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Short Communications

Abstracts of Ph.D. Thesis

Studies on Cultural and Chemical Weed Control in Mustard

(Brassica campestris)

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ABSTRACT

The experiment was conducted during 1985-86 and 1986-87 at JNKVV, Zonal Agricultural Reserach Station, Morena (MP) to study the effect of cultural and chemical methods of weed control in raya. Results shows that two hand weedings 30 and 45 DAS and isoproturon 1 kg ha recorded significantly higher seed yield, less weed population and dry wed biomass as compared to other cultural and chemical herbicides and weedy check. The technical feasibility and economic viability of isoproturon 1 kg/ha proved its superiority.

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INTRODUCTION

In norhern India mustard is grown under irrigated conditions which also favours luxuriant growth of monocot and dicot weeds. Mustard unlike other crops seems to have poor competitive ability against weeds resulting in yield losses upto 25-80%. Weed control in mustard at the initial stage of crop growth is most important since crop weed competition is maximum at this stage. The use of weed management methods (cultural and chemical) should be technically effective and economically viable. Although various weed control measures have been suggested in the past (Bains *et al.*, 1971; Singh *et al.*, 1986). Their economics based on the marginal cost concept has not been reported so far, particularly in mustard. Therefore, the present investigation was carried out to study cultural and chemical methods of weed control in mustard.

MATERIALS AND METHODS

Field experiment was conducted during rabi season of 1985-86 and 1986-87 at JNKVV-Zonal Agricultural Reserach Station, Morena (MP). The soil was sandy loam with pH 7.8 EC 0.12 ds/m, organic carbon 0.69% and initial available N, P, K 185, 16 and 288 kg/ha, respectively. There were twelve treatments i.e. four cultural methods(weedy check, one hand weeding by khurpi at 30 DAS, one weeding by hand-hoe at 30 DAS, and two hand weeding by khurpi at 30 and 45 DAS) and six herbicides (methobenzthiazuron 1 kg a.i./ha, pendimithalin 0.75 kg and 1 kg a.i./ha, isoproturon 0.75 kg and 1 kg a.i./ha; metazuron and 2, 4-D, 1 kg a.i./ha each) 2, 4-D was applied in 1985-86 and metazuron was applied preemergence. The experiment was laid out in a randomized block design with four replications. Mustard variety pusa bold was sown in rows 30 cm apart using 6 kg seed/ha. Half of the N (40 kg/ha) alongwith 30 kg P_2O_5 and 20 kg K_2O were applied at sowing and remaining N (40 kg/ha) was top dressed at the time of irrigation applied at flower initiation stage. The crop was sown on 20 and 24 October and harvested on 27 and 28 February in the respective seasons. For economic analysis marginal cost concept and rate of return was used.

RESULTS AND DISCUSSION

(i) Weed studies

Important weed species recorded in experimental plot in the descending order of intensity were *Boerahavia diffusa, Cyperus rotundus, Chenopodium album, Trianthema, monogyna, Aphodelus tenuifolius, Melilotus indica* and *Convolvlus arvensis* of all the weed species, *Boerahavia diffusa* constituted more than 70% in 1986-87 due to which higher biomass of weeds was recorded even with lower density.

Weed population appreciably decreased with increase in frequency of cultural practices (two hand weedings) as compared to chemical methods during both the seasons. Two hand weedings at 30 and 45 DAS recorded significantly less weed population as compared to other cultural and herbicidal treatments (Table 1). Isoproturon one kg/ha gave excellent control of both grassy as well as broad leaf weeds. It was more effective against broad leaf weeds and *Asphodelus tenuifolius*. Pendimithalin only partial controlled the grassy as well as broad leaf weeds and failed to control *Asphodelus tenuifolius*. Metazuron and 2, 4-D were inferior to other cultural and chemical methods of weed control but superior to weedy check.

With corresponding increase in frequency of cultural practices, dry weed biomass decreased considerably (Table 1). Two hand weedings at 30 and 45 DAS produced significantly less dry weight of weeds as compared to other cultural and chemical treatments. All the herbicides were more or less equally effective on weeds. They were, however, inferior to cultural practices but superior to the weedy check. The unweeded check produced the highest dry weed biomass of 41.0 and 223. 3 g/m^2 in 85-86 and 1986-87, respectively.

(ii) Yield attributes and yield

Significantly higher pooled values of yield attributes viz., number of pods and their weight/plant (Table 2) were recorded under two hand weeding at 30 and 45 DAS and isoproturon 1 kg/ha. The favourable effect on these characters may be due to less weed competition for moisture and nutrients. There was a substantial increase in seed yield of mustard with increase in frequency of cultural practices (Table 2). The highest seed yield of 1993 kg/ha was recorded with two hand weedings at 30 and 45 DAS. Cumulative effect of cultural practices facilitated better growth and pod development, greater crop canopy with less weed competition and consequently higher seed yield. Isoproturon proved its superiority among all the herbicides. The lowest seed yield of 1510 kg/ha was recorded with unweeded check.

(iii) Economic studies

Influence of weed management on yield and economics of mustard indicated that among the treatments, two hand weedings gave maximum yield and additional return over control closely followed by isoproturon 1 kg/ha (Table 2). The weed control efficiency of two hand weedings and isoproturon 1 kg/ha were 76.9 and 61.3 per cent, respectively.

