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Effect of Irrigation, Mulching and Fertility Levels on Mustard (*Brassica juncea*) and their Residual Effect on Succeeding Goundnut (*Arachis hypogaea*) Crop

A. C. Sadhu, D. D. Malavia and R. K. Mathukia

College of Agriculture, Gujarat Agricultural University, Junagadh - 362 001

ABSTRACT

A field experiment conducted on clayey soil at Junagadh revealed that frequent irrigations at 0.8 IW/CPE ratio recorded significantly higher plant height, siliquae/plant, seed weight/plant, oil content, nutrient uptake and yield of mustard than 0.5 IW/CPE ratio. Mulching with wheat straw increased plant height, seed weight/plant, 1000-seed weight, nutrient uptake, water use efficiency and yield of mustard. A marked increase in all the growth and yield parameters, nutrient uptake, water use efficiency and the yield of mustard was observed with each increase in fertilizer levels from 0 to 100% of the recommended dose, while oil content in seed was decreased. Application of FYM @ 10 t/ha significantly increased the growth and yield attributes, nutrient uptake, water use efficiency and yield of mustard. Residual effect of wheat straw mulch and FYM treatments increased plant height, filled pods/plant and pod and haulm yields of succeeding groundnut crop.

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INTRODUCTION

The mustard crop offers a good scope for diversification of cropping pattern in the *rabi* season, particularly in areas with limited water supply. It is also gaining popularity among the farmers of Saurashtra region, where groundnut is an important traditional rainy season crop. Water and nutrient management is considered the most important factors in production of mustard crop. However very little work has been carried out on the residual effect of organic mulches and manuring on the succeeding crops grown in a sequence. Therefore, a field experiment was undertaken

with integrated approach to have appropriate use of limited available resources efficiently under south Saurashtra conditions.

MATERIALS AND METHODS

The field experiment was conducted during winter and rainy seasons of 1992-93 and 1993-94 at Junagadh on fixed plots. The soil was clayey in texture, slightly alkaline (pH 7.9) and contained 0.83% organic carbon, 29.7 kg P₂O₅/ha and 289.0 kg K₂O/ha. Twenty four treatments consisting of 2 levels each of irrigation (0.5 and 0.8 IW/CPE ratio) and mulching (no mulch and wheat straw mulch @ 10 t/ha) in main plots and 3 levels of fertilizer

(0, 50 and 100% of the recommended dose of 50 kg N + 50 kg P_2O_5 /ha) and 2 levels of farmyard manure (no FYM and FYM @ 10 t/ha) in sub plots were laid out in split plot design with 3 replications. Half of the N and all of the P in the form of urea and single superphosphate, respectively were applied as per treatment at sowing and remaining half of N through urea was topdressed one month after sowing of mustard. Farmyard manure was incorporated before sowing of mustard crop, while mulching was done at 21 days after sowing. No fertilizer or manure was applied to the *kharif* groundnut crop for studying the residual effect of different treatments given to preceding mustard crop.

The measured quantity of water (50 mm depth) was applied with the help of parshall flume. Two common irrigations were given to mustard crop during both the years for uniform emergence and establishment of plantstand. The irrigations applied under 0.5 and 0.8 IW/CPE ratios were 5, 7 and 4, 6 in 1992-93 and 1993-94, respectively. Three supplementary irrigations were given to groundnut grown in *kharif*, 1993 because of dry condition prevailed during crop growing season. Total amount of rainfall received during 1993 and 1994 were 526.8 and 1181.3 mm, respectively. Thus, the rainfall received during 1994 was found higher than the normal.

RESULTS AND DISCUSSION

Effect on mustard

Irrigation scheduled at 0.8 IW/CPE ratio recorded significantly higher plant height, siliquae/plant, seed weight/plant and oil content in seed than 0.5 IW/CPE ratio (Table 1). Improved growth and yield attributes with

increased irrigation frequency at 0.8 IW/CPE ratio significantly increased the seed and stover yields over 0.5 IW/CPE ratio (Table 1). Frequent irrigations at 0.8 IW/CPE ratio also increased the N and P uptake by seed and stover of mustard (Fig. 1). The results confirm the findings of Malavia *et al.* (1988) and Tomar *et al.* (1990).

Mulching treatment significantly increased plant height, seed weight/plant, 1000-seed weight and also the N and P uptake by seed and stover of mustard, which resulted in significantly higher seed and stover yields over no mulch treatment in pooled results (Table 1). The beneficial effect of mulching was attributed to favourable hydrothermal regime leading to improved rhizosphere environment. Mulching with straw also increased water use efficiency (Table 1). This may probably be due to its favourable effect on soil moisture conservation and increased seed yield. The results are in accordance with the findings of Singh *et al.* (1990).

Each increment in fertilizer level from 0 to 100% of the recommended dose significantly increased the seed and stover yields of mustard (Table 1). Appreciable increase in growth and yield attributes viz., plant height, siliquae/plant, seed weight/plant and 1000-seed weight (Table 1) as well as increase in nutrients uptake by seed and stover (Fig. 1) as a result of fertilizer application might have increased the yield of mustard crop. The water use efficiency increased, while oil content in seed decreased with increasing level of fertilizer. The decrease in oil content might be due to the dilution effect of higher seed yield. The results confirm the findings of Singh (1983).

Residual effect of different treatments on pod and haulm yields and yield attributes of succeeding groundnut.

Treatments	Pod yield (kg/ha)			Haulm yield (kg/ha)	Oil content (%)	Plant height (cm)	Filled pods/plant
	1993	1994	Pooled				
Irrigation (IW/CPE)							
0.5	951	582	766	1551	49.36	24.5	7.1
0.8	998	652	825	1629	49.54	25.0	7.2
C. D. at 5 %	NS	NS	NS	NS	NS	NS	NS
Mulch (t/ha)							
0	965	556	760	1560	49.47	24.1	6.8
10	983	678	831	1621	49.43	25.5	7.5
C. D. at 5 %	NS	83	60	NS	NS	1.0	0.7
Fertilizer dose (%)							
0	999	639	819	1592	49.59	25.0	6.9
50	954	620	787	4595	49.39	24.8	7.3
100	969	593	781	1583	49.37	24.6	7.1
C. D. at 5 %	NS	NS	NS	NS	NS	NS	NS
FYM (t/ha)							
0	959	580	769	1545	49.49	24.5	6.9
10	989	654	822	1635	49.41	25.1	7.4
C. D. at 5 %	NS	52	32	65	NS	0.4	0.4

Application of FYM @ 10 t/ha to mustard crop produced significantly higher seed and stover yields and increased water use efficiency than no FYM treatment (Table 1). Manuring with FYM significantly increased plant height, siliquae/plant, seed weight/plant and 1000-seed weight as well as the N and P uptake by seed and stover, which in turn have increased the yield. However, it did not affect the oil content in seed. Organic manure acts as nutrient reservoir for plant and it also increases water availability through increasing water holding capacity of the soil. Khurana *et al.* (1991) also obtained similar results.

Residual effect on groundnut

Irrigation levels applied to preceding mustard crop did not show significant residual effect on yield parameters, yield and oil content of groundnut (Table 2). The pooled results showed that the incorporation of wheat straw mulch into the soil significantly increased plant height, filled pods/plant and pod yield of groundnut (Table 2). However, it had no residual effects on haulm yield and oil content in pooled results. The

beneficial residual effects of mulching might be associated with the availability of all the essential nutrients in organic matter due to its continuous mineralization. The results are in agreement with those of Reddy *et al.* (1991).

Application of fertilizers to mustard crop did not manifest significant residual effect on plant height, filled pods/plant, pod and haulm yields as well as oil content in kernels (Table 2). This was probably due to the fact that the requirement of the groundnut for N and P has been met by the soil itself and through N-fixation from atmosphere. Parida (1987) also reported similar results in groundnut crop at Junagadh.

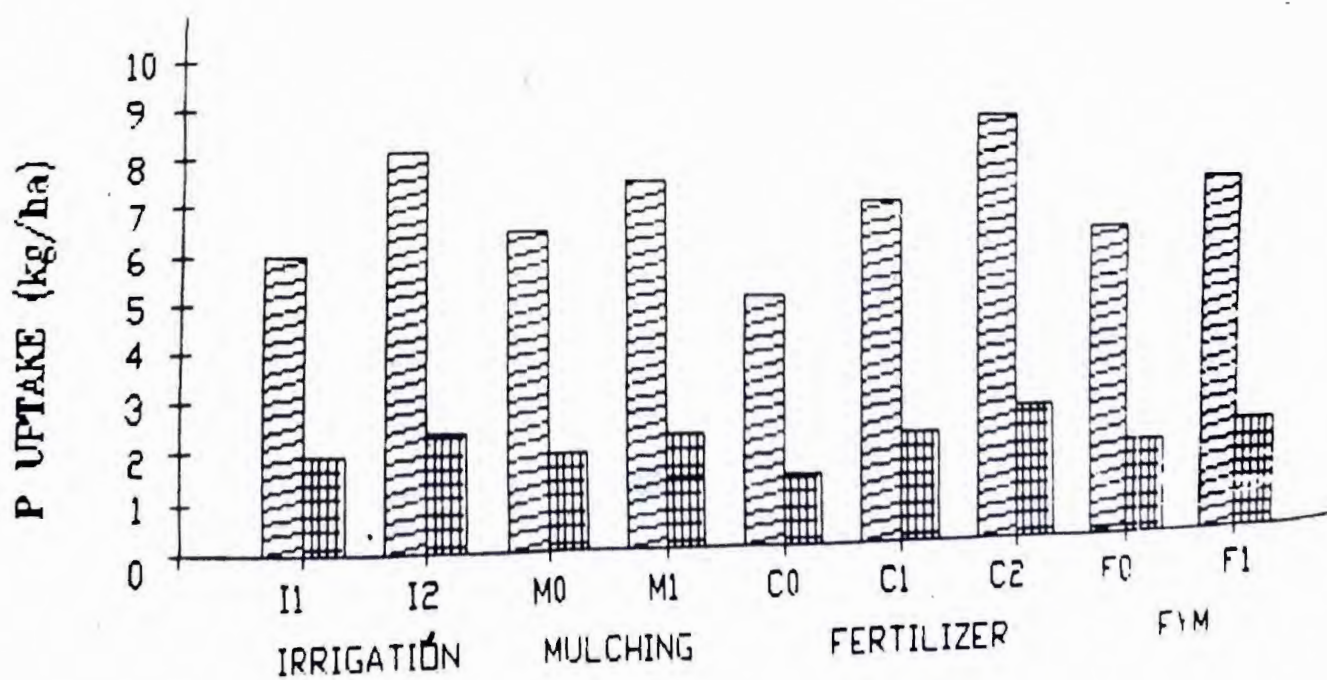
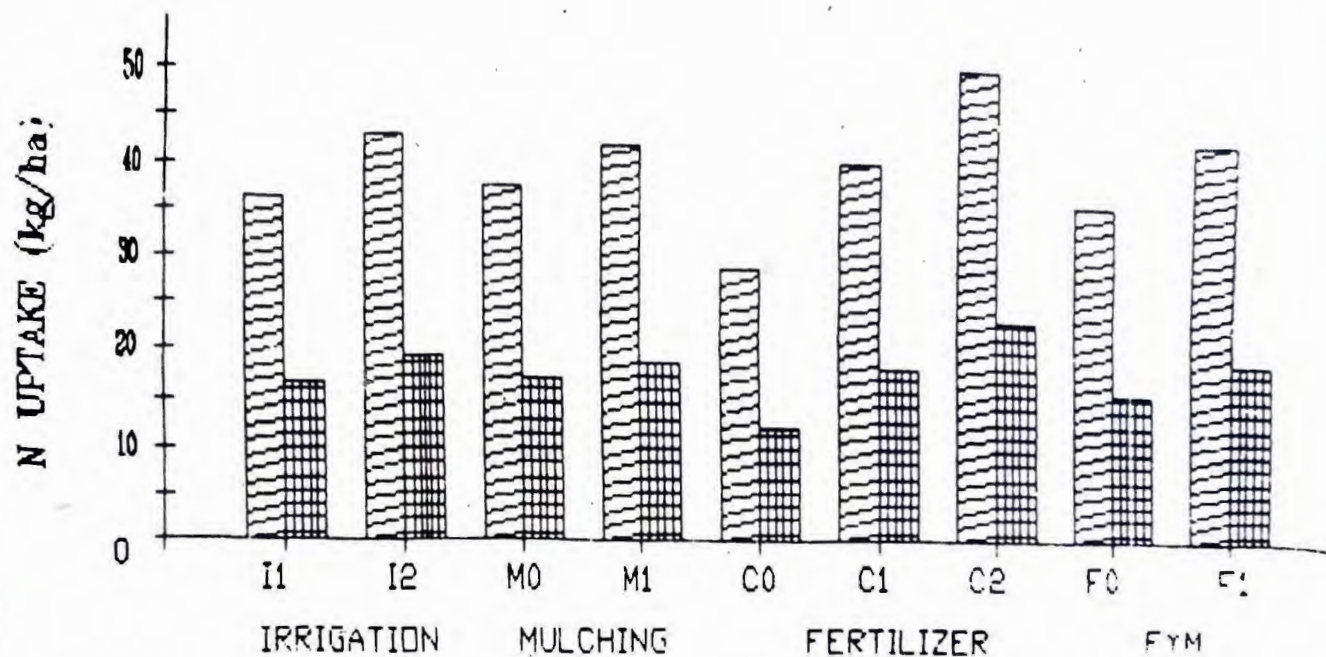
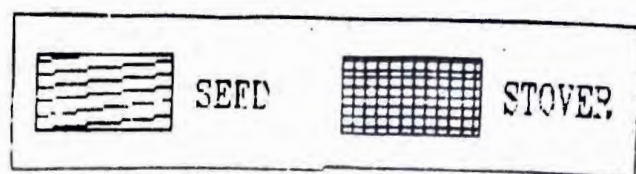
It was observed that FYM treatment showed significant residual effect on pod and haulm yields of succeeding groundnut crop in pooled results (Table 2). However, it had no appreciable influence on oil content in kernels. Higher yields under FYM treatment was attributed to improved growth and yield attributes viz., plant height and filled pods/plant. The results confirm the findings of Khurana *et al.* (1991).

TABLE 3

Residual effect of Irrigation and fertilizer interaction on filled pods/plant and pod yield of groundnut in pooled results.

Fertilizer dose (%)	Irrigation (IW/CPE)			
	Pod yield (kg/ha)		Field pods/plant	
	0.5	0.8	0.5	0.8
0	812	826	7.4	6.4
50	780	794	7.4	7.2
100			6.6	7.6
C. D. at 5%	707			0.7

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Interaction effect

The residual effect of interaction between irrigation and fertilizer levels revealed that the highest values of filled pods/plant and pod yield of groundnut crop were recorded under frequent irrigations at 0.8 IW/CPE ratio with full recommended fertilizer dose applied to the previous crop (Table 3). Scheduling irrigation at 0.5 IW/CPE ratio with full recommended fertilizer treatment in mustard produced significantly the lowest pod yield of groundnut crop indicating beneficial residual effect of the highest

level of irrigation. This might be due to the fact that fertilization increases the nutrient supply, while frequent irrigations mobilized the nutrients in soil (Patel and Saraf, 1991).

The results suggest that frequent irrigations at 0.8 IW/CPE ratio along with wheat straw mulch and full recommended fertilizer dose along with FYM application were essential to harvest full potential of mustard crop. Mulching with wheat straw and manuring with FYM into mustard were also found beneficial to the succeeding groundnut crop.

REFERENCES

- Khurana, G. P., G. P. Bhaya and S. K. Singh. 1991. Effect of soil ameliorants on wheat, mustard and their residual effect on pearl millet in an alkaline soil. *Indian J. Agron.*, **36** (Suppl.) : 273-275.
- Malavia, D. D., J. C. Patel and M. N. Vyas. 1988. Studies on irrigation, nitrogen and phosphorus levels on growth and yield of mustard. *Indian J. Agron.*, **33** (3): 245-248.
- Parida, K. 1987. Studies on crop response and soil fertility changes under varying levels of N and P in wheat groundnut cropping system. Ph. D. thesis (unpublished) submitted to Gujarat Agricultural University, Sardar Krushinagar.
- Patel, C. L. and C. S. Saraf, 1991. Residual effect of irrigation, phosphorus and weed control treatment applied to summer cowpea on yield and nutrient uptake by fodder sorghum and weeds in the rainy season. *Indian J. Agron.*, **36** (3): 337-339.
- Reddy, M. S. S., S.R. Reddy, M. G. Reddy and M. G. R. K. Reddy. 1991. Residual effect of organic matter and fertilizer applied to groundnut and maize on succeeding groundnut in groundnut-maize-groundnut sequence. *Indian J. Agron.*, **36** (Suppl.) : 298-300.
- Singh, B. P., B. N. Singh and A. Singh. 1990. Effect of mulch and irrigation on yield of Indian mustard on dry terraces in Alfisols. *Indian J. Agric. Sci.*, **60** (7) : 477-479.
- Singh, V. 1983. Response of mustard to irrigation and fertilization. *Madras Agric. J.* **70** (1) : 15-18.
- Tomar, S. S. Tomar and S. Singh. 1990. Influence of varying levels of irrigation and fertilizers on yield, nutrient uptake, WUE and quality of mustard. *Ann. Agric. Res.*, **11** (3-4) : 241-248.

Genetics of Plant Height and Flag Leaf Area in Bread Wheat (*Triticum aestivum* L. em. Thell) Under Normal and Salinity Conditions

K. B. Kathiria* and R. K. Sharma

Department of Genetics and Plant Breeding, Rajasthan Agricultural University, Jobner-303 329

ABSTRACT

A diallel cross analysis involving 8 varieties of bread wheat and their 28 F_1 hybrids (excluding reciprocals) was attempted under normal, sodic and saline sodic soils to study the nature and magnitude to gene action for plant height and flag leaf area. The additive genetic component (D) was highly significant and in general greater in magnitude than the respective non-additive components (H_1 and H_2) for both the traits over environments. This indicated preponderance of additive gene action in inheritance of both the traits under different environments. Estimates of degree of dominance showed partial dominance for both the traits over environments, except for flag leaf area in normal soil where it showed over-dominance, variance-covariance graphs confirmed most of these results. Heritability estimates were observed to be high for plant height and moderate for flag leaf area. A simple selection would be effective to improve both the traits under study.

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INTRODUCTION

Genetic information of quantitative characters provides a guide line to breeder in formulating an appropriate breeding method to bring about desired improvement in the crop. For detailed study of genetic architecture of characters, component and graphical analyses (Jinks and Hayman, 1953, and Hayman, 1954) seems to be more important. Plant height and flag leaf area are considered to be important yield related traits in bread wheat. Very little information is available on genetics of these two attributes under salinity stress conditions where this crop is also extensively grown. The present study was, therefore, carried out to get some information on genetics of plant height and flag

leaf area in wheat under normal and salinity conditions.

MATERIALS AND METHODS

Genetically diverse 8 varieties of bread wheat (K 8565, HD 2009, CPAN 1992, Kharchia 65, Raj 1972, Raj 3077, Lok 1 and HW 452) and their 28 half diallel crosses were grown in randomized block design with three replications under sodic (ECe 3.6 ds/ and pH 9.3), normal (EC 3.5 ds/m and pH 8.4) and saline sodic (ECe 8.6 ds/m and pH 9.1) soils at College Farm, S. K. N. College of Agriculture, Jobner. The experiment on sodic soil was conducted during *rabi* 1989-90, while on other two environments it was grown during *rabi* 1990-91. Each plot consisted of 1.5 m long

single row, which were spaced at 25 cm apart. A plant-to-plant distance of 5 cm was maintained in each row.

Data were recorded on 5 randomly selected plants from each treatment in each replication for plant height (cm) and flag leaf area (cm^2). The procedure of Jinks and Hayman (1953) and Hayman (1954) was adopted for component and graphical analysis. Heritability estimates in narrow sense were computed following Crumpacker and Allard (1962).

RESULTS AND DISCUSSION

The slope of regression line (b) in the variance covariance graphs (Fig. 1 and 2) deviated significantly from zero but not from unity, indicating the adequacy of additive - dominance model for both the traits over environments. The results of components and their different ratios are presented in Table 1. Estimates of additive genetic variance (D) were highly significant and greater in magnitude in most of the cases than the respective non-additive components (H_1 and H_2) for both the traits over environments. While H_1 was significant for plant height in sodic soil and flag leaf area in sodic and saline sodic soils. The component H_2 was observed to be significant only for flag leaf area across the environments. This results indicated the preponderance of additive type of gene action for the inheritance of both characters under normal and salinity stress environments. The findings of Singh *et al.* (1985) and Yadav *et al.* (1988) for plant height and Prabhu and Sharma (1984) for flag leaf area were also akin to the results of the present study. The values of F for plant height and flag leaf area under three environments

indicated higher frequency of recessive and dominant alleles in the parents for the inheritance of both the traits, respectively. These results were further confirmed by the ratio of dominant and recessive genes in the presents, as it was less than one for plant height and greater than one for flag leaf area over environments. The values of $H_2/4H_1$ for both the traits over environments were less than 0.23 which suggested asymmetrical distribution of genes with positive and negative effects in the parent. The degree of dominance indicated partial dominance for both the traits, except flag leaf area in normal soil where it was observed to be over-dominance. Most of these results were in confirmation with the results obtained in V_r , W_r graphs (Fig. 1 and 2). The h^2/H_2 ratio suggested that one gene or gene group operated uniformly the inheritance of both traits under different environments.

Estimated heritability in the narrow sense was consistently high for plant height and moderate for flag leaf area over environments. It showed simple nature of its inheritance. Similar findings for plant height (Prakash *et al.* 1981 and Sharma *et al.* 1984) and flag leaf area (Joshi and Sharma, 1984 and Singh *et al.* 1986) have been reported by various wheat workers. In case of self-pollinated crop like wheat, simple selection would be desirable for effective improvement of traits having preponderance of additive gene action with moderate to high heritability estimates.

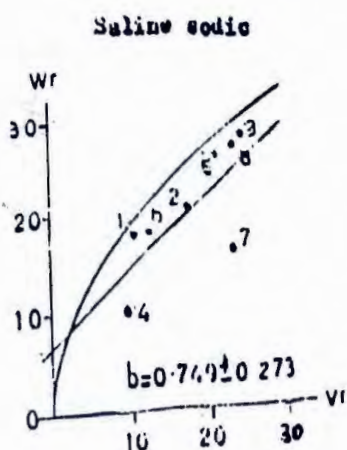
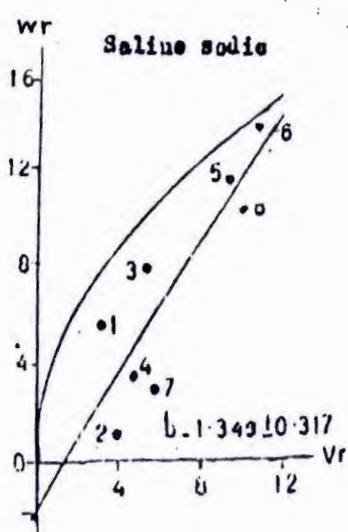
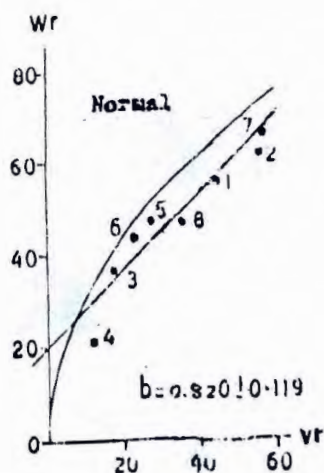
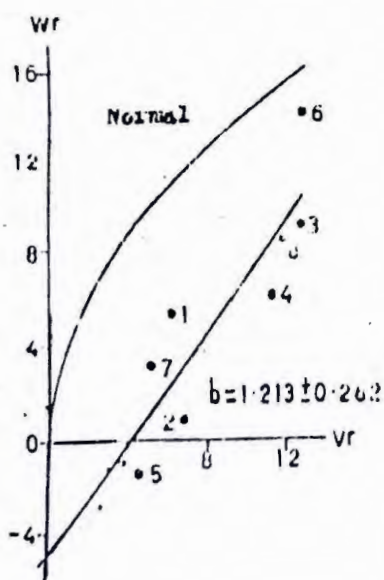
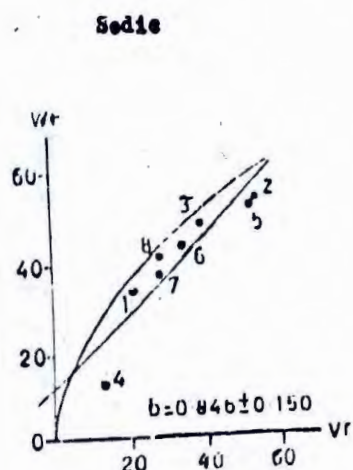
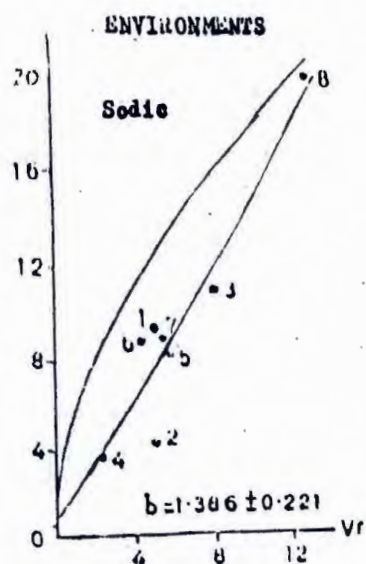
The V_r , W_r graphs (Fig. 1) for plant height reveal that, array point of parent Kharchia 65 was relatively nearer to the point of origin in all the environments indicating more proportion of dominant alleles for this

TABLE 1

Components of genetic variation and their ratios for plant height and flag leaf area in wheat under saline (S), Normal (N) and saline sodic (SS) conditions.

Components/ ratios	Plant height			Flag leaf area		
	S	N	SS	S	N	SS
D	63.584** ± 4.363	88.544** ± 4.299	33.091** ± 3.319	30.156** ± 1.598	16.307** ± 3.333	17.059** ± 1.873
H ₁	24.044* ± 10.029	20.659 ± 9.884	17.978 ± 7.631	13.427** ± 3.674	24.078 ± 7.663	12.115* ± 4.305
H ₂	15.890 ± 8.725	19.126 ± 8.599	13.726 ± 6.639	8.872* ± 3.196	19.598* ± 6.667	9.628* ± 3.746
h ²	22.062** ± 5.851	17.909* ± 5.767	0.572 ± 4.452	11.521** ± 2.143	7.206 ± 4.471	6.618* ± 2.512
F	34.189* ± 10.308	10.333 ± 10.159	14.769 ± 7.843	24.222** ± 3.776	11.504 ± 7.876	7.282 ± 4.425
E	4.247* ± 1.454	6.709** ± 1.433	3.667* ± 1.106	2.284** ± 0.533	3.251* ± 1.111	2.080* ± 0.624
(H ₁ / D) ^{0.5}	0.652	0.483	0.737	0.667	1.215	0.843
H ₂ / 4H ₁	0.147	0.231	0.191	0.165	0.203	0.199
(4 DH ₁) ^{0.5} + F	0.416	0.784	0.535	4.023	1.818	1.678
(4 DH ₁) ^{0.5} - F						
h ² / H ₂	1.388	0.936	0.042	1.298	0.368	0.687
Heritability	86.837	81.375	78.589	53.809	36.284	57.746

*** Significant at 5 % and 1 % level respectively.



1= K 8565, 2= MD 2009, 3= CPAN 1992, 4= Kharchia 65,
5= Raj 1972, 6= Raj 2077, 7= Lak 1, 8= SV 452

Fig. 1: Vr. Wr graphs for plant height under three environments.

Fig. 2 : Vr. Wr. graphs for flag leaf area under three environments.

trait. While for flag leaf area (Fig. 2), parental points of HW 452 over environments and Raj 3077 in normal and saline sodic soils were located far away from the point of origin suggesting that both parents possessed more recessive genes. For plant height narrow scattering of parental arrays along the

regression line indicated less diversity among the parents. Whereas opposite results were obtained for flag leaf area. However, relative changing position of most of parent arrays in different environments suggested the influence of environment in the expression of these traits.

REFERENCES

- Crumpacker, D. W. and R. W. Allard, 1962. A diallel cross analysis of heading date in wheat. *Hilgardia* **32** (6) 275-318.
- Hayman, B. I., 1954. The theory and analysis of diallel crosses. *Genetics* **39** : 789-808.
- Jinks, J. L. and B. I. Hayman. 1953. The analysis of diallel crosses. *Co-op. Genetics News Letter*, **27** : 48-54.
- Joshi, A. K. and G. S. Sharma, 1984. Genetics of flag leaf area in wheat diallel analysis. *Indian J. Genet.* **44** (3) : 399-405.
- Prabhu, K. V. and G. S. Sharma, 1984. Combining ability for flag leaf area in bread wheat. *Indian J. Agric. Sci.*, **57** (12) : 873- 875.
- Prakash, V. ; V. Agarwal,; R. P. Katiyar and R. D. Goyal, 1981. Genetics of some yield and developmental traits in bread wheat. *Indian J. Agric. Sci.* **51** : 283-387.
- Sharma, S. K.; K. S. Gill and G. S. Nanda, 1984. Gene systems affecting the heredity of various characters in wheat. *J. Res. Punjab Agric. Univ.* **2** (1) : 1-6.
- Singh, K. N. ; P. S. Ahuja and R. S. Rana, 1985. Combining ability in bread wheat grown in alkali soil. *Indian J. Genet.* **43** (3) : 441-444.
- Singh, R. S.; I. Ahmed; Y. P. Singh and K. N. Singh, 1986. Genetic studies in bread wheat. *Crop Imp.* **13** (2) : 149-153.

Estimates of Genetic Variability Parameters in Safflower

G. A. Pandya, R. M. Prajapati and P. S. Vashi

Department of Agricultural Botany, Gujarat Agricultural University, Navsari Campus, Navsari-396 450 (Gujarat)

ABSTRACT

Information on genetic variance, coefficient of variation, broad sense heritability and genetic advance for yield and related character has been given, using data from 66 genotypes of safflower evaluated during *rabi* 1992-93. The genetic coefficient of variances was higher for grain yield per plant, number of capitula per plant, 100-seed weight and number of secondary branches per plant. High heritability was recorded for days to 50 per cent flowering, grain yield per plant, 100-seed weight, number of capitula per plant and plant height. Further, grain yield per plant, number of capitula per plant and 100-seed weight had high genetic advance coupled with high heritability.

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INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is an important and potential oilseed crop. Its oil is of the best quality for human consumption. India is one of the main safflower growing countries in world in acreage but productivity is low. Hence it required genetic improvement to fetch the oil seed demand. To develop such genetically improved cultivars, a systematic breeding programme has to be adopted. The knowledge of variability, heritability and genetic advance is useful in the choice of appropriate selection criterion.

MATERIALS AND METHODS

The field experiment with 66 safflower genotypes including check was carried out at Navsari (Gujarat) during *rabi* 1992-93. The trial

was laid out in randomized block design with three replications. Each entry was represented by four rows spaced 45 cm apart with 10 cm distance between plants within rows. The usual agronomic practices were followed in raising the crop. Five plants were randomly selected from the middle rows at random for recording observations and their mean values were used for statistical analysis.

Using the mean values, analysis of variance was performed for each character (Panse and Sukhatme, 1978). The variance components were estimated as explained by Jhonson *et al.* (1955). Heritability (broad-sense) and genetic advance (at 5% selection intensity) were calculated by using the formula proposed by Allard (1960). Genotypic and phenotypic coefficients of variation were estimated according to Burton (1952).

RESULTS AND DISCUSSION

Analysis of variance indicated significant differences in respect of all characters. A wide range of phenotypic variation was present in respect of plant height and grain yield per plant, while, days to 50 per cent flowering and number of capitula per plant showed moderate range of phenotypic variation (Table 1). Similar results have also been reported by Deokar and Patil (1978). There was a close correspondance between genotypic and phenotypic coefficients of variance for most of the characters except plant height (Table 1). These characters, therefore, were least influenced by environmental variation and the phenotype would provide a fairly close assesment of the genetic worth of a geno-type. The genotypic coefficient of variation ranged from 1.39 for oil content to 27.09 number of capitula per plant (Table 1). The difference between the values of phenotypic and genotypic coefficient of variation for number of capitula per plant, grain yield per plant, number of secondary branches per plant and number of primary branches per plant were more as compared to days to 50 per cent flowering, plant height, days to maturity, 100-seed weight and oil content suggesting that the latter characters were less influenced by environment, thus these can be improved through phenotypic selection. Due to the less difference in the value of PCV and GCV, the improvement by phenotypic selection for certain characters also reported by Deokar and Patil (1978) and by Narkhede *et al.* (1985). Though genetic coefficient of variation is helpful in comparing the genetic variability present in the

quantitative characters, it is not possible to determine the extent of heritable variation with a genetic coefficient of variation alone. Burton (1952) had, therefore, suggested that genetic coefficient of variation along with heritability estimates would provide a better understanding of the amount of genetic advance expected by phenotypic selection.

The characters viz. days to 50 per cent flowering (88.38%), 100-seed weight (84.79%), grain yield per plant (84.01%), plant height (75.08%) and number of capitula per plant (72.47%) showed fairly high heritability while it was moderate to low for others (Table 1). Genetic advance was high for grain yield per plant (49.16%). Number of capitula per plant (47.50%), 100-seed weight (22.81%) and number of secondary branches per plant (22.63%) (Table 1). High heritability estimates coupled with high genetic advance were recorded for grain yield per plant, 100-seed weight and number of capitula per plant, Deokar and Patil (1978) also reported high genetic advance associated with high heritability for plant height, number of seeds for per capitulum and 100-seed weight and Narkhede *et al.* (1985) for characters viz. seed yield per plant and number of seeds per capitulum.

The occurance of such high heritability values coupled with high genetic advance for grain yield per plant, 100-seed weight and number of capitula per plant in the present investigation suggested the importance of additive gene action in their inheritance. This also supports the

TABLE 1

Range, mean, genotypic, phenotypic and environmental variances, GCV, PCV, H^2 (B.S.) and G.A. as % of $\bar{x}$ for the nine characters in safflower.

Character	Range	Mean	Genotypic variance	Phenotypic variance	Environmental variance	GCV (%)	PCV (%)	H^2 (B.S.)	G.A. % of $\bar{x}$
Grain yield per plant (g)	9.58 - 31.47	16.79	19.09	22.73	3.64	26.03	28.40	84.01	49.16
Days to 50% flowering	49.67 - 66.67	59.15	18.56	21.00	2.44	7.28	7.75	88.38	14.10
Plant height (cm)	58.07 - 86.13	75.74	38.56	51.76	13.20	8.29	9.57	75.08	14.79
Days to maturity	116.33 - 127.00	122.04	6.26	13.05	6.79	2.05	2.96	47.97	2.93
100-seed weight (g)	5.00 - 8.57	6.88	0.69	0.81	0.12	12.02	13.06	84.79	22.81
No. of primary branches per plant	3.93 - 5.93	5.10	0.17	0.56	0.39	8.09	14.63	30.54	9.21
No. of secondary branches per plant	6.00 - 13.87	10.96	2.44	4.09	1.65	14.24	18.45	59.55	22.63
Number of capitula per plant	6.00 - 23.67	13.09	12.58	17.35	4.77	27.09	31.82	72.47	47.50
Oil content (%)	30.26 - 33.63	32.75	0.21	0.39	0.18	1.39	1.91	53.12	2.09

observations reported by Narkhede *et al.* (1985). Thus, while exploiting variability of present material, high weightage should be given to those characters in selection

programme to be followed for safflower improvement because these characters are less influenced by environment and they can be improved through selection.

REFERENCES

- Allard, R. W. 1960. Principles of plant breeding. John Wiley and Sons Inc., New York.
- Burton, G. W. 1952. Quantitative inheritance in grasses *proc. 6th Int. Grassld. Cong.*, 1 : 227-283.
- Deokar, A. B. and F. B. Patil. 1978. Analysis of parameters of variability in some varieties of safflower. *J. Maharashtra Agric. Univ.*, 3 (1) : 69-70.
- Jhonson, H. W., H. F. Robinson and R. E. Comstock, 1955. Estimates of genetic and environmental variability in Soybean. *Agron. J.*, 47 : 314-318.
- Narkhede, B. N., J. V. Patil and A. B. Deokar, 1985. Estimates of variability parameters in safflower. *J. Maharashtra Agric. Univ.*, 10 (1) : 97-98.
- Pense, V. G. and D. V. Sukhatme, 1978. Statistical Methods for Agricultural Workers (II Ed). I.C.A.R. Publication, New Delhi.

Variability in Qualitative and Quantitative Characters of Forage Sorghum (*Sorghum bicolor* (L.) Moench)*

V. P. Borad, J. R. Patel** and N. M. Patel

Forage Research Project (ICAR), Gujarat Agricultural University, Anand Campus, Anand-388 110

ABSTRACT

A wide range of variation was observed for all the nine characters studied for forage sorghum. Green fodder yield, dry matter yield and HCN showed large genotypic variability. Highest genotypic coefficient of variation was observed for HCN followed by crude protein yield, green fodder yield and dry matter yield. HCN, green fodder yield and leaf breadth had high heritability estimates combined with high genetic advance. Whereas, dry matter yield and crude protein yield had high genetic advance but moderate heritability. Characters having high heritability and genetic advance indicated that these characters would be an ideal selection criterion in forage sorghum.

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INTRODUCTION

India is well known for its vast cattle wealth. In recent years India is facing an acute shortage of feeds and fodders. Therefore, development of fodder resources of the country becomes a high priority national programme. Sorghum (*Sorghum bicolor* (L.) Moench), locally known as jowar, is the cheapest source of feed for milch, beef and drought animals. In Gujarat, sorghum is grown with diversity of need, but in middle Gujarat it is mainly grown for fodder purpose. For any effective breeding programme, it is always essential to know the nature and magnitude of genetic variability present in the material. The present study was, therefore, undertaken, to estimate the genotypic variability for yield, its components and quality traits in forage sorghum.

MATERIALS AND METHODS

The experiment was conducted in a randomized block design with 49 genotypes including four checks replicated four times at the Forage Research Farm, Gujarat Agricultural University, Anand Campus, Anand during kharif-1992. The distance between rows were maintained 25 cm, whereas, seeds were drilled within rows keeping even seed rate. Observations were recorded on five randomly selected competitive plants for nine quantitative and qualitative characters (Table 1). Crude protein content was computed by multiplying the percentage of nitrogen [nitrogen estimation was done by modified Kjeldahl method (Jackson, 1958) with factor 6.25, whereas, IVDMD and HCN were analysed following one stage method of Baumgardt *et al.* (1962) and Hogg

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**Present address : Research Scientist (FC), Forage Research Project, Gujarat Agricultural University, Anand Campus, Anand

TABLE 1
Estimates of variability parameters for nine characters in forage sorghum.

