akola	19.2	31.3	0.44	1.00	Sub angular	Moderate slow	0.61
Mangrulpir	35.5	14.0	0.45	1.00	Blocky	Slow	0.48

vfs - Very fine sand, OC - Organic carbon, OM - Organic matter

Table 2. Average annual soil loss (t ha^{-1} $year^{-1}$) for Akola district

Tahasil	R	K	LS	C	P	Average annual soil loss (t ha^{-1} $year^{-1}$)
Balapur	221	0.65	0.28	0.55	0.30	6.63
Murtizapur	241	0.64	0.48	0.56	0.30	12.43
Akot	230	0.53	0.48	0.56	0.30	9.83
Malegaon	282	0.52	0.48	0.59	0.30	12.45
Patur	270	0.62	0.48	0.53	0.30	12.77
Akola	385	0.61	0.48	0.54	0.30	18.26
Mangrulpir	260	0.48	0.48	0.53	0.30	9.52

Malegaon tahasil in Akola district. In case of slow permeable soils, the soil erodibility ranges from 0.48 to 0.65, for moderate to slow permeable soils it ranges from 0.53 to 0.61 and for moderate to medium slow permeable soil it was 0.52. The soil erodibility factor depends upon soil parameters such as per cent sand, silt, and very fine sand contents, per cent organic carbon (OC), organic matter (OM) and soil structure and its permeability. These 'K' factors are important for advocating the conservation measures and also for implementing various soil conservation projects.

The information regarding various parameters of USLE was used and soil loss rates in each tahasil were worked out and these predicated values for different tahasils of Akola district are presented in Table 2. It is observed that the soil erosion in Akola district ranges from 6 to 18t ha^{-1} $year^{-1}$. The maximum area under Akola tahasil falls under very server soil erosion (18.26t ha^{-1} $year^{-1}$) due to high erosivity index, high soil erodibility factor and topography factor in addition to this crop and management factor play important role. Murtizapur, Malegaon and Patur tahasil, comes under moderate to severe soil erosion with average soil loss of 12.55t ha^{-1} $year^{-1}$. While, Mangrulpir has moderate to slow soil loss of 9.52t ha^{-1} $year^{-1}$. The slight soil erosion of 6.63t ha^{-1} $year^{-1}$ occurs in Balapur tahasil due

to low rainfall erosivity index and low topographic factor. From above results, it is seen that Akola tahasil requires immediate attention for soil conservation followed by Murtiazpur, Malegaon and Patur. These soil erosion values of Akola district serve as a very good tool for identifying erosion susceptible areas and planning soil conservation programmes.

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Improvement of Seed Quality in the Marginal Seed Lots of Cotton, Soybean and Safflower by Using Specific Gravity Separator

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ABSTRACT

An efforts were made to upgrade the seed quality of marginal seed lots of different crop seed by using specific gravity separator. The study was undertaken at Seed Technology Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, M.S., India during the year 2005-06, 2006-07 and 2007-08. Five seed lots of each crop variety having germination percentage 53 to 71 for Cotton (AKA -7), 54 to 72 for Soybean (JS-335) and 62 to 83 for Safflower (Bhima), were obtained from M/s. Maharashtra State Seeds Corporation Ltd., Akola. The seed quality parameters like germination percentage, physical purity percentage and test weight were significantly affected by specific gravity separator in addition to seed cleaner cum grader. Marginal seed lots having germination percentage above 56, 57 and 68 per cent in case of delinted Cotton, Soybean and Safflower seed respectively can be effectively up graded to minimum acceptable limit of germination and physical purity percentage by using specific gravity separator in addition to seed cleaner cum grader.

Availability of quality seeds is one of the major constrains in increasing the productivity of all the agricultural crops. There is a wide variation in seed size and seed weight due to poor seed filling which affects uniformity of crops. Optimum plant population is a basic requirement to obtain a higher yield. Adequate plant population density largely depends on seed germinability and seedling vigour. Air screen cleaner separate seed on the basis of size. But some size seeds will differ in germinability and seedling vigour both in laboratory and field because of variability in specific gravity (seed weight). Seed weight or specific gravity of seed is closely associated with viability, seedling vigour and growth and subsequently seed yield. The seed lots having low seed quality may be improved by subjecting the seed to specific gravity separation. Many times large number of marginal seed lots fail to meet the acceptable limit of seed quality and thus these lots are rejected and can not be used as a seed for sowing. Thus considerable quantities of seeds are rejected. Such lots are refined by using specific gravity separator in addition to seed grader. The seed quality of such marginal seed lots can be upgraded to a acceptable limit of seed quality as prescribed by Indian Seed Certification Board. Up to what extent of germination the seed should be taken for processing was not known. Hence the project was undertaken to study the effectiveness of specific gravity separator for upgrading the seed quality of marginal seed lots of different crop seeds.

MATERIAL AND METHODS

An experiment was conducted at Seed Technology Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2005-06, 2006-07 and 2007-08. Five seed lots of each crop variety i.e. Cotton (AKA -7), Soybean (JS-335) and Safflower (Bhima) having germination percentage 49 to 70 for Cotton, 52 to 71 for Soybean and 62 to 81 for Safflower were obtained from M/s. Maharashtra State Seed Corporation Ltd. Akola. Minimum acceptable limits for germination and physical purity are 65 and 98 per cent for Cotton, 70 and 98 per cent for Soybean and 80 and 98 per cent for Safflower (Tunwar and Singh, 1988). Seed lots were numbered as L_1, L_2, L_3, L_4 and L_5, where as, T_1 was unprocessed seed, T_2 was graded seed by seed grader and T3 was seed graded by seed grader including specific gravity separator. Each lot was divided into two parts. One part of the seed lot was processed by using seed cleaner cum grader alone whereas other lot was processed by using two machines in series i.e seed cleaner cum grader and specific gravity separator. During processing samples were drawn from

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all the product outlet points i.e. before grading, after using seed cleaner cum grader and after using both the machines in series. The samples thus collected from each point were tested for recovery percentage, seedling length, vigour index, 100 seed weight and moisture content. All the seed quality tests were conducted as per the standard procedure outline in the rules for seed testing (Anonymous, 1985). For size grading a seed cleaner cum grader consisting of two screens (59 x 31 cm size) and a fan were used. The screen was vibrated by using electric motor of 2 hp, 3 phase, 50 c/s. For gravity grading a laboratory model of specific gravity separator having 204 x 127 x 171 cm. size with rectangular deck (159 x80) vibrated by 3 hp electric motor were used. The seed samples thus collected were subjected to seed quality tests i.e. germination percentage, physical purity percentage, recovery percentage and 100 seed weight. The statistical analysis was done by using Factorial Randomized Block Design as per standard procedure (Panase and Sukhatme, 1976).

RESULTS AND DISCUSSION

1) Cotton (AKA - 7)

The pooled data of three years is presented in Table 1, it was observed that germination, physical purity and test weight were significantly improved by using specific gravity separator in addition to the seed cleaner cum grader. By using the seed cleaner cum grader alone the germination percentage could be improved to about 7.0 per cent but by using specific gravity separator in addition to seed grader there was improvement of 12.4 per cent in germination. The physical purity percentage was also improved significantly from 94.9 to 98.8 by using specific gravity separator in addition to seed grader in all the seed lots than using rather one. The 100 seed weight was also improved by using the specific gravity separator in addition to seed grader from 4.28 to 5.40 g.

2) Soybean (JS - 335)

The three years pooled data presented in Table 2 show that the germination percentage could be improved to about 6.9 per cent by using seed cleaner cum grader alone. When specific gravity separator was used in addition to seed cleaner cum grader there was improvement of 12.5 per cent in germination. The physical purity percentage from 94.6 to 98.7 and 100 seed weight from 10.28 to 11.80 g were also improved by using specific gravity separator in addition to seed grader while processing of Soybean seed.

3) Safflower (Bhima)

Three years pooled results indicated that there is significant increase in germination, physical purity percentage and 100 seed weight by using specific gravity separator in addition to seed cleaner cum grader (Table 3). The germination percentage can be improve up to 6.4 per cent by using seed cleaner cum grader alone but by using specific gravity separator with seed cleaner cum grader there was improvement of 11.3 per cent. The same results were obtained in case of physical purity and 100 seed weight . The physical purity can be upgraded up to minimum acceptable limit by using both the machine i.e. specific gravity separator in addition to seed cleaner cum grader while processing of safflower seed.

As regards the recovery percentage, though the percentage was found to be decreased by using specific gravity separator but there was significant improvement in seed quality parameter. It has revealed that heavier seeds were better in seed germination and vigour as compared to lighter seed. This finding was corroborate with the findings of Khairwal and Tomar (1976). They stated that the seed weight was positively correlated with the viability and germination.

From the above results it can be concluded that the marginal seed lots of delinted Cotton, Soybean and Safflower having a germination percentage 55, 57 and 67, respectively can be effectively upgraded to minimum acceptable limit (i.e. 65 % germination and 98 % physical purity for Cotton, 70 % germination and 98 % physical purity for Soybean and 80 % germination and 98 % physical purity for Safflower) by using specific gravity separator in addition to seed cleaner cum grader. These results are in conformation with the results of Kausal *et al.*, (2003). They reported that delinted cotton seed lots of NHH-44 and AKH-4 having germination percentage 55 and above can effectively upgraded to an acceptable limit by using both the machine. The single machine of seed cleaner cum grader is not enough to upgrade the seed quality to considerable extent. Seed

Table1 : Improvement in the seed quality of marigmal lots of delinted cotton (Var. - AKA-7) seed by using Sp. Gr. Separator Pooled data- 2005-06 to 2007-08.

Seed Lot	Germination%				Physical purity, %			
	T1	T2	T3	Mean	T1	T2	T3	Mean
L1	49.5	58.3	60.3	55.0	96.0	97.8	98.6	97.3
	(44.7)	(48.0)	(50.9)	(47.8)	(77.0)	(81.4)	(83.1)	(80.5)
L2	54.2	61.5	65.1	60.2	94.5	97.7	98.9	97.3
	(47.4)	(51.6)	(53.8)	(50.9)	(76.4)	(81.3)	(83.8)	(80.5)
L3	58.0	66.6	71.8	65.8	96.0	98.1	98.7	97.5
	(50.0)	(54.7)	(57.9)	(54.2)	(77.0)	(82.0)	(83.5)	(80.8)
L4	65.0	70.9	72.8	71.8	94.9	97.9	98.9	97.5
	(53.7)	(57.3)	(79.1)	(57.9)	(76.9)	(81.6)	(84.1)	(80.8)
L5	69.7	77.7	81.6	76.6	95.0	98.1	98.9	97.6
	(56.6)	(61.8)	(64.6)	(61.0)	(77.1)	(82.0)	(84.0)	(81.0)
Mean	59.6	66.6	72.0		94.9	97.9	98.8	
	(50.5)	(54.7)	(58.02)		(76.9)	(81.6)	(83.70)	
	L	T	L x T		L	T	LxT	
SE(m)±	0.36	0.46	0.80		0.15	0.20	0.35	
CD(5%)	1.04	1.35	2.34		0.45	0.59	1.02	

Seed Lot	Recovery %				100 Seed weight (g)			
	T1	T2	T3	Mean	T1	T2	T3	Mean
L1	100	86.9	82.5	93.1	4.23	4.86	5.27	4.79
	(90)	(68.8)	(65.3)	(74.7)				
L2	100	86.2	82.7	93.0	4.24	5.06	5.46	4.92
	(90)	(68.2)	(65.5)	(74.6)				
L3	100	85.6	81.3	92.4	4.23	5.16	5.49	4.96
	(90)	(67.7)	(64.4)	(74.0)				
L4	100	86.6	83.1	93.1	4.29	5.12	5.37	4.93
	(90)	(68.5)	(65.7)	(74.7)				
L5	100	86.0	83.0	92.9	4.41	5.20	5.39	5.00
	(90)	(68.0)	(65.6)	(74.5)				
Mean	100	86.3	82.6		4.28	5.08	5.40	
	(90)	(68.2)	(65.3)					
	L	T	LxT		L	T	LxT	
SE(m)+	0.14	0.18	0.32		0.03	0.04	0.08	
CD(5%)	0.41	0.53	0.93		0.10	0.14	0.24	

L1, L2, ... L5 = Seed lots
T1 = Unprocessed seed
T2 = Graded seed by seed grader
T3 = Seed graded by seed grader + Sp. gr. separator arranged in series..
Minimum acceptable limit for 1) Germination 65 per cent
2) Purity 98 per cent

lots of Cotton, Soybean and Safflower having germination percentage below 54, 56 and 66 respectively were unable to meet the minimum acceptable limit of germination and physical purity (as prescribed by the seed certification agency) even after using both the machine.

From the above study, it is concluded that the marginal seed lots of delinted cotton, soybean and safflower having germination percentage of 56, 57 and 68, respectively can be effectively upgraded to an acceptable limit by using specific gravity separator in addition to seed cleaner cum grader.

Table 2 : Improvement in the seed quality of marginal lots of soybean (Var. JS-335 seed by using sp. gr. separator Pooled data 2005-06 to 2007-08.

Seed Lot	Germination%				Physical purity, %			
	T1	T2	T3	Mean	T1	T2	T3	Mean
L1	52.5	59.6	64.1	58.7	94.6	97.5	98.5	97.1
	(46.4)	(50.5)	(53.3)	(50.0)	(76.6)	(80.9)	(82.9)	(80.1)
L2	57.1	64.6	72.0	64.4	94.7	97.8	98.6	97.2
	(49.1)	(53.5)	(58.0)	(53.5)	(76.7)	(81.4)	(83.2)	(80.4)
L3	62.2	69.5	75.3	69.1	94.7	98.2	98.8	97.5
	(52.0)	(56.5)	(60.2)	(56.2)	(76.7)	(82.2)	(83.7)	(80.9)
L4	67.0	73.5	78.2	73.0	94.5	98.1	98.9	97.4
	(54.9)	(59.0)	(62.1)	(58.7)	(76.4)	(82.0)	(83.8)	(80.7)
L5	70.5	76.0	81.8	76.2	94.4	97.7	98.7	97.2
	(57.1)	(60.6)	(64.7)	(60.8)	(76.7)	(81.3)	(83.4)	(80.4)
Mean	61.9	68.8	74.4		94.6	97.9	98.7	
	(51.9)	(56.0)	(59.6)		(76.6)	(81.6)	(83.4)	
	L	T	LxT		L	T	LxT	
SE(m)±	0.32	0.38	0.67		0.17	0.22	0.39	
CD(5%)	0.87	1.12	1.95		0.50	0.65	1.13	

Seed Lot	Recovery %				100 Seed weight (g)			
	T1	T2	T3	Mean	T1	T2	T3	Mean
L1	100	86.3	82.4	92.9	10.25	11.45	11.75	11.15
	(90)	(68.3)	(65.2)	(74.5)				
L2	100	85.6	82.4	92.7	10.35	11.51	11.83	11.23
	(90)	(67.7)	(65.2)	(74.3)				
L3	100	86.0	82.3	92.7	10.31	11.47	11.76	11.18
	(90)	(68.0)	(65.1)	(74.3)				
L4	100	84.2	82.6	92.4	10.21	11.12	11.84	11.05
	(90)	(66.6)	(65.3)	(74.0)				
L5	100	85.5	82.0	92.5	10.3	11.28	11.84	11.14
	(90)	(67.5)	(64.9)	(74.1)				
Mean	100	85.5	82.3		10.28	11.36	11.80	
	(90)	(67.6)	65.1					
	L	T	LxT		L	T	L x T	
SE(m)±	0.19	0.25	0.43		0.04	0.06		
CD(5%)	0.56	0.73	1.27		0.13	0.17		

L1, L2, ... L5 = Seed lots

T1 = Unprocessed seed

T2 = Graded seed by seed grader

T3 = Seed graded by seed grader + Sp. gr. separator arranged in series

Minimum acceptable limit for 1) Germination 70 per cent

2) Purity 98 per cent

Table 3: Improvement in seed quality of marginal lots of safflower (Var. Bhima) by using specific gravity separator Pooled data 2005-06 to 2007-08.

Seed Lot	Germination%				Physical purity, %			
	T1	T2	T3	Mean	T1	T2	T3	Mean
L1	62.0	68.3	73.3	67.9	92.9	96.8	98.5	96.4
	(51.9)	(55.7)	(58.9)	(55.5)	(74.6)	(79.7)	(82.8)	(79.0)
L2	66.0	73.5	80.6	73.2	93.6	97.6	98.8	97.0
	(54.3)	(59.0)	(63.1)	(58.8)	(75.3)	(81.1)	(83.6)	(80.0)
L3	71.6	78.8	84.4	78.5	94.0	97.2	98.7	96.9
	(57.8)	(62.6)	(66.7)	(62.4)	(75.8)	(80.4)	(83.4)	(79.9)
L4	77.1	82.5	86.0	82.0	74.4	98.1	98.9	97.4
	(61.4)	(65.3)	(68.0)	(64.9)	(76.3)	(82.0)	(83.8)	(80.7)
L5	80.8	86.5	90.2	86.0	94.3	98.1	99.1	97.5
	(64.0)	(68.4)	(71.7)	(68.0)	(76.2)	82.0)	(84.6)	(80.9)
Mean	71.8	78.2	83.1		93.8	97.6	98.8	
	(57.9)	(62.2)	(65.7)		(75.6)	(81.0)	(83.6)	
	L	T	L x T		L	T	L x T	
SE(m)±	0.34	0.43	0.76		0.21	0.27	0.47	
CD(5%)	0.98	1.27	2.20		0.62	0.80	1.38	

Seed Lot	Recovery %				100 Seed Wt.(g)			
	T1	T2	T3	Mean	T1	T2	T3	Mean
L1	100	86.2	82.4	92.8	5.16	5.76	6.30	5.74
	(90)	(68.1)	(65.2)	(74.4)				
L2	100	85.6	81.9	92.5	5.15	5.86	6.45	5.82
	(90)	(67.7)	(64.8)	(74.1)				
L3	100	85.9	81.7	92.6	5.17	6.11	6.17	5.82
	(90)	(67.9)	(64.7)	(74.2)				
L4	100	86.2	81.7	92.6	5.21	5.94	6.22	5.79
	(90)	(68.1)	(64.7)	(74.2)				
L5	100	86.1	81.6	92.6	5.38	6.01	6.45	5.95
	(90)	(68.1)	(64.6)	(74.2)				
Mean	100	86	81.9		5.21	5.93	6.32	
	(90)	(68.0)	(64.8)					
	L	T	LxT		L	T	LxT	
SE(m)±	0.22	0.29	0.50		0.05	0.06	0.11	
CD(5%)	0.65	0.84	1.47		0.14	0.18	0.33	

L1, L2, ... L5 = Seed lots
T1 = Unprocessed seed T2 = Graded seed by seed grader
T3 = Seed graded by seed grader + Sp. gr. separator arranged in series..
Minimum acceptable limit for 1) Germination 80 per cent, 2) Purity 98 per cent

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Comparison of Different Infiltration Equations on Different Land Covers

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ABSTRACT

The study was undertaken to find out the suitability of different infiltration equations under different land covers in clay soil. The different infiltration equations i.e. Kostiakov, Modified Kostiakov, Green Ampt, Horton and Philips were compared. The various land covers cultivated land, pasture land and forest land in clay soil at Central Research Station, Dr. Panjabrao Deshmukh Krishi Vidhypeeth Akola, were selected. The observations were taken under each land cover by double ring infiltrometer. The constants have been predicted for each equation. Measured and predicted values of infiltration rate /cumulative infiltration were compared by fitting linear regression. The suitability of each equation was decided on the basis of correlation coefficient, standard error and agreement between regression line and 1:1 line.

The Kostiakov equation is quite satisfactory for predicting cumulative infiltration for all three-land covers. It gives the best fit for the pasture land cover with $r^2 = 0.9999$ and standard error 0.2275 mm, which is very less. Modified Kostiakov equation works satisfactorily under all land covers. Amongst all it gives the best fit for pasture land cover ($r^2 = 0.9999$ and S.E. = 0.1991mm). Green Ampt and Horton equations are not found suitable to predict infiltration rate under all the three land covers, as standard error is very high. Phillip equation is found suitable for all land covers. The correlation coefficients are high ($r^2 > 0.999$) and standard error values are low (S.E. < 1mm).

Infiltration characteristics of the soil are important factor for the design of soil conservation works, irrigation and drainage systems or to appraise land use within a watershed. Infiltration rate of the soil is influenced by soil properties, vegetation, antecedent soil moisture and the land slope. Some of the well-known infiltration equations are Kostiakov equation (Kostiakov, 1932), Modified Kostiakov equation (Michael, 1978), Green Ampt equation (Green and Ampt, 1911), Horton equation (Horton, 1940), and Phillip infiltration equation (Phillip, 1975). Evaluation of test equation has been done under different land covers in this study.

MATERIAL AND METHODS

The study was conducted using double ring infiltrometer, at CRS of Dr Panjabrao Deshmukh Krishi Vidhypeeth Akola. The experimental site consisted of black soil. Three land covers viz, 1) Cultivated land, 2) Pasture land, and 3) Forest land were selected.

Infiltration equations:

Kostiakov equation: The functional relationship between F, f and t is best represented by equation.

$$F = at^{á} \quad (1)$$

Where, F is cumulative infiltration (mm) and a, á are parameters, also

$$f = áat^{á-1} \quad (2)$$

Where, f is the infiltration rate (mm/hour).

Modified Kostiakov equation: The functional relationship between F and t is best represented by equation.

$$F = at^{á} + b \quad (3)$$

Where, F is cumulative infiltration (mm) and a, á and b are parameters and t is the time.

Green Ampt equation: A simple equation based on Darcy law was proposed by Green Ampt (1911) for infiltration into uniform soil with uniform initial moisture content.

The parameters of green Ampt equation were estimated by empirical curve fitting.

$$f = k + ak/F \quad (4)$$

Where k is hydraulic conductivity (mm hour^{-1}) and a is constant.

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Horton equation: Horton (1940) recognized that the infiltration capacity decreases with time until it approached a more or less constant value. The Horton equation can also be expressed in terms of infiltration rate and cumulative infiltration.

$$F = f_c t + 1/a (f_0 - f_c) (1 - \exp(-at)) \quad (5)$$

$$f = f_c + (f_0 - f_c) \exp(-kt) \quad (6)$$

Where f_0, f_c and k are constants.

Philip infiltration equation: The Phillip equation is given as.

$$F = St^{1/2} + At \quad (7)$$

Where, S (sorbtivity) and A are constants.

The parameters of Phillip equation were estimated by empirical curve fitting.

The study was undertaken to test the validity of different infiltration equations e.g. Kostiakov equation, Modified Kostiakov equation, Green Ampt equation, Horton equation, and Phillip infiltration equation under different land covers (cultivated land cover, pasture land and forest land cover). The infiltration depth at the selected time intervals was measured in all land covers. The relationship of measured and predicted cumulative infiltration or infiltration rate under cultivated, pasture and forest land cover was determined at initial moisture content (imc) of 21.30 per cent, 24.25 per cent and 22.08 per cent, respectively.

RESULTS AND DISCUSSION

Physical Properties of Soil

The different physical properties of the soil under study viz. sand, silt and clay content, apparent specific gravity, absolute specific gravity, maximum water holding capacity, percent pores spaces and bulk density were evaluated.

The initial moisture content was maximum (24.25%) in pasture land cover followed by forest land cover (22.30%) and the cultivated land cover (21.30%). The type of soil was observed clayey under all the three-land covers under study. The bulk density was found maximum in pasture land cover i.e. 1.34 gm cc^{-1} and minimum in forest land cover i.e. 1.27 gm cc^{-1}.

The infiltration test was conducted using double ring infiltrometer on different land covers. The test was conducted for 180 minute at different interval of time. The observations of infiltration along with infiltration rate, cumulative infiltrations are presented in Table 1.

The initial infiltration rate of cultivated land, pasture land and forest land cover is 120 mm h^{-1}, 72 mm h^{-1} and 108 mm h^{-1}, respectively. The basic infiltration rate of cultivated land, pasture land and forest land is 62 mm h^{-1}, 31 mm h^{-1} and 37mm h^{-1} respectively. The cumulative infiltration for cultivated land is 201.3 mm whereas; it is 108.4 mm for pasture land and 133 mm for forest land cover. It is observed that cultivated land cover has greater initial infiltration rate as well as cumulative infiltration than pasture and forest land. The physical properties of cultivated land have a significant effect on infiltration rate.(Yadav *et. al.*, 2005) Forest land and pasture land have a lower infiltration rate than cultivated land, which is mainly due to the compact condition of soil and scanty litter deposited on the floor to hold and intercept water. (Mohan and Gupta, 1983).

Infiltration Constants

The constants in the different infiltration equations were determined using the standard procedures. The values of the constants obtained are given in table 2.

These constants were used to predict the infiltration rate/cumulative infiltration in the different equations. The correlation between the measured and predicted infiltration rate/cumulative infiltration was analyzed by linear regression equation. The degree of correlation between the measured and predicted cumulative infiltration was determined to test the goodness of fit of equation.

The performance of different equations of infiltrations under different land covers was evaluated and is presented in Table 3.

The Kostikov equation is quite satisfactory for predicting cumulative infiltration for all the three land covers. It gives best fit for the pasture land cover with $r^2 = 0.9999$ and standard error 0.2275 mm, which is very less. The Modified Kostiakov equation is quite

Table 1: Infiltration test data for different land covers by double ring cylinder infiltrometer.

S.N	Time(min)		Difference	Cultivated land cover			Pasture land cover			Forest land cover		
	Initial	Final	(min)	Depth (mm)	Infiltration rate (mm h^{-1})	Cumulative infiltration (mm)	Depth (mm)	Infiltration rate (mm h^{-1})	Cumulative infiltration (mm)	Depth (mm)	Infiltration (mm) rate (mm h^{-1})	Cumulative infiltration (mm)
1	0	5	5	10	120	10.00	6	72	6.00	9	108	9.00
2	5	10	5	8	96	18.00	4.5	54	10.50	6	72	15.00
3	10	15	5	7	84	25.00	4	48	14.50	5.5	66	20.50
4	15	20	5	6.5	78	31.50	3.8	45.6	18.30	5	60	25.50
5	20	30	10	12	72	43.50	7	42	25.30	9	54	34.50
6	30	40	10	11.5	69	55.00	6.8	40.8	32.10	8	48	42.50
7	40	50	10	11	66	66.00	6.3	37.8	38.40	7.5	45	50.00
8	50	65	15	16	64	82.00	9	36	47.40	10.5	42	60.50
9	65	80	15	15.8	63.2	97.50	8.5	34	55.90	10	40	70.50
10	80	100	20	21	63	118.50	11	33	66.90	13	39	83.50
11	100	120	20	20.8	62.4	139.30	10.5	31.5	77.40	12.5	37.5	96.00
12	120	150	30	31	62	170.30	15.5	31	92.9	18.5	37	114.50
13	150	180	30	31	62	201.30	15.5	31	108.40	18.5	37	133.00

Table 2: Values of constants in different infiltration equations

S.N	Equation	Constants	Cultivated land cover	Pasture land cover	Forest land cover
1	Kostiakov	a	0.8060	0.8060	2.7215
		α	1.6377	1.6377	0.7449
2	Modified Kostiakov	a	2.2985	0.9714	0.8500
		b	1.585	0.1615	0.8111
		α	2.7101	0.0924	0.7451
3	Green Ampt	K	57.2942	29.57	31.4096
		a	11.2104	8.5997	21.6473
4	Horton	f_o	140	62	4.1053
		f_c	95	31	3.6
		k	135	37	3.4186
5	Phillip	A	0.8955	0.4386	0.4674
		S	2.9464	2.2502	3.6662

Table 3: Performance of different equations under different land covers

Equation	Cultivated land cover		Pasture land cover		Forest land cover	
	h^2	S.E.	h^2	S.E.	h^2	S.E.
Kostiakov	0.9991	1.8297 mm	0.9999	0.2275 mm	0.9996	0.7880mm
Modified Kostiakov	0.9994	1.4083mm	0.9999	0.1991mm	0.9996	0.7828mm
Green Ampt	0.9941	1.3872mm h^{-1}	0.9844	1.5107 mm h^{-1}	0.9916	1.9248mmhr^{-1}
Horton	0.9490	4.7564 mm h^{-1}	0.9426	3.832mm h^{-1}	0.9498	6.1932mm h^{-1}
Phillip	0.9999	0.5326mm	0.9997	0.5450mm	0.9997	0.7196mm

satisfactory for predicting cumulative infiltration for all three land covers. It gives best fit for the pasture land cover with r^2 =0.9999 and standard error 0.1991mm, which is very less. The Green Ampt equation is not suitable to predict infiltration rate under all land covers, as standard error is high. The performance of Horton equation is not satisfactory under all land covers. The higher values of standard error have been found.. The Phillip equation is quite satisfactory for predicting cumulative infiltration under all three land covers. It gives best fit for all three land covers. Thus, Philip equation is most suitable under all three land covers of clay soil.

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Development of Clog Removal Mechanism for Tractor Drawn Seed Drill

C. N. Gangde[1], A. K. Kamble[2] and N. D. Hushangabade[3]

ABSTRACT

Automatic clog indicator cum removal mechanism for tractor drawn seed drill was developed in the Department of Farm Power and Machinery, Dr. Panjabrao Deshmukh, Krishi Vidyapeeth, Akola. This attachment can be installed on any tractor drawn seed drill with little modification in furrow openers. This mechanism consists of a clog indicator device comprising of LED and LDR, control unit, relay unit, indicator panel and clog removal mechanism. Clog removal mechanism, which remove the clogging, which occurs in the seed delivery tube and is a mechanical device operated with 12V battery and consist of solenoid switch, connecting rod and piston. From the trials conducted, it was found that automatic clog indicator cum removal mechanism works satisfactorily.

Sowing is a operation of prime importance which is directly associated with the overall yield of a crop. Now a day mechanical seed drills are being used widely to perform the sowing operation. The use of mechanical seed drill facilities precision, timeliness in operation and reduces human labourer requirement (Anonymous, 2000). The problem associated with seed drill is that, while sowing in moist soil conditions, the seed tubes get clogged due to wet soil adhering to the end of the seed delivery tube which results into accumulation of metered seeds in the tube and the area goes unsown until it has been detected.

To over come this problem the auto choke sensing cum removal mechanism is being attempted to be developed for tractor drawn seed drill and planters with the objectives of development of auto choke indicator and removal mechanism.

MATERIAL AND METHODS

Automatic clog indicator cum removal mechanism for tractor drawn seed drill is developed in the Department of Farm Power and Machinery, Dr. Panjabrao Deshmukh, Krishi Vidyapeeth, Akola (Fig.1). This mechanism consists of a clog indicator mechanism comprising of light emitting diode (LED) and light dependent resistor (LDR), control unit, relay unit, indicator panel and clog removal mechanism and the arrangement of the system is shown in fig 2. The diagrammatic presentation of clog removal mechanism is shown in the fig 3. Clog indicator is a sensor, which is attached to the end of the seed tube to sense the clog. The circuit diagram of control unit for single furrow opener is shown in fig 4. Control unit takes signals from the indicator in the form of variation in resistance. IC circuit valuates these signals. This circuit is a light activated relay control circuit. The relay switch operates the indicator light and buzzer signal, which is placed on the indicator panel. Simultaneously relay unit of the circuit operates the solenoid switch for removal of clog. The supply for circuit is taken from tractor battery 12 Volts and 40 amps. The supply is given through fuse to protect the circuit. Relay unit consisted two types of relay, 12 volts, 5 amp and 12 volts, 25 amp. Indicator panel consisted LED one for each furrow opener to indicate the continuation of input supply. Auto clog removal mechanism, which removes the clogging which has occurred in particular seed drill tube automatically, operates just after activation of clog indicator. It is a mechanical device operating with 12 volts battery consisting of solenoid switch, connecting rod and piston. Solenoid switch gives mechanical reciprocating motion to clean the clog. The mechanism developed was installed on tractor drawn seed drill and tested for its operation (Singh and Reddy, 1997).

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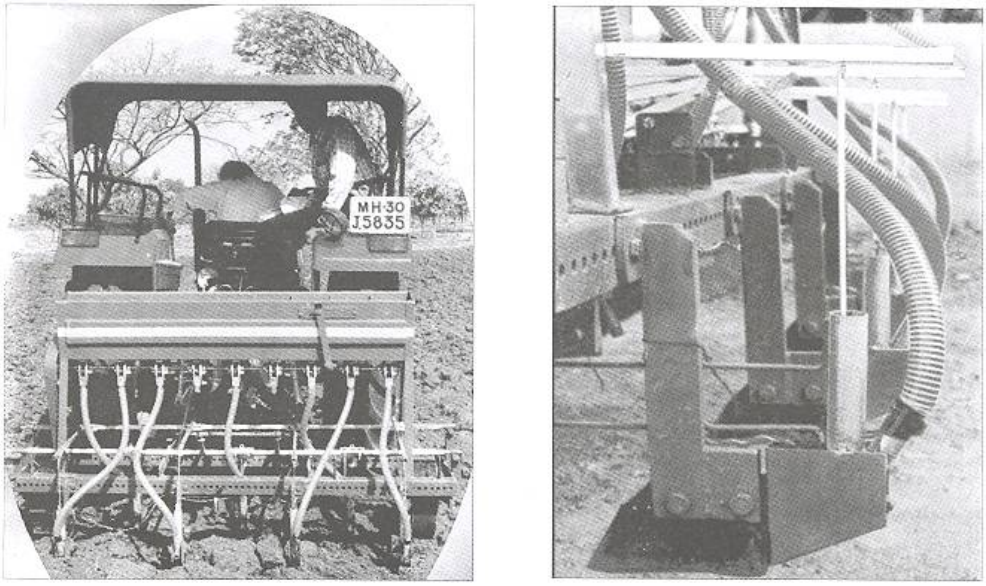


Fig 1 Auto sensing seed drill with clog removal mechanism

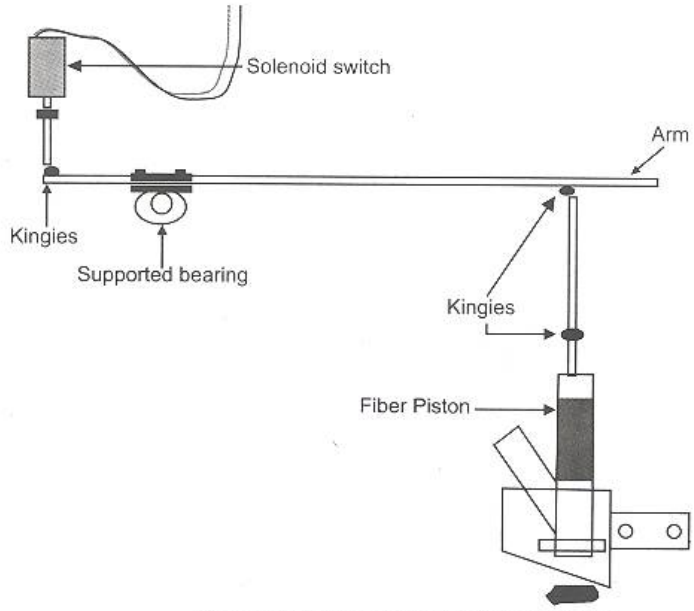


Fig 2. Arrangement of clog removal mechanism

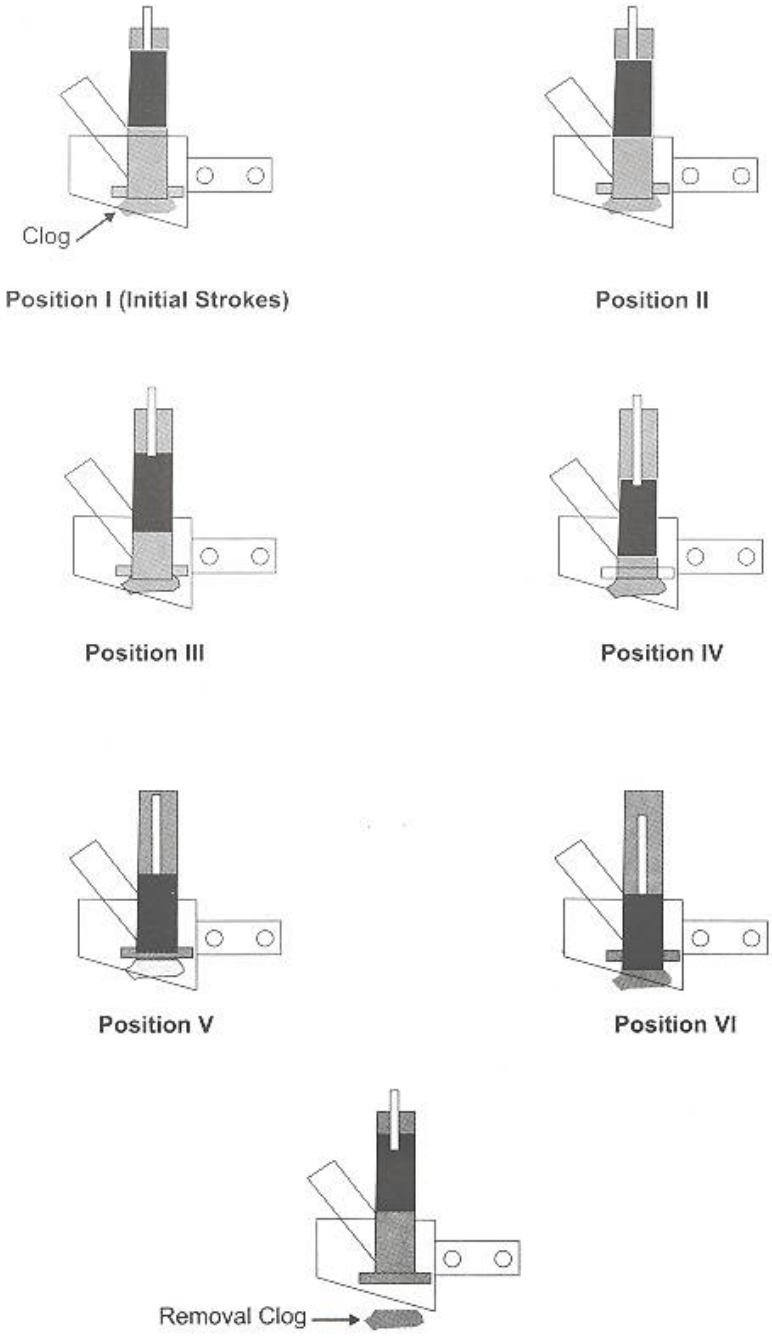
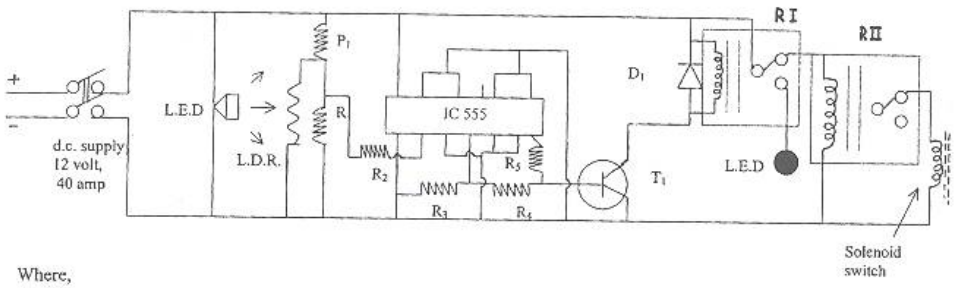


Fig 3. Diagrammatic presentation of clog removal mechanism



Where,

RI - Relay 12 volt, 5 amps.
RII - Relay 12 volt, 25 amps.
L.D.R. - Light dependent resistance (5 amp, 12 V)
L.E.D. - Light emitting diode

R_1, R_2, R_4 & R_5 = 5K
R_3 = 10K
D_1 = Diode IN 4001
T_1 = Transformer BC 158

Fig 4. Circuit diagram of control unit

RESULTS AND DISCUSSION

The tractor drawn seed drill with auto clog sensing and removal mechanism was preliminary tested in the field as per RNAM test code (Anonymous, 1995). Results of the field test are presented in Table 1. The seed drill was operated without seeds, in well-tilled seedbed. The moisture content of the field was 25.7 per cent (d.b.). The depth of the operation was 6 cm. The test run was 300 m. The first clog was detected in second run at 9 m from the headlines. It was sensed and removed in very small lag of time of 2 seconds. In ten tests run the clogging was occurred for 18 times and was removed effectively. From laboratory and preliminary field test it was found that both auto clog sensing and removal mechanism are workable. It was also observed that the detection and removal of clog by the mechanism was very quick and 100 percent efficient. This mechanism can be adopted on existing seed drill easily from farmer's point of view and very advantageous in night sowing.

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Study of Medicinal Plant Kalmegh in Polyhouse, Net House and Open Condition

S. M. Kawade[1], K. R. Gajbhiye[2], Swati Dindorkar[3], S. V. Gupta[4] and P. B. Kale[5]

ABSTRACT

An experiment was conducted at Nagarjuna Medicinal Plant Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 15th October 2006 to 26th April, 2007 in modified Quonset type structure of 17 m x 4 m covered with 50 per cent shade net, polyhouse of fan pad cooling system type and open field. Considering the importance and medicinal value, Kalmegh (Andrographis paniculata) crop were selected for study. The seed was manually sown on 15.10.2006. Before sowing seeds was magnetically treated on putting two samples on north pole and south pole and one sample revolved in rotary magnetic seed treator for 20 min and one was kept untreated. In the present study temperature, relative humidity, biometric characteristics and yield performance was measured. It has been observed that the micro climatic condition in the nethouse and polyhouse was favourable for the crop Kalmegh. The performance of southly treated seed was observed better compared to northly treated seed and 20 minutes rotated seeds. Similarly, the performance of southly treated seed in polyhouse was observed better in biomass yield, root yield and seed yield. The number of leaves, height of plant were more in southy treated seed in polyhouse as compared to northly treated seed, 20 minutes rotated seeds and untreated seed.

Experimentation and promising results in field of herbal medicines i.e. "Ayurveda" are gaining popularity in the world. Still the cultivation of such medicinal plant is not so popular amongst the farmer. The cultivation of such medicinal plant need special attention to train its quality. The medicinal plants have very high market value. It can gives better financial benefits to the farmer, if better quality of the plant is taken. Considering the climatic factor and requirement of crop, the greenhouse technology is the most suitable and practicable technology for getting better quality and quantity produce. Greenhouse technology most practical way of achieving the goal of protected cultivation. The quality produce can fetch foreign exchange. The whole idea of greenhouse technology is optimization all the inputs like nutrition, pesticides application, irrigation and light (Nelson, 1978). In nethouse one can control these factors and get a optimum results (Henan, 1978). So, in present study the efforts will be made to study the medicinal plant in nethouse, polyhouse and open field.

The climate of Vidarbha region of Maharashtra state is hot and dry. Specially during summer the temperature reaches at 45°C at relative humidity 10 to 20 per cent under such a condition to maintain a micro climate in polyhouse is a major problem. Also in commercial horticulture under polyhouse condition the microclimatic factor influences the growth and development of the crop (Alba, 1998). To overcome such a problems nethouse is advantages than the polyhouse. The cost of construction of nethouse is less than of polyhouse (Wanjari, 1994).

Kalmegh (Andrographis paniculata) is one of the most important medicinal plant species on which considerable amount of research has been conducted and its pharmaceutical, potential has been well established. It is widely distributed throughout part of India from Uttar Pradesh to Assam, Madhya Pradesh, Tamil Nadu and Kerala. Its cultivation is confined to gardens only especially by traditional uses of medicinal plant in indention system of medicine. Large scale systematic economical in India is yet to initiate.

Genus andrographis belongs to family Acanthaceae which consists about 40 species distributed in tropical Asia.

MATERIAL AND METHODS

The flat seed bed was prepared manually with 3.5 m x 1.5 m size in 8 plots. A pathway of 1 m width

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and 17 m length was left along the midway of the nethouse, polyhouse open field condition. A magnetic seed treater was used for presowing magnetic treatment of the seed samples. The seed had putted on north as well as south pole for 12 hrs and also putted in rotary seed treater for rotation for 20 minutes.

Biometric characteristics such as plant height, number of leaves were measured at regular interval.

The data of biometric characteristics was collected for fine representative plant. The interval of 5 days were taken the height of plant were measured with the help of scale and the number of leaves were counted manually. Before harvesting the crop seed maturity was confirm by pressing pods between two fingers till the matures seeds comes out. It was observed that the maturity was recorded approximately after 154 days after sowing.

Immediately after harvesting the plant was exposed to atmosphere for 3 days, then seed was separated manually by beating the pods with stick. Root yield was measured manually by cutting the root of the plant and measured by simple weight balance.

Similarly, the biomass yield was measured by simple weight balance.

RESULTS AND DISCUSSION

Environmental parameters

Temperature, relative humidity and air composition are the major factors for plant growth. In the present study temperature, relative humidity were recorded throughout the experiment from 19th October 2006 to 23rd March 2007.

Temperature

Temperature plays a vital role in the vegetative growth i.e. respiration, photosynthesis, transpiration, nutrient uptake etc. The maximum temperature recorded inside nethouse at 12.30 hours was 40.7°C and the minimum temperature recorded inside the nethouse at 8.30 hours was 13°C. Also the maximum temperature recorded inside the polyhouse at 12.30 hours was 41°C and the minimum temperature recorded inside the polyhouse was 15.6°C .

Relative humidity

Relative humidity plays an important role for the plant growth, respiration, transpiration and water uptake by the plant during the growth. The average humidity was observed to be 42.3 per cent inside the nethouse, 44.7 per cent inside the polyhouse and 40.09 per cent in open field. The difference was recorded in between nethouse and open field was 2.21 per cent and the difference was recorded in between polyhouse and open field was 4.61 per cent.

Biometric characteristics

Plant height (cm)

In the nethouse the maximum height recorded in north treated seed after 145 days was 31.2 cm. Whereas, 35.4 cm in south treated seed in polyhouse and 26.4 cm in open field condition.

In the present experiment it was observed that the height of south treated seed in polyhouse was about

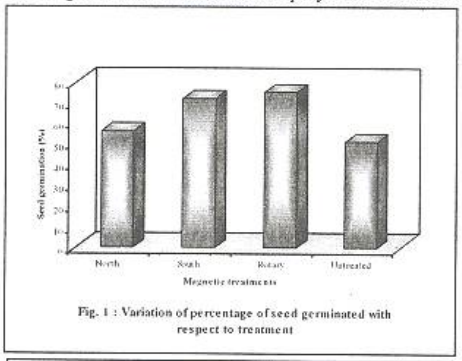

Fig. 1 : Variation of percentage of seed germinated with respect to treatment

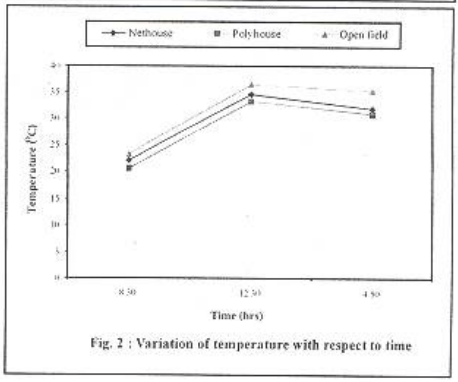

Fig. 2 : Variation of temperature with respect to time

1.34 times more than the height of plant grown in open field and the height of south treated seed in nethouse was observed 1.18 times more than open field seed.

Number of leaves

It was observed that number of leaves of south treated seed in polyhouse was about 1.51 times more than south treated seed in open field, also the number of leaves in south treated seed in nethouse was observed about 1.17 times more than south treated seeds in open field.

Biomass yield

The total biomass yield from the nethouse was recorded 1.925 kg biomass yield obtained from 8 plots of nethouse in which 0.605 kg biomass yield was recoded in south treated seed.