After considering the marginal cost and percentage range of return with the technical feasibility and economical viability of treatments, isoproturon 1 kg/ha was the best competetive as compared to two hand weedings due to low marginal cost on higher percentage rate of return per kg of grain production. Similar results, were also reported by Dhondyal (1990).

Though some chemical herbicides show lowest marginal cost but weed control efficiency and percentage rate of return were not found economically competetive (Table 2). Therefore, isoproturon 1 kg/ha can be recommended as preemergence herbicides for the mustard for controling the weeds most economically.

TABLE 1

Effect of different herbicides treatments on biomass/plant, pods/plant, density of weeds, biomass of weeds during the years 1985-86 and 1986-87.

Treatments	Biomass (g)/plant		No. of pods/plant		Density of weeds (No./m^2)		Biomass of weeds (g/m^2)	
	1985-86	1986-87	1985-86	1986-87	1985-86	1986-87	1985-86	1986-87
No weeding	43.3	42.6 (42.9)	148	193 (170.5)	52.0	42.8 (47.4)	41.0	223.3 (132.2)
One hand weeding (hoe)	52.6	47.8 (50.2)	194	202 (198.0)	41.0	31.3 (36.2)	11.5	126.7 (69.1)
One hand weeding (Khurpi)	53.4	48.6 (51.0)	217	203 (210.0)	24.2	21.3 (22.8)	8.8	73.3 (41.0)
Two hand weedings (30 to 45 DAS)	59.9	57.5 (58.7)	257	203 (230.0)	14.7	11.5 (13.1)	6.7	66.7 (36.7)
Methabenzthiazuron 1 kg a.i. / ha	49.7	43.3 (46.5)	178	189 (183.5)	37.0	32.5 (34.8)	14.7	190.0 (102.3)
Pendimithalin 0.75 kg a. i. /ha	48.9	46.8 (47.8)	167	178 (172.5)	39.2	32.8 (36.0)	20.9	166.7 (93.8)
Pendimithalin 1 kg a.i./ha	51.9	52.3 (52.1)	171	185 (178.0)	34.0	24.0 (29.0)	15.9	153.3 (84.6)
Isoproturon 0.75 kg a.i./ha	52.6	52.0 (52.3)	197	185 (191.0)	28.0	28.0 (28.0)	15.2	133.3 (74.2)
Isoproturon 1 kg a.i./ha	59.6	53.5 (56.6)	226	198 (212.0)	20.2	15.5 (17.8)	13.4	100.0 (56.7)
Metaxuron 1 kg a.i./ha	--	46.2	--	192.0	--	39.8	--	133.3
2.4-D Na salt 1 kg a.i./ha	52.9	--	195	--	44.5	--	24.0	--
CD at 5%	0.61	6.55 (3.53)	17.05	15.09 (12.68)	1.16	1.24 (0.84)	4.94	5.14 (30.37)

Figure in parentheis shows pooled value of two years.

TABLE 2

Effect of different herbicides on yield, economics and weed control efficiency in mustard during both the years 1985-86 and 1986-87.

Treatments	Seed yield (kg/ha)		Weed control efficiency		Pooled over two yeras		Rate of return (%)
	85-86	86-87	85-86	86-87	Additional yield/return over control	Matrginal cost (Rs/kg)	
No weeding	1704	1316 (1510)	---	---	---	----	----
One hand weeding (hoe)	2225	1487 (1856)	71.95	43.26 (57.6)	346 (2595)	1.87	75
One hand weeding (khurpi)	2197	1553 (1875)	28.5	67.17 (72.8)	365 (2738)	0.95	86
Two hand weeding (30 and 45 DAS)	2320	1667 (1993)	83.65	70.12 (76.9)	483.5 (3626)	1.86	98
Methabenzthiozuron 1 kg a.i./ha	1960	1420 (1690)	64.14	14.91 (39.5)	180.5 (1350)	1.35	44
Pendimithalin 0.75 lit. a.i./ha	1960	1430 (1695)	49.02	25.35 (37.2)	185.0 (1338)	0.93	65
Pendimithalin 1 lit. a.i./ha	2007	1534 (1770)	61.22	31.34 (46.3)	260.5 (1950)	0.81	46
Isoproturon 0.75 kg a.i./ha	2083	1458 (1770)	62.93	40.30 (51.6)	260.0 (1950)	1.27	99
Isproturon 1 kg a.i./ha	2272	1600 (1936)	67.32	35.35 (61.37)	426.0 (3195)	0.99	62
Metoxuron 1 kg a.i./ha	---	1581	----	40.30	---	---	---
2,4-D Na salt 1 kg a.i./ha	2083	----	41.46	----	---	---	---
C D at 5%	363.37	188.44 (191.20)	---	----	---	---	---

Figures in parenthesis shows pooled yield, average weed control efficiency and additional returns.

REFERENCES

Bains, S. S.; Chowdhary, S. L. and Turkhede, B. B. (1971). Profits, potential of crops i.e. dry lands. *Indian Farming* 3 (2) ; 2-15.

Dhondyal, S. P. (1990). Farm management an economic analysis. Friends Publication Merrut pp 258.

Singh, R. K., Giri, G. Gangasaran and Turkhede, B. B. (1986). Effect of special arrangement in mustard under rainfed condition. *Indian J. Agron.* **31** (4) : 367-69.

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Correlation and Regression Studies in Niger

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ABSTRACT

Regression analysis made on 35 varieties of niger (*Guizotia abyssinica* Cass.) revealed that the 4 variables days to maturity, number of branches, number of capitula and seeds per capitulum accounted for 84.4% variability of total variation in yield. For increasing the efficiency of selection, an index based on these variable is suggested.