Parameter	Plant height (cm)	Stem girth (cm)	Leaf length (cm)	Leaf breadth (cm)	Green fodder yield per plant (g)	Dry matter yield per plant (g)	Crude protein yield per plant (g)	IVDMD (%)	HCN (%)
Mean $\pm$ SE	183.070 $\pm$ 7.64	0.516 $\pm$ 0.03	67.859 $\pm$ 2.24	3.190 $\pm$ 0.15	61.797 $\pm$ 7.15	12.680 $\pm$ 1.70	0.715 $\pm$ 0.11	53.643 $\pm$ 1.76	2.404 $\pm$ 0.25
Range	147.65 — 216.25	0.359 — 0.837	57.35 — 85.30	2.41 — 4.47	35.40 — 124.90	7.218 — 23.28	0.365 — 1.305	42.77 — 68.075	0.192 — 7.044
$\sigma^2 P$	446.951	0.010	45.652	0.317	527.554	24.244	0.090	30.771	2.600
$\sigma^2 g$	213.329	0.006	25.615	0.229	323.212	12.626	0.045	18.401	2.341
PCV	11.548	19.688	9.957	17.650	37.168	38.816	41.974	10.341	67.063
CCV	7.978	15.041	7.458	14.996	29.092	28.023	29.759	7.997	63.633
H ² (B.S.) %	47.730	58.363	56.110	72.188	61.266	52.121	50.265	59.798	90.032
GA (% Mean)	11.355	23.671	11.509	26.246	46.909	41.677	43.463	12.738	124.380

$\sigma^2 P$: Phenotypic variance PCV : Phenotypic coefficient of variation
 $\sigma^2 g$: Genotypic variance GCV : Genotypic coefficient of variation
H² : Heritability GA : Genetic advance

and Ahigren (1942) methods, respectively. Range, phenotypic and genotypic variances, coefficients of phenotypic and genotypic variation, heritability (broad sense) and genetic advance (expressed as per cent of mean) were calculated to have an idea about the amount of variability present in the population studied.

RESULTS AND DISCUSSION

The analysis of variance revealed highly significant differences among the genotypes for all the characters except stem girth, leaf breadth and crude protein yield. The range of variation was substantially high for all the characters under study, and it was particularly pronounced in HCN, green fodder yield and dry matter yield (Table 1). Green fodder yield, dry matter yield and HCN showed large genotypic variability.

Among all the characters studied, HCN was least affected by environmental factors followed by leaf breadth and green fodder yield, on the other hand, plant height and crude protein yield were comparatively more influenced by external factors as evident by their respective estimates of phenotypic and genotypic variances. The estimates of phenotypic coefficient of variation (PCV) were higher than their respective genotypic coefficient of variation (GCV) for all the traits. The GCV was maximum for HCN followed by crude protein yield, green fodder yield and dry matter yield. It was low for leaf length, plant height, IVDMD and moderate for stem girth and leaf breadth. Same trend was observed for PCV. The heritability estimates that help breeders in selection based on the phenotypic performance, were moderate for IVDMD, stem girth, leaf length, dry matter yield, crude protein yield and plant height and high for

HCN followed by leaf breadth and green fodder yield, suggesting that there was much correspondence between the phenotypic and breeding value (Amirthadevarathinam *et al.* 1990). High heritability, combined with high genetic advance as per cent of mean was observed in case of characters HCN, green fodder yield, leaf breadth and these characters appeared to be under the influence of additive gene action (Panse, 1957). The expected genetic gain as per cent of mean was the highest in HCN with high heritability. Dry matter yield and crude protein yield also had high genetic gain as per cent of mean but had moderate heritability. The characters plant height, leaf length and IVDMD had moderate heritability but low genetic advance indicating the operation of non-additive gene-action. The lowest heritability estimate and comparatively low genetic gain recorded for plant height suggest the use of modified breeding methods other than selection. Similar findings were reported by Amirthadevarathinam *et al.* (1990).

Present study revealed that the traits like green fodder yield, dry matter yield, crude protein yield and HCN exhibited higher variability as compared to other yield components. High genetic variability in forage sorghum for green fodder yield and dry matter yield was also reported earlier by Paroda *et al.* (1975), Sidhu and Mehndiratta (1980), Grewal *et al.* (1983), Kaushik (1986), Patel *et al.* (1973) and Avtar and Jhorar (1992) whereas, high variability for protein content was supported by Sood and Ahluwalia (1980), Avtar and Jhorar (1992). High heritability coupled with high genetic advance for green fodder yield, leaf breadth and HCN suggested that atleast such traits can be improved through simple selection in the present population of forage sorghum.

REFERENCES

- Amirthadevarathinam, A.; R. Sankarapadian and N. Natarajan (1990). Estimates of Genetic parameters and Correlation coefficients in Fodder Sorghum. *Madras Agric. J.*, **77** (9-12) : 462-464.
- Avtar, R. and B. S. Jhorar (1992). Correlation and Path Analysis in Forage Sorghum (*Sorghum bicolor* (L.) Moench). *Forage Res.*, **18** (1) : 48-51.
- Baumgardt, B. R.; M. W. Taylor and J. L. Cason (1962). Evaluation of forage in the laboratory-II. Simplified artificial rumen procedures for obtaining repeatable estimates of forage. *J. Dairy Sci.*, **45** : 62-68.
- Grewal, R. P. S.; G. P. Lodhi and K. S. Bagarwa (1983). Correlation and Path-analysis in Forage Sorghum. *Forage Res.*, **9** : 185-188.
- Hogg, P. G. and H. L. Ahlgren (1942). A rapid method of determining hydrocyanic acid content of single plant of sudan grass. *J. Ame. Soc. Agron.*, **43** : 199-200.
- Jackson, M. L. (1958). Soil Chemical Analysis. Prentice Hall of India Private Limited, New Delhi, PP. 183-204.
- Kaushik, V. S. (1986). Variability and path-coefficient studies in forage sorghum in relation to stem borer resistance. M. Sc. thesis, HAU, Hissar.
- Panse, V. G. (1957). Genetic of quantitative characters in relation to plant breeding. *Indian J. Genet.*, **17** : 318-328.
- Paroda, R. S.; O. P. Dangi and R. P. S. Grewal (1975). Correlation and path analysis in forage sorghum. *Indian J. Genet.*, **35** : 83-89.
- Patel, K. C.; A. R. Dabholkar; S. W. Telang and S. S. Baghel (1973). Components of fodder yield in *Sorghum bicolor* (L.) Moench. *Indian J. Agric. Sci.*, **43** : 602-604.
- Sidhu, B. S. and P. D. Mehindratta (1980). The genetic analysis of forage yield components in sorghum. *Crop Improv.*, **7** : 38-42.
- Sood, B. C. and M. Ahluwalia (1980). Phenotypic and genotypic variability in forage sorghum. *Forage Res.*, **6** : 229-230.

Genetic Analysis of Seed Yield and its Components in Pigeonpea

H. R. Dhameliya* and A. R. Pathak

Department of Plant Breeding and Genetics, Gujarat Agricultural University, Sardar Krushinagar

ABSTRACT

Genetic architecture of eight characters in pigeonpea (*Cajanus cajan* (L.) Millsp) was studied in F_2 of a diallel set involving ten parents. Non-additive gene effects played a greater role in the control of yield and its components, though the additive gene effects were also important. Genes with positive and negative effects were asymmetrically distributed in parents. The narrow sense heritability was high for days to flowering, days to maturity and pods per plant, whereas moderate to low plant height, pod length, seeds per pod, seed yield per plant and branches per plant. Reciprocal recurrent selection has been suggested for evolving high yielding pigeonpea cultivars.

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INTRODUCTION

To fit arhar-wheat rotation, development of high yielding, early maturing pigeonpea variety is of greater importance. The information regarding the nature and magnitude of genetic variation can greatly help the plant breeder in deciding the method to be employed for the improvement of crop. This information is however, scarce in early pigeonpea. The present investigation was undertaken to study the gene effects for eight quantitative characters in early pigeonpea group.

45 F_2 's were evaluated in RBD with four replications at College Farm, Sardar Krushinagar during kharif 1989. Each entry was planted in four row plots, each 4 m long spaced at 60 x 15 cm. Data on 8 quantitative characters (Table 1) were recorded on 10 randomly selection plants from each of parents and F_2 's. Diallel analysis was done according to Jinks (1956). Heritability in narrow sense was estimated as per Verhalen and Murray (1969).

RESULTS AND DISCUSSION

Diallel analysis provides an overall genetic evaluation which would be helpful in selecting parents and their potential crosses in early segregating generations (Johnson 1963). Hayman (1954) emphasized the fulfilment of certain assumptions. In the present study

MATERIALS AND METHODS

Ten early maturing pigeonpea genotypes namely ICPL 269, Pusa Sweta-2, GAUT 82-99, H 76-208, ICPL 310, ICPL 151, ICPL 8306, BDN 31, BWR 245 and their half diallel

*Present address : Assistant Professor, Department of Agricultural Botany, College of Agriculture, Gujarat Agricultural University

TABLE 1

Estimates of genetic components of variance and their proportions for quantitative characters in pigeonpea.

Components	Days to 50% flowering	Days to maturity	Plant height	Number of branches per plant	Number of pods per plant	Pod length	Number of seeds per pod	Seed yield per plant
D	203.34** ± 9.88	285.84** ± 19.95	481.06** ± 50.44	1.17* ± 0.38	7687.73** ± 572.11	0.28** ± 0.07	0.24** ± 0.05	169.45** ± 32.89
H ₁	516.26** ± 84.10	1119.23** ± 169.85	2692.88** ± 429.45	20.14** ± 3.17	41925.73** ± 4871.17	1.93* ± 0.61	1.08** ± 0.42	1390.73** ± 280.05
H ₂	324.70** ± 71.48	720.56** ± 144.36	1200.69** ± 364.98	15.10** ± 2.78	20881.59** ± 4139.96	1.50* ± 0.51	0.73** ± 0.36	717.03* ± 238.01
h ²	5.19 ± 47.85	1231.21 ± 96.63	216.86 ± 244.30	5.58 ± 1.86	720.03 ± 2771.12	-0.11 ± 0.34	-0.013 ± 0.24	258.34 ± 159.31
F	165.99** ± 45.53	274.19** ± 91.94	169.09 ± 232.46	1.87 ± 1.77	12064.45** ± 2636.80	0.30 ± 0.33	0.28* ± 0.23	330.57 ± 151.59
E	0.40 ± 2.98	1.97 ± 6.01	28.98 ± 15.21	0.39 ± 0.12	41.11 ± 172.50	0.023 ± 0.021	0.021 ± 0.022	14.63 ± 9.92
1/4 (H ₁ /D) ^{0.5}	0.80	0.99	1.23	2.07	1.17	1.31	1.06	1.43
H ₂ /4H ₁	0.16	0.16	0.19	0.19	0.12	0.19	0.17	0.13
h ² /H ₂	0.02	1.71	0.10	0.37	0.03	-0.07	-0.08	0.36
K _D /K _R	3.10	2.88	1.33	2.25	5.10	2.41	3.60	5.27
Heritability	0.81	0.65	0.39	0.17	0.63	0.39	0.47	0.47
t ²	0.02	1.24	1.18	0.71	0.11	0.034	0.76	0.46

*, **: Significant at 5 and 1 per cent probability levels, respectively.

non-significant t^2 value revealed that all the assumptions underlying diallel analysis were satisfied for all the characters.

The estimates of parameters are given in Table 1. The components D and H_1 measuring variance due to additive and non-additive genetic effects, respectively were significant for all the characters studied. However, degree of dominance $1/4 (H_1/D)^{0.5}$, suggested partial dominance for days to flowering, near complete dominance for days to maturity and seeds per pod and over dominance for plant height, branches per plant, pods per plant, pod length and seed yield per plant. The present results are in accordance with the earlier reports of Dahiya and Brar (1977), Kapoor (1977), Malik *et al.* (1985) and Reddy *et al.* (1979). Sidhu *et al.* (1981) also reported importance of additive gene effects for days to flowering. The relative value of H_1 and H_2 and the proportion of $H_2/4H_1$ suggested that the genes with positive and negative effects were not equally distributed among the parental lines. An excess of increaser genes in parents for various traits was

indicated by greater than unit value of KD/KR ratio. The significant and positive value of F also confirmed above findings for days to flowering, maturity, pods per plant and seeds per pod. High narrow sense heritability (ranging from 0.63 to 0.81) was recorded for days to flowering, days to maturity and pods per plant. The characters such as plant height, branches per plant, pod length, seeds per pod and seed yield had moderate to low estimates of narrow sense heritability indicating a major contribution of the non-additive genetic effects for control of these traits. Dahiya and Brar (1977) and Malik *et al.* (1985) have also reported low heritability in pigeonpea for characters plant height, number of pods per plant seed yield per plant.

The results of these experiments showed that both the additive and non-additive gene effect were involved in the inheritance of all the characters studied with pre-dominance of non-additive gene action. It is therefore, suggested that reciprocal recurrent selection procedure may be gainfully employed develop superior lines.

REFERENCES

- Dahiya, B. S. and Brar, J. S. (1970). Diallel analysis of genetic variation in pigeonpea (*Cajanus cajan*), *Expl. Agric.* 13 : 193-200.
- Griffings, B. (1956). 'Concept of general and specific combining ability in relation to diallel crossing systems', *Aust. J. Biol. Sci.*, 9 : 463-493.
- Hayman, B. I. (1954). 'The theory and analysis of diallel crosses', *Genetics* 39 : 789-809.
- Johnson, L.P.V. (1963). 'Application of diallel cross techniques to plant breeding'. *Statistical genetic and plant breeding*. NAS-NRC Pub. 982 : 571-578
- Kapoor, R. (1977). Genetic analysis of some quantitative characters at different population levels in pigeonpea (*Cajanus cajan* (L.) Millsp.) unpublished M. Sc. Thesis, Punjab Agricultural University, Ludhiana.
- Malik, B. P. S.; Paroda, R. S.; Singh, S. and Singh, V. P. (1985). Genetics of some quantitative characters in pigeonpea *Crop. Improv.* 12 (1) : 80-81.
- Reddy, R. P.; Azem, M. A., Rao, K. V. and Rao, N. G. P. (1979). Combining ability and selection index in F_2 crosses of pigeonpea. *Indian J. Genet.* 39 : 247-254.
- Sidhu, P. S.; Verma, M. M. and Sandhu, T. S. (1981). Genetic analysis of seed yield and other traits in pigeonpea. *Crop Improv.* 8 (2) : 106-110.

Wheat Response to P Under Different Soil Treatments : III - Effect of M x F x P and M x AL x P

B. A. Golakiya, M. S. Patel and S. G. Savalla

Department of Agricultural Chemistry and Soil Science, Gujarat Agricultural University,
Junagadh Campus, Junagadh-362 001

ABSTRACT

A pot experiment was carried out to study the effect of phosphorus (0, 25, 50, 100 ppm) with moisture (-0.5 bar, -1.0 bar), FYM (0, 2 per cent) and active lime (0, 5, 25 per cent of the total 30 per cent lime added in the soil) on yield attributes, yield and concentration and uptake of P, Zn and Ca by wheat cv GW-120. The interaction M x F x P was significant only in case of the earhead length and the concentration and uptake of P and Zn by the grain and straw, respectively and concentration of Ca in grain. The interaction M x AL x P significantly affected the earhead length, straw yield, concentration and uptake of P, Zn and Ca in grain and straw except concentration of P and Ca in straw. The length of earhead and P concentration in the grain and straw were almost doubled even under M2 when FYM and P3 interacted together. Thus, the higher level of P fertilization and FYM incorporation could help overcome the adverse effects produced through the moisture stress. The wheat response to P fertilization was greatly limited by the higher moisture tension level and active lime content in the soil.

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INTRODUCTION

Low soil moisture level and a corresponding water deficit in plants is a typical constraint on plant growth in alkaline Aridisols. At low soil moisture levels both the diffusion of nutrients to root surface and root extension are impaired. The uptake of P is closely related to soil moisture and root extension. In alkaline calcareous soils with low level of labile P, its deficiency is, therefore, more closely related to decreasing soil moisture level than to increasing pH (Marschner, 1986). The incorporation of FYM along with NPK or P exhibited additive effect on the growth and yield of the field crops (Maurya

and Ghosh, 1972; Sandhu and Meelu, 1974), P uptake (Dahiya *et al.*, 1987) and availability of P in the soil (Chahal *et al.*, 1984). It has been also documented by many workers that adverse effect of lime on the crop growth and yield, nutrient uptake and nutrient availability in the soil (Patel and Golakiya, 1986; Sutaria and Patel, 1987; Golakiya and Patel, 1988).

MATERIALS AND METHODS

A pot experiment was carried out on a medium black calcareous vertisol during *rabi* 1986. The forty eight treatment combinations consisted of two moisture levels viz., -0.5 bar (M1) and -1.0 bar (M2), two levels of FYM viz.,

0 (F0) and 2 (F1) per cent, three levels of active lime viz., 0 (AL0), 5 (AL1) and 25 (AL2) per cent of the total 30 per cent lime added in the soil, and four levels of phosphorus viz., 0 (P0), 25 (P1), 50 (P2) and 100 (P3) ppm as a monocalcium phosphate $[\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot \text{H}_2\text{O}]$. These all treatments were repeated twice. A basal dose of N @ 60 ppm through urea was mixed with the soil and a split application of 60 ppm N was given at 25th days after sowing of wheat cv GW-120. Some of the soil characteristics are : sand 13.0%, silt 30.3%, clay 56.7%, p^{H} 7.8, EC 0.18 DSm^{-1} , CaCO_3 3.3%, CEC 53.0 me 100^{-1} g soil, organic C 0.84%, Olsen's P 5.73 ppm P_2O_5 , Available K 172.5 ppm K_2O , exchangeable Ca 44.5 me IOC^{-1} g soil and DTPA extractable Zn, Fe, Cu and Mn were 0.62, 6.53, 3.22 and 11.56 ppm, respectively. The polythylene lined earthen pots (12 liters capacity) were filled with 12 kg of treated soil. Healthy and bold wheat seeds were sown, which were thinned to nine plants per pot a week after germination. The pots were irrigated as per moisture treatment. The observations like plant height, effective tillers, grain and straw yield and test weight were made timely. After harvesting the crop, plant samples were digested in a diacid mixture. The acid extract was used for analysis of nutrient P, Zn and Ca. Phosphorus in the acid extract was determined by Vanadomolybdo phosphoric yellow colour method, Ca by Versenate method (Jackson, 1958) and Zn by atomic absorption spectrophotometry (Shimadzu make model No. AA-640-13).

RESULTS AND DISCUSSION

Moisture x FYM x Phosphorus Interaction Yield attributes and yield

The interaction among M x F x P was significant in case of the earhead length (Table 1).

Incorporation of FYM increased the earhead length by 19 and 3 per cent under M1F1P3 and M2F1P3 over that in M1F0P3 and M2F0P3, respectively. The interaction effect on the grain and straw yield was found nonsignificant but, the incorporation of FYM increased the grain and straw yield by 62 and 49 per cent, respectively, under M1F1P3 over that under M1F0P3. However, the corresponding per cent increase in these parameters at the same level of P under M2 was to the tune of 86 and 9 per cent. The adverse effect of water stress was alleviated mainly due to FYM application as there was little difference between M1F0P3 and M2F1P3.

Nutrient content and uptake

The concentration and uptake of P by grain and straw were significantly affected due to M x F x P interaction (Table 1). The P concentration in the grain and straw were almost doubled even under moisture stress (M2), when FYM and P3 interacted together as compared to F0P0. The increment in the P concentration is also attributed to reduced grain and straw yield under moisture stress conditions. The application of FYM alone increased the concentration and uptake of P by grain to the tune of 20 and 94 per cent, respectively, under M1F1P3 over that in M1F0P3. Similarly it was increased by 11 and 88 per cent under M2F1P3 over that under M2F0P3. The result of the present experiment was corroborate with that of Nambiar and Ghosh (1984) who concluded that addition of FYM along with 100 per cent NPK to medium black soils improved the grain yield of wheat (8%), P uptake and available P status of the soils. However, the reduction in its concentration and uptake by straw under M1F1P3 and M2F1P3 over M1F1P0 and M2F1P0 is contrary to the expectation and for that we have no explanation.

TABLE 1
Interaction effect of moisture, FYM and phosphorus on yield attributes, yield, concentration and uptake of phosphorus by wheat cv GW-120.

Treatment combinations	Plant height (cm)	Effective tillers	Earhead length (cm)	Test weight (g)	Grain yield (g pot ⁻¹)	Straw yield (g pot ⁻¹)	P concentration (mg g ⁻¹)		P uptake (mg pot ⁻¹)	
							Grain	Straw	Grain	Straw
M1FOPO	33.9	11.0	3.11	39.6	9.86	12.78	2.58	0.87	25.4	11.1
M1FOP1	42.3	14.6	4.88	40.5	11.85	23.30	4.12	0.58	48.8	13.5
M1FOP2	47.1	18.5	6.94	40.7	15.11	34.88	4.51	0.67	68.1	23.3
M1FOP3	47.5	19.4	7.73	42.0	12.95	32.19	4.24	0.72	54.9	23.2
M1F1PO	64.7	17.3	6.12	41.3	11.79	42.11	4.70	0.89	55.4	37.5
M1F1P1	48.0	20.0	7.30	43.2	14.45	95.23	5.19	0.80	75.0	36.2
M1F1P2	55.5	21.2	8.26	43.9	18.78	45.31	5.14	0.82	97.5	37.1
M1F1P3	57.8	22.1	9.22	44.7	20.95	48.03	5.10	0.60	106.8	28.8
M2FOPO	33.3	10.1	2.97	34.7	8.70	18.59	3.83	0.93	33.3	17.3
M2FOP1	40.1	9.4	3.31	35.8	9.58	20.28	4.81	0.89	46.1	18.0
M2FOP2	44.2	14.0	5.06	36.9	10.43	22.20	5.24	0.92	54.6	20.4
M2FOP3	44.5	15.6	6.00	38.4	9.70	22.53	4.97	1.00	48.2	22.5
M2F1PO	37.2	14.8	4.14	36.5	10.39	23.67	5.35	1.16	55.6	27.4
M2F1P1	43.7	18.4	5.54	36.9	10.93	25.10	5.18	1.13	56.6	28.3
M2F1P2	47.5	19.2	6.18	38.0	15.24	22.92	5.00	1.21	77.4	27.7
M2F1P3	48.0	20.4	6.20	39.3	18.08	23.87	5.01	1.12	90.6	26.7
CD (0.05)	NS	NS	1.12	NS	NS	NS	0.12	0.01	21.8	11.5

TABLE 2

Interaction effect of moisture, FYM and phosphorus on concentration and uptake of zinc and calcium by wheat cv GW - 120.

Treatment combinations	Zn concentration ($\mu\text{g g}^{-1}$)		Zn uptake ($\mu\text{g pot}^{-1}$)		Ca concentration (mg g^{-1})		Ca uptake (mg pot^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
✓ M1FOPO	81.4	70.8	802	905	1.20	3.68	11.8	47.0
✓ M1FOP1	82.9	64.3	982	1498	1.28	3.16	15.1	73.6
✓ M1FOP2	78.4	52.9	1184	1845	1.09	3.14	16.5	109.5
✓ M1FOP3	79.9	48.5	1035	1561	1.11	3.12	14.4	100.4
✓ M1F1PO	78.6	80.5	927	3390	1.14	3.20	13.4	134.7
✓ M1F1P1	68.0	68.5	982	3098	1.10	3.09	15.9	139.7
✓ M1F1P2	63.5	63.5	1192	2877	1.30	3.92	24.4	177.6
✓ M1F1P3	57.7	63.8	1209	3064	1.11	3.18	23.2	152.7
✓ M2FOPO	76.6	70.8	666	1316	1.10	3.00	9.6	67.1
✓ M2FOP1	69.1	56.9	662	1154	0.99	3.31	9.5	67.1
✓ M2FOP2	59.5	52.1	620	1157	1.06	3.58	11.0	79.4
✓ M2FOP3	59.3	38.5	575	867	0.93	3.00	9.0	67.6
✓ M2F1PO	69.2	51.2	719	1212	1.03	3.25	10.7	76.9
✓ M2F1P1	66.8	47.0	730	1180	0.93	3.11	10.2	78.0
✓ M2F1P2	51.7	46.5	780	1066	0.85	3.08	12.9	70.6
M2F1P3	56.2	51.9	1016	1239	0.93	3.06	16.8	73.0
CD (0.05)	6.8	0.5	61	112	0.07	NS	NS	NS

The concentration of Zn in the grain and straw was decreased with P and moisture stress (Table 2). Incorporation of FYM could not help in improving the concentration in the plant, possibly due to dilution effect in the plant and natural organic chelation of Zn (Chen and Stevenson, 1986) in the presence of FYM. The uptake of Zn by the grain and straw was reduced to 14 and 34 per cent under M2F1P3 over that under M2F0P0, respectively. In general, irrespective of P addition, incorporation of FYM increased the Zn uptake. Only the Ca content in the grain was affected due to interaction of M x F x P (Table 2). However, the Ca concentration and its uptake by grain and straw were higher under M1 compared to that under M2 conditions. The application of P alone, in absence of FYM reduced the Ca concentration in grain and straw by 8 and 15 per cent under M1F0P3 over M1F0P0, respectively. However, its uptake was increased by 22 and 113 per cent, respectively, in the grain and straw under same treatment combinations. The application of FYM failed to mitigate the adverse effect of water stress.

Moisture x active lime x phosphorus interaction

Yield attributes and yield : This interaction significantly affected the earhead length and straw yield (Table 3). Maximum P response on earhead length was obtained under M1AL0 (8.71 cm). Earhead length was decreased by 7 per cent under M1AL2P3 over that under M1AL1P3.

Similarly, it was decreased by just 2 per cent under M2AL2P3 over M2AL0P3. Under both the moisture levels, the earhead length was almost doubled at P3 level compared to that in P0 within any level of active lime. Irrespective of active lime, the application of P

increased grain and straw yield under both the moisture stress. The grain and straw yield were increased by 61 and 56 per cent under M1AL2P3 over that under M1AL2P0, respectively. Similarly, the corresponding increase under M2 was 49 and 3 per cent. But the incorporation of active lime reduced the grain and straw yield by 9 and 7 per cent under M1AL2P3 over that in M1AL0P3 and that of under M2 was 7 and 13 per cent, respectively. In general, the negative effect of both active lime and moisture stress on the crop was mitigated by P fertilization, most probably through higher P fertility resulting in increased root growth. Sutariya and Patel (1987) and Golakiya and Patel (1988) reported adverse effect of lime on the crop growth, yield nutrient uptake and nutrient availability in the soil. The incorporation of active lime react with P and produced a range of Ca-phosphates of varying solubility (Taylor and Woods, 1981) which determines crop response to P fertilization in the calcareous soils.

Nutrient content and uptake

The concentration and uptake of P were significantly affected by M x AL x P, except P concentration in the straw (Table 3). It generally increased the grain with the levels of P but with the lower magnitude as the active lime content increased in the soil. A slight depressing effect of AL on the P concentration was comparatively more pronounced under M1. The uptake of P by the grain and straw was generally increased with the levels of P but with the lower magnitude under active lime and precisely so under M1. In general, treatment differences under M2 were not as conspicuous as those under M1, perhaps due to reduced growth and yield in the former.

TABLE 3

Interaction effect of moisture, active lime and phosphorus on yield attributes, yield concentration and uptake of phosphorus by wheat cv GW-120.

Treatment combinations	Plant height (cm)	Effective tillers	Earhead length (cm)	Test weight (g)	Grain yield (g pot ⁻¹)	Straw yield (g pot ⁻¹)	P concentration (mg g ⁻¹)		P uptake (mg pot ⁻¹)	
							Grain	Straw	Grain	Straw
M1ALOP0	66.5	14.7	4.64	40.7	11.88	30.38	3.81	1.09	45.2	33.1
M1ALOP1	45.8	18.2	6.47	41.9	14.24	34.81	4.63	0.65	65.9	22.6
M1ALOP2	52.2	20.3	7.94	42.5	18.29	40.74	5.15	0.90	94.2	36.7
M1ALOP3	53.4	20.9	8.71	44.5	17.91	42.01	4.78	0.84	85.6	35.2
M1AL1P0	31.0	14.0	4.64	40.5	10.75	26.96	3.59	0.77	38.6	20.7
M1AL1P1	45.1	17.2	6.11	42.1	13.16	34.22	5.17	0.79	68.0	27.0
M1AL1P2	51.3	20.1	7.78	42.4	17.17	40.28	4.92	0.80	84.3	32.2
M1AL1P3	52.8	20.7	8.60	41.7	16.60	39.33	4.79	0.60	79.5	23.5
M1AL2P0	40.4	13.7	4.56	40.0	10.14	24.99	3.51	0.78	35.6	19.5
M1AL2P1	44.6	16.6	5.73	41.5	12.05	33.76	4.16	0.64	50.1	21.6
M1AL2P2	50.3	19.1	7.04	42.1	15.71	38.98	4.42	0.54	69.4	21.0
M1AL2P3	51.7	20.6	8.10	43.9	16.34	38.99	4.43	0.54	72.4	21.0
M2ALOP0	36.2	11.2	3.69	36.1	10.46	21.32	4.67	1.37	48.8	29.2
M2ALOP1	42.4	14.1	4.16	36.6	11.14	24.58	5.34	1.05	59.5	25.8
M2ALOP2	46.4	17.6	5.87	37.7	14.39	24.45	5.39	0.94	77.5	22.9
M2ALOP3	47.0	18.7	6.76	39.5	14.57	25.08	5.39	1.42	78.5	35.6
M2AL1P0	35.2	11.1	3.51	35.6	9.08	20.98	4.64	0.96	42.1	20.1
M2AL1P1	41.7	13.9	3.91	36.5	9.89	22.54	5.08	0.85	50.2	19.1
M2AL1P2	45.8	16.7	5.60	37.6	12.49	20.45	5.19	1.29	64.8	26.3
M2AL1P3	45.9	18.0	6.09	38.8	13.60	22.73	5.41	0.86	73.5	19.5
M2AL2P0	34.4	15.1	3.45	35.1	9.09	21.08	4.47	0.80	40.6	16.8
M2AL2P1	41.6	13.7	3.70	36.0	9.74	20.94	4.56	1.13	44.4	23.6
M2AL2P2	45.2	15.5	5.39	37.2	11.62	22.77	4.90	0.97	56.9	32.1
M2AL2P3	45.8	17.7	6.05	38.2	13.51	21.78	5.15	0.90	69.5	19.4
CD (0.05)	NS	NS	2.14	NS	NS	3.64	1.15	NS	13.6	8.2

TABLE 4

Interaction effect of moisture, active lime and phosphorus on the concentration and uptake of zinc and calcium by wheat cv GW-120.

Treatment Combination	Zn concentration (mg g^{-1})		Zn uptake (mg pot^{-1})		Ca concentration (mg q^{-1})		Ca uptake (mg pot^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
M1ALOP0	76.2	80.3	905	2439	4.26	3.54	15.0	107.5
M1ALOP1	78.7	81.0	1120	2819	1.44	3.16	20.5	110.4
M1ALOP2	71.5	70.4	1307	2868	1.21	2.87	22.1	117.1
M1ALOP3	68.2	69.3	1221	2911	1.16	2.86	20.8	120.0
M1ALIP0	82.7	77.0	889	2075	1.11	3.63	11.9	97.0
M1ALIP1	70.8	65.1	931	2238	0.97	3.07	12.7	105.1
M1ALIP2	72.7	49.7	1246	2002	1.07	3.04	18.3	127.4
M1ALIP3	71.0	59.0	1178	2330	1.05	3.18	18.1	125.0
M1AL2P0	81.3	69.5	824	1737	1.14	3.15	11.5	79.0
M1AL2P1	76.8	53.1	925	1792	1.16	3.15	14.0	106.3
M1AL2P2	68.5	54.0	1076	2105	1.30	3.18	20.4	123.4
M1AL2P3	67.2	70.2	1098	1567	1.00	3.41	17.6	132.9
M2ALOP0	78.1	55.9	817	1192	0.94	3.36	9.8	71.2
M2ALOP1	73.7	50.3	921	1236	0.98	3.62	10.9	90.4
M2ALOP2	57.4	40.3	826	9853	1.00	3.46	15.6	84.6
M2ALOP3	55.5	35.0	902	8782	1.01	3.14	14.7	78.7
M2ALIP0	67.0	63.2	608	1326	1.26	2.82	11.4	59.1
M2ALIP1	65.2	51.1	645	1152	0.96	3.21	9.5	72.3
M2ALIP2	51.9	56.2	648	1149	0.98	3.41	12.2	73.8
M2ALIP3	57.9	50.2	787	1141	0.93	3.48	12.6	79.1
M2AL2P0	73.5	64.0	668	1349	0.94	2.85	9.0	60.1
M2AL2P1	64.9	55.4	632	1160	0.93	2.96	9.0	61.9
M2AL2P2	57.4	91.5	667	2083	0.79	2.95	9.1	67.2
M2AL2P3	59.8	50.4	808	1098	0.84	3.25	11.3	70.8
CD (0.05)	10.8	10.5	159	162	0.07	NS	1.4	3.5

The concentration and uptake of Zn by the grain and straw were significantly affected by M x AL x P (Table 4). The concentration of Zn in the grain and straw was reduced with P levels under M1 and M2, its differences became wider with increasing contents of active lime in the soil, particularly under M2. This may be due to the higher concentration of P under M2, because of the reduced growth. Since the Zn uptake by the grain and straw increased with the levels of P due to higher yields in response to P fertilization. Contrary to this, the Zn uptake by grain and straw was curtailed by 10 and 46 per cent under M1AL2P3 over M1AL0P3, respectively. Possibly due to adverse effect of active lime when combined with P application which curtailed the growth and yield of field crops (Golakiya and Patel, 1988).

The concentration and uptake of Ca by the grain and straw were significantly affected by M x AL x P except Ca concentration in straw (Table 4). The Ca concentration was diminished with the P levels. However, its considerable reduction (6 – 26%) in the grain along the active lime content remained a moot point and this complexity was further intensified by no such effect of active lime on the Ca concentration in the straw. On the contrary, the Ca uptake was increase with increasing P levels, but it was curtailed with increasing content of active lime in the soil, particularly under M2. The Ca uptake by grain and straw was reduced by 23 and 10 per cent under M2AL2P3 over that under M2AL0P3, respectively.

REFERENCES

- Chahal, R., Singh, J. P. and Khera, A. P. (1984). Cumulative, direct and residual effects of phosphorus, potassium and farmyard manure on crop yield and soil characteristics. *J. Indian Soc. Soil Sci.*, **32** : 92-96.
- Chen, Y. and Stevenson, F. J. (1986). Soil organic matter interactions with trace elements. In (Chen, Y. and Avnimelech, Y. Ed.). "The Role of Organic Matter in Modern Agriculture". Martinus Nijhoff PP. 73 - 115.
- Dahiya, S. S.; Goel, S.; Antil, R. S. and Korwasra, S. P. S. (1987). Effect of farmyard manure and codmium on the dry matter yield and nutrient uptake by maize. *J. Indian Soc. Soil Sci.*, **35** : 460-464.
- Golakiya, B. A. and Patel, M. S. (1988). Effect of Ca/B ratio on yield attributes and yield of groundnut. *J. Indian Soc. Soil Sci.*, **36** : 287-290.
- Jackson, M. L. (1958). "Soil Chemical Analysis". Prentice Hall Inc. Englewood, chiff.
- Marschner, H. (1986). Mineral nutrition of higher plants Academic Press, London PP. 477-552.
- Maurya, P. R. and Ghosh, A. B. (1972). Effect of longterm manuring and rotational cropping on fertility status of alluvial calcareous soil. *J. Indian Soil Sci.*, **20** : 31-43.
- Nambiar, K. K. M. and Ghosh, A. B. (1984). Highlights of research on Longterm Fertilizer Experiments in India (1971-82). Long term fertilizer experiments Project PP. 100.
- Patel, M. S. and Golakiya, B. A. (1986). Effect of Calcium Carbonate and boron application on yield and nutrient uptake by groundnut *J. Indian Soc. Soil Sci.*, **34** : 815-820.
- Sandhu, R. S. and Meelu, O. P. (1974). Effect of P, K and FYM on the buildup and depletion of nutrients in soil in a fixed wheat maize rotation. *J. Res. P.A.U.*, **8** : 182-186.
- Sutaria, G. S. and Patel, M. S. (1987). Effect of phosphorus, sulphur, zinc and iron on yield and nutrient uptake (P, S, Zn and Fe) by groundnut grown on highly calcareous clay soils. *Indian J. Agric. Chem.*, **20** : 39-48.
- Taylor, A. W. and Woods, J. (1981). Inorganic phosphorus in calcareous rockland soils of the Bahams. *Soil Sci. Soc. Am. J.*, **45** : 730-734.

Biological Assessment of Trizophos Sprayed Aerially Against Sugarcane Whitefly

C. B. Patel*, R. C. Jhala, M. B. Patel, J. J. Pastagia, H. M. Patel, S. N. Saravaiya and J. M. Patel

Department of Entomology, N. M. College of Agriculture, Gujarat Agricultural University,
Navsari Campus, Navsari-396 450, Gujarat, India

ABSTRACT

Four doses of triazophos 40 EC (Hostathion) and other conventional insecticides were tested by aerial spraying during October 1991 in Chalthan sugar factory area of Gujarat State (India) to work out their efficacy against sugarcane whitefly *Aleurolobus barodensis*. The results indicated that triazophos 40 EC at dose of 593 g a.i./ha was the best treatment which exhibited the highest ovicidal effect.

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INTRODUCTION

bioefficacy of triazophos alongwith other insecticides against sugarcane whitefly.

MATERIALS AND METHODS

The whitefly, *Aleurolobus barodensis* Mask is a serious insect pest of sugarcane in South Gujarat since last five years. Both nymphs and adults of this pest suck cell sap from the under surface of the leaves. The affected crop becomes pale green to yellow and look sick in appearance. As a result, cane juice as well as jaggary quality are badly affected. There is also a loss in sugar recovery (Singh *et al.* 1956; Siddiqui and Saxena, 1960). Various insecticides have been tested by ground application for the control of this pest on sugarcane in India (Chandhary *et al.* 1988) Patel *et al.* 1989 and Kunjadia and Patel (1993). However, ground spraying of insecticides is very difficult in later stage of the crop. Looking to this fact, aerial spraying trial was conducted during 1991 to test the

Nine individual plots (each approximately of 8-10 acres) of sugarcane reasonably isolated from each other, located in Chalthan sugar factory area were selected for treatments. Each plot was divided into three blocks considering one block as one replication. Ten plants were randomly selected from each replication and from each plant, three leaves, each in the top, middle and lower portion of the plant were selected, plucked and brought to the laboratory for recording whitefly population. On each leaf, three spots of 24 cm² (8 cm x 3 cm) area each in top, middle and basal portion were observed under

*Present address : Professor of Entomology, Department of Entomology, N. M. College of Agriculture, Gujarat Agricultural University, Navsari Campus, Navsari-396 450

microscopes for whitefly population (nymph and puparia). Number of whitefly nymph/puparia were recorded before spraying as well as 3, 7, 14 and 21 days of aerial spraying. To study the ovicidal effect of insecticides, ten top leaves having whitefly eggs were selected randomly from each replication and tagged. These tagged leaves were brought into the laboratory and observation were recorded on per cent egg hatching by examining them under microscope. Based on these data the ovicidal effect was worked out in terms of per cent reduction in hatching.