The total biomass yield from the polyhouse was recorded as 2.754 kg in 8 plots and biomass yield in open field was recorded 1.465 kg (8 plots).

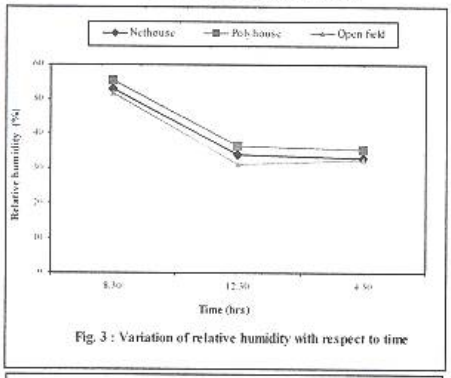

Fig. 3 : Variation of relative humidity with respect to time

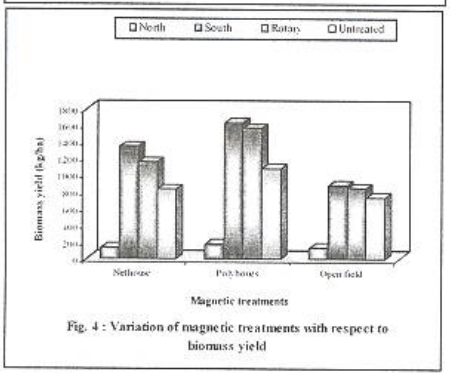

Fig. 4 : Variation of magnetic treatments with respect to biomass yield

It was observed that the biomass yield of polyhouse was about 1.87 times more than the biomass yield of open field.

The total biomass yield obtained from nethouse was 1.31 times more than the yield obtained from open field.

Root yield

The total root yield from the nethouse was recorded 0.205 kg obtained from 8 plots. The total root yield from the polyhouse was recorded 0.240 kg (8 plots) and the total root yield obtained from the open field was about 0.138 kg (8 plots).

The total root yield obtained from polyhouse was about 1.73 times more than the total root yield obtained from open field.

The total root yield obtained from nethouse was about 1.48 times more than the total root yield obtained open field.

Seed yield

Before harvesting the crop seed maturity was confirm by pressing pods between two fingers till the matures seeds comes out. It was observed that the maturity was recorded approximately after 154 days after sowing.

Immediately after harvesting the plant was exposed to atmosphere for 3 days, then seed was separated manually by beating the pods with stick. Care should be taken that during beating the seed should not be damage. The maximum seed yield was recorded about 68 grams recorded in 8 plots in nethouse whereas 79 gram was recorded in polyhouse and 60 gram recorded in open field condition.

It was observed that, the seed yield of nethouse was 1.13 times the open field seed also the total seed yield of polyhouse was observed 1.31 times more than the seed yield obtained from open field condition.

CONCLUSION

The performance of medicinal crop Kalmegh inside nethouse, polyhouse and open field condition can be concluded as follows.

Table 1. Average temperature, relative humidity inside the nethouse, polyhouse and open field condition during 19th October 2006 to 23rd March 2007

	TimeNet house temperature			Polyhouse temperature			Outside temperature		
	Temp. (°c)	RH (%)	LI (Lux)	Temp. (°c)	RH (%)	LI (Lux)	Temp. (°c)	RH (%)	LI (Lux)
8.30	22.00	53	4590	20.50	55.45	6972	23.2	51.6	9670
12.30	34.50	34	30712	33.20	36.50	34210	36.4	31.2	55240
4.30	31.8	33	7890	30.80	35.56	9910	35.2	32.5	14410

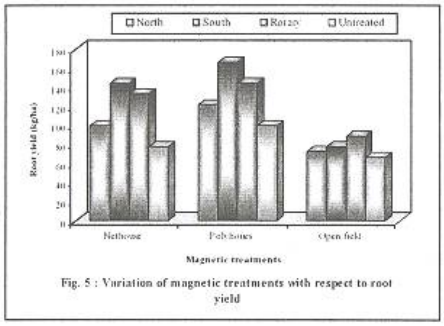

Fig. 5 : Variation of magnetic treatments with respect to root yield

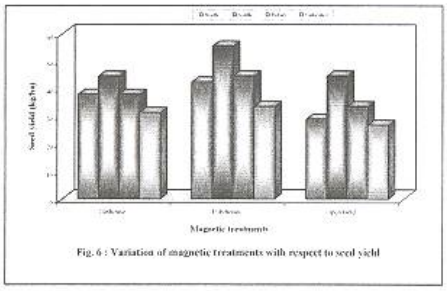

Fig. 6 : Variation of magnetic treatments with respect to seed yield

- The average temperature inside the nethouse was about 2.1°C less than outside temperature and the average relative humidity inside the nethouse was about 3.2 per cent more than outside relative humidity.
- The average temperature inside polyhouse was about 5.6°C less than the outside temperature and the average relative humidity inside polyhouse was about 4.7 per cent more than the outside relative humidity.
- The total biomass yield inside the nethouse, polyhouse and open field was 1.925 kg, 2.754 kg and 1.465 kg, respectively.
- The total root yield inside nethouse, polyhouse and open field was 0.205 kg, 0.240 kg and 0.138 kg, respectively.
- The total seed yield inside the nethouse, polyhouse and open field was 68 gm, 79 gm and 60 gm , respectively.

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PKV Res. J. Vol. 32 (2), 2008

Genetic Purity Testing of Cotton Hybrid by Morphological Characterization

H. J. Rajput[1], R. B. Patil[2] and S. M. Shinde[3]

ABSTRACT

Seven cotton hybrids i.e. PKVHY-2, CAHH-468, H-10, JKHY-1, PHH-316, RHH-1394 and RHB-0387 were characterized for morphological characters to test the genetic purity. The morphological characteristics exhibited by different genotypes/ hybrids indicated that, although some of the hybrids/genotypes had common morphological features in respect of some characters, they can be differentiated from each other on the basis of other specific characters like stem and leaf hairiness, flower colour, petal spot, pollen colour, position of stigma, boll shape and fibre properties. The grow out test showed that the per cent off types in three market seed lots each of PKVHY-2 and H-10 showed 9.50 to 13.75 per cent off types which were higher than the minimum seed certification standards prescribed for certification (10%). Similarly, seed germination, seedling length, seedling vigour index in the market seeds lots were lower and indicated that the market seeds were spurious/F2 and of low quality.

Cotton is one of the most important commercial crops in the world and exerts considerable influence on India's economy. Besides securing livelihood for about 60 millions people engaged in various vocation related to farming, trade and textile industry, this commodity is also instrumental in ensuring about 20 per cent of India's export earning. With the emergence of hybrids in the commercial cultivation marked by the release of H-4 in 1974. A large number of hybrids were evolved by 1999-2000 which occupied a total area of 43 per cent (Venugopal *et. al* 2000). Indian cotton farmers uses certified seed, truthful seed or seeds from open market and rarely their own planting seed. In India, genetic purity test is mandatory for certified seeds. The grow out test is expensive and time consuming and those lots conforming the seed standards are only distributed as certified seeds. Since the number of genotypes being tested is relatively more, it becomes difficult to distinguish one genotype from the other in the absence of information on stable diagnostic characters. So, need for characterization of different morphological characters along with their marker will be helpful to guide seed producers, seed certification agencies, state seed corporation as well as to the farming community.

MATERIAL AND METHODS

The experiment was conducted with six intra-specific hybrids viz., PKVHY-2, CAHH-468, H-10, JKHY-1, PHH-316, RHH-1394 and one interspecific hybrid i.e. RHB-0387 (Table 1) in Randomized Block Design with three replications, at cotton improvement project, Mahatma Phule Krishi Vidyapeeth, Rahuri during 2002-2003. All recommended agronomic practices were followed for raising a good crop. The morphological observations were recorded as standardized by "International Union for Protection of New Varieties" (UPOV,1989). The grow out test was conducted by the standard procedure given by Mehta (1993). The seed quality parameter analysis was conducted and the germination percentage was worked out from the count of normal seedlings recorded after twelve days. The mean root length and shoot length were worked out from randomly selected ten seedlings while the seedling vigour index was calculated with the help of formula given by Baki and Anderson (1973).

RESULTS AND DISCUSSION

The production of hybrid seed is achieved by manual emasculation and pollination. This requires a large number of skilled labourers, which increases the cost of seed. Due to this fact, the demand for hybrid seeds cannot be fulfilled which results in shortage of hybrid seeds and subsequently leads to use of low quality, spurious seeds and malpractices in seed industry.

1. Morphological markers

The intra specific hybrid PKVHY-2 possessed dense short hairs on leaf with hairy stem. Petal spot was light with pale yellow pollens and embedded stigma.

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The seeds were fuzzy and dirty white in colour. The fibres were fine (3.0 - 3.2 micronaire) and average in length (27.5-29.0 mm). These characters were specific to hybrid PKVHY-2 that deviated from either parent and can be used for identification of hybrid from parents. The hybrid CAHH-468 had light pink hypocotyls. The plant was conical in shape with hairy leaf and stem. The flowers were light yellow in colour with cream pollen and protruded stigma. The bolls were big and oval in shape. These observations are similar with those reported by Patil and Mate (1998). The hybrid JKHY-1 had a light pink hypocotyl. The plants were tall and conical in shape. It had light yellow petal colour with yellow pollens. The boll shape was oval with strong opening with high content of lint. Its fibres were, fine and average (3.7-3.9 micronaire). These observations are in accordance with those reported by Patil and Suryawanshi (1977). The hybrid H-10 was light pink hypocotyl with intermediate leaf and stem hairiness. Petals were light yellow with yellow pollens. The boll shape was oval, pointed at apex with strong opening. Though it was difficult to identify this hybrid from its parents, identification was mostly done at seedling stage where the female had a dark pinkish red spot on the base of cotyledonary leaves at 12 to 20 days of emergence (Anonymous , 2001 and Krishna *et. al* 1993).

In PHH-316, the plant was conical in shape with medium height. The petal colour was yellow with yellow pollens. Boll size was medium having strong boll opening. Quality of fibre was fine with low strength. The pre-released hybrid RHH-1394 was conical with light green leaves having medium leaf incision. Petal colour was light yellow with embedded stigma. Bolls were round in shape with strong opening.

The pre-released interspecific hybrid RHB-0387 possessed light pink hypocotyl with intermediate hairs on leaf and stem. The first fruiting branches were long and produced at lower node. The petal colour was yellow with red spot and yellow pollens. Bolls were ovate in shape with coarse pitted surface. The boll tip was prominent with medium boll opening. Seeds were medium in size with spares fuzz. Fibres were fine in quality with average strength. Similar results in interspecific hybrid were also reported by Patil and Suryawanshi (1997).

2. Grow-out test

The GOT test determines the genetic purity status of a given seed lots of a notified variety hybrid and the extent to which the sample in question conforms to the prescribed standards (Verma 1986). Considering the different facts influencing the seed quality, the grow out test was conducted to determine the extent of admixture in seed lots sold in market for released hybrids.

The experiment was conducted for three seed lots of PKVHY-2 and H-10 hybrid purchased from the local market. The GOT results for market seed lots of PKVHY-2 showed off types from 9.50 to 13.75 per cent while in H-10, it showed from 9.75 to 12.25 per cent (Table 3). The market seed lot No. of PKVHY-2 and market lot No. 1 and 2 for H-10 showed 9.50, 9.75 and

Table 1 : Hybrids and their parents used for study

S.N.	Hybrids	Parents		Year of release	Place
		Female	Male		
1.	PKVHY-2 (h x h)	AK-32	DHY-286-1	1981	Dr. PDKV, Akola
2.	CAHH-468 (h x h)	CAK-32 A	DHY-286-1 R	1993	Dr. PDKV, Akola
3.	H-lO(hxh)	BC-68-2	LRA-5166	1994	Main Cotton Research Station, Surat
4.	PHH-316(hxh)	PH-93	PH-325	1997	MAU, Parbhani
5.	JKHY-l(hxh)	Khandwa-2 (MB)	Reba-B-50	1976	JNKVV, Indore
6.	RHH-1394(hxh)	RHC-009	RHC-017	Pre-released	MPKV, Rahuri
7.	RHB-0387(hxb)	RHC-001	RHCb-001	Pre-released	MPKV, Rahuri

Table 2: Different morphological markers identified in parents and hybrids

Characters	Female AK-32	Male DHY-286-1	Hybrids PKVHY-2(H)
Stem hairiness	Slightly hairy	Dense hairy*	Hairy
leaf size	Medium	Upland in shape. Thick leathery and velvet in feel	Medium
Flower colour	Light yellow*	Whitish cream*	Light yellow
Petal spot	Present* (Intensity high)	Absent	Present (Intensity high)
Pollen colour	Pale yellow	Cream	Pale yellow
Position of stigma	Protruded*	Embedded	Embedded
Characters	**CAK-32A**	**DHY-286-1R**	**CAHH-468**
Stem hairiness	Slightly hairy	Dense hairy*	Hairy
Leaf hairiness	Slightly hairy	Dense hairy*. Leathery in feel	Dense hairy
Petal colour	Pale yellow*	Cream*	Pale yellow
Petal spot	Present* (Intensity high)	Absent	Present (Intensity high)
Pollen colour	Light yellow* (Sterile)	Cream*	Cream
Position of stigma	Protruded	Highly Protruded*	Protruded
Characters	**Khandwa-2**	**Reba-B-50**	**JKHY-1**
Plant height	Medium	Tall*	Medium/Tall
Leaf colour	Green	Light green*	Green
Flower colour	Light yellow*	Cream*	Yellow
Pollen colour	Yellow*	Cream	Yellow
Boll shape	Oval	Round*	Oval
Characters	**BC-68-2**	**LRA-5166**	**H-10**
Seedling pigmentation	Pinkhypocotyl*. Dark spot on base of 1 stcotyledonary Leaf at 10-12 days of germination	Pink hypocotyl	Pink hypocotyl
Pollen colour	Cream*	Yellow *	Yellow
Characters	**PH-93**	**PH-325**	**PHH-316**
Plant height	Medium	Short*	Medium
Plant growth habit	Erect	Dwarf*	Semi-erect
Red spot on base of cotyledonary leaf	Absence of red spot upto 8 days of germination*	Present	Present
Flower colour	Yellow*	Light yellow*	Yellow
Pollen colour	Yellow*	Cream	Yellow

Characters	RHC-009	RHC-017	RHH-1394
Flower colour	Cream*	Light yellow*	Light yellow
Position of stigma	Embedded	Slightly protruded	Embedded
Characters	**RHC-001**	**RHCb-001**	**RHB-0387**
Seedling pigmentation	Pink hypocotyl	Green hypocotyl*	Pink hypocotyl
Leaf and stem hairiness	Intermediate	Glabrous*	Intermediate
Plant height	Small	Medium	Tall
Leaf size	Medium	Medium	Large
Leaf colour	Light green	Green	Green
Leaf incision	Slightly deep*	Medium	Slightly deep
Flower colour	Light yellow*	Dark yellow*	Yellow
Petal spot	Absent	Dark spot present	Present (Intensity low)
Pollen colour	Yellow	Dark yellow*	Yellow
Boll size	Medium	Small	Medium
Boll shape	Oval	Ovate*	Ovate
Length of peduncle	Short	Medium	Medium
Locules/boll	4-5	3*	4
Content of lint	Medium	Low	Medium
Pitting of surface	Fine	Very coarse*	Medium
Boll opening	Medium	Weak	Medium
Fuzz	Fuzzy	Naked*	Sparse
Fuzz colour	White	Green*	Mixed/Green/white

*** indicate important marker characters**

Table 3 : Grow -out test for seed lots of PKVHY-2 and H-10 hybrids purchased from local market.

S.N	Hybrid	Number of plants observed	Off types	Per cent off types
1.	PKVHY-2 Market lot 1	400	55	13.75
2.	PKVHY-2 Market lot 2	400	45	11.25
3.	PKVHY-2 Market lot 3	400	38	9.50
4.	H-10 Market lot 1	400	39	9.75
5.	H-10 Market lot 2	400	30	7.50
6.	H-10 Market lot 3	400	49	12.25

7.50 per cent off types which were less than the permissible limit of the seed certification standards (10%).

The lot No. 1 and 2 for PKVHY-2 an d lot No. 3 for H-10 showed higher percentage off types than minimum seed certification standards. These seed lots failed to fulfill the genetic purity standards for seed certification. These GOT results gave proofs that F2 / spurious seeds were sold by some dealèrs to meet the huge demand of hybrid seeds. As a result farmers buy spurious seeds from unauthorized sources (Anonymous, 1997). These results are in accordance with Dadlani *et.al.* (1994).

Table 4: Seed quality parameters of parents, hybrids with their F_2s and market seed lots

Genotypes/ hybrids	Germination (%)	Root shoot length	Seedling vigour index	Fresh seedling wt (gm)	Dryseedling wt (gm)	Abnormal seedling (%)	Dead seeds (%)
AK-32	72.00(58.07)	19.85	1430	3.44	0.26	8.00	20.00*
DHY-286-I	75.00(60.04)	19.90	1493	4.95	0.34	6.00	19.00*
PKVHY-2	89.00(70.71)*	26.00	2314	5.04	0.40	4.00	7.00
F2	80.00(63.47)	22.21	1777	4.30	0.40	7.00	13.00
CAK-32-A	92.00(73.70)*	27.75*	2553*	6.10	0.52	3.00	5.00
DHY-286-1	78.00(62.08)	21.93	1713	6.79*	0.50	5.00	17.00
CAHH-468	85.00(67.23)	20.90	1777	5.75	0.51	7.00	8.00
F2	83.00(65.65)	26.60	2008	5.12	0.38	5.00	12.00
Khandwa-2	84.00(66.43)	23.78	1998	5.04	0.40	6.00	10.00
Reba-B-50	73.00(58.71)	20.75	1516	2.87	0.39	11.00*	16.00
JKHY-1	85.00(67.23)	22.55	1917	5.29	0.41	6.00	9.00
F2	76.00(60.71)	21.03	1598	5.32	0.48	8.00	16.00
BC-68-2	76.00(60.67)	20.55	1524	4.71	0.35	10.00*	14.00
LRA-5166	79.00(62.75)	22.65	1790	3.89	0.30	7.00	14.00
H-10	84.00(66.43)	25.70	2160	6.88*	0.50	6.00	10.00
F2	80.00(63.47)	23.56	1887	6.01	0.50	8.00	12.00
PH-93	76.00(60.67)	20.91	1590	5.01	0.35	5.00	19.00*
PH-325	79.00(62.75)	22.80	1803	2.04	0.37	10.00*	11.00
PHH-316	83.00(62.73)	22.30	1853	5.32	0.36	8.00	9.00
F2	8 0.00(63.47)	23.12	1851	5.12	0.37	7.00	13.00
PH-93	76.00(60.67)	20.91	1590	5.01	0.35	5.00	19.00*
PH-325	79.00(62.75)	22.80	1803	2.04	0.37	10.00*	11.00
PHH-316	83.00(62.73)	22.30	1853	5.32	0.36	8.00	9.00
F2	80.00(63.47)	23.12	1851	5.12	0.37	7.00	13.00
RHC-009	81.00(64.17)	21.95	1778	4.66	0.36	8.00	11.00
RHC-017	85.00(67.21)	22.70	1930	4.99	0.36	5.00	10.00
RHH-1394	88.00(69.80)	23.95	2109	5.19	0.44	5.00	7.00
F2	85.00(67.26)	24.80	2109	5.14	0.42	6.00	9.00
RHC-001	87.00(68.97)	24.12	2104	7.15*	0.48	4.00	9.00
RHCb-001	73.00(58.73)	22.55	1649	3.90	0.33	8.00	19.00*
RHB-0387	93.00(74.70) *	28.85*	2684*	5.87	0.54	3.00	4.00
F2	90.00(71.65)*	28.67*	2582*	6.97*	0.64*	3.00	7.00
PKV-2-Lot-I	77.00(58.29)	18.00	1298	4.72	0.40	7.00	21.00*
PKV-2-Lot-2	74.00(59.38)	20.45	1514	5.14	0.40	7.00	19.00*
PKV-2-Lot-3	80.00(63.45)	22.97	1838	5.20	0.39	5.00	15.00
H-10-Lot-I	76.00(60.69)	22.00	1673	5.52	0.40	7.00	17.00
H-10-Lot-2	72.00(58.07)	21.00	1513	6.19	0.48	10.00*	18.00
H-10-Lot-3	70.00(56.79)	20.35	1425	4.88	0.42	13.00	17.00
S.E.+	1.44	0.77	101.58	0.12	0.02	1.45	1.61
CD at 5%	4.14	2.20	291.94	0.34	0.06	4.15	4.62
CV%	3.18	4.74	7.76	3.25	6.77	30.48	17.70

* Significant (Figures in parenthesis indicate arcsin values)

3. Seed Quality Parameters:

The laboratory studies revealed that the market seed lots showed significantly lower seed germination, seedling length and seedling vigour index in both PKVHY-2 and H-10 hybrids while in PKVHY-2 the market seed lot 2 and 3 were higher for fresh weight and were almost equal for dry weight. In H-10 hybrid the market seed lot were significantly lower for fresh and dry seedling weight. The market seed lots of PKVHY-2 and H-10 had significantly higher abnormal seedling and dead seeds than PKVHY-2 and H-10 (Table-4). The germination and seedling vigour in these seed lots were significantly lower which gave a proof that spurious seed, sold by some dealers to meet the huge demand of hybrid seeds. These result are in accordance with Dadlani *et. al.* (1994). Since more than 70 hybrids are available in market, barely 30 per cent of the varietal seed are certified, hence information on stable diagnostic characters of genotypes will be helpful to guide seed producers, state certification agencies, state seed corporation, plant breeders as well as to the farming community to identify the off type plants of spurious seeds.

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Determination of Morphological Characteristics and Chemical Methods for Varietal Identification in Chickpea

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ABSTRACT

Nineteen varieties of chickpea were evaluated for study of diagnostic morphological characteristics and chemical methods. The study of seed and flower characteristics revealed that, both of them are important for characterization of varieties. Total five morphological and three chemical traits were studied. All the characteristics were polymorphic. The flower colour is important diagnostic morphological characteristics on the basis of which the varieties are grouped as pink and white. Out of nineteen varieties, seventeen varieties had pink flower, while virat and vihar had white flower. The seed colour, seed testa texture, seed ribbing and seed type are also important diagnostic morphological characteristics, on the basis of which 19 varieties of chickpea could be grouped into several subgroups. Variations in seed colour was prominently seen among the varieties, virat and vihar had beige, PG-5 had brown beige, chaffa had yellow, vishal, PG-9425-5,BDNG-797, JG 130 and JG 11 had dark brown seed colour, whereas remaining 10 varieties had brown seed colour. All the varieties had rough seed testa texture except vishal, PG-5, JG 16 and BDN-9-3 had smooth and tuberculated seed testa texture, respectively. The study of seed ribbing indicated that ribbing was absent in the varieties vishal, vihar, PG-5 and JG 16 and present in the remaining varieties. The varieties we can differentiate on the basis of seed type. Virat and vihar grouped under kabuli type whereas remaining varieties grouped under desi type. Phenol tests and KOH test appears to be promising for distinguishing chickpea varieties. Phenol and KOH test/colour reaction showed variations in reaction and could be grouped into brown and dark brown categories. The results indicate that all the varieties were distinguishable from each other on the basis of these differences.

In India, chickpea is an important pulse crop cultivated in *Rabi* season. In India, Chickpea grown on 7.10 million hectare with annual production of 5.65 million tones (Johnson *et.al.*, 2007)

Number of varieties / hybrids of various crops have been released. It is essential to record the morphological characteristics of most of the released varieties as per National Test Guidelines. It is difficult to identify off types in seed production. Plant breeders also quoting only few morphological characteristics that are related to yield and its contributing characters. Thus, it is essential to study key characteristics of the crops and utilize these characteristics for distinguishing varieties from each other. Similarly, Protection of Plant Varieties and Farmer's Rights Act 2001 has been enacted in India. Distinctness, Uniformity and Stability are the criteria's of PPV and FRA. Proper documentation of morphological characteristics of the varieties is the need of today.

Morphological characteristics of seed such as seed colour, seed testa texture, seed ribbing and seed type and flower colour have been invariably used by plant breeders to group the various chickpea varieties. Seedling characteristics have also often been used in identification of various crop varieties. (Agrawal and Karki,1989). However, it is not yet possible to group/ distinguish these varieties within each group on the basis of these morphological characteristics alone. In legumes response of different varieties to various chemical test *viz:* phenol and KOH test have been in used for distinguishing the varieties. Present investigation was undertaken with a view to identify diagnostic morphological characteristics of chickpea for varietal identification.

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MATERIAL AND METHODS

The nineteen varieties of chickpea genotypes were grown in field with 3 replications. Morphological characteristics *viz;* flower colour, seed colour, seed testa texture, seed ribbing and seed type were recorded. Similarly, response to various chemical tests *viz;* modified phenol test A ($CuSO_4$ test), modified phenol test B (Na_2CO_3 test) and KOH test were recorded. These varieties were grouped into white and pink group on the basis of flower colour. The seeds were observed visually for seed colour and classified into dark brown, brown, yellow, brown beige and beige group. Seed testa texture was also observed visually and grouped as smooth, rough and tuberculated category. The seeds were also observed visually for the seed ribbing and categorized as absent or present. All morphological characteristics were recorded as per National Test Guidelines for the conduct of tests for DUS in chickpea (Anonymous, 2004)

The methodology of chemical tests are given below :

a. Modified Phenol test A and B:

the seeds were soaked overnight in 0.4 per cent $CuSO_4$ and 0.6 per cent Na_2CO_3 separately for the phenol test 'A' and 'B' respectively (Chowdhury, 2004) at 20°C ± 1°C. The seeds were then placed in a petridish lined with filter paper presoaked with 1 per cent Phenol solution and kept at 30°C ± 1°C.The change in colour of seed was observed after 4 hours. The varieties were categorized into two groups *viz;* as dark brown and no change. For Phenol test 'A' and for Phenol test 'B' seeds were categorized into three groups as black, dark brown and no change.

b. Potassium hydroxide test (KOH test) :

Seeds were soaked in 5 per cent KOH solution for 6 hrs. at room temperature and observations were taken after development of colour and varieties are grouped as black, dark brown and no change (Chowdhury, 2004).

RESULTS AND DISCUSSION

The observations for different morphological characterization and response to chemical test have been presented in Table. 1. It is seen that all the characteristics found polymorphic.

The seed and flower characteristics revealed that both of them are important for identification of varieties. The flower colour is an important diagnostic morphological characteristics on the basis of which the varieties are grouped as pink and white. Seventeen varieties grouped into pink colour whereas variety virat and vihar grouped into white flower colour. The study of seed characteristics revealed that seed colour , seed testa texture, seed ribbing and seed type were important diagnostic morphological characteristics. On this basis, 19 varieties of chickpea could be grouped into several subgroups. This is due to the highly self-pollinated nature of chickpea crop. The varieties are pure lines and ,therefore, possess unique seed and flower colour. Similar characteristics have been reported under genetic control (Sen and Murthy, 1960; Pathak and Singh, 1961 and Verma, 1973). Therefore, these seed characteristics could be used as primary diagnostic characteristics. Variations in seed colour was prominently seen among the varieties, virat and vihar had beige, PG-5 had brown beige, Chaffa had yellow, vishal, PG-9425-5,BDNG-797, JG 130 and JG 11 had dark brown seed colour whereas remaining 10 varieties had brown seed colour. All the varieties had rough seed testa texture except vishal, PG-5, JG 16, which had smooth and BDN-9-3, which had tuberculated seed testa texture.

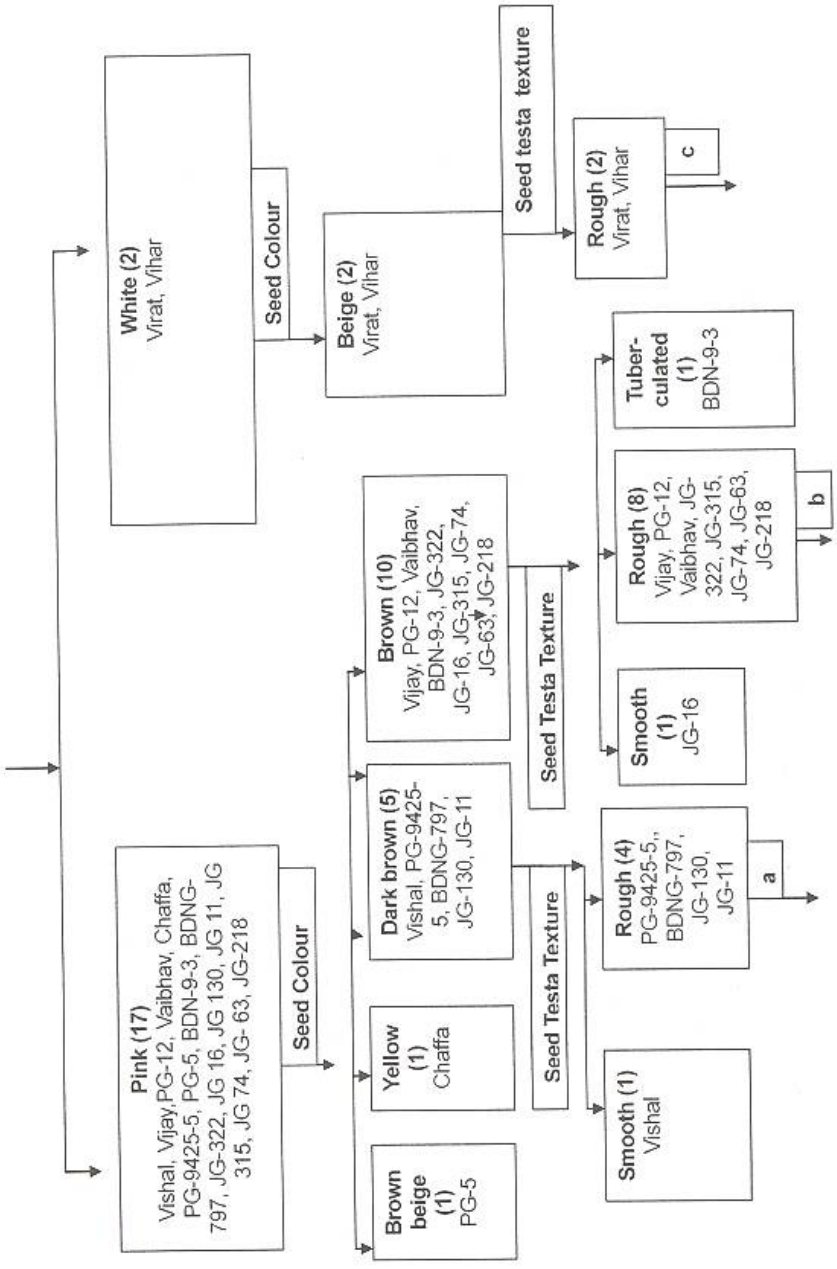
The study of seed ribbing indicated that ribbing was absent in the varieties vishal, vihar, PG-5 and JG 16 and present in the remaining varieties. The varieties we can differentiate on the basis of seed type. Virat and vihar are grouped under kabuli type whereas; remaining varieties were grouped under desi type.

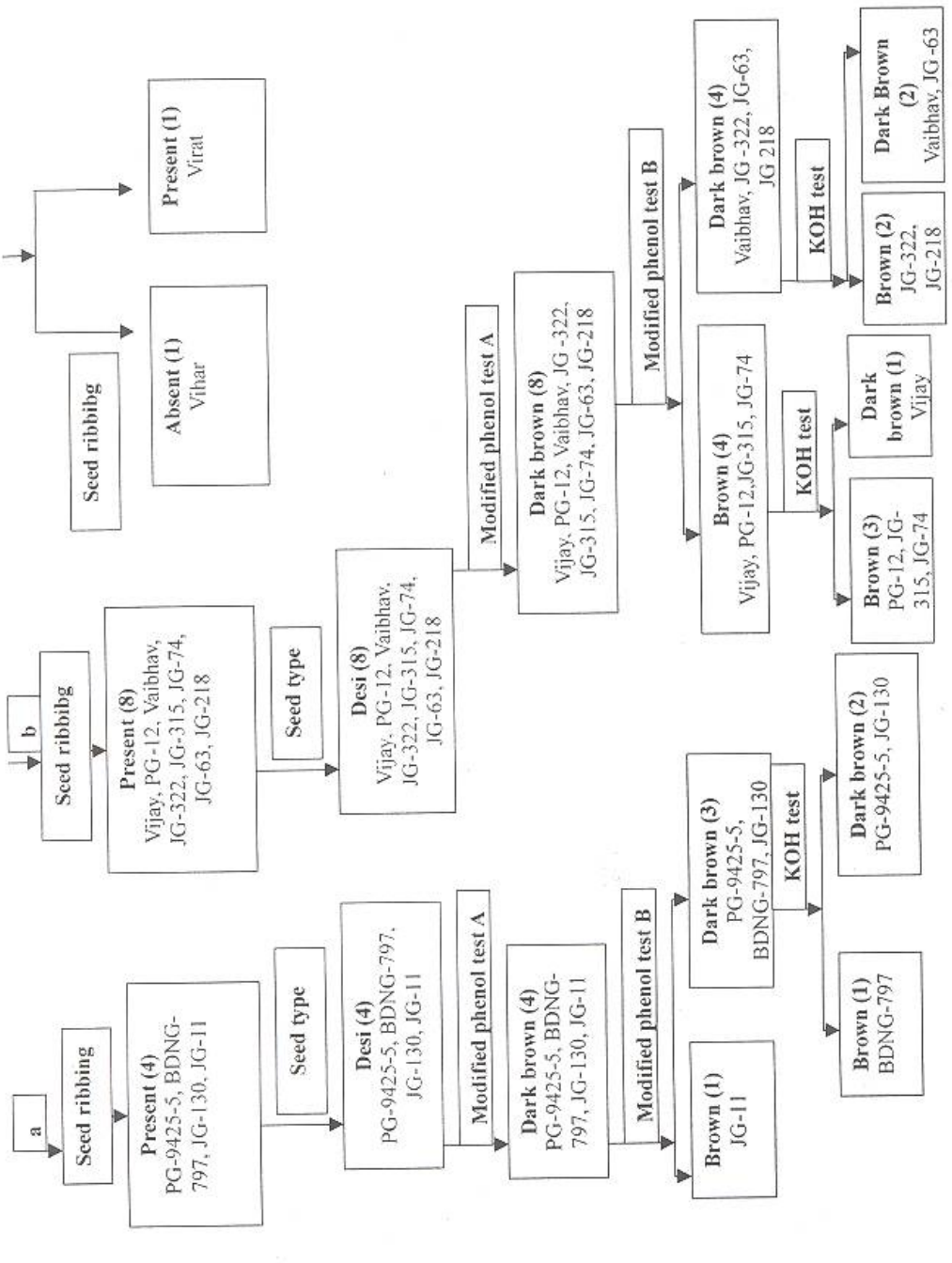
From the results, it is seen that the different genotypes had different response to the Phenol colour test. The varieties are grouped into two main reaction

TABLE 1. Characterization of Chickpea Genotypes based on Morphological and Chemical Characteristics

Varieties	Flower colour	Seed Colour	Seed Testa Texture	Seed Ribbing	Seed Type	Modified Phenol test 'A' (Cuso4 Test)	Modified Phenol 'B' (Na_2Co_3 test)	KOH Test
Vishal	Pink	Dark brown	Smooth	Absent	Desi	Dark brown	Brown	Dark brown
Virat	White	Beige	Rough	Present	Kabuli	No change	No change	No change
Vijay	Pink	Brown	Rough	Present	Desi	Dark brown	Brown	Dark brown
PG-12	Pink	Brown	Rough	Present	Desi	Dark brown	Brown	Brown
Vaibhav	Pink	Brown	Rough	Present	Desi	Dark brown	Dark brown	Dark brown
Chaffa	Pink	Yellow	Rough	Present	Desi	Dark brown	Brown	Brown
Vihar	White	Beige	Rough	Absent	Kabuli	No change	No change	No change
PG-9425-5	Pink	Dark brown	Rough	Present	Desi	Dark brown	Dark brown	Dark brown
PG-5	Pink	Brown Beige	Smooth	Absent	Desi	Dark brown	Dark brown	Brown
BDN-9-3	Pink	Brown	Tuberculated	Present	Desi	Dark brown	Dark brown	Brown
BDNG-797	Pink	Dark brown	Rough	Present	Desi	Dark brown	Dark brown	Brown
JG-322	Pink	Brown	Rough	Present	Desi	Dark brown	Dark brown	Brown
JG-16	Pink	Brown	Smooth	Absent	Desi	Dark brown	Brown	Brown
JG-130	Pink	Dark brown	Rough	Present	Desi	Dark brown	Dark brown	Dark brown
JG-11	Pink	Dark brown	Rough	Present	Desi	Dark brown	Brown	Brown
JG-315	Pink	Brown	Rough	Present	Desi	Dark brown	Brown	Brown
JG-74	Pink	Brown	Rough	Present	Desi	Dark brown	Brown	Brown
JG-63	Pink	Brown	Rough	Present	Desi	Dark brown	Dark brown	Dark brown
JG-218	Pink	Brown	Rough	Present	Desi	Dark brown	Dark brown	Brown

Grouping of Chickpea varieties on the basis of morphological and chemical characteristics.




a
Seed ribbing
Present (4)
PG-9425-5, BDNG-797, JG-130, JG-11
Seed type
Desi (4)
PG-9425-5, BDNG-797, JG-130, JG-11
Modified phenol test A
Dark brown (4)
PG-9425-5, BDNG-797, JG-130, JG-11
Modified phenol test B
Brown (1)
JG-11
Dark brown (3)
PG-9425-5, BDNG-797, JG-130
KOH test
Brown (1)
BDNG-797
Dark brown (2)
PG-9425-5, JG-130
b
Seed ribbibg
Present (8)
Vijay, PG-12, Vaibhav, JG-322, JG-315, JG-74, JG-63, JG-218
Seed type
Desi (8)
Vijay, PG-12, Vaibhav, JG-322, JG-315, JG-74, JG-63, JG-218
Modified phenol test A
Dark brown (8)
Vijay, PG-12, Vaibhav, JG-322, JG-315, JG-74, JG-63, JG-218
Modified phenol test B
Brown (4)
Vijay, PG-12,JG-315, JG-74
KOH test
Brown (3)
PG-12, JG-315, JG-74
Dark brown (1)
Vijay
Seed ribbibg
Absent (1)
Vihar
Present (1)
Virat
Dark brown (4)
Vaibhav, JG-322, JG-63, JG 218
KOH test
Brown (2)
JG-322, JG-218
Dark Brown (2)
Vaibhav, JG-63

groups, *viz;* dark brown and brown. As such phenol test appears to be promising for distinguishing chickpea varieties.

The chickpea varieties showed variations in KOH test and could be grouped into brown (11 varieties) and dark brown (6 varieties) categories. It is observed that varieties namely virat and vihar had no response to modified phenol test A, phenol test B and KOH test.

Development of seed keys: While preparing the seed keys the varieties were first divided into two groups of flower colors. Varieties within each flower color group were then divided into various seed color groups, which were further sub grouped on the basis of differences in seed testa texture, seed ribbing, seed type, Phenol test 'A', Phenol test 'B' and KOH test.

The present investigation clearly revealed that morphological characteristics and chemical tests could be beneficial for distinguishing varieties of chick pea from each other. Similarly, this information can be used in hybridization programme for chickpea cultivar improvement.

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Correlation Studies for Yield and Yield Contributing Characters in Safflower

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ABSTRACT

Correlation studies on safflower *Carthamus tinctorius* L. indicated that the seed yield was significantly and positively correlated with number of branches plant^{-1}, number of capitula plant^{-1}, number of seeds capitula^{-1} and 100 seed weight . Seed yield plant^{-1} showed negative correlation with days to first flower, days to 50 per cent flowering and days to maturity. There was no correlation between oil content and seed yield plant^{-1}.

India has legitimate pride of being the largest producer of safflower in the world. In India, Maharashtra and Karnataka are the two most important safflower growing states accounting 73 per cent and 22 per cent of total area under safflower, respectively. Safflower has been cultivated mainly for the vegetable oil extraction from its seeds, since time immemorial. Today safflower provides three main products i.e. oil, petal and livestock feeds. Safflower is grown as a rainfed crop and is considered to be drought tolerant. As safflower is grown in post monsoon season under receding soil moisture condition, it has a long tap root system. Yield is a complex character, therefore, the knowledge of relationship of the various yield contributing characters is of great importance in any crop improvement program for the effective selection. Such studies are also helpful for the plant breeder to develop appropriate line of action for crop improvement. The correlation coefficient gives the idea about the magnitude contribution made by various characters. The relationship between two or more quantitative characters is of great interest and carried much practical significance. Correlation is a measure of degree to which characters are associated with yield or among themselves. This help the plant breeder to build a selection criterion for selecting and developing high yielding genotypes in safflower.

MATERIAL AND METHODS

The material for the present study consisted of 171 progenies of safflower and two released varieties AKS-207 and Bhima as checks. They were evaluated in modified randomized block design with two replications during *Rabi* 2005-06 as suggested by Eckebil *et al.* (1977). Each replication consisted of nine blocks of twenty progenies along with two checks in each block. Each progeny represented by two rows of 5m length with a spacing of 45cm x 20cm. The recommended package of practices were followed to raise the healthy crop. The data were recorded on five randomly selected fertile plants from each family. The observations were recorded on plot basis and on plant basis viz. days to first flower, days to 50 per cent flowering, days to maturity, plant height(cm), number of branches plant^{-1}, number of capitula plant^{-1}, number of seeds capitulum^{-1}, 100 seed weight(g), oil content (%) and seed yield plant^{-1} (g). The correlation coefficients and other genetic parameters were estimated as per the conventional procedures suggested by Burton (1952).

RESULTS AND DISCUSSION

In most of the traits, the values of genotypic correlations were of higher magnitude than phenotypic correlations. This suggested that there was a strong inherent association between characters which was truly reflected in phenotypic expressions. The seed yield plant^{-1} showed highly significant and strong positive genotypic and phenotypic correlation with number of branches plant^{-1} (0.398**, 0.313**, respectively), number of capitula plant^{-1} (0.414**, 0.326**, respectively), number of seeds capitulum^{-1} (0.293**,

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Table 1. Genotypic (G) and phenotypic (P) correlations among ten quantitative yield contributing characters

Characters		Days to 1st flower	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches plant^{-1}	Number of capitula plant^{-1}	Number of seeds capitulum^{-1}	100 seed weight (gm)	Oil content (%)	Seed yield plant^{-1} (gm)
Days to first flower	G	1	0.659**	0.193**	0.231**	-0.410**	-0.337**	-0.131	0.035	-0.042	-0.247**
	P	1	0.611**	0.144**	0.167*	-0.268**	-0.232**	-0.014	0.023	-0.024	-0.173*
Days to 50% flowering	G		1	0.666**	0.036	-0.480**	-0.126	0.206**	-0.119	-0.220**	-0.266**
	P		1	0.585**	0.017	-0.330**	-0.071	0.119	-0.067	-0.174*	-0.230**
Days to maturity	G			1	-0.134	-0.297**	0.181**	0.306**	-0.111	-0.284**	-0.166*
	P			1	-0.121	-0.240**	0.156*	0.222**	-0.020	-0.274**	-0.161*
Plant height (cm)	G				1	0.265**	0.147*	1.455**	0.229**	0.059	0.028
	P				1	0.168*	0.094	0.001	0.185**	0.052	0.035
No. of branches plant^{-1}	G					1	0.542**	-0.111	0.251**	0.097	0.398**
	P					1	0.526**	-0.107	0.204**	0.070	0.313**
No. of capitula plant^{-1}	G						1	0.049	0.152*	-0.071	0.414**
	P						1	0.011	0.116	-0.061	0.326**
No. of seeds capitulum^{-1}	G							1	0.211**	0.052	0.293**
	P							1	0.128	0.031	0.198**
100 seed weight (gm)	G								1	-0.065	0.389**
	P								1	-0.056	0.320**
Oil content (%)	G									1	0.096
	P									1	0.087
Yield plant^{-1} (g)	G										1
	P										1

* - $P \leq 0.05$ ** - $P \leq 0.01$

The correlation coefficient was tested at n-2 degrees of freedom at 5% and 1% level of significance

0.198 **, respectively) and 100 seed weight (0.389**, 0.320**, respectively). Similar observations have been reported by Malleshppa and patil (1990), Lakshyadeep *et al.* (2005) and Goyal (2006). Seed yield per plant showed negative correlation with days to first flower (-0.247**, -0.173*, respectively), days to 50percent flowering (-0.266,** -0.230**, respectively) and days to maturity (-0.166*, -0.161*, respectively). Similar results have been reported by Naole (2004), Rathod (2005) and Goyal (2006). There is no correlation between oil content and seed yield plant^{-1}. Days to first flower exhibited positive and significant correlation with days to 50 per cent flowering, days to maturity and plant height (Table 1).

Correlation studies indicated that for selection of high yielding plants more emphasis should be laid on the characters like number of branches plant^{-1}, number of capitula plant^{-1}, number of seeds capitulum^{-1} and 100 seed weight. Thus, these trait should be incorporated in the safflower ediotype to achieve significant improvement in seed yield.

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Effect of Intercrops on Growth, Yield and Quality of Cotton Under Rainfed Condition

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ABSTRACT

A field experiment entitled "Effect of intercrops on growth, yield and quality of cotton under rainfed condition" was carried out during *Kharif* season of 2006 at Agronomy Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experiment consisted of 10 treatments of sole crops of cotton, greengram, blackgram, soybean and pigeonpea and cotton intercropped with greengram, blackgram, soybean and pigeonpea in 2:1 ratio and also with pigeonpea in 6:2 ratio. The results revealed that sole cotton in respect of plant height and sole cotton and cotton + pigeonpea (6:2) in respect of number of sympodial branches and dry matter accumulation plant^{-1} were found better than rest of the intercropping systems. Sole cotton and cotton + pigeonpea (6:2) recorded higher number of picked bolls and seed cotton weight plant^{-1} than rest of the intercropping systems. The treatment sole cotton recorded significantly higher seed cotton and stalk yield than rest of the treatments.

Among the major cotton growing states in India, Maharashtra ranks first in area (28.89 lakh ha) but productivity is only 271 kg lint ha^{-1} which is very low as compared to national average of 468 kg lint ha^{-1} because of its major area being rainfed. Vidarbha, which is famous for cotton crop occupy 12.50 lakh ha with production of 24 lakh bales and productivity 326 kg lint ha^{-1} (Anonymous, 2006).

For risk aversion in rainfed farming, intercropping in cotton is advocated instead of sole cropping. Intercropping is getting greater emphasis because of yield stability and returns per unit area even under adverse condition. This system uses resources efficiently and productivity is increased. Cotton has slow growth habit and when grown at wider row, spacing can be utilized for intercropping. Legumes when intercropped with cotton improve soil fertility status besides fulfilling the basic need of pulses for consumption purpose. The intercropping system under medium to heavy soil is suitable under rainfed condition of Vidarbha region than sole cropping (Kayande and Narnaware, 1995). Therefore, an attempt was made to find out suitable intercrop for cotton under rainfed conditions.

MATERIAL AND METHODS

The field experiment was conducted at Agronomy Farm, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Kharif* season of 2006. The soil of the experimental field was medium black, low in available nitrogen and phosphorus, and fairly rich in available potassium with moderate organic carbon content. The experiment was laid out in Randomized Block Design with 10 treatments consisting sole crops of cotton, greengram, blackgram, soybean, pigeonpea, cotton + greengram (2:1 ratio), cotton + blackgram (2:1 ratio), cotton + soybean (2:1 ratio) cotton + pigeonpea (2:1 ratio) and also cotton + pigeonpea in 6:2 ratio and replicated three times. The layout consisted of forty plots with gross and net plot size of 6.0 x 4.8 m^2 and 4.8 x 3.6 m^2, respectively. The sowing of cotton seeds AKH-8828 by dibbling 3-4 seeds hill^{-1} and seeds of intercrops by drilling method was done on 1st July, 2006. Optimum plant population was maintained by gap filling. The cotton and intercrop were fertilized with a recommended dose of fertilizer of cotton 50:25:25 kg NPK ha^{-1}. Fifty per cent nitrogen and full dose of phosphorus and potassium was applied at the time of sowing while remaining 50 per cent nitrogen was applied after 30 days

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of emergence. Plant protection schedule was followed for control of insect pests as per the recommendations.