(Received on 16th Janu., 1987)

INTRODUCTION

One of the chief objective of every breeding programme is to obtain increased yield. As this character is determined by complex gene action, selection of such character must be based on combination of characters related to it. Moreover, continuous selection for a character may result in loss of other characters which may be of equal importance (Hazel, 1983). Since selection based on number of characters not only reduces the possibilities of loss of character/characters, but also increases the efficiency of selection and higher genetic gain. Selection indices based on discriminant functions are helpful in determining the combination of characters. Niger which is a minor oilseed crop, has such information very limited. The present study was therefore conducted on selection indices based on regression analysis in niger.

MATERIALS AND METHODS

35 indigenous niger varieties representing all important niger growing states were planted in randomised block design with three repeats at Rajasthan College of Agriculture, Udaipur, in 1981 by following usual crop production practices. Data on 5 randomly selected plants were recorded for days to flower, days to maturity, number of branches, plant height, number of seed per capitulum, number of capitula and seed yield per plant. Correlations were computed as per Panse and Sukhatme (1967) and their phenotypic values were used for constructing selection indices which were arrived by discriminant function technique (Smith, 1936). Characters which had high direct/indirect positive affect along with positive correlations with yield, were considered for computing 'b' values which were analysed by Robinson *et al.* (1957) method. Finally the multiple regression equation was fitted by substituting the 'b' values which was as under :

$$YB=b_1 \times 1 + b_2 \times 2 + b_3 \times 3 + b_4 \times 4$$

RESULTS AND DISCUSSION

A high significant difference was noted among varieties for all the characters studied. Yield was found to be significantly and positively associated (Table 1) with number of

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TABLE 1

Correlation and path analysis in niger.

Character	Plant height	Days to flower	Days to maturity	Number of branches	Number of capitula	Seeds/ capitula	Seed yield	Herita-bility (h^2)
Plant height		0.307*	0.353*	0.916**	0.924**	-0.163	-.360*	9.20
	(-2.085)	(-1.540)	(1.833)	(0.870)	(1.466)	(-0.180)		
Days to flower			0.930**	0.547**	0.194	0.070	0.067	98.32
	(-0.640)	(-5.016)	(4.829)	(0.520)	(0.308)	(0.066)		
Days to maturity				0.720**	0.260	-0.176	0.684**	99.26
	(-0.736)	(-4.664)	(5.192)	(0.675)	(0.412)	(-0.195)		
Number of branches					0.423**	0.341	0.277	52.64
	(-1.910)	(-2.743)	(3.686)	(0.950)	(0.671)	(0.377)		
Number of capitula						0.488**	0.979**	66.34
	(-1.926)	(-0.973)	(1.350)	(0.402)	(1.586)	(0.540)		
Seeds per capitulum							0.682**	63.71
	(0.340)	(0.301)	(-0.914)	(-0.324)	(0.774)	(1.107)		

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

Figures in parenthesis are path coefficient values.

capitule per plant, days to maturity, seeds per capitulum and plant height, whereas weak but positive with days to flower and number of branches. The correlations among these characters were also significant and positive. The pattern of phenotypic correlations was similar to genotypic correlations, however the later was larger in magnitude. Importance of these characters was further realised by determining their direct/indirect effects on seed yield which indicated that days to maturity, number of branches, number of capitula and seeds per capitulum were the such variables which had high effect (Goyal and Kumar, 1985).

Considering these four factors and yield, regression analysis was done which was highly signiticant (Table 2) depicting very well dependency of yield on these characters.

TABLE 2

Analysis of variance.

Source	*d.f.*	*s.s.*	*m.s.s.*
Regression	4	160.1132	40.0283
Error	64	224.7292	3.5114

Multiple regression equation using 'b' values of these four variables was constructed as:

$$Y = 0.5159 - 0.0005\ X_1 - 0.0035\ X_2 + 0.0342\ X_3 + 0.062\ X_4$$

The results showed that these four variables contributed about 84.4% variability of the total variation in yield ($R = 0.9184^{**}$). It therefore, appeared that for improving yield in niger selection through days to maturity, number of branches, number of capitula and seeds per capitulum will be more effective. Since all these characters had high heritability (Goyal, 1985) significant positive correlation along with high direct and indirect effects on seed yield, it is possible to have rapid genetic gain. Sahu and Patnaik (1981) have also suggested a combination of characters like seeds per capitulum, days to flower, maturity, duration of flowering and seed weight for improving seed yield in niger. They have further noted that efficiency of selection increases up to 4-5 characters only and after that it fluctuates, if more characters are included in an index. It is therefore suggested that selection in niger should be done through days to maturity, number of branches, number of capitulum and seeds per capitulum for attaining rapid gain in yield.

REFERENCES

Goyal, S. N. 1985. Genetic studies in oilseeds. Ph.D., Thesis submitted to Sukhadia University, Udaipur (unpublished)

Goyal, S. N., and Sudhirkumar, 1985. Correlation and path analysis in niger. *J. Oilseeds Research.* **2** (1) : 34-38.

Hazel, L. M. 1943, The genetic basis for constructing selection indices. *Genetics.* **28** : 476-90.

Panse. V. G. and Sukhatme, P. V. 1967. Statistical methods for Agricultural Workers, I.C.A.R., New Delhi.