The insecticides viz.; triazophos, endosulfan, dimethoate and ethion were sprayed aerially with a VT-EAD helicopter having D-4 type 44 duromist nozzle under the pump pressure of 65 P.S.I. Spraying operation was done during 10.0 to 11.30 a.m. in calm wind condition. The helicopter effected 30.5 meter swath width while flying at 2.5 to 3 meter above the crop canopy. Insecticidal spray mixture was applied @ 21.25 lit/ha.

The data on whitefly population counts have been analysed adopting randomized block design after following root transformation while the data on per cent reduction in hatching have been analysed with the same design after following arc sin transformation. The data on whitefly population have also been pooled over days.

RESULTS AND DISCUSSION

From the table 1, it can be seen that the differences in whitefly population in all the treatments was non-significant before spraying showing the population of whitefly as homogenous in the initial stage of the experiment. Further, all the insecticidal

treatments recorded significantly lower population than control treatment in each observation after spraying.

The data recorded on 3 days after spraying (DAS) revealed that triazophos 593 g a.i./ha (3.06 nymph/puparia) was found to be significantly superior over others in controlling the whitefly. Similarly on 7 DAS, the treatments of triazophos 593 g a.i./ha (6.45 nymphs/puparia), triazophos 494 g a.i./ha (8.76) and endosulfan 432 g a.i./ha (10.63) were found to be at par with each other and significantly superior to rest of the treatments. On 14 DAS, triazophos 593 g a.i./ha (44.22) was at par with 494 g a.i./ha (56.70) but significantly superior to rest of the treatments. On 21 DAS triazophos 593 g a.i./ha (23.62) was found to be significantly superior to rest of the treatments. Further, the treatments of triazophos 395 g and 495 g a.i./ha were found at par with each other and superior to rest of the treatments.

The ANOVA of pooled analysis of data on number of whitefly nymph/puparia over days revealed that the interaction (D x T) was non-significant indicating consistant behaviour of different treatments during individual observations. Further, all the treatments differed significantly from each other. The pooled data revealed that triazophos 593 g a.i./ha was found to be significantly superior to rest of the treatments. The effectiveness of rest of the treatments in descending order was triazophos 494 g a.i./ha (26.11), triazophos 395 g a.i./ha (32.95), triazophos 296 g a.i./ha (43.96), endosulfan 432 g a.i./ha + dimethoate 371 g a.i./ha (55.50), ethion 371 g a.i./ha (70.90), endosulfan 432 g a.i./ha (76.74), dimethoate

Mean population of whitefly (nymph/puparia) population per 72 cm² leaf area.

Sr No.	Treatments	Dose a.l./ ha. (ml.)	Days after spraying					Pooled
			Before Spraying	3	5	14	21	
1.	Triazophos (Hostathlon 40 EC)	296 ml	154.26 (12.42)	14.90 (3.86) ^c	22.56 (4.75) ^b	76.74 (8.76) ^b	83.91 (9.61) ^c	43.96 (6.63) ^d
2.	Triazophos (Hostathlon 40 EC)	395 ml	134.10 (11.58)	9.30 (3.05) ^b	22.18 (4.71) ^b	73.10 (8.55) ^b	44.22 (6.65) ^b	32.95 (5.74) ^c
3.	Triazophos (Hostathlon 40 EC)	494 ml	121.88 (11.04)	9.99 (3.16) ^b	8.76 (2.96) ^a	56.70 (7.53) ^{ab}	46.24 (6.80) ^b	26.11 (5.11) ^b
4.	Triazophos (Hostathlon 40 EC)	593 ml	148.60 (12.19)	3.06 (1.75) ^a	6.45 (2.54) ^a	44.22 (6.65) ^a	23.62 (4.86) ^a	15.60 (3.95) ^a
5.	Endosulfan (Thiodan 35 EC)	432 ml	121.66 (11.03)	23.81 (4.88) ^d	10.63 (3.26) ^a	221.12 (14.87) ^c	144.00 (12.00) ^a	76.74 (8.76) ^e
6.	Endosulfan + Dimethoate	432 ml 371 ml	167.96 (12.96)	12.26 (3.50) ^{bc}	22.66 (4.76) ^b	109.41 (10.46) ^c	122.99 (11.09) ^{de}	55.50 (7.45) ^e
7.	Dimethoate (Rogor 30 EC)	371 ml	146.89 (12.12)	24.70 (4.97) ^d	33.18 (5.76) ^c	210.25 (15.50) ^c	99.80 (9.99) ^{ce}	82.08 (9.06) ^h
8.	Ethlon (E-mite 30 EC)	371 ml	145.44 (12.06)	20.98 (4.58) ^d	38.07 (6.17) ^c	169.00 (13.00) ^d	98.60 (9.93) ^{ce}	70.90 (9.06) ^h
9.	Control		141.85 (11.91)	120.12 (10.96) ^e	152.28 (12.34) ^d	295.15 (17.18) ^f	254.40 (15.95) ^f	198.81 (14.10) ⁱ
D Interaction								
S. Em. ±			(0.51)	(0.23)	(0.30)	(0.55)	(0.50) ^T	(0.17)
C. D. at 5% level of significance			NS	(0.57)	(0.74)	(1.36)	(1.23)	(0.34)
C. V. %			(10.52)	(8.85)	(9.89)	(8.35)	(9.07)	(7.69)
								MS.

* Figure in the parentheses are $\sqrt{x}$ transformed values those outside the parentheses are retransformed value.

** Figures with same letter did not differ significantly.

371 g a.i./ha (82.08) and control (198.81). Kunjadia and Patel (1993) have tested various insecticides against sugarcane whitefly by ground application and found triazophos 0.1% to be the most effective treatment in controlling all stages of sugarcane whitefly. Similarly, Patel *et al.* (1989) reported that the treatments of triazophos 0.1% and 0.05% could keep comparatively lower population of sugarcane whitefly (nymph) upto 21 days of

spraying. Thus, the present findings are in close confirmation with the findings of above workers.

The perusal of data on the per cent reduction in hatching of eggs (ovicidal effect) presented in Table-2 indicated that all the insecticidal treatments except ethion 371 g a.i./ha were found to be significantly superior to control. The treatments of triazophos 593 g

TABLE 2

Ovicidal effect of various insecticides.

Sr. No.	Treatments	Dose a.i./ha (ml.)	reduction in egg hatching(%)
1.	Triazophos (Hostathion 40 EC)	296 ml	23.93 (29.29*) ^c
2.	Triazophos (Hostathion 40 EC)	395 ml	34.39 (36.24) ^b
3.	Triazophos (Hostathion 40 EC)	494 ml	41.75 (40.25) ^{ab}
4.	Triazophos (Hostathion 40 EC)	593 ml	46.01 (42.71) ^a
5.	Endosulfan (Thiodan 35 EC)	432 ml	21.69 (27.76) ^c
6.	Endosulfan +	432 ml	22.40
7.	Dimethoate	371 ml	(28.25) ^c
7.	Dimethoate (Rogar 30 EC)	371 ml	17.46 (24.60) ^c
8.	Ethion (E-mite 30 EC)	371 ml	10.31 (18.73) ^d
9.	Control		7.89 (16.31) ^d
	S. Em. ±		(1.91)
	C. D. at 5% level of significance		(4.76)
	C. V. %		(11.28)

* Figure in the parentheses are arc sin transformed values while those outside parentheses are retransformed values.

** Figures with same letter did not differ significantly.

a.i./ha exhibited highest ovicidal effect (46.01%) and was significantly superior to rest of the insecticidal treatments except triazophos 494 g a.i./ha (41.75%). The order of effectiveness of rest of the treatments was triazophos 395 g a.i./ha (34.39%) > triazophos 296 g a.i./ha (23.93%) > endosulfan 432 g a.i./ha + dimethoate 371 g a.i./ha (22.40%) > endosulfan 432 g a.i./ha (21.69%) > dimethoate 371 g a.i./ha (17.46%) > ethion 371 g a.i./ha (10.31%). The ovicidal action of triazophos has been reported on sugarcane whitefly, *Aleurolobus barodensis* at 0.1% concentration (Kunjadia and Patel 1993).

Similar results were obtained with triazophos 0.1% and 0.05% by Patel *et al.* (1989).

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REFERENCES

- Chaudhary, J. P. ; Yadav S. R. and Gupta, J. N. (1985). Comparative efficacy of some systemic insecticides against sugarcane whitefly, *Aleurolobus barodensis* Mask. (Homoptera : Aleyrodidae). *Haryana Agric. Univ. J. Res.*, **15** (4) : 457-462.
- Kunjadia, C. D. and Patel, C. B. (1993). Efficacy of various insecticides for the control of sugarcane whitefly (*Aleurolobus barodensis*) GAU. *Res. Journal* **19** (1) : 154-158.
- Patel, C. B. ; Jhala, R. C. ; Patel, N. M. and Shah, A.H. (1989). Field testing of some newer insecticides against sugarcane whitefly, *Aleurolobus barodensis* Maskell (Aleyrodidae : Homoptera) paper presented at the Hostathion lanuch, 5 August, 1989 held at Hotel Surya palace, Baroda.
- Patil, A. S. ; Hapase, D. G. ; Jaiswal., P. M. Musmade, G. S. and Kanjane, J. B. (1988). Control of Sugarcane whitefly, *A. barodensis* Mask. with newer insecticides. *DSTA., 38th Convention* PP. A-15-23.
- Siddiqui, Z. A. and Saxena, A. P. (1960). Studies on the control of sugarcane whitefly and the effect of its infestation on juice quality, *Indian J. Ent.*, **22** (2) : 99-104.
- Singh, H. ; Kalra, A. N. and Sandhu, J. S. (1956). Sugarcane whitefly *Aleurolobus barodensis* Mask. and its control, *Indian Sugar*, **5** (12) : 689-696.

Chemical Control of Rice Yellow Stem Borer, *Scirpophaga incertulas* (Wlk.) and its Carryover in Gujarat

L. D. Vavadia, A. H. Shah, H. V. Pandya, M. S. Purohit, C. B. Patel and A. B. Rai

Department of Entomology, N. M. College of Agriculture, Gujarat Agricultural University, Navsari Campus, Navsari

ABSTRACT

An investigation was undertaken at Navsari during summer and kharif seasons of 1985 to evaluate carbofuran, phorate and BPMC as granules and fenitrothion and monocrotophos as foliar spray alone and in combination applied at 25, 50 and 75 DAT (days after transplanting) based on control of rice yellow stem borer, its carryover and yield.

The treatments of cerbofuran @ 0.45 kg a.i./ha at 25 and 50 DAT + fenitrothion @ 0.5 kg a.i./ha at 75 DAT; and carbofuran @ 0.45 kg a.i./ha at 25, 50 and 75 DAT alone were found to have the least incidence of yellow stem borer and recorded maximum grain yield. The lowest carryover of the pest was observed in carbofuran @ 0.45 kg a.i./ha at 25 and 50 DAT + fenitrothion @ 0.5 kg a.i./ha at 75 DAT.

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INTRODUCTION

Rice yellow stem borer, *Scirpophaga incertulas* (Wlk.) is the major pest of wetland rice in South Gujarat during both summer and kharif seasons. In view of the severity of damage caused by this pest as well as establishment of usefulness of carbofuran as granular insecticide and fenitrothion and monocrotophos as foliar spray individually for paddy pests, it was imperative to know the efficacy of different granular and foliar insecticides against yellow stem borer and its carryover in Gujarat. The present study was therefore undertaken to fill up the lacuna existing in the area.

MATERIALS AND METHODS

The insecticidal treatments viz., carbofuran, phorate and BPMC used as granules,

while fenitrothion and monocrotophos used as foliar spray were evaluated at the National Agricultural Research Project Farm, Gujarat Agricultural University, Navsari. The experiment was laid out in a randomized block design replicated thrice during summer and kharif seasons of 1985 on GR 11 variety of rice. Granular and foliar applications of insecticides were given at 25, 50 and 75 DAT (Table 1).

The yellow stem borer incidence was assessed by counting the number of dead hearts in the beginning and number of white earheads after flowering in all the clump in each plot. At maturity, the grain yield was recorded. After harvest, 10 stubbles were randomly dug out from each plot and number of hibernating larvae were recorded. The data on white earheads, grain yield and hibernating larvae for

*Present address : Professor of Entomology, N. M. College of Agriculture, Gujarat Agricultural University, Navsari Campus,

TABLE 1
Chemical control of rice yellow stem borer and its carryover in Gujarat.

Treatment	No. of DH (pooled)		No. of WEH Summer- Kharif (Pooled)	Grain yield (kg/ha) (Pooled)	Hibernating larvae/10 stubbles (No.)	
	Summer	Kharif			Summer	Pooled
1. Carbofuran 3 G @ 0.45 kg a.i./ha at 25, 50 and 75 DAT*	2.34** (4.48)	2.99** (8.94)	8.03*** (64.48)	6048	12.80	08.75
2. Carbofuran 3 G @ 0.45 kg a.i./ha at 25, and 50 DAT + fenitrothion @ 0.5 kg a.i./ha at 75 DAT	2.15 (3.62)	2.24 (5.03)	8.74 (76.39)	6417	11.00	07.63
3. Carbofuran 3 G @ 0.45 kg a.i./ha at 25 DAT + fenitrothion @ 0.5 kg a.i./ha at 50 and 75 DAT	2.65 (6.02)	3.81 (14.52)	9.06 (82.45)	5413	14.00	09.63
4. Phorate 10 G @ 1.2 kg a.i./ha at 25, 50 and 75 DAT	2.12 (3.49)	4.04 (16.32)	8.68 (75.34)	5788	15.80	10.13
5. Phorate 10 G @ 1.2 kg a.i./ha at 25 and 50 DAT + fenitrothion @ 0.5 kg a.i./ha at 75 DAT	2.22 (3.93)	3.70 (13.69)	9.82 (96.43)	5723	15.10	10.88
6. Phorate 10 G @ 1.2 kg a.i./ha at 25 DAT + fenitrothion @ 0.5 kg a.i./ha at 50 and 75 DAT	2.23 (3.97)	3.81 (14.52)	9.49 (90.06)	6252	13.80	09.75
7. BPMC 4 G @ 1.2 kg a.i./ha at 25, 50 and 75 DAT	3.55 (11.60)	4.40 (19.36)	9.56 (91.39)	5807	18.00	13.00
8. BPMC 4 G @ 1.2 kg a.i./ha at 25 and 50 DAT + fenitrothion @ 0.5 kg a.i./ha at 75 DAT	2.91 (7.47)	4.40 (19.36)	10.43 (108.78)	5203	15.00	10.50

1.	2.	3.	4.	5.	6.	7.	8.
9.	BPMC 4 G @ 1.2 kg a.i./ha at 25 DAT + Fenitrothion @ 0.5 Kg a.i./ha at 50 and 75 DAT	3.84 (13.75)	4.05 (16.40)	10.55 (111.30)	5752	17.00	12.13
10.	Fenitrothion @ 0.5 kg a.i./ha at 25, 50 and 75 DAT	2.97 (6.78)	3.35 (11.22)	9.20 (84.64)	5917	12.50	08.37
11.	Monocrotophos @ 0.5 kg a.i./ha at 25, 50 and 75 DAT	2.62 (5.86)	3.03 (9.18)	8.76 (76.74)	5798	11.30	07.75
12.	Untreated control	5.92 (34.05)	5.83 (33.99)	12.82 (164.35)	4190	30.50	17.00
	CD at 5 %	1.01	0.18	0.87	617	04.70	02.42
	CV %	35.00	5.80	9.10	9.20	22.40	23.20

* DAT = Days after transplanting; $\sqrt{x+1}$ and $\sqrt[3]{x}$ Values; DH + Dead hearts; WEH = White earheads;

Figures in parentheses are retransformed values; Foliar spray of fenitrothion 50% EC and monocrotophos 36% WSC.

individual season were pooled to know the performance of treatments over two seasons (Table 1).

RESULTS AND DISCUSSION

Dead hearts : For the control of dead hearts, all the chemical treatments were significantly superior to untreated control during summer (Table 1). However, the treatments of carbofuran @ 0.45 kg a.i./ha at 25 and 50 DAT + fenitrothion @ 0.5 kg a.i./ha at 75 DAT; carbofuran @ 0.45 kg a.i./ha at 25, 50 and 75 DAT and monocrotophos @ 0.5 kg a.i./ha at 25, 50 and 75 DAT were found better when compared to rest of the treatments in controlling the incidence of dead hearts during *kharif*. The present findings are in close agreement with those of Kandsamy *et al.* (1978), Thomas *et al.* (1978), Dhaliwal *et al.* (1982) and Sasmal *et al.* (1986),

White earheads : The lowest number of white earheads was recorded in the treatment of carbofuran @ 0.45 kg a.i./ha at 25, 50 and 75 DAT which was at par with carbofuran @ 0.45 kg a.i./ha at 25 and 50 DAT + fenitrothion @ 0.5 kg a.i./ha at 75 DAT and monocrotophos @ 0.5 kg a.i./ha at 25, 50 and 75 DAT. The similar findings were also reported by Natarajan and Chandy (1979), Dhaliwal *et al.* (1982) and Das and Ray (1984).

REFERENCES

- Das, B. B. and Ray, S. 1984. Efficacy of certain insecticides against rice stem borer in Tripura. *Pesticides*, 18 (9) : 32-33. 37.
- Dhaliwal, G. S., Singh, J. and Singh, D. P. 1982. Field control of yellow stem borer by foliar and granular insecticides. *Inter. Rice Res. Newsl.*, 7 (2) : 15-16.
- Kandsamy, S., Varadharajan, G., Krishnan, M. and Sathiyandam, V. K. R. 1978. Paddy water application of carbofuran for stem borer control. *Inter. Rice Res. Newsl.*, 3 (1) : 13-14.
- Natarajan, K. and Chandy, K. C. 1979. Evaluation of certain insecticides against the major insect pests of rice. *Madras Agric. J.*, 66 (3) : 196-198.
- Sasmal, S., Kulshreshtha, J. P. and Rajamani, S. 1986. Economic control of rice stem borer, *Scirpophaga incertulas* (Wlk.) *Pestology*, 10 (1) : 13-18.
- Subramanian, R., Murthy, G. R. K. and Sharma, P. V. 1981. Control of paddy stem borer, *Tryporyza incertulas* (Wlk.) with phenyl carbamate insecticide. *Pestology*, 5 (1) : 22-24.
- Thomas, B., Karunakaran, K. and Sitarama Rao, D. 1978. Relative efficacy of some granular insecticides against gall midge, stem borer and leafroller pests. *Pestology*, 2 (10) : 12-13.

Grain yield

The highest grain yield (6417 kg/ha) was recorded in the treatment of carbofuran @ 0.45 kg a.i./ha at 25 and 50 DAT + fenitrothion @ 0.5 kg a.i./ha at 75 DAT, whereas the lowest (4190 kg/ha) in untreated control. This is in concurrence with Thomas *et al.* (1978) who obtained 34.4 per cent higher grain yield over control when carbofuran was used @ 0.5 kg a.i./ha at 15 and 45 DAT. Similar results were also obtained by Subramanian *et al.* (1981).

Carryover

The higher number of hibernating larvae were found in summer compared to *kharif*. Pooled analysis revealed that all chemical treatments were significantly superior to untreated control. The lowest number of hibernating larvae was recorded in the treatment of carbofuran @ 0.45 kg a.i./ha at 25 and 50 DAT + fenitrothion @ 0.5 kg a.i./ha at 75 DAT, while the highest number of hibernating larvae was recorded in untreated control. This indicated that the treatment of carbofuran @ 0.45 kg a.i./ha at 25 and 50 DAT + fenitrothion @ 0.5 kg a.i./ha at 75 DAT is effective in curtailing the carryover of yellow stem borer to the next season as population of hibernating larvae remains at lower level.

Population Dynamics of *Coccidohystrix insolita* (Green) on Pigeonpea*

P. K Borad** and P. A. Bhalani

Pulse Research Station, Gujarat Agricultural University, Junagadh

ABSTRACT

Studies on population dynamics of *Coccidohystrix insolita* (Green) infesting pigeonpea were made during 1991-93 at Pulse Research Station, Gujarat Agricultural University, Junagadh. The first peak of the pest was recorded in the 35th to 38th standard weeks (September) and second peak in the 47th to 49th standard weeks (December). Relative humidity, rainy days, rainfall and entomogenous fungi were negatively correlated with the population build up to the pest. The temperature (27 to 28° C) and relative humidity (85 to 95%) were found to be favourable for pest multiplication. Among biotic factors, entomogenous fungi were most active recording 17 to 42 and 16 to 75 per cent parasitization of bug during 1991-92 and 1992-93, respectively.

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INTRODUCTION

Recently, the mealybug, *Coccidohystrix insolita* (Green) (Pseudococcidae : Homoptera) has been found seriously infesting pigeonpea (*Cajanus cajan* (L.) Millsp.) crop in isolated patches in the region. It is commonly known as brinjal mealybug and has been reported by Chaudhuri (1976) and Nair and Nair (1977) attacking brinjal. It has also been reported to feed on pigeonpea in Gujarat (Patel *et al.* 1985 and Bhalani, 1990). There is no information available regarding population dynamics of *C. insolita* vis-a-vis pigeonpea. Hence, an attempt was made to know the population dynamics of *C. insolita* on pigeonpea and pinpoint the main period of

activity of the pest which could be utilised in formulating the strategies of Integrated Pest Management.

MATERIALS AND METHODS

The pigeonpea crop (var. BDN 2) was sown at Pulse Research Station, Gujarat Agricultural University, Junagadh in the third week of July in both the years, (1991-92 and 1992-93). All the recommended agronomical practices were followed for raising the crop. In order to record the mealybug population, sample quadrates of five plants were selected randomly and tagged with label and such 20 quadrates were observed at weekly intervals till crop maturity. From each tagged plant, five

* Part of Ph.D. thesis submitted by senior author.

secondary branches were selected randomly and observations were recorded on three leaves from top, middle and bottom of each branch for mealybug population. The activity of biotic factors viz., predators, parasitoids and entomogenous fungi was also recorded at weekly intervals. Data thus obtained were correlated with biotic and abiotic factors for determining the fluctuation of mealybug population by using correlation coefficient analysis.

RESULTS AND DISCUSSION

During 1991-92, mealybug incidence (Table 1) on pigeonpea crop commenced from the 31st standard week (0.23 mealybug/leaf) i.e. from the first fortnight of August and gradually increased in succeeding weeks reaching the highest peak (20.83 mealybugs/leaf) by the 38th standard week. Thereafter, the population started declining gradually, though not smoothly onwards till the end of crop season. Thus, there were two distinct peaks, first occurred during the 38th and the next during the 49th standard week. The temperature during the period was found between 27 and 29° C with 85 to 90 per cent relative humidity and these were found conducive for pest multiplication under field condition (Fig. 1). Mainly entomogenous fungi played an important role in pest suppression (Fig. 2). The temperature below 24° C and 80 per cent relative humidity were unfavourable for the development of entomogenous fungi.

During the year 1992-93 (Table 2) the mealybug first appeared on pigeonpea crop in the 31st standard week (0.22 mealybug/leaf). It increased gradually up to the 35th standard week (17.67 mealybugs/leaf) i.e. first fortnight

of September then declined from 36th standard week being minimum (0.8 mealybug/leaf) during 38th standard week. Again, the population increased from 39th standard week exhibiting the highest peak (21.67 mealybugs/leaf) during the 47th standard week and then decreased in succeeding weeks till the end of crop season. Thus, this year's study also indicated two distinct peaks, the first peak in the 35th standard week (second fortnight of November). Among the major abiotic factors, temperature and relative humidity played important role on pest activity (Fig. 1). These factors also influenced the activity of entomogenous fungi and parasitoids. The temperature below 27° C and 80 per cent relative humidity did not favour the development of fungi and parasitoids under field condition (Fig. 2).

Thus, from foregoing results the major activity of the pest was noticed during the 35th to 38th (September) and the 47th to 49th (December) standard weeks in both the years under Junagadh condition. The highest peaks of *C. insolita* were recorded during the 38th and 47th standard week in the year 1991-92 and 1992-93, respectively. Similarly, Iyer (1922) noted the activity of the mealybug, *Phenacoccus insolitus* Green on egg plants during the month of September in Mysore. According to Patel *et al.* (1989), the incidence of *C. insolita* occurred from November to January on pigeonpea in Bharuch region of Gujarat State.

The correlation coefficient values presented in Table 3 revealed that the relative humidity, rainy days and rainfall has shown significantly negative association with the build up of mealybug population during both the years, whereas, the

TABLE 1
Effect of abiotic and biotic factors on incidence of *C. insolita* on pigeonpea during the year 1991-92.

Standard week	Abiotic factors				Biotic factors				
	No. of mealybug / leaf	Temp. °C	R.H. (%)	Rainy days	Rain-fall (mm)	Sun-shine (hr.)	Per cent parasitism		
							Entom. fungi	para-sitoids	Predatory larvae/100 leaves
30	0.00	27.2	94	3	107.8	0.1	0.00	0.00	0
31	0.23	27.5	94	4	8.7	1.0	9.63	0.74	1
32	0.40	27.2	93	3	16.6	1.7	14.50	0.00	2
33	0.53	27.4	95	6	28.9	2.9	16.75	1.08	3
34	0.63	26.9	94	6	24.0	1.3	27.38	2.98	4
35	1.20	26.6	93	3	19.1	0.6	34.65	6.25	2
36	4.50	26.9	91	2	10.5	1.5	41.55	3.87	0
37	1095	26.5	90	0	0.0	7.0	30.33	1.29	2
38	20.83	28.02	86	0	0.0	8.0	21.27	2.66	2
39	10.35	28.5	86	0	0.0	9.1	17.77	6.28	4
40	11.78	27.3	70	0	0.0	909	17.39	5.56	5
41	11.50	28.5	92	0	0.0	8.3	13.89	5.21	3
42	12.50	26.7	67	0	0.0	8.5	13.02	4.45	4
43	11.33	27.0	72	0	0.0	8.5	13.39	4.46	3
44	14.45	24.8	76	0	0.0	7.9	10.81	5.83	2
45	13.60	24.4	75	0	0.0	7.8	12.97	2.40	3
46	15.25	26.4	69	0	0.0	6.8	6.44	2.15	0
47	15.55	26.1	61	0	0.0	6.6	6.53	1.51	1

1	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
48	15.63	23.2	60	0	0.0	7.5	5.12	1.40	1	0
49	15.90	22.2	68	0	0.0	8.1	3.12	2.08	2	0
50	14.38	22.2	69	0	0.0	8.4	0.00	0.95	2	0
51	10.53	22.0	75	0	0.0	8.2	2.04	2.04	1	0
52	6.63	17.3	85	1	10.3	7.2	0.00	0.77	2	0
1	5.83	18.4	72	0	0.0	8.9	0.97	0.00	3	0
2	3.67	18.3	60	0	0.0	8.7	0.00	0.63	0	0
3	0.12	20.4	50	0	0.0	9.1	0.00	0.00	0	0
AV	8.78	24.9	78.3	3.5	28.2	6.3	13.39	2.58	2.08	0.92

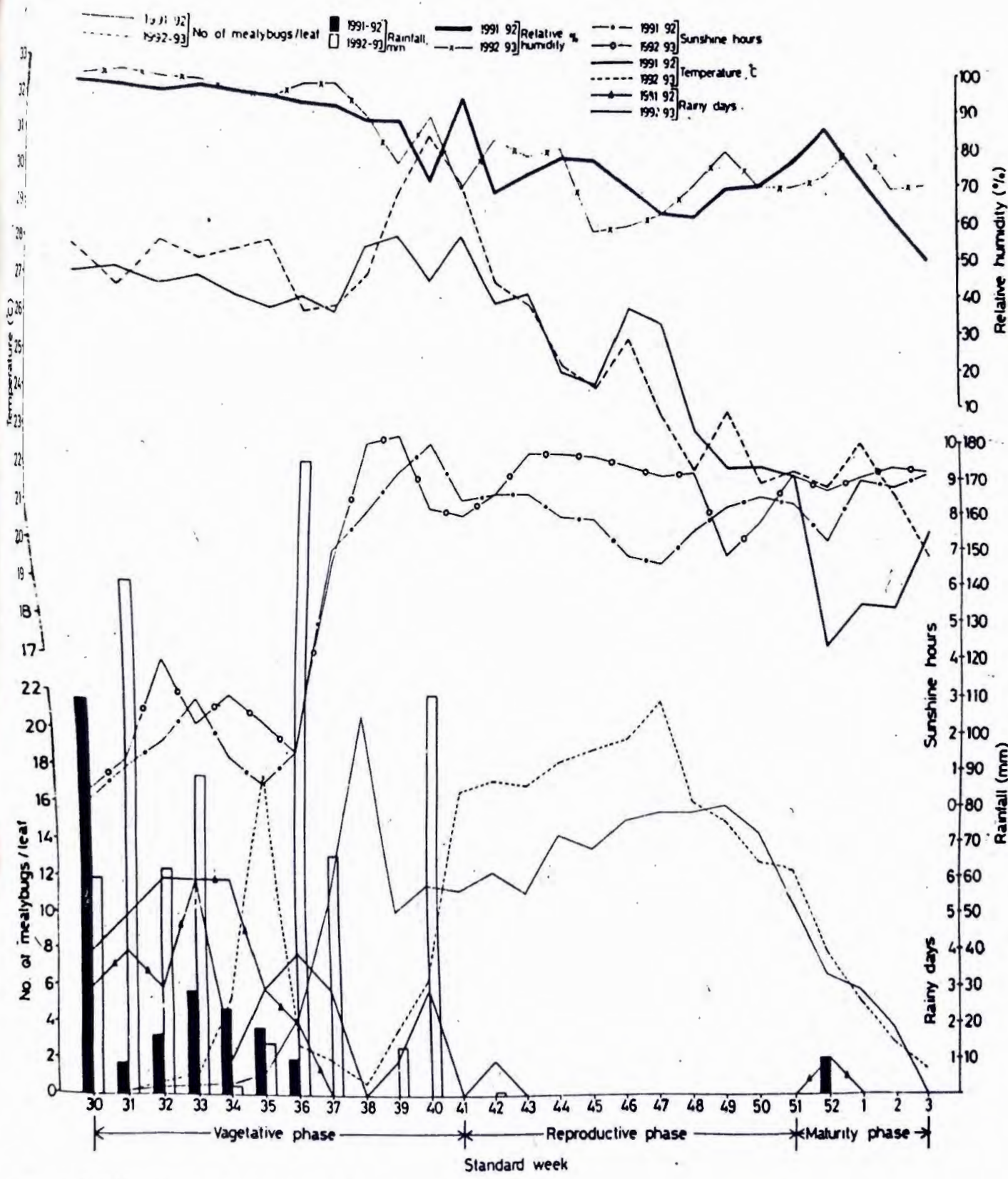


Fig. 1: Effect of abiotic factors on incidence of mealybug on pigeonpea during the years 1991-92 and 1992-93.

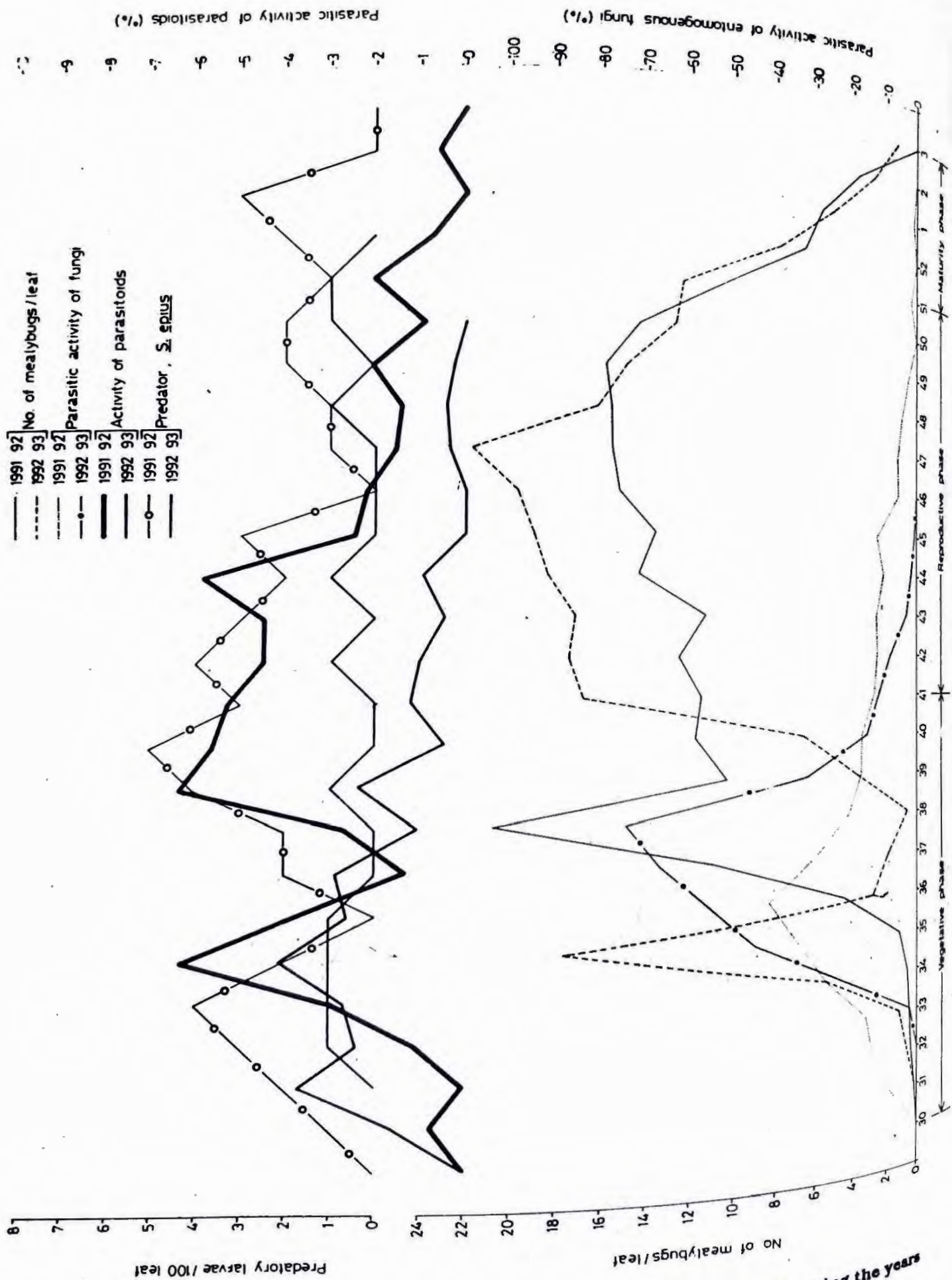


Fig. 2 : Effect of biotic factors on incidence of mealybug on pigeonpea during the years 1991-92 and 1992-93.

TABLE 2
Effect of abiotic and biotic factors on incidence of *C. insolita* on pigeonpea during the year 1992-93.

Standard week	No. of mealybug / leaf	Abiotic factors					Biotic factors				
		Temp. (°C)	R.H. (%)	Rainy days	Rain-fall (mm)	Sun-shine (hr.)	Per cent parasitism		Predatory larvae / 100 leaves		
							Entom. fungi	para-sitoids	S. eptus	M.bo-nne-nsis	
30	0.00	28.0	96	4	59.7	0.4	0.00	0.00	0	0	
31	0.22	27.0	98	5	140.2	1.2	0.00	1.61	0	0	
32	0.69	28.3	97	6	62.7	3.9	0.00	3.70	0	0	
33	1.18	27.8	97	6	87.8	2.2	3.00	2.39	1	1	
34	5.49	28.1	94	1	2.8	3.0	24.68	2.67	1	0	
35	17.67	28.4	93	3	15.1	2.3	44.62	4.05	1	1	
36	2.87	26.5	96	4	174.2	1.5	55.92	2.63	1	1	
37	2.02	26.6	96	3	67.1	6.6	67.30	2.88	0	1	
38	0.67	27.5	88	0	0.0	9.9	74.61	1.06	0	0	
39	3.82	29.6	75	1	14.4	10.1	32.58	2.33	1	0	
40	6.56	31.2	88	3	110.0	8.1	16.18	0.51	0	1	
41	16.82	29.1	68	0	0.0	7.9	12.36	1.18	0	1	
42	17.44	27.2	82	1	0.8	8.5	8.87	0.99	1	1	
43	17.11	26.6	77	0	0.0	9.6	3.67	0.46	0	1	
44	18.44	24.9	79	0	0.0	9.6	1.91	0.95	1	1	
45	19.02	24.3	56	0	0.0	9.5	0.75	0.00	0	0	
46	19.71	25.7	58	0	0.0	9.3	0.00	0.00	0	0	
47	21.67	23.6	61	0	0.0	9.0	0.00	0.36	0	1	

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1	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
48	16.22	22.2	69	0	0.0	9.1	0.00	0.46	1	0
49	15.00	23.7	79	0	0.0	6.8	0.00	0.27	0	0
50	12.67	21.8	69	0	0.0	7.7	0.00	0.00	1	0
51	12.42	22.1	69	0	0.0	9.0	0.00	0.00	1	0
52	7.89	20.7	72	0	0.0	8.6	0.00	0.00	0	0
1	5.20	22.9	82	0	0.0	9.0	0.00	0.00	0	0
2	2.89	21.5	69	0	0.0	9.3	0.00	0.00	0	0
3	1.42	19.8	70	0	0.0	9.2	0.00	0.00	0	0
AV	9.43	25.6	80.3	3.7	73.5	7.0	26.65	1.14	0.40	0.40

TABLE 3

Correlation coefficient between mealybug (*C. insolita*) population and bioecological factors during the years 1991-92 and 1992-93.

(A) Abiotic factors

Year	Temperature (°%)	R.H. (%)	Rainy days	Rainfall (mm)	Sunshine (hr)
1991-92	0.0561	-0.4068*	-0.7223*	-0.5824*	0.6658*
1992-93	-0.1589	-0.6438*	-0.5593*	-0.5343*	0.0458

(B) Biotic factors

Year	Per cent parasitism		Predatory larvae/100 leaves	
	Entomogenous fungi	Parasitoids	<i>S. epius</i>	<i>M. boninensis</i>
1991-92	-0.1184	0.2930	0.1606	0.2002
1992-93	-0.2989	0.2840	0.1482	0.2920

* Significant at 0.05 level (n=26).

sunshine hours exhibited significantly positive correlation with this pest only during the year 1991-92. The activity of entomogenous fungi exhibited negative correlation with

population build up of mealybugs, while the parasitoids and predators showed positive correlation with this pest.