RESULTS AND DISCUSSION

The data in respect of growth attributes, yield attributes, seed cotton yield, stalk yield and quality attributes are presented in Table 1 and 2, respectively.

Effect on growth attributes

Number of functional leaves and monopodial branches plant^{-1} were not influenced significantly by different cotton based intercropping systems (Table 1). Sole cotton (Ti) recorded significantly higher plant height than all other cotton based intercropping systems. Amongst intercropping' treatments, cotton + pigeonpea (6:2) recorded significantly taller cotton plants than rest of intercropping treatments, whereas the treatments cotton + blackgram (2:1) and cotton + greengram (2:1) were at par with each other. The treatments sole cotton and cotton + pigeonpea (6:2) being at par with each other recorded significantly higher number of sympodial branches and dry matter accumulation plant-^{1} than rest of the treatments. However, cotton + blackgram and cotton + greengram (2:1) for number of sympodial branches plant^{-1} and cotton + blackgram, greengram and pigeonpea at 2:1 for dry matter accumulation plant^{-1} were at par with each other. Similar findings were reported by Wankhade *et al.* (2000) and Deoche (2001).

Effect on yield attributes, yield and quality attributes

Sole cotton (Ti) recorded significantly more number of picked bolls plant-^{1} than intercropping treatments (Table 2). However, seed cotton weight plant^{-1} was statistically equal under sole cotton (T_1) and cotton + pigeonpea 6:2 (T_{10}). Cotton + pigeonpea 6:2 (T_{10}) was at par with cotton + blackgram (T_7) and cotton + greengram (T_6) in respect of number of picked bolls and seed cotton weight plant^{-1}. The treatment cotton + pigeonpea 2:1 (T_9) recorded significantly lowest number of picked bolls and seed cotton weight plant^{-1}. It may be due to efficient utilization of light, moisture, nutrient and space for better growth and development of cotton in sole cropping as compared to intercropping. Similar results were reported by Kalyankar (2001) and Kote *et al.* (2005). Seed cotton yield boll-^{1} and ginning per cent being a genetic character were not influenced significantly by the various intercropping systems. Sole cotton (T_1) recorded significantly higher seed cotton and stalk yield than intercropping systems. Cotton intercropped with either blackgram (T_7) or greengram (T_6) in 2:1 ratio recorded statistically equivalent seed cotton and stalk yield and proved superior to rest of the intercropping systems. Cotton + pigeonpea (2:1)

Table 1 : Growth attributes of cotton as influenced by different treatments

Treatments	plant height (cm)	Number of functional leaves plant^{-1}	Number of monopodial branches plant^{-1}	Number of sympodial branches plant^{-1}	Total dry matter accumulation plant^{-1} (g)
T_1 - Sole cotton	84.60	53.90	3.95	19.03	69.26
T_6 - Cotton + Greengram (2:1)	74.24	49.75	3.85	14.91	58.12
T_7 - Cotton + Blackgram (2:1)	76.15	50.00	3.86	14.97	59.40
T_8 - Cotton + Soybean (2:1)	62.93	43.06	3.76	10.64	54.59
T_9 - Cotton + Pigeonpea (2:1)	57.62	40.23	3.66	8.29	45.03
T_{10} - Cotton + Pigeonpea (6:2)	81.08	51.12	3.88	18.38	67.56
SE (m) ±	0.98	4.88	0.10	1.21	2.85
CD at 5%	2.97	NS	NS	3.58	8.46

Table 2 : Yield attributes, yield and quality attributes of cotton as influenced by different treatments

Treatments	Number of picked bolls plant^{-1}	Seed cotton weight boll^{-1} (g)	Seed cotton weight plant^{-1} (g)	Seed cotton yield (q ha^{-1})	Stalk yield (q ha^{-1})	Ginning per cent	Seed index
T_1 - Sole cotton	7.15	3.17	21.43	10.98	32.16	37.06	8.54
T_6 - Cotton + Greengram (2:1)	5.35	3.08	17.04	9.02	27.10	36.97	7.95
T_7 - Cotton + Blackgram (2:1)	5.75	3.14	17.90	9.31	28.10	37.14	8.26
T_8 - Cotton + Soybean (2:1)	4.36	3.08	14.65	6.67	21.58	37.00	7.89
T_9 - Cotton + Pigeonpea (2:1)	3.07	3.13	10.12	4.17	12.04	36.71	7.69
T_{10} - Cotton + Pigeonpea (6:2)	4.28	3.17	18.19	6.48	23.06	37.06	8.49
SE (m) $\pm$	0.41	0.03	1.14	0.58	0.96	0.21	0.09
CD at 5%	1.17	NS	3.48	1.65	2.78	NS	0.29

recorded significantly lowest seed cotton and stalk yield. These results are in agreement with those reported by Wankhade *et al.* (2000), Deoche (2001) and Kote *et al.* (2005).

Seed index was maximum in sole cotton, followed by cotton + pigeonpea (6:2) and cotton + blackgram. Similar results were reported by Gode *et. al.*, (1992).

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Adoption of Production Technologies of Safflower by the Farmers Through Front Line Demonstrations

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ABSTRACT

Total of 239 farm trials were conducted on farmers field during last two decades (1987-88 to2005-06) in Maharashtra state. About eight different components. viz, Whole package (rainfed), whole Package (irrigated), intercropping, spacing, thinning, improved variety, recommended dose of fertilizers and plant protection measures were tested. Results indicated that the net monetary returns as well as the benefit cost ratio was observed to be high in improved practice for all the components when compared to local practice. The sole cropping. safflower Vs gram under Rainfed conditions was the most economical component which increased 106 per cent in monetary returns over local practice and 3.89, 4.96 BC ratio of local practice and Improved practice respectively. The investigation also revealed that farmers must adopt the improved package of practices in order to obtain high yields and maximum monetary benefits.

Safflower (*Carthamus tinctorious* L.) is one of the important *Rabi* oilseed crops grown on vertisols under residual soil moisture in India. There has been dramatic and significant change in the oil seed scenario of India in recent past. The country has certainly achieved the stupendous task of becoming self reliant in the oilseeds production and got a premier position from one net importer to that of exporter during the nineties. Though, India occupies premier position in the word with regards to safflower, accounting 4.0 lakh ha area and production of 2.2 lakh tonnes.(2005-06), the present productivity of 550kg ha^{-1} is very low. One of the major reasons of low productivities is non adoption of improved technology by the farmers. To overcome this problem, the Indian Council of Agriculture Research, New Delhi has launched the programme of "Frontline Demonstrations", on Safflower in collaboration with the Mahatma Phule Agricultural University with an objective to demonstrate the improved technology to farmers on their farm itself.

Therefore, frontline demonstrations were organized in the farmers' field to show the productivity potentials and profitability of the latest improved crop production technologies including cropping systems as well as other components viz. Improved varieties/ hybrid, irrigation, plant protection measures, thinning, spacing and recommended dose of fertilizers, etc., were considered and demonstrated successfully on cultivators' fields.

MATERIAL AND METHODS

Two hundred thirty nine demonstrations were conducted on farmer's fields during 1987-88 to 2005-2006 on eight components viz. whole package (irrigated), whole package (rainfed), intercropping, spacing, thinning, variety, recommended dose of fertilizers and need based plant protection measures. The whole package components under irrigated and rainfed conditions include *viz.*, improved variety, recommended seed rate, optimum sowing time, seed treatment, spacing, thinning, hoeing, and recommended plant protection measurers and recommended dose of fertilizers.

Most farmers use local variety with some exception of improved variety. Farmers demonstration use of plant protection measures adequately and recommended spacing of 45 X20 cm. In case of intercropping of safflower Vs gram in 2:1, 3:1 and 6:3 row ratio, Safflower Vs Linseed it is 4:2 row ratio under irrigated and rainfed conditions. The safflower is also cultivated either as a sole crop or strip cropping with sorghum instead of gram and Linseed. The cycocel (CCC) is a recommended plant growth regulator which is used @ 1000 ppm in 500 litre of water ha^{-1} for getting the higher seed yield and net monetary returns under

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rainfed conditions. This practice is, however; yet to be popularized among the farmers. The trials were conducted in one acre area each for improved V/s, local practice in Solapur district. All the inputs required for improved package for one acre area viz. seed, fertilizers, insecticides, etc., were supplied by the project and the demonstrations were monitored regularly for all timely operations and success of the trials. The data on seed yield kg ha^{-1} were recorded from the farmers' field after harvesting every year and net returns, per cent increase in seed yield, net monetary returns, per cent increase in net monetary returns and benefit cost ratio were worked out and compared with local practice.

RESULTS AND DISCUSSION

Sole cropping

The data on average of 11 demonstrations seed yield, gross monetary returns and BC ratio are presented in Table-1. The results revealed that from the sole cropping i.e. safflower Vs gram, the higher net monetary returns of Rs12051 ha^{-1}, per cent increase in net monetary returns (106.00 %) and BC. Ratio (4.96) were observed to be higher in improved practice than farmers' practice viz. net monetary returns of Rs.5831ha^{-1} and BC ratio 3.89, respectively. Another 2 demonstrations of sole cropping of safflower Vs wheat under irrigated conditions the higher net returns of (Rs.10601 ha^{-1}), per cent increase in monetary returns (127.02%) and BC. Ratio 3.13 were observed to be higher in improved practice than farmers' practice viz.net monetary returns of Rs 4670 ha^{-1} and BC ratio 2.66, respectively. Patil *et al.* (1992) and Anonymous (1987) also reported high yields of sole safflower under protective irrigations.

Whole package

On the basis of 32 demonstrations conducted under rainfed and irrigated conditions it was observed that the net returns of (Rs.9141 ha^{-1}) and (Rs.8550 ha^{-1}) and per cent increase in yields over local practices of 70.12 and 81.62, respectively under rainfed and irrigated conditions.

Variety

On the basis of 36 demonstrations of sole rain fed safflower (Table 1), it was observed that the varieties i.e, cv. Bhima /Phule Kusuma recorded higher seed yield (1161kg ha^{-1}) which was 40.0 per cent more than the local varieties (828 kg ha^{-1}).

Fertilizers

It was observed that the use of recommended dose of fertilizer (50:25:0 NPK kg ha^{-1}) under rainfed conditions resulted into increase in the productivity 64.53 per cent with additional net returns of Rs.4304 ha^{-1} and B:C ratio 2.05 in improved technology and 1.67 in farmer's practice viz. no or less use of recommended fertilizers. These results are in conformity with Tomar *et al.* (2001) who reported that application of RDF increased the seed yield by 84 per cent over farmer's practice (62.0 %), respectively.

Plant Protection

The adoption of need based plant protection measures for effective control of safflower aphids and alternaria leaf spot one need- based spray of NSKE 5 per cent, followed by dimethoate 0.05 per cent 15 days after first spray and one or two need –based spray of mancozeb (Dithane M-45) under rainfed conditions increased the productivity by 26.39 percent thereby providing additional net returns to the extent of Rs.3092 ha^{-1}. The B:C ratio was observed 1.53 in improved technology and 1.43 in farmers' practice.

Thinning

The 22 demonstrations indicated that the practice of thinning at proper time (21 days after sowing) gave 54.35 per cent superiority in seed yield over no thinning.

Intercropping

On an average of 10 demonstrations in intercropping of gram + safflower under rainfed conditions in 2:1 row proportions net monetary returns of Rs. 7462 ha^{-1}, BC. Ratio 2.64 and per cent increase in net monetary returns was 93.31 per cent over farmer's practice viz net monetary returns of Rs. 3860 ha^{-1} and BC ratio 1.94, respectively .While with the same row proportion on an average of 5 demonstrations under irrigated condition the net monetary returns of Rs. 6763 ha^{-1} and 5212 ha^{-1} and BC ratio 2.13 and 2.06 were observed to be higher in improved practice and local practice, respectively. Another 24 demonstrations with 6:3 row proportion were conducted under rainfed

Table No. 1 Summary of Frontline Demonstration from 1987-88 to 2005-06

Crops	Technology	No of Demo ns	Av. yield (kg ha^{-1})		Gross Monetary Returns (Rs. ha^{-1})		Cost of Cultivation (Rs. ha^{-1})		Net Monetary Returns (Rs. ha^{-1})		Per cent increase in yield and Monetary returns (Rs. ha^{-1})	B.C ratio	
			LP	IP	LP	IP	LP	IP	LP	IP	Over F Practice	LP	IP
Safflower Vs. Gram	Sole cropping-R	11	1120 (G)	1762 S	7843	15216	2012	3165	5831	12051	106.00 M	3.89	4.96
SafflowerVs. Wheat	Sole cropping-I	02	1360 (W)	1638 (S)	6332	15556	2810	5955	4670	10601	127.02 M	2.66	3.13
Linseed Vs Safflower	Intercroppin (4:2) –R	04	770 (SL)	667 (L) 730 (S)	6492 (L)	10891	3250	3850	3242	7041	117.80 M	1.99	2.82
Safflower Vs. Linseed	Sole cropping-R	0!	983 (L)	1630 (S)	5159	10432	3060	4260	3099	6172	99.16 M	2.50	3.20
Gram + Safflower	Intercroppin (2:1) -R	10	978 (SG)	782 (G) 718 (S)	7964 (G)	12012	4104	4550	3860	7462	93.31 M	1.94	2.64
Safflower	Whole Package-I	17	974	1769	7607	12800	3275	4250	4332	8550	81.62 (Y)	2.32	3.01
Safflower	Sole cropping-I	10	1211JG 4768JF	1840 S	11254	18575	3685	4850	7569	13725	81.33 M	3.05	4.00
Safflower	Whole Package-R	15	800	1361	7362	12564	2951	3423	4411	9141	70.12 (Y)	2.49	3.67
Safflower	Fertilizer (RDF)	38	578	951	5337	8399	3180	4095	2157	4304	64.53 (Y)	1.67	2.05

Crops	Technology	No of Demons	Av. yield (kg ha^{-1})		Gross Monetary Returns (Rs. ha^{-1})		Cost of Cultivation (Rs. ha^{-1})		Net Monetary Returns (Rs. ha^{-1})		Per cent increase in yield and Monetary returns (Rs. ha^{-1}) Over F practice	B.C ratio	
			LP	IP	LP	IP	LP	IP	LP	IP		LP	IP
Saff. Vs.Jower.	Sole cropping-R	10	789JG 2449JF	1232 S	8331	12640	3328	3877	5003	7763	55.16 M	2.54	3.0
Safflower	Thinning-R	22	712	1099	7714	12158	4428	4980	3286	7178	54.35 (Y)	1.74	2.44
Safflower	Spacing-R	03	1010	1545	10218	15142	3475	3600	6743	11542	52.97 (Y)	2.94	4.20
Safflower	Varietal-R	36	828	1161	7363	10018	3885	4638	3478	5380	40.21 (Y)	1.89	2.15
Safflower	Pl. Protection	17	610	771	7010	8825	4878	5733	2132	3092	26.39 (Y)	1.43	1.53
Gram + Safflower	Intercropping (2:1)-I	05	1082-SG	844-G 673 (S)	10096	12747	4884	5984	5212	6763	26.75 M	2.06	2.13
Gram + Safflower	Intercropping (6:3) –R	24	918 (SG)	709 (G) 699 (S)	12776	15107	4836	5177	7940	9930	25.00 M	2.64	2.91
Safflower	Cycocel Spray	14	947	1142	11925	14511	5364	6309	6561	8202	20.59 (Y)	2.22	2.30
Total		239											

.P = Local Practice IP = Improved Practice JG-Jowar Grain JF- Jowar Fodder W-Wheat SG- Sole Gram
SS-Sole Safflower G-Gram L-Linseed Y-Yield I- Irrigated R- Rainfed
M = Percent increase in net Monetary Returns.

condition of Solapur district in Maharashtra state. In this demonstrations the net monetary returns of Rs.9930 ha^{-1}, BC ratio 2.91and per cent increase in net monetary returns *viz.*, 25.00 per cent were observed to be higher in improved practice over farmers' practice viz net monetary returns of Rs 7940 ha^{-1} and BC ratio 2.64, respectively The results of Patil *et al.* (1992), Anonymous (2000) and Anonymous (2006) are in conformity with these findings.

Growth regulators

The intervention through the use of cycocel @ 1000 ppm in 500 Litre of water as a growth regulator, was demonstrated to increase the productivity by 20.59 per cent under rainfed conditions. Thus, resulting in additional net returns of Rs.8202 ha^{-1} and Rs 656 ha^{-1} in improved practice and farmers' practice. However, in case of B C ratio were 2.30 and 2.22 with improved practice and farmers' practice, respectively. Thus, it is evident from the above results the safflower growers of our country must adopt the improved package of practices as suggested and demonstrated above in order to obtain high yields and maximum monetary benefits.

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Productivity and Profitability of Maize-Chickpea Sequence as Influenced by Integrated Nutrient Management and its Residual Effect on Soil Health

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ABSTRACT

An experiment was conducted at AICRP on Cropping Systems Research, Dr. PDKV, Akola from 2003-04 to 2005-06 to study the productivity and profitability of maize-chickpea cropping sequence as influenced by INM. Considering productivity, monetary gain and soil fertility build up application of 3/4th recommended NPK through fertilizer and 1/4th recommended N through leucaena lopping coupled with azatobacter application to maize was found beneficial. Application of ½ recommended dose of NPK to succeeding chickpea has enhanced its yield.

Integrating chemical fertilizers with organic manures has been found to be quite promising not only in maintaining higher productivity but also in providing greater stability in crop production (Nambier and Abrol, 1992). Farmyard manure is being used as a major source of organic manure in field crops since ancient times. Limited availability of FYM is, however, an important constraint in its use as source of nutrients.

Escalating cost of inorganic fertilizer on one hand and their undesirable impact on the physical condition of soil on the other call for immediate inclusion of organic sources in crop production. Due to wide use of short- statured high–yielding varieties and hybrids in different crops, the availability of crop residues as organic manures. Green manuring is the most efficient agronomic practices for stimulating various biological transformations in the soil leading to improved soil fertility.

Due to inadequate use of organic sources and continuous imbalanced use of inorganic nutrients, the yield levels of many crops are showing a declining trend in recent years. INM with leucaena lopping seems to be appropriate to augment in generation of organic matter to improve soil productivity. An effort was made in this investigation to study the effect of integrated nutrient management with LL and biofertilizer in maize-chickpea cropping sequence.

MATERIAL AND METHODS

An experiment was conducted at AICRP on Cropping Systems Research, Dr. P.D.K.V., Akola during 2003-04, 04-05 and 05-06. It was arranged in split plot design with eight treatments of INM for maize replicated thrice. The treatments consisted of application ½ RDF (T_1), T_1 + application of ½ recommended N through LL (T_2), T_2+ Azatobacter seed treatment (T_3), application of 3/4 th RDF (T_4), T_4 coupled with application of 1/4th recommended N through LL (T_5), T5+ Azatobacter seed treatment (T_6), application of RDF (T_7) and control (T_8) allotted to main plots. Control and ½ RDF to chickpea were allotted to sub plots in *Rabi* season. Recommended doses of fertilizer for maize and chickpea utilized were 120:60:30 and 25:50:0 kg NPK ha^{-1}, respectively.

The soil of experimental site was clayey, neutral in reaction with low to moderate in organic carbon, medium in available N (180 kg ha^{-1}), low in available P (28.20 kg ha^{-1}) and high in available K (285 kg ha^{-1}). Maize (Ajay) and chickpea (AKG-46) were raised with recommended package of practices except fertilizer dressing. Half of nitrogen, complete P and K, as per treatments were applied to maize at sowing and remaining half nitrogen one month after that. Leucaena lopping were spread on both the sides of crop row 15 days after crop emergence as per treatments. Complete NP was given to chickpea at sowing as per treatments.

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Rainfall received during crop season (June to April) during 2003-04, 2004-05 and 2005-06 were 369.1,538.9 and 808.6 mm, respectively.

RESULTS AND DISCUSSION

Grain Yield:

Application of recommended dose of fertilizer to maize (T7) has recorded the highest mean grain yield of 37.74 q ha^{-1} (Table 1). It was at par with the yield recorded due to INM treatment of 3/4 th recommended dose of NPK through fertilizer + ¼ rec. N through LL + azatobacter application (T6) but significantly superior over rest of the INM treatments. The INM treatment T6 recorded the maize grain yield at par with T5 i.e. 3/4th RDF+ 1/4th rec. N through LL but was significantly superior over T1 to T4. Sharma and Gupta (1998) has reported that integration of 3/4th recommended N through fertilizer and 1/4th through subabhul recorded equal yield to recommended NPK in maize. Mean grain yield of succeeding chickpea was significantly enhanced due to application of half recommended dose over no fertilizer application. This conforms the findings of Khandkar *et al.* (1986).

Maize grain equivalent yield:

The highest mean maize grain equivalent yield (59.74 q ha^{-1}) was recorded (Table 1) with the application of recommended dose of NPK through fertilizer (T7). It was closely at par with INM treatment T6 and both were significantly superior over rest of the treatments (T1 to T5).

Monetary return and B: C ratio:

Application of 3/4th RDF and 1/4th recommended N through LL (T6) has recorded the highest mean GMR (Table 3). It was closely followed by RDF (T7) and both were significantly superior over rest of the treatments. More or less similar trend was recorded in case of NMR and B: C ratio. Application of ½ RDF to

Table 1: Grain yield of maize and chickpea and maize grain equivalent yield (q ha^{-1}) as affected by different treatments.

Treatments	Maize				Chickpea				Maize grain equivalent			
	03-04	04-05	05-06	Mean	03-04	04-05	05-06	Mean	03-04	04-05	05-06	Mean
Main plot												
T1	25.90	24.10	14.06	21.35	9.04	9.00	12.87	10.31	40.53	37.32	51.94	43.26
T2	31.39	34.72	15.45	27.19	9.51	8.84	13.31	10.56	46.78	47.71	54.58	49.69
T3	30.89	39.08	19.42	29.80	10.15	8.23	13.42	10.59	47.30	51.17	58.81	52.43
T4	30.54	34.92	23.13	29.53	8.80	9.13	13.23	10.39	44.76	48.33	62.02	51.70
T5	32.56	35.91	25.69	31.38	10.63	9.46	12.60	10.89	49.74	49.80	62.71	54.08
T6	38.01	39.58	27.88	35.16	11.70	8.92	13.69	11.44	56.92	52.68	68.11	59.24
T7	40.03	43.35	29.84	37.74	10.90	9.17	11.88	10.65	57.65	56.82	64.75	59.74
T8	18.03	19.54	8.75	15.44	8.75	7.70	9.79	8.77	32.18	30.97	37.52	33.56
CD at 5%	4.66	7.43	2.21	4.01	1.54	0.87	NS	NS	6.35	7.50	9.54	4.34
Sub plot												
F 0	30.03	32.04	20.18	27.65	8.95	8.13	12.05	10.07	44.51	43.98	55.62	48.03
F 50	31.80	35.75	20.87	29.25	10.92	9.51	13.15	10.83	49.46	49.72	59.49	52.89
CD at 5%	0.63	1.36	0.66	1.08	0.50	0.46	0.85	NS	0.90	1.45	2.58	2.28

Table 2: Straw yield of maize and chickpea (q ha-1) as affected by different treatments.

Treatments	Maize			Chickpea		
	03-04	04-05	05-06	03-04	04-05	05-06
Main plot						
T1	42.40	53.57	47.19	10.96	10.57	22.68
T2	45.14	44.84	52.64	10.44	10.86	22.86
T3	50.57	59.52	54.47	10.60	10.23	24.40
T4	51.26	5.59	55.29	10.75	11.01	24.57
T5	56.42	52.08	56.27	10.99	11.81	24.91
T6	63.30	66.78	58.09	11.44	11.06	27.03
T7	53.05	71.42	61.72	10.97	11.58	30.39
T8	25.36	30.75	43.56	7.33	9.84	22.50
CD at 5%	14.12	13.15	NS	0.76	NS	NS
Sub plot						
F 0	45.13	46.69	53.31	9.08	10.48	23.35
F 50	51.74	60.70	54.00	11.78	11.26	26.48
CD at 5%	0.88	1.98	NS	0.75	0.57	2.50

Table 3: Total GMR, NMR and B: C ratio as affected by different treatments.

Treatments	Total GMR (Rs ha^{-1})				Total MR (Rs ha^{-1})				B: C ratio			
	03-04	04-05	05-06	Mean	03-04	04-05	05-06	Mean	03-04	04-05	05-06	Mean
Main plot												
T1	35352	34268	37560	35726	16601	15517	18809	16975	1.89	1.83	2.00	1.90
T2	39227	38041	39878	39049	18596	17410	19247	18418	1.90	1.84	1.93	1.89
T3	40885	41456	42622	41654	20049	20619	21786	20818	1.96	2.00	2.04	2.00
T4	38665	39439	44566	40886	19241	20025	25152	21472	1.99	2.03	2.29	2.10
T5	43455	40715	45120	43097	23101	20361	24767	22743	2.13	2.09	2.21	2.14
T6	49041	43890	48549	47160	28679	23528	28187	27128	2.40	2.27	2.38	2.35
T7	47074	46879	47361	47105	26996	26801	27284	27027	2.34	2.30	2.35	2.33
T8	27867	26715	28863	27815	10444	9293	11440	10392	1.60	1.54	1.65	1.59
CD at 5%	5005	4572	5063	2315	5005	4572	5063	2160	0	0	0	0
Sub plot												
F 0	37504	35905	40590	38816	17446	15847	21185	18812	1.92	1.79	1.91	1.87
F 50	42884	41946	43040	41807	23480	22541	22982	22431	2.13	2.16	2.14	2.14
CD at 5%	727	1010	1438	2257	727	1012	1438	2244	0	0	0	0

Table 4: Balance sheet for available NPK (kg ha^{-1}) as affected by different treatments.

Treatments	Initial status of soil 03-04			Status at the end 05-06			Net gain (+) / Net loss (-)		
	N	P	K	N	P	K	N	P	K
Main plot									
T1	180	28.20	285	188.16	28.40	289.11	8.16	0.20	4.11
T2	180	28.20	285	195.36	28.41	292.31	15.36	0.21	7.31
T3	180	28.20	285	198.32	28.88	307.10	18.32	0.68	22.10
T4	180	28.20	285	195.36	29.52	314.65	15.36	1.32	29.65
T5	180	28.20	285	217.78	30.01	315.84	37.78	1.81	30.84
T6	180	28.20	285	230.32	30.98	320.15	50.32	2.78	35.15
T7	180	28.20	285	235.76	31.32	325.18	55.7	3.12	40.18
T8	180	28.20	285	182.04	27.28	286.29	2.04	-0.92	1.29
Sub plot									
F 0	180	28.20	285	188.41	25.76	294.71	8.41	-2.44	9.71
F 50	180	28.20	285	222.36	32.93	317.94	42.36	4.73	32.94

succeeding chickpea has significantly enhanced the GMR and NMR and improved B: C ratio. Similar monetary benefit was recorded by Mishra et al (1998).

Nutrient balance sheet:

There was gain in available N content (Table 4) of soil in all the treatments. However, the highest gain was in treatment T7 and it was closely followed by T6. In all the treatments, except control there was increase in available P content of soil. The highest increase was in T7 and it was followed by INM treatment T6. The trend in available K content of soil was similar to N content.

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Efficacy and Dissipation of Chlorpyrifos and Chlorpyrifos-Methyl Against Pests of Brinjal

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ABSTRACT

Studies on efficacy of chlorpyrifos (Dursban 20EC)and chlorpyrifos-methyl (Reldan 50 EC) were undertaken against pests of brinjal *viz;* jassid, whitefly and fruit borer in comparison to monocrotophos and endosulfan. Each pesticide treatment consisted of three sprays given at an interval of about 15 days at the doses of 250, 500 and 750 g a.i.ha^{-1} by initiating the first spray 5 weeks after transplanting. Both the pesticides significantly reduced the infestation of jassids, whiteflies and fruit borers on brinjal, but effectiveness was better only in respect of higher doses of chlorpyrifos (750 g a.i. ha^{-1}) and chlorpyrifos-methyl (750 g a.i. ha^{-1}). Also chlorpyrifos and chlorpyrifos-methyl were studied for the residues on brinjal fruits after their spray treatment. Dissipation studies on brinjal suggest the waiting period of 8 and 9 days after spraying of chlorpyrifos and chlorpyrifos-methyl , respectively.

Maximum yield of 155.8 q ha^{-1} was obtained in respect of spray treatment of 750 g a.i. ha^{-1} chlorpyrifos-methyl followed by 750 g a.i ha^{-1} chlorpyrifos (148.0 q ha^{-1}).

Brinjal (*Solanum melongena* Linnaeus) is an important vegetable crop cultivated throughout the warmer region of the world. It suffers heavily due to incidence of jassids (*Amrasca biguttula biguttula* Ishida), whitefly (*Bemisia tabaci* Gennadius) and shoot and fruit borer (*Leucinodes orbonalis* Guenee1987). Infestation of shoot and fruit borer can reach to the extent of 70 to 90 per cent (Singh, 1983) and mostly higher in *Kharif* season in summer (Pawar *et al.*1987), Losses due to sucking pests vary from 10 to 50 per cent depending on the intensity of infestation. Several pesticides from organochlorine, organophosphate, carbamate and synthetic pyrethroid groups have been used to control pests of brinjal. However, the work on chlorpyrifos and chlorpyrifos-methyl is limited. Hence, it was proposed to study their efficacy and residues against jassid, whitefly and fruit borer infesting summer crop of brinjal.

MATERIAL AND METHODS

A field experiment was planned in a randomized block design with three replications in treatment plot of 4.6x 3.6 m by transplanting the seedlings of brinjal "Krishna" on September 5, 2001. Chlorpyrifos (Dursban 20 EC) and chlorpyrifos-methyl (Reldon 50 EC) were evaluated as spray treatment at doses of 250, 500 and 750 g a. i.ha ha^{-1} spray^{-1}. These pesticides were compared with monocrotophos and endosulfan (@ 250 g a. i. ha^{-1}). Each spray treatment consisted of three sprays given at an interval of 15 days by initiating the first spray on appearance of incidence of jassids which was noticed during sixth week after transplanting. The count was recorded on 3rd , 7th and 14th day after spray. Only nymphs of jassids and whiteflies were counted on five randomly selected plants from each treatment plot. On each plant three leaves each from top, middle and bottom portions of the plant were observed to note the pest count. Per cent infestation of brinjal fruits due to shoot and fruit borer on number and weight basis was recorded at each plucking. For determination of residues on the brinjal fruits, edible quality fruits were harvested after third spray at an interval of 0 (2 h.), 1, 3,5,7 and 10 days. Residues of both the pesticides were estimated by Gas-Liquid Chromatograph equipped with Electron Capture Detector at the detectable limit of 0.05 ppm. Average recovery from the fortified samples of fruits at 0.5 ppm level was 87.8 and 89.6 per cent in case of chloropyrifos and chlorpyrifos-methyl, respectively. Yield of healthy

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fruits recorded from each plot was taken for comparison of treatment effect.

RESULTS AND DISCUSSION

Jassid : The average population count of jassids in untreated crop (5.54) was significantly higher than the population noticed on sprayed crop. The data based on the cumulative effect of total spray schedule of three sprays are given in Table 1. The count in treated crop was in the range of 2.67 to 4.16. Among various pesticides treatments chlorpyrifos-methyl at 750 g a.i. ha^{-1} was most effective recording the lowest average count of 2.67 jassids. The next better treatments were 750 g a.i. ha^{-1} chlorpyrifos, 250 and 500 g a.i. ha^{-1} chlorpyrifos-methyl and 250 g a.i. ha^{-1} monocrotophos. However, all the spray treatment were on par,

Table 1 : Cumulative effect of different treatments on population of jassids on brinjal

Treatments	Doseg a.i.ha^{-1}	Number of jassids 3 leaves^{-1} plant^{-1}							
		I spray		II spray		III spray		Mean	
		A	T	A	T	A	T	A	T
Chlorpyrifos	250	4.74	2.29	3.96	2.11	3.78	2.05	4.16	2.15
Chlorpyrifos	500	4.48	2.23	3.63	2.03	3.29	1.92	3.80	2.06
Chlorpyrifos	750	3.81	2.05	3.18	1.92	2.63	1.75	3.21	1.91
Chlorpyrifos-methyl	250	4.00	2.12	3.52	2.00	3.15	1.79	3.56	1.97
Chlorpyrifos-methyl	500	3.93	2.10	3.30	1.93	2.52	1.73	3.25	1.92
Chlorpyrifos-methyl	750	3.26	1.92	2.92	1.85	2.11	1.59	2.67	1.79
Monocrotophos	250	3.63	2.03	3.11	1.89	3.00	1.87	3.25	1.93
Endosulfan	250	3.96	2.11	3.33	1.95	3.26	1.94	3.52	2.00
Control	——	6.66	2.67	5.15	2.38	4.81	2.31	5.54	2.45
S.E. (m) ±			0.07		0.09		0.06		0.03
C.D. at 5%			0.22		0.26		0.19		0.10

A=Natural count T= Transformed value

Table 2 : Cumulative effect of different treatments on population of white fly on brinjal

Treatments	Doseg a.i.ha^{-1}	Number of white flies 3 leaves^{-1} plant^{-1}							
		I spray		II spray		III spray		Mean	
		A	T	A	T	A	T	A	T
Chlorpyrifos	250	3.48	1.96	3.86	2.10	4.48	2.23	3.94	2.10
Chlorpyrifos	500	3.33	1.92	3.64	2.04	3.90	2.12	3.62	2.03
Chlorpyrifos	750	2.31	1.80	3.14	1.92	3.44	1.98	3.18	1.90
Chlorpyrifos-methyl	250	2.92	1.81	3.52	2.90	3.78	2.07	3.41	1.96
Chlorpyrifos-methyl	500	2.63	1.74	2.90	1.84	3.18	1.95	2.90	1.84
Chlorpyrifos-methyl	750	2.63	1.72	2.55	1.74	2.86	1.84	2.68	1.77
Monocrotophos	250	2.89	1.69	3.29	1.95	3.26	1.93	3.70	1.86
Endosulfan	250	3.22	1.89	3.58	2.11	4.44	2.23	3.05	2.08
Control	——	4.70	2.28	5.11	2.37	6.19	2.59	5.33	2.45
S.E. (m) ±			0.07		0.09		0.08		0.04
C.D. at 5%			0.20		0.27		0.24		0.12

A=Natural count T=Transformed value

effectiveness was only better in respect of higher doses of chlorpyrifos-methyl (750 and 500 g a.i plant^{-1}) ,chlorpyrifos (750 g a.i. plant^{-1}). At the same time there was no prominent difference with the efficacy of monocrotophos against sucking pests. This is quite obvious as both the evaluated pesticides are not systemic insecticides as that of monocrotophos. Sawant and Dethe (2001) reported effectiveness of chlorpyrifos as well as chlorpyrifos-methyl at the dose of 0.5 and 0.75 kg a.i. ha^{-1} against sucking pests and fruit borer. In studies conducted by Singh *et.al.* (1996) chlorpyrifos was found effective against jassids at lower concentrations of 0.03 percent, which is not noticed in the present study. Deka and Saharia (1981) obtained effective control of fruit borer due to spraying of 0.75 kg a.i. ha^{-1} chlorpyrifos, but these workers used only two sprays at an interval of 3 weeks.

White fly : The cumulative data of mean counts for three sprays are given in Table 2, the mean population (5.33) in untreated crop was significantly higher than in all the treatments. The lowest count in chlorpyrifos-methyl 750 g a.i. ha^{-1} was on par with its treatment at lower dose of 500 g a.i. ha^{-1} and monocrotophos 250 g a.i. ha^{-1}.

Fruit borer : The data on assessment of chemical treatments against fruit borer on the basis of per cent infestation are presented in Table 3. Untreated crop showed fruit infestation of 39.97 and 39.52 per cent on the basis of number and weight, respectively. All chemical treatments were significantly effective in minimizing the fruit damage. On the basis of number, chlorpyrifos-methyl 750 g a.i. ha^{-1} proved most effective (22.22%) but it was on par with at lower dose 500 g a.i. ha^{-1}, chlorpyrifos 750 g a.i. ha^{-1}, endosulfan 250 g a.i. ha^{-1} and monocrotophos 250 g a.i. ha^{-1}. Even on weight basis these treatments except endosulfan showed similar performance in minimizing the damage of fruit borer. Sawant and Dethe (2001) reported effectiveness of chlorpyrifos as well as chlorpyrifos-methyl at the dose of 0.5 and 0.75 kg a.i. ha^{-1} against sucking pests and fruit borer. Deka and Saharia (1981) obtained effective control of fruit borer due to spraying of 0.75 kg a.i. ha^{-1} chlorpyrifos. As against yield of 96.3 q ha^{-1} in untreated plots, the yields were in the range of 116.5 to 155.8 q ha^{-1} in treated plots. Maximum yield was recorded in spray treatment of chlorpyrifos-methyl at 750 g a.i. ha^{-1} (155.8 qha^{-1}) followed chlorpyrifos at 750 g a.i. ha^{-1} (148.0 q ha^{-1}).

Table 3. Effect of different treatments on infestation on brinjal fruits and yield

Treatments	Doseg a.i.ha^{-1}	% infested fruits				Yield	
		No. basis		Wt. basis		Kgplot^{-1}	Q ha^{-1}
		A	T	A	T		
Chlorpyrifos	250	29.78	33.03	32.13	34.50	13.98	116.5
Chlorpyrifos	500	28.33	32.03	29.38	32.77	15.68	130.7
Chlorpyrifos	750	22.74	28.44	27.30	31.46	17.76	148.0
Chlorpyrifos-methyl	250	29.54	32.86	32.39	34.65	14.62	121.8
Chlorpyrifos-methyl	500	27.60	31.63	28.74	32.33	16.78	139.8
Chlorpyrifos-methyl	750	22.22	28.02	24.41	29.58	18.70	155.8
Monocrotophos	250	27.22	31.37	31.22	33.88	15.73	131.1
Endosulfan	250	25.62	30.30	28.69	31.30	16.18	134.8
Control	--	39.97	39.30	39.52	38.91	11.55	96.3
S.E. (m) ±		--	1.18	--	0.99	0.42	3.5
C.D. at 5%		--	3.53	--	2.96	1.26	10.47

A=Natural count T= Arcsin transformation

Dissipation of chlorpyrifos : Levels of residues obtained in brinjal fruits plucked at 0, 1, 3, 5, 7 and 10 days after third spray are given in Table 4. At the normal spray doses of 250,500 and 750 g a.i. ha^{-1}. the initial residues were 1.07,1.45 and 2.56 ppm, respectively. These levels dissipated to the maximum residue limit (MRL) of 0.2 ppm in 4.03, 5.28 and 7.15 days, respectively. However, at higher dose of 1000 g a.i. ha^{-1} initial residues of 2.86 ppm reached MRL in 9.17 days. The residues half-life was in the range of 1.73 to 2.29 days. Initial residues reached below detectable limit (BDL) of 0.05 ppm in 7.49, 8.90, 9.82 and 13.75 days in crop sprayed at the dose of 250, 500, 750 and 1000 g a.i. ha^{-1}, respectively. Considering the dissipation of residues on brinjal fruits in crop sprayed at commonly used dose of 250 to 750 g a.i. ha^{-1}, a waiting period of 5 to 8 days can be considered safe to consumers.

Dissipation of Chlorpyrifos-methyl : The data on dissipation of residues of chlorpyrifos-methyl on brinjal fruits after third spray are presented in Table 5. At normal dose of 250, 500, and 750 g a.i. ha^{-1}, the initial residues were 1.17, 1.57 and 2.47 ppm, which dissipated to MRL of 0.1 ppm in 6.58, 6.99 and 8.76 days, respectively. At higher dose of 1000 g a.i. ha^{-1}, the initial residues of 3.0 ppm took 10.22 days to reach the MRL. Taking into account normally used dose in the range of 250 to 750 g a.i. ha^{-1} against crop pests, a waiting period of 7 to 9 days can be considered appropriate after spraying brinjal crop during fruit bearing stage.

In dissipation studies, by Sawant and Dethe (2001) a waiting period of 6 to 7 days has been worked out at the dose of 0.75 kg a.i. ha^{-1} Chloropyrifos and Chloropyrifos-methyl. In view of of harvesting practice, the waiting periods worked out by these workers would also be problematic. Persistence period of 10 days reported by Patel *et.al.* (1999), due to use of 0.04 to 0.08 percent chlorpyrifos is also not safe to consumers. Hence, it is suggested from the present investigation that, spraying of chloropyrifos and chlorpyrifos-methyl should be avoided in fruit bearing stage of the crop, as the crop growers pluck the fruits at 2 to 3 days interval.

Table 4 : Dissipation of chlorpyrifos on brinjal fruits

Days after last spray	*Mean residues in ppm (± S.D.)			
	Dose of chlorpyrifos 20 EC for spray (g a.i.ha^{-1})			
	250	500	750	1000
0	1.07 (0.02)	1.45 (0.02)	2.56 (0.04)	2.86 (0.03)
1	0.65 (0.02)	0.97 (0.01)	1.93 (0.03)	2.43 (0.03)
3	0.33 (0.01)	0.52 (0.03)	0.88 (0.03)	1.62 (0.02)
5	0.13 (0.01)	0.26 (0.01)	0.42 (0.04)	0.67 (0.03)
7	BDL	0.09 (0.03)	0.23 (0.02)	0.35 (0.02)
10	BDL	BDL	0.08 (0.02)	0.16 (0.01)
Reg. equation	y=3.0050-0.1745x	y=3.1791-0.1664 x	y=5.9840-0.5151 xy=3.5077-0.1316 x	
RL_{50} (days)	1.73	1.81	1.98	2.29
T_{MRL} (days)	4.03	5.28	7.15	9.17
T_{BDL} (days)	7.49	8.90	9.82	13.75

* Means of three replicates (± standard deviation of mean)
MRL- Maximum residue limit of 0.2 ppm.
BDL- Below detectable level .05 ppm.

Table 5. Dissipation of chlorpyrifos-methyl on brinjal fruits

Days after last spray	*Mean residues in ppm (± S.D.)			
	Dose of chlorpyrifos-methyl 50 EC for spray (g a.i.ha^{-1})			
	250	500	750	1000
0	1.17 (0.03)	1.57 (0.04)	2.47 (0.05)	3.00 (0.09)
1	0.75 (0.04)	1.05 (0.03)	2.00 (0.05)	2.57 (0.08)
3	0.48 (0.02)	0.56 (0.02)	1.00 (0.05)	1.71 (0.03)
5	0.22 (0.02)	0.22 (0.02)	0.48 (0.04)	0.74 (0.03)
7	0.07 (0.01)	0.09 (0.01)	0.18 (0.02)	0.28 (0.02)
10	BDL	BDL	0.06 (0.01)	0.10 (0.02)
Reg. equation	y=3.0943-0.1662 x	y=3.2173-0.1742 x	y=3.4232-0.1658 x	y=3.5726-0.1538 x
RL_{50} (days)	1.73	1.81	1.82	1.86
T_{MRL} (days)	6.58	6.99	8.76	10.22
T_{BDL} (days)	3.39	8.72	10.58	12.18

* Means of three replicates(± standard deviation of mean)

MRL- Maximum residue limit of 0.1 ppm.

BDL- Below detectable level of 0.05 ppm.

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Seasonal Incidence of *Spodoptera litura* and Influence of Weather Parameters on its Abundance on Cauliflower

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ABSTRACT

The *Spodoptera litura* attack the Cauliflower from in the middle crop stage and remain in field till the maturity of the crop during 2002-03 and 2003-04. The population increases from 49th Meteorological Week during until 2nd Meteorological Week in 2002-03 and 3rd Meteorological Week during 2003-04. The peak population was attain during 1st meteorological week as 52.32 larvae 10plant^{-1} during 2002-03 and 54.21 larvae 10plant^{-1} in 2003-04. The influence of the biotic factors on pest incidence varied with the cropping season.

The *S. litura* have been identified as the major constraints in increasing productivity of cauliflower. In Maharashtra, among the pests of attacking cauliflower *S. litura* in the most important pest causing great losses to the crop productivity. Literature released meager information on population build up of this pest.

The studies on population dynamics provide reliable estimate of field population densities of pests which is the primary need in pest management, ultimately it gives an idea of population patterns and seasonal activity. The emerging concepts of pest management embodies the idea that knowledge of seasonal incidence of different pests of cauliflower at different growth stages of the crop and its relation with weather parameters will be of great use to plan appropriate control strategies. The workers like Narsimhamurthy *et al.* (1998) and Mustafa and Mashal (1994) have already attempted to study the distribution pattern of major pests of cauliflower. Thus the present investigation are therefore carried out to study the impact of weather factors on the population fluctuation of the *S. litura* on cauliflower in Marathwada region of Maharashtra.

MATERIAL AND METHODS

For the study of population dynamics of *S. litura* on cauliflower (var. snowball -16) the crop was sown in October and transplanted in November during till consecutive years (2002 and 2003) in four quadrates measuring 10 m^2 in experimental field of Deptt. of Horticulture. M.A.U. Parbhani.

The inter and intra raw spacing of 60 X 45 cm. was maintained. A gap of 1 m. was maintained among the plot. The crop was raised without any insecticidal treatment so that population of pest and its natural enemies could build-up freely. Observations were made at weekly intervals right from 46th meteorological weeks and continue till 10th MW of second year number of larvae were counted from the randomly selected plants. Daily records of a biotic factors such as maximum and minimum temp., relative humidity, total rainfall, sunshine hours that prevailed during the period of field experimentation were collected from the meteorological Deptt. of M.A.U., Parbhani.

The data thus collected were computed and subjected to correlation analysis in order to find out the relationship of environmental factors with the population density of insect pest.

RESULTS AND DISCUSSION

A) Incidence of *Spodoptera*

The data on incidence of *Spodoptera* on cauliflower are presented in Table 1.

During the first season 2002-03 incidence of *Spodoptera* (4.12 larvae/10 plants) was first noticed in 47th MW. The *Spodoptera* population was found increasing upto 1st MW and reached its peak during the same 1st MW (52.32 larvae/10plants) and started declining upto 10th MW (1.75 larvae/10 plants).

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Table 1. Incidence of *S. litura* during 2002-03 and 2003-04.

MW	Population per ten plants	
	2002-03	2003-04
46	0.00	0.00
47	4.12	2.15
48	7.32	4.17
49	13.87	19.10
50	16.05	17.92
51	12.95	29.10
52	23.20	28.32
1	52.32	33.12
2	38.10	20.37
3	30.50	54.22
4	29.25	50.12
5	11.67	49.72
6	11.45	32.13
7	10.87	17.12
8	14.32	8.22
9	5.02	3.22
10	1.75	1.22

During the second season 2003-04 incidence of *Spodoptera* (2.15 larvae 10 plants^{-1}) was first observed during 47th MW. The *Spodoptera* population was found increasing upto 3rd MW (54.2 larvae 10 plants^{-1}) and it started decline upto 10th MW (1.22 larvae10 plants^{-1}).

Devjani and Singh(2002) reported that *S. litura* occurred in Feb.-March in late season on cauliflower. Surender Kumar *et al.* (1998) reported that *S. litura* was the major cauliflower pest and present throughout crop growth period. Nandihalli *et al.* (1989) reported that the *S. litura* was active throughout the year particularly large population in July-January. Lee (1989) revealed that the peak numbers of *S. litura* were trapped between December and January. Mishra and Sontakke (1992) reported three peaks in late August, late November and mid December during one year and late June, early September and early October in another year.