Robinson, H. F., Comstock, R. E. and Harvey P. H. 1951. Genotypic and phenotypic correlation in corn and their implications in selection. *Agron. J.* **43** : 282-87.

Sahu, D. P. and Patnaik, M. C. 1981. Variability, correlation and path analysis in niger. *Indian J. Agric. Sci.* **51** : 287-91.

Smith, M. F. 1936. A discriminant function for plant selection. *Annals of Eugen.* 7 : 240-50.

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Induced Micromutation in Relation to Mutagen Induced Stress in Wheat

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ABSTRACT

Differential response of two wheat varieties in M_1 generation was obtained, when treated with two potent chemical mutagens viz., Ethyl methane sulphonate and Sodium azide. Two parameters such as Mutation Index and Strees Response Index, basing on pollen traits and some quantitative data on growth respectively were used for comparing the response of varieties to mutagens as mutagenic and stress causing agent. It is possible to induce useful mutations with less of physiological damage for which selection of appropriate mutagen, its dose and the genotype is considered most important.

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INTRODUCTION

Mutation breeding is considered as an useful supplement to conventional breeding. Induction of useful genetic variations is a more desirable goal than simply increasing variability. The present study was carried out to determine differential response of genotypes to the mutagens in the form of mutagen induced stress and induced micromutations basing on the variability in some quantitative traits and pollen traits respectively. This work emphasizes the economy in investment by selection of M_1 plants (both within and between treatments) carrying micromutations and selection of proper chemical, its dose and the genotypes with definite response.

MATERIALS AND METHODS

Five hundred uniform seeds of two prerelease varieties viz., OW 32 (two-gene dwarf) and OW 13 (semi tall) were treated with two chemical mutagens such as Ethyl methane sulphonate (EMS) and Sodium azide. (SA). The concentrations of EMS and SA were 0.5%, 0.25% and 0.02%, 0.01% respectively with treatment period of 6 hours and presoaking of 12 hours at room temperature of 26 ± 1°C. Distilled water and phosphate buffer at 3.0 pH were taken as control for EMS and SA treatments respectively. The observations on germination, flowering, seedling survival and young plants survival were noted. Spikelets were collected randomly from 30 plants of each treatment to record observations on pollen sterility and pollen size by using 0.5% IKI solution in low power and high power objective respectively. After the crop was harvested, 25 plants were sampled randomly for observations on some quantitative traits such as plant height, length of 1st, 2nd, 3rd internode (from top), spike length, peduncle length, spikelet number, grain number, length of 1st, 2nd and 3rd leaf sheath.

Three different aspect of variation in pollen traits such as pollen sterility, reduction in pollen size and increase in its size variability compared to control population were used to obtain a rough measure of mutational response in each variety. Former trait was used as an index of chromosomal mutations, while later two indicated occurence of presumable factor mutations. Sampled plants were scored for all the 3 pollen characteristics

individually for occurrence of at least a mutant sector and then Mutation Index (MI) was calculated as follows :

$$\text{Mutation Index (M.I.)} = \frac{\text{Total scores}}{\text{No. of plants} \times 3}$$

Plants within population of different treatments were further categorised as Type I, Type II and Type III, where Type I was believed to carry only chromosomal aberrations (evidence from sterility), Type II plants carrying only factor mutations (evidence from mean pollen size and or coefficient of variability/range of pollen size) and Type III plants carrying both chromosomal aberrations and factor mutations (evidence from the above three aspects).

Similarly all the characters excepting pollen traits were used to calculate Stress Response Index (SRI) for each treatment variety combination after scoring the characters in suitable scale as given in the next section.

RESULTS AND DISCUSSION

Table 1 indicated higher value of Mutation Index in EMS treatments and lower value for SA treatments in OW 32 whereas OW 13 exhibited medium mutational response for both the chemicals.

It is reasonable to consider mutagen as a stress factor since these bring about adverse physiological changes within the plant body resulting in reduction in growth, survival, germination and other traits. Since the mutagenic treatments in general cause two major phenotypic changes viz., (1) Reduction in mean values and (2) increase in variability, it was argued that the same effects could be used as a simple approach to the problem of quantification of stress response. Following this approach a 'stress response index' (SRI) was calculated for each variety combination. The rational was obtained from the observations of Johnson and Frey (1967) in oats and Sinha and Patnaik (1969) in rice regarding phenotypic expression of quantitative characters under 'stress' and 'non-stress' conditions. The steps for calculation of SRI are as follows : (1) For each of the character above, reduction in mean value as well as increase in coefficients of variability (C.V.) compared to control was given an index score of 1 separately. Thus for each treatment the index score would vary from 0 to 2 since in the event of no change or reverse change the score given was zero for both mean and C.V. (2) For flowering appreciable delay in first flowering was given an index score of 1 and increase in range of flowering was also given the score 1. Conversely the score 0 was given for no change or reverse change. (3) For each of the remaining two aspects i.e., germination and survival, reduction to the tune of 10 % of the control was given the index score 0; between 11-30% was given the score 1; between 31-50% was scored 2 and reduction beyond 50% was scored 3. (4) These individual scores were summed up and total index score (Range 0 to 30) divided by maximum value 30 to obtain SRI with maximum value 1. Table 1 (last column) indicates that SRI values were smaller but more variable in OW 32 compared to higher but consistent value in OW 13.