REFERENCES

- Bhalani, P. A. (1990). Laboratory evaluation of some insecticides for the control of pigeonpea mealybug, *Coccidohystrix insolita* (Green), *GAU Res. J.*, 15 (2) : 54-55.
- Chaudhuri, S. (1976). *Metarrhizium anisopliae* (Metch.) sorokin on brinjal mealybug and its use in the biological control of the pest. *Curr. Sci.* 45 (1) : 34.
- Iyer, S. T. V. (1922). Notes on the more important insect pests of crops in Mysore State. *J. Mysore Agric. & Exptl. Union, Bangalore*, 4 (2) : 78-81.
- Nair, G. M. and Nair, M. R. G. K. (1977). Use of some insecticides and their mixtures for control of brinjal pests. *Agric. Res. J. Kerala*. 14 (2) : 101-104.
- Patel, G. M.; Shah, A. H.; Patel, M. B. and Patel, C. B. (1985). First record of *Coccidohystrix insolita* (Green) as a pest of pigeonpea in South Gujarat. *GAU Res. J.*, 11 (1) : 61.
- Patel, I. S., Jose V. T.; Shah, A. H. and Patel, P. G. (1989). Laboratory evaluation of some newer insecticides against mealybug, *Coccidohystrix insolita* G. on pigeonpea. *Pestology*, 13 (4) : 13-14.

Evaluation of *Heliothis* Nuclear Polyhedrosis Virus for Control of *Heliothis armigera* on Chickpea at Pantnagar, (U.P.)

H. G. Vyas and B. D. Lakhchaura*

Department of Agricultural Chemistry and Soil Science, B. A. College of Agriculture, Gujarat Agricultural University, Anand

ABSTRACT

The bioefficacy on NPV of *Heliothis armigera* and insecticides (endosulfan and monocrotophos) on the larval population and per cent mortality by NPV of gram pod borer on chickpea at Pantnagar, U. P. was investigated under the field conditions. Three sprays of NPV @ 250 LE/ha significantly reduced the larval populations and increased per cent mortality by NPV. However, two applications of 0.07% endosulfan had an edge over NPV spraying and proved best amongst all treatments. The combination of NPV @ 125 LE/ha and 0.04% endosulfan (two applications) was better than combination of NPV with 0.02% monocrotophos in reducing larval population and viral mortality.

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INTRODUCTION

The gram pod borer, *Heliothis armigera* (Hubner) causes heavy damage to leaves, flowers and pods in chickpea (*Cicer arietinum* L.) its control with insecticides has been reported by several workers (Chaudhary et al. 1980; Gunasekaran and Balasubramanian, 1987). The bioefficacy of NPV in the control of *H. armigera* has also been established (Jayaraj et al. 1987; Rabindra and Jayaraj, 1988). The compatibility of NPV with chemical insecticides has also been found encouraging (Santharam and Balasubramanian, 1982; Pawar et al. 1987).

The present investigation was carried out with a view to prove the bioefficacy of NPV of *H. armigera* on chickpea at Pantnagar, U.P.

MATERIALS AND METHODS

A field experiment was conducted on chickpea (*Cicer arietinum* L.) Kabuli L-550 variety in randomized block design. Chickpea was sown in plots measuring 12 M². The plant to plant and row to row distance was maintained at 10 and 30 cm respectively. The NPV was propagated in the fourth instar larvae of *H. armigera* reared on a semi synthetic diet. Semi-purified suspension was used after standardizing polyhedral inclusion body counts microscopically. Surfactant teepol was added at 0.05% to the virus suspension before the spray. The spray volume used was @ 250 LE/ha. There were twelve treatments including control, each replicated four times (Table 1). The first spray of NPV was given at 50%

*Present address : Department of Microbiology, College of Basic Science and Humanities, G. B. Pant University of Agriculture, Pantnagar, U. P.

TABLE 1
Effect of NPV alone, NPV + Insecticides and Insecticides alone on the larval population of *H. armigera* at various periods in chickpea.

Treatments	9/3	11/3	16/3	18/3	23/3	25/3	31/3
	P ₁ *	P ₂ *	P ₃ **	P ₄ **	P ₅ ***	P ₆ ***	P ₇
T ₁ NPV @ 250 LE/ha - one round	0.82	0.84	1.05 ^{bc}	1.09 ^{bc}	1.30 ^{ab}	1.36 ^{ab}	1.45 ^b
T ₂ NPV @ 250 LE/ha - two rounds	0.75	0.85	0.98 ^{bcd}	1.05 ^{bcd}	1.29 ^{ab}	1.35 ^{bc}	1.29 ^{bad}
T ₃ NPV @ 250 LE/ha - three rounds	0.74	0.77	1.03 ^{bcd}	1.04 ^{bcd}	1.12 ^{bc}	1.20 ^{bcd}	1.07 ^{cde}
T ₄ 0.07% Endosulfan - one round	0.80	0.82	0.91 ^{cde}	0.92 ^d	0.93 ^c	1.12 ^{cde}	1.17 ^{cde}
T ₅ 0.07% Endosulfan - two rounds	0.78	0.72	0.95 ^{bcd}	0.97 ^{bcd}	0.97 ^c	0.91 ^e	0.91 ^e
T ₆ 0.04% monocrotophos - one rounds	0.78	0.84	0.86 ^e	0.93 ^{cd}	1.04 ^{bc}	1.12 ^{cde}	1.29 ^{bcd}
T ₇ 0.04% monocrotophos - two rounds	0.83	0.75	0.94 ^{bcd}	0.97 ^{bcd}	1.12 ^{bc}	1.02 ^{de}	1.05 ^{de}
T ₈ NPV @ 125 LE/ha + 0.04% Endosulfan - one round	0.83	0.75	1.10 ^b	1.12 ^b	1.08 ^{bc}	1.13 ^{bcd}	1.34 ^{bc}
T ₉ NPV @ 125 LE/ha + 0.02% Monocrotophos - one round	0.78	0.82	0.97 ^{bcd}	1.01 ^{bcd}	1.17 ^{abc}	1.32 ^{abc}	1.47 ^b
T ₁₀ NPV @ 125 LE/ha + 0.04% Endosulfan - two rounds	0.82	0.75	0.87 ^{de}	0.89 ^d	0.95 ^c	0.97 ^e	1.05 ^{de}
T ₁₁ NPV @ 125 LE/ha + 0.02% Monocrotophos - two rounds	0.75	0.77	0.97 ^{bcd}	1.03 ^{bcd}	0.03 ^{bc}	1.14 ^{bcd}	1.30 ^{bcd}
T ₁₂ Control	0.86	0.86	1.47 ^a	1.52 ^a	1.40 ^a	1.59 ^a	2.14 ^a
C. D. at 5%	NS	NS	0.16	0.16	0.23	0.21	0.23
S. Em. ±	0.05	0.04	0.05	0.05	0.08	0.07	0.08

* P₁ and P₂ correspond to one day pre and post first round NPV/insecticide application respectively.

** P₃ and P₄ correspond to one day pre and post second round of NPV application respectively.

*** P₅ and P₆ correspond to one day pre and post third round of NPV or second round of NPV + insecticide and insecticide application, respectively.

(NS = Non significant)

Treatment means with the letter(s) common are not significant by Duncan's New Multiple Range Test at 5% level of significance.

flowering during evening hours and repeated a week later. The first round of insecticides and combination with NPV at 50% reduced doses was concided with first spraying of NPV and repeated after 14 days interval.

Observation on larve/plant was recorded from 10 plants from each plot one day pre and post spraying operations. Last observation was recorded after 7 days from last spraying. The per cent mortality by NPV was recorded from 10 plants from each plot.

RESULTS AND DISCUSSION

The larval population data revealed that the post spraying populations of *H. armigera* were lowest in plots receiving two sprays of 0.07% endosulfan, followed by two sprays of NPV @ 125 LE/ha + 0.04% endosulfan and three sprays of NPV alone @ 250 LE/ha (Table 1). Pawar *et al.* (1987) reported that post spraying populations were lowest in plots sprayed with two rounds of endosulfan followed by NPV spraying. Although larval population showed a

TABLE 2

Effect of NPV alone and combination of NPV + insecticides on per cent mortality of *Heliothis armigera* by NPV in chickpea.

Treatments	Mortality of <i>H. armigera</i> by NPV (%)				
	16/3 P_3^*	18/3 P_4^*	23/3 P_5^{**}	25/3 P_6^{**}	31/3 P_7
T ₁ NPV @ 250 LE/ha — one round	18.1	25.8 ^a	25.7 ^a	26.1 ^a	24.2 ^{bc}
T ₂ NPV @ 250 LE/ha — two rounds	21.2	20.8 ^{ab}	30.4 ^a	31.2 ^a	30.5 ^{ab}
T ₃ NPV @ 250 LE/ha — three rounds	20.0	20.3 ^{ab}	19.4 ^{ab}	25.4 ^a	39.5 ^a
T ₈ NPV @ 125 LE/ha + 0.04% Endosulfan — one round	17.1	10.4 ^{bc}	12.0 ^{bc}	16.9 ^b	14.5 ^{cd}
T ₉ NPV @ 125 LE/ha + 0.02% Monocrotophos — one round	13.8	7.9 ^c	11.9 ^{bc}	13.0 ^b	14.9 ^{cd}
T ₁₀ NPV @ 125 LE/ha + 0.04% Endosulfan — two rounds	10.5	5.5 ^c	4.6 ^c	4.5 ^c	25.3 ^{bc}
T ₁₁ NPV @ 125 LE/ha + 0.02% Monocrotophos — two rounds	8.9	7.9 ^c	3.8 ^c	3.2 ^c	16.1 ^{cd}
T ₁₂ Control	5.9	6.4 ^c	9.0 ^{bc}	13.2 ^b	7.0 ^d
C. D. at 5%	N.S.	10.2	10.5	6.9	9.8
S. Em. ±	5.2	3.4	3.6	2.3	3.3

* P_3 and P_4 correspond to one day pre and post second round of NPV spraying respectively.

** P_5 and P_6 correspond to one day pre and post third spraying of NPV or second spraying of NPV + insecticide application respectively.

NS = Non significant.

Treatment means with the letter(s) in common are not significant by Duncan's New Multiple Range Test at 5% level of significance.

general increase with time periods (P_1 to P_7), the increase in case of treatments was smaller than control plots. A combination of NPV with insecticides gave significantly lower larval populations compared to check plots. When the overall effect of NPV and insecticides alone and their combinations at reduced doses were compared, the chemical insecticides proved superior over both, NPV alone or its combination with insecticides. This may be due to the knock down effect by insecticides or the long incubation period required by NPV to kill the host populations.

The data on mortality inflicted by NPV has been presented in Table 2. Since there was no mortality at the time of first spraying of NPV (P_1 and P_2), the results are presented only for five periods (P_3 to P_7). The control plots showed a mortality in the range of 5.9 to 13.2% during various periods due to its natural presence in the environment.

Application of NPV @ 250 LE/ha caused mortality from a minimum of 18.1% in one spray at P_3 to a maximum of 39.5% in three spraying at P_7 . The multiple spraying appeared more effective than single NPV application. Mortality data for the combination of NPV + insecticides at reduced doses showed

considerable variation under each treatment. This could be either due to sub-lethal viral dose or rapid inactivation of NPV by solar irradiation. Similar low mortality values have been observed by several investigators when NPV was combined with different insecticides (McKinley, 1982; Abdally *et al.* 1987). Santharam *et al.* (1981) reported delayed mortality when NPV was used in combination with insecticides.

The hope of using nuclear polyhedrosis virus for the control of *H. armigera* and its incorporation in the IPM system has been substantiated by the positive effect in reducing larval population and pod damage and increase in yield have been reported for chickpea (Mistry *et al.*, 1984; Ethiraju *et al.* 1988).

The present studies have clearly shown the promise to utilise the NPV for the control of *H. armigera* on chickpea at Pantnagar, U. P.

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REFERENCES

- Abdally, A., K. M. Makkouk and C. Cardona. 1987. Control of *Heliothis* spp. on chickpea by insect pathogenic nuclear polyhedrosis virus. *Arab. J. Pl. Prot.* **5** : 78-80.
- Chaudhary, J. P., L. S. Yadav and K. B. Rustogi, 1980. Control of gram pod borer (*Heliothis armigera* Hubner) and semilooper (*Plusia* spp.) with different insecticidal dust on gram (*Cicer arietinum*). *Pesticides* **11** : 22-24.
- Ethiraju, S., R. J. Rabindra and S. Jayaraj. 1988. Laboratory evaluation of certain formulations of nuclear polyhedrosis virus against the larve of *Heliothis armigera*. *J. Biol. Control* **2** : 21-25.
- Gunasekaran, R. and D. N. Balasubramanian, 1987. Field efficacy of diflubenzuron against *Heliothis armigera* (Hbn) in chickpea. *Madras Agric. J.*, **74** : 52-53.
- Jayaraj, S. R. J. Rabindra and G. Santharam, 1987. Gram pod borer control with nuclear polyhedrosis virus on chickpea and lablab. *Indian J. Agric. Sci.*, **57** : 738-741.

- McKinley, D. J., 1982. The prospects for the use of nuclear polyhedrosis virus in *Heliothis* management. In proceedings of the International Workshop on *Heliothis* management. 15-20 November, 1981. ICRISAT Centre, Patancheru, A. P. India. P. 123-135.
- Mistry, A., D. N. Yadav and R. C. Patel. 1984. Field evaluation of nuclear polyhedrosis virus against *Heliothis armigera* Hubner (Lepidoptera : Noctuidae) in Gujarat. *Indian J. Plant Prot.* 12 : 31-33.
- Pawar, V. M., Aaleemuddin and B. B. Bhosle, 1987. Bioefficacy of HNPV in comparison with endosulfan against pod borer in chickpea. *International Chickpea Newsl.* 16 : 4-6.
- Rabindra, R. J. and S Jayaraj, 1988. Efficacy of nuclear polyhedrosis virus with adjuvants as high volume and ultra low volume applications against *Heliothis armigera* Hbn. on chickpea. *Trop. Pest Management* 34 : 441-44.
- Santharam, G. M., M. Balasubramanian and S. Chelliah, 1981. Control of *Heliothis armigera* (Hubner) on red gram (*Cajanus cajan* L.) with nuclear polyhedrosis virus and insecticides. *Madras Agric. J.* 68 : 417-20.
- Santharam, G. and M. Balasubramanian, 1982. Effect of nuclear polyhedrosis virus used alone and in combination with insecticides in controlling *Heliothis armigera* on bengal gram. *J. Ent. Res.* 6 : 179-181.

Biology of Galerucid Flea Beetle, *Madurasia obscurella* Jacoby (Galerucinae : Chrysomelidae : Coleoptera) on Cowpea *Vigna unguiculata* (L.) Walp*

R. U. Oza**, M. B. Patel and C. B. Patel

Department of Entomology, N. M. College of Agriculture, Gujarat Agricultural University, Navsari

ABSTRACT

Biology of the galerucid beetle, *M. obscurella* J. was studied on cowpea under laboratory conditions which indicated that eggs were laid singly on the soil near the base of the plant. Freshly laid eggs were spherical and white which later changed to pale yellow. The average incubation period was 4.0 days. The larva passed through three instars. The freshly emerged larva was creamy white which later changed to pale yellow. The average larval period was 20.27 ± 1.44 days. The full grown larva measured on an average 3.63 ± 0.162 mm and pupated in soil near the root zone of the host plant. The pupa was white with dorsum convex and antennae folded under legs. Average pupal period was 11.53 ± 1.19 days. Newly emerged adult beetle was delicate and white with dark brown eyes but later on brown pigmentation developed on its body. Average egg laying capacity of the female was 37.52 ± 3.88 . The male and female adult longevity was 6.0 ± 0.71 days and 15.04 ± 0.57 days, respectively. The sex ratio of the male : female was found to be 1:1.25. Average life period from egg to death of adult male and female was 41.9 ± 4.5 days and 5.14 ± 4.5 days, respectively.

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INTRODUCTION

Cowpea, *Vigna unguiculata* (L.) Walp., is one of the principal pulse crop of the tropics. The importance of this crop lies in its versatility being a fodder, a vegetable a legume and a green manure crop. Among many causes lowering the production of the crop, attack of insect pests has been a major constraint causing up to 90 per cent reduction in yield (Raheja, 1976). Major insect pests of the crop are green jassid, *Amrasca Kerri* Pruthi, Semilooper, *Plusia orichalcea* Koch, Ground nut aphid, *Aphis craccivora* Koch, and *Madurasia obscurella* Jacoby. The galerucid flea beetle, *M.*

obscurella was reported as an important pest of pulses by Naresh and Nane (1968) and Saxena (1978). Knowledge of biology of crop pests facilitates designing of pest management programme. However, not much work has been done on biology of *M. obscurella* in India and abroad. Therefore it was considered necessary to study the biology of galerucid flea beetle on cowpea.

MATERIALS AND METHODS

Initially, the adults of *M. obscurella* were collected from the fields of the College Farm, Gujarat Agricultural University, Navsari and

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**Present address Associate Professor, Department of Entomology, N. M. College of Agriculture, GAU, Navsari

released in a glass jar-petridish unit for egg laying. About 0.5 cm thick layer of moist soil was spread in the petridish which was kept in the jar. Tender trifoliate leaves of cowpea were provided as food to the beetles. The food was changed daily. The top of the jar was covered with muslin cloth held in position by rubber band. The eggs laid in the soil in petridishes were used for further rearing. Counted number of eggs were examined daily till hatching to workout incubation period and hatching percentage.

Counted number of newly emerged larvae were released in pots with cowpea plants and observed till pupation. After about 15 days of released, the soil in the pots was scratched daily to confirm pupation. The date of pupation was noted and larval period was calculated. The pupae collected from the soil were kept separately on moist soil and the date of emergence of adult was noted.

Pairs of freshly emerged male and female adults were released in glass jar separately and covered with muslin cloth to study the pre-oviposition, oviposition and post-oviposition period and egg laying capacity of female. Longevity of male and female was recorded individually.

Subterranean habit of the larvae made the study of instars difficult as survival of the larvae till pupation was not possible if they were dug out from the soil and observed under microscope frequently. Therefore it was decided to determine number of instars from the size of head capsules of the larvae. For this purpose, fifty larvae of various sizes were dug out from the soil and killed by dipping in 70 per cent alcohol. Head capsules of these larvae were measured under microscope and

the data were plotted on a graph taking number of larvae and head width. As insects show marked change in head width with the change of instar, the number of peak obtained on the graph was considered to be the number of larval instars.

RESULTS AND DISCUSSION

The study on biology of the galarucid beetle, *M. obscuralla* J. was carried out in the laboratory during July-November 1993. Average minimum, and maximum room temperature during the study was 29.2°C and 30.0°C, respectively and average relative humidity was 87.5 per cent. The results obtained are as under :

Eggs were laid singly on the soil near the base of the potted plants. They were also laid on glass surface of petridish. Freshly laid eggs were spherical and white which later changed to pale yellow. Prior to hatching, the egg shell became almost transparent through which movement of the larva could be easily seen. The diameter of the egg varied from 0.53 mm to 0.556 mm with an average of 0.539 ± 0.008 mm (Table 1). Incubation period varied from 3 to 5 days with an average of 4.0 days (Table 2), while hatching varied from 64 to 80 per cent (Av. 72.5 ± 5.2). The present findings on dimension of eggs and incubation period are almost in confirmity with those reported by Gupta and Singh (1984).

The freshly emerged larva was creamy white and possessed a few long setae on head and body segments. Number of larval instars as determined from the increase in size of head capsule were found to be three. The lengths of the first, second and third instar

TABLE 1
Measurement of different stages of *Madurasia obscurella* Jacoby.

Stage	Length (mm)			Head/body width (mm)		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Egg	0.53	0.556	0.539 ± 0.008	—	—	—
Larva	I instar	1.15	1.23 ± 0.056	0.21*	0.25*	0.24 ± 0.015*
	II instar	2.20	2.42 ± 0.133	0.29*	0.35*	0.33 ± 0.019*
	III instar	3.40	3.63 ± 0.162	0.70*	0.83*	0.74 ± 0.21*
Pupa	3.15	3.56	3.38 ± 0.15	1.60	1.86	1.77 ± 0.07
Adult	Male (Body)	2.48	2.52 ± 0.02	1.20	1.28	1.22 ± 0.024
	Female (Body)	2.63	2.79 ± 0.08	1.30	1.38	1.35 ± 0.025

* Head width.

larvae were 1.23 ± 0.056 mm, 2.42 ± 0.133 mm and 3.63 ± 0.162 mm, respectively, while their head width were 0.24 ± 0.015 mm, 0.33 ± 0.019 mm and 0.74 ± 0.21 mm, respectively (Table 1). Gupta and Singh (1984) also obtained almost similar figures in respect to body size of different larval instars of *M. obscurella*. The larval period varied from 18 to 22 days with an average of 20.27 ± 1.44 days (Table 2).

The full grown larva pupated in soil near the root zone of the host plant. The pupa was white with dorsum convex and antennae folded under legs. The length of pupa varied from 3.15 mm to 3.56 mm (Av. 3.38 ± 0.15 mm)

while the width across the mesothorax ranged between 1.6 to 1.86 mm (Av. 1.77 ± 0.07 mm) (Table 1). The duration of pupae varied from 10 to 13 days with an average of 11.53 ± 1.19 days (Table 2). Similar observations have been reported by Gupta and Singh (1984).

Newly emerged adult beetles were delicate and white with dark brown eyes. After 2 to 3 days they developed brown pigmentation. The adults had varying number of spots on elytra. They had moniliform antennae and convex eyes. The beetles get attracted towards light. The male adult measured 2.48 to 2.55 mm (Av. 2.52 ± 0.02) in length and 1.20 to 1.28 mm (Av. 1.22 ± 0.024) in width whereas the female adult

TABLE 2

Information regarding life history of *Medurasia obscurella* Jacoby on cowpea.

Sr. No.	Particulars	Range	Average
1.	Egg period (days)	3.5	4.0
2.	Larval period (days)	18-22	20.27 ± 1.44
3.	Pupal period (days)	10-13	11.53 ± 1.19
4.	Adult period (days)		
	Male	5-7	6.00 ± 0.71
	Female	13-17	15.04 ± 0.97
5.	Total life period (days)		
	Male	35-48	41.90 ± 4.5
	Female	43-58	51.40 ± 4.5
6.	Fecundity (No. of eggs)	30-48	37.52 ± 3.88
7.	Hatching percentage	64-80	72.5 ± 5.2
8.	Sex ratio	—	1:1.25

measured 2.63 to 2.89 mm (Av. 2.79 ± 0.08 mm) in length and 1.30 to 1.38 mm (Av. 1.35 ± 0.025) in width. Thus the females were larger in size than the males.

Pre-oviposition, oviposition and post-oviposition periods were 2 to 4 days (Av. 2.6 ± 0.76 days) 7 to 10 days (Av. 8.9 ± 0.73 days) and 2 to 4 days (Av. 3.4 ± 0.88 days), respectively. Egg laying

capacity of the females varied from 30 to 48 eggs (Av. 37.52 ± 3.88). Longevity of adult male varied from 5 to 7 days (Av. 6.0 ± 0.71 days) while that of the female ranged between 13 to 17 days (Av. 15.04 ± 0.97 days). The sex ratio of male : female was found to be 1:1.25. Total life period from egg to death of adult for male was 35 to 48 days (Av. 41.9 ± 4.5 days) while in case of the female it was 43 to 58 days (Av. 51.4 ± 4.5 days).

REFERENCES

- Gupta, P. K. and Singh, J. (1984). Biology of *Madhurasia obscurella* Jacoby, an important pest of rainy season pulses. *Indian J. Agric. Sci.*, **54** : 931-934.
- Naresh, J. S. and Nane, Y. L. (1968). Survey evaluation of economic importance pests of pulses. *Annual Report Pradesh Agricultural University* 177-178.
- Raheja, A. K. (1976). Assessment of losses caused by insect pests to cowpeas in Northern Nigeria. *PANS*, **22** (2) : 229-233.
- Sexena, M. C. (1978). Water, fertilizer and pest control in food legumes. ICARDA : 653-658.

Response of GA to Extend the Shelf Life of Sapota Fruits After Transportation

Anil B. Patel and J. S. Katrodia

Department of Horticulture, Gujarat Agricultural University, Sardar Krushinagar - 385 506

ABSTRACT

For extending the shelf life and to stabilize the market demand the sapota fruits should be treated with GA 150 ppm for 8 to 10 minutes followed by drying and then packing in wooden boxes using paddy straw as a packing material which not only helps in safe transportation of fruits to the distant market but also without adversely affecting the quality of fruits.

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INTRODUCTION

Sapota (*Manilkara achras*) is highly delicious dessert fruit enjoys much popularity throughout India. It occupies an estimated area of 23,824 ha with an annual production of 3.38 lakh tones in India (Chadha, 1991). In Gujarat it occupies an area of 8000 ha of which 7079 ha is in South Gujarat only. Out of this, 7000 ha is in Valsad district only (Table-1) which comes to 85 per cent area of the contribution of Gujarat State (Anonymous, 1989). Kalipatti is the leading variety of the Gujarat State and therefore, more than 99 per cent area under Sapota in South Gujarat is of this cultivar which accounts to monoculture (Chundawat and Bhuva, 1982).

Due to lack of adequate post harvest handling facilities and proper infrastructure,

post harvest losses due to spoilage are very high. The group of perishable agricultural commodities headed by Dr. M. S. Swaminathan had estimated that actual post harvest losses are as high as 25 to 30 per cent of the value of the produce depending on perishability of products.

Sapota fruit is highly perishable, ripen within 3 to 4 days during summer and becomes unconsumable very soon and rated poor for processing, therefore, chiefly used for table purpose only. It is also sensitive to cold storage and hence farmers are bound to sell their produce. So fruit required immediate marketing soon after harvest. Hence it become essential that sapota fruits must be transported to the distant market without spoilage. Therefore, attempts were made to study the effect of Gibberellic acid on the shelf life of sapota fruit after transportation.



TABLE 1

District and talukawise area (ha) under sapota in South Gujarat.

Sr. No.	District	Taluka	Area (ha)
1.	Dang	Ahwa	—
2.	Surat	Mahuva	60.00
		Vyara	10.00
		Valod	9.00
3.	Valsad	Songadh	—
		Gandevi	2425.00
		Navsari	1375.00
		Umargam	1232.00
		Valsad	973.00
		Pardi	750.00
		Chikhli	150.00
		Vansada	50.00
		Dharampur	45.00
Total			7079.00

MATERIALS AND METHODS

Initially, a preliminary trial with 30 different treatments was tried to screen suitable treatment with appropriate concentration to find the best treatment to be recommended to farmers for marketing sapota fruits in bulk. To choose few most important sapota ripening retardants, screening was carried out and five treatments such as GA (150 and 200 ppm), Waxol (2%) Kinetin (10 ppm) and MH (2000 ppm) in combination with Bavistin 500 ppm were found promising on various physico-chemical changes during ripening of sapota fruits.

Finally from the all five ripening retardants GA 150 ppm + Bavistin 500 ppm was found most effective in delaying the ripening of sapota fruits. Above both trials were conducted in the departmental laboratory of Horticulture, N. M. College of Agriculture,

Navsari. To see the practical utility of the best treatment i.e. GA 150 ppm on commercial scale following trial was conducted. The study was carried out at the Gadath Cooperative Society (Ta. Gandevi and Dist. Valsad) during summer season of 1992. Sapota fruits were transported from Gadath to Azadpur Mandi, New Delhi by truck, which is 1300 km far away which takes about 40 hours from Gadath. Mature fruits of uniform size and free from injuries were selected for the study. The fruits were then separated into different lots of 18 kg fruits and dipped in Gibberellic acid 150 ppm solution for 8 to 10 minutes and shade dried for 30 minutes. Treated fruits were packed in wooden boxes having 18 kg capacity with paddy straw as a packing material, those packing method and material generally used by all co-operative societies of South Gujarat. About 80 boxes fruits were treated and sent to New Delhi.

Observation of fruits for various parameters were recorded at one day interval.

Physiological loss in weight (PLW) was determined by recording the initial weight of fruits prior to packing and subsequently at one day interval. The reduction in weight was expressed on percentage basis. For marketable fruits, the numbers of visibly sound fruits that can be marked were counted and expressed on percentage over the total number of fruits at one day interval. Similarly, for spoilage percentage, the number of visibly diseased, over ripe fruits were counted and expressed as percentage over the total number of fruits are one day interval. Total soluble solids were recorded by using a Erma hand refractometer. Organoleptic evaluation of the fruits was done by a panel of three experts of I.C.A.R. and two retail sub agent of sapota seller on Hedonic Scale (Amerine *et al.*, 1965). The fruit pressure firmness was recorded with pocket penetrometer. In Azadpur Mandi, New Delhi the ambient temperature was recorded $45 \pm 2^{\circ}\text{C}$ during the above study.

RESULTS AND DISCUSSION

The results of analysis for different storage period after transportation of sapota fruits revealed that there were significant differences for various physiological parameters.

TABLE 2

Effect of GA on days taken to ripening and shelf-life of sapota fruits cv. Kalipatti after transportation.

Treatment	Days taken to ripening	Shelf-life (days)
Control	3.70	5.00
GA 150 ppm	5.00	6.76

The results of days taken to ripening and shelf-life of sapota fruits after transportation as a result of GA treatment is presented in Table-2. Fruits treated with GA 150 ppm required maximum number of days (5.00) to attain ripeness as compared to control (3.70). GA treatment could extend the ripening period by 1.30 days over the control which ultimately increase the shelf-life of sapota fruits by 1.76 days. Corroborative results has been obtained by Patel and Katrodia (1995) in sapota.

The results of physiological parameters per cent ripe and unripe fruits, PLW, marketable fruits, spoilage, T.S., pressure (kg/cm^2) and organoleptic score of sapota fruits after transportation as a result of GA treatment is presented in Table-3.

On 3rd day of storage, minimum ripe fruits (30.17%), PLW (9.00%). Spoilage (2.44%), T.S.S. (18.0%), Pressure ($5.00 \text{ kg}/\text{cm}^2$), Organoleptic score (3.93) and maximum unripe fruits (69.83%) and marketable fruits (97.56%) was recorded in the fruits treated with GA 150 ppm.

On 4th day of storage, minimum ripe fruits (40.00%), PLW (11.10%), spoilage (3.00%) and maximum unripe fruits (60.00%) marketable fruits (97.00%), T.S.S. (21.00%), pressure ($3.95 \text{ kg}/\text{cm}^2$) and organoleptic score (7.35) was recorded in the fruits treated with GA 150 ppm.

TABLE 3
Effect of GA on physiological parameters of sapota fruits cv. Kallpatti after transportation.

Days after treatment	Treatments	Ripe fruits (%)	Unripe fruits (%)	PLW (%)	Marketable (%)	Spoilage (%)	T.S.S. (%)	Pressure (kg/cm ²)	Organoleptic score
3	Control	42.98	57.02	15.02	96.61	3.39	19.00	4.95	4.85
	GA 150 ppm	30.17	69.83	9.00	97.56	2.44	18.00	5.00	3.93
4	Control	52.95	47.05	21.15	95.28	4.72	20.15	3.30	6.80
	GA 150 ppm	40.00	60.00	11.10	97.00	3.00	21.00	3.95	7.35
5	Control	74.27	25.73	25.08	60.00	40.00	23.00	1.50	6.00
	GA 150 ppm	55.00	45.00	13.19	90.12	9.88	25.00	3.00	7.53

with GA 150 ppm. Similarly on 5th day of storage same trend was recorded with GA 150 ppm treatment. This may be due to treatment effect which retarded ripening and reduced weight loss through controlled transpiration and respiration rate. Similar finding was reported by Patel and Katrodia (1995) in sapota fruits. They transported sapota fruits to S. K. Nagar from Navsari (which is 550 km far away) by bus as a pilot trial.

From the above discussion, it is concluded that for prolonging or extending the

storage or shelf life and to stabilize the demand the sapota fruits should be treated with GA 150 ppm for 8 to 10 minutes followed by drying and then packing in wooden boxes using paddy straw as a packing material.

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REFERENCES

Amerine, M. A.; Pangborn, R. M. and Roessler, E. B. (1965). Principles of sensory evaluation of food. Academic Press, London.

Anonymous (1989). Status report, National Agril. Research Project, Navsari Centre, Gujarat.

Chadha, K. L. (1991). Paper presented in National Seminar on Sapota held at Navsari.

Chundawat, B. S. and Bhuvra, H. P. (1982). *Haryana Hort. Sci.*, 11 (3-4) : 154-158.

Patel, A. B. and Katrodia, J. S. (1995). Paper presented in seminar on fruit processing and export held at Anand, Gujarat.

Knowledge of Health and Hygiene Practices of the Beneficiaries and Non-Beneficiaries Under ICDS Programme in Marathwada Region

B. M. Thombre* R. R. Chole

Department of Veterinary Extension Education Veterinary College, Udgir 413 517, Dist. Latur (MS)

ABSTRACT

The Government of India launched an ambitious multidimensional welfare programme in 1975-76 on an experimental basis for improving the health and hygiene of children and mothers. It was gradually expanded throughout the country. The present study intends to appraisal of the knowledge of the beneficiaries and non-beneficiaries about health and hygiene practices under Integrated Child Development Services (ICDS) in Marathwada region. One hundred and forty beneficiaries and equal No. of non-beneficiaries were selected from oldest block in each of the district of Marathwada for the study. Except use of bleaching powder no considerable difference was observed in use of health and hygiene practices between beneficiary and non-beneficiary women.

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INTRODUCTION

Integrated Child Development Services (ICDS) scheme is an important feature of the Twenty Point Programme. ICDS is one of the most ambitious, multidimensional welfare programme to reach millions of children and their mothers who are caught in the grip of malnutrition, diseases, illiteracy, ignorance and poverty. The scheme was launched in the country in 1975-76 with only 33 ICDS projects in the different states of India. At present, there are 2594 ICDS projects functioning in the country. ICDS aims to reach all the needy children in the age group of 0-6 years, expectant and nursing mothers and women in the age group of 15 to 45 years with basic services. The package includes services like health check-up,

referral services, nutrition and health education etc. It is essential to apprise the knowledge of the beneficiaries and non-beneficiaries about health and hygiene practices so as to know the impact of the ICDS scheme pertaining to the health and hygiene component of the scheme. Therefore, the present study intends to focus on appraisal of the knowledge of the beneficiaries and non-beneficiaries about health and hygiene practices under the ICDS programme in Marathwada Region with the following specific objectives :

1. To study the knowledge of health and hygiene practices of the respondents.
2. To measure the knowledge levels of the beneficiaries and non-beneficiaries about health and hygiene practices.

*Present address : Assistant Professor of Veterinary Extension Education, Veterinary College, Udgir (M.S.).

MATERIALS AND METHODS

One oldest block from each district of Marathwada region was purposively selected. The first block established in a given district is termed as oldest block. Thus Ambad (1990), Bhoom (1984), Georai (1979), Kalmanuri (1990), Mukhed (1982), Udgir (1982) and Vaijapur (1983) ICDS blocks were selected, which were established in the year given in bracket. Four villages from each of the blocks were selected randomly. Five beneficiary women and five non-beneficiary women were randomly selected from each of the villages. One shot case study (two groups) design was adopted for the study. The selected women from these two groups namely beneficiaries (140) and non-beneficiaries (140) were randomly selected and interviewed only once for the appraisal of knowledge of health and hygiene practices under the ICDS scheme.

Knowledge level of health and hygiene practices refers to the respondents knowledge regarding the health and hygiene. The scores of 1 and 0 were given for the correct and wrong answers respectively on each item. Summation of the scores indicated the level of the

knowledge of the respondents about health and hygiene practices. The respondents were grouped into high, medium and low categories on their knowledge of health and hygiene practices based on the mean score $\pm$ standard deviation.

RESULTS AND DISCUSSION

It is observed that the majority of beneficiaries (99.29%) and non-beneficiaries (97.14%) were having knowledge of 'covering the cooked food', while 'washing of hands before meal' (97.14% and 96.43%), cleaning of house regularly (90.17% and 82.29%), and the knowledge that mosquitoes develop in stagnant water (65.71% and 60.71%) was possessed by the beneficiaries and non-beneficiaries respectively. (Table 1) The knowledge of 'use of bleaching powder' for cleaning the drinking water was possessed by 35.57 per cent beneficiaries and only 9.29 per cent non-beneficiaries. Thus, among the above mentioned practices greater difference was found in case of use of bleaching powder. The other practices are simple and followed traditionally.

TABLE 1

Distribution of the respondents based on the knowledge of individual health and hygiene practices.

Sr. No.	Items	Beneficiaries		Non-Beneficiaries	
		No.	Per cent	No.	Per cent
1.	Use of bleaching powder	19	35.57	13	9.29
2.	Covering the cooked food	139	99.29	136	97.14
3.	Washing of hands before meal	136	97.14	135	96.43
4.	Cleaning of house	127	90.71	118	82.29
5.	Mosquitoes develop in stagnant water	92	65.71	85	60.71
6.	House flies spread the cholera	74	52.86	54	38.57

TABLE 2

Distribution of respondents based on the knowledge level (cumulative) of health and hygiene practices.

Sr. No.	Category	Beneficiaries		Non-Beneficiaries		Z' Value
		No.	Per cent	No.	Per cent	
1.	Low level	22	15.71	36	25.71	3.123**
2.	Medium level	114	81.43	74	52.86	
3.	High level	4	2.86	30	21.43	
Mean		4.19		3.86		

The knowledge level about health and hygiene practices was assessed in case of beneficiaries and non-beneficiaries of the ICDS programme. The distribution of respondents is given in Table 2. The results indicated that about 82.43 per cent and 15.71 per cent beneficiaries had medium and low level of knowledge respectively about the selected practices of health and hygiene. In case of non-beneficiaries 52.86 per cent had medium level of knowledge and 25.71 per cent had low level of knowledge about the health and hygiene practices.

beneficiaries and non-beneficiaries differed in the knowledge level of health and hygiene practices. These findings are in line with the findings quoted by Chopdar (1979), Patel and Udani (1984), Mittal and Gupta (1986) and Sheshadri and Gopaldas (1986).

Conclusion

Knowledge of health and hygiene practices of the beneficiaries and the non-beneficiaries were assessed into three categories namely, low, medium and high. Majority (81.43%) of the beneficiaries and non-beneficiaries (52.86%) had medium level of knowledge. The beneficiaries possessed a higher level of knowledge than the non-beneficiaries about the practices. It leads to the conclusion that there was gain in the knowledge of health and hygiene practices among the beneficiaries due to the implementation of ICDS programme.

REFERENCES

- Chopdar, A. 1979. Impact of health component of ICDS on the beneficiaries, *Ind. J. of Pediatrics*, 46 : 53-57.
- Mittal, S. and Gupta, M. C. 1986. Evaluation of a supplementary feeding programme through take-home system, *J. of Tropical Pediatrics*, : 50-53.
- Patel, R. B. and Udani, R. H. 1982. Impact of ICDS of pre-school of urban slums. *Ind. J. of Pediatrics*, 49 : 215-218.
- Scheshadri Subhadra and Tara Gopaldas, 1986. Training research in nutrition and health education for field functionaries of ICDS. *Research on ICDS-An Over View*, I : 215-217.