Narasimhamurthy *et al.* (1998) reported that December month was more favourable for multiplication of *S. litura.*

Ong and Soon (1989) reported that the cool temperature and high relative humidity was ideal for quick multiplication of *S. litura.* the incidence of *S. litura* varied from region to region according to climatic conditions and crop use pattern. However, the literature pertaining to incidence of *S. litura* by earlier worker are more or less in conformity of present findings.

B) Correlation between weather parameters and *Spodoptera* population

The correlation coefficient between weather parameters and population of *Spodoptera* are presented in Table 2 and Fig.1.

a) Correlation of *Spodoptera* and weather parameters during 2002-03

The data from the Table 2 indicates that there is significant negative correlation of *Spodoptera* with maximum temperature (-0.621) and bright sunshine hours (-0.590). However, correlation with rainfall (-0.134), rainy days (-0.092), minimum temperature (-0.144) were negative but non-significant. The non-significant positive correlation was observed with

Table 2. Correlation coefficient between weather parameters and *Spdoptera litura* population.

Abiotic factors	2002-03	2003-04	Pooled
Rainfall (mm)	-0.134	-0.042	-0.078
Rainy days	-0.092	-0-.042	-0.035
Temperature maximum (°C)	-0.621*	-0.531**	-0.574**
Temperature minimum (°C)	-0.144	-0.271	-0.238
Humidity (a.m.)	0.241	0.363	0.321**
Humidity (p.m.)	0.410	0.513**	0.502**
Bright sunshine (hrs)	-0.590*	-0.506**	-0.509**
No. of observations	17	16	33

** Significant at 5 %. * Significant at 1 %.

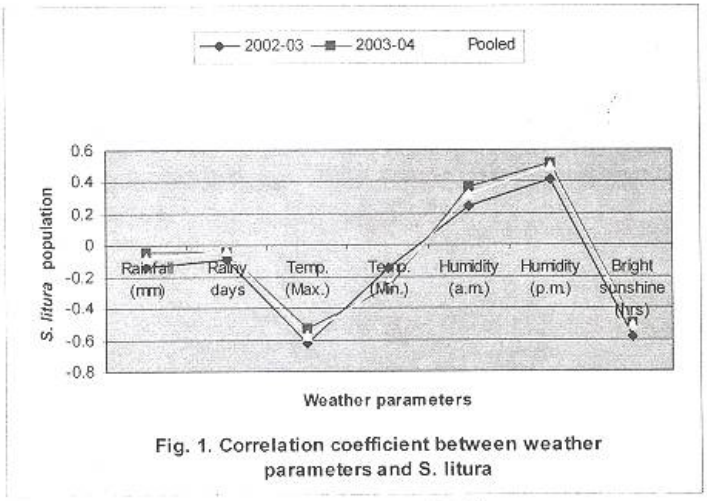

Fig. 1. Correlation coefficient between weather parameters and S. litura

Fig. 1 : Seasonal incidence of *S. litura*

morning relative humidity (+0.241) and evening relative humidity (+0.410).

b) Correlation of *Spodoptera* and weather parameters during 2003-04

The data from the Table 2 indicates that there is significant negative correlation with maximum temperature (-0.531) and bright sunshine hours (-0.506). The correlation with rainfall (-0.042), rainy days (-0.042), minimum temperature (-0.271) were negative but non-significant. There is positive significant correlation with evening relative humidity (+0.513), however, *Spodoptera* population was positively but nonsignificantly correlated with morning humidity (+0.363).

c) Correlation of *Spodoptera litura* and weather parameters during 2002-03 and 2003-04 (pooled)

During 2002-03 and 2003-04, the pooled data from Table 2 on correlation indicate that there is significant negative correlation with maximum temperature (-0.574) and bright sunshine hours (-0.509).

The correlation with rainfall (-0.078), rainy days (-0.035) and minimum temperature (-0.288) were negative but non-significant. The correlation with evening humidity was positive (+0.502) and significant. However, morning humidity was positively correlated but non-significant.

Earlier researcher like Narsimhamurthy (1998) reported positive non-significant correlation with morning relative humidity and negative non-significant correlation with evening relative humidity, maximum and minimum temperature.

Nandihalli (1989) reported the negative correlation between *S. litura* and morning relative humidity, maximum and minimum temperature. Lee (1989) reported that high temperature and humidity reduced number trapped in mid June and October. Kharub *et al.* (1996) reported that the maximum and minimum temperature (33.8 °C and 18.6 °C, respectively) and 61 per cent relative humidity were conducive for the development of *S. litura*.

Mahalingam *et al.* (2003) stated that total rainfall had no influence on trap catches throughout the study period. The maximum temperature and minimum temperature had positive association during two different winter seasons and the relative humidity influenced positively during rainy season and negatively during winter season. As the ecofactors prevailing in different ecosystem exert profound effect on pest population

buildup, the result may be vary at different regions. However, the results obtained in present studies are in conformity with findings of earlier workers.

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Effect of Organic and Inorganic Nutrients Coupled with Biofertilizer on Growth, Yield and Quality of Nagpur Mandarin

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ABSTRACT

A field experiment was conducted during 1999-2000 to 2005-2006 to study the effect of organic and inorganic nutrients with biofertilizers on Nagpur mandarin. Results indicated that, three applied with 50kg FYM+10kg neem cake influenced the fruit yield during *Ambia* and *Mrig Bahar*. Desirable parameters of physico-chemical characteristics of fruits were also exhibited due to the application of organic manures, inorganic manures, inorganic and bio-fertilizers.

The organic manure plays a very important role in maintaining soil productivity.Oil cakes incresed organic carbon, phosphorous content in the soil. Edible oil cakes released more inorganic nitrogen from soil than nonedible cakes. Nonedible oil cakes liberated available phosphorus from soil in greater proportions than edible oil cakes. Karanj and neem cakes being nonedible are used exclusively as manure in fruit crops. Among these, neem cake is very popular with our farmers cultivating fruit crops. It is nonedible concentrated organic manure, easily available and contains high amount of nitrogen and organic carbon. They also retard nematode population in soil, if present in hazards amount,Gandhi (1956) has also recommended the utility of oil cakes in fertilizer mixtures. Citrus is a nutrient sensitive and responsive plant and it requires adequate nutrition for proper growth and development (Ghosh 1990).

MATERIAL AND METHODS

The present investigation was carried out on twelve years old Nagpur mandarin plants of uniform growth and vigor at Regional Fruit Research Station, Katol, Distt. Nagpur. The general characteristics of experimental soil and chemical preperties of neem cake, FYM and sunhemp have been mentioned along with treatment details (Tables 1). The finely ground and well powdered neem cake was used. The PSB was applied 20 g tree^{-1}. All the fertilizers and organic manures were applied in the month of June. The treatments were applied in randomized block design with three replications having two plants under each treatment. Growth of plant, number of fruits plant^{-1} were counted. Physico- chemical characters of fruits were measured.

Table1. General characteristics of experimental soil

Soil status	Initial	Final
Bulk density g cm^{-1}	1.56	1.54
p^{H}	7.3	7.1
EC dsm^{-1}	0.35	0.32
Organic carbon (%)	0.52	0.54
Available P_2O_5 kg ha^{-1}	46	49
Available k_2o kg ha^{-1}	430	439

Chemical analysis of FYM, neem cake and sunhemp

	N.	P.	K.
FYM	0.84	0.59	1.35
Neem cake	4.48	0.85	1.85
Sunhemp	2.24	0.87	0.85

Treatment details

T_1 1200 gN + 400g p_2o_5 + 400

T_2 900g N +300g p_2o_5 + 300 g k_2o + 50kg FYM

T_3 50 KG FYM

T_4 50 kg FYM +10 KG neem cake

T_5 50 kg FYM + showing of sunhemp around the basin (rainy and summer season)

T_6 900 g N + 300 g p_2o_5 + 300 g k_2o +50 kg FYM + PSB (20 g tree^{-1})

T_7 50 kg FYM + PSB (20 g tree^{-1})

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RESULTS AND DISCUSSION

Table 2 revealed that tree volume of Nagpur mandarin was not signfucantly influenced by different treatment of manuring. But in respect of fruit yield during *Ambia* and *Mrig bahar* signficantly higher fruit yield (395.6 and 356.5, respectively) was obtained from the trees applied with T4 (50kg FYM + 10kg neem cake). These results conform the the findings of Rokba *et at* (1975).

Physico- chemical characteristics of fruits

All the physico-chemical aspects of Nagpur mandarin viz. weight of fruit, height and diameter of fruit, juice percentage, total solube solid, acidity in *Ambia* and *Mrig Bahar* could not be influenced signficantly by various treatment combinations (Table 3 ane 4). However, the desirable parameters were exhibited by T4. The present investigation is in the line of findings of Rokba *et al.*(1975) and Tiwari *et al.* (1999).

Table 2. Tree volume and yield of Nagpur mandarin as influenced by different treatment of nutuients (pooled results of 1999-2000 to 2005-2006).

Treatment	Tree volume (cu.m.)	Fruit yield (No.) in Ambia Bahar	Fruit yield (No.) in Ambia Bahar
T1	46.69	372.4	324.7
T2	45.57	344.8	306.6
T3	45.85	311.2	304.5
T4	44.73	395.6	356.5
T5	45.08	358.6	265.0
T6	44.18	324.0	312.0
T7	46.32	298.6	269.2
SE (m) ±	0.89	18.7	15.88
CD at 5%	----	54.6	47.18

Table 3: Physico-chemical properties of *Ambia bahar* fruits of Nagpur mandarin as influence by different treatment of nutrients (Pooled results of 1999-2000 to 2005-2006).

Treatments	Wt. of fruit (g)	Height (cm)	Diameter (cm)	Juice (%)	TSS (%)	Acidity (%)
T_1	147.04	5.16	5.57	43.28	8.40	0.72
T_2	145.38	5.21	5.70	43.96	8.38	0.71
T_3	144.74	5.59	5.47	44.38	8.26	0.71
T_4	159.84	5.57	5.71	45.68	8.58	0.54
T_5	140.26	5.18	5.40	43.32	8.34	0.69
T_6	140.86	4.85	5.29	42.44	8.40	0.60
T_7	139.36	5.00	5.21	42.64	8.46	0.60
SE (m) ±	2.94	0.09	0.09	0.61	0.085	0.014
CD at 5%	8.58	0.26	0.26	1.85	---	---

Table 4: Phsico-chemical properties of Mrig Bahar fruits of Nagpur mandarin as influence by different treatment of nutrients (pooled results of 1999-2000 to 2005-2006).

Treatments	Wt. of fruit (g)	Height (cm)	Diameter (cm)	Juice (%)	TSS (%)	Acidity (%)
T_1	135.82	4.99	5.47	44.63	9.50	0.73
T_2	121.22	5.05	5.50	46.56	9.47	0.75
T_3	145.02	5.19	5.45	46.23	9.57	0.77
T_4	151.95	5.26	5.90	47.26	9.60	0.77
T_5	145.87	5.15	5.78	45.79	9.35	0.57
T_6	122.30	5.11	5.62	46.15	9.42	0.72
T_7	147.88	5.11	5.71	45.87	9.30	0.60
SE (m) ±	9.91	8.07	0.12	0.54	0.06	0.014
CD at 5%	----	---	-----	1.59	0.187	0.041

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Nutritional Status of Acid Lime Orchards in Akola District

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ABSTRACT

The present investigation was conducted to determine nutritional status of acid lime orchards. The soil samples were collected from the fourteen villages of Akola district. The results showed that total nitrogen of acid lime orchards soil varied from 0.037 to 0.085 per cent, with the mean value of 0.064 per cent. Available nitrogen varied from 161.50 kg ha^{-1} to 276.60 kg ha^{-1} with a mean value of 236.08 kg ha^{-1}. Available phosphorus content varied from 21.28 kg ha^{-1} to 53.20 kg cmol (p^+) kg ha^{-1} with a mean value of 29.52 kg ha^{-1}. Available potassium content varied from 299.50 kg ha -1 to 930.80 kg ha^{-1} with a mean value of 755.53 kg ha^{-1}. Exchangeable calcium ranged between 31.17 cmol (p^+) kg ha^{-1} and 45.15 cmol (p^+) kg ha^{-1} with an average of 38.25 cmol (p^+) kg ha^{-1}. Exchangeable Magnesium ranged between 7.12 cmol (p^+) kg ha^{-1} and 12.20 cmol (p^+) kg ha^{-1} with a mean value of 9.73 cmol (p^+) kg ha^{-1}.Available sulphur ranged between 12.53 kg ha^{-1} and 35.40 kg ha^{-1} with a mean value of 21.23 kg ha^{-1}. Exchangeable sodium ranged between 3.80 and 6.85 cmol (p^+) kg ha^{-1} with a average of 4.31 cmol (p^+) kg ha^{-1}. Micronutrient status of acid lime orchard soil showed that available copper ranged between 1.89 ppm and 4.42 ppm with an average of 3.46 ppm. Available zinc ranged between 0.41 and 0.81 ppm with an average of 0.61 ppm. Available manganese ranged between 10.41 ppm and 20.42 ppm with an average of 14.10 ppm and available iron ranged between 3.39 ppm and 7.41 ppm with an average of 5.56ppm.

Citrus is often regarded as a queen of all fruits and is one of the remunative commercial fruit crops of india after mango and banana occupying an area of 4.82 lakh ha with total production of 42.6 lakh tonnes, there by placed at 6th position on the basis of total production amongst frontline citrus growing countries. Fertilizers inputs account for 30-40 per cent of total cost of citrus production, suggesting the significance of citrus nutrition among the important citrus fruit. Acid lime is cultivated on an very large scale specially in central and south Indian states. Maharashtra state is leading in acid lime cultivation. Vidarbha region of the Maharashtra state particularly in Akola district have more acid lime growing area (2283 ha).

Nutritional status in recent years have been widely used to identify nutritional problems to detect deficiencies of nutrients and to measure the response to the applied plant fertilizer need of citrus plants.

Therefore, the present study has been taken to determine nutritional status of acid lime orchard based on the soil analysis, have not been documented so far.

MATERIAL AND METHODS

The study area is located in fourteen villages of Akola district. The area falls in tropical dry subhumid monsoonic type climate, forty eight composite representative surface soil samples (0-30 cm) were collected from circular band of 30-40 cm away from stem by means of soil tube auger. All forty eight soil samples were collected from fourteen villages of Akola district acid lime orchards.

Soil samples were analysed for total nitrogen and available phosphorus, potassium, sulpher which was determined by modified Kjeldhal's method (Pipper, 1966), Alkaline potassium permanganate method (Subbaih and Asija, 1956), Olsen's method (Jackson, 1967), flame photometer method (Jackson, 1967) and turbidimetric method (Chopra and Kanwar, 1976), respectively. Exchangeable cations (Calcium and magnesium) and exchangeable sodium was determined by neutral normal ammonium acetate method (Richard, 1954) and flame photometer method (Jackson, 1967), respectively. Available micronutrients (copper, zinc, iron and manganese) were determined by Atomic adsorption spectrophotometer method (Lindsay and Norvell, 1978).

RESULTS AND DISCUSSION

Total Nitrogen

The importance of nitrogen was shown by the large proportion, which is found in plants substances.

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In 10 year old orange trees, 41 per cent of the total nitrogen content of the dry matter occurs in the leaves, 20.5 per cent in the fruits, 20 per cent in the stem and twigs and 10.5 per cent in the roots. Nitrogen is a constituent of protein so without a sufficient supply no new cells can be formed. Therefore, total nitrogen is more important property in soil analysis. Total nitrogen of acid lime orchard soil varied from 0.037 per cent to 0.085 per cent with the mean value of 0.064 per cent.

Available nitrogen

Scrutiny of the data revealed that the available nitrogen content varied from 161.50 kg ha^{-1} to 276.60 kg ha^{-1} with the mean value of 236.08 kg ha^{-1}. Kharkar *et al.* (1991) and Raina (1988) reported similar observations. Nijjar and Singh (1971) also reported similar trend of nitrogen in citrus orchards soil in Amritsar district of Panjab.

It was also observed that soils of all acid lime orchards under study were low in available nitrogen content, which is due to the limited nitrogen application. The high soil pH might be the other reason of low nitrogen as it escapes the ammonia, where the soils are alkaline.

Available phosphorus

The available phosphorus content varied from 21.28 kg ha^{-1} to 53.20 kg ha^{-1} with mean value of 29.52 kg ha^{-1}. As per the system available P_2O_5 content of soil was low to moderately high. However, relatively higher of available phosphorus in acid lime orchard soil may be attributed to the application of organic manures which further buildup the levels of phosphorus in the soil. Raina (1988), Kharkar and Patil (1999) and Borade (2000) recorded similar observations.

The excess of phosphorus in the soil might lower the availability of zinc. Higher level of phosphorus in the growth medium either reduced the solubility of zinc or interfere with its movement to the functional location in the plants (Lous and Legsett, 1964).

Available potassium

The available potassium content in acid lime orchard soils varied from 299.50 kg ha^{-1} to 930.80 kg ha^{-1} with mean value of 755.53 kg ha^{-1}. As per the six tier system soil comes under very high potassium content category. Nijjar and Singh (1971), Kalbande *et al.* (1983), Ingole *et al.* (1993) also reported similar observations. Kharkar *et al.* (1991), indicating that the soil acid lime orchards of Akola district were rich in available potassium content.

Like phosphorus, excess of potassium in soil might adversely affect the availability of zinc. Ruther and Smith (1950) reported that the excessive application of potassic fertilizers aggravated the incidence of motelling in citrus.

Exchangeable calcium

The calcium occurs in nature as carbonate, sulphate and hydroxide form, complex calcium silicate and organic matter. It occurs as exchangeable cation in vast majority of approximately neutral or slightly saline soil.

The exchangeable calcium ranged between 31.17 cmol (p^+) kg ha^{-1} and 45.15 cmol (p^+) kg ha^{-1} with an average of 38.25 cmol (p^+) kg ha^{-1}. Similar observations were also reported by Borade (2000).

Exchangeable magnesium

Magnesium being a secondary plant nutrient, has not observed to be deficient on wide scale in any part of India. However , usually soil containing less than 1 meq exchangeable magnesium 100 g^{-1} soil are considered deficient (Biswas *et al.*, 1985).The exchangeable magnesium ranged between 7.12 cmol (p^+) kg ha^{-1} and 12.20 cmol (p^+) kg ha^{-1} with a mean value of 9.73 cmol (p^+) kg ha^{-1}, indicating that the soils of acid lime orchard under study well supplied with magnesium. Borade (2000) also recorded similar observations.

Available sulphur

Sulphur is considered as the fourth major nutrient for plant growth. Crop generally absorbs sulphur in amount comparable to phosphorus which is another major nutrient. Sulphur plays an important role in improving the quality and marketability of the produce as reported by Kanwar (1976).

The available sulphur ranged between 12.53 kg ha^{-1} and 35.40 kg ha^{-1} with a mean value of 21.23 kg

Table 1. Nutrients status of acid lime orchards

S.N.	Name of village	Total N (%)	Avai. N (Kg ha^{-1})	Avai. P_2O_5 (Kg ha^{-1})	Avai. K_2O (Kg ha^{-1})	Exch. Ca (cmol(p$^+$) kg ha^{-1})	Exch. Mg (cmol(p$^+$) kg ha^{-1})	Exch. S (cmol(p$^+$) kg ha^{-1})	Exch. Na (cmol(p$^+$) kg ha^{-1})
1	Maispur	0.058	212.4	29.25	884.80	32.50	11.50	18.29	3.90
2	Maispur	0.062	244.3	22.40	840.00	35.60	10.39	18.08	3.90
3	Maispur	0.052	221.3	25.76	929.60	39.20	9.20	14.72	3.95
4	Maispur	0.062	276.6	24.64	862.40	34.20	12.20	14.89	4.00
5	Lakhanwada	0.047	196.5	25.76	705.60	38.86	9.80	29.05	3.80
6	Lakhanwada	0.053	201.4	24.50	761.60	36.45	10.10	20.99	.95
7	Lakhanwada	0.061	214.2	28.00	806.40	31.52	9.70	24.54	4.05
8	Lakhanwada	0.052	209.8	21.28	672.00	33.38	8.50	16.04	3.90
9	Barshitakali	0.081	276.3	26.88	907.20	41.50	12.00	18.89	6.80
10	Barshitakali	0.082	272.5	28.90	884.80	43.38	11.59	20.81	6.85
11	Kapshi	0.068	264.3	25.76	929.40	41.92	11.90	28.78	3.80
12	Kapshi	0.059	240.3	23.68	873.60	38.15	7.88	24.12	3.80
13	Chikhalgaon	0.085	268.3	26.70	896.00	31.17	9.95	12.53	4.10
14	Chikhalgaon	0.079	262.5	28.00	926.50	42.75	8.74	14.80	4.00
15	Chikhalgaon	0.065	258.8	24.64	784.00	38.10	9.15	16.20	4.05
16	Chikhalgaon	0.081	273.4	23.52	828.80	36.70	8.52	19.30	4.10
17	Deulgaon	0.058	236.3	32.48	764.00	38.50	11.25	22.40	3.90
18	Deulgaon	0.082	276.5	32.72	827.60	42.90	10.12	19.20	4.00
19	Deulgaon	0.064	255.6	31.36	728.00	45.15	8.07	28.50	4.20
20	Deulgaon	0.067	243.8	28.40	761.60	34.85	7.12	26.04	4.10
21	Wadegaon	0.059	206.3	25.76	426.50	41.92	11.92	21.30	3.80
22	Wadegaon	0.062	253.3	31.46	536.80	40.31	8.05	25.32	3.90
23	Wadegaon	0.079	259.4	33.60	772.80	32.50	9.31	20.86	4.10
24	Wadegaon	0.085	266.5	32.58	705.60	31.20	7.28	22.36	4.60
25	Patur	0.049	192.6	33.76	390.80	36.80	10.38	24.99	4.15
26	Patur	0.063	249.9	31.36	358.60	39.50	9.08	29.39	3.90
27	Patur	0.065	221.3	36.88	299.50	37.33	10.22	19.80	3.85
28	Patur	0.037	161.5	33.59	452.80	35.38	8.53	22.40	3.80
29	Babhulgaon	0.056	221.2	32.46	918.40	41.40	7.58	14.72	3.90
30	Babhulgaon	0.061	219.7	30.25	896.00	39.42	10.19	18.39	4.25
31	Babhulgaon	0.039	166.5	26.78	817.60	41.38	12.20	18.28	4.20
32	Babhulgaon	0.051	200.2	26.10	884.50	42.53	8.53	14.92	4.25
33	Borgaon (Manju)	0.068	240.3	33.50	537.80	38.40	9.38	14.69	3.95
34	Borgaon (Manju)	0.072	258.8	35.84	584.70	33.58	10.35	12.67	4.10
35	Donargaon	0.059	215.4	47.72	873.60	40.58	9.58	12.63	5.20
36	Donargaon	0.049	184.6	33.60	772.80	39.50	10.32	16.79	5.10
37	Donargaon	0.043	175.5	31.36	817.60	37.50	8.03	19.44	4.90
38	Donargaon	0.065	228.8	53.20	862.40	41.45	10.32	16.99	4.30
39	Wyala	0.074	262.6	34.72	806.40	44.60	11.58	30.48	4.50
40	Wyala	0.069	243.8	29.50	761.80	42.57	9.80	35.40	4.55
41	Wyala	0.08	266.5	30.24	864.50	38.23	8.72	29.31	33.90
42	Wyala	0.086	274.8	26.50	705.00	39.50	9.13	32.58	4.15
43	Kanheri	0.071	258.7	28.70	590.80	32.42	7.45	28.99	6.15
44	Kanheri	0.063	217.5	21.28	630.60	35.71	11.50	24.96	5.90
45	Kanheri	0.077	270.1	24.52	720.50	33.20	8.60	28.78	4.80
46	Kanheri	0.065	228.8	38.04	850.30	37.50	9.36	25.32	3.90
47	Shadad	0.064	256.4	24.64	920.50	41.80	10.67	14.42	4.05
48	Shadad	0.068	235.3	22.40	930.80	43.20	11.58	14.89	3.95
	Mean	**0.064**	**236.08**	**29.52**	**755.53**	**38.25**	**9.73**	**21.23**	

Table 2. Micronutrients status of acid lime orchards

S.N.	Name of village	Avai. Cu (ppm)	Avai. Zn (ppm)	Avai. Mn (ppm)	Avai. Fe (ppm)
1	Maispur	4.40	0.41	11.72	6.44
2	Maispur	4.19	0.59	14.58	5.94
3	Maispur	4.20	0.62	10.70	6.38
4	Maispur	3.92	0.43	14.51	4.51
5	Lakhanwada	3.40	0.47	15.72	6.70
6	Lakhanwada	3.68	0.50	16.82	5.69
7	Lakhanwada	1.89	0.62	14.78	4.30
8	Lakhanwada	2.94	0.73	19.69	7.12
9	Barshitakali	3.98	0.61	10.43	4.18
10	Barshitakali	3.75	0.43	12.96	4.29
11	Kapshi	2.89	0.68	13.10	5.10
12	Kapshi	4.23	0.52	14.59	4.92
13	Chikhalgaon	3.95	0.58	12.73	3.39
14	Chikhalgaon	2.38	0.72	13.57	4.17
15	Chikhalgaon	3.50	0.81	11.43	3.76
16	Chikhalgaon	3.68	0.59	10.79	5.98
17	Deulgaon	4.19	0.47	15.48	6.18
18	Deulgaon	3.52	0.68	15.57	7.10
19	Deulgaon	1.10	0.75	16.48	5.98
20	Deulgaon	4.18	0.61	14.20	6.58
21	Wadegaon	3.38	0.58	20.42	7.32
22	Wadegaon	2.96	0.57	19.82	6.50
23	Wadegaon	3.69	0.52	17.45	7.18
24	Wadegaon	3.75	0.73	16.89	6.80
25	Patur	4.20	0.59	18.74	5.18
26	Patur	4.35	0.67	14.58	5.9
27	Patur	3.90	0.81	17.92	6.20
28	Patur	3.67	0.74	12.35	7.19
29	Babhulgaon	2.39	0.49	14.32	5.65
30	Babhulgaon	2.74	0.45	17.59	4.90
31	Babhulgaon	3.50	0.47	10.78	7.29
32	Babhulgaon	1.95	0.55	13.52	7.41
33	Borgaon (Manju)	4.40	0.57	10.41	3.95
34	Borgaon (Manju)	3.91	0.68	12.56	4.28
35	Donargaon	2.71	0.72	11.45	3.59
36	Donargaon	3.90	0.78	10.82	4.38
37	Donargaon	2.87	0.69	13.11	4.96
38	Donargaon	1.98	0.57	13.44	3.71
39	Wyala	4.42	0.44	12.71	5.85
40	Wyala	3.51	0.49	13.79	5.96
41	Wyala	4.10	0.58	13.58	6.38
42	Wyala	3.98	0.65	12.75	6.21
43	Kanheri	2.31	0.53	11.58	6.01
44	Kanheri	2.49	0.72	14.29	5.28
45	Kanheri	3.10	0.67	13.89	4.39
46	Kanheri	3.43	0.59	10.58	4.65
47	Shadad	3.32	0.70	14.38	5.38
48	Shadad	3.13	0.78	13.18	6.15
	Mean	**3.46**	**0.61**	**14.10**	**5.56**

ha^{-1}. Similar findings were also reported by Borade (2000).

Exchangeable sodium

The exchangeable sodium in acid lime orchard soils was in the range between 3.80 cmol (p^+) kg ha^{-1} and 6.85 cmol (p^+) kg ha^{-1} with an average of 4.31 cmol (p^+) kg ha^{-1}, Similar findings were recorded by Bharambe and Ghonsikar (1985).

Tamhane and Namjoshi (1959) reported that the exchangeable sodium in soil formed from basaltic parent material was 1.3 to 8.4 meq 100 g^{-1} soil. As our soils are also derived from basaltic parent material, so it conforms the results.

Micronutrient status of acid lime orchard soil

Data regarding available copper, zinc, manganese and iron content in soil are presented in Table 2.

Available copper

Results indicate that available copper ranged between 1.89 ppm and 4.42 ppm with an average of 3.46 ppm. Similar observations were recorded by Malewar *et al.* (1978) and Raina (1988). Considering 0.2 ppm as the critical limit of copper (Lindsey and Norvell, 1978) these soils were adequate in available copper. It was significantly and positively correlated with clay and organic carbon. This suggests that availability of copper in this soil was being predominantly governed by these factors. Singh and Tripathi (1985) also observed similar relationship in growing soils of Agra region.

Adequate to excessive level of available copper in these soils might be due to the frequent use of copper containing fungicides by the cultivators to protect the crop from fungal disease.

Available zinc

Results indicate that available zinc ranged between 0.41 ppm to 0.81 ppm with an average of 0.61 ppm. These soils were seen to be deficient in available zinc , in light of suggested critical limit of 1.0 ppm. Similar observations were reported by Nijjar and Singh (1971), Awasthi *et al.* (1984) and Raina (1988). It was significantly and positively correlated with organic carbon.

Chapman (1960) reported that zinc less than 1.0 ppm in the soils having Ph above 7 was inadequate to citrus. Thus, the wing status of all the orchard soils surveyed was poor and it may be attributed to high Ph and excessive phosphorus and potassium content in the soil.

Available manganese

Results indicate that available manganese content in the soil of acid lime orchard ranged between 10.41 ppm and 20.42 ppm with an average of 14.10 ppm. Similar result was recorded by Borade (2000).

Available iron

Results indicate that available iron ranged between 3.39 ppm and 7.41 ppm with an average of 5.56 ppm. Considering 2 ppm as critical limit (Follet and Lindsey, 1970). These soils are quite sufficient in their iron status. Singh and Tripathi (1985) also reported similar distribution of iron in growing soils. Similar results were also recorded by Sakal *et al.* (1985) and Borade (2000).

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Characterization of Pearl Millet Hybrids and their Parental Lines Through Morphological Characteristics

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ABSTRACT

Seven pearl millet hybrids and their parental lines were evaluated by using fourteen morphological characteristics. Among them twelve characters were found to be polymorphic between cultivars indicating their potential for varietal characterization. It was observed that plant : anthocynain colouration of first leaf sheath at seedling stage, spike bristles , bristle colour at dough grain stage and seed colour at harvest maturity were found most important characteristics for identification of cultivars. Among all the genotypes, GHB 526, ICMA 95222, ICMA 94555 and HHB 146 genotypes had plant anthocyanin coloration of first leaf sheath. It was found that red node pigmentation is the distinct morphological character in the hybrid GHB 526. Purple and white internode pigmentation is also the distinct character in the ICMA 95222 and HTP-94/54 genotypes. Seed colour and spike shapes could help for identification of admixture at harvest maturity stage based on various categories. Yellow and yellow brown seed colour of the varieties HTP 94/54 and GHB 577 hybrids was distinct character. No character could identify all the cultivars individually. However, when used in combination, these could distinguish all cultivars individually.

Seed is the basic input in modern agriculture and quality of seed determines the crop productivity. The varieties and hybrids attain wide acceptability when farmers get genetically pure seed of high standards. The quality seed programme in general is characterized by high genetic and physical purity, high germination, vigor and viability and freedom from diseases and pests. For this purpose, well defined field and seed standards are available in pearl millet, however the information on descriptors/ characteristics of varieties for characterization of cultivars is meagre.

The utility of precise characterization of hybrids and varieties and parental lines of hybrids have attained grater priority under Plant Variety Protection Act of GATT for obtaining information on Distinctness (D), Uniformity (U), and Stability(S) of genotypes. DUS testing form the basis for the Plant Breeder's Right (PBR). Guidelines for the DUS testing have been formulated in pearl millet to identify stable diagnostic characteristics of seed, seedling and plant of hybrid / parental lines and varieties under National Seed Project. Distinctness, uniformity and stability are the main criteria's of DUS testing. It is well known that breeders are given top priority for the stability and uniformity of the qualitative characteristics in pearl millet breeding programmes (Minocha, 1980).

In view of above, the present study was undertaken to characterize seven Pearl millet hybrids and their parental lines to develop database on morphological characteristics for DUS testing.

MATERIAL AND METHODS

Genetically pure seeds of seven hybrids and their parental lines were obtained from AICPIP, Jodhpur. The experiment was conducted at Seed Technology Research Unit, MPKV, Rahuri in three replications during the year 2004-05,05-06 and 06-07. The sowing was done in the plot having six rows of length 5 m. with 60 x 15 cm spacing in randomized block design. All recommended agronomic practices were followed to raise good crop.. The qualitative and quantitative morphological characteristics were recorded as per the National Test Guidelines for pearlmillet (Anonymous, 2003). The list of morphological characteristics, their categories and stages of observations are given in table 1. Among twenty six morphological characteristics listed in National Test Guidelines for DUS test for pearlmillet, fourteen characteristics were explored for

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varietal description of pearl millet hybrids and parental lines that are most important in terms of genetic purity and seed production. The laboratory observations were made on hundred seeds of each cultivar for seed colour and seed shape.

RESULTS AND DISCUSSION

The different morphological characteristics observed for different hybrids and their parental lines of pearlmillet have presented in Table 2.

Out of fourteen characteristics studied, 12 characteristics are found to be polymorphic and only two characters are found monomorphic (viz. leaf sheath pubescence and anther colour). The seed morphological characteristics such as seed colour and seed shape are the most important diagnostic characteristics easy to detect and could classify into few broader categories.

Seedling characters:

Based on the anthocyanin pigmentation of seedling, cultivars are differentiated into two groups as absent comprising fifteen cultivars and present having five cultivars (Table:2). Among all the studied hybrids and parental lines, GHB 577, GHB 526, HHB 146 hybrids, ICMA 95222 (A line of hy. GHB 526 & HHB 146), ICMA 94555 (A line of hy. GHB 558) could differentiate from others at seedling stage based on their presence of leaf sheath pigmentation. This character is found to be stable over three seasons and no variation was seen with respect to cultivar. This character is very useful for identification of admixture of pigmented seedlings from green leaf sheathed seedlings. Similar results have been reported by Yadav (1976). Several workers had also used seed and seedling characteristics for distinguishing varieties of different crops (Burbridge *et al.*, 1986; Agrawal and Pawar, 1990; Jaiswal and Agrawal, 1990). However, the intensity of pigmentation might be varied due to effect of environment. Pigmentation of seedling was persistent during the entire plant growth and in some cultivars intensity of pigmentation might be increased at advanced plant growth stage. These results are inconformity with those reported by Arunkumar *et al.*, (2004).

Plant morphological characters:

From the study, it was observed that flowering period of parental lines of each hybrid is different. Flowering period hybrids and their parental lines grouped into very early (ICMA-94555), early (GHB 577), medium (9), late (3) and very late (6) categories. The plant node pubescence was present in GHB-526, ICMA-95222, J-2372, GHB-558, RHRBH-8924, RHRBI-458, RHRBH-8609, RHRB-1A and RHRBI-138 and absent in remaining 11 hybrids/parental lines. Variations were observed in the plant node pigmentation and were grouped into various categories *viz*, brown (4), green (9), purple (4), red (1) and white (2). It was found that red node pigmentation is the distinct morphological character of the hybrid GHB 526. The plant internode pigmentation of most genotypes studied were grouped into green category, whereas, ICMA 95222 and HTP-94/54 were grouped into purple and white category, respectively. Based on the spike shape, it was observed that GHB-577, GHB-526,J-2290, MS-732A and RHRB-5A had candle shape, JMSA-101, RHRB-1A had cylindrical shape, J-2405, GHB-558, ICMA-94555, HHB-146, HTP-94/54, MS-732A,CoHcu-8, PT-4450, and RHRBI-458 had lanceolate shape, ICMA-95222, J-2372and RHRBI-138 had conical shape, whereas RHRBH-8924 and RHRBH-8609 had spindle shape. Similarly, based on spike bristles, RHRBH 8924, RHRBI 458 and RHRBH 8609 were grouped in present category, whereas remaining seventeen genotypes were grouped in absent category. Spike bristle colour was observed in the genotypes having spike bristles among which RHRBH 8924 had brown colour while, RHRBI 458 and RHRBH 8609 had purple colour. The spike exertion was observed at dough stage and ten cultivars were grouped into each of category *viz*. complete and partial. Based on plant growth habit, 16 cultivars were grouped as intermediate whereas, HHB 146, HTP-94/54, PT 4450 and RHRB 1A cultivars were grouped as erect.

Seed characters:

Seed morphological characteristics such as seed colour and seed shape are the important for

Table 1. List of morphological characteristics as per NTG

S. N.	Characteristics	States	Stage of observation
1. (*)	Plant: anthocyanin coloration of first leaf sheath	Absent Present	seedling emergence
2.	Plant : growth habit	Erect Intermediate	spike emergence
3. (*)	Time of spike emergence (50% plants with atleast one spike emerged fully)	very early (<43 days) early (43-46 days) medium (47-50 days) late (51-54 days) very late (>54)	spike emergence
4.	Leaf : sheath pubescence	absent present	spike emergence
5.	Leaf: sheath length	short (<11 cm) medium (11-15 cm) long (>15 cm)	spike emergence
6.	Leaf : blade length	very short(<41 cm) short (41-50 cm) medium (51-60 cm) long (61-70 cm) very long (>70 cm)	spike emergence
7.	Leaf : blade width (at widest point)	narrow (<3 cm) medium (3-4 cm) broad (>4 cm)	spike emergence
8. (*)	Spike : anther colour	Yellow Brown purple	anthesis
9. (*)	Plant : node pubescence	absent present	dough grain
10.	Plant: number of nodes	low (<11) medium (11-15) high (>15)	dough grain
11. (*)	Plant: node pigmentation	Whitish Green Brown Red Purple	dough grain
12. (*)	Plant: internode pigmentation (between 3rd and 4th node from top)	Whitish Green Brown Red Purple	dough grain
13.	Spike: exsertion	Partial Complete	dough grain

14. (*)	Spike: length	very small (<11 cm) small (11-20 cm) medium (21-30 cm) long (31-40 cm) very long (>40 cm)	dough grain
15. (*)	Spike: anthocyanin pigmentation of glume	absent present	dough grain
16.	Spike: bristle	Absent present	dough grain
17. (*)	Spike: bristle colour	Green Brown Red Purple	dough grain
18. (*)	Spike: girth at maximum point (excluding bristles)	thin (<1.6 cm) medium (1.6-3.0 cm) thick (>3.0 cm)	dough grain
19. (*) (+)	Spike: shape	Cylindrical Conical Spindle Candle lanceloate dumb-bell, club oblanceolate globose	dough grain
20. (*) (+)	Plant: number of productive tillers	Monoculm low (2-3) medium (4-6) high (>6)	dough grain
21. (*)	Plant: height (excluding spike)	very short (<101 cm) short (101-150 cm) medium (151-200 cm) tall (201-250 cm) very tall (>250 cm)	dough grain
22.	Spike: tip sterility	Absent, present	harvest maturity
23. (*)	Spike: density	very loose loose semi-compact compact very compact	harvest maturity
24. (*)	Seed: colour	Whitish, cream,yellow Grey,deep grey grey brown yellow brown purple,purplish black	harvest maturity
25. (*) (+)	Seed: shape	Obovate, elliptical Hexagona, globular	harvest maturity
26. (*)	Seed: weight of 1000 grains	very low (<5 gm) small (5.1-7.5 gm) medium (7.6-10.0 gm) bold (10.1-12.5 gm) very bold (>12.5 gm)	harvest maturity

Table 2 Characterization of pearl millet hybrids and their parental lines based on morphological characteristics

Sr. NO	Characteristic	H	A	R	H	A	R	H	A	R	H	R	H	A	R	H	A	R	H	A	R
		GHB-577	JMSA-101	J-2405	GHB 526	ICMA 95222	J 2372	GHB-558	ICMA 94555	J-2290	HHB 146	HTP 94/54	CoHcu8	MS-732A	PT 4450	RHRBH-8924	RHRB 5A	RHRBI 458	RHRBI-8609	RHRB 1A	RHRBI 138
1.	Plant: anthocyanin coloration of first leaf sheath	+	-	-	+	+	-	-	+	-	+	-	-	-	-	-	-	-	+	-	-
2.	Plant : growth habit	Int	Int	Int	Int	Int	Int	Int	Int	Int	Et	Et	Int	Int	Et	Int	Int	Int	Int	Et	Int
3.	Plant : time of spike emergence (50% plants with at least one spike emerged fully) days	E (46)	Lt (53)	Me (53)	Me (49)	VL (57)	Lt (53)	Me (47)	VE (54)	VL (64)	Me (47)	VL (57)	Lt (52)	VL (64)	VL (61)	Me (48)	L (54)	M (50)	Me (47)	M (50)	Me (49)
4.	Leaf : sheath pubescence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	Plant : node pubescence	-	-	-	+	+	-	+	-	-	-	-	-	-	-	+	-	+	-	+	+
6.	Spike : anther colour	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw	Yw
7.	Plant: node pigmentation	Br	Gr	Pur	Red	Pur	Gr	Br	Pur	Gr	Pur	Wht	Wht	Gr	Gr	Br	Gr	Br	Gr	Gr	Gr
8.	Plant: internode pigmentation (between 3rd and 4th node from top)	Gr	Gr	Gr	Gr	Pur	Gr	Gr	Gr	Gr	Gr	Wht	Gr	Gr	Gr	Gr	Gr	Gr	Gr	Gr	Gr
9.	Spike: exertion	Com	Par	Par	Com	Com	Com	Par	Par	Par	Com	Com	Par	Par	Com	Par	Par	Com	Com	Com	Par
10.	Spike: bristle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-
11.	Spike: bristle colour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Br	-	Pur	Pur	-	-
12.	Spike: Shape	Can	Cyl	Lan	Can	Con	Con	Lan	Lan	Can	Lan	Lan	Lan	Can	Lan	Spn	Can	Lan	Spn	Cyl	Con
13.	Seed: Colour	Yb	Gray	Gray	Gb	Gray	Gb	Dg	Gb	Gb	Gray	Yw	Gb	Gray	Gb	Dg	Dg	Dg	Dg	Br	Br
14.	Seed Shape	Ob	Glo	Hex	Ob	Glo	Ob	Ob	Ob	Glo	Glo	Glo	Ob	Glo	Ob	Ob	Ob	Ob	Hex	Glo	Ob

Note : A line of GHB 526 and HHB 146 is the same. Figures in parenthesis are the days for 50% spike emergence

Abbreviations used:

+	-	Present	Gr	-	Green	Can	-	Candle	-	Elp	-	Elliptical	Cyl	-	Cylindrical	Lt	-	Late
-	-	Absent	Br	-	Brown	Com	-	Complete	-	Gb	-	Gray brown	Con	-	Conical	Yb	-	Yellow brown
VE	-	Very early	Me	-	Medium	Par	-	Partial	-	E	-	Early	VL	-	Very late	Hex	-	Hexagonal
Dg	-	Deep gray	Et	-	Erect	Ob	-	Obovate	-	Glo	-	Globular	Spd	-	Spreading	Wht	-	White
Yw	-	Yellow	Int	-	Intermediate	Lan	-	Lanceolate	-	Pur	-	Purple	Yb	-	Yellow brown	Spn	-	Spindle

identification of varieties at maturity stage. Genotypes studied were categorized as *viz;* yellow brown (1), grey (5), grey brown (6), deep grey (5), yellow (1) and brown (2) based on seed colour. It was observed that among all the cultivars, GHB 577 and HTP-94/54 had yellow brown and yellow seed colour, respectively. This can be considered as a distinct morphological character. The variation may be observed to some extent in seed colour over year however, that can be corrected by removing the affected grains from seed lot under test. Musel, (1963) reported that under unfavorable climatic conditions some variations may be observed in seed colour of same cultivars.

Based on the seed shape, the genotypes were categorized into three categories viz; obovate (11), globular (7) and hexagonal (2). J 2405 and RHRBH 8609 genotypes were grouped in hexagonal seed shape.

The accurate description and identification of varieties, inbred lines and hybrids are not only prerequisites for DUS testing but are also crucial for production of pure foundation and certified seeds. Morphological characteristics are useful to establish distinctness, uniformity and stability. This is the basis for protecting new cultivars under PPV and FR Act.

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Mutations for Morphological Characters in Sugarcane

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ABSTRACT

A wide range of viable mutations for morphological, quality and yield contributing characters were obtained in sugarcane through *in vitro* mutagenesis using gamma irradiation. The mutation spectrum was broader in sugarcane cv. Co 94012 for morphological characters. However for quality and yield characters, sugarcane cv. Co 86032 showed wider range of mutations. The range of mutations was 0.06 to 0.56 per cent for morphological characters. Maximum mutations observed overall for cane color (0.14), followed by leaf size 0.1 per cent. Mutations observed were between 0.16 to 0.48per cent for quality characters like high and low brix. More mutations were observed in high brix (0.04 %) as compared to low brix (0.008 %). Mutations for early maturity were observed in Co 86032 (0.17 %) and for midlate maturity in CoC-671 (0.16 %. Overall mutations were 0.003per cent for the maturity characters. The range of mutations observed was 0.09 to 0.38 per cent for the cane yield contributing characters for different gamma rays treatment and varieties. Maximum mutations observed overall for cane weight plant^{-1} 0.023 (%), followed by cane diameter and cane height.

Sugarcane is an important agro-industrial sugar crop, contributing about seventy percent of the world sugar. The somaclonal variation in combination with *in vitro* mutagenesis can improve competitiveness of commercial sugarcane varieties through widening of genetic base (Saif et al., 2001). The role of induced mutations in crop improvements is evident from a large number of improved high yielding varieties of several crops developed and released for commercial cultivation through mutation breeding (Kharkwal, 1996; Shadakshari et al., 2001). In order to induce variability and utilize useful mutations directly for crop improvement, a systematic study of induced mutations is necessary.

MATERIAL AND METHODS

The material for this study comprised of three popular Indian cultivars Co 86032, CoC-671 and Co 94012. Young leaves from 5-6 months field grown plants were used for callus induction on MS basal medium supplemented with 2 mg l^{-1} 2,4-D and 3 per cent sucrose.

The embryogenic calli were gamma irradiated at Fiply, BARC, Trombay, Mumbai in Gamma Cell 220 at the dose rate of 9 Gy min^{-1}. After three subcultures, the calli were cultured on regeneration medium (Callus induction medium without 2,4-D). The regenerated shoots were then rooted on MS medium with 4 mg l^{-1} NAA. Hardened plantlets were then planted in field of Sugarcane Research Centre, Dr. PDKV, Akola, MS for further evaluation. The plants were planted at 2'x2' plant-to-plant distance and 3'x3' row-to-row distance with 20 plants in a row.

The data on various characters like number of milliable canes, stool weight, number of internodes, height, cane diameter and HR brix of sugarcane mutant and the control plants was recorded at maturity stage i.e. 12 months of the planting.

RESULTS AND DISCUSSION

Mutations observed were ranged between 0.06 to 0.56 per cent for morphological characters namely leaf size, leaf angle, non-spiny leaf sheath, cane color, bud groove, and tillering habit (Table. 1). Maximum mutations observed (Fig. 1) overall for cane color (0.14 %), followed by leaf size (0.1) however minimum for non-spiny, dew lap color, leaf angle and tillering habit and these characters are important in isolation of mutations from the population. Mutations observed were between 0.16 to 0.48per cent for quality characters like high brix and low brix. More mutations were

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Table. 1 Mutations observed for morphological characters in sugarcane plants regenerated through *in vitro* mutagenesis.