In mutation breeding experiments, mutagens with low physiological effect and strong genetic effects are desirable. A number of M_1 parameters have been recognised as possible indicators of M_2 mutation frequency (Blixt *et al.*, 1964; Rana and Swaminathan, 1967; Savin *et al.*, 1968; Karunakaran and Kiss; 1971). In this study, average pollen grain size and pollen size variation were used as possible indicators of M_2 mutation frequency, based on the previous work in this laboratory (Mishra *et al.*, 1981).

Despite limited number of pollen criteria, differential response of genotypes and different effects of the two mutagens could be clearly distinguished vide Table 1 showing

TABLE 1

Mutation index, Frequencies of Type I, Type II, Type III plants and stress response index in M_1 population.

Treatment	*M.I.*	*No. of Type I*	*No. of Type II*	*No. of Type III*	*Type II frequency*	*Frequency of all types*	*SRI*
$V_1 T_1$	0.344	12	5	7	0.166	0.80	0.37
$V_1 T_2$	0.178	3	5	4	0.166	0.40	0.27
$V_1 T_4$	0.074	3	1	1	0.037	0.19	0.70
$V_1 T_5$	0.010	--	1	--	0.033	0.03	0.23
$V_2 T_1$	0.089	2	4	1	0.133	0.23	0.67
$V_2 T_2$	0.130	2	6	2	0.200	0.33	0.57
$V_2 T_4$	0.100	2	2	1	0.100	0.25	0.63
$V_2 T_5$	0.174	1	4	3	0.190	0.38	0.67

V_1 = OW 32 T_1 = 0.5% EMS T_4 = 0.02 % SA

V_2 = OW 13 T_2 = 0.25 % EMS T_5 = 0.01 % SA

M.I. = Mutation Index

SRI = Stress Response Index

relationship between Type II and overall. If Type II M_1 plants truely represent those carrying only factor (gene) mutations, the increase in this ratio could provide an estimate of the expected M_2 families segregating for mutation exploitable for crop improvement. Applying this criterion Sodium azide (SA) would appear to be more useful in the sense that along with increase in overall frequency, the Type II plant frequency would correspondingly increase. By the same yardstick, OW 13 could be considered responsive to both EMS and SA mutagenesis (at lower dose) in a more desired way than OW 32, which appears to be more sensitive to EMS but not to SA. But with EMS, OW 32 did not show increase in Type II frequency even with about two fold increase in overall M_1 mutant plant frequency.

When the effect of mutagens on the varieties was examined from both mutational and stress response point of view (Table 1), the following picture emerged.

Variety	Response to SA	Response to EMS
OW 32	Low mutational response relative to stress response	High mutational response relative to stress response
OW 13	Medium mutational response relative to stress response	Medium mutational response relative to stress response

It reveals high variability in the response of OW 32 to the chemicals as mutagenic and stress causing agent. On the other hand OW 13 showed high consistency for both categories of response to the two chemicals.

Another point worth emphasizing is the distinct difference between the two potent mutagens from following angles i.e., (i) relation between Type II and all types of M_1 plants, (ii) mutational response relative to the induced

stress. These observations further suggest (a) that the physiological effects of SA are entirely different from those of EMS, (b) that EMS is a broad spectrum mutagen compared to SA, (c) that mutations relative to the induced stress may be relatively less for SA than EMS and (d) that more useful mutations may be obtained from OW 13 by use of both the mutagens at lower doses, whereas OW 32 was responsive to only EMS at lower dose.

REFERENCES

Blixt, S., O. Gelin, R. Mossberg, G. Attnstrom, L. Ehrenberg, and R. A. Lofgren. 1964. Studies of induced mutation in peas IX. Induction of leaf spots in peas. *Agri. Hort. Genet.*, **22** : 186-194.

Johnson, G. R. and K. J. Frey. 1967. Heritabilities of quantitative attributes of oats (*Avena* sp.) at varying levels of environmental stress. *Crop Sci.*, **7** : 43-46.

Karunakaran, K. and I. S. Kiss. 1971. M_1 chlorophyll chimeras induced by different mutagens and their M_2 chlorophyll mutation yields of rice. *Biol. Plant.*, **13** (3) : 207-208.

Mishra, R. C., B. N. Samolo, and S. K. Sinha. 1981. Relationship of M_1 parameters with M_2 mutation frequency in green gram (*Vigna radiata*, Wilczek). *J. Res., Haryana Agric. Univ.*, **11** (4) : 481-484.

Rana, R. S. and M. S. Swaminathan. 1967. Relationship between chimeras and mutation induced by 60 Co-γ-rays and 2 Mev fast neutrons at specific loci in bread wheats. *Rad. Bot.*, **7** : 543-548.

Savin, U. N., M. S. Swaminathan, and B. Sharma. 1968. Enhancement of chemical induced mutation frequency in barley through alteration in the duration of presoaking of seeds. *Mutat. Res.*, **6** : 101-107.

Sinha, S. K. and J. K. Patnaik. 1969. A study of variability in quantitative traits at two levels of fertility and its bearing on selection in rice. *Oryza*, **6** (2) : 9-17.

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Hybrid Vigour in Eight Parent Diallel Cross in Okra (*Abelmoschus esculentus* (L.) Moench)*

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ABSTRACT

Diallel analysis was carried out by using eight parents of Okra (*Abelmoschus esculentus* (L.) Moench) alongwith their 28 hybrids. These were evaluated for heterosis. Analysis of variance revealed significant differences for all the characters indicating the presence of genetic diversity in the studied material. The amount of heterosis was high for number of pods per plant and yield per plant, moderate for first fruting node, pod length, pod girth, internodal length and plant height, while remaining characters exhibited low heterosis. The most heterotic hybrids for yield per plant were Padra 18-6 x KS-312, Punjab Selection x KS-312, Parbhani Kranti x Padra 18-6 and Punjab Selection x Padra 18-6.