Orientation of Research Scientists Towards Research Work in Gujarat Agricultural University

Arun A. Patel* H. L. Patel, Mahesh R. Patel and C. P. Desai

Directorate of Extension Education, Gujarat Agricultural University, Ahmedabad-380 003

ABSTRACT

The quality and quantity of the research work carried out by the scientists are mainly depending on the attitude of the scientists towards research work. In all, 60 scientists working as head of department/station/project/scheme in Gujarat Agricultural University were studied through mailed questionnaire. The scale developed for the purpose was administered (Patel A. A. 1993). The results indicated that majority (70.00 per cent) of the respondents had medium level of attitude towards their research work. It also revealed that among all characteristics, personal characteristics viz., age and academic qualification of heads, job related characteristics viz., cadre, total experience and experience as research head, organisational characteristics viz., experimental/station climate and office/research facilities and socio-psychological characteristics viz., workload, job involvement and achievement motivation had positive significant relationship with their attitude towards research work. Off-campus situation and job stress negatively correlated with the attitude of research scientists towards the research work.

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INTRODUCTION

Without having strong research base, it is not possible to increase agricultural production and also reduce poverty, stabilize prices and supplies. Gujarat Agricultural University has been entrusted with triple functions of promoting agricultural education, research and extension education in the State. The considerable emphasis has been given on expanding its research activities so as to enable the scientists to tackle the production constraints faced by the cultivators in the State. Research scientist working as head of department/station/project/scheme plays a vital role in research work done at different research stations. He has

to perform many research management functions. He has to discuss problems, of his co-workers with an active interest. He has to provide maximum help and encouragement to his co-workers. He has to encourage for team work in the department for research tasks. He has to initiate new research activities. Hence, to a considerable extent, the success of overall research done by GAU largely depends on the attitude of the heads of the department/ station/project/scheme towards their research work. Therefore, the present study was conducted to explore the attitude of the research scientists working as head of the department/station/project/scheme in GAU towards their research work.

MATERIALS AND METHODS

Gujarat Agricultural University has about 75 independently working agricultural research departments/stations/projects/schemes. These all departments/stations/projects/schemes were selected for the study purpose. However, few independent research departments/stations/projects/schemes were not included in the study as their heads were below Assistant Research Scientists cadre. Thus, finally 69 independent research departments/stations/projects/schemes of the GAU were selected for the study purpose. The heads of selected 69 departments/stations/projects/schemes were considered as respondents for the study. However, during the study the complete responses were received from only 60 out of 69 research departments/stations/projects/schemes. The data were collected by mailing questionnaire to each head by name with self-addressed stamped envelope. For measuring the attitude of the heads towards research work, the scale developed for the purpose was administered to heads on a five point continuum with categories, strongly agree, agree, undecided, disagree and strongly disagree. The scores assigned to these categories were 5 to 1 for positive statements and 1 to 5 for negative statements. The scores obtained by respon-

dents were summed up and based on the mean and standard deviation, the heads were categorised into three groups as low (Mean-S. D.), medium (Mean $\pm$ S. D.) and high (Mean + S. D.).

Coefficient of correlation test was applied to find out the relationship between the independent variable and the dependent variable.

RESULTS AND DISCUSSION

The data (Table 1) revealed that majority (70.00 per cent) of the respondents had medium level of attitude towards research work followed by low (16.67 per cent) and high (13.33 per cent) level of attitude towards research work.

Relationship between different characteristics

Personal Characteristics : The data presented in Table 2 indicates that out of five personal characteristics, age and academic qualifications of heads were significantly correlated with their attitude towards research work. Such findings may be due to the fact that background/knowledge regarding research work may increase with increase in age and academic qualifications which may lead to favourable attitude.

TABLE 1

Distribution of research scientists according to their attitude towards research work.

N = 60

Attitude	Frequency	Per cent
Low level attitude	10	16.67
Medium level attitude	42	70.00
High level attitude	8	13.33
Total	60	100.00

TABLE 2

Relationship between different characteristics of Research Scientists working as head of the department/station/project/scheme in GAU and their attitude towards research work.

N = 60

<i>Relationship</i>	<i>Coefficient of correlation</i>
A. Personal characteristics	
Age and attitude	.31641*
Academic qualification and attitude	.36165*
Family size and attitude	.18452
Belonging state and attitude	.23140
Health and attitude	.19810
B. Job related characteristics	
Cadre and attitude	.44747*
Total experience and attitude	.44927*
Experience as a research head and attitude	.35135*
Inservice training received and attitude	-.07517
C. Organizational characteristics	
Campus situation and attitude	-.19500
Span of control and attitude	.16903
Research experiments to be conducted and attitude	.31590*
Interpersonal communication and attitude	.29082*
Perception for departmental/station climate and attitude	.26495
Perception for grant facilities for research material and attitude	.07639
Office/Research facilities and attitude	.41552*
Sociopsychological characteristics	
Perception for workload and attitude	-.42977*
Job involvement and attitude	.29432*
Job stress and attitude	-.35963*
Achievement motivation and attitude	.34941*

NS = Nonsignificant at 0.05 level

DF = 58

* = Significant at 0.05 level.

Job related characteristics : Among job related characteristics, cadre, total experience and experience as a research head had significant association with the attitude of head, towards the research work, whereas inservice training received and absence at headquarters had no association with thier attitude. It implies that as cadre upgrades the attitude of head towards the research work increases. Total experience and experience as a research head also positively influenced the attitude of heads towards research work.

Off campus situation had negative and non-significant relationship with attitude of the heads. Though the finding was negatively nonsignificant. It indicated that on campus situation increases the attitude of the heads. This might be due to the fact that on campus station/department/project/scheme had more availability of facilities as compared to off campus, which may develop favourable disposition of the heads.

Organizational characteristics : In respect of organizational characteristics it was found that attitude of heads towards research work had positive significant relationship with research experiements to be conducted, inter-personal communication, departmental/station

climate and office/research facilities. This might be due to facts that work/physical facilities positively affect the mentality of the person.

Psychological characteristics : In case of psychological characteristics, job involvement and achievement motivation had positive significant relationship with the attitude of heads towards research work. Whereas Job stress had negative and significant relationship with the attitude of heads towards research work. These results are in line with those of Herzberg *et al.* (1959) and England (1971).

The probable reason for this might be that job involved and achievement motivated head considered his research work as an important part of his life and he has affinity with it which resulted in his favourable attitude, whereas the heads experiencing different degrees of job stress fall in depressing condition and take less interest in his research work.

In general majority of the research scientists working as head of department/station/project/scheme in Gujarat Agricultural University were in the medium level of attitude. Hence, there is a scope to develop favourable attitude of the scientist through improvement in academic qualifications inter personal communication, departmental/station climate, office/research facilities, job involvement, etc.

REFERENCES

- England, G. M., Agrawal, N. C. and Trerise, R. E. (1971). Union leaders and managers : A comparision of value system. *Industrial Relation*, 10 : 211-214.
- Herzberg, F. B., Mauser and Snyderman, B. B. (1959). *The motivation to work*, Wiley, New York.
- Patel, A. A. (1993). A study on Research Management Ability of Research Scientists working as Head of department/station/project/scheme in Gujarat Agricultural University, Ph. D. (agri.) Thesis (Unpublished), Gujarat Agricultural University, S. K. Nagar.

Farmers' Satisfaction with Adoption of Cumin Cultivation

C. P. Desai,* D. N. Pandya, M. R. Patel and Arun A. Patel

Directorate of Extension Education, Gujarat Agricultural University, Ahmedabad-380 003

ABSTRACT

The present study was carried out in five talukas of Bhavnagar district to find out farmers' satisfaction as a result of the introduction of cumin crop cultivation. The results indicated that majority of the respondents had expressed some degree of satisfaction for introducing cumin cultivation. It also highlighted from the study that increase in age upto middle age was found to have positive influence on the level of satisfaction derived as a result of cumin cultivation, while the highest level of family education was found to have negative influence on the level of satisfaction.

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INTRODUCTION

Generally, farmers look for a crop which is more paying with less water, fertilizers and labour requirements. Cumin is such a short duration crop which requires less irrigation, less fertilizers and less labour as compared to wheat crop, which is generally grown in the Saurashtra region during the rabi season. The farmers of the Saurashtra region have been attracted towards cumin crop and have introduced this crop with the hope of getting more economic return per unit of land.

Introduction of any new crop involve two aspects of adoption and the satisfaction, derived as a result of adoption. These are the integral parts of adoption process. It is fact that if person is satisfied with adoption of new crop cultivation, naturally he will continue same in future. It was, therefore, felt necessary to study

the farmers' satisfaction with adoption of cumin cultivation with the specific objectives of the study as given under :

1. To determine farmers' satisfaction as a result of the introduction of cumin crop cultivation.
2. To know the relationship between degree of satisfaction attained due to adoption of cumin cultivation and the selected personal socio-economic characteristics of cumin growers.

MATERIALS AND METHODS

The study was conducted in five talukas of Bhavnagar district having maximum area under cumin crop. The data were collected by arranging personal interview with the 205 cumin growers.

*Present address : Technical Officer, Directorate of Extension Education, GAU, Ahmedabad.

A three point satisfaction scale was developed to measure the satisfaction. Nine statements reflecting farmers' feeling of satisfaction for the cultivation of the cumin crop were developed. Out of these, six were positive, indicating farmers' satisfaction regarding cumin cultivation and three were negative, indicating dissatisfaction for adopting cumin cultivation.

Positive statement was assigned score 3 for "agree" down to 1 for "disagree" response. While for negative statement, score was assigned in reverse way i.e. score 1 for "agree" up to 3 for "disagree" response. The total score for individual respondent was obtained by summing-up all the scores of the statements. The score attained by all respondents were summed up to calculate the mean ($\bar{X}$). Afterwards, on the basis of mean ($\bar{X}$) and standard deviation (S.D.) they were categorised into three groups with help of following formula ; $X_1 = \text{Mean} \pm \text{Standard deviation}$.

The data were analysed by chi-square (X^2) test to ascertain the existence or non-existence of relationship between some of the personal and socio-economic characteristics of cumin growers and their satisfaction attained due to adoption of cumin cultivation.

RESULTS AND DISCUSSION

A. Farmers' satisfaction for adoption of cumin cultivation

The data (Table 1) reveals that majority (63.41 per cent) of the respondents expressed moderate satisfaction followed by high (20.00 per cent) and low (16.59 per cent) satisfaction for adoption of cumin cultivation. It is observed that the majority of the respondents expressed some degree of satisfaction for introducing cumin cultivation. This finding is in line with the findings of Shukla (1968), Dongaonkar (1975), Vyas (1976) and Patel (1977).

TABLE 1

Distribution of cumin grower according to thier satisfaction for introducing cumin cultivation.

<i>Satisfaction Level</i>	<i>Frequency</i>	<i>Per cent</i>
Low	34	16.59
Moderate	130	63.41
High	41	20.00
Total	205	100.00

B. Relationship between degree of satisfaction attained due to adoption of cumin cultivation and the selected personal socio-economic characteristics of cumin growers.

To study the relationship between degree of satisfaction attained due to adoption of cumin

cultivation and the selected personal socio-economic characteristics of cumin growers are of great importance.

It can be seen from the data presented in Table 2 that the computed chi-square value 10.34 indicates that there was significant association between age of the head of family and

satisfaction derived as a result of cumin cultivation. The farmers belonging to middle age group were found to be more satisfied than the young and old age groups. The probable reason for this may be that the young farmers

may have high level of achievement motivation as compared to the middle age group. Old farmers are generally less innovative and hence satisfaction from innovation may be expressed at low level.

TABLE 2

Relationship between satisfaction attained due to adoption of cumin cultivation and the selected personal socio-economic characteristics of cumin growers.

Characters	Satisfaction			χ^2 value
	Low	Moderate	High	
Age				
Young	9	24	11	10.34*
Medium	24	72	19	
Old	1	34	11	
Highest level of education in the family				
Primary level	18	72	18	14.65**
Secondary level	8	50	13	
Above secondary level	8	8	10	
Education of the head of the family	34	130	41	6.12 N.S.
Average educational level of the family	34	130	41	2.90 N.S.
Size of family	34	130	41	0.88 N.S.
Type of family	34	130	41	0.38 N.S.
Social participation	34	130	41	4.43 N.S.
Size of land holding	34	130	41	8.0 N.S.
Economic Status	34	130	41	3.96 N.S.

* — Significant at 0.05 level

** — Significant at 0.01 level

N.S. — Non-significant

The calculated chi-square value of (14.65) proved that level of satisfaction was inversely associated with the level of education in the respondents' families. In other words, the respondents in whose family highest level of education was up to primary level, the degree of satisfaction was high.

It is also indicated in table 2 that education of the head of the family, average educational level of the family, size of family, type of family, social participation, size of land holding and economic status of the respondents had no significant association with the level of satisfaction derived as a result of adoption of cumin cultivation.

REFERENCES

- Dongaonkar, N. W. (1975). A study of hybrid-4 cotton seed producers with special reference to their socio-economic characteristics and their decision making pattern in Anand taluka of Gujarat State, M. Sc. (Agri.) thesis (unpublished), GAU, Anand.
- Patel, S. M. (1977). A study of purchase behaviour of pumpset owners of Kheda district, Gujarat, Ph. D. thesis (unpublished), GAU, Navsari.
- Shukla, B. D. (1968). A study of the adoption of hybrid bajra cultivation in Ajarpura village of Anand taluka of Gujarat State, M. Sc. (Agri.) thesis (unpublished), GAU, Anand.
- Vyas, U. I. (1976). A study of communication behaviour of farmers and impact of H. Y. V. P. on their economic and social aspects of life in Matar taluka of Kaira district, M. Sc. (Agri.) thesis (unpublished), GAU, Anand.

Cause and Effect Analysis for Fruit Yield in Ber (*Zizyphus mauritiana*, Lamk)

B. H. Prajapati, D. G. Gauswami and M. R. Prajapati

Department of Agriculture Statistics, C. P. College of Agriculture, Gujarat Agricultural University,
Sardar Krushinagar-385 506, Dist : Banaskantha (Gujarat)

ABSTRACT

The data on six biometrical characters collected from a physiological experiment on ber (Cv. Umran) conducted at the Arid Zone Research Station, Gujarat Agricultural University, Sardar Krushinagar during 1991-92 were subjected to correlation and path analysis. The results showed significant positive association between fruit yield and fruit set, pulp-stone ratio, whereas yield had negative significant association with fruit drop and stone weight. The total variation accounted by all the characters was 86 per cent. Path analysis revealed positive direct contribution of fruit set and fruit length and negative contribution of fruit drop and stone weight. In breeding programme for ber genotypes due weightage should be given to these four characters for evolving high yielding genotypes.

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INTRODUCTION

The estimate of simple correlations provide information, which is incomplete in the sense that they do not throw light on the underlying causal schemes that are operative for various interrelationships. A better picture of the contribution from the component in building the total architecture of a complex character, may be obtained through the analysis of causal scheme i.e., path coefficient approach. Very limited work has been done and reported on fruit crops particularly on cause and effect analysis. In the present paper, efforts have been made to obtain such information on yield and its attributes in ber, which is an important fruit crop of arid and semi-arid region.

MATERIALS AND METHODS

The raw data were collected from physiological experiment on ber (Cv. Umran) conducted at the Arid Zone Research Station, Gujarat Agricultural University, Sardar Krushinagar during the *rabi* season of the year 1991-92 and were subjected to correlation and path analysis. The experiment was conducted in RBD with three replications. Nineteen treatment combinations consisting of three levels of NAA (10, 20, 40 PPM), three levels of GA₃ (10, 20, 40 PPM) and three levels of spraying (S₁, S₂, S₃) alongwith control were tried for the purpose. Single tree of ber was treated by each treatment, the distance being 8 meter between two trees. All the recommended practices in vogue were followed. The observations on six

biometrical characters alongwith yield recorded, were fruit set per cent (X_1); fruit drop per cent (X_2); fruit length in cm (X_3); fruit width in cm (X_4); stone weight in gm (X_5); pulp-stone ratio (X_6) and fruit yield kg/plant (Y). The observations on Y , X_1 and X_2 were recorded per tree basis whereas for X_3 , X_4 , X_5 and X_6 were recorded on ten randomly selected per fruits ber treatment. The data were analysed for correlation and path-co-efficients (Dewey and Lu, 1959).

RESULTS AND DISCUSSION

The estimate of simple correlation co-efficients presented in Table 1 revealed significant positive correlation of fruit yield with fruit set per cent (0.7065) and pulp-stone ratio (0.5588) whereas, it was negatively correlated with fruit drop per cent (-0.8063) and stone weight (-0.6413). Both fruit length and fruit width exhibited non-significant positive association. Jawanda and Bal (1987) reported high significant positive correlation between fruit set per cent and fruit yield and negative significant association in case of fruit drop with fruit yield.

The progress through selection for economic traits as stated by Gupta and Athwal

(1986) also depends upon the relationship of an economic trait. The interrelationships of yield components revealed positive significant association between stone weight and fruit set, fruit width and fruit length; pulp-stone ratio with fruit length and fruit width. However, negative significant association was observed between stone weight and fruit drop, pulp-stone ratio with fruit drop. The total variation accounted for by all the characters was 86 per cent.

Since yield is influenced by its components, simple correlation does not provide clear picture about cause and effect of the components, which could be studied through path analysis. The estimates of path analysis are given in Table 2. The results (Table 2) showed the direct effect of fruit set per cent on fruit yield which was high and positive (0.3704). However, it had maximum indirect effect Via fruit drop per cent (0.2073) which was followed by stone weight (0.2033). Its contribution through other characters was negative.

The fruit drop per cent had a negative and high direct effect on fruit yield per plant (-0.4250). Indirect effect of this trait Via pulp-stone ratio was positive (0.1815), but the remaining indirect effects were negative. The

TABLE 1
Correlation co-efficients for seven characters in ber.

Characters	Y	X1	X2	X3	X4	X5
X1	0.7065**					
X2	-0.8063**	-0.4878				
X3	0.3531	-0.0668	-0.2218			
X4	0.3799	0.0119	-0.2085	0.9423**		
X5	-0.6413**	0.5995**	-0.7064**	0.1687	0.2135	
X6	0.5588**	0.1550	-0.5132	0.8539**	0.7946**	-0.2686

TABLE 2
Direct and indirect effects for various yield attributes in ber.

Characters	X1	X2	X3	X4	X5	X6	Corr. with Y
X1	0.3704	0.2073	-0.0235	0.0037	0.2033	-0.0548	0.7065**
X2	-0.1807	-0.4250	-0.0781	-0.0643	0.2396	0.1815	-0.8063**
X3	-0.0247	0.0943	0.3522	0.2906	-0.0572	-0.3020	0.3531
X4	0.0044	0.0886	0.3319	0.3084	-0.0724	-0.2810	0.3799
X5	-0.2221	-0.3003	0.0594	0.0658	-0.3392	0.0950	-0.6413**
X6	0.0574	0.2181	0.3007	0.2450	0.0911	-0.3536	0.5588**
Residual effect = 0.0663							R ² = 0.8658

Legend :

** Significant at P = 0.01

Y = Fruit yield kg/plant

X1 = Fruit set per cent

X2 = Fruit drop per cent

X3 = Fruit length (cm)

X4 = Fruit width (cm)

X5 = Stone weight (gm)

X6 = Pulp-stone ratio

direct effect of fruit length on fruit yield was positive and high (0.3522). Its indirect effect Via fruit set per cent, pulp-stone ratio, stone weight were negative but Via fruit drop per cent (0.0943) and fruit width (0.2906) were positive. The fruit width also had positive direct contribution (0.3084) to fruit yield per plant. Its indirect effect Via fruit set, fruit drop and fruit length were positive but Via stone weight and pulp-stone ratio were negative.

The direct effects of stone-weight and pulp-stone ratio with fruit yield per plant were negative (-0.3392 and -0.3536 respectively). The indirect effect of stone weight Via all the characters studied except fruit set and fruit drop were positive, whereas in case of pulp-stone ratio the indirect effect Via all the characters

were observed positive. The characters studied accounted for 86.58 per cent of the total variation in ber fruit yield.

The residual effect for the path was low in magnitude (0.0663) suggesting that the characters studied are sufficient to express their contribution towards fruit yield of ber.

Based on the above discussion, the results lead to that the fruit set per cent and fruit length contributed positive and high direct effects whereas fruit drop and stone weight exhibited negative direct effects on fruit yield per plant in ber. These are the important attributes for selection criteria. In breeding research programme for ber crop, due weightage should be given to these four characters for evolving high yielding genotypes.

REFERENCES

- Dewey, D. R. and K. H. Lu, 1959. A correlation and path coefficient analysis of components of crested wheat gross seed production. *Agron. J.* 51 : 515-518.
- Jawanda, J. S. and J. S. Bal. 1987. Correlation analysis in Ber, *Punjab Hort. J.*, 21 (1) : 17-22.
- Gupta, V. P. and D. S. Athwal. 1966. Genetic variability correlation and selection indices for green fodder characters in Pearlmillet. *J. Res., PAU*, 3 (4) : 581-584.

Pattern of Rural Employment and Migration in Drought Affected Areas of Gujarat

P. K. Singh

Department of Agricultural Economics, B. A. College of Agriculture, Gujarat Agricultural University, Anand Campus, Anand-388 110

ABSTRACT

The severe drought of 1987-88 caused large-scale disruption in economic activities resulting in decline in employment and increase in the migration was mainly seasonal and temporary. During the drought year the total mandays available for work with a family were 1478 however, the family members could get the work for only 908 days. Thus, the unemployment rate was about 39 per cent. Relief operations taken up by the Governments and voluntary organisations were moderately successful in mitigating the misery of the affected population. The long term measures taken up in the area in the past could not provide any drought proofing. The economy was less diversified and commercialisation was also less. The existence of large scale unemployment calls for multipronged efforts towards creating demand for labour both on-and-off the farm, and qualitatively improving the capacity of labour force and thereby its productivity.

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INTRODUCTION

One major problem that has always drawn attention could be that of increasing unemployment and under employment in rural areas particularly among the landless labourers, marginal and small farmers and rural artisans. This problem has contributed to the growth of poverty and inequalities accentuated by uneven agricultural development. The problem of rural unemployment is more serious in arid zones and drought prone areas. In arid zones of Gujarat State the periodic failure of rain and consequent drought is a recurring feature. Drought in any region causes change in resource use, large scale

socio-economic distress, unemployment, change of occupation and migration. In the context of effective man-power planning, it becomes necessary to have quantitative assessment of the extent and pattern of both unemployment and migration. There is lack of adequate information on rural unemployment in drought prone areas. Such situation indicates the need for collecting reliable data on employment, unemployment and migration at different points of time. Such information would provide useful guidelines for regional and sub-regional manpower planning and would enable the government to properly design and implement appropriate schemes. With this in mind this study was initiated to

provide empiricism to the consequences of the drought year as compared with the moderate year on the extent and pattern of rural employment, unemployment and migration in drought prone areas.

MATERIALS AND METHODS

The study has utilized the data generated under I.C.A.R. funded project entitled, "Socio-economic Impact of 1987 Drought in Gujarat". The project covered two drought prone districts of Gujarat State, viz., Banaskantha and Surendranagar. From each district, One Drought Prone Area Programme taluka was selected randomly with probability proportion to rural population in the taluka. Next, four villages were selected randomly from each chosen taluka. Thus, a total of eight villages comprised the study area. From each of these villages, 40 rural households were chosen randomly. The total sample thus, consisted of 320 rural families. For the purpose of analysis the selected households were categorised into five occupation classes. The sample consisted 177 agricultural producers (AP), 59 landless agricultural labourers (LAL), 31 landless non-agricultural labourers (LNAL), 19 rural artisans (RA) and 34 households belonged to 'others' category. The data were collected through survey method for the drought year (DY) of 1987-88 and the local normal year (NY) i.e., 1983-84. Some general information about the sample villages was also gathered from the respective village panchayats.

RESULTS AND DISCUSSION

As discussed earlier the study is based on a sample survey of 320 rural households belonging to five occupation categories. In

Table 1 the categorywise number of workers, total mandays available for work, the pattern of employment and unemployment of the average household have been presented. The number of working members in a family were worked out by calculating the adult equivalents. Thus, family members of less than 15 years of age were not considered, those between the age of 15 to 18 years were taken as half and those above 18 years were taken as full unit. The number of workers in a family, thus arrived was multiplied by 365 for determining the total mandays available for work with a family during the year. Main sources of employment in the area were farming (crop and livestock raising) and works like artisanship, custom service, service, business, etc. Household chores were not considered here. During the year households also got employment on different relief works initiated by government and non-government organisations.

Pattern of employment and unemployment

As given in Table 1 the total available mandays per household during the drought year varied from 1069 on LNAL to 1646 on AP category. Farm and off the farm activities were the main sources of employment on all categories of household. The per household employment on such activities varied from 390 mandays on LNAL group to 910 on AP and 'others' categories. The extent of employment on relief works organised during the year ranged from 392 mandays on 'others' category to 602 days on RA category. Thus, about 29 per cent to 44.4 per cent of total workers remained unemployed on different categories of households. The total number of workers on an average household were 405 which came to 1478 mandays during the year. An average

TABLE 1
Employment pattern of sample households during drought year.

Sr. No.	Household category	Family size	Number of Total available		Employment (days) on		Unemployment (days)
			workers	mandays	Farm & off the farm	Relief works	
1.	AP	7.55	4.51	1646	910	262	474 (28.80)
2.	LAL	6.17	3.39	1237	440	346	451 (36.46)
3.	LNAL	5.84	2.93	1069	390	204	475 (44.43)
4.	RA	8.57	4.45	1624	800	222	602 (37.07)
5.	Others	6.34	3.73	1361	910	59	392 (28.80)
	Average	7.05	4.05	1478	690	218	570 (38.57)

1 Figures in parentheses are percentage to total available mandays.

2. Notes : AP - Agricultural Producer, LAL-Landless Agricultural Labourer,

LNAL - Landless Non Agricultural Labourer, RA - Rural Artisan.

household, during DY, got an employment of 690 days on and off the farm activities and 218 days work on different famine relief programmes. Thus, during the year the family members remained unemployed for 570 days. In 'other' category the average rate of unemployment during DY was 38.57 per cent.

Pattern of migration

Due to economic hardship at home the drought prone areas have traditionally been the areas of out migration, whether seasonal or permanent. People belonging to lower economic strata like marginal and small farmers, landless labourers and poor village artisans move out in search of work as it is not available locally. Similarly, livestock owners, particularly goat and sheep herd owners, also migrate along with their animals in search of pastures.

An attempt has been made here to study the pattern of migration of sample households at two points of time (see Table 2). It was observed that in the study area there was no

in-migration of human beings and livestock. Only seasonal and temporary out-migration from the area was observed. Table shows that the number of persons going out for work and returning daily was 369 during NY and as much as 1471 during DY. Thus, as compared to NY when only 3.10 per cent of the total population commuted everyday the per cent of commuters during DY was 12.34.

This indicates that number of such persons during DY increased by 298.64 per cent over the NY. Number of persons moved to other places temporarily increased from 220 during NY to 560 during DY showing a 154.55 per cent increase during the later period over the former. Likewise, the number of families moved to other areas along with their animals increased from 133 during NY to 378 during DY. Thus, the number of families migrated out of their villages along with their livestock showed an 184.21 per cent increase during the latter period over the former period.

TABLE 2

Pattern of out migration from sample villages during normal and drought years.

		(Number)	
Particulars	Normal year	Drought year	Per cent change
1. Total persons	11927	11927	—
1.1 Persons going out for work & returning daily	369 (3.10)	1471 (12.34)	298.64
1.2 Persons shifted out in search of work	220 (1.85)	560 (4.70)	154.55
2. Total rural families	2028	2028	—
2.1 Families shifted out for work along with their animals	133 (6.56)	378 (18.64)	184.21

Figures in parentheses are percentage to total number of persons-rural families.

The survey has revealed the existence of unemployment among large population and among all the occupation categories. This calls for multipronged efforts towards

- (a) Creating demand for labour both on-and-off the farms, and (b) qualitatively improving the capacity of labour force and thereby improving its productivity. Such efforts should cover :
- (i) Increasing the adoption of drought tolerant farm technology to enhance productivity of farm resources, and sta-

bilize production and increase demand for labour.

- (ii) Keeping the contingency plans and input supplies particularly the seeds of short duration crops and varieties ready at taluka and agro-climatic zonal level to meet the drought like situation.
- (iii) Diversifying the economic activities through the identification and encouraging rural and cottage industries on skills and raw materials available locally. This would create employment in secondary and tertiary sectors.

Short Communications

Response of Castor (*Ricinus communis* L.) GCH-4 to Planting Geometry and N Fertilization under Rainfed Condition

N. K. Thadoda, N. M. Sukhadia, D. D. Malavia and
A. M. Moradia

Department of Agronomy, Gujarat Agricultural University,
Junagadh-362 001

A field experiment was conducted with GCH-4 castor (*Ricinus communis* L.) to study the effect of varying planting geometries and nitrogen levels on yield at Junagadh during *kharif* 1992-93. The soil was clayey having 70.96% clay with pH 7.7, electrical conductivity 0.31 mmhos/cm, medium in total nitrogen (0.066%) and available phosphorus (30.40 kg P_2O_5 /ha) and fairly rich in available potash (284.40 kg K_2O /ha). Eighteen treatment combinations consisting of six levels of spacing (60 x 45, 90 x 45, 120 x 45, 60 x 60, 90 x 60 and 120 x 60 cm as main plots and three levels of N (50, 75 and 100 kg/ha) as sub-plots were tried in split plot design with four replications. The castor hybrid GCH-4 was sown on 25th August 1992 with seed rate of 6 kg/ha manually and harvested according to maturity of different spikes. Nitrogen was applied as per treatments, half of the quantity as basal and remaining at 45 DAS in the form of urea. Entire recommended dose of P was

uniformly applied for all the plots in form of single superphosphate before sowing.

The seed and stalk yields were significantly affected by varying planting geometries (Table-1). The spacing 90 x 60 cm gave the highest seed and stalk yield of 23.83 and 27.89 q/ha, respectively but remained statistically at par with 60 x 60 cm and 90 x 45 cm. The lowest seed and stalk yields was obtained at 120 x 60 cm spacing. The appreciable increase in seed and stalk yields in favour of 90 x 60 cm spacing was probably due to adequate interception of sunlight by the crop canopy even at low level of illumination, consequently higher rates of photosynthesis and ultimately increase in yield. Eventhough the higher values of yield attributes under widely spaced plants, could not increase the yield as against the narrow spaced plants. The reason for reduction in seed and stalk yields under closer spacing of 60 x 45 cm would be the narrow planted crop invariably had lower values of growth and yield contributing characters under study (Narkheda *et al.* 1984). These findings are in agreement with those of Sarma (1985) and Patel *et al.* (1991).

The seed and stalk yields were significantly affected by various levels of nitrogen and they were increased with each increment in N level (Table 1).

TABLE 1

Effect of planting geometry and N fertilization on growth yield attributes and yield of castor.

Treatment	Plant height (cm)	No. of branches per plant	Length of main spike (cm)	Capsules/ main spike	Spikes/ plant	Seed weight plant (g)	100 seed weight (g)	Seed yield (q/ha)	Stalk yield (q/ha)
Spacing (cm)									
S ₁ 60 x 45	107.5	4.7	36.0	48.1	4.4	51.6	25.2	18.80	22.11
S ₂ 90 x 45	117.7	5.1	37.4	55.0	5.0	90.3	26.9	21.90	24.98
S ₃ 120 x 45	123.5	6.2	41.8	56.0	6.2	100.9	28.1	18.09	21.38
S ₄ 60 x 60	116.6	5.0	36.2	51.3	4.8	84.0	25.4	22.81	26.10
S ₅ 90 x 60	118.8	5.9	40.6	55.5	5.7	132.0	27.5	23.83	27.89
S ₆ 120 x 60	124.1	6.6	42.4	58.0	6.4	133.7	29.3	17.98	21.98
S. Em ±	3.4	0.3	1.4	2.1	0.4	4.5	0.9	0.91	0.91
C. D. (P = 0.05)	10.3	0.8	5.0	6.3	1.2	13.6	3.0	2.75	2.76
Nitrogen (kg N/ha)									
N ₁ 50	114.4	5.3	37.2	48.0	5.0	92.5	25.9	19.31	22.88
N ₂ 75	116.6	5.6	39.1	55.3	5.5	97.4	27.1	21.13	24.62
N ₃ 100	123.1	6.0	41.0	58.8	5.3	105.4	28.1	21.27	24.71
S. Em. ±	2.4	0.1	1.0	1.5	0.2	3.1	0.6	0.56	0.56
C. D. (P = 0.05)	6.9	0.4	3.0	4.2	0.5	8.8	1.7	1.60	1.62

The highest seed and stalk yields of 21.27 and 24.71 q/ha was recorded with application of 100 kg N/ha but these were at par with 75 kg N/ha (21.13 and 24.62 q/ha respectively). However, both these levels were found significantly superior than application of 50 kg N/ha (19.31 and 22.88 q/ha). The highest seed and stalk yields obtained under higher level of nitrogen was probably due to improvement

and development of growth and yield attributes viz., plant height, number of branches/plants, number of spikes/plant, number of capsules/spike, length of main spike, seed weight/plant and 100 seed weight. The results confirm the findings of Paidá (1976) and Patel (1991).

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REFERENCES

- Narkhede, B. N., Patil, A. B. and Deokar, A. B. 1994. Varietal response to plant densities and nitrogen application in castor. *J. Oilseeds Res.* 1 (2) : 109-114.
- Paidá, V. J. 1976. Effect of nitrogen and phosphorus fertilization on growth, yield and oil content of castor (*Ricinus communis* L.) M. Sc. (Agriculture) thesis (unpublished), Gujarat Agricultural University, Sardar Krushinagar.

- Patel, M. K., Fatteh, U. G. and Patel, V. J. 1991. Effect of nitrogen and its times of application on yield of castor GAUCH-1 (*Ricinus communis* L.) under irrigated condition in North Gujarat. *GAU. Res. J.* 17 (1) : 27-29.
- Sarma, D. A. 1985. Studied on influence date of sowing and plant density on yield of castor. *Andhra Agric. J.*, 32 (1) : 65-66.

Response of Green Gram and Black Gram Genotypes to Plant Density

Suresh S. Tomar* and A. S. Tiwari

J. N. Krishi Vishwa Vidyalaya-Zonal Agricultural Research Station, Morena-47 6001 (Madhya Pradesh)

A field experiment was conducted at Zonal Agricultural Research Station, Morena during late spring seasons of 1983 and 1984 to find out suitability of green gram and black gram crops, their genotypes and plant density to achieve higher yields in northern Madhya Pradesh. The soil of experimental plot was sandy loam in texture, having pH 7.8, 205 kg available nitrogen, 23.20 kg P_2O_5 and 400 kg K_2O /ha. Four genotypes each of green gram (Pusa baisakhi, K 851, PS 16 and ML 131) and black gram (PU 19, JU 77-41, RU 2 and GWLS-1) were evaluated under four plant densities viz., 4, 6, 8 and 10 lakh plants/ha in inter and intra row spacing of 25 x 10 cm, 30 x 5.6 cm, 25 x 5 cm and 20 x 5 cm, respectively. The treatments were replicated thrice in split plot design. Keeping genotypes in main plot and plant density in sub plot. The crop was sown on 20 March during both the years. The intra row spacing was maintained by thinning out extra plants after 10 days of sowing as per plant densities treatments. The crops were raised with recommended package

of practices for the zone. Effect of green gram and black gram genotypes and plant density on growth, yield attributes and yield are given in Tables 1 and 2.

It is evident from the Table 1 that green gram produced significantly more plant height, seeds/pods, harvest index (in 1984 only) and seed yield (Table 2) than black gram in both the years. Green gram gave 12.50% higher seed yield over black gram.

Green gram genotype K 851 was found comparatively taller than other genotypes during both the years (Table 1). K 851 recorded significantly higher number of pods/plant (12.9) than PS 16 (10.0) in 1983. Pusa baisakhi and K 851 produced significantly higher number of seeds/pod than ML 131 and PS 16 in both the years. In 1984, significantly higher harvest index of 32.4% was recorded by K 851 over other genotypes (25.3 to 28.0%).

In case of seed yield, K 851 was found significantly higher yielder (921 kg/ha) than Pusa baisakhi, PS 16 and ML 131 genotypes (Table 2). Pusa baisakhi (807 kg/ha) and ML 131 (816 kg/ha) were at par in yield. Rajpur (1993) also reported the highest seed yield from K 851 when sown in Middle of March.

*Present address : Scientist (Agronomy), Repeseed Mustard Project, JNKVV, Jabalpur.

TABLE 7
Growth and yield attributes of green gram and black gram as influenced by genotypes and plant densities.

Treatment	Plant height		Pods/plant		Seeds/pod		Harvest Index (%)	
	1983	1984	1983	1984	1983	1984	1983	1984
Green gram (GG)								
Pusa balsakhi	28.6	28.3	10.3	8.7	7.6	6.4	38.1	28.0
K 851	29.0	29.0	12.9	8.1	7.7	5.9	36.4	32.4
PS 16	27.2	29.1	10.0	7.0	6.2	5.2	37.0	25.3
ML 131	27.7	25.8	12.2	7.6	6.4	5.5	24.4	27.0
Mean (GG)	27.9	28.0	11.3	7.8	7.0	5.8	36.5	28.2
CD at 5 %	1.8	2.3	2.7	NS	0.9	0.6	NS	4.1
Black gram (BG)								
PU 19	15.2	12.9	11.2	9.5	5.6	4.3	33.8	23.8
JU 77-41	16.2	14.5	10.9	8.9	4.9	3.5	30.9	29.0
RU 2	12.8	13.1	14.1	8.6	5.3	4.2	37.4	24.1
GWLS - 1	16.2	14.4	11.7	7.5	5.1	3.4	32.1	21.5
Mean (BG)	15.1	13.7	11.8	8.6	5.2	3.9	33.6	24.6
CD at 5%	1.8	NS	NS	NS	NS	0.6	NS	4.1
CD at 5% for GG and BG	0.9	1.2	NS	NS	0.4	0.3	NS	2.0

1.	2.	3.	4.	5.	6.	7.	8.	9.
Plant densities (Plants/ha)								
4 lakh	20.9	20.6	13.7	8.9	6.4	5.9	36.5	26.9
6 lakh	22.0	21.4	12.4	8.5	6.1	4.9	35.8	26.6
8 lakh	22.1	21.3	10.4	7.9	5.9	4.8	34.6	26.2
10 lakh	21.0	20.8	9.9	7.7	5.9	5.7	33.3	25.7
CD at 5 %	1.1	NS	1.4	NS	0.4	NS	NS	NS

Black gram, GWLS-1, JU 77-41 and PU 19 were significantly taller (16.2 to 15.2 cm) than RU 2 (12.8 cm) in 1983 only. Higher number of seeds/pod were produced by PU 19 (5.6 and 4.3) and RU 2 (5.3 and 4.2) than JU 77-41 (4.9 and 3.5) and GWLS-1 (5.1 and 3.4) during both the years. Higher harvest indices were recorded in RU 2 (37.4%) and PU 19 (33.8%) in 1983 and in 1984, it was higher in JU 77-41 (29.0%) and RU 2 (24.1%).

Genotype RU 2 (798 kg/ha) gave significantly higher seed yield than PU 19 (650 kg/ha) and GWLS-1 (700 kg/ha). JU 77-41 was superior over PU 19 (Table 2).

In 1983, higher plant densities of 6 and 8 lakh plants/ha recorded significantly taller plant height than 4 lakh plants/ha (Table 1). Lowest plant density of four lakh plants/ha gave significantly higher number of pods/plant (13.7) than 8 lakh (10.4) and 10 lakh plants/ha (9.9).