Variety	Dose Gy	Total Plants	Mutations for morphological characters (Per cent)						
			Leaf size	Leaf angle	Spiny leaf sheath	Dew lap color	Tillering habit	Cane color	Bud groove
Co 86032	R	203	0.49	-	-	-	0.98	-	-
	20	1128	0.09	-	-	-	0.18	0.18	-
	30	295	-	-	-	-	-	0.33	-
	40	262	-	-	-	-	-	-	-
CoC-671	R	42	-	-	-	-	-	2.38	-
	20	1639	-	-	-	-	-	0.06	-
	30	618	0.16	-	0.16	0.16	0.32	0.32	0.16
	40	40	-	-	-	-	-	-	-
Co 94012	R	30	3.33	-	-	-	-	3.33	-
	20	420	0.24	0.24	-	-	0.48	-	-
	30	303	0.33	-	-	-	-	0.66	-
	40	179	0.56	-	-	-	-	-	-
Total	5159	0.1	0.005	0.003	0.003	0.038	0.14	0.003	

Table. 2 Mutations observed for quality and cane yield contributing characters in sugarcane plants regenerated through *in vitro* mutagenesis.

Variety	Dose Gy	Total Plants	Mutations for quality characters (per cent)				Mutations for yield contributing characters (per cent)			
			High Brix	Low Brix	Early maturity	Mid late maturity	Cane diameter	Cane height	Cane weight per plant	No of internodes
Co 86032	R	203	-	-	-	-	-	-	-	-
	20	1128	0.27	-	-	-	0.09	0.09	0.17	0.09
	30	295	0.34	-	0.17	-	0.33	-	0.33	-
	40	262	0.38	-	-	-	-	-	0.38	-
CoC-671	R	42	-	-	-	-	-	-	-	-
	20	1639	-	-	-	-	-	-	0.12	-
	30	618	0.32	0.16	-	0.16	0.32	0.16	0.16	0.16
	40	40	-	-	-	-	-	-	-	-
Co 94012	R	30	-	-	-	-	-	-	-	-
	20	420	0.48	0.24	-	-	-	-	-	-
	30	303	0.33	-	-	-	0.33	-	-	0.33
	40	179	-	-	-	-	-	-	-	-
Total		5159	0.04	0.008	0.003	0.003	0.02	0.005	0.023	0.011

observed in high brix (0.04 %) as compared to low brix (0.008 %). Mutations for early maturity were observed in Co 86032 (0.17%) and for midlate maturity in CoC-671 (0.16%). Overall mutations were 0.003 per cent for the maturity characters (Table 2). Mutations observed were between 0.09 to 0.38 per cent (Table 2) for the cane yield contributing characters like cane diameter, cane height, cane weight plant^{-1} and number of internodes for different gamma rays treatment and varieties. Maximum mutations were observed overall for cane weight plant^{-1} (0.023), followed by cane diameter and cane height. The range of mean performance of mutants with respect to their bud propagated control for the characters were recorded (Table. 3).

Table. 3 Mean performance of yield contributing characters of sugarcane mutants at maturity stage

SugarcaneCultivar/ Mutants	Milliable canesNos.	Stool Weight Kg	Mean Internodes Nos.	Mean Height Cm	Mean Total HeightCm	Mean Cane Diametermm	Mean Brix
Co 86032							
Bud Control	3-4	5.33-6.1	22.33-24.67	231.67-248.33	285.33-300.33	34.67-35.33	22.80-23.0
Callus Regenerated	5-8	5.5-8.33	19.33-25.33	161.67-258.33	290.67-333.33	28.33-29.33	18.83-23.06
40 Gy	2-16	3.75-14	6.33-21.33	203.33-251.67	230.33-330.33	16.67-26.67	19.23-24.5
30 Gy	2-20	5-18.75	11.33-25.67	115.33-284.33	147.33-322.33	15.33-34.67	20.07-24.06
20 Gy	2-23	1-19.83	4.67-27.33	43.33-261.33	73.33-336.33	9.7-31.33	17.67-24.93
CoC-671							
Bud Control	2-3	4.5-5.5	19.33-21.67	183.33-240.33	299..99-328.34	30.67-33	23.07-23.5
40 Gy	3-9	5-21	15.3-24.67	162.33-280.67	241-345.67	21.33-31.67	18.07-23.07
30 Gy	2-17	1.5-23.37	4.33-30.67	116.33-301.67	156.33-346.67	18.67-33.67	17.7-24.93
20 Gy	1-14	1-16.25	6.33-28.33	53.33-265.33	70.-344.33	8-34.67	17.6-24.93
Co 94012							
Bud Control	3-4	5.5-6.5	19.33-21.67	195.33-213.33	293.33-303.33	33.33-34.33	22.8-23.5
40 Gy	3-19	5.4-27.5	12.24-24.67	106.33-245.33	154.33-308.67	16.33-28.67	22.5-25.46
30 Gy	3-14	3-23.37	8.67-25.67	143.67-271.33	190.33-342.33	16.67-31.33	19.13-25.27
20 Gy	3-13	2-16.67	15.67-25.67	118.33-281.67	168.33-348.33	21.33-34.33	19.8-24.97

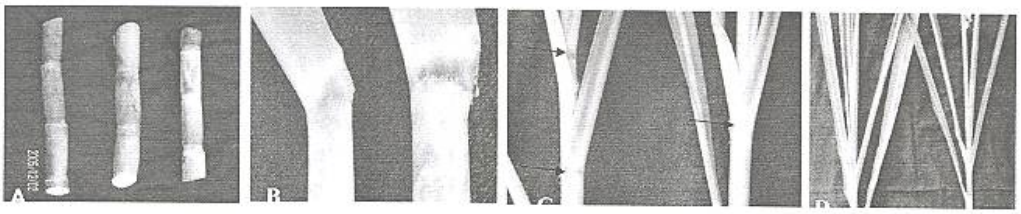

Fig.1 Mutations for morphological characters in sugarcane

A- Cane color variation in Co 86032 ; B-Variation for leaf angle (cv. Co 94012); C- Dew lap color variation (cv. Co 86032); D- Broad leaf mutant (Co 86032)

Co 8152, a mutant cultivar of sugarcane was obtained through gamma irradiation of Co 527 out yielded 40 per cent than the parent variety. Smut resistant gamma ray induced mutant clone Co 8153 was obtained from the smut susceptible sugarcane variety Co 775 (Singh, 2005). In another report, a vigorous fast growing, early maturing mutant clone was isolated from gamma irradiated vegetative buds of sugarcane cv. Co 527. The mutant clone matured 60 days earlier than the parent variety (Jagathesan and Ratnam, 1978). Also the economic characteristics like sucrose content and juice purity remained unaffected. Several somaclones have been developed through tissue culture with improved productivity and eliminating certain defects like spines, leaf drying, disease susceptibility etc. Improvement in agronomic characters also has been reported in somaclones like Co 94012, Co 95016, Co 99012 etc. (Anonymous, 2007). Hence, mutagenesis using gamma irradiation combined with *in vitro* culture method appears to be valuable in crop improvement program.

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Identification and Molecular Mapping of QTLs for Drought Related Component Traits in Rice

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ABSTRACT

A double haploid mapping population consisting 75 lines of a cross between the irrigated *indica* variety IR64 and the upland *japonica* variety Azucena was used in the present experiment. The complete set of double haploid lines along with parents was evaluated under two sets of conditions, 1. Transplanted with water stress and 2. Transplanted with no stress over two years. Water stress was imposed at flowering and observations were recorded for eighteen component traits. A total of 39 putative QTLs for various traits were detected, which were found to be explaining a minimum of 9.8per cent to maximum of 21.3per cent of phenotypic variation, individually. These QTLs were mapped on the rice genome and linked DNA markers have been validated for use in the marker assisted breeding programme. A set of three hundred microsatellite markers was used for parental polymorphism screening of which 60 markers were found polymorphic. Thirty-one of these markers were associated with QTLs of different traits and are distributed on eight different rice chromosomes. These markers can be successfully used to transfer some of the QTLs into different genetic backgrounds.

Drought is a major abiotic stress, which limits plant growth and productivity, and is a major cause of yield instability. However, most measures of agricultural productivity, such as size, shape, yield and quality are influenced by many genes (polygenes), so that traits in a population do not fall into discrete classes, but show a continuos range of phenotypes. Quantitative variation in phenotype can be explained by the combined action of many discrete genetic factors, each having a rather small effect on the overall phenotype, and the influence of environments. As a result, breeding for quantitative traits tends to be a less efficient and time-consuming process. These genes cannot be studied individually using the methods of classical Mendalian genetics because their effects are lost in the statistical fog of all other background variation. Recently QTL mapping studies in rice revealed two important results on the genetic basis of quantitatively inherited traits. First, identification of few QTLs each having relatively large phenotypic effect and second, the complex phenotype tend to show greater QTL X E interaction, which makes marker-aided selection (MAS) for QTL to genetic improvement of complex trait difficult. Considering this aspect in view, a study of identification and molecular mapping of QTLs for drought related component traits in rice was underteken.

MATERIAL AND METHODS

A population of 75 Double Haploid (DH) lines derived from a cross between the irrigated *indica* variety IR64 and the upland *japonica* variety Azucena (Guiderdoni *et al.* 1992) developed at IRRI, was used in the present investigation. IR64 is high yielding improved semidwarf *indica* rice variety suitable for irrigated habitats, wereas Azucena is a more drought tolerant *japonica* rice variety. A population of 75 Double Haploid (DH) lines were grown in randomized complete block design with two replications under two different environmental conditions viz., 1. Transplanted with water stress (TD) and 2. Transplahted with irrigated conditions (TI). In both conditions, the seeds were sown in a bed and seedlings were transplanted to a paddy field 31 days latter, with single plant hill^{-1} spaced at 15 X 20 cm. Each plot included three lines with ten plants per line. All normal packages of practices were followed to raise a good crop. The drought condition was imposed by stopping irrigation at 50per cent flowering stage. Observations were recorded on ten plants in each replication. Observations were recorded to qualitative and quantitative traits, which include plant height, number of effective tillers, days to flowering, 100 grain weight, grain length, grain breadth, spikelet fertility,

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

RESULTS AND DISCUSSION

A summary of number of QTLs detected under different environmental condition and different season is presented in Table 1. The identified QTL can be classified in two types, first type represent major gene that affect quantitative traits, which were detected with large LOD score (>10). The second types included most of QTL identified in rice, which had relative small effect. In this study, 39 QTLs were identified and had small phenotypic effect and LOD score of <10, this was expected as a different characters were under different genetic control and depend on its complexity along with variable level of QTL X E interaction. This is in agreement with the Li *et al.*, (1999) who reported that more than 80per cent of loci identified in rice are of this type. Number of QTLs identified in this study has been reported by other workers to be present on the same chromosome. e.g. the QTLs for days to flowering has been reported to be present on chromosome # 3 by Maheswaran *et al.*, (2000), similarly for yield, QTLs on chromosome # 4 was detected in this study. Shashidhar *et al.*, (1999) reported the QTLs on chromosome # 1 and 4 for plant height (Fig.1), this genomic segment is closely linked to the map position of *sd-1*, a major gene controlling semi-dwarfism Cho *et al.*, (1994). Yan *et al.*, (1998a) reported the QTL on chromosome # 3 for fertile tiller per plant. Yan *et al.*, (1998b) reported the presence of QTLs on chromosome # 2 for number of tiller plant^{-1}. Redofia and Mackill (1998) reported the presence of QTLs on chromosome for grain breadth on chromosome # 2, as in this study. Price *et al.*, (1999) reported the QTLs on chromosome # 4, similar to the finding of this study. The identification of QTLs at same position by different workers in different populations has significant implication and can be inferred as real. These QTLs, which are common, stable and if their relative contribution is also high can be the real candidate for MAS and even the map based cloning (Fig. 1). Apart from these QTLs number of other QTLs were also detected in the present study, which are not reported by the previous workers. The difference in location of QTLs for various traits may be because of different cross combination used in this analysis, as the detection of QTL is based on allelic differences between parental lines, different population size, statistical threshold for detecting putative loci, the number of markers used in the analysis (Yano and Sasaki, 1997).

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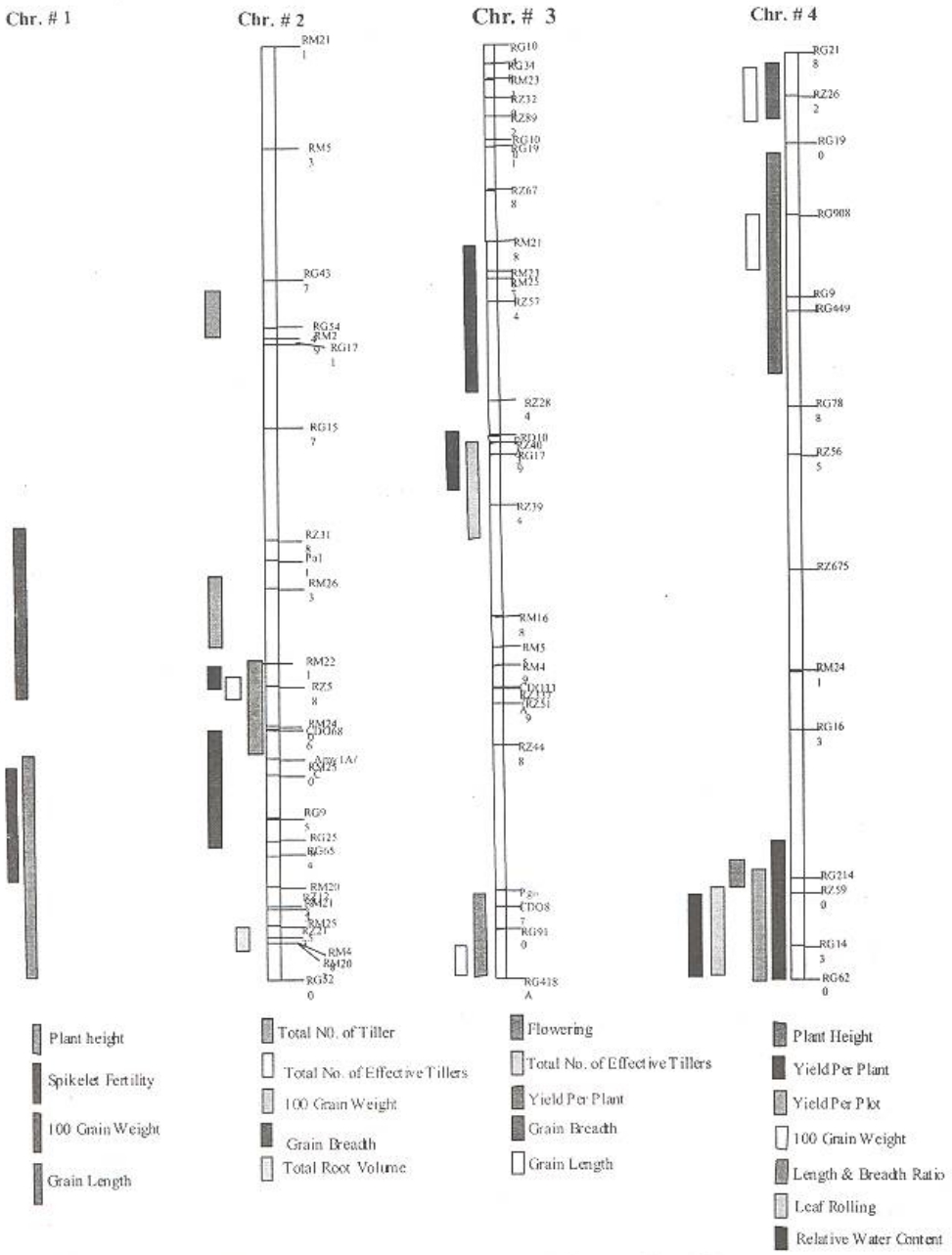

Fig. 1 Putative QTLs for Yield Related Traits on Different Rice Chromosome

Table 1 Putative QTLs detected using interval mopping

Character	Regions between DNA markers	Chr. #	Additive effect	per cent Variation explained	LOD
Days to Flowering					
Irrigated	RG910 - GR418A	3	4.1	13.8	1.5
Drought	RG910 - GR418A	3	3.8	10.6	1.7
Plant Height					
Irrigated	RZ730 - RZ801	1	0.9	17.8	2.4
	RZ262 - RG449	4	-6.4	17.3	2.7
Drought	RZ730 - RZ801	1	4.7	13.6	2.4
Total Number of Tiller					
Drought	RM221 - CDO686	2	-5.1	11.2	1.6
Total Number of Effective Tillers					
Irrigated	RG179 - RM168	3	3.8	12.2	1.7
Spikelet Fertility					
Irrigated	RM212 - RG810	1	3.5	10.9	1.6
Grain Yield / Plant					
Irrigated	RM218 - RZ284	3	-0.8	21.3	2.5
Drought	RG214 - RG620	4	-1.2	15.2	2.7
Grain Yield / Plot					
Drought	RG163 - RG620	4	-15.1	12.8	1.8
100 Grain Weight					
Irrigated	Pall - RM221	2	6.3	10.4	1.5
Drought	RG472 - K5	1	-5.3	11.7	1.7
	RG437 - RG171	2	4.2	10.2	1.5
Grain Breadth					
Irrigated	CDO686 RG256	2	4.0	14.0	2.1
Grain Length					
Drought	RH34 - RZ19	1	-5.1	12.2	1.9
Leaf Rolling	RZ590 - RG620	4	0.9	10.9	1.5
Relative Water Content					
	RZ590 RG620	4	-0.7	13.5	2.3

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Exploitation of Interspecific Derivatives for Heterosis Breeding in Sunflower

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ABSTRACT

The crossing programme was undertaken to study the extent of heterosis in F_1 hybrids. (Eight CMS lines mated with five male lines in Line x Tester design) in sunflower where heterosis is of general occurrence for almost all characters. The cross CMS 240 A x ID 5016 exhibited highest heterosis, heterobeltiosis and standard heterosis for seed yield plant^{-1} and yield contributing characters like head diameter, percentage of filled seeds head^{-1} and oil content. The crosses CMS 336A x ID1020, CMS 240A x ID1020, and CMS 147A x ID5020 need consideration for future sunflower breeding programme.

In India, sunflower (*Helianthus annuus* L.) has gained the status of an important edible oilseed crop within a short span after its introduction. Sunflower is global oilseed crop of economic importance. The hybrid development in sunflower is possible due to induction of cytoplasmic male sterility (Leclercq, 1969) and development fertility restoration system (Kinman, 1970).

The success of heterosis breeding depends on the extent of genetic diversity present in the parental lines. Information on heterosis in sunflower is essential for developing new hybrids. Therefore, the present study was undertaken.

MATERIAL AND METHODS

The experimental material comprised of eight CMS lines, five interspecific derivatives male lines and their 40 F_1s. A standard check, PKVSH 27 was included in the study for comparison. Interspecific derivatives were obtained from Director of Oilseed Research, Hyderabad. Experimental material was sown in randomized block design replicated thrice. Recommended package of practices were followed to raise healthy crop. The observations were recorded on five randomly selected plants for yield and yield contributing characters like, days to 50 per cent flowering, head diameter (cm), percentage of filled seeds head^{-1}, hundred seed weight (g), harvest index (%), seed yield plant^{-1} (g), oil content (%) and hull content (%). These thirteen parents and forty hybrids along with check were studied for magnitude of heterosis for seed yield and its components. The heterotic effects were calculated and tested for its significance at 1 per cent and 5 per cent probability level.

RESULTS AND DISCUSSION

The range of heterosis over mid-parents, better parent and standard check i.e. PKVSH-27 for yield contributing characters along with best heterotic crosses is presented in Table 1. Promising crosses showing heterosis over mid parents, better parent and standard check for yield and yield contributing characters with yield performance is presented in Table 2. The data indicated that an appreciable amount of heterosis over mid parents, better parent and standard check was observed for almost all the characters under study. In sunflower positive heterotic values are desirable for all the characters under study except for days to 50 per cent flowering and hull content, where negative values are preferred.

For days to 50 per cent flowering average heterosis ranged from -12.68 to 8.94 per cent. Highest significant negative heterosis was observed in CMS 336 A x ID 1078 (-8.94%) followed by CMS 147 A x ID1078 (-8.46%), Heterobeltiosis ranged from –12.68 to 11.36 per cent and the same cross CMS 336 A x ID1078 (-12.68%) exhibited significant negative heterobeltiosis.

Heterobeltiosis ranged from 6.68 to 42.23 per cent for head diameter. Maximum significant heterobeltiosis and standard heterosis was exhibited by CMS 237 A x ID5020 (42.23%) and CMS 237 A X ID 5016 (31.00%), respectively.

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Table 1: Range of heterosis over mid and better parent and standard check in sunflower with best heterotic crosses.

S. N.	Characters	Range of average heterosis (%)	Best heterotic cross	Range of heterobeltiosis (%)	Best heterotic cross	Range of standard heterosis (%)	Best heterotic cross
1	Days to 50% flowering	-12.68 to 8.94	CMS 336 A x ID 1078	-12.68 to 11.36	CMS 336 A x ID 1078	1.17 to 17.54	CMS 237 A x ID 5016
2	Head diameter (cm)	14.17 to 51.30	CMS 336 A x ID 5020	6.68 to 42.23	CMS 237 A x ID 5020	1.71 to 31.00	CMS 237 A x ID 5016
3	Percentage of filled seeds head^{-1}	-15.33 to 37.46	CMS 240 A x ID 5016	-20.73 to 35.60	CMS 240 A x ID 5016	-20.54 to 8.77	CMS 240 A x ID 5016
4	Hundred seed weight (g)	-23.48 to 39.08	CMS 147 A x ID 1078	-41.65 to 25.75	CMS 240 A x ID 1078	-13.68 to 24.79	CMS 240 A x ID 1078
5	Harvest index (%)	-60.88 to 189.44	CMS 240 A x ID 1020	-76.17 to 117.64	CMS 240 A x ID 1020	-54.81 to 95.72	CMS 240 A x ID 1020
6	Seed yield plant^{-1} (g)	-15.61 to 154.28	CMS 240 A x ID 5016	-42.27 to 91.32	CMS 240 A x ID 5016	-30.21 to 76.85	CMS 240 A x ID 5016
7	Oil content (%)	-12.69 to 21.84	CMS 240 A x ID 3030	-16.65 to 15.34	CMS 240 A x ID 3030	-5.35 to 24.12	CMS 103 A x ID 5020
8	Hull content (%)	-27.50 to 24.59	CMS 103 A x ID 5020	-13.89 to 90.05	CMS 60 A x ID 3030	-23.67 to 23.70	CMS 103 A x ID 5020

Table 2: Yield performance and average heterosis (H_1), heterobeltiosis (H_2) and standard heterosis (H_3) in some promising crosses of sunflower.

Sr. No.	Crosses	Seed yield plant^{-1} (g)	Heterosis for seed yield plant^{-1}			Desirable significant heterosis for other characters		
			H_1	H_2	H_3	H_1	H_2	H_3
1	CMS 240 A x ID 5016	47.20**	154.28**	91.32**	76.85**	2,3,5,7	2,3,5	2,4,5
2	CMS 336 A x ID 1020	44.01**	78.60**	36.28**	64.75**	1,2,3,5	2,5	2
3	CMS 240 A x ID 1020	42.80	91.28**	32.55	60.24**	2,3,4,5,7	4,5,8	2,4,5
4	CMS 147 A x ID 5020	42.26**	98.54**	30.90**	58.20**	2,4,8	2,7	2,7,8
5	CMS 360 A x ID 3030	37.97**	75.89**	44.81**	42.15**	2,5,7	2	2
6	CMS 237 A x ID 5020	37.57**	38.63**	16.39**	40.66**	2,8	2	2,7
7	CMS 240 A x ID 3030	37.19**	92.30**	39.69**	39.22**	2,3,5,7	4,5,7	4
8	CMS 60 A x ID 5020	35.39**	60.28**	9.64*	32.51**	2,3,7,8	2	7
9	CMS 240 A x ID 5020	35.30**	57.80**	9.35*	32.15**	2,7,8	2	-
10	CMS 145 A x ID 1020	34.49**	43.94**	6.81	29.12**	2,5,8	2,3	2,8
	SE (D)	1.76	1.29	1.48	1.48			
	CD at 1%	3.49	2.55	2.94	2.94			
	CD at 5%	4.61	3.38	3.89	3.89			

Where, 1 – Days to 50% flowering 2- Head, diameter (cm) 3- Percentage of filled seed head^{-1} (%) 4- 100 seed weight (g)
5- Harvest index (%) 6- Seed yield plant^{-1} (g) 7- Oil content (%) 8- Hull content (%)

The range of heterosis over mid parent, better parent and standard check for percentage of filled seeds head^{-1} was observed from -15.33 to 37.46, -20.73 to 35.60 and –20.54 to 8.77 per cent, respectively. The cross CMS 240 A x ID 5016 exhibited significant positive heterosis (37.46%), heterobeltiosis (35.60%) and standard heterosis (8.77%).

The average heterosis ranged from –23.48 to 39.08 per cent heterobeltiosis from –41.65 to 25.75 per cent and standard heterosis from –13.68 to 24.79 per cent for hundred seed weight. The cross CMS 240 A x ID 1078 exhibited maximum significant positive heterobeltiosis (25.75%) and standard heterosis (24.79%) respectively. The cross CMS 240 A x ID 1020 exhibited highest significant positive average heterosis (189.44%), heterobeltiosis (117.64%) and standard heterosis (95.72%) for the harvest index.

The average heterosis ranged from –15.61 to 154.28 per cent heterobeltiosis ranged from –42.27 to 91.32 per cent and standard heterosis ranged from –30.21 to 76.85 per cent for seed yield plant^{-1}. The cross CMS 240 A x ID 5016 recorded maximum significant average heterosis (154.28%), heterobeltiosis (91.32%) and standard heterosis (76.85%), respectively for seed yield plant^{-1}. The maximum significant positive average heterosis (21.84%) and heterobeltiosis (15.34%) for oil content was recorded by the cross CMS 240 A x ID 3030. The cross CMS 103 A x ID 5020 recorded maximum significant negative average heterosis (-27.50%) and standard heterosis (-23.67%) for hull content. The above results are in agreement with the findings of Jayalakshmi *et.al.* (2000) and Phad *et. al.*(2002).

Out of 40, 10 crosses were found promising on the basis of mean performance, average heterosis, heterobeltiosis and standard heterosis for seed yield plant^{-1} and other characters. The cross CMS 240 A x ID 5016 exhibited highest seed yield plant^{-1} (47.24g) with highest significant average heterosis (154.28%), heterobeltiosis (91.32%) and standard heterosis (76.85%), the same cross also exhibited significant average heterosis for characters like, head diameter, percentage of filled seeds head^{-1}, harvest index and oil content. Significant heterobeltiosis for head diameter, percentage of filled seeds head^{-1}and harvest index and standard heterosis for head diameter, 100 seed weight and harvest index. The cross CMS 336 A x ID1020 exhibited 44.01g seed yield plant^{-1} and recorded significant average heterosis (78.60%), heterobeltiosis (36.28%)and standard heterosis (64.75%) for seed yield plant^{-1} with some yield contributing characters as shown in Table 2.

The significant all three types of heterosis for seed yield and yield contributing characters was also reported in sunflower by Sassikumar and Gopalan (1999), Madrap and Nerkar (1996) and Sakhthivel (2003).

The crosses CMS 240 A x ID 1020, CMS 147 A x ID 5020, CMS 240 A x ID 3030 and CMS 60 A x ID 5020 also showed good seed yield plant^{-1} with moderate to high significant average heterosis, heterobeltiosis and standard heterosis for seed yield plant^{-1} and other yield contributing characters. These crosses were found promising and might be useful in future heterosis breeding programme.

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Correlation Studies in Some Grain Mould Tolerant Derivatives in Sorghum Genotypes

S. T. Rathod[1], S. B. Datke[2], S. M. Shinde[3], V. H. Satpute[4] and S.V. Koshatwar[5]

ABSTRACT

Correlation studies in some grain mould tolerant derived sorghum genotypes were carried out. The grain yield plant^{-1} was significantly and positively correlated with specific gravity and 1000-seed weight. Lines AKDL-13, AKDL-15, AKDL-17, AKDL-29 and AKDL-30 may provide further scope for improvement by involving in breeding. Since the selection for tolerance coupled with good yield attributer has been observed in them.

Several early maturing and high yielding hybrids were produced which replaced traditional tall varieties in sorghum. But these hybrids, however succumb to mould unlike the local cultigens due to their earliness. Grains mature during the wet weather and are more vulnerable to infection by several fungi. The grain mould problem has become very severe during recent years and posed threat to the *Kharif* sorghum cultivation. Thus resistance breeding for grain mould has become a major activity in many sorghum improvement programmes. The present study was therefore, undertaken to find out the correlation of characters among some of the derived AKDL lines, for grain mould tolerance.

MATERIAL AND METHODS

The experimental material comprised of 32 derived lines viz., AKDL-1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,14, 15,16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32 two susceptible lines AKMS-14 B and ICS-70 B, four tolerant lines IS- 14332, SVD-9601, GJ-40 and PVK-809 and two elite lines AKR-150 and RS-673 as checks. These lines were sown in randomized block design with three replications during *Kharif* 2004. The observations were recorded on five randomly selected plants from each genotype replications^{-1} on 16 characters viz. days to 50 per cent flowering, plant height (cm), panicle length (cm), panicle breadth (cm), threshed grain mould rating (TGMR), 1000-seed weight (g), seed hardness (kg/cm^2), specific gravity (gml^{-1}), electrical conductivity (dsm^{-1}) water absorption rate (ml), germination percentage, endosperm texture (%), *Curvularia* spp., (%), *Fusarium* spp., (%), other fungi spp., (%) and grain yield plant^{-1} (g) for grain yield and yield contributing components.

The simple genotypic, phenotypic and environmental correlation co-efficient were worked out from the respective variance and covariances as per by Hays, *et.al* (1955). To study the seed borne mycoflora Standard Blotter Method (SBM) of ISTA (1976) was used through the study. Electrical conductivity of the grain leachates was measured using the method of Hendricks and Taylorson (1976) with some modifications.

RESULTS AND DISCUSSION

The genotypic correlations were generally higher than the phenotypic one indicating inherent relationship between the characters (Table 1). The correlation studies indicated that grain yield plant^{-1} was significantly and positively correlated with specific gravity and 1000-seed weight. Similar results were noticed by Patel *et.al* (1980), Bhongle *et al.*, (2002) and Thorat *et al.* (2004). 1000-seed weight was

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Table 1 : Estimate of genotypic, phenotypic and environmental correlation coefficient

S.N.	Character		Plant height (cm)	Panicle length (cm)	Panicle breadth (cm)	TGMR	1000 seed weight (gt	Seed hardness (kg/cm²)	Specific gravity (g/ml)	Electrical conductivity (dsm-1)	Water chseoption rate (ml)	Germination percentage	Endosperm texture (%)	Curvularia spp	Fusarium spp	Other spp	Yield
1	Days to 50% Flo	G	0.087	-0.155	-0.055	-0.204	-0.272	0.116	-0.019	0.037	0.033	0.190	-0.134	-0.225	0.042	-0.159	0.210
		P	0.032	-0.072	-0.048	-0.124	-0.199	0.024	0.018	0.005	0.028	0.103	-0.094	-0.149	0.030	-0.104	0.125
		E	-0.117	0.046	-0.068	0.070	-0.114	-0.116	0.106	-0.152	0.093	-0.144	-0.023	0.146	0.050	-0.021	-0.132
2	Plant height	G		0.024	0.103	-0.305	-0.008	0.639**	0.292	-0.048	0.092	0.183	0.202	-0.171	-0.030	0.014	0.130
		P		0.021	0.098	-0.263	-0.005	0.533**	0.262	-0.040	0.088	0.130	-0.193	-0.069	-0.026	-0.007	0.127
		E		0.011	0.031	0.240	0.111	0.090	0.046	0.097	0.010	0.052	-0.054	0.056	0.136	0.109	0.103
3	Panicle length	G			0.402*	-0.228	-0.288	0.072	-0.083	-0.120	0.029	0.140	-0.217	0.194	-0.056	-0.350*	0.071
		P			0.355*	-0.199	-0.238	0.069	-0.039	-0.090	0.021	0.087	-0.202	0.166	-0.043	-0.297	0.038
		E			0.218	-0.102	0.006	0.061	0.114	0.094	-0.072	0.020	-0.065	0.113	0.105	-0.085	-0.201
4	Panicle breath	G				-0.095	-0.231	0.067	-0.016	-0.043	0.055	0.266	-0.263	0.041	-0.208	-0.270	0.147
		P				-0.093	-0.218	0.071	-0.042	-0.038	0.056	0.181	-0.254	0.038	0.202	-0.261	0.146
		E				-0.043	0.134	0.135	-0.325*	0.078	0.165	0.030	0.082	-0.137	0.072	0.059	0.107
5	TGMR	G					0.307	-0.127	0.062	0.142	0.016	-0.443**	0.426**	0.194	0.408**	0.479**	-0.045
		P					0.299	-0.125	0.058	0.130	0.016	-0.293	0.407**	0.191	0.397*	0.460**	0.043
		E					0.141	-0.153	0.021	-0.107	0.028	-0.012	-0.161	0.120	0.192	0.134	0.003
6	1000 seed weight	G						0.113	0.158	0.436**	0.301	-0.221	0.119	0.047	-0.012	0.335*	0.362*
		P						0.105	0.136	0.429**	0.298	-0.136	0.117	0.047	0.011	0.323*	0.350*
		E						0.119	-0.129	0.198	0.146	0.109	-0.033	0.060	0.026	-0.034	-0.059
7	Seed hard ness	G							0.167	0.117	0.183	0.490**	-0.086	-0.020	0.132	0.184	0.069
		P							0.087	0.105	0.153	0.279	-0.075	-0.023	0.108	0.160	0.044
		E							-0.218	0.073	-0.048	-0.113	-0.038	-0.0169	-0.162	0.057	-0.146
8	Specific gravity	G								-0.026	0.001	-0.166	0.067	0.006	-0.109	-0.280	0.383*
		P								-0.033	-0.005	-0.074	0.064	0.007	-0.098	-0.254	0.336*
		E								-0.133	-0.207	0.105	0.058	0.090	-0.139	-0.024	-0.155
9	Electrical cond	G									0.884**	-0.036	0.358*	0.102	-0.028	0.144	0.142
		P									0.865**	-0.045	0.349*	0.100	-0.207	0.138	0.141
		E									-0.161	-0.161	-0.063	-0.044	0.005	0.004	0.117
10	Water absorption rate	G										-0.025	0.254	0.122	-0.102	0.035	0.085
		P										-0.017	0.252	0.121	-0.101	0.036	0.085
		E										-0.000	-0.035	-0.089	0.153	0.085	0.122
11	Germination %	G											-0.429**	0.073	-0.130	-0.159	0.062
		P											-0.286	-0.043	-0.084	-0.117	0.034
		E											0.051	0.154	0.101	-0.079	-0.054
12	Endosperm texture	G												0.299	0.375*	0.320*	-0.122
		P												0.298	0.373*	0.313*	-0.122
		E												0.153	0.101	0.071	-0.143
13	Curvularia	G													0.661**	0.288	0.029
		P													0.659**	0.280	0.027
		E													-0.005	-0.123	-0.086
14	Fusarium spp	G														0.479**	-0.154
		P														0.471**	-0.152
		E														0.229	0.030
15	Other fungi spp	G															-0.292
		P															-0.278
		E															0.070

*, ** Significant at 5% and 1% level respectively 'r' value at 5% = 312 and at 1% =403

G,P,E- Genotypic, phenotypic and environmental corelation co-effecient

Table 2: Mean performance of genotypes for different characters

S. N.	Genotypes	Days to 50 per cent flowering	Plant height (cm)	Panicle length (cm)	Panicle breath (cm)	TGMR	1000seed weight (g)	Seed hardness (kg/cm^2)	Specific gravity (g/ml)	Electrical conductivity (dsm^{-1})	Water absorption rate (ml)	Germination percentage	Endosperm texture %	Curvularia ssp.	Fusarium ssp	Others fungi ssp	Grain yield plant (g)
1	AKDL-1	72.33	214.60	29.00	7.42	2.40	28.56	9.81	1.17	137.63	0.896	75.86 (59.26)	77.23 (61.50)	37.86 (37.97)	24.90 (29.93)	22.06 (28.01)	58.82
2	AKDL-2	77.33	230.93	22.4	6.75	2.40	26.73	7.99	1.10	121.80	0.387	76.00 (60.71)	74.56 (59.71)	41.56 (40.14)	30.36 (33.44)	23.56 (29.04)	48.81
3	AKDL-3	78.33	235.40	28.8	6.16	2.46	24.59	8.72	1.23	118.46	0.430	75.33 (60.27)	54.76 (47.73)	43.10 (41.03)	31.26 (34.00)	22.83 (28.54)	59.81
4	AKDL-4	73.66	205.26	27.82	7.70	2.26	29.17	8.52	1.22	125.76	0.832	68.93 (56.42)	75.53 (59.04)	66.03 (54.35)	28.36 (32.18)	21.20 (27.41)	55.92
5	AKDL-5	75.33	204.60	20.23	5.98	3.46	33.76	8.08	1.22	119.53	0.310	68.40 (55.88)	38.23 (38.19)	29.70 (33.02)	24.43 (29.62)	23.73 (29.28)	79.14
6	AKDL-6	67.00	196.80	29.75	5.88	4.26	34.66	7.87	1.23	120.26	0.428	58.66 (50.29)	72.16 (58.16)	43.63 (41.34)	32.86 (34.97)	24.83 (29.88)	59.90
7	AKDL-7	74.00	238.00	23.06	6.22	2.60	31.21	7.71	1.23	127.73	0.886	72.66 (58.52)	51.10 (45.63)	47.90 (43.89)	32.00 (34.45)	20.80 (27.13)	61.72
8	AKDL-8	73.33	226.20	23.45	6.96	2.50	35.24	9.54	1.25	116.46	0.294	72.00 (58.21)	41.40 (40.04)	51.33 (45.76)	34.16 (35.77)	25.93 (30.61)	76.11
9	AKDL-9	70.00	217.46	21.99	5.84	3.60	34.92	8.62	1.21	121.66	0.380	80.66 (63.92)	67.43 (56.43)	57.83 (49.51)	42.33 (40.59)	27.76 (31.79)	80.21
10	AKDL-10	73.00	229.13	25.52	5.63	3.40	36.94	10.60	1.02	123.83	0.541	73.86 (59.28)	70.26 (56.95)	58.26 (49.76)	50.50 (45.28)	41.06 (39.85)	44.10
11	AKDL-11	74.00	221.60	25.09	6.49	2.20	32.44	10.81	1.23	122.66	0.469	81.86 (65.18)	78.56 (62.43)	33.93 (35.62)	22.60 (28.38)	20.60 (26.99)	74.73
12	AKDL-12	72.33	243.60	25.13	6.56	3.46	34.14	10.87	1.22	121.33	0.474	76.66 (61.14)	48.33 (44.04)	48.10 (43.91)	33.66 (35.47)	23.96 (29.30)	65.02
13	AKDL-13	72.66	269.26	27.49	7.78	2.33	36.14	8.80	1.41	119.73	0.331	75.33 (60.42)	34.26 (35.82)	34.40 (35.91)	19.56 (26.25)	20.43 (26.86)	98.04
14	AKDL-14	73.00	210.00	24.55	761	3.60	27.60	9.08	1.09	119.40	0.364	69.46 (56.59)	34.50 (35.96)	37.73 (37.09)	32.16 (34.55)	24.85 (29.91)	68.65
15	AKDL-15	73.00	265.06	25.42	6.63	3.40	31.55	9.21	1.65	120.16	0.438	69.46 (56.69)	75.00 (60.00)	49.36 (44.63)	23.06 (28.70)	19.46 (26.17)	89.60
16	AKDL-16	70.33	280.06	27.18	6.98	2.40	26.73	8.29	1.22	121.33	0.479	71.73 (57.93)	63.13 (52.61)	67.23 (55.08)	41.90 (40.33)	20.20 (26.70)	54.01
17	AKDL-17	73.33	203.20	29.35	6.26	2.73	28.98	7.94	1.23	121.86	0.392	75.20 (60.76)	46.66 (43.09)	39.30 (38.82)	25.26 (30.17)	20.11 (26.67)	90.47
18	AKDL-18	76.00	165.60	23.36	5.82	2.20	29.83	7.29	1.09	117.73	0.256	76.13 (60.13)	76.66 (61.12)	34.26 (35.83)	29.63 (32.98)	21.50 (27.62)	59.10
19	AKDL-19	75.66	163.86	21.53	5.53	2.40	27.89	7.72	1.23	119.00	0.289	81.33 (64.41)	29.10 (32.64)	37.06 (37.49)	27.13 (31.39)	21.33 (27.50)	35.86
20	AKDL-20	79.66	250.73	29.43	6.48	2.20	28.10	9.55	1.17	117.73	0.286	73.20 (58.82)	46.06 (42.74)	46.03 (42.72)	31.76 (34.30)	21.16 (27.38)	34.64
21	AKDL-21	73.33	227.86	28.76	8.03	2.60	27.94	10.54	1.21	122.60	0.558	84.26 (66.64)	48.86 (44.35)	30.33 (33.42)	22.83 (28.54)	20.66 (27.03)	73.75

22	AKDL-22	74.66	180.53	29.08	7.14	4.20	22.32	8.74	1.23	117.20	0.256	76.00 (60.68)	84.06 (66.48)	83.53 (66.06)	76.76 (61.18)	22.83 (28.54)	37.00
23	AKDL-23	68.66	174.73	25.52	7.68	2.60	28.22	7.92	1.23	115.53	0.262	73.60 (59.11)	58.90 (50.13)	47.36 (43.48)	25.86 (30.57)	22.23 (28.13)	63.61
24	AKDL-24	78.33	233.66	23.83	7.60	3.53	35.03	8.68	1.20	115.33	0.216	69.06 (56.21)	61.46 (51.63)	24.60 (29.73)	43.93 (41.51)	24.56 (29.71)	27.88
25	AKDL-25	72.33	182.66	29.86	6.82	2.40	30.37	8.19	1.23	120.00	0.356	78.26 (62.21)	48.93 (44.39)	56.20 (48.56)	46.63 (43.07)	23.73 (29.15)	68.52
26	AKDL-26	76.66	177.40	29.25	7.05	2.40	22.50	7.03	1.02	119.26	0.350	71.60 (57.86)	49.53 (44.73)	47.46 (43.55)	24.40 (29.59)	18.96 (25.81)	56.55
27	AKDL-27	78.66	187.00	30.61	7.14	2.26	28.67	8.13	1.18	121.93	0.515	81.73 (64.70)	19.96 (26.53)	48.00 (43.85)	29.70 (33.02)	20.23 (26.73)	57.01
28	AKDL-28	77.00	175.60	27.88	7.01	2.40	27.82	8.53	1.33	118.53	0.314	72.20 (58.19)	47.30 (43.45)	49.33 (44.61)	29.40 (32.83)	20.33 (26.80)	73.77
29	AKDL-29	76.33	157.66	26.60	6.66	2.53	30.92	7.84	1.18	118.86	0.451	73.60 (59.14)	47.13 (43.35)	25.00 (30.00)	20.30 (26.78)	13.43 (21.50)	86.63
30	AKDL-30	73.33	173.13	28.90	6.50	2.20	33.11	7.77	1.22	119.06	0.328	67.73 (55.39)	46.26 (42.86)	44.96 (42.11)	32.90 (35.00)	18.13 (25.20)	80.78
31	AKDL-31	67.00	182.53	26.68	6.37	3.60	33.28	8.28	1.20	115.60	0.272	68.40 (55.79)	69.00 (56.17)	51.10 (45.63)	39.03 (38.66)	24.26 (29.51)	45.30
32	AKDL-32	74.00	225.53	28.73	8.49	2.40	27.86	10.52	1.14	119.26	0.39	86.00 (68.06)	19.86 (26.46)	55.83 (48.35)	27.43 (31.58)	20.53 (26.94)	72.58
33	IS-14332	63.00	305.86	32.48	7.02	1.40	18.96	10.63	1.21	106.46	0.152	82.66 (65.40)	19.40 (16.12)	30.86 (33.75)	23.93 (29.28)	17.63 (24.82)	27.79
34	SVD-9602	80.66	212.60	21.22	5.24	2.60	22.82	10.69	1.33	119.53	0.394	72.66 (58.48)	71.60 (57.80)	42.73 (40.82)	46.83 (43.18)	23.80 (29.19)	33.05
35	GL-40	73.33	197.80	28.82	6.33	2.53	20.37	8.82	1.21	118.66	0.364	74.66 (59.78)	53.40 (46.97)	34.70 (36.09)	24.43 (29.62)	19.83 (26.44)	66.34
36	PVK-809	74.66	256.26	22.02	7.19	2.40	22.60	7.82	1.14	116.13	0.273	74.66 (59.79)	50.00 (45.00)	34.66 (36.07)	25.30 (30.19)	22.43 (28.25)	64.63
37	AKR-150	67.00	126.66	27.14	7.29	4.30	27.65	7.13	1.17	120.16	0.359	73.73 (59.17)	70.76 (57.27)	50.33 (45.19)	29.03 (32.60)	23.90 (29.26)	33.21
38	RS-673	80.33	167.26	28.88	7.41	2.53	17.72	7.30	1.17	108.16	0.174	74.66 (59.78)	47.06 (43.31)	43.40 (41.20)	24.70 (29.80)	22.86 (28.56)	53.56
39	AKMS-14B	57.00	132.93	25.26	6.46	2.60	27.90	6.94	1.17	119.80	0.326	71.06 (57.46)	68.46 (55.84)	53.20 (46.83)	27.90 (31.88)	24.76 (29.84)	25.31
40	ICS-70B	73.66	157.46	25.02	7.08	4.53	32.20	7.82	1.23	125.26	0.569	75.33 (60.22)	69.23 (56.31)	34.73 (36.11)	28.40 (32.20)	24.83 (29.88)	36.02
	Range	57.00 80.66	126.66 305.86	20.23 30.61	5.24 8.49	2.20 4.53	17.72 36.94	6.94 10.87	1.02 1.65	106.46 137.63	0.152 0.896	50.29 (68.06)	26.12 (66.48)	29.73 (66.06)	26.25 (61.18)	21.5 (39.85)	25.31 98.04
	SE(m)+	2.42	7.13	1.05	0.09	0.105	0.425	0.386	0.023	0.518	0.007	1.816	0.590	0.245	0.200	0.317	2.07
	CD at 5% level	6.80	20.03	2.95	0.262	0.295	1.19	1.08	0.066	1.45	0.02	5.10	1.65	0.688	0.562	0.890	5.81

* Figure in parentheses are arc sine values

positively and significantly associated with electrical conductivity, grain yield plant $^{-1}$ and other fungi infection. Grain hardness showed significant positive association with germination percentage. These results are in conformation with the results obtained by Ghorade (1995), Bhongle *et al*., (2002) and Thorat *et al*., (2004). Specific gravity showed significantly positive correlation with grain yield plant^{-1}. Electrical conductivity exhibited positive significant association with water absorption rate and endosperm texture. Similar observations were reported by Ghorade (1995). Germination percentage from the practical point of view is an important trait in grain mould breeding programme. It revealed negative and significant association with endosperm texture. Endosperm texture had positive and significant association with *Fusarium* spp. and other fungi infection. Glueck (1977) and Glueck and Rooney (1980) reported that grain with more corneous endosperm were more likely to resist deterioration than floury endosperm which contribute towards resistance in white grain genotypes. TGMR exhibited positive and significant association with other fungi infection, endosperm texture and *Fusarium* spp., and negative significant association with germination percentage. Correlation studies indicated that *Curvularia* when predominates the infection due to *Fusarium* and other fungi are less. Weather is favourable to mould development.

It was observed from the mean values of the AKDL lines and other check genotypes under study (Table 2). AKDL lines viz., AKDL-13, AKDL-15, AKDL-17, AKDL-29 and AKDL-30 observed to be mould tolerant ones as compared to the susceptible checks and other tolerant and elite checks because they were exhibiting comparatively low values of *Curvularia, Fusarium* and other fungi infection, lower TGMR score with good germination percentage, grain hardness, 1000-seed weight and grain yield.