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INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) is an important delicious vegetable cultivated extensively throughout India in summer and rainy seasons.

Exploitation of hybrid vigour in okra has been recognised as an important tool by the breeder for increasing the yield. The aim of present study was to spot out the best combinations of parents giving high degree of useful heterosis.

MATERIALS AND METHODS

Eight diverse genotypes of okra viz., Gujarat Okra-1, Punjab Selection, PB-57, Parbhani Kranti, Padra 18-6, KS-312, Selection-2 and AE 36-2 were selected for the present study. These varieties were crossed in all possible combinations excluding reciprocals during summer 1989. A set of 36 genotypes comprising of eight parents and their 28 hybrids were planted during *kharif* 1989 in a randomized block design with three replications. Each plot consisted of a single row of 2.5 m length. Inter and intra row distance was kept 60 cm and 25 cm, respectively, accommodating 10 plants per plot. From each plot five competitive plants were selected at random for recording the data on days to flowering, days to first picking, first fruiting node, pod length, pod girth, number of pods per plant, number of nodes on main stem, internode length, plant height and yield per plant. Relative heterosis and heterobeltiosis expressed by the hybrids, was calculated as the deviation of hybrid from its mid parent and better parent, respectively.

RESULTS AND DISCUSSION

Analysis of variance for experimental design revealed significant differences among genotypes for all the characters

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indicating the presence of considerable genetic variability in the studied material (Table 1). Parents and hybrids differed significantly for all the characters. The diversity among the parents ultimately resulted into hybrids significantly different from each other. The parents Vs hybrids comparison indicated that means of hybrids were significantly different from that of parents as a group for all the characters except days to first picking, number of nodes on main stem and internodal length.

Several crosses exhibited conspicuous heterotic response over mid parental values for different characters. The measure of heterosis over mid parent value has limited commercial value. Therefore, from practical point of view, the haterosis may better be measured in term of superiority of F_1 over better parent(heterobeltiosis). The degree of heterosis varied from cross to cross for all the traits (Table 2). For days to flowering elevan and seven hybrids had significant negative relative heterosis and heterobeltiosis, respectively. Hybrid Gujarat Okra-1 x Punjab Selection exhibited lowest significant relative heterosis(-11.63) and heterobeltiosis(-10.75). Similar results were also reported by Maksoud *et al.* (1986) and Poshiya and Shukla (1986). With regard to days to first picking seven and three hybrids had shown significant negative heterosis over mid and better parent, respectively. Raman (1965) and Jalani and Graham (1973) reported negative heterosis over mid parents, whereas, Kulkarni and Virukshappa (1977) observed negative heterobeltiosis. For first fruiting node, only two hybrids showed significant negative relative heterosis, whereas none of the hybrids exhibited negative heterobeltiosis. The flowering at a lower internode wil be helpful in increasing the number of pods per plant, therefore, the hybrids exhibiting negative heterosis were considered as favourable for this character. These results are in agreement with the results obtained by Elangovan *et al.*, (1981) and Poshiya and Shukla (1986). In case of pod length, thirteen and eight hybrids manifested significant positive relative heterosis and heterobeltiosis, respectively. Moderate heterosis was observed for this character. Similar results were reported by Sharma and Mahajan (1978). Partap and Dhankar (1980), Elangovan *et al* (1981) and Poshiya and Shukla (1986). For pod girth nine and eight hybrids exhibited significant positive heterosis over mid parent and better parent, respectively. Thicker pods beyond certain limit are not preferred by the consumers. However, pod length and pod girth directly contribute to yield and hence their positive values increase the total yield These results are in agreement with Lal and Srivastav (1973), Lal *et al.* (1975) and Swamy Rao and Ramu (1975).

With regards to number of pods per plant, 13 hybrids manifested significant positive heterosis over mid parent and only two cross combinations showed significant positive heterobeltiosis. The range of heterobeltiosis varied from -7.48 per cent to 44.39 per cent. None of the hybrids showed significant negative relative heterosis and heterobeltiosis. Elangovan *et al.* (1981), Dhillon and Sharma (1982) and Changani and Shukla (1985) reported similar results. For number of nodes on main stem, none of the hybrids exhibited significant positive heterosis and heterobeltiosis. Lal *et al.* (1975) found negative heterosis for this character. Only one hybrid Punjab Selection x Parbhani Kranti showed desired significant negative heterosis over mid parent for internode length. None of the hybrids manifested significant negative heterobeltiosis. Similar results were reported by Lal *et al.* (1975), Changani and Shukla (1985) and Poshiya and Shukla (1986). For plant height, thirteen and five hybrids manifested significant positive relative heterosis and heterobeltiosis, respectively. Plant height with shorter internodal length plays an important role in increasing the number of pods per plant as well as pod yield per plant. Elangoven *et al.* (1981), Dhillon and Sharma(1982) and Maksoud *et al* (1986)

TABLE 1

Analysis of variance (mean squares) for experimental design for different characters.