TABLE 2

Seed yield (kg/ha) of green gram, black gram and its genotypes as influenced by plant densities and their interactions (Mean of two years).

Crops/Genotypes	Plant densities (lakh plants/ha)				Mean
	4	6	8	10	
Green gram (GG)					
Pusa baisakhi	754	840	844	790	807
K 851	839	916	977	948	921
P S 16	638	668	750	735	698
ML 131	765	768	830	904	816
Mean (GG)	745	798	850	844	810
Black gram (BG)					
PU 19	590	639	641	729	650
JU 77-41	671	672	715	886	735
RU 2	761	755	832	845	798
GWLS-1	654	666	710	772	700
Mean (BG)	669	683	724	808	720
Mean over GG & BG	709	740	787	826	765
CD 5% for crop (GG & BG)					36
CD 5% for genotypes					73
CD 5% for plant density					38
CD 5% for interaction (Genotypes x plant density)					106

Four lakh plants/ha also produced significantly higher number of seeds/pod (6.4) than highest plant density of 10 lakh plants/ha (5.9). In 1984, similar trend was observed for all these characters, though the differences were not significant. The number of pods/plant, seeds/plant and harvest indices decreased with increasing plant density. The lower expression of yield attributes at higher plant densities may be due to more competition between plants for space, radiation, nutrients etc. Reduction at higher plant population in pods/plant and seeds/pod was also reported by Tomar *et al.* (1993) in mung bean.

In case of seed yield, interaction between green gram and black gram crops x plant density was found significant (Table 2). Green gram recorded significantly higher seed yield of 850 kg/ha with a plant density of 8 lakh plants/ha (25 x 5 cm spacing) than 4 lakh (745

kg/ha) and 6 lakh (798 kg/ha) plants/ha. In black gram 10 lakh plants/ha (20 x 5 cm spacing) produced significantly higher seed yield of 808 kg/ha than 4 lakh (669 kg/ha), 6 lakh (683 kg/ha) and 8 lakh (724 kg/ha) plants density/ha. Similar results have been reported by Ali (1986) in case of mung bean and Singh *et al.* (1986) in case of urid bean.

Another interaction due to genotypes of green gram, black gram x plant density was also found significant in seed yield (Table 2). Green gram K 851 produced significantly higher seed yield of 977 kg/ha with 8 lakh plants/ha than 4 lakh plants/ha (839 kg/ha). In black gram JU 77-41 (886 kg/ha) and RU 2 (845 kg/ha) gave significantly higher seed yield with 10 lakh plants/ha over 4 lakh plants/ha.

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REFERENCES

- Ali, Masood, (1986). Role of non monetary and low cost input in pulse production. *Indian Farming* XXXVI (10) : 23-28.
- Rajput, R. L. (1993). A study on production efficiency of green gram varieties in gird zone of Madhya Pradesh. *Bhartiya Krishi Anusandhan Patrika*. 8 (2) : 119-124.
- Singh, R. C., Singh, Mehar., Dahiya. D. R. and Phogat, S. B. (1986). Effect of dates of sowing and seed rate on summer season urid bean. *Indian Journal of Agronomy* 31 (2) : 188-189.
- Tomar, S. S. Kushwaha, P. S., Yadav, N. S., Verma, O. P. and Jain, A. K. (1993). Influence of moisture regime, phosphorus and seed rate on yield attributes, yield and protein content in summer green gram. *Journal of Water Management* 1 (1) : 37- 39.

Response of Soybean to Dates of Sowing and Row Spacings Under Varying Plant Densities

**B. B. Ramani, M. M. Modhwadia and
D. D. Malaviya**

Department of Agronomy, College of Agriculture,
Gujarat Agricultural University, Junagadh-362 001

Soybean (*Glycine max* (L.) Merr.) being a treasure of nutrition, seems to be only ray of light to sustain vegetarian population of India in general, and Gujarat in particular. Scarce knowledge available with farmer on soybean agronomy which otherwise has the greatest contribution towards production at the lowest cost of cultivation, hence the study.

An experiment was conducted at Instructional Farm, Gujarat Agricultural University, Junagadh during *kharif*, 1988. The soil was calcareous, medium black, clayey in texture, slightly alkaline in reaction (pH 7.8) and normal in respect to salt content. From fertility point of view, it was high in organic carbon, low in available phosphorus and high in available potash. The experiment was laid out in a split-split plot design with three replications. The treatments assigned were, dates of sowing to main plots, row spacing to sub plots and plant densities to sub - sub plots. The crop was fertilized with 30 kg N and 60 kg P_2O_5 per hectare in the form of DAP and urea

as basal application. Two seeds per hill were placed manually maintaining inter and intra row spacings as per treatments, thereafter, one healthy seedling was maintained by thinning and gap filling. the soybean var. Guj.-Soy-1 was used as the test crop. The crop season received 1290 mm rainfall which was above normal by 345 mm.

The crop sown on 7th July recorded significantly higher grain, oil and protein yields as well as production efficiency than 22nd July and 6th August sown crop (Table 1). The higher grain yield with 7th July sowing was due to more branches, pods and grain yield per plant rather than its test weight. The higher values of yield attributes with the crop sown immediately at onset of monsoon might be due to more congenial growth conditions during crop period and sufficient time to complete all physiological processes properly than late sown crop. Silimar trend was observed in straw yield. The results corroborate with those of Raghuwanshi *et al.* (1988).

Significantly higher grain, straw, oil and protein yield as well as production efficiency was observed when crop was sown at 45 cm row spacing than narrow (30 cm) and wider (60 cm) row spacings (Table 1). The higher yield was due to higher grain yield per plant and test weight. These findings are in agreements with those of Deshmukh *et al.* (1977).

The plant density of 60 plants per M^2 gave significantly higher grain yield and ultimately oil and protein yield as well as production efficiency than other plant densities under test (Table 1). Though the yield attributes reduced with increase in plant density, the higher grain yield was obtained at 60 plants per m^2 , might be due to optimum plant density. On the other hand, straw yield was increased upto the highest plant density of 80 plants per m^2 . Thus, the respective results regarding grain and straw yield showed the parabolic and asymptotic relationship with plant density as suggested by Holliday (1960) and results also

confirm with those of Soni *et al.* (1987) under Indian conditions.

Interactions among date of sowing, row spacing and plant density were significant. The crop sown on 7th July at 45 cm row spacing with the plant density of 60 plants per m^2 gave significantly higher grain yield than rest of the treatment combinations. The higher grain yield with this treatment combination may be due to reduction in intra-row spacing competition as well as co-operative interaction (Duncaon, 1977).

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REFERENCES

- Deshmulh, S. C., Saxena, M. C. and Pandey, R. K. (1977). Yield, yield components and grain quality of Clark-63 soybean as influenced by date of planting, row spacing and plant population. *Indian J. Agron.*, **22** (1) : 27-34.
- Duncaon, W. G. (1977). Cultural manipulation for higher yield "Physiological aspects of crop yield". Amer. Soc. Agron. and Crop Sci. Soc. America (U.S.A.) : 327-339.
- Holliday, R. (1960). Plant population and crop yield. *Field Crop Abst.* **13** : 159-167, 247-254.
- Raghuwanshi, R. K. S.; Nem, M. L.; Umat, R. and Thakur, H. S. (1988). Effect of sowing dates and fertility levels on the grain yield of soybean. *J. Oilseeds Res.* **5** (2) : 168-169.
- Soni, J. C., Singh, R. V. Rathore, R. S. and Awasthi, P. K. (1987). Response of soybean varieties to seedling rates. *Indian J. Agron.* **32** (3) : 275-276.

Suitability of Pearlmillet Genotypes for Intercropping with Pigeonpea

T. N. Barevadia, D. P. Mogharia and J.B. Patel

B. A. College of Agriculture, Gujarat Agricultural University, Anand Campus, Anand-388 110

Intercropping has been recognised as a potentially beneficial system of crop production in semi-arid tropics and evidences suggest that intercropping can provide substantial yield advantage due to utilization of natural resources like space, air, moisture and nutrient more efficiently as compared to sole cropping. There are three major approaches to maximise yields in intercropping (i) plant population/spatial arrangement relationship (ii) fertilizer and water and (iii) identification of compatible genotypes (Willey, 1979). Intercropping of pigeonpea with pearlmillet has been practiced in Gujarat but suitable row ratio alongwith suitable genotype of pearlmillet for intercropping system is meagre. Keeping these objectives in view, the present investigation was undertaken to achieve higher productivity.

A field investigation was carried out at the College Agronomy Farm, Gujarat Agricultural University, Anand Campus, Anand during *kharif* season of 1990-91 to study the performance of pearlmillet genotypes for intercropping with pigeonpea under rainfed conditions. The soil of the experimental field

was loamy sand having pH 7.6, 0.4% organic matter, 43.5 kg available P_2O_5 /ha and 261.0 kg available K_2O /ha. The total rainfall received during the season was 702 mm in 37 rainy days which was less than the average rainfall of 862 mm of the region. Fifteen treatment combinations comprised of three levels of spacing cum intercropping ratios (90 x 30 cm cum 1:1, 135 x 30 cm cum 1:2 and 180 x 30 cm cum 1:3) as one way main plot and five different cropping systems of pigeonpea and genotypes of pearl/millet (sole crop of pigeonpea cv. T 15-15, pigeonpea + pearlmillet cv. GHB-27, pigeonpea + pearl millet cv. GHB-30, pigeonpea + pearl/millet cv. MH-179 and pigeonpea + pearlmillet cv. BK 560-230) as cross way main plot were tried in strip plot design replicated four times. Intra-row spacing of 15 cm was maintained in all pearlmillet genotypes. The crops were sown on 3 July, 1990 as per the respective treatments. Pigeonpea was manured with 25 kg N + 50 kg P_2O_5 /ha, while pearlmillet with 80 kg N + 40 kg P_2O_5 /ha according to number of lines. Pearlmillet and pigeonpea were harvested on 29 September, 1990 and 3 January, 1991, respectively. The results are presented in Tables 1 and 2.

Effect on pigeonpea

The different levels of spacing cum ratio had significant influence on the seed yield of pigeonpea (Table 1). Significantly the highest

TABLE 1

Effect of spacings cum ratios and cropping systems on yield of pigeonpea and pearl millet

Spacing cum inter-cropping ratios (SR)								
Cropping systems (C)	90 x 30 cm		135 x 30 cm		180 x 30 cm		Mean	
	+		+		+			
	1 : 1 (S ₁ R ₁)		1 : 2 (S ₂ R ₂)		1 : 3 (S ₃ R ₃)			
	Pige- onpea (kg/ha)	Pearl- millet (kg/ha)	Pige- onpea (kg/ha)	Pearl- millet (kg/ha)	Pige- onpea (kg/ha)	Pearl- millet (kg/ha)	Pige- onpea (kg/ha)	Pearl- millet (kg/ha)
PP - sole crop (C ₁)	712 a	—	631 b	—	532 d	—	625 z	—
PP + PM Cv. GHB-27 (C ₂)	410 f	1307 ef	360 g	1763 bcde	263 i	2208 ab	344 w	1760 z
PP + PM Cv. GHB-30 (C ₃)	576c	1483 def	412 f	1600 cdef	324 h	1741 bcdf	437 y	1608 z
PP + PM Cv. MH-179 (C ₄)	393 f	1486 def	319 h	1927 abcd	248 i	2287 a	320 v	1900 z
PP + PM Cv. BK - 560 - 230 (C ₅)	507 e	1240 f	409 f	1511 cdef	336 h	2025 abc	417 x	1592 z
Mean	520 p	1379 r	426 q	1700 q	341 r	2065 p	—	—
Pearlmillet								
Effect	S. Em.	C.V. %	Effect	S. Em.	C.V. %			
SR	6.6	6.9	SR	46.9	10.9			
C	3.7	3.0	C	114.2	23.1			
SR x C	2.3	3.4	SR x C	151.9	17.7			

NB : (1) Treatment means with letter/s in common are not significant by Duncan's New Multiple Range Test at 5% level of significance in the respective crops.

(2) PP = Pigeonpea PM = Pearlmillet

TABLE 2
Effect of spacing cum ratios and cropping systems on pigeonpea crop equivalent

Cropping systems (C)	Spacing cum inter-cropping ratios (SR)						Mean
	90 x 30 cm +	135 x 30 cm +	180 x 30 cm +	1 : 3 (S ₃ R ₃)			
	1 : 1 (S ₁ R ₁)	1 : 2 (S ₂ R ₂)	Pigeonpea (kg/ha)	Net return (Rs/ha)	Pigeonpea (kg/ha)	Net return (Rs/ha)	
PP - sole crop (C ₁)	712 cd	3074 cde	631 be	2693 de	532 e	2167 e	2855 y
PP + PM Cv. GHB-27 (C ₂)	821 bc	3471 bcd	914 ab	4320 ab	957 ab	4809 ab	4200 z
PP + PM Cv. GHB-30 (C ₃)	1043 a	5176 a	914 ab	4267 ab	871 b	4036 abc	4493 z
PP + PM Cv. MH-179 (C ₄)	859 b	3772 bcd	924 ab	4235 abc	967 ab	4604 ab	4204 z
PP + PM Cv. BK - 560 - 230 (C ₅)	897 ab	4145 abc	884 b	4047 abc	973 ab	4909 ab	4367 z
Mean	866 p	3928 p	853 p	3913 p	860 p	4105 p	—

Pigeonpea			Pearlmillet		
Effect	S. Em.	C.V%	Effect	S. Em.	C.V%
SR	15.3	7.9	SR	110.6	12.4
C	33.9	13.7	C	277.6	24.2
SR x C	44.4	10.3	SR x C	349.0	17.5

NB : (1) Treatment means with letter/s in common are not significant by Duncan's New Multiple Range Test at 5% level of significance in the respective crops.

(2) PP = Pigeonpea PM = Pearlmillet

seed yield was recorded when pigeonpea was grown with 90 x 30 cm spacing and intercropped with one row of pearl millet (S_1R_1). The magnitude of increase in seed yield of pigeonpea under S_1R_1 was 22.07 and 52.49 per cent over that of S_2R_2 and S_3R_3 , respectively. The higher yield under S_1R_1 might be due to higher plant population.

Further, it was observed that pearl millet intercropping with pigeonpea significantly reduced the seed yield of pigeonpea and the reduction was to the tune of 44.96, 30.08, 48.80 and 33.80 per cent with the intercropping of pearl millet cultivars viz., GHB-27, GHB-30, MH-179 and BK-560-230, respectively over that of sole cropping of pigeonpea. This might be due to competitive effect of pearl millet genotypes for natural resources which might have reduced the growth and development of pigeonpea. On an average, the reduction in seed yield of pigeonpea due to pearl millet intercropping was to the tune of 39.28 per cent. These results are akin to those reported by Katare *et al.* (1983) and Bar *et al.* (1988).

Intercation effect of spacing cum ratio and cropping systems on seed yield was also found significant and closest spacing of 90 x 30 cm under pigeonpea as a sole crop significantly recorded the highest yield, while with different genotypes of pearl millet, treatment combination $S_1R_1C_3$ recorded the highest seed yield and the least value was recorded under $S_3R_3C_4$. This might be due to higher deleterious effects of pearl millet cv. MH-179 and GHB-27 and also lower plant population of pigeonpea under widest row spacing.

Effect on pearl millet

Grain yield of pearl millet was gradually increased with increase in levels of spacing

cum ratio (Table 1). Pearl millet intercropped with three rows in pigeonpea by following 180 x 30 cm spacing (S_3R_3) gave significantly the highest grain yield which was increased to the tune of 21.47 and 49.75 per cent over that of S_2R_2 and S_1R_1 , respectively. The higher yield of pearl millet under S_3R_3 was mainly due to higher plant population.

It was further observed that different cropping systems had no significant effect on grain yield of pearl millet. However, interaction effect between spacing cum ratio and cropping systems was found to be significant. Among different treatment combinations, $S_3R_3C_4$ recorded higher yield followed by $S_3R_3C_1$, $S_3R_3C_5$ and $S_2R_2C_4$. All these treatments were equally effective but found significantly superior to rest of the treatment combinations. The higher yield under above treatments was might be due to more plant population and genetic constitution of the respective variety. In other wards, lower yield under $S_1R_1C_5$ was due to the fact that this treatment combination received lower plant population and the genotype was susceptible to downy mildew resulted in lower yield.

Effect on pigeonpea equivalent

Data presented in Table 2 revealed that total productivity on terms of pigeonpea equivalent yield was not significantly affected due to different row spacing cum ratio which indicated more or less equal amount of pigeonpea crop equivalent under different spacings cum ratios. Further, it was observed that different levels of cropping systems had significant influence on the pigeonpea crop equivalent. Intercropping of all four pearl millet cultivars were remained at par in respect of pigeonpea crop equivalent and gave significantly higher pigeonpea equivalent over

that of sole crop of pigeonpea. This was attributed to higher grain yield of pearl millet which had compensated for reduction of seed yield of pigeonpea to the tune of 39.28% under cropping systems.

Thus, pigeonpea crop equivalent clearly indicated the superiority of intercropping treatments over sole cropping by achieving 47 per cent yield advantage. This was attributed to complementary effect of component crops to each other for use of resources than grown separately due to identical growth pattern (Trenbath, 1974).

The interaction effect due to spacings cum ratios and cropping systems for pigeonpea crop equivalent was found to be significant. Intercropping of pearl millet cv. GHB-30 with one row in pigeonpea planted at

90 x 30 cm gave the highest pigeonpea crop equivalent might be due to higher seed yield of pigeonpea owing to less competitive effect of cv. GHB-30 under 1:1 intercropping ratio. These results are in accordance with the findings of Dhingra *et al.* (1980).

Profitability

Data on economics revealed that intercropping of pearl millet gave 51.10 per cent higher gain over sole crop of pigeonpea and intercropping of pearl millet cv. GHB-30 gave maximum net realization when it was intercropped with one row in pigeonpea planted at 90 x 30 cm. Thus, growing of pearl millet in pigeonpea as intercrop is advisable for substantial yield advantage as compared to sole crop of pigeonpea.

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REFERENCES

- Bar, A. K., R. C. Gautam and S. K. Kaushik. 1988. Performance of pearl millet genotypes in sole and intercropping systems under rainfed conditions. *Indian J. Agron.* 33 (1) : 52-55.
- Dhingra, K. K., S. Singh and H. P. Tripathi. 1980. Phenological behaviour under different dates of planting and row spacings. Proc. Int. Workshop on Pigeonpea. Vol. II., ICRISAT, Patancheru, India, pp. 229-234.
- Katare, R. A., V. M. Bhale and K. S. Mulgir, 1983. Pigeonpea/pearl millet intercrop pays more. *Int. Pigeonpea News L.* 2 : 30-31.
- Willey, R. A. 1979. Intercropping, its importance and research needs, Part-II : Competition and yield advantages. *Field Crop Abstr.* 32 (2) : 73-85.
- Trenbath, B. R. 1974. Bio-mass productivity mixtures. *Advances in Agronomy.* 26 : 177-210.

Correlation and Regression Studies in Maize (*Zea mays* L.) Types

M. Padmaja, K. L. Rao* and D. Sreelatha

Department of Agronomy, Agricultural College,
Bapatla-522 101, Andhra Pradesh
Agricultural University (A.P.)

The information on the correlation coefficients between grain yield and yield components is a pre requisite for crop improvement as well as studying the yield increasing potential of Agronomic practices.

A field experiment was carried out during *rabi*, 1993-94 season to study the nitrogen requirement of maize (*Zea mays* L.) types on clay soils at Agricultural College Fram, Bapatla (A. P.). The treatments consisted of four maize types viz., popcorn (Amber popcorn), Hybrid (DHM-107), Composite (Harsha) and Sweet corn (Madhuri) assigned to main plots and four N levels viz., 0, 50, 100 and 150 kg ha⁻¹ to sub plots. The experiment was laid out in split plot design with three replications. The maize seeds of different types were dibbled in their respective treatments on November 19, 1993 adopting an inter and intra row spacing of 60 cm and 25 cm, respectively. The gross and net plot sizes were 4.8 m x 6.0 m and 2.4 m x 5.5 m, respectively. From the data recorded on yield attributes and yield, the relationship between grain yield and yield

contributing characters was worked out by correlation and regression studies as described by Snedecor and Cochran (1967).

All yield attributing characters viz., number of grains per cob, test weight, weight of the grains per cob (g), LAI, plant height, dry matter accumulation at 75 DAS and cob length were positively and significantly correlated with grain yield indicating that increase in these parameters, the grain yield increases correspondingly. These results are in conformity with the findings of Patel *et al.* (1987), Singh *et al.* (1987), Khanday and Thakur (1990) and Jadhav *et al.* (1991).

Number of grains per cob was positively correlated with all these yield components except with test weight. Similarly, test weight had significant positive correlation with weight of the grains per cob, LAI, plant height and dry matter accumulation, but showed non significant relation with cob length. The correlation also existed between weight of the grains per cob and LAI, plant height, dry matter accumulation and cob length. LAI had significant association with plant height, dry matter accumulation and cob length. Similarly, plant height had significant positive correlation with dry matter accumulation and cob length. Positive relationship was exhibited between dry matter accumulation and cob length.

* Present address : Agronomist, R.A.R.S., Tirupati 517 502 (A. P.)

TABLE 1

Relationship of correlation coefficients (r) for growth and yield attributing characters (X) with grain yield (Y) of maize.

Grain yield (Y)	Number of grains per cob (X_1)	Test weight (X_2)	Weight of the grains per cob (X_3)	LAI (X_4)	Plant height (X_5)	Dry matter g plant ⁻¹ (X_6)	Cob length (X_7)
1.000	0.831	0.743	0.992	0.941	0.939	0.968	0.806
X_1		0.354	0.822	0.784	0.774	0.750	0.931
X_2			0.763	0.744	0.731	0.720	0.325
X_3				0.911	0.905	0.940	0.762
X_4					0.975	0.927	0.808
X_5						0.936	0.826
X_6							0.784
X_7							—

$n = 16$; $r = \text{at } 5\% = 0.9973$

The number of grains per cob (X_1), test weight (X_2), weight of the grains per cob (X_3), leaf area index (X_4), plant height (X_5), dry matter accumulation at 75 DAS (X_6) and cob length (X_7) on seed yield (Y) were worked for multiple linear regression and the coefficient of prediction (R^2) are presented hereunder :

$$Y = -3.17 - 0.009X_1 - 0.008X_2 + 0.448X_3 + 0.723X_4 + 0.012X_5 + 0.526X_6 + 0.244X_7$$

$$R^2 = 0.99$$

From the equation it is evident that weight of the grains per cob, leaf area, dry

matter accumulation and cob length are more potent than other characters in the determination of yield. These four characters accounted for nearly 99 per cent of the variability in yield indicating primary dependence of yield on these independent variables. Hence selection pressure may be exercised to improve the seed yield in maize to increase these important yield attributing characters viz., weight of the grains per cob, leaf area index, dry matter accumulation at 75 DAS and cob length.

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REFERENCES

- Jadhav, A. S., Pawar, S. D. and Dukara, N. S. 1991. Correlation and Regression studies in Maize. *J. Maharashtra Agril. Univ.* 16 (3) : 372-373.
- Khanday, B. and Thakur, R. C. 1990. Correlation of yield components in rainfed maize (*Zea mays*). *Indian J. agric. Sci.*, 60 (12) : 830-1.
- Patel, P. G., Singh, R. P. and Raja, K.R.V. 1987. A correlation study of maize yield with its components. *Research J., Gujarat Agril. Univ., Junagadh*, 13 (1) : 7.
- Singh, K., Rao, D.S.R.M. and Singh, H. 1987. Correlation and coefficient analysis of yield and yield components of maize, Ganga hybrid-5. *J. Res. Haryana Agril. Univ., Hissar*, 17 (1) : 64 - 7.
- Snedecor, G. W. and Cochran, W. G. 1967. Statistical Methods. 6th Edn. Oxford and IBH Pub., Co, New Delhi, India, pp : 135-198.

Effect of Irrigation, Weed Management and Phosphorus on Yield of Summer Green Gram [*Vigna radiata* (L.)]

L. K. Arvadiya, C. L. Patel and M. K. Arvadiya

Department of Agronomy, N. M. College of Agriculture,
Gujarat Agricultural University, Navsari, Gujarat-396 450

Field experiment was conducted during the summer season of 1992 at Navsari to study the response of K-851 summer green gram (*Vigna radiata* (L)) to irrigation, weed management and phosphorus. The soil was clayey (PH 7.6), containing total N 0.049%, available phosphorus 10.30 kg P/ha and potassuim 220 kg k/ha. The field capacity, permanent wilting point and bulk density in 0-30 cm soil depth were 32.60 and 18.20 % and 1.38 g/cc, respectively. The treatments comprised three IW:CPE ratios (0.3, 0.5 and 0.7 i.e. 3, 4 and 5 irrigation including two common irrigation of 70 mm irrigation depth, three weed control treatment (weeded control, hand weeding at 20 + 40 days after sowing and pre-emergence application of pendimethalin 1.0 lit/ha) and three phosphorus levels (0, 15 and 30 kg p/ha) were tried in a 3^3 partial confounded randomized block design with two replications. Full dose of N as urea and

phosphorus as per treatments in form of single superphosphate were applied at the time of sowing. Well water of good quality was used for irrigation and was measured with 75 mm Parshall flume installed in channel in the experimental field.

Different irrigation treatment have pronounced effect on growth and yield of summer green gram. Though IW/CPE ratio of 0.7 gave higher value, statistically it did not differ with IW/CPE ratio 0.5. The yield increased were to the tune of 26.5 and 21.8 per cent with IW/CPE ratio of 0.7 and 0.5 than IW/CPE ratio of 0.3. This finding is in accordance with that of Patel *et al.* (1988). The water use efficiency decreased with higher IW:CPE ratios as frequent irrigation applied under these treatments increased moisture loss due to evapotranspiration in summer season.

Weed control treatments had favourable effect on yield attributing characters and manual weeding (twice) recorded the highest value but was at par with pendimethalin @ 1.0 lit/ha. The per cent increase in grain yield with hand weeding (Twice) and pendimethalin over weedy check was 27.4 and 24.1 per cent, respectively. This finding is in agreement with that of Gupta *et al.* (1990). Hand weeding (twice) gave the highest

D² Analysis in Soybean for Chlorophyll Under Rainfed Condition

Jay Lal Mahto and Z. A. Haider

Department of Plant Breeding and Genetics, Birsa Agricultural University, Kanke, Ranchi-834 006

In any breeding programme, inclusion of genetically diverse parents is essential in order to create new reservoirs of genetic variability. The present investigation has assessed genetic diversity in a set of 40 soybean

genotypes through multivariate analysis on the basis of chlorophyll and carotene.

Forty genotypes pertaining to different agroclimatic regions were grown in a randomised block design with 3 replications at Ranchi during *kharif* 1986. Each genotype was sown in 3 rows of 3 m long at a distance of 45 cm between rows. Chlorophyll and carotene were estimated as per Arnon (1949), Withan *et al.*, (1971), Starness and Hadley (1965) and Mukherji and Biswas (1979). Sample of leaves were taken from flower initiation (FIN) and other nodes (ON). The genetic divergence

TABLE 1

Distribution of 40 genotypes in clusters for chlorophyll in soybean.

Cluster	No. of genotypes	Genotypes
I	26	BR 16, BR 17, Bragg, DS 2, DS 9, DS 10, Himso 1520, Himso 1533, J 323, JS 71-5, JS 81-503, JS 81-607, Js 81-714, KD 2, MACS 13, PK 416, PK 472, PK 879, PK 884, PK 885, SH 84-85, SL-141, SL 142, VLS 7, VLS 8
II	5	Himso 1532, KB 34, KB 38, MACS 153, MACS 189
III	1	J 140
IV	1	J 75-27-51
V	2	PK 838, PK 863
VI	1	LS 140
VII	1	MACS 141
VIII	2	KD 1, DS 2
IX	1	UGM 21

TABLE 2

Mean intra - and inter - cluster distance (D^3) values in soybean for chlorophyll

[illegible]

analysis was carried out using Mahalanobis' D² statistics. The genotypes were grouped into clusters by the Toucher's methods as described by Rao (1952) and Mahalanobis (1986).

The wilks test revealed highly significant differences for all the characters (Table 3). 40 genotypes were grouped into the nine clusters

(Table 1). The constellations obtained by D² analysis were also confirmed by canonical analysis (Table 3). The first three canonical vectors accounted for 95.9% of total genetic divergence. Maximum intra-cluster distance is in cluster VIII and minimum is in cluster V. The highest inter-cluster distance between cluster I and IX (60.303) and the lowest between III and IV (7.976) Table 2.

TABLE 3

Canonical vectors and contribution of quantitative characters in soybean for chlorophyll.

Characters	Canonical vectors			Contribution % of diversity (D ²)
	Z ₁	Z ₂	Z ₃	
Chlorophyll 'a' (FIN)	0.0647	-0.1983	0.1016	8.05
Chlorophyll 'a' (ON)	-0.0116	0.0359	-0.0074	0.0
Chlorophyll 'b' (FIN)	0.0080	-0.0220	-0.0037	0.0
Chlorophyll 'b' (ON)	0.0193	-0.0223	-0.0431	0.0
Carotene (FIN)	-0.0219	0.0278	-0.0117	0.0
Carotene (ON)	0.2554	-0.9876	-0.1375	23.45
Total Chlorophyll (FIN)	1.0712	0.2588	-0.1213	46.90
Total Chlorophyll (ON)	-0.1409	0.0751	-1.1281	21.60
Variability % accounted for	51.8858	32.9266	11.0902	
Total variability		(95.903)		

FIN - Flower initiation nodes, ON - Other nodes.

The analysis for estimating the contribution of various characters towards the expression of genetic divergence (Table 3) indicate that chlorophyll 'a' (FIN), carotene (ON), total

chlorophyll (FIN), total chlorophyll (ON) are the basic physiological attributes of plant, which need greater attention for selection criteria.

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REFERENCES

- Arnon, D. I. (1949). Copper enzymes in isolated chloroplast. *Plant Physiol.*, **24** : 1-15.
- Mahalanobis, P. C. (1936). On the generalised distance in statistics. *Proc. Nat. Inc. Sci. India.*, **2** : 49-55.
- Mukherji, S. and Biswas, A. K. (1979). Modulation of chlorophyll, carotene and xanthophyll formation by penicillin, benzyl-adenine and embryonic axis in mungbean cotyledons. *Ana. Bot.*, **43** : 225-229.
- Rao, C. R. (1952). *Advanced statistical Methods in Biometric Research*. John Weley & Sons, New York.
- Starnes, W. J. and Hadley, K. H. (1965). Chlorophyll content of various strains of soybean (*Glycine max.*) *Crop Sci.*, **5** : 9-11.
- Withan, F. H.; Maydes, D. F. and Devalin, R. M. (1971). Chlorophyll absorption spectrum and quantitative determinations. *'Experiments in plant physiology'* Pub. Van Nestrand Rein.

Isolation and Purification of Protoplasts of Castor (*Ricinus communis* L.) and *Jatropha* spp.

Chandran K.* and Sujatha M.

Genetics and Cytogenetics Laboratory, Directorate of Oilseeds Research, Rajendranagar, Hyderabad

Resistance breeding programme in castor is hindered by lack of adequate variability within the species and being a monotypic genus. A closely related genus *Jatropha* is often looked for incorporating resistant genes especially for wilt disease and semilooper infestation. Owing to various incompatibility barriers, conventional breeding programme was not successful between these species. Hence somatic hybridization is being identified as a tool for overcoming such barriers (Schielder, 1982). In view of this, isolation and purification of protoplast from both the genus was standardized.

The hypocotyl tissues from *in vitro* grown seedlings of castor varieties 'Aruna' and 'Bhagya' and the two species of *Jatropha* namely, *J. curcas* L. and *J. panduraefolia* Andr. were used as the source of protoplasts. Seedlings of age group between 4 to 16 days after germination were treated with various enzyme combinations, comprising Cellulase, Pectinase, Driselase and Hemicellulase supplemented

with CaCl_2 , Mannitol, MES (Methyl Ethyl Sulphonate) and Sucrose as osmoticum. Incubation was carried out in dark for 16 hrs and viability of the protoplast was tested using FDA (Flourescein diacetate) stain (Widholm, 1972). The protoplast yield was calculated using haemocytometer after purification by layering over 20% sucrose solution. Enzyme mixture found suitable from the above treatment was used further to find optimum age of the seedlings to get maximum protoplast yield.

The experiment showed that the enzyme mixture consisting of 0.5% Cellulase and 0.5% Pectinase was ideal for releasing viable protoplast in castor and 0.25% Cellulase and 0.5% Pectinase in *Jatropha* species, in osmoticum containing 0.4 M Mannitol, 200 mM CaCl_2 and 2 mM MES. Ten to twelve days old seedlings of castor gave the highest yield (8.8×10^6) of protoplasts while on *Jatropha* spp., 12 to 14 days old seedlings were found to give better results (8.8×10^3) (Table 1). However, no difference in protoplast yield was observed between varieties of Castor and between species of *Jatropha* used in this experiment. Compared to Castor the yield was poor in *Jatropha*, probably because of high quantity of reserve food materials, especially oil globules in the seedlings, which affect the stability of the protoplasts. This is the first report of isolation and purification of protoplasts from castor and *Jatropha* spp.

*Present address : Chandran K., Genetic Resources Section, NRCG, Junagadh-362 001, Gujarat.

TABLE 1

Protoplast yield in relation to age of the seedlings.

Age of seedlings	Castor (<i>'Aruna'</i> & <i>'Bhagya'</i>)			Jatropha spp. (<i>J. curcas</i> & <i>J. panduraefolia</i>)		
	Protoplast release	Stability	Yield/ g/4mlE	Protoplast release	Stability	Yield g/4mlE
4	R	US	—	NR	—	—
6	R	US	—	NR	—	—
8	R	S	8.8×10^3	R	US	—
10	R	S	8.8×10^6	R	US	—
12	R	S	8.8×10^6	R	S	8.8×10^3
14	NR	—	—	R	S	8.8×10^3
16	NR	—	—	NR	—	—

R = Release, NR = No release, US = Unstable, S = Stable.

The information generated in this study can be used for further research in protoplast culture and somatic hybridization between Castor and *Jatropha* spp.,

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REFERENCES

- Schielder, O., 1982. Somatic hybridization : A new method for plant improvement. In plant improvement and somatic cell genetics (eds. I. K. Vasil, W. R. Scowcroft and K. J. Frey). Academic Press, Newyork. pp 239-253.
- Widholm, J. M., 1972. The use of flourescein diacetate and phenosaphranine for determining viability of cultured plant cells. *Stain Technology* 47 (4) pp 189-195.

Effect of Mulching on the Yield of Rainfed Cotton in Bhal Zone of Gujarat

A. Das and G. L. Maliwal

Bhal and Coastal Zone, Gujarat Agricultural University, Arnej-382 230 [Gujarat]

Cotton is one of the most important crops grown in the *Bhal* zone and farmers have their first preference for cotton (Maliwal, 1989). In *Bhal* zone cotton crop is rainfed and survives on residual soil moisture. Because of low and erratic rainfall and development of cracks in the soil (Vertic Ustochrept and Typic Chromustert), moisture stress at flowering and boll formation stage very often serves as a limiting factor for cotton yield. Therefore, *in situ* moisture conservation in *Bhal* zone assumes paramount importance. A field experiment was undertaken to study the effect of surface mulching on moisture conservation and cotton yield.

The study was conducted in 1991-92 at National Agricultural Research Farm at Arnej, Gujarat Agricultural University, with cotton variety 'G-Cot.-13'. The year 1991 received rainfall of 386.2 mm in twenty two rainy days and most of rain (92%) being received during the period between last week of July and first week of September. The soil is clayey in

texture having moisture retention capacity of 28.0 and 12.2 per cent (W/W), respectively at 33 KPa and (1) 1500 KPa for upper 60 cm depth. The crop was sown on 24-8-91 in the intra and inter row spacing of 60 and 30 cm, respectively. Four mulch (treatments viz.) (1) no mulch (control), (2) organic mulch (wheat straw chopped at 5 cm length) @ 10tha⁻¹, (3) black polythene sheet (approx 200 gauge thick), (4) soil mulch (stirring surface soil with wheel-hoe once a week) were laid out on 17-9-91 after cessation of monsoon in randomized block design with six replications. Soil moisture at 15 days interval from 0-15, 15-30, 30-45 and 45-60 cm depth was monitored thermogravimetrically till harvest of the crop. Soil temperature at 5 cm depth was recorded daily at 8.00 and 14.00 hrs.

The effect of mulching on growth parameters, yield of cotton and weed infestation are presented in Table 1. Plant population was little higher under mulch treatments compared with control. Number of branches was slightly more under polythene and organic mulch as compared to control and soil mulch. However, the differences in plant population, number of bolls per plant and number of branches per plant were not significant. Organic mulch showed significant reduction (8.6%) in plant height as compared to control and polythene mulch, but it was a

TABLE 1
Effect of mulching on growth parameters, yield and weed infestation.

Mulch treatment	Plant population per net plot	Height of plant (cm)	No. of bolls per plant	No. of branches per plant	Yield of seed cotton (kg/ha)	Per cent increase in yield (kg/ha) over control	Wt. of dry II weed at harvest (gm/net plot)
Control	77.3	71.23	13.36	3.63	976.8	—	242.5
Black polythene	84.2	69.73	13.70	4.20	1029.5	5.4	53.3
Soil	82.3	68.17	12.67	3.60	1112.2	13.9	72.2
Organic	81.8	65.10	12.87	4.17	1201.4	23.0	104.0
@ 10 t ha ⁻¹							
S. Em ±	2.20	1.26	0.91	0.31	47.27		14.14
C. D. 0.05	NS	3.77	NS	NS	142.39		42.61
C. V. %	6.61	4.50	17.01	19.49	10.73		27.88

par with soil mulch. Pahdey *et al.* (1988) reported significantly higher number of tillers/plant in rainfed pearl millet under straw mulch while number of branches plant, pod/plant in chickpea under dryland condition was higher under soil mulch as compared to other mulches and control (Tiwari *et al.*, 1991).

Differences in seed cotton yield due to mulch treatments were significant. The higher yield of 1201.4 kg/ha was obtained under organic mulch and this was significantly more

than the control polythene mulch but was at par with soil mulch (Table 1). So far as benefit of mulching is concerned, 23% and 14% higher seed cotton yield was obtained under organic mulch and soil mulch, respectively as compared to control (Table 1). Straw mulch registered maximum grain yield of rainfed pearl millet compared with other treatments and control (Pandey *et al.*, 1988), while Tiwari *et al.* (1991) recorded higher yield of chickpea under soil mulch compared with other mulch treatments and control in dryland situation.

TABLE 2

Effect of mulches on soil moisture (%) at different depths during the growth of cotton in Bhal zone (Average of 3 replications).