It was observed from Table 2 that there were significant differences in genotypes in respect of days to 50 per cent flowering. The range was 57.00 to 80.66 days. AKMS-14B seems to be earliest in flowering percentage i.e. 57.00 days. This is susceptible and because of its earliness and more chances of getting grains caught in rains. SVD-9601 was found to be the late in flowering i.e. 80.66 days and generally escape the mould incidence. Meteorological studies show that generally the late hybrids are not caught in rains. Wet weather following flowering is necessary for incidence and lower the wet period greater the mould development. (Rao and Williams, 1977). . Loose panicle shows less incidence. TGMR exhibited that material does not showed resistance. Test weight ranged from 17.72 to 36.94 g. maximum weight 36.94 g. by AKDL-10 derivative noted for its tolerance to *Curvularia* spp., variation in grain hardness observed to be significant. Lowest value of hardness was given by susceptible check AKMS-14B (6.94 kg/cm^2), while high value was recorded by derivative AKDL-12 (10.87 kg/cm^2) possessing tolerance to *Curvularia, Fusarium* and other fungi infection with good test weight. As regard specific gravity lowest specific gravity was indicated by AKDL-10 (1.02 g m^{-1}) and AKDL-26 (1.02 g m^{-1}) while highest specific gravity by AKDL-15 (1.66 g ml^{-1}).The lowest electrical conductivity recorded in IS-14332 (106.46 dsm^{-1}) and highest in AKDL-1 (137.63 dsm^{-1}). Also water absorption rate was from 0.152 to 0.896. Glueck (1977) suggested that test like rate of water absorption and electrical conductivity of leachates is very useful for screening the material at preliminary level. In respect of germination percentage showing lowest value by AKDL-6 (50.29%). The lowest endosperm texture recorded in IS-14332 (check) and highest recorded in AKDL-22. Present studies on *Curvularia* infection indicated lowest by derivative like AKDL-24 (29.73%) but it appears that AKDL-22 derivative is prone to *Curvularia* infection recording higher infection value (66.06%). As regard *Fusarium* infection it ranged from 26.25 to 61.18 per cent. AKDL-13 derived line shown lowest percentage of infection while highest value was exhibited by AKDL-22. The minimum value recorded

by AKDL-10. Lowest grain yield plant^{-1} was recorded by AKMS-14B check (25.31 g) and hig hest by AKDL-13 (98.04 g) a derived line indicating that there is a scope to evolve a good producing line with tolerance or resistance to mould.

These AKDL lines may provide future scope for improvement by involving in breeding. Since the selection for tolerance coupled with good yield attributes may be possible in segregating populations.

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Population Improvement in Safflower Using Male Sterile Plants

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ABSTRACT

The study conducted on 171 families of safflower showed high genetic advance coupled with high heritability for days to maturity, seed yield per plant, oil content (%) indicating scope for the improvement of these characters through population improvement using recurrent selection method. Thirty top progenies significantly superior over checks AKS-207 and Bhima were selected on the basis of seed yield per plant. The remnant seeds of selected progenies were composited for recombination cycle.

Safflower *Carthamus tinctorius* L. is an important *Rabi* oilseed crop of India and other countries of recent introduction. More than 60 countries of the world grow safflower, but over half is produced in India mainly for the domestic vegetable oil market. Safflower oil is rich in polyunsaturated fatty acid (linoleic acid 78%) which is important for reducing blood cholesterol level. Recently it is understood that safflower petals had got very important medicinal value. Petals used to prepare tea i.e. herbal tea which removes constipation and other health problems. Safflower gives better option to farmers in dryland crop rotation with respect to weed and disease control. Safflower crop has vast scope, as it thrives well in lighter soils and can easily adapt to saline-alkaline conditions.

Population improvement is the method applied to cross pollinated crops. Breeders are paying more attention to population improvement programs, since last four decades. The productivity of safflower is very low mainly due to lack of genetically improved cultivars with high oil content. Therefore, there is urgent need to develop improved cultivars for obtaining break through in productivity potential of this crop through genetic manipulations, which can be improved by recurrent selection. Recurrent selection is the reselection, generation after generation for gradual increasing the frequency of favourable genes and at the same time maintaining genetic variability.

MATERIAL AND METHODS

The experimental material for present study included safflower progenies segregating for genetic male sterility. Random mating population-II was developed from the male sterile plants located in the breeding field of safflower at Oilseed Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Rabi* season 2003-04. Seed set on sterile plants were composited in equal proportion and sown for recombination in open pollinated condition in isolation. Two hundred and fifty male sterile plants were tagged at the time of flowering during *Rabi* season 2004-2005 and harvested individual plant separately. Out of these 171 families with sufficient seeds were selected for evaluation. In *Rabi* 2005-06, 171 progenies along with two check varieties namely Bhima and AKS-207 were grown for evaluation in modified randomized block design with two replications as followed by Eckebil *et al.* (1977) to constitute next cycle of random mating population. Each replication consisted of nine blocks with twenty progenies along with two checks in each block. The spacing between plant to plant was 20 cm and row to row was 45 cm. Recommended package of practices for safflower were followed. Observations on ten different quantitative traits were recorded on five randomly selected fertile plants in each replication. The data were subjected for computation of genotypic (GCV) and phenotypic (PCV) coefficient of variation (Burton, 1952). Heritability in broad sense as per Burton and De Vane (1953) and genetic advance as percentage of mea (GA) according to Johnson *et al.* (1955).

RESULTS AND DISCUSSION

Analysis of variance indicated that mean square due to the progenies were significant for all the traits

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Table 1.Analysis of variance for various characters in the progenies of safflower

Source of variation	Degrees of freedom	Days to first flower	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of capitula per plant	Number of seeds per capitulum	100 seed weight (gm)	Oil content (%)	Yield per plant (gm)
Replication	1	230	138	33	40	30.41	154.34	22.78	0.07	0.19	3.38
Treatments / progenies	197	28.53**	44.94**	538.23**	79.86**	11.85**	108.48**	58.45**	0.41^{NS}	6.34**	191.46**
Error	197	8.28	5.76	1.64	9.47	2.43	17.81	17.58	0.08	0.21	8.12

* - Significant at 0.05 ** - Significant at 0.01

Table 2. Estimates of genotypic coefficients of variation, phenotypic coefficients of variation heritability in broad sense and expected genetic advance over mean of safflower progenies

Characters	Genotypic coefficient of variation	Phenotypic coefficient of variation	Heritability estimates (%)	Expected genetic advance (5%)
Days to 1st flower	3.81	5.13	55.02	4.86
Days to 50% flowering	4.92	5.60	77.27	8.02
Days to maturity	11.66	11.69	99.39	33.64
Plant height (cm)	6.43	7.25	78.80	10.85
No. of branches plant^{-1}	18.69	22.99	66.02	3.63
No. of capitula plant^{-1}	23.49	27.72	71.80	11.75
No. of seeds capitulam^{-1}	17.06	23.27	53.75	6.83
100 seed weight (gm)	6.70	8.15	67.67	0.69
Oil content (%)	6.38	6.59	93.75	3.49
Seed yield plant^{-1}	26.86	28.03	91.86	18.90

Table 3. Evaluation of improved population and base population on the basis of seed yield

S.N.	Treatments	Seed yield (kg ha^{-1})
1.	Improved population	1247.93
2.	Base population	1103.55
3.	Bhima	1389.22
4.	AKS-207	1339.11
	SE (diff) ±	85.95
	C.D. 5%	170.69

except 100 seed weight (Table 1). Similar findings were reported by Ghorpade *et al.* (1993) . For all the characters phenotypic coefficient of variation (PCV) was greater than genotypic coefficient of variation (GCV) indicating the effect of environment on the expression of characters (Table 2). Higher GCV and PCV were reported for seed yield plant^{-1} (26.86, 28.03, respectively) and number of capitula plant^{-1} (23.49, 27.72, respectively). Moderate values of GCV and PCV were observed for number of seeds per capitulum (17.06, 23.27, respectively) and number of branches plant^{-1} (18.69, 22.99, respectively). Similar results were reported by Gupta *et al.* (1996).

High genetic advance coupled with high heritability was observed for days to maturity (33.64, 99.39, respectively), seed yield plant^{-1} (18.90, 91.86, respectively), number of capitula plant^{-1} (11.75, 71.80, respectively) and plant height (10.85, 78.80, respectively). These results were also been reported by Narkhede *et al.* (1985). The occurrence of such high heritability with high genetic advance suggested the additive gene action. Therefore, it indicates that due weightage should be given to seed yield plant^{-1}, number of seeds capitulum^{-1}, plant height and oil content (%) in selection program to be followed for safflower improvement. These traits are less influenced by environment.

The top 30 progenies were selected on the basis of seed yield per plant significantly superior over checks AKS-207 and Bhima and were selected for recombination cycle in safflower population improvement programme during *Rabi* 2006. Improved population exhibited better performance than base population (Table 3).

Making use of population improvement approach through recurrent selection is expected to achieve the desired results. Because the strategy envisages the possibility of breaking undesirable linkages and accumulation of desirable genes in the population as a result of intermating and recombination. On the basis of the results recorded in the present study, it is expected that the genetic progress cycle after cycle of recurrent selection may end up in isolation of superior progenies having substantially high mean values for several desirable characters which is urgently required to minimize the oil crisis experienced.

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Efficacy and Dissipation of Chlorpyrifos and Chlorpyrifos-Methyl Against Pests of Okra

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ABSTRACT

Bioefficacy of chlorpyrifos and chlorpyrifos-methyl was tested against pests of okra *viz;* jassid, aphid and fruit borer in comparison with monocrotophos and endosulfan. A treatment schedule consisting of three sprays given at the doses of 250, 500 and 750 g a.i.ha^{-1} applied at an interval of about 15 days by initiating the first spray 7 weeks after sowing, lowered the pest incidence of sucking pests and fruit borer and also recorded more yield of healthy fruits (77.7 to 106.2 qha^{-1}) compared to untreated control (65.33 qha^{-1}). Residues were estimated by gas-liquid chromatograph equipped with electron capture detector at the detect ability limit of 0.05 ppm. Initial residues of chlorpyrifos 1.35 to 2.86 reached MRL of 0.2 in 5.18 to 10.07 days in spray treatments while initial residues of chlorpyrifos-methyl 1.45 to 2.90 ppm reached MRL of 0.1 ppm in 7.48 to 10.41 days. The residues half-lives of chlorpyrifos and chlorpyrifos-methyl were 1.79 -2.01 and 1.37-2.35 days, respectively.

Okra (*Abelmoschus esculantus* (L.) Moench) commonly known as *Bhendi* is susceptible to various pests viz., jassids (*Amrasca biguttulla biguttulla* Ishida), whitefly (*Bemisia tabaci* Gennadius), thrip (*Thrips tabaci* Lindemann) and spider mite (*Tetranychus ludeni* Zatcher) in early stage. Subsequently the shoot and fruit borer, (*Earias vittella* Fabricious and *E. insulana* Biosduval) cause considerable damage.

Okra is one of the most important crops, susceptible to jassid, aphid, whitefly and shoot and fruit borer. The losses in the yield of okra to the extent of 69 per cent have been noticed due to fruit borer (Rawat and Sahu, 1973). Krishnaiah (1980) reported 50 to 52 and 49 to 74 per cent losses due to jassid and fruit borer, respectively. Damage due to fruit borer accounts for nearly 45 per cent in Karnataka (Srinivasan and Krishnakumar, 1983), 22.5 percent in U.P. (Verma, 1985) and 25.9 to 40.9 per cent in M.P. (Dhamdhere *et.al.* 1985). Loss in the seed yield of okra due to jassid was 42.6 per cent (Mahal *et.al.* 1994).

Several chemical insecticides have been evaluated and recommended and are being used extensively by farmers to control pests of okra. Nevertheless, it is possible to some extent to minimize the load of toxic residues by applying safe and less persistent pesticides and by respecting recommended doses and safe waiting periods. Chlorpyrifos and chlorpyrifos-methyl were tested against the pests, both pesticides were also studied for their residues on okra fruits.

MATERIAL AND METHODS

A field experiment was planned in a randomized block design with three replications in treatment plot of 4.6 x 3.6 m by sowing the seeds of okra var. "Arka Anamika" on July 27, 2001. Chlorpyrifos (Dursban 20 EC) and chlorpyrifos-methyl (Reldan 50 EC) were evaluated as spray treatments at doses of 250, 500 and 750 g a. i ha^{-1} spray^{-1}. One more higher dose of 1000 g a.i. ha^{-1} of both insecticides was sprayed for the study of residues on fruits . These pesticides were compared with monocrotophos and endosulfan (@ 250 g a. i. ha^{-1}). Each spray treatment consisted of three sprays given at an interval of 15 days by initiating the first spray 45 days after sowing when the incidence of jassids / aphids was noticed. The counts were recorded on 3rd, 7th and 14th day after spray. Only nymphs of jassids and both adults and nymphs of aphid were counted. The count was taken on five randomly selected plants from each treatment plot. On each plant three leaves each from top, middle and bottom portions of the plant were

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observed to note the pest count. Per cent infestation of okra fruits due to shoot and fruit borer on number and weight basis was recorded at each picking.

Edible quality fruits harvested after last spray at an interval of 0 (2 h.), 1, 3, 5, 7, 10 and 15 days were studied for the residues. Residues of both the pesticides were estimated by Gas-Liquid Chromatograph equipped with Electron Capture Detector at the detectable limit of the 0.01 ppm. Average recovery from the fortified samples of fruits (at 0.5 and 0.1 ppm level) was 87.8 and 89.6 percent in case of chlorpyrifos and chlorpyrifos-methyl, respectively. Yield of healthy fruits recorded from each plot was taken for comparison of treatment effect.

Table 1 : Cumulative effect of different treatments on population of jassid on okra

Treatments	Doseg a.i.ha^{-1}	Number of jassids 3 leaves^{-1} plant^{-1}							
		I spray		II spray		III spray		Mean	
		A	T	A	T	A	T	A	T
Chlorpyrifos	250	2.55	1.68	7.16	2.76	5.60	2.44	5.10	2.29
Chlorpyrifos	500	2.33	1.62	6.62	2.66	5.40	2.39	4.78	2.22
Chlorpyrifos	750	2.00	1.49	5.60	2.46	5.00	2.30	4.20	2.08
Chlorpyrifos-methyl	250	2.31	1.59	6.36	2.61	4.93	2.29	4.53	2.16
Chlorpyrifos-methyl	500	2.02	1.49	5.87	2.51	4.62	2.19	4.17	2.06
Chlorpyrifos-methyl	750	1.71	1.39	5.07	2.33	4.31	2.11	3.70	1.94
Monocrotophos	250	1.98	1.50	6.31	2.61	5.09	2.31	4.46	2.14
Endosulfan	250	2.40	1.63	6.22	2.59	5.25	2.35	4.62	2.19
Control	——	3.28	1.89	12.02	3.52	9.22	3.11	8.17	2.94
S.E. (m) ±			0.07		0.13		0.17		0.07
C.D. at 5%			0.22		0.40		0.52		0.20

A=Natural count T=Transformed value

Table 2 : Average effect of different treatments on population of aphids on okra

Treatments	Doseg a.i.ha^{-1}	Number of white flies 3 leaves^{-1} plant^{-1}					
		I spray		II spray		Average	
		A	T	A	T	A	T
Chlorpyrifos	250	0.99	1.19	0.45	0.97	0.72	1.08
Chlorpyrifos	500	0.82	1.12	0.33	0.89	0.58	1.01
Chlorpyrifos	750	0.73	1.07	0.31	0.89	0.52	0.98
Chlorpyrifos-methyl	250	0.91	1.15	0.35	0.92	0.63	1.04
Chlorpyrifos-methyl	500	0.69	1.07	0.31	0.88	0.50	0.98
Chlorpyrifos-methyl	750	0.67	1.04	0.24	0.85	0.46	0.95
Monocrotophos	250	0.64	1.04	0.13	0.78	0.39	0.91
Endosulfan	250	0.39	1.15	0.89	1.13	0.89	1.14
Control	——	1.49	1.40	2.08	1.61	1.79	1.48
S.E. (m) ±			0.04		0.11		
C.D. at 5%			0.10		0.26		

A=Natural count T=Transformed value

RESULTS AND DISCUSSION

Jassid : The data on the cumulative effect of three sprays of insecticide treatments are presented in Table 1. The initial count (3 leaves^{-1}plant^{-1}) of jassid was 2.80 to 3.80. The mean count of 8.17 jassids in untreated control was significantly higher than the counts noticed in sprayed crop (3.70 to 5.10). Chlorpyrifos-methyl at 750 g a.i.ha^{-1} 4 sprayed crop was with the lowest incidence level of 3.70. However, equally effective treatments were 500 g a.i. ha^{-1} chlorpyrifos-methyl and 750 g a.i. ha^{-1} chlorpyrifos. Rest of the chemical treatments were on par with each other.

Aphid : As the incidence of aphids was almost negligible after 3 weeks from the initiation of spray treatment, the observations were not recorded after third spray. The data based on average of two sprays are given in Table 2. In unsprayed crop the aphid count of 1.79 was higher than the counts recorded in treated crop (0.39 to 0.89). As the level of aphid incidence was much low, the treatment effect was not reflected to decide the merit of particular spray treatment.

Fruit borer : The data on infestation of okra fruit borer on the basis of number and weight are presented in Table 3. Per cent infestation of fruits in unsprayed crop was 40.29 and 40.66 on the basis of number and weight, respectively. Among chemical treatments, spraying of chlorpyrifos-methyl 750 g a.i.ha^{-1} was most effective in minimizing the infestation of fruit borer. However, this treatment performed similar to chlorpyrofos 750 g a.i. ha^{-1}and endosulfan 250 g a.i. ha^{-1} . The yield data (Table 3) were not significant hence, the cumulative effect of pesticides treatment in terms of yield could not be decided. However, yield recorded in plots sprayed with chlorpyrifos-methyl 750g a.i. ha^{-1} was maximum (106.2 q ha^{-1}), followed by the same treatment at 500 g a.i ha^{-1} and chlorpyrifos 750 g a.i ha^{-1}. chlorpyrifos-methyl at 750 and 500 g a.i ha^{-1} spray treatments performed better, followed by 750 g a.i ha^{-1} chlorpyrifos in minimizing the incidence of jassids. Although, the level of aphid infestation was low, the systemic insecticide monocrotophos was most effective but on par with chlorpyrifos, chlorpyrifos-methyl and endosulfan. Moreover, damage to fruits due to borers (*Helicoverpa armigera* and *Earias insulana*) was significantly minimum in treatments of chlorpyrifos-methyl and chlorpyrifos at 750 g a.i. ha^{-1}. However, effective management of pests has been reported due to spraying of chlorpyrifos by Krishnaiah *et.al.* (1976) and Verma (1985). All these workers achieved effective control of

Table 3 : Effect of different treatments on infestation on okra fruits and yield

Treatments	Doseg a.i.ha^{-1}	% infested fruits				Yield	
		No. basis		Wt. basis		Kgplot^{-1}	Q ha^{-1}
		A	T	A	T		
Chlorpyrifos	250	32.63	34.65	32.45	34.69	9.32	77.7
Chlorpyrifos	500	28.53	32.26	30.35	33.40	10.84	90.3
Chlorpyrifos	750	25.63	30.37	27.16	31.37	11.76	98.0
Chlorpyrifos-methyl	250	31.08	33.82	32.25	34.57	11.09	92.4
Chlorpyrifos-methyl	500	27.63	31.67	29.08	32.60	11.82	98.6
Chlorpyrifos-methyl	750	24.48	29.62	25.21	30.11	12.74	106.2
Monocrotophos	250	27.95	31.88	29.73	32.98	10.11	84.3
Endosulfan	250	25.98	30.61	27.53	31.60	11.38	94.8
Control	——	40.29	39.36	40.66	39.56	7.84	65.33
S.E. (m) ±			0.65		0.87	1.24	10.36
C.D. at 5%			1.94		2.61	NS	NS

A=Natural count T= Arcsin transformation N.S. = Not significant

pests by using the dose 200 to 525 g a.i. ha^{-1} which is certainly less than the dose of 750 g.a.i. ha^{-1} found effective in the present investigation.

Dissipation of chloropyrifos : The data on dissipation of chlorpyrifos are presented in Table 4. At the normal recommended dose of 500 to 750 g a.i. ha^{-1}., the initial residues were in the range of 1.35 to 2.86 ppm. The residues half-life was 1.79 to 2.01 days. Initial residues in spray treatment at 250, 500 and 750 g a.i. ha^{-1} reached below detectable limit (BDL) of 0.05 ppm in 8.76, 10.73 and 12.15 days, respectively. The Codex Maximum Residue Limit of chlorpyrifos is 0.2 ppm (FAO, 2000). Keeping this value in view the waiting periods were worked out. The time required by initial residues to reach the MRL of 0.2 ppm was 5.18 to 10.07 days in case of spray treatment of chlorpyrifos at 250 to 750 g a.i ha^{-1}. At higher dose of 1000 g a.i. ha^{-1}., the initial residues of 3.17 ppm reached MRL (0.2 ppm) and BDL (0.05 ppm) in 11.36 and 16.77 days, respectively. Keeping in view the normal dose range of 250 to 750 g a.i. ha^{-1}, a waiting period of 6 to 11 days can be considered most appropriate if the spraying is performed in fruit bearing stage of the crop.

Dissipation of Chlorpyrifos-methyl : The data on dissipation of residues of chlorpyrifos-methyl presented in table 5, indicated that the the initial residues were 1.45, 1.87 and 2.90 ppm in spray treatments of chlorpyrifos-methyl at the rate of 250, 500 and 750 g a.i. ha^{-1}. The residue half-lives were in the range of 1.37 to 3.05 days. The initial residues reached below detectable limit of 0.05 ppm in 9.35, 11.17, 10.76 and 18.72 days after third spray of chlorpyrifos-methyl at the rate of 250, 500, 750 and 1000 g a.i. ha^{-1}, respectively. The Codex Maximum Residue Limit (MRL) specified for okra is 0.1 ppm (FAO, 2000). Residues level reached MRL of 0.1 ppm in 7.48, 9.04 and 10.41 days in spray treatment of chlorpyrifos-methyl at 250, 500, and 750 g a.i. ha^{-1}, respectively. At higher dose of 1000 g a.i. ha^{-1}., the initial residues of 3.29 ppm reached MRL of 0.1 ppm in 15.67 days. Keeping in view the normal MRL of 0.1 ppm, a waiting period of 8 to 11 days should be considered essential after spraying of chlorpyrifos-methyl at 250, 500, and 750 g a.i. ha^{-1}, in fruit bearing stage of okra crop.

In case of both the pesticides i.e. chlorpyrifos and chlorpyrifos-methyl, the worked out waiting period

Table 4 : Dissipation of chlorpyrifos on okra fruits

Days after last spray	*Mean residues in ppm (± S.D.)			
	Dose of chlorpyrifos 20 EC for spray (g a.i.ha^{-1})			
	250	500	750	1000
0	1.35 (0.04)	1.75 (0.04)	2.86 (0.06)	3.17 (0.05)
1	0.95 (0.05)	1.27 (0.05)	2.23 (0.04)	2.73 (0.04)
3	0.61 (0.04)	0.80 (0.04)	1.17 (0.06)	1.92 (0.04)
5	0.21 (0.02)	0.34 (0.03)	0.72 (0.02)	0.97 (0.04)
7	0.09 (0.02)	0.18 (0.02)	0.37 (0.04)	0.75 (0.03)
10	BDL	0.07 (0.01)	0.16 (0.04)	0.29 (0.02)
15	BDL	BDL	0.08 (0.01)	0.12 (0.02)
Reg. equation	y=3.1724-0.1683 x	y=5.6867-0.4905 x	y=5.2074-0.2887 x	y=3.5643-0.1112 x
RL_{50} (days)	1.79	1.83	2.01	2.71
T_{MRL} (days)	5.18	6.90	10.07	11.36
T_{BDL} (days)	8.76	10.73	12.15	16.77

* Mean of three replicates(± standard deviation of mean)
MRL= Maximum residue limit of 0.2 ppm
BDL= Below detectable level of 0.05 ppm

Table 5 : Dissipation of chlorpyrifos-methyl on okra fruits

Days after last spray	*Mean residues in ppm (± S.D.)			
	Dose of chlorpyrifos 50 EC for spray (g a.i.ha^{-1})			
	250	500	750	1000
0	1.45 (0.05)	1.87 (0.06)	2.90 (0.10)	3.29 (0.02)
1	1.00 (0.06)	1.35 (0.04)	2.31 (0.03)	2.37 (0.07)
3	0.68 (0.04)	0.85 (0.05)	1.28 (0.07)	2.01 (0.02)
5	0.23 (0.02)	0.31 (0.02)	0.73 (0.04)	1.03 (0.04)
7	0.10 (0.01)	0.18 (0.02)	0.40 (0.02)	0.78 (0.02)
10	BDL	0.08 (0.02)	0.20 (0.02)	0.33 (0.02)
15	BDL	BDL	0.09 (0.01)	0.12 (0.02)
Reg. equation	y=3.2031-0.1609 x	y=3.2746-0.1410 x	y=11.1131-0.8752 x	y=3.5468-0.0987 x
RL_{50} (days)	1.37	2.13	2.35	3.05
T_{MRL} (days)	7.48	9.04	10.41	15.67
T_{BDL} (days)	9.35	11.17	10.76	18.72

* Mean of three replicates(± standard deviation of mean)

MRL= Maximum residue limit of 0.1 ppm
BDL= Below detectable level of 0.05 ppm

is more than 3 days. At cultivators level observance of higher waiting is practically difficult as the okra fruits are harvested at an interval of 2 to 3 days after application of pesticides. Hence, both the evaluated pesticides should be used prior to formation of fruits only.

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Economic Appraisal of Soybean in Akola District

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ABSTRACT

The study on economic appraisal of soybean in Akola district revealed that the growth in area, production and productivity significantly increased over the period of 15 years. The area retention in soybean crop has been higher over the period. The input output ratios were greater than unity, which indicate that the soybean is the most profitable oilseed crop in Akola district.

Soybean crop has attained importance due to its nutritional and industrial value. It occupies an important place as it gets more foreign exchange from export of soya powder due to its greater demand in the international market. It is highly nutritious food item, as it contains 20 per cent oil and 40 per cent protein. In addition, it also contains 21 per cent carbohydrates, 11.5 per cent iron, 4 per cent mineral salts like calcium phosphate and many important vitamins.

As a food item, soybean has significant contribution in India, since the Indian diet is predominantly vegetarian and deficient in protein. Soybean has the potential to make significant contribution to fill the widening gap in the availability of edible oil in the country and has now emerged as an important oilseed crop with a potential to narrow down the oil and protein gap.

Soybean is getting prominence in the new cropping pattern because of its higher price and less input requirement as compared to other crops in general and cotton in particular. Soybean has an ability to grow well in a variety of soil conditions including light and black cotton soils. It can also be grown successfully under rainfed conditions on upland and sloppy land as it withstands a temporary dry spell.

Soybean crop is originated from China. In India it is cultivated in the states of Madhya Pradesh, Maharashtra, Rajasthan, Andhra Pradesh, Karantaka and Chattisgarh. In Maharashtra state, the area under soybean cultivation during 2004-2005 was 21,02,200 hectares with total production of 18,12,400 metric tones. Maharashtra is the second largest soybean growing state in the country.

In Vidarbha region the area under soybean cultivation during 2004-2005 was 13,27,600 hectares with production of 10,50,100 metric tonnes. From the statistical information available, it is surprising to note that the area under cotton and other crops is decreasing and the area under soybean is increasing practically every year in Vidarbha region.

The area under high yielding varieties of soybean in the Vidarbha is increasing, while the yields obtained are not showing appreciable increase. The general notion is that the farmers are not fully exploiting the available technology in soybean production and that's why the economic returns are not at expected level and this need to be studied. To overcome the spatial changes, the micro level study is important. Looking to this need the efforts were made to study the economic appraisal of the soybean in Akola district.

In view of above, the present study was undertaken with the following objectives.

1. To study the growth in soybean area production and productivity in Akola district.
2. To study the diversification in soybean
3. To study the economics of soybean in Akola district

MATERIAL AND METHODS

The major aspect of the study was to assess the extent of growth and instability in area, production and productivity of soybean in Akola and Washim districts combinely as per availability of data. The study was based on primary as well as secondary data collected from Akola and Washim district. The secondary data on area, production and productivity of soybean collected from various government publications. The data pertain to the period 1990-91 to 2004-2005.

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The selected farmers were stratified into three groups on the basis of size of holding viz., small farmers with size of holding upto 2 ha, medium farmers with 2 to 4 ha and large farmers with the holding 4 hectares and above.

Analytical tools

1. Estimation of growth rates

The growth in area, production and productivity was studied by estimating compound growth rates at different periods. Both linear and compound growth rates were estimated. However, finally the compound growth rate was used for the study.

The growth rate was estimated using following model.

$$Y = a \cdot b^t$$

Where,

Y = Area / production / productivity
a = Intercept
b = Regression coefficient
t = Time variable

From the estimated function, the compound growth rate was worked out by -

CGR (r) = [Antilog (log b) - 1] x 100

Where,

r = Compound growth rate

2) Degree of instability in area, production and productivity

The degree of instability in area production and productivity of soybean for different period was measured using coefficient of variation and coefficient of instability.

$$\text{Coefficient of variation (CV)} = \frac{\sigma}{X} \times 100$$

Where

$$\sigma = \text{Standard deviation} = \sqrt{\frac{(X - X)^2}{n}}$$

X = Arithmetic means

Coefficient of instability was worked out using Coppock's instability index.

$$V \log = \frac{(\log \frac{X_{t+1}}{X_t} - m)}{N}$$

$$\text{The instability index} = [\text{Antilog}(\sqrt{V \log}) - 1] \times 100$$

Where,

X_t = Area / production/ productivity of crop in year t
N = Number of years minus one
m = Arithmetic mean of the differences between the log of X_t and X_{t-1}, X_{t-2}, etc.
V log = Logarithmic variance of the series.

3 Diversification in area under soybean

The diversification in soybean was studied by using statistical method 'Markov Chain Model'. The area diverted from soybean to other crops and area gain by soybean from other crops is analyzed by this method.

4. Economics of soybean

The economics was worked out using standard cost concepts i.e. Cost-A, Cost-B and Cost-C

RESULTS AND DISCUSSION

1. Growth in area, production and productivity

An attempt was made to estimate the growth rates of area, production and productivity of soybean with the help of growth rate model explained, in methodology. The results obtained are presented in Table 1. It could be seen from Table-1 that the growth rate of area for entire period under soybean was positive (25.63%) and significant. The growth rate of soybean production for Akola and Washim districts as a whole was positive and significant i.e. 28.32 per cent over the entire period.

Productivity is the most important criteria in measuring the growth of any crop output. The success or failure of any improvement in the art of agriculture is measured by the res ultant increase or decrease in the productivity. The soybean productivity in Akola and Washim districts for entire period registered growth of 8.79 per cent, which v as significant at one per cent level. The results conform the finding of Kakde and Malthane (2007).

Table 1. Performance of Soybean in Akola districts

S. N.	Particular	Compound growth rate	Coefficient of variation	Coppocks Instability index (%)
1)	Area	25.63***	93.621	18.17
2)	Production	28.32***	117.31	23.19
3)	Productivity	8.79***	145.72	13.59

(*** - 1 per cent significant)

2 Instability in area, production and productivity

There was instability in production of soybean. Therefore, it was considered necessary to study the instability in area, production and productivity of soybean. Coefficient of variation and instability were estimated for this purpose. The results obtained are presented in the Table-1.

The coefficient of variation for soybean area for entire period was 93.62 per cent. The district witnessed very high instability of production as indicated high coefficient of variation value of 117.27 per cent for entire period. The productivity of soybean over the entire period showed coefficient of variation of 45.72 per cent.

3 Coefficient of instability

The coefficient of variation measures the absolute variations while coefficient of instability, which is also called as instability index measures the variation around the trend. It is a close approximation of the average year to year percentage variation adjusted for trend. Thus, the variation round the trend are more pronounced than the absolute variation. The instability index computed using "Coppock's instability index" are presented in Table 1.

The value of instability index for the area, production and productivity under soybean for entire period was 18.17, 23.19 and 13.59 per cent, respectively. It indicate the production was more unstable for the entire period as compared to area and productivity.

4 Dynamics of cropping pattern

A farmer changes his cropping pattern due to many social, ecological, biological and economic factors. His decisions are based on monetary returns, availability of production technologies and many others. The change in cropping pattern and contribution of crops towards retention and diversification in Akola district was worked out using "Markov Chain Approach". The results of Markov Chain analysis are presented in Table 2.

It could be seen from Table-2 that in district rice, cotton, *Kharif jowar, tur*, soybean, sunflower and other pulses comprises a major part of the cropping pattern. Farmers of Akola district retain 6 per cent of the previous years area of rice during current year. They shifted 93 per cent of the previous year area of rice to cotton and *Kharif* groundnut. However, rice gained 93 per cent area from cotton and *Kharif jowar*. With regards to *Kharif jowar* retained 58 per cent of the previous years area. They diverted 42 per cent of previous years area to rice, sunflower and other crop. However, *Kharif jowar* gained 24 per cent to previous year area from sunflower and other crop. *Tur* retained 40 per cent of the previous years area. They diverted 60 per cent of the previous years area to other crops and *Tur* gained 20 per cent area of previous years from sunflower and soybean. Sunflower retained 47 per cent of previous years area. They diverted 28 per cent area to other crop. However, sunflower gained 72 per cent of previous year area. Farmers could retained 87 per cent previous years area of soybean and diverted 6 per cent of previous years area to sunflower.

5. Economics of production of soybean

Studies on economics of production of soybean help to understand the profitability and selection of appropriate crop on the farm. The data on cost and returns from soybean are presented in Table 3.

It could be revealed from the Table 3 that gross return from, soybean production for the overall average size groups was Rs. 12351.37 per hectare. The gross return ranged between Rs. 12130.04 in small size group to Rs. 12774.08 in large size group. The overall cost 'A', cost 'B' and cost 'C' were Rs. 8943.76, Rs. 11581.86 and Rs. 12513.03, respectively. Profit at cost 'A' for

Table 2 Contribution of crops towards retention and diversification in Akola and Washim district

Crop	Rice	Kh. jowar	Tur	Sunflower	Cotton	Kh. G.nut	Soybean	Others pulses
Rice	0.06	0.00	0.00	0.00	0.25	0.69	0.00	0.00
Kh. jowar	0.01	0.58	0.00	0.10	0.00	0.00	0.00	0.31
Tur	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.60
Sunflower	0.00	0.07	0.12	0.47	0.00	0.00	0.06	0.28
Cotton	0.93	0.00	0.00	0.00	0.07	0.00	0.00	0.00
Kh. G.nut	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
Soybean	0.00	0.00	0.06	0.00	0.00	0.00	0.87	0.07
Other pulses	0.00	0.17	0.02	0.72	0.00	0.06	0.00	0.03

Table 4. Input-output ratio of soybean

S. N.	Particulars	Input-output relationship			
		Small	Medium	Large	Overall
1)	Cost 'A'	1.33	1.38	1.45	1.38
2)	Cost 'B'	1.01	1.08	1.14	1.07
3)	Cost 'C'	0.92	0.99	1.07	0.99

overall size group from soybean cultivation was 3407.00 at cost 'B' was Rs. 769.51. The net return at cost 'A' ranged between Rs. 3041.77 in small size group to Rs. 4000.27 in large size group. The results conformed with the finding of Pawar *et. al.*, (2000).

6. Input-output ratio in soybean

Efficiency of investment in the cultivation of crop is judged by calculating input-output ratio. The results are presented in Table 4.

As evident from Table 4, input-output ratios for overall size group at cost 'A', cost 'B' and cost 'C' were 1.38, 1.07 and 0.99, respectively. The input-output ratios calculated at cost 'A" and cost 'B' were greater than utility in all the size groups indicating thereby that the production of soybean was profitable. Input-output ratio at cost 'A' was highest i.e. 1.45 in large size group followed by medium 1.38 and small 1.33 size group.The soybean is the most profitable crop at Cost 'A' and Cost 'B' in Akola district, Anonymous (2005).

CONCLUSION

It is concluded from the results that the compound growth rate of area, production and productivity for entire period was positive and significant. The coefficient of variation of area, production and productivity for entire period was 93.62 per cent, 117.31 per cent and 45.72 per cent, respectively. The instability index worked out with the help of "Coppock's instability index" were 18.17, 23.19 and 13.59 per cent for area, production and productivity, respectively. The results of "Markov Chain Analysis" indicated that 5.7 per cent and 7.1 per cent of soybean grown in previous year was diverted to *Tur* and other pulses crops, respectively for the next year. The ha^{-1} total cost of cultivation of soybean for the sample as a whole was Rs. 12513.03. At overall level the ha^{-1} cost 'A', cost 'B' and cost 'C' was Rs. 8943.76, Rs. 11581.87 and Rs. 12513.03, respectively. Per hectare gross return from soybean at overall level was Rs. 12351.37. Profit at Cost 'A' and Cost 'B' for overall size group was Rs. 3407 and Rs. 769.51 respectively. The input-output at overall level at Cost 'A', Cost 'B' and Cost 'C' was 1.38, 1.07 and 0.99 respectively.

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Structural changes in Export of Indian Spices in the Context of Global Competitiveness

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ABSTRACT

The structural changes in export of spice and their global competitiveness are important aspects governing the trade related aspects under the changing scenario. They are studied using Markov Chain Model and the export competitiveness of selected commodities on the basis of Nominal Protection Coefficient computed using domestic as well as International prices. The secondary data were collected from various government publications and FAO web site. The study pertains to the year 1980 to 2004. The results of study are summarized below. The share of spices export to world exports reduced from 14.55 per cent to 7.66 per cent during 1980-81 to 2003-04. For estimation of transitional probability showed that 85 per cent share of pepper export was retained their share of previous year export to 55 per cent, 20 per cent and 14 per cent respectively. Pakistan imported 82 per cent of total Ginger export from India. Indian garlic export was retained by Bangladesh and retained 78 per cent of its previous year share.

India is World's largest producer of spices, accounting for 18 per cent of the total World trade in spices. Spices such as garlic, onion, cumin have anti-bacterial effects. In India, garlic has been traditionally used for controlling cholesterol and ginger as an antiemetic.

Under these situations it is worth to make an indepth study of structural changes in export of spices and their global competitiveness. An identification of commodities having greater comparative advantage in export is very much needed so as to plan our export strategies in near future.

The study was under taken with the following objectives.

- To study the structural changes in export of spices.
- To examine the global competitiveness of spices.

MATERIAL AND METHODS

The study was based on secondary data on export of vegetables, spices and processed products. The data were collected from various government publications and FAO web sites. The study pertains to the year 1980 – 81 to 2003 – 2004. (WWW.FAO.org & www.agricoop.com)

Structural Changes in Exports

Markov Chain technique was used to know the direction of exports over the years. Markov Chain analysis is the estimation of transitional probability matrix 'P', whose elements P_{ij} indicate the probability with which the export to the country (i) will move on to the country (j).

The diagonal elements P_{ii} of the matrix measure the probability that the commodity available for the export for that particular country is retained by the same country in the next year.

Global Competitiveness

Under liberalized economy, analysis of global competitiveness is a must for economic enterprise engaged in production of the tradable commodity. A similar study were taken by Gopal Naik *et al.* (2001). They studied WTO : Competativeness and bound tariff requirements of Indian Agril. commodities. The global competitiveness was measured in terms of Nominal Protection Coefficient (NPC) being a simplified method for assessing the competitiveness of the commodity.

Nominal Protection Coefficient (NPC)

It is the measure of divergence of domestic price from international prices and therefore it determines the degree of export competitiveness of the commodity in question, where

$$NPC = P_i^d \Big/ P_i^b$$

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Where P_i^d = Domestic Price of "i" th commodity.

P_i^b = Border Price (CI or FOB) of "i" th commodity.

When there is no protection given to the commodity its domestic price is equal to its border price and as such NPC is equal to 1.NPC more than 1 indicates the protection is given to the commodity and therefore, trade liberalization would reduce the domestic prize. NPC less than 1 indicates that the commodity is taxed and liberalization would raise the domestic price of that commodity.

RESULTS AND DISCUSSION

India's share in World Export of Spices

India at present is the largest producer, consumer and exporter of spices in the world. It grows over 50 different varieties of spices and exports spices to some 120 countries in the world. India's share of spices in world export is presented in table-1.

It revealed from table 1 that, the exports of spices were 7,48,800 crores in 1980-81 with the steady increase in export it reached to 10,22,400 in 2003-04. However, in 2001 the quantity exported was less i.e. 9,88,800 crores, the reason may be due to fall in the prices of spices. In terms of share the proportion of spices export to World export decreased from 14.55 per cent to 7.66 per cent during 1980-81 to 2003-04. The results are accordance with VPS Arora (1987).

Table 1 : India's Share in World Export of Spices:

(Rs.000' crores)

S.N	Years	World Exports	India's Exports	% share
1	1980-81	5145.60	748.80	14.55
2	1985-86	5702.40	1099.20	19.28
3	1990-91	12720.00	2808.00	22.07
4	2000-01	14817.60	2068.80	13.97
5	2001-02	10752.00	988.80	9.20
6	2002-03	11971.20	1017.60	8.50
7	2003-04	13348.80	1022.40	7.66

Source: Economic Survey 2004-05

Structural Changes in Exports

The changes in Indian export of vegetables, processed products and spices to different countries were studied by using First Order Markov Chain model. The transitional probability matrix worked out gave the diagonal elements as the probability of retention of the previous year export by the country in question and off diagonal elements indicated gain or loss in export. The results of structural changes in export is presented in table-2(a to d). for the exports of different crops.

Pepper

The results of structural changes in export of Pepper is presented in Table 2(a).

It is seen from Table 2(a) that the major countries importing pepper from India are Canada, Russia, USA and others. As far as export of pepper is concerned, Australia, Italy, UAE and UK could not continue to import pepper from India. Where as Canada, Russia, USA and other countries retained 85 per cent, 47 per cent, 53 per cent and 4 per cent probabilities of retention of respectively of their import of pepper from India.

Ginger

The results of transitional probability matrix of Ginger is presented in Table 2(b).

It is seen from Table 2 (b) that Bangladesh, Pakistan, Saudi Arabia, UK and USA were the major importing countries for Indian ginger. However, Bangladesh continued to import ginger with probability of retention as 38.42 per cent while the remaining shares were diverted to Pakistan, Saudi Arabia and other Countries.

Next to Bangladesh, Pakistan retained its share to the extent of 82 per cent and the reaming share was diverted to Bangladesh.

Garlic

The results of transitional probability matrix of Garlic are presented in Table 2(c).

Table 2(c) reveals that the major countries importing garlic from India were Bangladesh and Philippines. So far as export of garlic is concerned, Bangladesh retained its share had probability extent of 78 per cent and the remaining export was diverted to

Table No. 2(a): Transitional probability matrix of Pepper Export.

Country	Australia	Canada	Italy	Russia	UAE	UK	USA	Other countries
Australia	**0**	0	1	0	0	0	0	0
Canada	0	**0.8555**	0.01445	0	0	0	0	0
Italy	0	0	**0**	0	0	0	0	1
Russia	0	0	0.03943	**0.04784**	0.544	0.0346	0.1649	0.2282
UAE	0	0	0	0	**0**	0	1	0
UK	0.01164	0	0.0257	0	0	**0**	0	0.9626
USA	0.02121	0.0304	0.0555	0.0301	0.0148	0.04167	**0.5395**	0.2666
Other countries	0	0	0	0	0	0.0345	0.9246	**0.0409**

Table No. 2(b): Transitional probability matrix of Ginger Export.

Country	Bangladesh	Pakistan	Saudi Arabia	UK	USA	Other countries
Bangladesh	**0.3842**	0.1305	0.1575	0.0782	0.1079	0.1415
Pakistan	0.1818	**0.8182**	0	0	0	0
Saudi Arabia	0	0	**0**	0	0	1
UK	0	0	0	**0**	0	1
USA	0.9436	0	0.05636	0	**0**	0
Other countries	0	0	0	0	0	**1**

Philippines, UK, Japan and others while Japan, Phillipines and U.K. did not export Garlic from India during the current year.

Chilli

The results of Markov Chain analysis for export of Chilli is presented in Table 2(d).

The major countries who were importing chilli from India are Canada, Malysia, Pakistan, Singapur, Srilanka, UAE and other countries of which Pakistan, Singapur, UAE and Other countries retained share to the extent of 19 per cent, 8 per cent, 14 per cent and 55 per cent, respectively to its previous year share in the current year as compared to previous year share. The Canada and Malaysia did not import chilli from India during the current year.

Export competitiveness

Competitiveness of countries with respect to individual commodities in market assumes a greater role in trade in the content of implementation of WTO.

In liberalized and Globelized situation, commodity can be freely exported and imported. Hence factors like International prices, domestic and International transportation cost, agro-processing and marketing cost tends to influence resource allocation. This is so when the farmer is producing an internationally tradable commodity, which can be exported at a profit in international market or can be imported at a lower cost. The analysis of global competitiveness is must for any economic enterprise engaged in the production of tradable commodity.

In the present study, Nominal Protection coefficient (N.P.C.) as a measure of assessing competitiveness, which measures the degree of protection to the domestically produced commodity are estimated and presented in Table-3.

Pepper

India is world's largest producer of spices, It accounts for 18 per cent of the total world trade in spices Pepper is one of the important spice crops of India and accounts for 20 per cent of India's production of spices India has started producing and exporting organic black and white pepper. In the recent years, the domestic prices of pepper have fallen drastically in India due to fall in its international prices, which resulted in fall in India's pepper exports. The average NPC for export of pepper was worked out to be slightly more than unity (1.04) indicated that India had less advantage in exporting pepper.

Garlic : India exports fresh and chilled garlic, dried garlic, dehydrated garlic flakes to Bahrain, Bangladesh,

Table No. 2(c): Transitional probability matrix of Garlic Export.

Country	Bangladesh	Japan	Philippines	UK	Other countries
Bangladesh	**0.7863**	0.002259	0.1702	0.0043	0.03694
Japan	0	**0**	0	0	1
Philippines	0.9136	0.02127	**0**	0.0652	0
UK	1	0	0	**0**	0
Other countries	0.7909	0.00198	0.0451	0	**0.162**

Table No. 2(d): Transitional probability matrix of Chilli Export.

Country	Canada	Malaysia	Pakistan	Singapore	ShriLanka	UAE	Other countries
Canada	**0**	0	1	0	0	0	0
Malaysia	0	**0**	0	0	0	0	1
Pakistan	0.0084	0.1602	**0.1987**	0.0238	0.3349	0.1427	0.2596
Singapore	0.0434	0.1218	0	**0.0857**	0	0	0.749
ShriLanka	0	0	0	0	1	0	0
UAE	0	0.08305	0	0.1477	0	**0.1472**	0.3512
Other countries	0.1301	0.0791	0.1974	0	0.0636	0.9197	**0.5549**

Table 3:Nominal protection coefficient (N.P.C.)

S. N.	Crop	N.P.C.
1	Pepper	1.04
2	Garlic	1.40
3	Ginger	1.09
4	Chilli	1.05

Germany, Japan, Sri Lanka and UK. India faces tough competition from china in its exports of garlic and garlic products. The yields of garlic in china are much higher than in India. India's export of garlic declined from 8667 tonnes valued at Rs. 12.89 crores in 2000-01 to 4846 tonnes valued at Rs. 7.33 crores in 2001-02.

The average NPC of Garlic is 1.40 thereby indicates that the protection is given to garlic and therefore, trade liberalization in this situation would reduce the domestic price.