Source of variation	*D. F.*	*Days to flowering*	*Days to first picking*	*First fruiting node*	*Pod length*	*Pod girth*	*Number of pods per plant*	*Number of nodes on main stem*	*Inter nodal length*	*Plant height*	*Yield per plant*
Replications	2	3.867**	3.219*	0.282	0.230	0.033	1.091	1.045	0.219	68.375	21.750
Genotypes	35	11.093**	12.249**	1.286**	9.156**	0.538**	19.744**	9.496**	2.902*	628.550**	2338.593**
Parents	7	13.089**	16.613**	1.417**	3.205**	0.341**	23.334**	16.512**	3.977*	881.781**	1782.469**
Hybrids	27	10.685**	11.519**	1.198**	10.941**	0.590**	14.397**	7.885**	2.724*	565.738**	2301.597**
Parents Vs. Hybrids	1	8.156**	1.438	2.761**	2.619**	0.524**	138.973**	3.879	0.183	551.875**	7230.500**
Error	70	0.471	0.699	0.106	0.326	0.022	4.012	2.688	0.394	13.679	77.089

*, ** = Significant at 5% and 1% level of significance, respectively.

TABLE 2

Heterosis in percentage over mid parent (MP) and better parent (BP) for various characters.

Crosses	Days to flowering		Days to firt picking		First fruiting node		Pod length		Pod girth	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
1	2	3	4	5	6	7	8	9	10	11
G-1 x P.S.	-11.63**	-10.75**	-10.22**	-9.38**	2.06	19.35**	8.11*	-3.79	2.56	0.12
G-1 x PB-57	0.00	1.33	1.85	3.13*	21.98**	33.82**	21.95**	9.52**	2.58	-2.91
G-1 x P.K.	-1.01	-0.67	0.63	0.64	-3.45	1.27	19.80**	14.87**	12.91**	7.79**
G-1 x Padra 18-6	-2.70**	-2.04	1.90	3.21*	13.54**	31.46**	4.85	-1.49	-11..68**	-13.41**
G-1 x KS-312	-0.71	5.28**	0.66	7.06**	-9.09*	-3.62	11.55**	5.89	13.43**	10.61**
G-1 x Selection-2	-4.08**	-2.75**	-2.53*	-1.29	21.65**	42.31**	10.32**	5.11	-2.86	-5.35*
G-1 x AE 36-2	-1.67	-1.35	-1.86	-1.24	12.71**	22.97**	12.19**	8.44	13.70**	10.0**
P.S. x PB-57	-2.95**	-2.64**	-2.14	-1.84	1.91	8.03*	-12.89**	-13.77	1.70	-1.47
P.S. x P.K.	4.67*	-3.37**	-3.41*	-2.49	2.97	14.17**	12.20**	3.78	24.17**	21.37**
P.S. x Padra 18-6	-1.00	0.67	0.31	2.56	2.73	3.58	-14.34**	-19.17**	-6.30**	-10.28**
P.S. x KS-312	-3.16**	3.77**	-0.98	6.34**	4.90	15.00**	-1.60	-8.09*	10.67**	5.41**
P.S. x Selection-2	-10.44**	-8.28**	-10.35**	-8.33**	-4.51	-4.46	-19.81**	-25.37**	-2.99	-3.18
P.S. x AE 36-2	-1.99*	-1.34	-2.15	-1.85	-7.18*	-0.92	-1.32	-9.42**	2.40	1.47
PB-57 x P.K.	0.33	2.03	0.62	1.88	-4.21	0.00	-1.14	-7.68**	14.71**	13.68**
PB-57 x Padra 18-6	-6.00**	-4.08**	-4.38**	-1.92	14.42**	20.15**	-28.62**	-31.98**	-1.02	-8.05**
PB-57 x KS-312	5.59**	13.53**	5.88**	14.09**	4.17	7.58	-14.29**	-19.18**	-2.33	-9.72**
PB-57 x Selection-2	0.00	2.77*	0.63	3.21*	-0.95	5.05	-35.22**	-39.13**	-6.82**	-9.56**
PB-57 x AE 36-2	-0.99	0.00	0.00	0.61	3.55	4.13	4.90	-2.80	18.32**	15.67**
P.K. x Padra 18-6	-7.80**	-7.49**	-6.33**	-5.13**	3.00	13.18**	3.24	1.07	-3.64	-9.72**
P.K. x KS-312	7.47**	13.53**	7.95**	14.79**	9.78*	10.87*	14.11**	12.92**	-2.67	-9.28**
P.K. x Selection-2	-1.71	-0.68	-0.63	0.63	4.95	16.47**	-23.56**	-24.07**	3.25	1.10
P.K. x AE 36-2	0.67	1.36	0.62	1.26	14.29**	18.62**	-0.79	-1.62	5.30**	3.86
Padra 18-6 x KS-312	7.14**	12.79**	7.38**	12.68**	14.85**	24.68**	16.80**	15.52**	-4.00*	-4.53*
Padra 18-6 x Sele.-2	3.43**	4.14**	3.21**	3.21*	-2.73	-1.93	24.93**	23.09**	0.53	-3.91
Padra 18-6 x AE 36-2	1.01	2.04	1.26	3.21	2.42	8.27	23.10**	19.52**	-5.12**	-9.94**
KS-312 x Sele. -2	0.00	4.51**	-0.67	4.23**	14.71**	25.1**	2.19	1.80	-5.87**	-10.50**
KS-312 x AE 36-2	4.59**	11.28**	2.63*	9.87**	12.04**	15.00**	35.61**	33.10**	3.57	-2.21
Selection -2 x AE 36-2	-3.73**	-2.07	-3.15**	-1.29	14.83**	22.51**	26.16**	24.29**	13.95**	13.11**
S.E. ±	0.49	0.56	0.59	0.68	2.32	2.66	0.40	0.47	0.10	0.12

*,** = Significant at 5% and 1% level of significance, respectively.