Period	Treatments	Depth (cm)				Mean
		0-15	15-30	30-45	45-60	
17 Sept., '91 (Initiation of treatment)	Control	16.12	18.94	19.58	21.14	18.95
	Polythene	16.12	18.94	19.58	21.14	18.95
	Soil	16.12	18.94	19.58	21.14	18.95
	Organic	16.12	18.94	19.58	21.14	18.95
16 Oct., '91	Control	9.60	14.91	15.08	17.60	14.30
	Polythene	14.32	13.82	12.79	23.83	13.69
	Soil	11.02	15.81	17.39	17.46	15.42
	Organic	11.02	15.81	17.39	17.46	15.42
29 Oct., '91	Control	10.68	13.11	14.49	15.42	13.43
	Polythene	10.44	13.47	14.50	15.53	13.49
	Soil	10.15	12.57	15.04	15.46	13.30
	Organic	11.26	12.10	14.92	15.31	13.40
16 Nov., '91	Control	10.12	12.90	13.84	14.76	12.91
	Polythene	9.19	13.55	14.55	15.18	13.12
	Soil	9.08	14.28	14.37	15.20	13.23
	Organic	10.23	12.87	13.23	13.72	12.51
3 Dec., '91	Control	9.59	11.95	12.43	12.12	11.52
	Polythene	10.61	12.06	11.02	12.55	11.56
	Soil	8.79	11.82	12.70	13.07	11.60
	Organic	8.48	10.26	11.98	11.77	10.62

1.	2.	3.	4.	5.	6.	7.
18 Dec., '91	Control	6.80	9.99	10.43	10.63	9.46
	Polythene	8.37	10.66	11.28	10.97	10.32
	Soil	6.93	10.84	10.69	12.04	10.13
	Organic	7.48	8.83	10.48	12.34	9.78
3 Jan., '92	Control	4.22	5.83	6.25	7.75	6.01
	Polythene	5.68	7.35	8.53	9.89	7.86
	Soil	3.93	6.74	8.87	9.29	7.21
	Organic	6.60	8.05	8.73	9.19	8.14
20 Jan., '92	Control	3.94	6.11	4.96	8.41	5.86
	Polythene	4.04	6.64	7.03	8.28	6.50
	Soil	5.88	5.83	5.56	7.45	6.18
	Organic	6.05	8.08	7.05	7.20	7.10
3 Feb., '92	Control	4.27	6.06	6.61	7.29	6.10
	Polythene	3.18	4.90	6.83	6.82	5.43
	Soil	3.27	7.53	7.25	7.89	6.49
	Organic	4.68	6.25	6.79	7.60	5.33
1 April, '92	Control	3.43	3.81	4.74	5.50	4.37
	Polythene	4.74	4.66	5.34	6.08	5.21
	Soil	2.95	4.67	4.27	6.05	4.49
	Organic	3.52	3.50	3.88	5.55	4.11

Mulching significantly decreased the weed infestation. Weed infestation was minimum under black polythene followed by soil and organic mulch (Table 1). Tiwari *et al.* (1991) however, reported lowest weed population/m² under soil mulching as compared to other mulching and control.

The variation in soil moisture content at varying depths due to different mulch treatments were not appreciable during vegetative growth period. However, during December 18 to January 20 i.e. at the flowering to boll formation stage moisture status of deeper layers under mulch treatment was slightly higher (Table 2). Results also showed that the crops grew at 33 Kpa

moisture i.e. field capacity for larger part of its growth period and gave substantial yield. This particular character of cotton is the reason for the farmers' preference for cotton under residual moisture in *Bhal*. Black polythene and organic mulch, in general, showed slightly higher soil temperature over control at 8.00 hrs, while at 14.00 hrs soil temperature was lowest under organic mulch followed by black polythene and control (Table 3). Ghildyal and Tripathi (1987) reported that surface mulching is beneficial for water conservation and soil temperature modification. Black plastic mulch absorb much of radiation but permits little energy downward while straw mulch works as a heat sink during the day and source during night. Koniger and Winter (1993) reported that

TABLE 3

Influence of mulches on the soil temperature ($^{\circ}\text{C}$) during the growth of cotton in Bhal tract of Gujarat (Average of 2 replications).

Period	8.00 hr.			14.00 hr.		
	Control	B. Poly- thene	Organic	Control	Poly- thene	Organic
24-9-91 to 3-10-91	29.5	31.3	31.0	39.9	40.0	38.7
3-10-91 to 11-10-91	27.2	28.7	28.9	41.5	40.5	30.0
4-10-91 to 22-10-91	27.0	28.2	27.9	41.0	40.0	39.3
23-10-91 to 11-11-91	25.9	26.9	26.6	42.2	40.4	38.5
12-11-91 to 19-11-91	24.8	25.3	25.3	35.1	34.0	32.8
20-11-91 to 28-11-91	22.6	23.3	23.1	34.4	33.2	31.9
29-11-91 to 26-12-91	18.5	19.5	19.4	31.8	30.4	29.5
7-12-91 to 16-12-91	17.9	18.5	18.5	31.5	30.4	29.4
17-12-91 to 26-12-91	16.1	17.0	17.0	29.8	29.0	28.0
27-12-91 to 6-1-92	11.8	13.3	12.5	27.3	26.2	25.3
7-1-92 to 16-1-92	12.6	15.5	14.9	28.8	27.5	26.1
17-1-92 to 24-1-92	13.8	15.5	14.6	32.1	30.3	29.4
25-1-92 to 3-2-92	15.2	19.7	18.8	33.6	31.7	31.0
4-2-92 to 12-2-92	17.1	19.1	18.1	36.7	34.5	33.1
13-2-92 to 20-2-92	15.5	17.4	16.6	37.0	35.3	34.5
21-2-92 to 29-2-92	16.2	18.0	17.0	40.6	37.6	37.4
3-3-92 to 10-3-92	19.5	21.5	20.2	38.5	41.3	40.5
11-3-92 to 13-3-92	22.4	24.3	23.5	46.6	42.8	41.8

higher soil temperature increased total dry weight of *Gossypium hirsutum* but did not effect light use efficiency of leaf pigment content. The comparatively higher yield of cotton under organic mulch and soil mulch might be attributable to conservation of soil

water and control of weeds. Dubey *et al.* (1995) showed that, soil moisture conservation treatments i.e. mulching and tillage gave significant effect on grain and straw yield of wheat under rainfed situation.

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REFERENCES

- ✓ Dubey, Y. P., Ranjodh Singh and Vipin Kalia (1995). Residual soil water, wheat growth and yield as affected by maize varieties, mulching and Tillage in rainfed maize-wheat sequence in Himachal Pradesh, *J. Indian Soc. Soil Sci.*, **43** (1) : 6-8.
- Ghildyal, B. P. and R. P. Tripathi (1987). Soil Physics. Wily Eastern Limited; New Delhi, P.P. 656.
- Koniger, M. and K. Winter (1993). Growth and photosyntherin of *Gossypium hirsutum* L. at high photon flax densities, effects of soil temperature and Nocturnal air temperatures *Agronomic* **13** (5) : 423-431.
- Maliwal, G. L. (1989). Bhal and Coastal Zone, Important research accomplishment, Gujarat Agricultural University, Arnej, P.P. 44.
- Pandey S. K.; S. K. Kaushik and R. C. Gautam (1988). Response of rainfed pearlmillet (*Pennisetum glaucum*) to plant density and moisture conservation. *Indian J. Agric. Sci.*, **58** (7) : 517-20.
- ✓ Tiwari, R. B. S. S. Parihar and R. S. Tripathi (1991). Effect of mulching on yield and yield attributes of chikpea (*Cicer arietinum*) *Indian J. Agron.*, **36** (4) : 599-600.

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Effect of Silicate Effluent on Chemical Properties of Soil and Groundnut Yield

J. D. Gundalia*, M. S. Patel, K B. Polara,
N. K. Tank and M. B. Meisheri

Department of Agricultural Chemistry and
Soil Science, Gujarat Agricultural University, Junagadh

More than 1500 textile units print about 4.5 lakhs sarees per day using about 3650 lakh litres of water daily (Menon, 1987). Of late, the treatment of urea in saree printing has been substituted by sodium silicate as the latter given better shining and lustrous printing. Since the effluent washing of urea treated sarees when used as irrigation was beneficial to crops, some farmer's also unknowingly started using the effluent of sodium silicate treated sarees for irrigating their crops. But the experience of farmers showed that use of effluent of first two washings of the sodium treated sarees was detrimental to both crops and soils. Therefore, the farmers now let out the first two washings either in the open grazing public land or in ponds around their fields. This not only leads to waste of costly commodity but also to water pollution. It might be possible that dilution of this effluent may prevent spoilage of soil and adverse effect on crop growth. This note reports the results of a study on the effect of different dilutions of

silicate treated textile effluent on growth of groundnut and soil properties.

A pot experiment was conducted during summer 1989 with seven dilution treatments of silicate effluent water (Table 1) with three replications in a completely randomized design on calcareous caly soil (Vertic Ustochrepts). The soil, clay in texture, had pH (1:2.5) 8.2, EC (1:2.5) 0.45 dSm⁻¹, CaCO₃ 19%, organic C.O. 45%, Olsen's P 6.9 mg/kg and available K 268 mg/kg. A basal doses of nitrogen and phosphorus were applied through urea and DAP respectively. The earthen pots were filled with 13 kg of the soil. Three seedlings of groundnut variety GG-2 were raised in each pot. The pots were irrigated with silicate effluent water of different dilutions as per the treatment (Table 1) throughout the crop season. At maturity, the crop was harvested and soil samples were collected and analysed for chemical properties following the standard methods (Jackson, 1973).

Effect on soil

An increase in the concentration of irrigation water with the silicate effluent considerably increased as per the expectation the values of EC, pH, Na⁺, K⁺, CO₃²⁻, HCO₃⁻, RSC', SSP' and SAR but decreased those of Ca⁺⁺ and MG⁺⁺ (Table 1). When this effluent treated water were used for irrigation, the values of EC (dSm⁻¹), pH, SAR, RSC (me L⁻¹),

*Present address : Associate Research Scientist, Department of Agricultural Chemistry and Soil Science, GAU, Junagadh.

TABLE 1

Composition of dilute silicate effluent water used for Irrigation.

Treatment	EC $\times 10^3$ (dSm ⁻¹)	pH	Na ⁺	K ⁺	Ca ⁺⁺	NG ⁺⁺	CO ₃ ⁻	HCO ₃ ⁻	Cl ⁻	RSC	SSP	SAR
----- (me L ⁻¹) -----												
T ₀ (Control)	1.0	7.5	2.5	—	4.8	2.6	0.4	2.8	5.4	Nil	25.25	1.39
T ₁ (1% effluent)	1.1	8.3	4.7	0.08	2.0	2.2	1.0	2.5	6.6	Nil	52.21	3.2
T ₂ (2.5% effluent)	1.3	8.5	8.9	0.12	0.8	1.6	1.6	3.1	7.0	2.3	77.91	8.2
T ₃ (5% effluent)	2.3	9.0	17.3	0.25	0.8	0.8	4.0	5.0	7.7	7.4	90.3	19.3
T ₄ (7.5% effluent)	3.0	9.2	25.5	0.36	0.6	0.6	6.6	7.0	8.2	12.4	93.2	32.9
T ₅ (10% effluent)	3.8	9.4	33.3	0.47	0.4	0.4	8.8	10.1	9.4	18.1	96.3	52.6
T ₆ (15% effluent)	5.2	9.6	45.0	0.64	0.4	0.2	13.6	15.7	11.1	28.7	97.3	82.2
T ₇ (20% effluent)	6.4	9.9	51.6	0.82	0.4	0.1	24.4	17.6	13.4	41.5	97.5	103.1

TABLE 2

Effect of effluent silicate water on chemical properties of soil and yield of groundnut.

Treatment	Water soluble (1:2.5)					Exch. (c mol (P ⁺) kg ⁻¹)			Avall. P ₂ O ₅ kg ha ⁻¹	organic carbon (%)		yield (g pot ⁻¹)	
	EC x 10 ³ (dSm ⁻¹)	pH	SAR	RSC	SSP	Ca+Mg	Na	K		carbon	Pod	Haulm	
	—	—	—	(meL ⁻¹)	—	—	—	—					
T ₀	0.20	8.2	0.90	1.24	36.2	37.3	1.7	0.33	30.8	0.55	10.32	25.3	
T ₁	0.25	8.2	2.59	1.84	35.2	35.2	2.6	0.33	30.7	0.55	9.33	24.3	
T ₂	0.35	8.3	3.79	1.75	70.0	33.5	4.4	0.38	30.7	0.56	8.01	23.7	
T ₃	0.50	8.3	5.30	1.88	74.9	33.2	10.3	0.45	30.7	0.54	6.99	21.2	
T ₄	0.75	8.4	5.82	2.39	75.0	30.2	15.3	0.55	29.1	0.52	7.11	19.5	
T ₅	0.83	8.6	6.31	2.99	75.7	26.7	18.0	0.55	29.1	0.54	5.62	14.3	
T ₆	0.92	8.7	7.70	4.25	78.2	20.5	20.1	0.59	28.3	0.48	4.36	14.0	
T ₇	1.13	9.2	9.30	6.08	80.6	15.4	21.6	0.68	29.1	0.48	4.26	13.0	
C. D. @ 5%	0.08	0.1	0.8	0.66	5.5	2.2	1.5	0.06	NS	NS	1.92	5.3	

NS : Non significant

Susceptibility of Some Genotypes of Pigeonpea to *Coccidohystrix insolita* (Green)*

P. K. Borad** and P. A. Bhalani

Pulse Research Station, Gujarat Agricultural
University, Junagadh-362 001

Spectacular success has been achieved in protecting the crops from insect damage and reduce losses by using one of the relatively less emphasised methods, the 'host plant resistance'. Plant resistance against the mealybug offers a good control avoiding all hazards but efforts in this direction are scanty. To determine the source of resistance as well as to locate the source of resistance, 16 genotypes of pigeonpea were screened against the mealybug, *Coccidohystrix insolita* (Green).

The field and pot experiments were conducted during rainy season of 1991-92 and 1992-93 at College Farm, Junagadh adopting randomized block design with 16 genotypes (Table 1) of pigeonpea and three replications. In the field, each pigeonpea genotype was planted in two rows with 4.80 m length and spaced at 60 cm between the rows and 30 cm between the plants. All the recommended agronomic practices were adopted for raising the crop. Five plants with five secondary branches from each plant were selected for recording the mealybug population. The observations were recorded from top, middle and bottom leaves of each branch. In pot study, five mature females of mealybug were released on each potted plant of pigeonpea after five weeks of germination. Observations on mealybug index (0-4) were taken as categorised below :

Degree of infestation of mealybug on pigeonpea genotype	Mealybug index
— Plant free from mealybug pest	0
— Mealybug present but no colonies and no injury on the plant	1
— Small colonies present on tender leaves and leaves exhibited slight yellowish colour	2
— Leaves completely covered with mealybug and infested plant parts turn yellowish and withered	3
— Plants covered by mealybug and plants died	4

*Part of Ph.D. Thesis submitted by senior author to G.A.U.

Present address : Training Associate (Pl. Prot.), Tribal Research-cum-Training Centre, Gujarat Agricultural
University, Devgad Baria-389 380.

TABLE 1

Population and Incidence of *C. insolita* In different genotypes of pigeonpea.
(Mean of 1991-92 and 1992-93)

Genotype	No. of <i>C. insolita</i> per leaf in field condition		Index value of <i>C. insolita</i> per plant in pot condition
ICPL 2	3.34*	(11.16)	2.67
GAUT 86-10	3.40	(11.56)	2.83
GAUT 87-3	3.42	(11.70)	2.50
GAUT 84-13	3.49	(12.18)	2.83
T 21	3.95	(15.60)	2.83
Sehore 197	4.01	(16.08)	2.17
ICPL 6	4.02	(16.16)	3.17
ICPH 8	4.03	(16.24)	2.83
ICPL 87	4.15	(17.22)	2.17
UPAS 120	4.85	(23.52)	3.33
GAUT 89-17	4.93	(24.30)	2.50
T 15-15	5.11	(26.11)	3.50
BDN 2	5.45	(29.70)	3.17
GAUT 82-104	5.92	(35.05)	3.50
GT 100	6.00	(36.00)	3.83
ICPL 187-14	6.02	(36.24)	3.50
S. Em. ±	0.51		0.27
C. D at 5%	1.43		0.76
C. V. %	27.97		23.85

* $\sqrt{x}$ transformed values.

Figures in parentheses are retransformed values.

None of the genotypes was completely free from mealybug infestation (Table 1 and Fig. 1). However, in field screening, the genotype ICPL 2 was found significantly less susceptible (11.16 mealybugs/leaf) and it was statistically at par with GAUT 86-10, GAUT

87-3, GAUT 84-13, T 21, Sehore 197, ICPL 6, ICPH 8 and ICPL 87. The genotype, ICPL 187-14 was found to be the most susceptible (36.24 mealybug/leaf) and at par with GT 100, GAUT 82-104, BDN 2, T 15-15, GAUT 89-17 and UPAS 120.

Mealybug index/plant

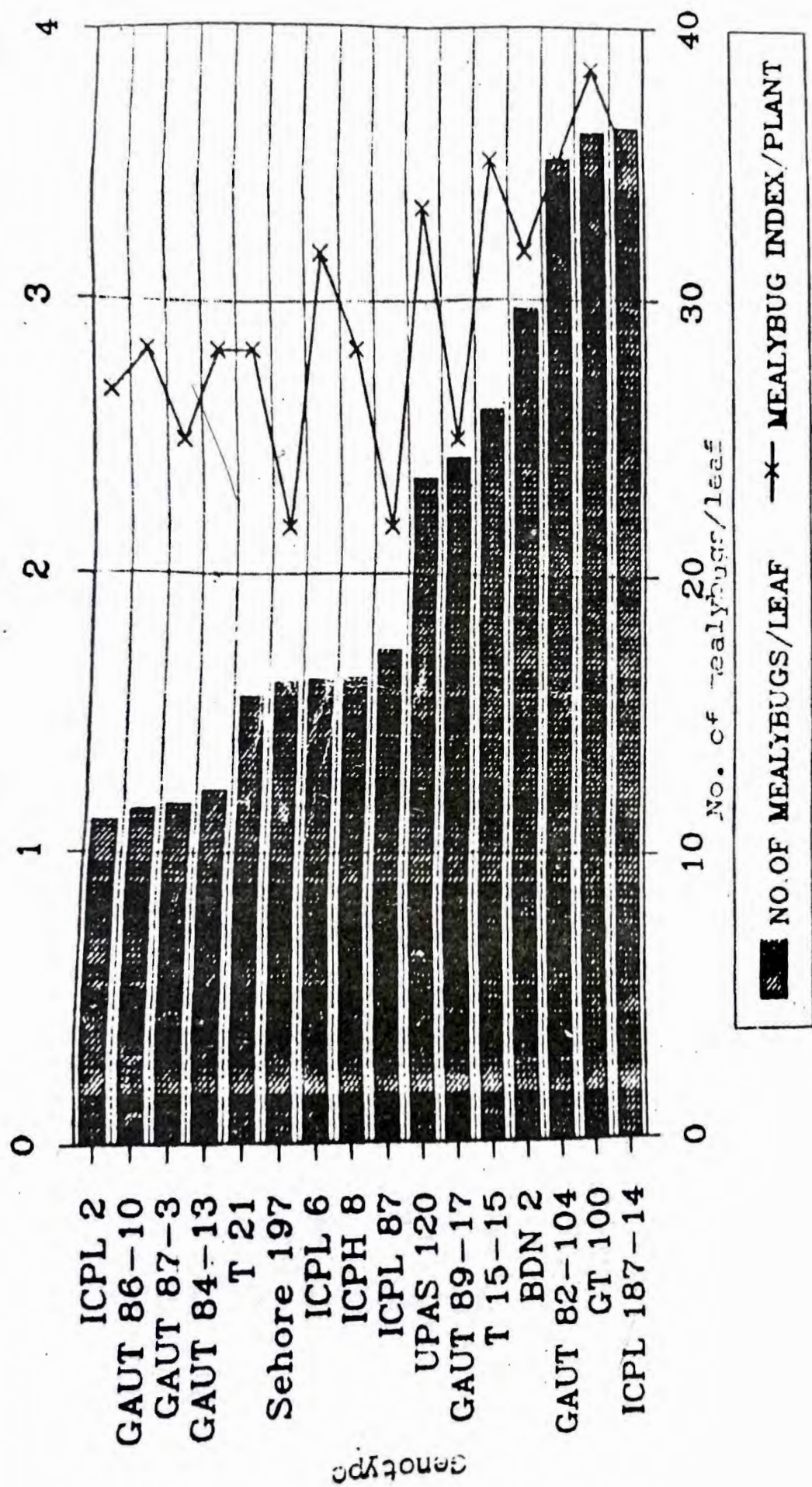


Fig. 1 : Incidence of *C. insolitica* in different genotypes of pigeonpea.

In pot screening, the infestation of the pest ranged from 2.17 to 3.83 mealybugs index values per plant in different genotypes of pigeonpea was recorded (Table 1 and Fig 1). Among these, minimum (2.17) index value was observed in Sehore 197 and ICPL 87. These were at par with GAUT 89-17, GAUT 87-3, ICPL 2, GAUT 86-10, T 21, ICPH 8 and GAUT 84-13. The variety GT 100 was found to be the

most susceptible with 3.83 mealybug index value.

Patel *et al.*, (1991) reported genotype GAUT 85-18 as less susceptible while BDN 2 and GAUT 82-90 as highly susceptible to mealybug infestation.

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REFERENCES

- Patel, J. A.; Yagnik M. S.; Patel, D. J. and Tilva D. G. (1991). An outbreak of mealybug at Pulse Research Station, Baroda, India. *Int. Pigeonpea Newsl.*, 13 : 26.

Evaluation of Botanicals Against Jassid, *Amrasca biguttula biguttula* Ishida Infesting Castor

V. B. Patel and J. R. Patel

Department of Entomology, B. A. College of Agriculture,
Gujarat Agricultural University, Anand-388 110

Use of plant products as insecticides against crop pests is gaining importance in recent years in view of environmental and health hazards posed by synthetic organic insecticides. The present investigation was taken up to evaluate some of the locally and readily available botanical insecticides against jassid, *Amrasca biguttula biguttula* Ishida infesting castor.

An experiment was conducted at Gujarat Agricultural University Campus, Anand during summer, 1991 in Randomised Block Design with three replications using GAU castor Hybrid-1. The plot size was 3.0 x 2.7 m. The row to row and plant to plant distance of 45 and 30 cm was maintained respectively. The seeds were dibbled in the first week of March.

The locally and readily available botanical insecticides (Table 1) were studied in comparison with cartap for their bio-efficacy against jassid. The application of insecticides was started at the 6 weeks age of the castor crop with the appearance of jassid and

continued at an interval of one week till 10 weeks age of the crop. Five sprays were given. Prior to spray application of the respective treatment, from each plot on twenty randomly selected young leaves, only nymphs of jassid were counted and recorded during the study period. The data were subjected to analysis of variance by adopting standard statistical procedure.

The data on bioefficacy of various botanicals against jassid (Table 1) revealed significant superiority of readily available formulations viz., Neemark (0.5%) and Repelin (1%) over all other botanicals and cartap (0.5%) at the 7 weeks age of the castor crop. After second spray at the 8 weeks age Repelin and Neemark while not differing from 5% Neem (*Azadirachta indica* A. Juss) seed kernel Suspension, 3% Neem seed kernel + 2% Lantana (*Lantana camara* L.) leaves suspension, 2% Wellgro and 0.05% cartap were found significantly more effective against jassid than Neem, *Ardusa* (*Alianthus excelsa* Roxb.) and Lantana leaves extract. Among the latter group 5% Neem leaves extract was equally effective as Neem seed kernel suspension, Neem seed kernel suspension + Lantana leaves suspension, Wellgro and cartap.

The effectiveness of Repelin, Neemark, Wellgro, cartap, Neem seed kernel, Neem

TABLE 1

Bio-efficacy of various botanicals and cartap against jassid, *A. biguttula biguttula* Ishida, infesting castor.

Treatment	No. of jassid nymphs per leaf at the age (weeks) of						
	6	7	8	9	10	11	Pooled
5% Neem seed kernel suspension	3.60	2.03	1.72	1.68	1.98	2.13	1.87
5% Neem seed kernel suspension + 2% Lantana leaves suspension	3.65	2.20	1.85	1.93	2.08	2.03	2.02
5% Neem suspension	3.66	3.15	2.08	2.25	2.18	2.18	2.37
5% Ardusa leaves suspension	3.55	3.20	2.76	3.38	3.35	3.70	3.28
5% Lantana leaves suspension	3.83	3.36	2.83	3.71	3.65	3.56	3.44
2% Wellgro	3.30	1.83	1.92	2.05	1.88	1.96	1.93
0.5% Neemark	4.00	1.15	1.52	1.63	1.80	1.71	1.60
1% Repelin	3.70	1.38	1.48	1.60	1.71	1.68	1.57
0.05% Cartap	3.56	1.86	1.71	1.71	1.91	1.65	1.73
Control	3.41	3.56	3.45	3.78	3.71	3.75	3.64
S. Em. ±	0.39	0.08	0.18	0.22	0.20	0.20	0.08
C. D. (P = 0.05)	NS	0.24	0.54	0.65	0.58	0.60	0.23
C.V. (%)	18.60	5.98	14.76	16.00	14.05	14.42	13.07

leaves, Neem seed kernel with Lantana leaves suspension applications at the crop age 9, 10 and 11 weeks was found at par but superior to Ardusa, Lantana and control.

The overall population build up of jassid was significantly lower on castor crop sprayed

with repelin and Neemark as compared other treatments, but they did not differ from cartap which also remained at par with Neem seed kernel and Wellgro, Latter two were at par to a mixture of Neem seed kernel & Lantana leaves. The Neem leaves suspension spray prevented population build up of jassid.

more effectively than suspension of *Ardusa* and *Lantana* leaves which could not prevent jassid infestation effectively.

Thus, the infestation of jassid, *A. biguttula* on young castor crop was prevented very effectively with spray application of plant

origin insecticides Repelin 1% and Neemark 0.5%, Patel and Sojitra (1993) and Khandal *et al.* (1989) have also found effectiveness of Repelin and Neemark against jassid infesting okra and cotton respectively.

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REFERENCES

- Khandal, V. S., Rahalka, S. B. and A. D. Phadke, 1989. Herbal Plant Protection Approach for Pest Control in Cotton. Paper presented at National Seminar on 'Futuristic Approaches in Cotton Improvement' February 24-25, 1989.
- Patel, J. R. and I. P. Sojitra, 1993. Repekin a plant origin insecticide for pest control on okra, *Abelmoschus esculentus* L. paper presented at World Neem Conference, Bangalore, February 24-28, 1993.

Doze and Efficacy Period of Methyl Eugenol to Attract Mango Fruitfly, *Bactrocera dorsalis* Hendel

C. B. Patel, K. G. Patel and S. N. Saravalya

Department of Entomology, N. M. College of Agriculture,
Gujarat Agricultural University, Navsari Campus, Navsari

It is an established fact that the male of mango fruitfly *Bactrocera dorsalis* Hendel is attracted to a chemical methyl eugenol (Hinckley (1964); Steiner *et al.*, (1965), Kawano *et al.* (1968), Chambers *et al.* (1972) and Patel (1973).

To take advantage of this behaviour of the fruitfly, a strategy was proposed to manage this pest by reducing population of males in nature by killing them in large number through methyl eugenol traps. Though the males are attracted to methyl eugenol, the data on the optimum doze of the chemical and period of effectiveness of particular doze are not available. To generate these data, a study was carried out by the Department of Entomology, N. M. College of Agriculture, Gujarat Agricultural University, Navsari Campus, Navsari in the year 1994.

Methyl eugenol trap was prepared by using plastic jar and a couple of funnals, in such a way that the fruit flies can enter in the trap but can not escape from it (figure-1).

Measured quantity of methyl eugenol was dropped on cotton pad in a small petri dish of glass placed inside the plastic jar. The traps were hung under the mango trees with a string, keeping 30 meter distance between one another.

To find out the effective doze of methyl eugenol the chemical was used in four dozes viz.; 0.026 ml (2 drops), 0.042 ml (3 drops), 0.056 ml (4 drops) and 0.070 ml (5 drops). The experiment was conducted in completely randomized design with four replications. Observations for number of fruitflies trapped recorded at an interval of three days till the chemical remained effective to attract male fruitflies. Immediately after recording observations, the living flies were released from the traps, very far (not less than 500 meters) from the experimental area. The data obtained are statistically analysed and presented in Table 1.

After fixing proper doze of methyl eugenol to attract male mango fruitflies it was necessary to test the period for which this dozes remain effective. For the purpose, another experiment laid out in completely randomized design with four replications. Number of fruitflies trapped in each replication was counted at three days interval starting first count on second February '94. Immediately after taking each observation the cage was emptied. The observations were

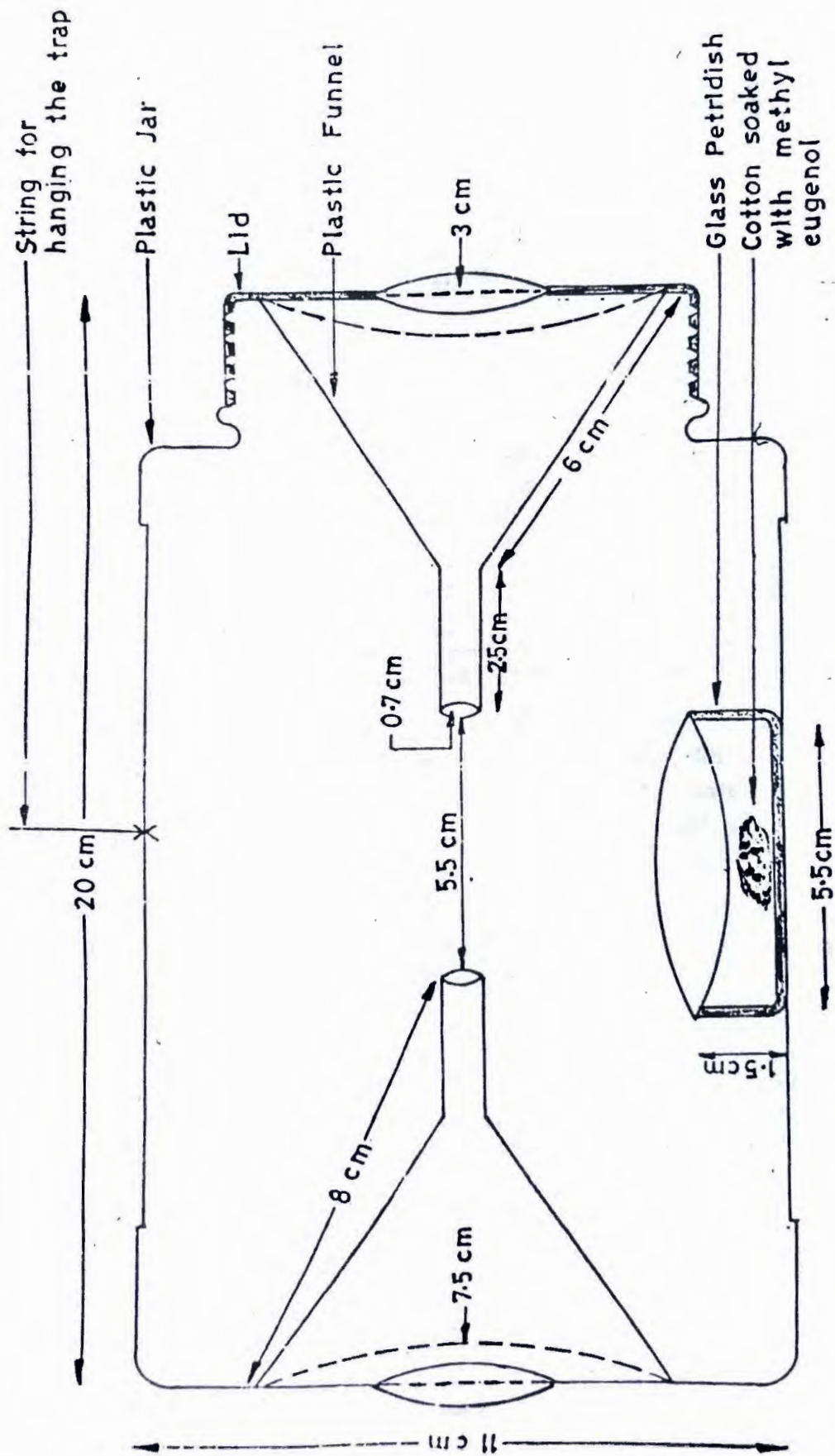


Fig. 1: Methy/eugenol trap.

TABLE 1

Number of fruitflies attracted to different dozes of methyl eugenol.

Sr. No.	Treatment (Quantity of methyl eugenol)	Number of fruitflies attracted in each replication*				Mean
		I	II	III	IV	
1.	0.028 ml (2 drops)	104	43	49	162	89.5 ^{bc}
2.	0.042 ml (3 drops)	49	69	56	163	84.25 ^c
3.	0.056 ml (4 drops)	161	106	182	212	165.25 ^{ab}
4.	0.070 ml (5 drops)	175	188	299	222	221.00 ^a
* Total of 16 observations.						
S. Em. $\pm$						26.23
C. D. at 5% level						80.59
C. V. %						52.46

Note : Figures with same letter (s) in respective column are at par with each other.

continued till no fly could be trapped in any of the experimental traps. Thereafter presence of fruitflies in the area was confirmed after placing trap with fresh methyl eugenol. The data, statistically analysed are presented in Table 2.

From Table 1 it is clear that mean number of fruitflies attracted to doze 0.070 ml (5

drops) was the highest (221) and significantly superior to doses 0.028 ml (2 drops) and 0.042 ml (3 drops) but was at par with the doze 0.056 ml (4 drops). Thus statistically there was no difference between efficacy of the doze 0.056 ml and 0.070 ml. Therefore the doze 0.056 ml per trap should be used to attract mango fruitflies.

TABLE 2

Number of male fruitflies attracted trapped in methyl eugenol trap (doze 0.056 ml) at every three days interval.

Sr. No.	Date of Observation	No. of flies trapped in each replication				Mean
		I	II	III	IV	
1.	2-2-94	2.24 (4.00)	1.72 (2.00)	4.69 (21.00)	7.81 (60.00)	4.12 ^a (21.75)
2.	5-2-94	3.00 (8.00)	2.45 (5.00)	3.00 (8.00)	4.36 (18.00)	4.27 ^a (9.75)
3.	8-2-94	2.24 (4.00)	2.24 (4.00)	5.92 (34.00)	5.92 (34.00)	4.08 ^a (19.00)
4.	11-2-94	2.00 (3.01)	2.83 (7.00)	6.40 (40.00)	5.83 (33.00)	4.27 ^a (20.75)

1.	2.	3.	4.	5.	6.	7. NO. CA
5.	14-2-94	3.00 (8.00)	2.65 (6.00)	2.00 (3.00)	4.47 (19.00)	3.03 ^a (9.00)
6.	17-2-94	3.16 (9.00)	3.00 (8.00)	3.32 (10.00)	2.83 (7.00)	3.08 ^a (8.50)
7.	20-2-94	3.46 (11.00)	3.32 (10.00)	3.61 (12.00)	3.16 (9.00)	3.39 ^a (10.50)
8.	23-2-94	4.24 (17.00)	3.61 (12.00)	4.36 (18.00)	2.45 (5.00)	3.67 ^a (13.00)
9.	26-2-94	3.61 (12.00)	3.00 (8.00)	3.16 (9.00)	2.65 (6.00)	3.11 ^a (8.75)
10.	1-3-94	3.74 (13.00)	3.32 (10.00)	2.65 (6.00)	2.00 (3.00)	2.93 ^a (8.00)
11.	4-3-94	4.12 (16.00)	5.00 (24.00)	2.45 (5.00)	2.45 (5.00)	3.51 ^a (12.5)
12.	7-3-94	6.32 (39.00)	3.16 (9.00)	2.24 (4.00)	2.24 (4.00)	3.49 ^a (14.00)
13.	10-3-94	3.16 (9.00)	3.00 (8.00)	2.65 (6.00)	2.00 (3.00)	2.70 ^a (6.5)
14.	13-3-94	2.00 (3.00)	2.00 (3.00)	2.65 (6.90)	2.65 (6.00)	2.33 ^b (5.25)
15.	16-3-94	2.45 (5.00)	1.41 (1.00)	1.00 (1.00)	1.00 (0.00)	1.47 ^b (1.5)
16.	19-3-94	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 ^b (0.00)
S. Em. ±						0.64
C.. D. at 5% level						1.81
C. V. %						41.83

Note : 1. Figure outside the parenthesis are $\sqrt{x+1}$ value while figures inside the parenthesis are original value.

2. Figures with same letter (s) in respective column are at par with each other.

From Table 2 it can be seen that there was no significant difference in number of fruitflies trapped in all the 13 observations up to 39 days. Thereafter, number of flies trapped was significantly reduced suddenly and the

number reached to zero in all the replications on 16th observation after 48 days of placing the traps. This showed that the doze of 0.056 ml (four drops) remained effective to attract male mango fruitflies up to 39 days.

From these two experiments, it can be concluded that the optimum dose of methyl eugenol required per trap to attract mango fruitfly, *B. dorsalis* is 0.056 ml (four drops)

which remained effective up to 39 days in the months of February - March in South Gujarat conditions.

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REFERENCES

- Chambers, D. L.; Dhinata, K.; Fujimoto, M. and Kashjiwai, S. (1972). Treating tephritids with attractants to enhance their effectiveness in sterile release programme. *J. Econ. Ent.*, **65** (1) : 279-282.
- Hinckley, A. D.; (1964). Fruitfly trapping in Fiji. *J. Econ. Ent.*, **57** (2) : 297.
- Kawano, Y., Mitchell, W. C. and Metsumoto, H. (1968). Identification of the male oriental fruitfly attractant in the golden shower blossom. *J. Econ. Ent.*, **61** (4) : 986-988.
- Patel, R. C. (1973). Studies on control of mango fruitfly, *Dacus correctus bezzii* (Tephritidae : Diptera) with use of insecticidal baits impregnated with chemical sex attractant. A thesis submitted to, Gujarat Agricultural University for the degree of M.Sc. (Agri.) in Entomology.
- Steiner, L. F.; Mitchell, W. C.; Harris, E. J.; Kozuma, T. T. and Fujimate, M. S. (1965). Oriental fruitfly eradication by male annihilation *J. Econ. Ent.*, **58** (5) : 961-964.

Ovicidal Property of Some Indigenous Plant Extracts Against *Spodoptera litura* Fab.*

V. B. Patel and J. R. Patel

Department of Entomology, Gujarat Agricultural
University, Anand Campus, Anand-388 110

Castor, *Ricinus communis* L. being grown extensively under rainfed condition. Of the various pests infesting castor, *Spodoptera litura* Fab. and *Achaea janata* L. are important insect pests. Chemical insecticides are often

recommended to combat the infestation of these two pests. The use of such chemicals is not only uneconomical but leads to many hazards. Botanicals under such circumstances can be the best solution to above problems along with the encouragement of their egg parasites. The ovicidal property of botanicals have been reported by Patil (1989) and Rao *et al.* (1990) from Maharashtra and A. P. respectively but no information on local plant materials from Gujarat is available. Keeping all these points in mind, study was carried out on the bio-efficacy of locally available plant materials against the eggs of *S. litura*.