Chilli : Table 3 reveals that NPC for chilli under exportable hypothesis remained above one over the years. There by it indicated that due to liberalization would reduce the domestic price. In other words, India had comparative advantage in chilli production.

CONCLUSION

At present, India is largest producer and exporter of spices in the world. In spite of this India's share of spices export to world exports reduced from 14.55 per cent to 7.66 per cent during 1980-81 to 2003-04. As regards to export of ginger from India., Pakistan and Bangladesh contribute the maximum share. With regards to export of chilli, other countries, Pakistan and UAE retained their shares of previous years export to 55 per cent, 20 per cent and 14 per cent, respectively. The export competitiveness as measured by Nominal protection coefficient, on an average indicated that pepper, garlic, ginger and chilli are export competitive under importable hypothesis.

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Quality of Yoghurt Prepared from Goat Milk

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ABSTRACT

Yoghurt was prepared from goat milk blended with cow milk in different proportions. The chemical composition showed higher fat and protein content in goat milk yoghurt with increasing blending of cow milk. Increase in the SNF and lactose content in yoghurt, whereas decrease in the acidity of yoghurt prepared from 25 per cent goat milk blended with 75 per cent cow milk was found to be superior in the quality. While yoghurt obtained from equal proportions of cow and goat milk combination was observed to be acceptable at cheaper cost.

Yoghurt is the exotic counterpart of curd (*Dahi*). From the early origins in the Balcans and Middle East yoghurt has achieved and acclaimed worldwide, where the production of its various forms can be known as described by Robinson and Tamine (1975). Commercial production of yoghurt increased rapidly in Europe early in 20th century after Metchnikoff publications advocated consumption of sour milk to prolong human life. Yoghurt like acid *Dahi* has a thick consistency, pleasant acid taste and aroma. It may be with a firm set or may be stirred yoghurt.

India is current leader in the milk production and producing 84.6 million tonnes (2004). The contribution of milk production in India includes 55 per cent by buffaloes, 40 per cent by cow and 5 per cent by sheep and goats. The rate of increase in goat population is much higher than cattle, buffalo and sheep. Hence, the production of goat milk in total milk production will be increased. Goat milk is used for preparation of *khoa*, curd, channa, *shrikhand*, butter and *Chakka*. Tyagi and Prasad (1989) reported that in goat milk, fat globules are smaller; hence, it can be easily assimilated. Due to its richness in antibiotics, it is considered to have therapeutic value. It has also greater digestibility and contains more minerals that is very less in other milks with alkaline nature.

Yoghurt is fermented milk product and believed to be effective against both in prevention and treatment of various ailments like gastro-intestinal disorders, heart diseases, tumor development and deficiency diseases in human. Fermented milk products from goat milk played a very significant role since past securing food and money for rural people of developing countries. The present investigation has been undertaken the quality assessment study to evaluate the possibilities of goat milk with different combinations of cow milk in the preparation of good quality yoghurt.

MATERIAL AND METHODS

The present research work was undertaken at Department of Animal Husbandry and Dairying, Dr. P.D.K.V., Akola during the year of 2003-04. The experiment was planned with five combinations *i.e.* (GM : CM.) 100 : 00 (T_1), 75 : 25 (T_2), 50 : 50 (T_3), 25 : 75 (T_4) and 00 : 100 (T_5). The milk was heated at 85°C to 90°C for 15 min. and immediately cooled to incubation temperature of 37 - 42°C. The starter culture *Lactobacillus bulgaricus* and *Streptococcus thermophilus* Sp. (1:1 proportion) was incubated 2 per cent and milk kept for incubation for 6 - 8 hrs. The yoghurt transferred to refrigerator till judging. Yoghurt was analysed for fat, protein, lactose, SNF, ash and acidity as per BIS standard specifications. Sensory evaluation of yoghurt was done by offering the product to the team of Judges to put the score in 9-point Hedonic scale.

RESULTS AND DISCUSSION

1. Chemical composition of yoghurt

A) Fat content in yoghurt

It was observed that in T_1 fat per cent in go milk yoghurt was highest (4.10 %); however, when blending of goat milk with cow milk was increased, there was gradual decrease in fat per cent in yoghurt *i.e.* T_2 (4.00), T_3 (3.94) and T_4 (3.82) (Table 1). The fat content

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in T_3, T_4 and T_5 were found at par being non significant. The above findings are in agreement to those of Laxminarayana (1980) and Kumar (1994).

B) SNF content in yoghurt

It is cleared from Table 1 that the treatment T_5 contains highest SNF (9.01%). When the goat milk blended with increased levels of cow milk blending, there was gradual increase in the SNF per cent as estimated in T_2 (8.95), T_3 (8.96) and T_4 (8.99). In yoghurt SNF content showed significant differences. Shrinivasan and Anantkrishan (1964) reported 8.0 to 8.5 per cent SNF in *Dahi*.

C) Protein content in yoghurt

Statistically higher significant protein content (3.50%) was exhibited by the combination in T_3. The protein per cent in T_1 (3.74) was observed to be highest. Thus, the protein content was found to be increased with respective increase in goat milk in the yoghurt preparation. These findings are in support with Krishna *et al.* (1982) who reported that there was slight increase in the protein content.

D) Lactose content in yoghurt

It was observed that there was variation in lactose content in different treatment combinations with significant differences. The lowest value of lactose was estimated in T_1 (4.36 %); while highest in T_5 (4.80 %). The lactose per cent in T_4, T_3 and T_2 yoghurt were 4.70, 4.58 and 4.48 per cent, respectively. It indicated that, as cow milk percentage increased with goat milk for preparation of yoghurt, there was significant increase of lactose content in yoghurt. De (1980) reported the lactose percentage in the range of 4.2 to 4.6.

E) Ash content in yoghurt

It is noticed from Table 1 that the ash content of yoghurt varied significantly. There was significant increase in the ash content of yoghurt. The highest ash content was recorded in T_1 (0.81 %) and lowest in T_5 (0.71 %). Kumar (1994) reported that yoghurt showed slightly higher level of available minerals than milk.

F) Acidity content of yoghurt

The first treatment showed significantly higher acidity of 0.85 per cent over T_2 (0.84), T_3 (0.82), T_4 (0.81) and T_5 (0.80); whereas T_4 combination was appeared to be at par with T_5 combination.

The results revealed that increased blending of cow milk with goat milk for yoghurt preparation, there was significant decrease in acidity of yoghurt. Similar conclusions were drawn by Balasubramanyam and Anant Krishan (1990) and Broadway and Biju (1998).

G) Curd tension of yoghurt

The curd tension was lowest in T_1 (21.2 g) than T_5 (26.0 g), which was significantly higher than T_4 (25.4 g) and T_3 (23.8 g) and T_2 (22.2 g); where, T_4 treatment was found to be at par with control treatment (T_5). The results obtained in the present investigation are in agreement with Patil (1982).

2. Sensory evaluation of yoghurt

Sensory evaluation of yoghurt was done by offering the product to the team of Judges and put the score in 9 point Hedonic scale (Table 2).

a) Appearance

The data of appearance of yoghurt revealed that the average score of appearance decreased significantly,

Table 1 : Mean performance of the effect of goat milk and its blending with cow milk on the chemical composition of yoghurt

Treatment (GM:CM)	Fat (%)	SNF (%)	Protein (%)	Lactose (%)	Ash (%)	Acidity (%)	Curd Tension
T1 (100:00)	4.10	8.91	3.74	4.36	0.81	0.85	21.20
T2 (75:25)	4.00	8.95	3.69	4.48	0.78	0.84	22.20
T3 (50:50)	3.94	8.96	3.63	4.58	0.75	0.82	23.80
T4 (25:75)	3.82	8.99	3.56	4.70	0.73	0.81	25.40
T5 (00:100)	3.76	9.01	3.50	4.80	0.71	0.80	26.00
'F' test	sign	sign	sign*	sign*	sign*	sign	sign*
SE (m)±	0.015	0.009	0.005	0.003	0.004	0.001	0.251
CD at 0.05%	0.045	0.028	0.016	0.012	0.014	0.005	0.752

*Significant at 0.05 % level of probability

Table 2: Mean performance of sensory evaluation of goat milk yoghurt and its blending with cow milk yoghurt

Treatment (GM:CM)	Appearance	Flavour	Body & Texture	Overall acceptability
T1 (100:00)	8.80	8.04	8.00	8.40
T2 (75:25)	8.60	8.12	8.12	8.52
T3 (50:50)	8.44	8.32	8.36	8.68
T4 (25:75)	8.32	8.56	8.60	8.76
T5 (00:100)	8.20	8.76	8.80	8.94
'F' test	sign	sign*	sign*	sign*
SE (m)±	0.039	0.065	0.065	0.059
CD at 0.05%	0.116	0.196	0.196	0.177

*Significant at 0.05 % level of probability

as cow milk was increased by 25, 50 and 75 per cent with goat milk blending for preparation of yoghurt. All these treatments differ significantly from each other, whereas T_4 (8.32) treatment was found at par with T_5 (8.20) treatment.

b) Flavour

Flavour score for cow milk yoghurt in T_5 (8.76) was superior over T_4 (8.56), T_3 (8.32), T_2 (8.12) and T_1 (8.04). Whereas, T_4 was found at par with T_5. The present investigations are in the agreement with the results reported by Morgen and Garbit (2001).

c) Body and texture

Treatment T_5 (8.80) was superior over T_4 (8.60), T_3 (8.36), T_2 (8.12) and T_1 (8.00). Similarly, treatment T_4 was superior over T_3, T_2 and T_1. There was significant reduction in body and texture score of yoghurt.

d) Overall acceptability

The overall acceptability of Yoghurt exhibited that the control treatment T_5 (8.94) was significantly superior with followed by T_5 (8.76), T_3 (8.68), T_2 (8.52) and T_1 (8.40). Overall acceptability of yoghurt T_3 (50:50) and T_4 (25:75) was appeared to be at par with each other (Table 2). This result is in conformity with those of Rangappa and Acharya (1974).

From this investigation, in general, the yoghurt prepared from blending of 25 per cent goat milk with 75 per cent cow milk produced good quality yoghurt. At this level the goaty flavour was disappeared. However, 50 per cent goat milk with 50 per cent cow milk combination also produced acceptable quality yoghurt.

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Haemobiochemical Studies in Sheep Infected with *Haemonchus contortus*

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ABSTRACT

The present investigation was undertaken to study the haemobiochemical alteration in sheep infected with *H. contortus* . The study revealed lower level of Hb, PCV, TEC, serum total protein, serum albumin, serum iron, serum copper as compared to the normal healthy group. Treatment with Single oral dose of Ivermectin and Closantel restored all the altered haemobiochemical and clinical parameters to normalcy within 30th day post treatment.

Parasitism is a major problem of livestock industry in India. Among the gastrointestinal parasites of sheep, *H. contortus* is the most common and most dominant blood sucking nematode occurring in the fore stomach (abomasum) resulted into anaemia , hypoproteinaemia , loss of body weight, etc. Heavy infection causes production losses and ultimately economic losses (Thomas and Ali, 1983). The present study was undertaken with a view to find out the haemobiochemical alterations in sheep infected with *Haemonchus contortus* .

MATERIAL AND METHODS

Total of 12 sheep of either sex (3-4 years of age) maintained in a semi intensive managemental condition at sheep research unit of PGIVAS, Akola were selected for the study . All these sheep had natural infection of *Haemonchus contortus* . One additional group of 6 clinically healthy sheep negative for any parasitic egg was kept as normal healthy control (T_1) for comparison. One group (T_2) of six *Haemonchus* infected sheep was treated with Ivermectin @ 200 µg/ kg body weight once orally. Another group (T_3) of six *Haemonchus* infected sheep was treated with Closantel @ 15 mg/kg body weight orally once. Egg per gram of faeces (EPG) was determined by modified stolls dilution technique (Soulsby, 1982) prior to treatment ('0' day) and daily upto 10 days post treatment and then on 21st day post treatment.

Blood and serum samples were collected from each sheep for estimation of haemoglobin (Hb), Packed cell volume (PCV), total erythrocyte count (TEC) (Benjamin, 2001) and serum total protein , serum albumin (Autospan Test Kit on Autoanalyzer - Autochem, 2011) and serum copper and serum iron (AAS-6300 -Shimadzu make model)at various intervals before treatment ('0' day) and on 15th and 30th day after treatment . All the sheep were subjected for detail clinical examination during the study .

RESULTS AND DISCUSSION

The average values of Haemobiochemical parameters in normal healthy and helminth infected sheep at different intervals are presented in Table 1. The haematological investigation revealed reduction in Hb, PCV, TEC of haemonchus infected sheep as compared to healthy control group indicating anaemia due to the blood sucking activity of *H. contortus* (Maiti *et al.*, 1999) .This observation is in agreement with Patil *et al.* (1993), Bhat *et al.* (2004). In both the treated groups (T1 & T2) post treatment values of these parameters were found to be increased over the pretreatment level of corresponding group.

In helminthiasis serum total protein and albumin before initiation of treatment was apparently decreased than normal healthy control group (T_1) indicated Hypoproteinaemia and hypoalbuminaemia in Haemonchus infested sheep. This finding is in agreement with the finding of Patil *et al.* (1993);; Bhat *et al.* (2004), and Ramteke *et. al.*(2004).. The decrease in these parameters could be due to the continuous leakage of plasma protein through damaged mucosa, hypersecretion of mucosa and ulcers in the abomasum caused by *H. contortus* worms (Bhat *et al.*, 2004). In

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both the treated group (T_2 and T_3) , the serum total protein and serum albumin values were apparently increased over the pre-treatment values within 30th day post treatment.

Haemonchus infected sheep showed low serum iron as compared to normal healthy group. Similar finding was observed by Hamid *et al.* (1981), Waghmare (1990), Ramteke *et al.* (2004) and Siddique and Cameron (2005), who also recorded low level of serum iron in helminthiasis. The decrease in serum iron level might be due to chronic haemorrage with excessive loss of erythrocytes into the lumen of gut (Mahanta and Roychaudhary, 1978). In both the treated groups, the serum iron level was slightly increased over the pretreatment values within 30 days of treatment.

The serum copper level was lowered in haemonchus infected sheep as compared to normal healthy group (T_1). These findings are in agreement with the findings of Hucker and Young (1986) and Adogwa *et al.*, (2005), who also reported decrease in serum copper level in ruminants infected with nematodes.

This reduction in serum copper level could be due to interference in copper absorption from the gastrointestinal tract by increasing the pH of the gastric environment and thus affect the copper metabolism (Bank *et al.*, 1990). Slight increase in serum copper level in both the treatment group (T_2 and T_3) was observed. The increase might be due to elimination of parasites, restoration of abomasal pH, improvement in copper absorption and metabolism.

Table 1.Haemobiochemical status in haemonchus infected and healthy sheep at various intervals (Mean ± SE)

Parameters	Group	Pre treatment	Post treatment	
		'0' Day	15th Day	30th Day
Haemoglobin (g%)	T_1	9.06 ± 0.28	9.06 ± 0.27	9.08 ± 0.27
	T_2	6.63 ± 0.21	7.38 ± 0.29	7.35 ± 0.24
	T_3	6.4 ± 0.27	7.15 ± 0.26	7.65 ± 0.19
Packed cell volume (%)	T_1	30.50 ± 0.80	31.33 ± 1.25	33.50 ± 0.76
	T_2	26.33 ± 1.11	26.50 ± 1.14	29.50 ± 0.619
	T_3	29.17 ± 0.83	30.67 ± 0.80	31.67 ± 1.52
Total erythrocyte count (millions/cumm)	T_1	8.37 ± 0.16	8.32 ± 0.21	8.36 ± 0.15
	T_2	6.16 ± 0.16	6.71 ± 0.14	6.94 ± 0.12
	T_3	5.99 ± 0.15	8.6 ± 0.13	8.69 ± 0.1
Serum total protein (g/dl)	T_1	6.43 ± 0.11	6.51 ± 0.14	6.55 ± 0.10
	T_2	5.53 ± 0.09	6.03 ± 0.12	6.25 ± 0.05
	T_3	5.51 ± 0.36	6.51 ± 0.39	6.95 ± 0.37
Serum albumin (g/dl)	T_1	2.80 ± 0.08	2.95 ± 0.04	3.05 ± 0.04
	T_2	2.57 ± 0.04	2.87 ± 0.04	2.92 ± 0.06
	T_3	2.52 ± 0.07	2.87 ± 0.09	2.97 ± 0.04
Serum iron (µg/dl)	T_1	145.08 ± 2.54	145.22 ± 2.39	145.65 ± 2.41
	T_2	130.17 ± 3.85	131.73 ± 3.80	133.88 ± 3.82
	T_3	136.02 ± 3.98	138.20 ± 4.10	141.55 ± 3.64
Serum copper (µg/dl)	T_1	61.22 ± 1.62	61.20 ± 1.34	61.73 ± 1.42
	T_2	51.78 ± 0.61	52.45 ± 0.667	53.20 ± 0.779
	T_3	52.67 ± 0.87	55.53 ± 0.77	59.28 ± 0.77

Both the anthelmintic drugs were found highly effective in eliminating worm burden of *H. contortus* in sheep as evident by 100 per cent reduction in faecal egg count after treatment . The haemonchus affected sheep showed signs of dullness, emaciation, loss of body weight, hide bound condition, pale conjunctivae, inappetance, pot belly appearance, loss of wool crimp, dropping of head, mush faeces, soiled perineum. Both the anthelmintic drugs initiated improvement in clinical signs within the experimental period .

From the above study it is concluded that the sheep harboring *H. contortus* infection had lower value of Hb , PCV , TEC , serum total protein , serum albumin , serum iron and copper as compared to normal healthy group indicated anaemia and hypoproteinaemia. All these haemobiochemical parameters were restored to normalcy after treatment with Ivermectin and Closantel within the experimental period .

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Research Notes

Determination of Planting Ratio for Hybrid Seed Production of Sorghum

Hybrid seed production is affected by several factors such as synchronization of flowering and choice of ratios of parental lines which in turn depend upon pollen production ability of the pollinator line, vigour of parental lines, pollinator activity and wind direction. The proportion of male parent planted is an important factor in hybrid seed production. The present study was aimed at working out the optimum ratio of pollinator to seed parent in respect of sorghum hybrid CSH-14 for maximizing hybrid seed yield.

The seeds of male (R-150) and female (AKMS-14A) parental lines of hybrid CSH-14 were sown in two plots of sizes 4.5 x 4 m with 45 x 15 cm spacing in four replications The different ratio of pollinator seeds used were 1:4, 1:8, 2:4, 2:8 and 2:10. Thus, the number of male lines in these ratios was 4, 2, 6, 4 and 2, respectively and the number of female lines was 16, 16, 12, 16 and 10. The blank rows in 1:8, 2:4 and 2:10 treatments of planting ratios were 1, 2 and 6, respectively. The different replications and treatments were separated by 1 m distance and demarcated by growing thickly sown dhaincha.

The observations on plant population and seed yield were recorded and the data obtained were analyzed by using standard method for Randomized Block Design (Snedecor and Cochran, 1967). The data pertaining to plant population and seed yield in different planting ratio are presented in Table 1.

The difference in male and female plant population were significant in different planting ratio. The male plant population in 2:4 ratio was significant higher than rest of the ratio. The planting ratio 1:4 and 2:8, 1:8 and 2:10 however, were at par in this regard. This is obviously due to similar number of rows in these pairs of ratio. In case of female 1:4 and 2:8 planting ratio had significantly higher population of male and female line per row, however was at par in all the planting ratios.

The difference in seed yield/row was significant in various planting ratio. The planting ratio 2:4 recorded significantly higher seed yield than rest of the ratios. The planting ratio 1:4 was significantly superior than 1:8 and 2:10 ratios but was at par with 2:8 ratio. The later two ratios, however, were at par with each other. The higher seed yield in 2:4 ratio might be attributed to the increased proportion of male plants in 2:4 ratio from 1:4 ratio which gave ample pollens for fertilization of the respective stigma resulted in increased hybrid seed yield. The results are in conformity with those reported by Kathavate (1967). There was decrease in hybrid seed yield in 1:8 and 2:10 ratios. This might be due to poor fertilization and seed set as a result of

Table 1. Effect of planting ratio on plant population and seed yield in sorghum hybrid CSH-14.

Planting ratio	No. of rows per plot	Plant population at harvest	Plant Population at harvest		Seed yield g/row
	Male	Female	Male	Female	
1:4	4	16	68	247	687.18
1:8	2	16	81	258	508.41
2:4	6	12	102	206	806.79
2:8	4	16	68	278	623.77
2:10	2	10	29	164	427.10
S. E. (m) ±			3.70	10.56	41.62
CD at 5 %			11.40	32.55	128.26

insufficient pollen movement and inadequate pollen supply. Similar type of results were also reported by Sharma *et al.* (1986) and Khairwal and Singh (1987) in pearl millet. However, they also indicated that every possibility of increasing the planting ratio of male and female rows from 2:4 to 2:10 without affecting the seed set on female rows.

Thus the experiment conducted suggests that, the planting ratio 2:4 due to higher of population to seed parent gave higher seed yield than the rest of the ratios in the newly released sorghum hybrid CSH-14 hence may be adopted.

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Correlation Studies in Greengram

The experiment was conducted at the Instructional Farm of College of Agriculture,IGAU, Raipur (C.G.) during *Kharif* 2002, in randomized complete block design with four replications. The spacing was 30 x10 cm whereas gross plot size was 4.0 x2.4 cm with 6 genotypes of green gram. The recommended cultural practices were followed whenever necessary. Observations were recorded on five randomly selected plants from each plot for ten characters viz. plant height (cm),leaf area index, days to 50 per cent flowering, days to maturity, total dry matter (g), pods plant $^{-1}$, seeds pod $^{-1}$. Seed yeild plant^{-1} (g), seed index (g), and seed yield ha^{-1}. The yield parameters were recorded and the data were statistically analyzed as per methods given by Panse and Sukhatme (1995). Correlations were worked out as suggested by Dewey and Lu (1967).

The genotypes having highest mean plant height recorded higher yield plant^{-1}, from the positive correlation of plant height with seed yield were revealed. Similar results were also reported by Parmeswarappa et al (1993) in black gram. The positive correlation was observed between pods plant^{-1} (g). The mean total dry matter or plant^{-1} revealed positive correlation with seed yield.

The stem and leaves reached its maximum dry matter production shortly after pod formation began and quantity of dry matter was higher just before crop maturity. This might be due to translocation of leaf and stem phtosynthetic development of sink senescence of leaves.

A positive correlation of the mean total dry matter with seed yield plant^{-1}, was noticed. High dry matter with simultaneous enhancement of harvest index might contribute to increase seed yield reported by Augustinussen (1973) in field bean. A significant positive correlation of seed index with seed yield plant^{-1} was recorded. A negative correlation of leaf area index, days to 50 per cent flowering and days to maturity was observed.

A positive and significant correlation was observed between number of pods plant^{-1} and seed yield plant^{-1}. More the number of pods plant^{-1} more will be the yield plant^{-1} and ultimately more will be the yield plant^{-1}. These findings conforms the findings of Priya et

Table 1: Correlation studies in green gram genotypes

S.N.	Characters	Plant height (cm)	LAI	Days to 50 per cen flowering	Days to maturity	TDM	Pods Plant^{-1}	Seeds pod^{-1}	Seed yield plant^{-1}	Seed index (g)	Seed yield ha^{-1} (qt)
1	plant hight (cm)	1.00									
2	LAI	-0.048	1.00								
3	Days to 50 per cent flowering	-0.024	-0.105	1.00							
4	Days to maturity	0.134	-0.460	0.812*	1						
5	TDM	0.553	-0.144	-0.534	-0.056	1.00					
6	pods plant^{-1}	0.177	-0.121	-0.343	-0.718	0.265	1.00				
7	Seeds pod^{-1}	0.670	0.309	-0.568	-0.565	0.383	0.609	1.00			
8	Seed Yield plant^{-1}	0.509	-0.085	-0.505	-0.560	0.124	0.898*	0.822*	1.00		
9	Seed index (g)	0.387	-0.204	-4.76	-0.756	0.123	0.842*	0.750	0.836*	1.00	
10	Seed yield ha^{-1} (qt)	0.497	-0.109	-0.386	-0.581	0.011	0.921**	0.7566	0.989*	0.807	1.00

al (1989) and Mahajan et al (1995) and also more will be the number of seeds pod^{-1}, ultimately more will be the seed yield plant^{-1}so pods plant^{-1} and seed pod^{-1} had signficant and positive association with seed yield plant^{-1} these significantly and positive association with pods plant^{-1} and seed yield plant^{-1} these results were comformed with findings of Amarnath et al (1990). Lastly days to 50 per cent flowering showed significantly and positive correlation with days to maturity, supported by the findings of Singh et al (1995).

It could be summarized that these are the most important morph physiological characters in green gram for higher productivity and therefore they are useful to the breeders for selection of parents, hybrids or breeding material for evolving high yielding genotypes in green gram, which is an important pulse crop.

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Response of Bt Cotton Hybrids to Various Spacing and Fertilizer Levels Under Rainfed Condition

Cotton plays a vital role in Indian economy. Cotton oftenly referred as "The White Gold" or the "The King of Fibers". In India, cotton is grown on an area of 91.30 akh hectares which accounts over 27 per cent area of the world (34.1 million ha.). The present productivity of India is low i.e. 503 kg lint ha^{-1} as compared to world average of 742 kg ha^{-1}. In Maharashtra, cotton occupies about 31.24 lakh ha. area which is 31.21 per cent of the country with production of 50.00 lakh bales. Productivity of cotton in Maharashtra is too low (272 kg lint ha^{-1}) as compared to national average. (Anonymous, 2007). Recently the area under Bt cotton is increasing at faster rate (53%),due to its bollworm resistance particularly (*H. armigera).* By and large, fertilizer and plant density are the most important crop production factors. The spacing and fertilizer requirement of Bt cotton hybrids are not studied. In view of this, the present investigation was carried out to study

the effect of spacing and fertilizer levels on growth, seed cotton yield and monetary returns of Bt. Cotton hybrids under rainfed condition.

The experiment was conducted at Cotton Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.) during the *Kharif* season of 2005-06. The soil of experimental site was clayey in texture with low in available nitrogen (182.5 kg ha^{-1}), low in available phosphorous (18.7 kg ha^{-1}), and very high in available potassium (478 kg ha^{-1}), and medium in organic carbon content (3.986 g kg^{-1}). The experiment was laid out in split plot design with two main treatments a) three spacings (Si-90 x 30, S2-90 x 45 and S_3-90 x 60 cm) and b) two Bt. Cotton hybrids (V_1-NCS-913 Bt. And V_2-NCS-138 Bt.) and three fertilizer levels in sub treatments (F_1-50:25:25, F_2-75:37.5:37.5 and F_3-100:50:50 NPK kg ha^{-1} and replicated thrice. Sowing was done on dated 12/07/2005. The half dose if nitrogen and full dose of phosphorous and potassium were applied at the time of sowing and remaining half dose of nitrogen was top dressed at 30 DAE. Sucking pests were controlled by three sprays of systemic insecticides.

Data presented in Table 1 revealed that spacing of 90 x 30 cm (S_1) recorded significantly higher seed cotton yield than 90 x 45 cm (S_2) and 90 x 60 cm (83) spacing. Similarly, 90 x 45 cm also recorded significantly more yield than 90 x 60 cm. However, reverse results were observed in case of number of harvested bolls plant^{-1}. Lower density (18518 plants ha^{-1}) with wider spacing showed significantly higher number of bolls plant^{-1} than higher density (24691 and 37037 plants ha^{-1}) with closer spacing between plants. These results are in conformity with the findings of Nehra *et. al.* (2004). Maximum GMR was obtained with closer spacing of 90 x 30 cm (S_1) which was significantly superior to wider spacing (S_2 and S_3). There was significant increase in cost of cultivation with decreasing plant to plant spacing. Highest NMR and B:C ratio were recorded in S_2 treatment than S_1 and S_3 treatments.

Table 1: Seed cotton yield (kg/ha) and yield parameters as influenced by various treatments.

Treatments	Seed cotton yield (kg ha^{-1})	No. of bolls harvested plant^{-1}	Seed cotton yield plant^{-1} (g)	GMR (Rs.ha^{-1})	COC (Rs ha^{-1})	NMR (Rs ha^{-1})	BC ratio
I) Main Treatments			a) Spacing (cm)				
S_1 90x30	2304	18.64	69.75	44312	37090	7222	1.19
S_2- 90 x 45	1959	24.20	79.31	37677	28467	9210	1.32
S_3- 90 x 60	1530	26.83	89.57	29422	23650	5772	1.24
S.E(m) ±	31.08	0.77	0.85	598	---	---	---
C.D. at 5 %	97.97	2.42	2.70	1884	---	---	---
			b) Cotton hybrids				
VpNCS-913 Bt	1591	21.48	70.68	30594	29073	1521	1.05
V_2-NCS-138 Bt	2271	24.96	88.41	43680	30399	13281	1.43
S.E. (m) ±	25.39	0.63	0.70	488	---	---	---
C.D. at 5 %	79.99	1.99	2.20	1538	---	---	---
II) Sub treatments		Fertilizer levels(N, P_2O_5 & K_2O kg ha^{-1})					
F_1 -50+25+25	1814	21.94	71.90	34895	28805	6090	1.21
F_2-75+37.5+37.5	1930	23.14	79.85	37117	29772	7345	1.24
F_3 - 100+50+50	2049	24.58	86.89	39399	30631	8768	1.28
S.E (m) ±	43.17	0.42	1.20	830	---	---	---
C.D. at 5 %	126.01	1.25	3.53	2423	---	---	---

Market rate of cotton Rs. 1 923/- q^{-1}

The Bt cotton hybrid NCS-138 exhibited significantly better performance than hybrid NCS-913 in case of seed cotton yield ha^{-1}. Similarly the same hybrid (NCS-138) was also significantly superior to NCS-913 Bt cotton hybrid in respect of number of harvested bolls and seed yield $plant^{-1}$. Higher GMR, NMR and B:C ratio was observed with NCS-138 Bt cotton hybrid than NCS-193 Bt cotton hybrid.

The highest fertilizer dose (100+50+50 NPK kg ha^{-1}) recorded significantly higher seed cotton yield than RDF (50+25+25 NPK kg ha^{-1}) but it was at par with 150 per cent more dose than RDF (75+37.5+37.5 NPK kg ha^{-1}). The difference between RDF (F_1) and 150 per cent more dose than RDF (F_2) was at par. Highest fertilizer dose (F_3) produced significantly more number of bolls $plant^{-1}$ than F1 and F_2 fertilizer levels but the difference between these two levels was not significant. There was a progressive and significant increase in seed cotton yield per plant with increase in fertilizer levels. These findings are supported with work of Raut *et. al.* (2005).

Highest GMR was observed with fertilizer higher higher level (F_3) being at par with F_2 but significantly superior to F_1 (RDF). Higher NMR was noticed in F_3 treatment followed by F_1 and F_1 treatments. Similar type of trend was observed in case of B: C ratio. These finding are supported with work of Raut *et al.* (2005). Interaction effects were found not significant.

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Growth and Yield of Sunflower Influenced by Nutrient Management in Soybean-Sunflower Sequence

Soybean (*Glycine max* (L.) Merrill) being a oilseed cum legume crop respond well to sulphure, boron and zinc with recommended dose of NPK. Virtually no information is available for soybean under Akola pedoenvironment regarding differential response of NPK (alone and in combinations) with and without S,B and Zn and hence present investigation was carried out.

The experiment was conducted during 2002-03 at oilseeds Research Unit of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in Randomized Block Design with twelve treatments replicated thrice. The details of the treatments are as below

Treatments of soybean T_1-P as per RDF,T_2-NP as per RDF,T_3-NPK as per RDF,T_4-50 percent NPK as per RDF,T_5-150 per cent NPK as per RDF,T_6- NPK (RDF) + Crop residue incorporation,T_7 - NPK (RDF)+FYM 5 t ha^{-1}., T_8- NPK as per RDF,T_9- NPK as per RDF, T_{10}- NPK as per RDF,T_{11}- NPK as per RDF,T_{12}- No manures/fertilizers

Treatments of sunflower T_1-N as per RDF,T_2-NP as per RDF,T_3-NPK as per RDF,T_4-50 percent NPK as per RDF,T_5-150 per cent NPK as per RDF,T_6- NPK as per RDF,T_7- NPK as per RDF,T_8- NPK (RDF) + Sulphur @ 20 kg ha^{-1},T_9- NPK(RDF) + Sulphur + B @

Table1.An extract of data on growth and development, yield attributing characters of sunflower.

Characters	Treatments												Cd
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}	@5%
Height of plant (cm)	140. 15	137.86	142.6	139.0	145.57	145.98	163.24	161.28	160.35	170.00	147.42	133.7	11.94
Leaf area at 60 DAS (dm^{-1})	22.53	23.81	24.95	23.15	24.43	26.06	30.99	29.63	27.24	34.02	26.56	22.1	2.86
Dry matter/plant	75.38	76.28	79.26	77.04	83.43	85.24	96.0	95.18	88.93	98.81	88.43	71.1	7.00
Number of filled seed/head	480.0	489.33	510.6	490.0	624.66	588.00	653.33	624.66	636.0	704.66	615.33	422.6	51.46
Diameter of disk (cm) at harvest	9.6	10.00	10.00	10.5	10.7	10.8	11.1	10.8	10.8	12.3	10.7	8.30	1.31
100 seeds weight (gm)	3.86	3.89	4.10	3.92	4.02	3.96	4.0	4.18	4.06	5.02	4.20	2.92	0.76
Seed yield q/ha	11.53	13.01	18.18	13.13	14.33	16.29	21.16	20.2	14.95	32.27	15.97	10.4	1.86
Harvest index (%)	34.63	34.33	34.42	34.41	34.72	34.86	34.29	34.73	34.68	34.93	34.21	34.2	—
Oil content (%)	38.63	39.56	39.53	38.80	39.60	40.22	40.53	41.86	41.20	42.20	41.40	38.0	0.76
Protein content (%)	18.19	18.45	19.20	18.26	18.93	19.52	20.66	20.93	20.32	21.20	19.66	18.0	1.24

1 kg ha^{-1}. as borax in alternate year, T_{10}- NPK (RDF) + Sulphur + B + limiting micronutrient (Zn) through zinc sulphate @ 10 kg ha^{-1},T_{11}- NPK (RDF) + Sulphur + limiting micronutrient (Zn) through zinc sulphate @ 10 kg ha^{-1},T_{12}-No manures/fertilizers

Experimental soil was low in total nitrogen (0.049) and moderately high in organic carbon (0.65%), medium in available phosphorus (27 kg ha^{-1}) and highly rich in available potassium (363).Sunflower variety KBSH-1 was sown on 1st November, 2002 with proposed integrated nutrient management (Anonymous, 2003). All recommended package were followed for cultivation.

It is evident from the Table1. that sunflower crop height was found to be increased significantly with T_{10} which was at par with T_7,T_8 and T_9 at 60,75 DAS and at harvest. Total dry matter production and leaf area was significantly more in treatment T10 over other treatments. Increase in total dry matter production per plant in this treatment might be ascribed to combined effects of added production factor viz., sulphur, Boron and Zinc with NPK fertilizer by way of producing more number of leaves and photosynthesis to sink, supporting the finding of Legha and Giri (1999).

The seed yield plant^{-1} and test weight showed that treatment T_{10} (100%RDF +S+B+Zn) significantly superior over rest of the treatments. This highest seed, yield was obtained in treatment 100 percent RDF +S+B+Zn which was significantly superior over rest of the treatments. The above result conform the finding of Anonymous (2003).The same treatment statistically boosted up oil content (42.2%) as well as protein content over other treatments. Similar results were obtained by Sankaran *et al* (2001).

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Effect of Intercropping and Planting Geometry on Crude Protein and Nitrogen Uptake by Forage Sorghum

Population of milch animal in India is 219.6 million of cattle, 94.1 million of buffalo, 58.2 million of sheep and 123.5 million of goat but their productivity is very less (Anonymous 2004). Feeding of milch animals only on the cereals fodder does not lead to increase in production due to insufficient quantity of crude proteins present in them, production of milk can be increased if supply of crude proteins through fodder is increased and that can be achieved through addition of legume in fodder.

Intercropping of forage cereals with legumes enhances the total productivity and improves the quality of forages as well as maintains soil fertility. Introduction of legume with grasses increase the total biomass yield and quality of forage (Prasad *et.al.*, 1990). Legumes forage crop also make nitrogen available to cereals forage crop, thus increase the yield of main crop (cereals). In this aspect sorghum can successfully be grown along with legume fodder, especially cowpea to obtain higher yield of quality forage (Sood and Sharma, 1992).

Table 1 Nitrogen uptake by sorghum (kg/ha), crude protein percent content in sorghum and total crude protein yield (kg ha^{-1}) as influenced by different treatments.

Treatments	Nitrogen uptake by sorghum (kg ha^{-1})	Crude protein % content in sorghum	Total crude protein yield of (Sorghum + intercrop) (kg ha^{-1})
Row ratio			
R_1 - 2:1	110.80	7.94	796.47
R_2 - 3:3	122.44	8.36	950.83
R_3 - 4:2	90.28	7.06	702.05
SE ±	1.34	0.10	16.19
CD at 5%	3.90	0.30	46.92
Intercrop			
I_1 - Cowpea	126.98	8.55	990.45
I_2 - Cluster bean	92.45	7.14	695.02
I_3 - Mothbean	113.35	8.07	760.99
I_4 - Velvetbean	98.60	7.38	819.35
SE ±	1.04	0.16	14.78
CD at 5%	3.01	0.46	42.83
Interaction (Rx I)			
SE (m) ±	1.80	0.28	25.60
CD at 5%	NS	NS	NS

Therefore, attempts are made to bring about agronomic aspect of intercropping of sorghum with cowpea (*Vigna unguiculata* L. walp.), clusterbean (*Cyamopsis tetragonoloba*), mothbean (*Vigna acunitifolius Jacq.*) and velvetbean (*Stizolobium deeringianum*). It is, therefore, necessary to workout suitable intercrops with optimum row ratios (2:1, 3:3 and 4:2) that may improve the quality of sorghum forage without affecting the total yield. Thus an experiment was conducted to assess the total yields, quality and economic feasibility of sorghum var. PVK 809, and intercrops viz cowpea (Pusakomal) clusterbean (Pusanavbahar), mothbean (Local) and velvetbean (Local) under different row proportions during *Kharif* season of 2004-2005 at the farm of Department of Agronomy, Marathwada Agricultural University, Parbhani. The experiment was laid out in Split plot design with four replications.

Among the different row ratios maximum uptake of N (122.44 kg ha^{-1}) by sorghum was recorded in 3:3 row ratio and among the intercrops, higher uptake of N (126.98 kg ha^{-1}) by sorghum was recorded when sorghum intercropped with cowpea as compared to other intercrops. The results conform the finding of Ram and Singh (2003).

As regards to crude protein per cent content in sorghum, growing of sorghum with intercrops in 3:3 row ratio recorded highest crude protein of 8.36 per cent which was significantly superior over other row ratio. The lowest crude protein of 7.06 per cent was recorded when growing of sorghum with intercrops in 4:2 row ratio.

Among the intercrops, maximum crude protein was observed in sorghum intercropped with cowpea, which was significantly superior over rest of intercrops, while minimum crude protein content in sorghum was observed with clusterbean and it was on par with velvetbean. The results conform the finding of Sood and Sharma (1992).

Among the different row ratios, 3:3 row ratio recorded highest total crude protein yield (sorghum +

intercrop) of 950.83 kg ha^{-1} over other ratios. Paried row association of maize (*Zea mays*) with cowpea also gave the highest crude protein yield (Kumar and Prasad, 2003) and among the intercrops, intercropping of sorghum with cowpea gave significantly higher total crude protein yield of 990.45 kg ha^{-1} over other intercrops. The lowest total crude protein yield 695.02 $kgha^{-1}$ was recorded when growing of sorghum with clusterbean. Similar findings were also reported by Patel and Rajagopal (2003).

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Studies Determining the Proper Time of Harvest in Nagpur Mandarin

Citrus fruit is botanically classified as a hesperidium containing juice vesicles with in segments. The development of citrus fruit comprises of three major stages. According to Bain (1958) the first stage is cell division, the second stage is enlargement and the third stage is fruit maturation. Maturation is the last and most important stage of fruit development and it is biologically most active phase, often involving high metabolic activity and cellular changes which lead to physical and chemical properties of Nagpur mandarin. Changes in peel colour is one of the index commercial use for fruit maturity. The present study was aimed to determine the proper time of harvesting of Nagpur mandarin.

The experiment was carried out in the orchard of Regional Fruit Research Station, Katol, Dist. Nagpur, Maharashtra during 2005-06. Fifteen years old healthy Nagpur mandarin orchard on rough lemon rootstock was used and ten uniform fruits per tree were collected from labeled branches at ten days interval starting from January 2006 in *Mrig Bahar* during developing period of fruit. The physico-chemical analysis of fruits was carried out using the standard method.

Bain (1958) observed an increase in weight and volume of fruit during the first few months after fruit set. It is mainly due to the growth of pulp segments. The fruit size increase with development of fruit up to first week of February. This might be due to increase of fruit volume. The juice percentage increased with development of fruit.

The total soluble solid and reducing sugar content of Nagpur mandarin fruit was increased gradually with the maturity of the fruits. Harding and Fisher (1945) reported that gradual increase in the

Table 1. Physico-chemical analysis of *Mrig Bahar* fruits of Nagpur mandarin.

Date of observation	Fruit weight (g)	Fruit volume (m)	Fruit size Height (cm)	Fruit size Diameter (cm)	Juice (%)	TSS (%)	Acidity (%)	Reducing sugar (%)
24-12-2005	090	092.3	4.35	4.95	30.38	6.5	1.09	2.00
02-01-2006	115	097.5	4.70	5.07	38.26	7.8	1.02	2.15
12-01-2006	120	102.0	5.10	5.25	39.53	8.7	0.95	2.78
22-01-2006	124	110.5	5.15	5.75	43.06	9.0	0.85	3.03
01-02-2006	129	125.0	5.20	5.80	44.37	8.9	0.90	3.22
10-02-2006	137	132.5	5.25	5.98	46.40	9.1	0.83	3.30
20-02-2006	153	177.5	5.30	6.00	46.64	9.2	0.80	3.35
02-03-2006	160	180.5	5.30	6.05	48.10	9.3	0.81	3.40
10-03-2006	165	185.0	5.35	5.09	48.40	9.3	0.80	3.45

percentage of sugar, which reached the maturity in Florida grape fruit

Acidity in the juice of Nagpur mandarin showed decrease as the fruit reached to the maturity. Such trend was also observed by Harding and Fisher (1945) in grape fruits.

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Evaluation of Various Doses of Heli-cide Against *Helicoverpa armigera* on Cotton

Helicoverpa armigera is the most dreaded pest of many agriculturally important crops. As a bollworm of cotton, it causes 24.68 per cent losses of seed cotton at national level (Vadodaria *et al.*, 1998) and as high as 45.57 per cent in Maharashtra (Satpute *et al.*, 1986). Various insecticides belonging to different classes are being used for the management of this pest all over the world. However, indiscriminate and extensive use of chemical insecticides in past few decades have led to many serious problems including development of resistance. Therefore, there was always a need of an alternative pest management tactic which will be effective and ecofriendly. *Helicoverpa armigera* Nuclear Polyhedrosis Virus provides one such alternative which is host specific, effective and environment friendly pest control component. Considering the above points, an experiment was conducted to study the effectiveness of Heli-cide against *H. armigera* on cotton.

A field experiment was conducted at the experimental field of Entomology Department, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the *Kharif* season of 2005-06. Heli-cide 0.43 per cent AS was provided by Pest Control (India) Ltd., Mumb i which was compared with the HaNPV produced at Dr. PDKV, Akola. Seven treatments were tested in Randomized Block Design with three replications. Five observational plants were randomly selected from each of the net plot. All the recommended agronomic practices were followed to raise the healthy crop. Sprayings were initiated at 50 per cent flowering, in all

Table 1: Effect of different treatments on *Helicoverpa armigera* population on cotton.

Treatments	I spray			II spray			III spray		
	3DAS	7DAS	10DAS	3DAS	7DAS	10DAS	3DAS	7DAS	10 DAS
T1 - Heli-cide 0.43% AS @ 500 ml/ha	0.40	0.20	0.26	0.26	0.13	0.26	0.20	0.06	0.13
	(0.94)	(0.83)	(0.87)	(0.87)	(0.79)	(0.87)	(0.83)	(0.74)	(0.79)
T2 - Heli-cide 0.43% AS @ 1000 ml ha^{-1}	0.46	0.26	0.33	0.26	0.13	0.13	0.13	0.13	0.13
	(0.97)	(0.87)	(0.91)	(0.70)	(0.79)	(0.79)	(0.79)	(0.79)	(0.79)
T3 - Heli-cide 0.43% AS @ 1500 ml ha^{-1}	0.26	0.13	0.26	0.20	0.13	0.20	0.20	0.06	0.20
	(0.87)	(0.79)	(0.87)	(0.83)	(0.79)	(0.83)	(0.83)	(0.74)	(0.83)
T4 - Heli-cide 0.43% AS @ 2000 ml ha^{-1}	0.26	0.13	0.33	0.26	0.06	0.13	0.06	0.06	0.13
	(0.87)	(0.79)	(0.91)	(0.87)	(0.74)	(0.79)	(0.74)	(0.74)	(0.79)
T5 - Endosulfan 35 EC @ 0.07 %	0.06	0.06	0.26	0.06	0.06	0.20	0.06	0.06	0.13
	(0.74)	(0.74)	(0.87)	(0.74)	(0.74)	(0.83)	(0.74)	(0.74)	(0.79)
T6 - HaNPV (Dr. PDKV) @ 250 ml ha^{-1}	0.53	0.20	0.26	0.20	0.06	0.20	0.13	0.06	0.06
	(1.01)	(0.83)	(0.87)	(0.83)	(0.74)	(0.83)	(0.79)	(0.74)	(0.74)
T7 - Untreated control	0.80	0.80	0.80	0.66	0.60	0.53	0.40	0.33	0.26
	(1.14)	(0.83)	(1.14)	(1.07)	(1.04)	(1.01)	(0.94)	(0.91)	(0.87)
SE (m) ±	0.07	0.05	0.05	0.04	0.04	0.04	0.03	0.04	0.04
CD at 5 %	0.20	0.14	0.15	0.11	0.12	0.13	0.11	0.12	0.11

Figures in parentheses are square root transformed values

Table 2: Effect of different treatments on per cent damage due to *Helicoverpa armigera* and yield of cotton

Treatments	Pre	I spray	II spray	III spray	Yield (q ha^{-1})
T1, Heli-cide 0.43% AS @ 500 ml ha^{-1}	3.54	3.22	2.29	2.13	3.67
	(1.88)	(1.79)	(1.51)	(1.46)	
T2, Heli-cide 0.43% AS @ 1000 ml ha^{-1}	3.95	3.07	1.85	1.47	3.71
	(1.98)	(1.75)	(1.36)	(1.21)	
T3, Heli-cide 0.43% AS @ 1500 ml ha^{-1}	3.09	2.90	2.26	2.23	4.04
	(1.75)	(1.70)	(1.50)	(1.49)	
T4, Heli-cide 0.43% AS @ 2000 ml ha^{-1}	3.11	2.64	2.23	1.44	4.15
	(1.76)	(1.62)	(1.49)	(1.20)	
T5, Endosulfan 35 EC @ 0.07 %	2.63	2.63	1.39	1.44	4.21
	(1.62)	(1.62)	(1.18)	(1.19)	
T6, HaNPV (Dr. PDKV) @ 250 ml ha^{-1}	3.05	2.47	2.14	1.44	4.09
	(1.74)	(1.57)	(1.46)	(1.19)	
T7, Untreated control	4.09	4.16	4.33	3.02	2.64
	(2.02)	(2.04)	(2.08)	(1.73)	
SE (m) ±	0.23	0.17	0.18	0.11	0.13
CD at 5 %	NS	NS	0.52	0.33	0.37

Figure in parentheses are square root transformed values

three sprayings (7/ 10/2005, 18/10/2005 and 26/10/2005) were undertaken. The observations were recorded for each spraying on larval count and natural enemies on 3rd, 7th, and 10th day after spraying. Boll damage was assessed after each spraying by counting total number of bolls and the number of bolls infested on randomly selected observational plants. Also observations were recorded on yield of seed cotton and the data obtained were statistically analyzed in order to compare the effect of different treatments and results are presented in respective Tables.

The data after first spray revealed significant differences among the treatments at 3rd, 7th and 10th day after spraying. Endosulfan was found to be the best treatment having least *Helicoverpa* population. However, all the HaNPV treatments were found at par with the treatment of endosulfan. Similar trend was observed after 2nd and 3rd spray wherein endosulfan was the best, followed by the higher dose of Heli-cide, being at par with each other. During most of the observations, all the Heli-cide treatment doses as well as the HaNPV (Dr. PDKV) treatment were at par with each other and also with the endosulfan and significantly superior to untreated control (Table 1). In general, the infestation was low throughout the cropping season, which might be the reason for not having differences in treatment efficacy in some way or the other.

The data on per cent boll damage due to *H. armigera*, presented in Table 2 revealed non-significant differences among the treatments after first spraying. However, the observations after 2nd and 3rd spray recorded significant differences. Although the treatment of endosulfan recorded the lowest per cent boll damage, the Heli-cide at different doses and HaNPV (Dr. PDKV) treatment were at par with it. At second spray, the least boll damage of 1.39 per cent was recorded in endodulfan, followed by 2.14 per cent in HaNPV (Dr. PDKV) and 2.23 per cent in higher dose of Heli-cide (@ 2000 ml ha^{-1}) as compared to 4.33 per cent in untreated control. Whereas, after third spray, the per cent boll damage varied from 1.44 to 3.02 per cent. HaNPV was also reported to be effective in reducing the bollworm damage on cotton by Sarode *et al.*, (1996) and Jayraj (1991).

The data on yield of cotton recorded significant differences among the treatments (Table 2). Significantly maximum yield of 4.21 q ha^{-1} was recorded in the treatment spray of endosulfan, which was at par with

Table 3: Effect of different treatments on beneficials on cotton

Treatments	I spray		II spray		III spray	
	3DAS	7DAS	3DAS	7DAS	3DAS	7DAS
T1, Heli-cide 0.43% AS @ 500 ml ha^{-1}	0.73	0.26	0.86	0.40	0	0
	(1.10)	(0.87)	(1.16)	(0.94)	(0.70)	(0.70)
T2, Heli-cide 0.43% AS @ 1000 ml ha^{-1}	0.73	0.26	0.26	0.33	0.06	0
	(1.10)	(0.87)	(0.87)	(0.91)	(0.74)	(0.70)
T3, Heli-cide 0.43% AS @ 1500 ml ha^{-1}	0.60	0.33	0.40	0.40	0.06	0
	(1.04)	(0.91)	(0.94)	(0.94)	(0.74)	(0.70)
T4, Heli-cide 0.43% AS @ 2000 ml ha^{-1}	0.73	0.73	0.66	0.46	0.06	0
	(1.10)	(1.10)	(1.07)	(0.97)	(0.74)	(0.70)
T5, Endosulfan 35 EC @ 0.07 %	0.60	0.66	0.46	0.33	0.13	0
	(1.04)	(1.07)	(0.97)	(0.91)	(0.79)	(0.70)
T6, HaNPV (Dr. PDKV) @ 250 ml ha^{-1}	0.60	0.33	0.33	0.40	0	0
	(1.04)	(0.91)	(0.91)	(0.94)	(0.70)	(0.70)
T7, Untreated control	0.60	0.53	0.26	0.40	0.20	0.13
	(1.04)	(1.01)	(0.87)	(0.94)	(0.83)	(0.79)
SE (m) ±	0.08	0.05	0.07	0.04	0.03	0.01
CD at 5 %	NS	0.14	0.19	NS	0.09	0.04

Figure in parentheses are square root transformed values

the treatments, T4, T6 and T3 with 4.15, 4.09 and 4.04 q ha^{-1}, respectively. The next better treatments were T2 and T_1 with 3.71 and 3.67 q ha^{-1}, which were superior to untreated control, (2.64 q ha^{-1}). Sarode *et al.*, (1996) also reported that the HaNPV had significant influence on yield of cotton which lend supprot to the present findings.

Inconsistent results were obtained as far as effect of Heli-cide on beneficial insects in cotton ecosystem are concerned. The data on three days after first spray and seven days after second spray revealed non-significant differences. However, observations at 7 days after first spray revealed that the treatments, T_4 and T_5 were significantly superior over rest of the treatments. Whereas, Treatments, T_1 and T_4 were found significantly superior over rest of the treatments on 3rd day after second spray. However, after third spray, untreated control treatment was significantly superior to rest of the treatments and recorded slight but significantly more number of beneficial insects (Table 3).

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Agronomic Evaluation of Bt Cotton Hybrid RCH-2 Under Rainfed Condition

Cotton is an important cash crop of Maharashtra ranking first in acreage in the country. However, the productivity is very low because the entire area is under rainfed condition (96-97%). Looking towards the heavy consumption of pesticides for the control of bollworm, transgenic cotton i.e. Bt cotton hybrids playing a vital role for the control of bollworm thus reducing the cost on the use of conventional pesticides. Because of the novel character of Bt cotton to minimum incidence of bollworm particularly *Helicoverpa armigera* it is gaining the high popularity among the farmers and its area under cultivation is increasing (50%) day by day.

It is necessary to find out location specific package of practices for every new released Bt cotton hybrid to augment productivity. The agronomic requirement needs to be optimized for newly developed Bt cotton hybrids under rainfed situation of Vidarbha region. The production and productivity of any cotton genotypes can be improved with suitable agronomic package of practices like maintenance of optimum plant population along with appropriate application of fertilizer doses. The present investigation was carried out to study the effect of spacing and fertilizer levels on the productivity of Bt cotton hybrid RCH-2.

Table 1: Seed cotton yield, number of bolls and seed cotton yield per plant. GMR, NMR and B:C ratio as influenced by various treatments.

S. N	Treatments	Seed cotton yield (kgh^{-1})	No. of bolls $plant^{-1}$	Yield $plant^{-1}$ (g)	Boll weight (g)	GMR($Rsha^{-1}$)	Net profit (Rs ha^{-1})	B.C. Ratio
1	I. Main plot treatments	Spacing (cm)						
	(S1) - 90 x 90 (12346)	950	31.01	83.90	2.69	18047	(-)1858	0.90
	(S2) - 90 x 60 (18518)	1132	27.93	62.98	2.28	21503	1109	1.05
	(S3)- 90 x 45 (24691)	1210	27.35	55.35	2.04	22986	2177	1.10
	SE (m)±	26.05	0.90	1.26	0.11	495	-	-
	CDat 5%	90.13	NS	4.35	0.38	1713	-	-
2	II. Sub plot treatment	Fertilizer LevelsN, P_2Os & KaO kg ha^{-1})						
	FI-37.5:18.75:18.75 (75 % RDF)	1033	27.75	64.18	2.32	19631	1424	1.07
	F2 - 50 : 25 : 25 (100 % RDF)	1109	28.75	66.21	2.28	21080	625	1.03
	F3-62. 5:31.25:31.25 (125 % RDF)	1149	29.80	71.83	2.40	21825	(-) 620	0.97
	SE (m)±	21.60	0.61	2.33	0.10	411	-	-
	CDat 5%	64.19	NS	NS	NS	1220	-	-
	C.V. (%)	6.82	7.34	11.99	15.20	6.82	-	-
	Int.	NS	NS	NS	NS	NS	-	-

Interactions between spacing and fertilizer levels in respect of growth parameters were not significant.

The field experiment was conducted at Cotton Research Unit, Dr. PDKV, Akola during the *Kharif* season 2006-07. The experiment was laid out in split plot design with three spacings (SI)-90x90, (S2) - 90x60, (S3)- 90x45 cm as main treatments and three fertilizer levels Fl - 37.5 : 18.75 : 18.75 (75 % RDF), F2 - 50 : 25 : 25 (100 % RDF), F3 - 62.5 : 31.25 : 31.25 N, P_2O_5 and K_2O Kg ha^{-1} (125 % RDF) as sub plot treatments and replicated four times. The experimental field was clayey (61.2 % clay) in texture with low available nitrogen (193.8 kg ha^{-1}), Phosphorous (14.2 kg ha^{-1}) and high available potassium (427 kg ha^{-1}) with medium organic carbon content (4.13 g kg^{-1}). The newly released Bt cotton hybrid RCH-2, was sown with dibbling method in the last week of June. Half dose of nitrogen and full dose of phosphorous, potassium was applied at the time of sowing and remaining half dose of nitrogen was applied at 30 DAE. Systemic insecticides were used for the control of sucking pest. Seed cotton yield and yield contributing characters along with economics in terms of net returns were studied.

Closer spacing of 90 x 45 cm (S3) recorded significantly higher seed cotton yield than wider spacing of 90 x 90 cm (SI) but it was at par with 90 x 60 cm spacing (S2). These results are in accordance with Nehra *et al* (1982), Narkhede *et al.* (2000) and Nehra *et al* (2004). Number of bolls were more in wider spacing (SI) but differences due to various spacing were not significant. Higher values of seed cotton yield per plant and boll weight were observed in wider spacing (SI) which were significantly more than 90 x 60 cm (S2) and 90 x 45 cm (S3) spacing. There were progressive and significant increase in gross monetary returns with increasing plant density by reducing plant to plant spacing. Higher values of NMR and B:C ratio were also observed in 90 x 45 cm spacing, followed by 90 x 90 cm spacing.

Application of 125 per cent RDF (F3) recorded significantly higher seed cotton yield than 75 per cent of RDF(Fl) but it was at par with 100 per cent RDF (F2) The similar results were also reported by Raut *et al* (2005). Application of 100 per cent RDF all (F2) and 125 per cent RDF (F3) recorded statistically equal gross monetary return but these two treatments were significantly superior to 75 per cent of RDF (Fl). Reverse trend was observed in respect of NMR and B:C ratio with increasing fertilizer levels.

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Effect of Different Fertilizer Treatment on Oil Content of Soybean Grown on Vertisol

Soybean is an important oilseed as well as pulde crop of Maharashtra. A lot of work on fertililzer treatment for the crops wheat, paddy have been done. With reference to maintenance of soil health and increase in cost of fertilizers it is imperative to reduce the quantity of fertilizers and increase their efficiency, for that, nutrient availability in soil and crop should be taken in to consideration (Kanwar 1971).

It is possible to make fertilizer recommendations to farmers considering their financial conditions for higher yield. No such data are available on Soybean particularly in vertisol of maharashtra hence, this investigation was conducted in vertisol.

Kharif soybean (CV PK-472) was sown in 2000-2001 at the Department farm of Agricultural Chemistry and Soil Science, M. A. U., Parbhani with different fertilizer treatments with four replications. Six treatments contained

N_0: P_0: K_0, (T_1), N_{30}: P_{60}: K_0 (T_2), N_{38}: P_{75}: K_0 (T_3),

N_{15}: P_{24}: K_2 (T_4), N_{55}: P_{85}: K_{28}: (T_5), N_{90}: P_{146}: K_{54}(T_6)

The fertilizer material used were Urea, S.S.P and M.O.P (Table 1). The oil content of Soybean seed was estimated by soxhelt extraction method.

With the different fertilizer treatment the oil content of Soybean seed was estimated with the following formula.

$$\text{Ether extract / oil percentage} = \frac{\text{Weight of oil}}{\text{Weight of seed sample}} \times 100$$

The oil content was significantly increased in

Table 1. Treatment and fertilizers applied.

Treatments	Fertilizers applied
T_1 - Control	0: 0: 0
T_2 - Recommended dose	30: 60: 0
T_3 - As per soil test value	38: 75: 0
T_4 - 20 q ha^{-1} target seed yield	15: 24: 2
T_5 - 30 q ha^{-1} target seed yield	55: 85: 28
T_6 - 40 q ha^{-1} target seed yield	96: 146: 54

Table 2: Effect of different fertilizer treatments on oil content (percent) of Soybean.

Treatment	Oil content (percent)
T_1	17.72
T_2	19.60
T_3	29.27
T_4	19.87
T_5	19.82
T_6	18.97
SE (m) $\pm$	0.46
CD at 5%	1.40

treatment. The oil content was signivicantly increased in treatments N30: P_{60}: K_0 (T_2), N_{38}: P_{75}: K_0 (T_3), N_{15}: P_{24}: K_2 (T_4), N_{55}: P_{85}: K_{28}: (T_5) over N_0: P_0: K_0 (Control). The highest oil content was observed in treatment T3 (29.27) receiving N-38, P-75, K-0 kg ha^{-1} and superior over control (Table 2).

Any qualitative parameter depends upon the nourishment / nutrition of the crop. The oil cotent was signficantly increased in treatment receiving balanced fertilization. Similar results were reported by Nayak *et. at.* (1989) and Deshmukh *et. at.* (1994).

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Development of Manually Operated Gradual Reduction System for Extraction of Aloe Vera Gel

Aloe vera is very short-stemmed plant with thick leaves containing smoothing mucilaginous juice. Indian Aloe (Aloe barbadensis) family Lilliaceae which is known by different names in different areas such as in Gujarat 'Kuwar', in Maharashtra 'Korphad', in Punjab 'Kunwar gandal' etc. Basically it is grown in tropics and semi arid tropics quite strong and sturdy shrub, originated in South Africa, Malagasy and Arabia, in spite of its large potential its utilization has remained unearthed. It is grown in almost all parts of India, even under constant drought condition (Maiti and Chandra, 2002). Well-drained loam to coarse sandy loam soil with moderate fertility and P^H up to 8.5 is preferred for its commercial cultivation. An Aloe plantation gives commercial yield from second year to fifth year of transplanting. Genarally 3-4 picking per year can be taken up depending upon growth of plants. On an average 15-20 t ha^{-1} fresh leaf is obtained from a second year plantation. It is best suited for cultivation in arid and semiarid region specially in Rajasthan, Gujarat, Madhya Pradesh and Maharashtra. The Aloe gel contains over 75 nutrients and 200 active compounds including 20 minerals, 18 amino acids, 12 vitamines, enzymes and proteins. Priciple constituent of Aloin is a water-soluble crystalline glycoside barboloin. Among others glycoside constituent reported are isobarbalabin, B-barbaloin. Aloes also contain small quantities of free anthraquinones such as Aloe emodin and isomodin and resin (Pharm Pharmacol, 1963).

Aloe vera juice has been used mainly for therapeutic and cosmetic purposes. In the field of medicine it has a large spectrum of application, such as drug Aloe is obtained from yellow bitter juice of Aloe vera. It heals burnt superficial wounds. Aloe vera gel products may also be used internally and has beneficial effect on peptic ulcers. Aloe vera has been shown earlier to exert a stabilizing effect on blood sugar, diabetic and include prevention of asthma, kidney stone and relief of arthris pain. It is also used in eye troubles and liver ailments. The leaf juice forms an important use for constituents of a large number of Ayurvedic preparations and also used in veterinary medicine. Aloe vera fresh juice is useful in fevers, pulp is used on uterus and root is used in colic. Similarly in cosmetic it has vast potential use. The juice extracted from its mature leaves is used in cosmetic industry for preparation of shampoo, moisturizer, body lotion, hair oil etc.

Shifting pattern of agriculture and cultivation has inspired few farmers to go for Aloe vera cultivation but the end effect is not encouraging probably due to exploitation in the market. Many times the cost of transportation is not being met out through scale of Aloe vera leaves. This gloomy picture of present situation has a hidden challenge to establish a technological milestone, so that a farmer can go for primary processing of their produce and sale the product directly to the cosmetic and pharmaceutical industries. This will not only help the industry but city garbage will also be reduced which is often the disposal of factory. Thus the pollution will be eliminated and environment will be protected. The farmer can recycle the plant waste and convert it into vermicompost, which will be useful for its land.

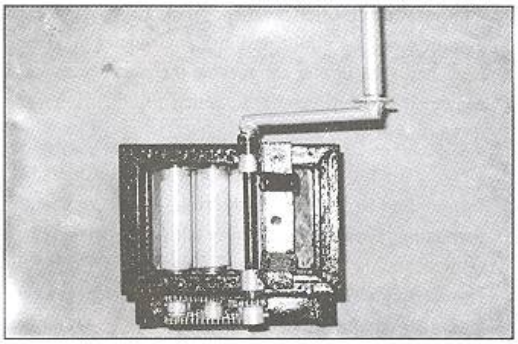
To fulfill this dream of integral business, a farmer has to go for production, processing and marketing. Therefore, need was felt to develop an on-farm technology for extraction of juice from Aloe vera leaves. Extraction of gel from Aloe vera leaves is a tedious, time consuming operation and also giving lower recovery. Thus Aloe vera gel extractor was devised consisting of a pair of roller through which Aloe leaf passes and 83 per cent extractability was obtained. It was observed that the fresh leaf is frequently broken into pieces while passing through the extractor (Thakare and Das, 2003). Thus a modified system to extract gel has been developed in the department of Agricultural Process Engineering, Dr.PDKV Akola, consisting of three pairs of rollers with gradual reduction of clearance that will do the job efficiently. Due to lack of electricity

in rural region manually operated extractor is preferred over mechanically operated extractor.

An extractor was developed consisting of three pairs of roller with gradual reduction of clearance. The clearance between rollers of pair was adjusted to extract maximum gel from Aloe leaves of varring thickness. Each roller was held firmly in two bushes (Inner and outer diameter of 17 mm and 25 mm, respectively) on two sides fixed on frame with the help of U-bolt. The roller dimensions are 200 mm and 37 mm as length and diameter, respectively. PVC coating of 3 mm thickness is provided over the roller. Roller length turned out from left side and right side are 50 mm and 25 mm respectively. Ten toothed gears of 19 mm diameter and 14 teeth were installed on left side of these rollers connected by chain. A handle was fixed on shaft, which is held on two bushes attached to angle iron plate. Also idle gear was installed on this shaft for revolving upper and lower roller assembly in opposite direction. Whole assembly of roller was installed on MS rectangular pipe frame. The leaves of Aloe vera plant are procured and cleaned with moist cloth. The clean leaf was fed between the rollers. In gradual reduction system of extractor the clearance between rollers of a pair is gradually reduced from first pair to third pair of roller. This clearance can be adjusted with four nut-bolt fixed on frame. Rotation of rollers causes the gradual extraction of gel. This

Table 1: Aloe vera leaf dimensions.

S.N.	Length (mm)	Width (mm)	Thickness (mm)
1	340	28.50	7.16
2	475	52.50	12.66
3	520	97.16	23.00
4	510	80.16	17.33
5	490	61.83	19.00
6	505	72.33	17.66
7	560	87.00	17.00
8	550	72.66	16.33
9	480	54.16	12.00
10	460	70.16	19.66
Avg. (mm)	489	67.65	16.18



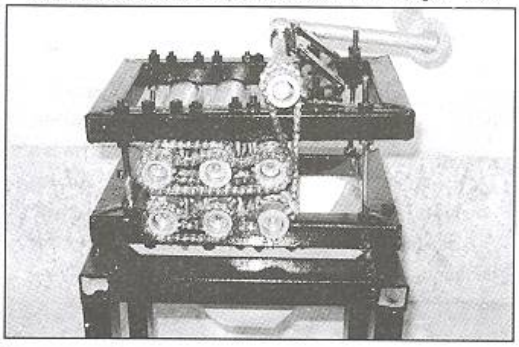


Table 2: Performance evaluation of developed extractor.

S.N.	Wt. of leaf (g)	Extraction time (min)	Wt. of peel (g)	Gel Wt .(g)	Gel loss (g)	Juice Recovery (%)	Extract ability (%)	Capacity (kg h^{-1})
1	121.42	2.0	40.23	51.56	4.91	42.38	91.23	3.64
2	178.12	1.5	59.66	65.30	12.50	36.66	83.93	7.12
3	195.82	2.0	58.15	100.47	4.33	51.30	95.86	5.87
4	191.10	2.0	65.59	100.50	2.01	52.59	98.03	5.73
5	197.60	2.5	74.82	94.71	6.77	47.93	93.32	4.74
6	292.91	2.0	89.69	171.89	6.76	58.68	96.21	8.78
Avg.						48.26	93.10	5.98

extracted gel gets collected in trapezoidal collection hopper firmly held on frame to collect all gel.

The overall dimensions of leaves i.e. Length, breadth and thickness were measured with the help of scale and vernier caliper and results obtained are given in Table 1.

From above observations an average dimension of Aloe vera leaf are 489 mm, 67.64 mm and 16.18 mm as length, breadth and thickness, respectively.

Performance test of extractor was carried out for various sizes of leaf. The weight of peel and gel was measured. Gel adhered to peel was separated manually and weighted as gel loss. The observations noted are given in Table 2.

The capacity, extractability and recovery of extractor were calculated with formulae given below

$$\text{Capacity (kg h}^{-1}\text{)} = \frac{\text{Wt. of leaf (g)}}{\text{Time (min)}}$$

$$\text{Extractability (\%)} = \frac{\text{Wt. of gel (g)}}{\text{(Wt. of gel + gel loss) (g)}}$$

$$\text{Recovery (\%)} = \frac{\text{Wt. of gel (g)}}{\text{Wt. of leaf (g)}}$$

The average gel recovery, extractability and capacity were found to be 48.26 per cent, 93.10 per cent and 5.98 kg h^{-1} respectively. Extractability obtained is 10 per cent higher than single pair extractor. Also extraction capacity was found 50 per cent higher than single pair extractor.

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Sodicity of Irrigation Water in Relation to Precipitation / Dissolution of Calcium Carbonate

SAR of irrigation water has a strong influence on SAR of equilibrium, indicating that concentration of CO_3^{--} and HCO_3^- ions (Bower *et al.*, 1965 and Cass, 1980), ion pair formation (Graffin and Jurinak, 1973) and precipitation/ dissolution of $CaCO_3$ in soil also influence the SAR of the equilibrium soil solution. Langelier (1936) has devised an index termed as saturation index (SI) for indicating the extent to which waters flowing in a close system (no loss of CO_2) will precipitate or dissolve $CaCO_3$. The saturation index is defined as the actual pH of water (pHa) minus the theoretical pH (pHc) that the water would have if it were in equilibrium with $CaCO_3$. If SI is positive, then it indicates that $CaCO_3$ precipitates from the water whereas negative value indicates that the water dissolve $CaCO_3$.

An investigation entitled "Sodicity of irrigation water in relation to precipitation/ dissolution of $CaCO_3$". Ground water samples from 20 wells in cultivator's fields at identified villages from Akola and Amravati districts were collected during the last week of September 2000. These water samples and artificial water samples after equilibrium with $CaCO_3$ were

Table 1: Ionic composition, pHc, SI and Δ SAR of ground water samples after equilibration with $CaCO_3$

Sample No.	Farmer's Name	Village	Cations ($meqL^{-1}$)				Anions ($meqL^{-1}$)				SAR	RSC	pHc	SI	ΔSAR
			Na^+	K^+	Ca^{++}	Mg^{++}	CO_3^-	HCO_3	Cl^-	SO_4					
1	Suresh Khatre	Sersoli	9.5	0.9	2.8	27.2	15.2	18	3.8	3.4	1.73	3.2	6.93	0.51	-1.45
2	Khangi Patil	Malkapur	3.5	0.7	4.3	12.7	11.2	6.4	2.4	1.2	0.84	0.6	6.98	0.53	-0.94
3	Gangabai Agrawal	Kharap	32.8	30.0	10.5	5.5	6.4	7.6	54.0	10.8	4.37	Nil	6.80	0.76	3.42
4	Shriram Gonchewar	Kharap	3.8	1.4	3.9	14.5	8.0	3.6	2.6	9.4	0.88	Nil	7.26	0.60	-0.67
5	Kiran Chawrasia	Kharap	3.0	1.0	4.1	8.5	8.0	11.6	1.4	-	0.84	7.0	6.86	0.77	-0.60
6	M.S.. Balinge	Yawalkhed	49.8	50.0	18.7	21.5	16.8	2.4	69.0	11.8	6.76	Nil	6.62	0.62	5.47
7	Ramrao Chandarkar	Akola	32.6	3.9	12.4	33.8	3.2	2.8	72.8	3.9	4.00	Nil	6.82	0.56	-1.74
8	Gajanand Vikbe	Mahispur	10.4	8.7	3.8	10.96	20.0	9.6	12.2	-	2.74	15.2	6.77	0.62	-0.87
9	Dilip Dewani	Washim	30.7	7.9	10.1	20.5	7.2	0.8	57.6	3.6	5.54	Nil	7.12	0.60	-2.17
10	Kiran Chore	Malu	27.0	0.9	2.1	4.3	29.6	18.4	15.0	21.6	10.6	41.6	6.87	0.83	-5.47
11	Baliram Gawali	Apatapa	23.2	26.8	5.3	15.3	26.4	0.8	21.8	-	5.11	5.0	7.15	0.59	-2.26
12	Haribhahu Bhakre	Kalamba	13.1	3.5	5.8	13.0	6.4	8.2	23.6	-	3.02	Nil	7.18	0.39	0.79
13	Ramesh Rode	Chindawad	24.8	6.0	2.5	6.5	32.0	21.5	12.2	-	8.26	44.6	6.93	1.11	-9.3
14	S.R. Karande	Sangwa	19.8	0.6	2.8	5.8	31.2	19.6	6.0	-	6.75	42.2	7.00	1.43	-12.75
15	R.S. Jaiswal	Daryapur	8.0	0.5	2.3	5.9	10.4	9.6	5.0	-	2.79	11.8	7.25	0.44	-1.80
16	Vishnupant Ramteke	Antora	40.9	1.3	7.1	10.3	24.8	0.4	60.8	-	9.8	3.4	6.02	0.01	-1.47
17	Nur. Ahemad Rasid	Sasan	39.2	0.6	20.3	30.5	30.4	20.8	38.6	-	5.02	Nil	6.95	1.65	-8.32
18	Ganesh Puri	Daryapur	11.8	0.5	4.2	8.0	17.6	10.0	9.0	-	3.37	15.4	6.82	0.28	0.07
19	Kailash Dongardive	Itki	26.6	0.5	3.5	6.9	28.0	23.6	12.4	-	8.24	41.2	6.66	0.95	-2.56
20	Devrao Borkar	Nardoda	49.7	60.0	10.3	29.8	4.0	7.2	74.6	24	5.9	Nil	6.87	0.44	1.07

Table 2: Ionic composition, pHc, SI and ΔSAR of artificial water after samples equilibration with $CaCO_3$

Sample No.	Farmer's Name	Village	Cations ($meqL^{-1}$)				Anions ($meqL^{-1}$)				SAR	RSC	pHc	SI	ΔSAR
			Na^+	K^+	Ca^{++}	Mg^{++}	CO_3^-	HCO_3^-	Cl^-	SO_4					
1	Suresh Khatre	Sersoli	17.9	2.6	3.6	3	-	1.8	3.6	15.7	6.99	0.6	7.94	-1.07	-3.91
2	Khangi Patil	Malkapur	15.8	1.4	6.4	-	0.8	2.1	6.4	12.6	7.53	4	7.53	-0.33	1.02
3	Gangabai Agrawal	Kharap	16.1	1.4	5.2	-	3.2	2.6	5.2	12.6	9.00	7.2	7.39	1.11	2.97
4	Shriram Gonchewar	Kharap	20.5	1.3	3.0	-	6.4	3.5	3.0	15.8	12.25	11.2	7.46	1.35	5.00
5	Kiran Chawrasia	Kharap	13.7	2.3	1.8	4.6	-	1.2	1.8	12.6	5.41		8.39	-0.98	1.26
6	M.S.. Balinge	Yawalkhed	20.1	1.7	1.0	3.4	4.0	2.7	1.0	16.0	9.58	6.4	8.11	-0.13	3.23
7	Ramrao Chandarkar	Akola	28.1	2.4	4.4	0.8	5.6	2.4	4.4	25.2	12.60	4.4	7.45	0.93	5.99
8	Gajanand Vikbe	Mahispur	21.1	2.1	4.8	-	4.0	3.1	4.8	17.6	10.82	8.6	7.38	1.20	4.73
9	Dilip Dewani	Washim	10.0	1.4	2.0	4.2	-	0.8	2.0	7.6	4.01		8.48	-1.29	1.39
10	Kiran Chore	Malu	7.3	1.3	2.4	3.8	-	1.2	2.4	7.0	2.93		8.2	-0.09	0.83
11	Baliram Gawali	Apatapa	20.1	1.5	4.8	0.4	-	-	4.8	15.3	8.81	1.6	7.84	-0.01	3.53
12	Haribhahu Bhakre	Kalamba	17.7	1.3	2.4	-	-	1.9	2.4	13.6	9.59	4.2	8.07	0.22	4.00
13	Ramesh Rode	Chindawad	6.5	1.4	2.2	5.2	-	0.7	2.2	5.5	2.38		8.49	-1.08	0.76
14	S.R. Karande	Sangwa	20.3	1.5	3.2	3.2	-	1.4	3.2	15.2	8.02		8.10	-0.47	3.22
15	R.S. Jaiswal	Daryapur	11.6	1.5	2.4	1.6	-	0.8	2.4	10.9	5.80		8.41	-1.40	1.15
16	Vishnupant Ramteke	Antora	10.2	1.2	3.4	0.8	-	1.9	3.4	8.8	4.97	3.4	7.87	-0.18	1.06
17	Nur. Ahemad Rasid	Sasan	9.5	1.4	4.2	-	1.6	1.1	4.2	8.9	5.31	1.2	7.77	0.28	1.55
18	Ganesh Puri	Daryapur	10.9	1.3	1.2	2.6	2.4	2.1	1.2	10.1	5.59	4.6	8.09	0.35	-0.15
19	Kailash Dongardive	Itki	8.2	1.2	2.0	2.8	-	1.0	2.0	7.7	3.74		8.36	-1.43	0.43
20	Devrao Borkar	Nardoda	8.1	1.5	4.6	-	-	1.7	4.6	7.1	3.86	2.4	7.77	-0.15	1.24

analyzed for EC, pH and ionic composition, following appropriate methods of analysis as outlined earlier. For equilibrating water samples with $CaCO_3$, the method followed by Bower *et al.* (1965).

The data pertaining to ionic composition, calculated pHc and SI (Saturation index) and SAR are given in Table 1. Measured pH values of ground water samples were found higher than the pHc values of corresponding samples. Saturation index values for ground water samples were found positive significant which ranged between 0.01 to 1.65, indicating that its use for irrigation would lead to practically irreversible precipitation of $CaCO_3$ and hence steeper increasing SAR of soil solution. Measured pH values for natural water samples were recorded higher than pHc of corresponding water samples with positive SI values by Sharma (1994).

The data pertaining to ionic composition, calculated pHc and saturated index are given in Table 2. Measured pH values in synthetic water samples (No.3, 4, 7, 8, 12, 17 and 19) were found higher than pHc values of corresponding samples. Whereas measured pH of remaining synthetic water samples (No. 1,2,5,6,9,10, 11, 13,14,15,19 and 20) were lower than pHc values of corresponding samples.

It is observed that fourteen ground water samples from villages Sersoli, Malkapur, Kharap (4), Kharap (5), Mhaispur Malu, Apatapa, Chindawad, Sangwa, Daryapur (11), Antora, Sasan, Daryapur (18), Itki were found unfit for irrigation purpose based on RSC. However, thirteen water samples from villages viz., Sersoli, Malkapur, Kharap (3), Kharap (4), Kharap (5), Malu in Akola district and villages viz., Chindwada, Sangwa, Daryapur (11), Antora, Sasan, Daryapur (18), Itki in Amravati district were noted as of marginal alkali, alkali and high alkali quality and were considered as unsuitable for irrigation as per criteria.

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Export Performance and Instability of Vegetables, Spices and Processed Products

Agriculture plays a key role in the overall economic and social well being of India. Since the establishment of W.T.O., dramatic change has occurred in international trade. India is second largest producer of vegetables in the world after China, India's share in the world production is 8.2 per cent for vegetables.

The study is based on secondary data. The data are collected from various government publications and FAO web sites. The study pertains to the year 1980–81 to 2005–06. The export performance of selected vegetables, spices and processed products is examined by fitting exponential curve and the fluctuations in the export of commodities are judged using Coefficient of Variation (%), Coppock's Instability Index (C.I.I.) and Cuddy and Della Index.

Trade performance of Indian agriculture in monetary terms with respect to export and import for the period 1990-91 to 2003-04 is presented in Table-1.

It is evident from the Table 1 that India exported agricultural commodity worth Rs. 6012 crores during 1990-91 while during the same year imported agricultural commodities worth Rs.1206 crores. Showing positive balance of trade and the same is continued over the years. These results are similar with the results of Naik, *et. al.* (2001).

To accomplish this the compound growth rates in terms of quantities for these crops for the period 1980-81 to 2004-05 are estimated and presented in Table-2. The analysis of volume of export shows that the performance of vegetable with respect to growth of export in quantity exhibited a positive growth rate of 8.87 per cent, which is significant at 1 per cent level. Onion is one of the important commercial crops grown in India on varying scale in different parts of the country and used as vegetable spices or as condiments.

The export of potato in terms of quantity registered a marked compound growth rate of 12.88 percent per annum, which is positive and significant. Similar studies carried out on Potato and Onion by their research workers collaborated the present results (Jain and Narendra Kumar,1998).

Table No. 1:Trade Performance of Indian Agriculture

(Rs. Crores)

S.N.	Year	Agriculture Exports	Agriculture Imports	Balance of Trade
1	1990-91	6012.76	1205.86	4806.9
2	1991-92	7838.13	1478.27	6359.86
3	1992-93	9040.3	2876.26	6164.04
4	1993-94	12586.55	2327.33	10259.22
5	1994-95	13222.76	5937.21	7285.55
6	1995-96	20397.74	5890.1	14507.64
7	1996-97	24161.29	6612.6	17548.69
8	1997-98	24843.45	8784.19	16059.26
9	1998-99	25510.64	14566.48	10944.16
10	1999-2000	25313.66	16066.73	9246.93
11	2000-01	28657.37	12086.23	16571.14
12	2001-02	29728.61	16256.61	13472
13	2002-03	33126.46	17100.15	16026.34
14	2003-04	36893.90	21894.37	14999.53

Table 2: Compound Growth Rates of Export of Vegetables, Spices and Processed Products (1980-81 to 2004-05).

S.N.	Commodity	CGR
1	Vegetables Fresh	8.87**
2	Tomato	36.71**
3	Cabbage	5.38
4	Potato	12.88**
5	Onion	4.87**
6	Spices	6.21**
7	Pepper	-0.75
8	Garlic	-4.65
9	Ginger	2.45
10	chilli	42.19**
11	Dried and Processed Vegetables	18.04**
12	Pickles and Chutneys	16.46**
13	Other Processed Fruits and Vegetables	12.01**
14	Total Processed Fruits and Vegetables	15.92**

* Significant at 5% level, ** Significant at 1% level

The analysis of volume of export of processed products shows that export of processed fruits and vegetables are increasing every year. In general, the combined growth rate of export of total processed fruits and vegetables is 15.92 per cent.

The performance of export during given time period is assessed not only from the point of view of increase / decrease in export but also on the extent of fluctuations in the export and presented in Table. 3.

The export instability was highest i.e. C.V. 241.27 percent in tomato and lowest C.V. 34.12 per cent in pepper thereby indicating least consistency in export of tomato to different countries while the minimum value of C.V in pepper shows the consistency in export. While, the higher values of Coefficient of Variation are observed in chilli, vegetable fresh cabbage and potato indicating inconsistent export performance. These results are confirmed by estimating the instability indices with the help of Coppock's and Cuddy and Dells index..

Table No. 3: Instability Indices of Vegetables, Spices and Processed Products.

S.N.	Crop	C.V.%	C.I.	C &D
1	Vegetables Fresh	129.28	101.51	109.39
2	Tomato	241.27	137.42	77.06
3	Cabbage	178.90	261.58	171.70
4	Potato	111.29	98.80	69.77
5	Onion	50.77	37.51	33.23
6	Spices	47.30	22.78	18.92
7	Pepper	34.12	45.00	33.74
8	Garlic	69.69	238.03	66.34
9	Ginger	66.95	79.94	64.43
10	Chilli	119.05	85.73	43.49
11	Dried and Processed Vegetables	64.87	60.56	41.75
12	Pickles and Chutneys	59.23	114.54	22.49
13	Other Processed Fruits and Vegetables	44.00	77.12	21.16
14	Total Processed Fruits and Vegetables	53.67	60.59	25.24

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Entrepreneurship Development Among Women Through Selfhelp Group

Present case study of Keshav Swamy self help group of women was conducted from Erandeshwar village, Tq.Purna Dist. Parbhani of Marathwada region of Maharashtra state to know the entrepreneurship development among women through self help group. Keeping above objective in mind the information was collected by personal interview, extensive talks with the Chairman, Secretary and some of the members of the group. The data was collected from registers, passbook maintained by the self-help group. Findings of the study reveals that Keshav Swamy self help group of women was started in December 2002 with 15 members, contributing Rs.50/- per month, total amount collected was Rs. 40,200/-. Vermicomposting, establishing herbal garden, inter loaning were the other activities carried out by SHG members. The most important gain of SHG as per the view of member was feeling of confidence, self identity and unity among the members.

Self help groups have emerged in order to help the poor women in securing inputs like credit and other services. The concept of SHG in India was introduced during 1985. Self help group is a small, economically homogeneous and affinity group of rural poor who is voluntarily ready to contribute to common fund to be lent to its members as per group decision which works for group solidarity, self group awareness, social and economic empowerment in the way of democratic functioning (NABARD, 1995)

Self help groups are considered as agent of socio-economic transformation in rural areas. The characteristics feature of SHGs are voluntary membership, participatory planning, holistic approach, education and training, resource mobilization, self management, anti bureaucracy, empowerment building, linkage development, process and extension and movement building, on going evolution sustainability.

It is obvious that collective work, leadership with fixed tenure mutual trust and co-operative philosophy would be driving force for SHGs. The basic objective of Self-Help Groups is to develop saving capability among the poorest sections of the society, which in turn reduce dependence on financial institutions and develop self-reliance. Therefore, the present study was conducted with the following objectives:

- To study the profile of Keshav Swamy self help group
- To study the entrepreneurship development among women through self help group

It is a case study of self help group of women. For the present study, Keshav Swamy self help group of women from Erandeshwar village was selected. The

Table : 1 Profile of SHG

S.N.	Particulars	Details
1.	Name of the self-help group	Shri. Keshav Swamy Mahila Bachat Gat, Erandeshwar
2.	Initiation of SHG	Dec.2002
3.	Total number of members	15
4.	Monthly contribution	Rs.50/-
5.	Meetings	Twice in a month
6.	Total amount collected	Rs.40,200/-
		Contribution - Rs. 27000/-
		Interest - Rs. 3,540/-
		Dues - Rs. 460/-
		Subsidy - Rs. 5000/-
		Benefit from enterprise- Rs. 4,200/-
7.	Activities undertaken by SHG	• Vermicomposting
		• Establishing herbal garden
		• Interloaning

Table: 2 Details of Enterprise

1	Enterprise undertaken	Goat keeping
2	Initiation of Enterprise	Aug. 2004
3	Investment	Rs.9,850/-
4	Amount earned	Rs.4300/-
5	Medical expenses	Rs. 100/-
6	Number of goats increased	From 5 to 7

information was collected by personal, extensive talks with the Chairman, Secretary and some of the members of the group. The data were collected from registers, passbook maintained by the self-help group and expressions of the Chair-man and Secretary were also recorded.

An awareness campaign was organized in the village Erandeshwar along with an exhibition depicting objective, procedure, advantages and formation of Self Help Group (bachat gat). The group of rural women was also addressed regarding the goals of the bachat gat.

The *bachat gat* started saving Rs. 50/- per month. The group comprised 15 members. The women members of the group were trained in using different women friendly agricultural technology and different enterprises, such as poultry keeping, sericulture, animal husbandry, mushroom cultivation, etc.

The total amount collected by Keshawswami group was Rs.40,200/- (Rs.Forty thousand and two hundred only).The *bachat gat* was also engaged in the activities such as vermicomposting, establishing of herbal gardens of medicinal plants. The money collected by the bachat gat was also used for interloaning purpose. An amount of Rs. 1000 to 5000/- was lent to the members of *bachat gat* and also to the members who were not the part of *bachat gat*. The rate of interest for the loan was Rs.2 / month/100/- and for outsider Rs.3 / month / 100/-. Thus an amount of Rs. 3,540/- was gained through interloaning. The purposes of using money for interloaning were attending marriage, attending *jatra*, meeting medical expenses, meeting educational expenditure. This finding is in the line with the finding of Selvi (2005).

After a period of 16-18 months, women of Keshawshwami *bachat gat* decided to start goat rearing enterprise. For this, 4-5 members from the group surveyed the market and in June 2004, five goats were purchased by the group by spending Rs. 9850/-. A person is hired for taking care of the goats under the supervision of rural women from the *bachat gat*. After 6 months, from five goats 8 kids were produced, out of which by selling 4 kids of goat, Rs. 3200/-, Rs. Three thousand two hundred, (Rs. 800 each). Two more kids were sold (Rs. 800+300/-) for Rs. 1100/-, out of which Rs. 100/- were spent for medical expenditure of the goat and remaining were deposited in the saving account of the *bachat gat*. Now total no. of goats are – 7 Younger 2 goats are now ready for reproduction.

The members of self help group expressed that they had discovered their inner strength and they were empowered in decision making, communication skills, risk taking, social and economics aspects. These findings are in the line with the findings of Katyal(2003).

From the study, it is concluded that all the members of Keshav Swamy Self Help Group had a feeling of confidence and unity was developed among the members.

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Cost Effectiveness of Anthelmintic Drugs in Haemonchus Infected Sheep

Various drugs have been used against gastrointestinal nematodes in sheep. Since helminthiasis is widely accepted as a cause of loss of production in sheep, it is necessary to assess the value of helminth control measures in economic terms. Very scanty information is available on benefit cost analysis of anthelmintics. In the present investigation, attempts were made to determine the cost effectiveness of three different anthelmintic drugs for sheep helminthiasis.

For present study, 18 local sheep of either sex harbouring *Haemonchus contortus* infection were randomly divided into 3 equal groups of 6 sheep. First group (T_1) was treated with Ivermectin @ 200 µg kg^{-1} b.wt. orally once. Second group (T_2) was treated with Closantel @ 15 mg kg^{-1} b.wt. orally once and third group (T_3) was treated with herbal formulation @ 5 g $animal^{-1}$ day^{-1} orally for 10 days. Herbal formulation was made of equal quantity of powder of seeds of *Artemisia maritima* (Krmani ova), *Butea frondosa* (Palash), *Veronia anthelmintica* (Kalizeera) and stem bark of *Holarrhena antidysentrica* (Kura).

The eggs per gram of faeces (EPG) was determined by modified Stoll's dilution technique (Soulsby, 1982) before treatment ('0' day) and daily till infection becomes nil and on 21st day of treatment. The clinical, haematological and biochemical parameters were studied before treatment ('0' day) and on 15th and 30th day post treatment. The efficacy of each treatment was judged on the basis of reduction in EPG, clinical improvement and restoration of altered haemato-biochemical parameters to normal. Cost economics of drugs was calculated as per the method described by Anderson *et al.* (1976).

All the anthelmintic drugs (Ivermectin, Closantel and herbal formulation) were found effective against *H. contortus* infection in sheep as evident by 100 per cent reduction in fecal egg count on 7th , 10th and 13th day after treatment, respectively (Prasad Babu and Suryanarayana , 2004 and Jawale ,1997) . All the treatments initiated improvement in altered clinical, haematological and biochemical parameters close to normalcy within experimental period.

Cost-effectiveness analysis of these anthelmintic drugs is presented in Table 1. The average body weight before treatment ('0' day) were 41.00 Kg , 37.50 Kg and 33.00 Kg in T1 , T2 and T3 group, respectively . In all the treatment groups , there were gradual increase in body weight over a period of 30th day post treatment . At the end of the experiment (30th day post treatment), animals in group T_1, T_2 and T_3 gained average of 1.16 (2.83%), 3.33 (8.88%) and 1.66 (5.03%) Kg body weight, respectively , indicating the highest weight gain in Closantel treated group (T_2), followed by herbal formulation (T_3) and Ivermectin (T_1). However, single dose of Ivermectin brought down 100 per cent reduction in mean faecal egg count (FEC) with improvement in clinical and haemobiochemical parameters close to normalcy on 7th day post treatment indicated that Ivermectin induced early recovery as compared to closantel (10th day) and herbal formulation (13th day).

Based on market price, the average cost of treatment of each animal were Rs. 9.90, Rs. 14.24 and Rs. 6.50 for Ivermectin (10 mg), Closantel (579 mg) and Herbal drug (5000 mg), respectively (Table 1). This indicated that the cost of herbal formulation was less as compared to Ivermectin and Closantel. The actual average expenditure incurred for gain in 1 kg body weight were Rs. 8.53, Rs. 4.27 and Rs. 3.91,showed herbal formulation was cheaper than Closantel and Ivermectin treatment even these drugs induced early recovery than herbal drug (Table 1).

It was also observed that the per cent return on invested funds was more (25.55%) in group treated with herbal formulation (T_3) , indicated that the herbal drug was more beneficial than Closantel and Ivermectin (Table 1). This observation indicated that the herbal formulation administered once in a day for 10 days worked out to be the cheapest available remedy eventhough 100 per cent reduction in FEC was observed on 13th day post treatment with improvement in clinical and haemobiochemical parameters near to normalcy.

Thus, on the basis of cost-effectiveness analysis the specially formulated herbal anthelmintic preparation

Table 1. Cost-effectiveness analysis of Ivermectin (T_1), Closantel (T_2) and herbal formulation (T_3) in haemonchus infested sheep

S. N.	Item	Anthelmintic treatments		
		Ivermectin (T_1)	Closantel (T_2)	Herbal formulation (T_3)
A.	Initial average body weight before treatment ('0' day)	41.00 kg	37.50 kg	33.00 kg
B.	Average body weight at the end of experiment (30th day post treatment	42.16 kg	40.83 kg	34.66 kg
C.	Average weight gain after 30th day post treatment (B-A)	1.16 kg	3.33 kg	1.66 kg
D.	Per cent weight gain after 30th day post treatment (C/A x 100)	2.83%	8.88%	5.03%
E.	Dose of anthelmintic drugs given orally	@ 200 µg/kg b.wt. single	@ 15 mg/kg b.wt. single	@ 5 gm powder per animal for 10 days
F.	Duration of 100% recovery (100% reduction in FEC after treatment)	7th day	10th day	13th day
G.	Average dose per animal	10 mg	579 mg	5000 mg
H.	Average cost of dose of each animal	Rs. 9.90	Rs. 14.24	Rs. 6.50
I.	Average cost required for gain in 1 kg body weight	Rs. 8.53	Rs. 4.27	Rs. 3.91
J.	Percentage return on marginal invested funds (Marginal return divided by marginal cost i.e. C/H x 100) (Anderson *et al.*, 1976)	11.7%	23.38%	25.53%

made of easily available indigenous plant material (seeds of *A. maritima, B. frondosa, V. anthelmintica* and stem bark of *H. antidysentrica*) was the effective and economical remedy for deworming of sheep and may be recommended as an effective andeconomic control measure in haemonchus infection in sheep.

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RESEARCH NOTE

CONTENT

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