TABLE 1

Ovicidal effects of various botanical materials (5%) on eggs of *S. litura*.

Plants	Egg mortality (%)	
Karen (<i>Nerium indicum</i> Mill) leaf (Y)	38.53*	(38.30)
Matsyagandhati (<i>Gynandropsis pentaphylla</i> L.) leaf	35.25	(33.31)
Lilly (<i>Zephyranthus</i> spp.) bulb	24.08	(16.16)
Lilly leaf	17.99	(9.54)
Kadva giloda (<i>Coccinia indica</i> W. & A.) fruit	17.51	(9.05)
Kadva giloda leaf	15.11	(6.79)
Bitter gourd (<i>Momordica balsamina</i> L.) leaf	13.17	(5.19)
Karanj (<i>Pongamia glabra</i> Vent.) kernel	11.22	(3.79)
Mahuda (<i>Mahudha longifolia</i> L.) seed	11.22	(3.79)
Akda (<i>Calotropis gigantea</i> R. Br.) leaf	11.22	(3.79)
Piludi (<i>Solanum nigrum</i> L.) leaf	8.81	(2.34)

*Part of M.Sc. (Agri.) thesis submitted by the

1.	2.
S. Em. $\pm$	3.06
C. D. (P=0.05)	8.99
C. V %	28.95
Plants	Egg mortality (%)
Ardusa (<i>Alanthus excelsa</i> Roxb.) leaf	48.18* (55.54)
Neem (<i>Azadirachta indica</i> A. Juss) kernel	28.11 (22.20)
Neem leaf	26.77 (20.29)
Damra (<i>Ocimum basillicum</i> L.) leaf	19.46 (11.10)
Karen leaf (P)	8.82 (2.35)
Fudina (<i>Mentha piperata</i> L.) leaf	8.82 (2.35)
Ardusi (<i>Adhatoda vasica</i> Nees.) leaf	8.82 (2.35)
Eucalyptus (<i>Eucalyptus globulus</i> Labill) leaf	6.42 (1.25)
Tulsi (<i>Ocimum sanctum</i> L.) leaf	6.42 (1.25)
Lantana (<i>Lantana camara</i> L.) leaf	6.42 (1.25)
S. Em. $\pm$	1.43
C. D. (P=0.05)	4.20
C. V. %	15.61

*Arcsin/percentage.

Figures in parentheses are retransformed values.

To evaluate the ovicidal property of various plant materials (Table 1) against the eggs of castor leaf eating caterpillar, *Spodoptera litura*, laboratory experiments were conducted at Gujarat Agricultural University, Campus Anand during 1989-90 and 1990-91. Twenty four to thirty six hours old eggs were transferred with utmost care on the glass slide measuring 7.5 cm x 2.5 cm with the help of fine camel hair brush. The spray suspension at 5 or 3+2 per cent concentration of each plant material was applied with the help of Potter's tower at a constant air pressure of

22.5 kg/cm². Water spray was given in the control treatment. The glass slides were thoroughly dried under ceiling fan for 10 minutes and placed in a glass petridish containing tender castor leaf having water dipped cotton wool around petiole to prevent the damage by freshly emerged larvae to unhatched treated eggs.

The eggs were observed everyday under binocular stereoscopic microscope and the larvae half way out at the egg shell were considered as hatched. Observations on egg hatching for each

TABLE 2

Ovicidal effect of various combinations of botanical materials (3+2) on eggs of *S. litura*.

Plants	Egg mortality (%)	
Karen (Y) + Matsyagandhati leaf	39.96*	(41.24)
Ardusa leaf + Neem Leaf	39.80	(40.97)
Ardusa leaf + Fudina leaf	36.57	(35.49)
Ardusa leaf + Matsyagandhati leaf	33.28	(30.11)
Ardusa leaf + Lantana leaf	33.22	(30.01)
Ardusa leaf + Neem kernel	28.44	(22.68)
Ardusa leaf + Damra leaf	24.77	(17.55)
Ardusa leaf + Karen leaf (Y)	19.05	(10.65)
S. Em. $\pm$	2.54	
C. D. (P=0.05)	7.43	
C. V. (%)	13.83	

*Arcsin / percentage

Figures in parentheses are retransformed values.

treatment were recorded for 10 days. Eggs which did not hatch over in this period were considered to be toxified i.e. dead. The

percentage mortality of eggs was worked out by using following modified Abbott's formula (Abbott, 1925).

TABLE 3

Ovicidal effect of various combinations of botanical materials (3+2) on eggs of *S. litura*.

Plants	Egg mortality (%)	Plants	Egg mortality (%)	
Matsyagandhati leaf + Karen leaf (Y)	35.25* (33.31)	Fudina leaf + Lantana leaf	34.90	(32.73)
Lilly bulb + Karen leaf (Y)	26.77 (20.29)	Lantana leaf + Damra leaf	19.69	(11.35)
Lilly bulb + Matsyagandhati leaf	17.51 (9.05)	Fudina leaf + Karen leaf (P)	10.63	(3.40)
Karen leaf (Y) + Piludi leaf	13.17 (5.19)	Fudina leaf + Damra leaf	8.13	(1.20)
Matsyagandhati leaf	11.22 (3.79)			
Piludi leaf				
S. Em. $\pm$	2.26		2.90	
C. D. (P = 0.05)	7.13		9.14	
C. V. %	18.86		31.74	

*Arcsin / percentage.

Figures in parenthesis are retransformed values.

$$\text{Percentage mortality} = 1 - \frac{\text{Ta} \times \text{Cb}}{\text{Tb} \times \text{Ca}} \times 100$$

where,

Ta = Nos. in treatment after application

Tb = Nos. in treatment before application

Ca = Nos. in check after application

Cb = Nos. in check before application

The data recorded on egg hatching were compiled and statistically analysed by adopting standard statistical procedure on computer.

Among the various botanicals studied for their ovicidal properties against the eggs of *S. litura* the 5% leaves extract suspension of yellow flower karen (*Nerium indicum* Mill), matsyagandhati (*Gynandropsis pentaphyllia* L.) and ardusa (*Alianthus excelsa* Roxb.) showed

good ovicidal properties. Ardusa leaves showed higher ovicidal effect than neem (*Azadirachta indica* A. Juss) seed kernels and neem leaves.

Among the various combinations the leaves extract mixtures of yellow flower karen (3%) with matsyagandhati (2%), ardusa (3%) with neem (2%) as well as fudina (*Mentha piperata* L. 2%) and fudina (3%) with lantana (*Lantana camara* L. 2%) gave higher egg mortality of *S. litura* (Table 2). However, except a mixtures of fudina (3%) with lantana (2%) and karan (3%) with matsyagandhati (2%) none of the mixture could showed thier additive ovicidal property against the eggs of *S. litura*.

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REFERENCES

- Abott, W. S. 1925. A method of computing the effectiveness of an insecticide *J. Econ. Ent.*, 18 : 265-267.
- Patil, A. P. 1989. Mortality and ovicidal property of *Parthanium hysterophorus* and *Acorus calamus* on *Spodoptera litura*. *Environ. Ecol.*, 7 (3) : 763-766.
- Rao, R. G., Raghavaiah, G, and Nagalingam, B. 1990. Effect of botanicals on certain behavioural responses and on the growth inhibition of tobacco caterpillar, *Spodoptera litura* F. Paper presented at National Symposium on "Problems and Prospects of Botanical Pesticides in Integrated Pest Management", CTRL, Rajahmundry (A.P.), January, 12-13.

**Parasitism of the Sugarcane
Mealybug, *Saccharicoccus sacchari*
(Cockerell) in Relation to the
Weather Parameters**

G. J. Parsana*, P. G. Butani, M. N. Kapadia

Department of Entomology, College of Agriculture,
Gujarat Agricultural University, Junagadh-362 001

The pink mealybug, *Saccharicoccus sacchari* (Cockerell), a serious pest of sugarcane was found parasitized by five parasitoids of which *Anagyrus punctulatus* Agrawal (Encyrtidae : Hymenoptera) was the most dominant, checking the pest throughout the crop season under Junagadh conditions (Gujarat). Mass rearing technique of this parasitoid has been developed. Information regarding the influence of abiotic factors on the parasitoid activity against this pest, is not available except a report of Barro (1990) on *A. Saccharicola* in Australia and therefore, the present investigation for determining the parasitism, the mature mealybugs were collected fortnightly from the unsprayed cane field grown at the Departmental Farm, College of Agriculture, Junagadh for three consecutive year, i.e. 1991-1993.

The collected mealybugs were pasted on the papercard (17 x 3 cm) and kept in the glasstube (20 x 4 cm) under laboratory conditions up to 20 days. The observations were recorded on parasitoids emerged and the parasitized mealybugs. The percentage parasitism was calculated on the basis of total number of mealybugs observed and the number of parasitized mealybugs. The data on the weather factors (Table 2) were obtained from the Meteorological Station, Gujarat Agricultural University, Junagadh. The simple correlation of the parasitism and weather parameters were statistically analysed.

The data (Table 1) revealed that the percentage parasitism of mealybug varied from 10-20 to 53-00 during different months of the years, 1991-1993. The highest parasitism (53.00%) was recorded in July 1992, followed by 52.40 per cent in July, 1991.

The parasitism observed was the least during the months of November and December where the temperature ranged between 21 and 24°C, humidity between 69 and 72 and no precipitation. It seemed to be affected

*Present address : Assistant Research Scientist (Entomology), Department of Entomology, College of Agriculture, Gujarat Agricultural University, Junagadh.

TABLE 1

Percentage parasitism of sugarcane mealybug and weather parameters during different months of the years, 1991-93.

Month	Parasitism (%)			Weather parameters				
	1991	1992	1993	Ave.	Temperature rature (°C)	Relative humidity (%)	Rain- fall (m)	Rainy day
January	28.22	17.60	30.00	25.27	20.28	65.00	—	—
February	28.80	19.00	36.00	27.93	22.55	63.66	—	—
March	30.00	23.00	33.33	28.44	26.78	60.66	—	—
April	24.00	31.00	27.00	27.33	29.71	72.66	—	—
May	39.43	42.00	28.00	36.47	32.10	80.33	—	—
June	47.00	51.00	48.00	48.66	31.51	87.00	70.50	5.00
July	52.40	53.00	46.00	50.46	28.58	89.00	285.10	13.33
August	42.00	45.00	33.00	40.00	27.91	92.00	93.50	12.66
September	30.67	38.00	26.40	31.69	27.86	88.00	119.30	5.66
October	31.67	35.00	31.33	32.66	27.88	76.33	89.53	3.00
November	10.20	24.00	18.00	17.40	24.39	69.33	1.00	1.00
December	26.00	21.00	19.00	20.00	21.25	72.66	—	—

TABLE 2

Correlation coefficients between weather parameters and parasitism of sugarcane mealybug.

Weather parameters	Parasitism (%)*
Temperature (°C)	0.680
Relative humidity (%)	0.715
Rainfall (mm)	0.722
Rainy day	0.726

*Significant at 5%.

with rise in all parameters. During June and July high temperature 30-31° C, high rainfall, 285 mm and greater number of rainy days (13) leading higher humidities (89 per cent) caused maximum parasitism of the extent of 49 to 53 per cent. High humidity, thus, appeared to be most crucial. This is correlated with high coefficient of correlation (Table 2) worked out. The results are also in confirmity of those of

Barro (1990) who had reported abundance of *A. saccharicola* with rainfall.

The study suggested that the activity of *A. punctulatus* can be accelerated by releasing the supplement amount of parasitoid adults during monsoon i.e. of June to August to suppress the pest in the subsequent period.

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REFERENCE

- Barro, P. J. 1990. Natural enemies and other species associated with *Saccharicoccus sacchari* (Cockerell) (Hemiptera : Pseudococcidae) in the Bundberga area, Southeast Queensland. *J. Aust. Ent., Soc.*, 29 : 87-88.

Growth of three Isolates of *Botryodiplodia Theobromae* in Relation to Carbon, Nitrogen Sources and C/N Ratio

**A. M. Parakhia, Smt. Jungu Andharia and
M. U. Vaishnav**

Department of Plant Pathology, College of Agriculture,
Gujarat Agricultural University, Junagadh

Fungi differ in their ability in utilizing various carbon and nitrogen compounds for the growth and sporulation. Carbon occupies an unique position among the essential elements required by living organisms. The studies of Lilly and Barnett (1951) and Steinberg (1950) have clearly established that the fungi differ in their ability to utilize carbon and nitrogen sources. *Botryodiplodia theobromae* is an important pathogen causing considerable damage to different parts of the economic crop plants (Luke, 1982, Maholay and Sohi, 1986, Parakhia *et al.*, 1984. Shillingford, 1977, Vyas and Singh, 1977). To find out the nutritional requirements of three isolates in utilizing the different carbon, nitrogen sources and its optimum ratio, the fungal isolates causing fruit rot of Indian almond (A), dieback in mango (B), drying of roots of coconut (C) were isolated and maintained on PDA. Richard's medium was used as basal medium. From the basal

medium, sucrose and potassium nitrate were replaced by different carbon and nitrogen sources. Their quantities were determined on the basis of their molecular formula so as to supply an equivalent amount of carbon and nitrogen as was present in 50 g of sucrose and 10 g of potassium nitrate respectively per litre in the Richard's medium. The polysaccharides were added at the rate of 50 g per litre of medium. In order to determine best carbon nitrogen ratio. Richard's medium was supplemented with 2.5, 5.0, 7.5, 10.0, 12.5, 15.0 g of potassium nitrate per litre which supplied 0.3968, 0.693, 1.809, 1.385 and 1.732 and 2.079 of nitrogen respectively and 12.5, 25.0, 37.5, 50.0, 62.5 and 75 g sucrose per litre which supplied 5.25, 10.52, 15.77, 21.09, 26.29 and 31.57 carbon respectively. All the possible combinations of carbon and nitrogen were taken. The pH of the medium was adjusted to 6.0 before autoclaving.

Fifty ml medium was dispensed in each of the 250 ml corning flasks and then autoclaved at 0.69 kg/cm² pressure for 20 minutes. Each flask was inoculated with a single disc of 4 mm diameter obtained from 7 days old culture grown on PDA. Flasks were incubated at 28 ± 2° C. The mycelial mate (15 days old) were filtered by using Whatsmen filter paper No. 42, washed with

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TABLE 1

Effect of various sources of carbon on growth and sporulation of three isolates of *Botryodiplodia theobromae*.

Sr. No.	Name of carbon source	Isolates		
		Almond (A)	Mango (B)	Coconut (C)
1.	D. Glucose	260	438	318
2.	Galactose	443	618	566
3.	Sucrose	1485	1550	1471
4.	Maltose	479	628	509
5.	Lactose	408	458	233
6.	Fructose	414	446	397
7.	Starch	364	523	380
8.	Mannitol	666	586	426
9.	Control	90	65	71
	C. D. at 5%	95.4	82.4	102
	C. V. %	10.8	8	12.2

like warm sterilized distilled water and dried at 62° C until it attained the constant weight. Colony character, pigmentation and sporulation were recorded.

It is evident from Table 1 that all the three isolates of the pathogen utilized a variety of compounds as a source of carbon. Sucrose proved to be the best source for the growth of all the isolates followed by maltose for isolate B and galactose for isolate C and mannitol for isolate A. Remaining carbon sources supported good growth of isolate A being the least on D glucose. The growth of isolate A and B was good on galactose and mannitol. Remaining carbon sources supported moderate growth of isolate B., the least being on lactose. Good growth of isolate C was observed on maltose and mannitol

being the least on lactose. These results are in agreement with the results obtained by Shreemala, 1973.

No sporulation was observed in isolate A and B on any of the carbon sources tested but scanty sporulation was observed in case of isolate C on all the carbon sources. This supports the report of Shreemala 1973 while working on six different isolates of *B. theobromae* reported that some of the isolates of *B. theobromae* did not sporulate on medium having different carbon sources.

On perusal of Table 2, all the isolates of the fungus under study vary in utilizing the different nitrogen sources. Isolate A grew well where the ammonium molybdate was used

while the growth of isolate B and C was medium on calcium nitrate and magnesium nitrate respectively. Second best source was calcium nitrate for isolate A and C and ammonium dihydrogen orthophosphate for isolate B. The least growth of isolate A and C was observed on sodium nitrate and isolate B grew least on ammonium oxalate.

Results of carbon nitrogen ratio shows that the growth of all the isolate increased proportionately as concentrations of carbon in

the medium increased up to 26.29 g/l. Higher quantity of carbon inhibited the growth of all the isolates i.e. (31.57 g/l carbon). Increase in nitrogen also improved growth in some cases while in some cases the growth was declined. Highest growth of isolate A and B was observed at C_5N_5 C/N ratio while isolate C grew at C_5N_3 ratio. Sporulation was only observed in case of isolate C which was isolated from coconut in all the combinations of carbon and nitrogen.

TABLE 2

Effect of various sources of nitrogen on growth and sporulation of three isolates of *Botryodiplodia theobromae*.

Sr. No.	Name of nitrogen source	Isolates		
		Almond (A)	Mango (B)	Coconut (C)
1.	Potassium nitrate	387	539	466***
2.	Magnesium nitrate	484	579	614
3.	Ammonium chloride	351	355	372
4.	Ammonium sulphate	467	592	335
5.	Ammonium nitrate	469	472	382
6.	Ammonium dihydrogen Orthophosphate	402	615	469
7.	Ammonium oxalate	485	95	224
8.	Sodium nitrate	465	579	431**
9.	Calcium nitrate	627	618	598*
10.	Sodium nitrate	49	311	208
11.	Urea	485	581	346**
12.	Ammonium molybdate	792	493	575
13.	Control	000	000	000
	C.V. at 0.05%	116	126	93
	C. V. %	16.3	16.7	14.3

*Sporulation observed.

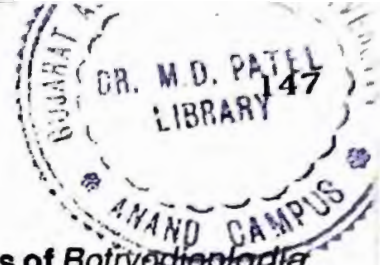


TABLE 3

Effect of different C/N ratio on growth and sporulation of three of isolates of *Botryodiplodia theobromae*.

Carbon Level	Isolate	Nitrogen					
		N1	N2	N3	N4	N5	M6
C1	A	141	346	210	271	253	300
	B	233	296	260	341	196	386
	C	78	310	160	253	183	213
C2	A	263	256	260	311	355	326
	B	276	370	343	455	385	516
	C	150	360	413	310	356	373
C3	A	390	286	396	406	423	378
	B	436	396	460	601	583	616
	C	473	463	530	343	396	403
C4	A	430	503	533	435	406	360
	B	426	413	573	706	680	693
	C	453	423	500	410	410	413
C5	A	573	536	493	472	623	535
	B	633	760	726	686	985	915
	C	590	506	726	453	541	486
C6	A	480	446	735	578	618	620
	B	483	470	623	833	698	953
	C	600	533	615	503	600	580
C. D at 0.05% N		A		B		C	
		35		67		NS	
	C	35		67		72	
	NC	85		165		172	

A = Indian Almond

B = Mango

C = Coconut

Looking to the nutritional requirements of the isolates and the capacity to use different carbon and nitrogen sources for the growth and sporulation, it seems that isolates A, B and C of *B. theobromae* do not differ in their ability to use carbon sources while all the isolates are differed in utilizing the nitrogen sources for their growth. They are also

different as far as the quantity of nitrogen source in C/N ratio is concern. They are definitely different as far as the ability of sporulation concern. Isolate A and B did not sporulate on medium having any sources or quantity of nitrogen or carbon.

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REFERENCES

- Lilly, V. B. and H. L. Barnett, (1951). Physiology of fungi. McGraw Hill Book Co. Inc., New York, pp. 464.
- Luke, P. B. (1982). A new record of *Botryodiplodia theobromae* Pat. on *Morus alba* (on mulberry) *Curr. Sci.*, 51 (8) : 427.
- Maholay, M. M. and Sohi, H. S. (1986). Studies on *Botryodiplodia* rot of *Delichos biflorus*. *Indian J. Mycol. and Pl. Path.* 16 (2) : 126-129.
- Parakhia, A. M., M. U. Vaishnav and J. P. Bhatt (1984). A new fruit rot of Indian almond. *India Phytopath.*, 37 (3) : 583.
- Shillingford, C. A. (1977). Control of banana fruit rots and fungi that contaminate washing water. *Tropical Science* 19 (4) : 322.
- Shreemala, J. L. (1973). The effect of carbon and nitrogen sources on growth and sporulation of six different isolates of *Botryodiplodia theobromae*. *Indian Phytopath* 26 (2) : 220-228.
- Steinberg, R. A. (1950). Growth of fungi in synthetic nutrient solution II *Bot. Rev.* 16 : 208-228.
- Vyas, S. C. and D. Singh (1977). Control of storage diseases of apple fruits with fungicides. *Pesticides*, 11 (8) : 44.

The Improvement of Germination and Seedling Growth of *Acacia nilotica* (Linn.) Wild. by Scarification Methods*

V. S. Patel, M. U. Kukadia, B. G. Vashi and
D. B. Jadeja

Department of Forestry, Aspee College of Horticulture &
Forestry, Gujarat Agricultural University,
Navsari-396 450 (Gujarat)

Acacia nilotica (Linn.) is an important wild tree legume which combines the best utility wood where, hardness and toughness required. The wood is an excellent fuel. Leaves and twigs are good fodder for animal (Troup, 1975). Seed dormancy of *Acacia nilotica* is imposed by the hard impermeable seed coat and hence seeds record poor germination. Softening of the seed coat by various methods will improve the germination percentage of seeds (Pandya, 1989). This paper deals with the method of breaking dormancy by scarification i.e. acid treatment (Conc. H_2SO_4), hot water ($60^\circ C$) treatment and plant growth regulator (Gibberellic acid) treatment.

The experiment was carried out at the nursery area of Instructional farm of Aspee College of Horticulture and Forestry, Gujarat Agricultural University, Navsari during the year 1994-95.

The fresh ripe pods were collected during first week of June from horticulture farm of the campus. The seeds from pods were extracted. The healthy seeds were sorted for uniformity of size and shape. The immature infested and damaged seeds were rejected.

Seeds were given following treatments :

- (1) T_1 – soaking in conc. H_2SO_4 for 5 minute.
- (2) T_2 – soaking in conc. H_2SO_4 for 10 minute.
(seed were immersed in sufficient quantity of acid and constantly stirred for 5 and 10 minutes treatment. At the end of treatment the seeds were immediately washed thoroughly in running water to remove the acid).
- (3) T_3 – soaking in hot water for 60 minutes.
- (4) T_4 – soaking in hot water for 80 minutes (water was boiled in vessel and $60^\circ C$ temperature of water was maintained and then seeds were put in boiled water).
- (5) T_5 – GA 100 ppm for 16 hrs.
- (6) T_6 – GA 300 ppm for 16 hrs.
- (7) T_7 – control (with any treatment).

*Part of M.Sc. (Forestry) thesis submitted by senior author to Gujarat Agricultural University, S. K. Nagar.

TABLE 1
Effect of presowing treatments on germination and seedling growth of *Acacia nilotica* (Linn.) wild.

Treatment details	Comment- days for germination (dates)	Germina- tion per centage (%)	Plant he- light (cm)	No. of leaves	Collar diameter (cm)	Fresh weight (g)	Dry weight (g)
T 1 - conc. H_2SO_4 for 5 minutes	6.33	56.36 (74.00)*	31.42	22.16	0.29	13.77	3.74
T 2 - conc. H_2SO_4 for 10 minutes	6.00	64.96 (82.00)	34.24	25.86	0.32	15.13	3.94
T 3 - Hot water (60°) for 60 minutes	9.00	51.15 (60.66)	27.40	20.56	0.26	12.73	3.61
T 4 - Hot water (60°) for 80 minutes	8.66	54.33 (66.00)	30.38	23.45	0.28	13.72	3.77
T 5 - GA 100 ppm for 16 hrs.	14.66	44.98 (50.00)	25.55	20.60	0.26	11.24	3.18
T 6 - GA 300 ppm for 16 hrs.	12.00	42.68 (46.00)	28.39	19.60	0.26	11.93	3.31
T 7 - Control	15.33	27.89 (22.00) [†]	20.42	18.33	0.24	9.33	2.96
S. Em. ±	0.53	1.22	0.32	0.22	0.007	0.27	0.05
C. D. at 5 %	1.48	3.45	0.91	0.61	0.020	0.67	0.14
C. V. %	5.12	5.14	3.40	3.58	4.38	5.55	4.91

* Figures in paranthesis are retransformed values.

Fifty seeds were treated with each of seven treatments and were replicated thrice in the randomized - block design with factorial experiment. Number of seeds germinated on each day and commencement of germination were recorded. Growth parameters like plant height, collar diameter, no. of leaves and fresh and dry weight of seedlings were recorded after 10 weeks of seedlings emergence.

scarified with conc. H_2SO_4 for 15 minutes gave maximum germination percentage against control.

Subsequent seedling growth study in *Acacia nilotica* showed that conc. H_2SO_4 treatment enhanced plant height, number of leaves, collar diameter and fresh and dry weight production in seedlings. The present findings are in conformity with the findings of Ghosh and Sen (1989) who reported that Ber seeds (*Zizyphus mauritiana*) scarified with conc. H_2SO_4 treatment increased seedling height, leaf number and basal girth over control. Fresh and dry weight of seedling significantly increased in conc. H_2SO_4 for 10 minutes treatment. Obviously, the seeds which commenced germinating earlier also gave more fresh and dry weight of seedlings.

On the basis of investigation, it could be concluded that treatment T_2 gave quicker as well as better germination percentage and produced better subsequent growth of Babul seedlings and can be adopted for raising seedlings in nursery.

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REFERENCES

- Ghosh, S. N. and Sen, S. K. (1988). Effect of seed treatment on germination, seedling growth and longevity of *Zizyphus mauritiana* seeds, *South Ind. Hort.*, 36 (5) : 260-261.
- Pandya, S. (1989). Improving forest production through quality seeds, *J. Trop. For.*, 5 (11) : 251-255.
- Pathak, P. S. and Debroy R. (1980). Studies on seed polymorphism, germination and seedling growth of *Acacia tortilis* Hyne. *Indian J. For.*, 3 (1) : 64-67.
- Sehgal, R. N. and Singh B. (1990). Effect of pre-treatment of seed germination of *Pistacia integerrima*, *Indian J. For.*, 13 (1) : 57-60.
- Troup, R. S. (1975). The silviculture of Indian trees, FRI publication, Dehra Dun, Vol. II.

Enhancement of Nutritional Value of *Prosopis juliflora* Pods Through Urea Supplementation

P. M. Talpada, D. C. Patel, H. B. Desai and
M. C. Desai

Animal Nutrition Department, Gujarat Agricultural
University, Anand Campus, Anand-388 110

Feeding of huge bovine population during recurrent drought periods, poses major problems besides availability of drinking water. The deficiency of feeds and fodders is already existing in our country (NCA, 1976). Gujarat State Forest Department has planted *Prosopis juliflora* trees in 44,380 ha of land as afforestation in the states desert region (Talpada, 1985). These tree grow over a wide range of soil conditions, saline, desert, coastal etc. and flourish where other plants normally do not grow. *Prosopis juliflora* trees bear pods which have 12-14% c. protein and 20-30% sucrose (Figueirido, 1975 and Talpada, 1985). These pods provide 7.02% DCP and 75.20% TDN on dry matter basis (Talpada *et al.* 1979). These pods are available to the tune of 0.2 million tonnes in Gujarat State alone and still more in the country (Talpada and Shukla, 1987). *Prosopis juliflora* pods are good sources of energy. Supplementation of *Prosopis juliflora* pods with urea would form an

alternate feed resource for feeding animals during scarcity periods. Hence, an experiment was planned to determine the nutritive value of *Prosopis juliflora* pods with urea.

Six cross bred (Jersey x Kankrej F_1) bullocks were fed a daily ration consisting of 6 kg ground *Prosopis juliflora* pods mixed with 60 g urea, 30 g mineral mixture, 50 g salt and 4 kg mature pasture grass. The pods of *Prosopis juliflora* were procured in bulk from Forest Development Corporation, Vadodara and were ground to break the seed including seed coat.

The metabolism trials for calculation of digestibility coefficients of proximate nutrients of 1% urea supplemented *Prosopis juliflora* pods were conducted and the same were calculated by different method.

The digestibility of basal roughage (mature pasture grass) was also determined on the same set of animals. The preliminary period was of 21 days followed by 7 days collection period. The samples of feeds, feces and urine were collected and analysed (AOAC, 1975).

The proximate composition of feeds and fodders used for feeding of animals is given in Table 1.

TABLE 1

Chemical composition of experimental feeds (% on DM basis).

Feeds Constituents	Ground <i>Prosopis</i> <i>juliflora</i> pods	Ground <i>Prosopis</i> <i>juliflora</i> pods with 1% urea	Mature pasture grass	Mineral mixture
C. Protein	11.99	14.64	2.41	—
E. Extract	3.47	3.77	1.84	—
C. fibre	19.42	16.62	38.55	—
Nitrogen free extract	58.90	56.89	47.39	—
Ash	6.22	8.08	9.81	89.72
Silica	0.59	0.90	7.01	4.48
Phosphorus	0.20	0.50	0.02	13.90
Calcium	0.61	0.68	0.37	24.06

Ground *Prosopis juliflora* pods contained about 12% C. Protein and it was increased to 14.64 % due to 1% urea supplementation. The pods were having fair amount of calcium.

The average daily dry matter intake was 1.33 kg/100 kg body weight and 95.30 g/kg $W^{0.75}$. The bullocks consumed daily 5.64 kg dry matter from *Prosopis juliflora* pods. These data indicate that these pods

TABLE 2

Digestibility coefficients (%) and digestible nutrients of urea supplemented *Prosopis juliflora* pods.

Nutrients Animal No.	C. Protein	E. Extract	C. fibre	Nitrogen free extract	Organic matter
1	62.03	66.97	24.02	83.71	64.95
2	55.16	62.38	18.87	83.75	63.11
3	66.22	48.61	27.92	84.10	67.17
4	59.52	58.78	24.21	82.28	59.86
5	59.71	32.66	16.57	84.79	66.04
6	63.20	46.98	17.26	83.60	63.19
Av.	60.98	52.73	21.46	83.71	64.05
	± 1.54	± 5.11	± 1.87	± 0.34	± 1.06
Digestible nutrients (%)	DCP		TDN		
	8.93		64.59		

were quite palatable. These results are in line with those reported by Talpada (1985).

The digestibility coefficients are given in Table 2 along with digestible nutrients.

TABLE 3

Average* balances of nitrogen, phosphorus and calcium (g/day/animal) of whole ration.

Particulars	Nitrogen	Phosphorus	Calcium
Total intake	149.18	52.60	29.00
Voided in feces	64.90	50.30	22.19
Voided in urine	52.66	2.02	0.28
Total voided	117.56	52.32	22.47
Balance	+31.62 ± 3.49	+ 0.28 ± 1.51	+ 6.53 ± 2.71

* Average of six animals.

The digestibility coefficient of C. fibre was found to be low while that of nitrogen free extract was high. The digestibility of organic matter and C. protein was also found to be higher. The data indicate that supplementation of 1% urea to *Prosopis juliflora* pods increases the DCP content.

The balances of nitrogen, phosphorus and calcium of whole ration are presented in Table 3.

The perusal of data given in Table 3 indicated that the balance of nitrogen and calcium were positive while that of phosphorus balance was marginally positive.

The over all results indicated that incorporation of 1% urea in *Prosopis juliflora* pods increased the digestibility of C. protein from 56.24 to 60.98% and it provided 8.93% DCP and 64.59% TDN on dry matter basis.

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REFERENCES

- AOAC, 1975. Official Methods of Analysis, 12th edn. Association of Official Analytical Chemists, Washington, DC, 20044, USA.
- Figueirido, A. A., 1975. *Lebensmittel Chemische relevante in haltstoffe der schotin der algarobeira*. Ph. D. Thesis, Wurzburg, Germany (C. F. Felker, P. and G. Waines, 1977. Potential use of mesquite as a low energy and machinery requiring food. *Proc. Energy Farm Workshop. Sacraments, California* July 14, 1977).
- NCA, 1976. National Commission on Agriculture, Part VII, Animal Husbandry, Ministry of Agric. and Irrig., Govt. of India, New Delhi, India pp 382-435.
- Talpada, P. M. 1985. Study on *Prosopis juliflora* pods and its utilization as cattle feed by lactating cows. Ph. D. Thesis submitted to Gujarat Agricultural University, Anand Campus, Anand, India.
- Talpada, P. M., M. B. Pande, B. H. Patel and P. C. Shukla, 1979. Feed value of *Prosopis juliflora* DC pods for growing calves. *Indian J. Dairy Sci.*, **32** (4): 482-483.
- Talpada, P. M. and P. C. Shukla, 1987. Effect of feeding *Prosopis juliflora* pods to lectating cows on certain rumen metabolites. *Indian J. Anim. Nutr.* **4** (4): 249-255.

Abstracts of Ph. D. Thesis

Studies on Genetic Improvement of Green Lace Wing, *Chrysopa scelestes* Banks (*Chrysopidae* : *Neuroptera*) : Selection for Monocrotophos Resistance

Submitted to Gujarat Agricultural University

Student
I. S. Patel

Major Guide
D. N. Yadav

Biological Control Research Project
Gujarat Agricultural University, Anand-388 110

Studies were carried out to develop genetically improved monocrotophos resistant strain of *C. scelestes* during 1989-92 at Biocontrol Research Laboratory, G.A.U., Anand. Monocrotophos was selected as test insecticides because it proved effective against jassid, *A. bigutulla bigutulla* I, as well as very toxic to *C. scelestes* and commonly used in cotton ecosystem.

Of the three bioassay methods tried, Topical application method was found better and with insecticidal pressure for 9 generation, the strain could be improved to resist 0.04% monocrotophos. This method gave higher resistance index (442.38) while at same number of generation, Food impregnation and film exposure method showed 4.06 and 1.00 resistance index respectively. Therefore considering the high level of resistance, Topical application method was found very effective and therefore further selection was stopped and at this stage, level of resistance was maintained in *C. scelestes* for further studies. It was noted during the investigation that susceptible strain showed increased susceptibility to monocrotophos as compared to the parental stock (LC=0.02368) of the susceptible strain (LC=0.01151). It was also observed that resistance developed in *C. scelestes* reversed in third generation when selection pressure of insecticide was relaxed.

The cross resistance study revealed intra group cross resistance may be attributed to the presence of methyl group and structural similarity with monocrotophos, while other insecticide of same group did not show resistance and perhaps due to structural dissimilarity having ethyl and close benzene ring.

Biological and morphometric differences also differed significantly in resistance as well as susceptible strain. Biochemical analysis revealed that resistant strain had higher amounts of lipids and higher activity of Acetylcholinesterase enzyme (AChE) than the susceptible strain. The TLC (Thin Layer Chromatography) separation of polar lipids showed the presence of NAPE in both strain but phosphatidyl inositol was lacking in resistant strain. Likewise, TLC separation of non polar lipid showed the presence of steryl ester and free fatty acid in resistant strain while in susceptible strain only steryl ester was present and free fatty acid was lacking. Activity of AChE in resistant strain had 2 fold higher at final incubation period but no change was observed in susceptible strain. Hence, higher Ache activity appears to be responsible for imparting resistance in resistant strain.

Genetic analysis of monocrotophos resistance showed that additive as well as non additive gene effect controlled the expression of this trait. It suggested the polygenic nature of inheritance for monocrotophos resistance in *C. scelestes*.

The collection of *C. scelestes* from 10 different regions showed wide variation in their biological characteristics and response to monocrotophos. Resistance as well as susceptible strain integrated with monocrotophos gave effective control of aphid, *A. gossypi* and jassids, *A. bigutulla bigutulla* when open and confined release were made. The resistant strain remained unaffected by monocrotophos and gave effective control of *B. tabaci*.

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On Comparison of Some Stability Analysis Models

Submitted to Gujarat Agricultural University

Student
B. H. Prajapati

Major Guide
N. M. Patel

Department of Agricultural Statistics, B. A. College of Agriculture,
Gujarat Agricultural University, Anand Campus, Anand

The present study was carried out to compare some stability analysis models including safety-first indices empirically and ultimately to searchout stable genotype. For this purpose nine genotypes of pearl millet were screened under four weed management treatments viz. no weeding, hand weeding and herbicide atrazin at two levels (0.75 kg. a.i./ha. and 1.25 kg. a.i./ha.) during the *kharif* season of the years 1990, 1991 and 1992 at Gujarat Agricultural University, Anand Campus, Anand.

The genotypes tested were GHB-27, GHB-30, GHB-32, GHB-181, GHB-183, GHB-184, GHB-229, MH-179 and B. K.-560. The data on grain yield, dry fodder yield, plant stand, plant height, earhead length and weed counts were recorded at harvest and analysed. Three stability analysis models proposed by Eberhart and Russell (1966), Perkins and Jinks (1968a) and Freeman and Perkins (1971) were compared empirically for thier efficiency. Safety-first indices were also attempted for the purpose.

Differential response of genotypes to environment was observed in individual year as well as in pooled analysis for grain and dry fodder yield.

Ranking pattern of genotypes based on stability parameters viz., b_i (Regression coefficient) S_{di} (deviations from regression) was similar under Eberhart and Russell (1966) and Perkins and Jinks (1968a) models; Freeman and Perkins (1971) model deviated from Eberhart and Russell and Perkins and Jinks models in this respect. Eberhart and Russell (1966) model was considered as better from precision and computation convenience.

Safety-first indices studied had limited practical utility.

The environment-wise analysis also showed variable response of genotypes to weed control treatments. GHB-229 was high yielding stable genotypes in no weeding and hand weeding environments but not under herbicide application. MH-179 appeared high yielding and stable under herbicide application for weed control conditions.

"No weeding no herbicide application" practice as cost saving agronomic practice can be advocated if genotype like GHB-229 is made available to the farmers. This hybrid is high yielding and stable in performance.

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Assessment of Quality of Effluent Waters and Studies on Spent Wash Usage for Irrigation in Clayey Soils of South Gujarat

Student
N. M. Zalawadia

Major Guide
S. Raman

Soil and Water Management Project,
Gujarat Agricultural University, Navsari Campus, Navsari

Rapid industrialization and urbanization has created serious problems of water pollution. However, industrial effluents are not always hazardous and can be used advantageously in agriculture. Keeping this in mind the present investigation was planned.

A survey study indicated that the waste water from paper mill, sugar factory and metal industry showed minimum pollution hazard and can safely be used for irrigation. In a pot study, sugarcane, sorghum, alfalfa and paragrass responded well to 25 times diluted spent wash, while onion responded upto 50 times dilution. In all the cases major, secondary, micronutrient and heavy metal contents and uptake by different crops increased with increase in concentration of spent wash. Further, there was betterment in nutrient status and physical condition of soil.

In another pot study with sorghum and onion, 25 per cent of fertilizers could be saved when spent wash was used for irrigation. In the field trial, sugarcane did not respond to application of N, P and K when irrigated with 50 times diluted spent wash in clayey soils of South Gujarat.

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