TABLE -2 (Contd)

Crosses	Number of pods per plant		Number of nods on main stem		Internodal length		Plant height		Yield per plant	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
	12	13	14	15	16	17	18	19	20	21
G-1 x P.S.	14.12	-4.72	11.66	10.53	17.52*	58.14**	5.67*	3.37	14.18**	3.54
G-1 x PB-57	1.12	-3.63	4.96	4.96	-7.85	14.59	0.58	-4.53	11.45**	4.20
G-1 x P.K.	19.28	9.43	-11.48	-12.20	33.41**	70.40**	7.55**	0.90	3.54	-3.42
G-1 x Padra 18-6	9.11	1.00	-0.36	-12.73**	21.21*	39.53**	3.69	-2.11	5.29	-6.38
G-1 x KS-312	33.82**	9.20	11.24	4.75	20.85*	35.06**	-10.41**	-15.61**	24.97**	11.21*
G-1 x Selection-2	-4.51	-6.35	4.63	1.96	-0.46	30.02**	4.12	-0.17	11.02*	6.00
G-1 x AE 36-2	-3.27	-5.90	2.96	-6.61	-8.20	-1.06	-6.32*	-25.13**	-1.04	-5.07
P.S. x PB-57	38.83**	11.53	-7.98	-8.91	1.55	8.53	11.51**	8.13**	14.36**	-2.34
P.S. x P.K.	25.08	12.71	2.64	2.43	-15.15*	-11.43	4.12	-0.24	1.19	-1.85
P.S. x Padra 18-6	36.32**	7.03	3.34	-8.70	5.37	21.10*	12.71**	4.23	30.38**	6.48
P.S. x KS-312	1.09	-1.76	4.80	-0.37	4.53	23.80**	3.94	0.00	46.59**	43.53**
P.S. x Selection-2	37.38**	12.93	6.77	5.10	-9.86	-7.60	1.39	-0.67	29.04**	12.27**
P.S. x AE 36-2	53.29**	30.92**	9.46	-1.62	9.75	35.10**	30.35**	5.95*	2.89	-2.99
PB-57 x P.K.	7.54	-5.56	0.00	-0.81	9.73	12.23	1.51	0.26	13.62**	-0.40
PB-57 x Padra 18-6	0.62	-2.41	8.87	-4.66	-7.23	-6.49	12.67**	1.29	14.53**	8.50*
PB-57 x KS-312	50.82**	18.59	3.10	-2.92	-6.06	3.60	-5.76*	-6.53*	27.26**	6.80
PB-57 x Selection-2	-4.73	-7.48	10.26	7.45	1.00	5.41	10.20**	9.05**	-2.50	-4.62
PB-57 x AE 36-2	10.01	2.14	7.52	-2.48	-1.71	12.43	-5.31	21.12**	16.24**	4.56
P.K. x Padra 18-6	27.23**	8.84	-7.04	-18.01**	4.29	14.45	-0.46	-11.50**	41.95**	18.79**
P.K. x KS-312	45.34**	27.68	-6.15	-10.95	-5.41	6.85	11.31**	10.83**	0.71	-4.29
P.K. x Selection-2	18.49	6.80	12.98	10.98	-11.30	-9.52	5.53*	3.16	2.15	-8.72
P.K. x AE 36-2	30.86**	23.19	-8.35	-17.48**	-4.57	11.88	4.13	-12.38**	-5.00	-7.74
Padra 18-6 x KS-312	55.09**	19.28	-10.07	-16.77**	-13.33	-10.96	-6.38*	-16.44**	51.38**	21.62**
Padra 18-6 x Sele.-2	2.02	-3.82	-1.56	-11.80	16.77*	30.68**	88.55*	-1.50	4.97	-2.61
Padra 18-6 x AE 36-2	21.02*	9.24	-2.51	21.43**	-4.64	1.46	-17.81**	-37.06**	22.26**	4.83
KS-312 x Sele. -2	24.68*	0.23	6.62	2.92	16.87*	34.76**	13.40**	11.32**	24.25**	6.18
KS-312 x AE 36-2	73.09**	44.39**	12.10	-3.65	-12.20	-9.14	24.82**	4.66	-9.23	-16.09**
Selection -2 x AE 36-2	2.38	-2.27	12.39	-0.39	-5.70	12.98	27.57**	5.38	5.92	-2.80
S.E. ±	1.42	1.64	1.16	1.34	0.44	0.51	2.61	3.02	6.21	7.17

*,** = Significant at 5% and 1% level of significance, respectively. Sele. = Selection.

reported similar results. In case of yield per plant, sixteen and six hybrids exhibited significant positive heterosis over mid parent and better parent, respectively. Heterobeltiosis ranged from -16.09 to 43.53 per cent. Hybrid, Punjab Selection x KS-312 recorded maximum heterobeltiosis (43.53). High heterosis for yield per plant seems to have resulted due to the combined effect of heterosis observed in its yield component characters such as number of pods per plant, pod length, pod girth, plant height and internodal length. The genetic divergence of selected parents seems to be another cause for high heterosis observed in yield. Similar results were also reported by Partap and Dhankhar (1980), Elangovan *et al.* (1981) and Poshiya and Shukla (1986).

Considerable high heterosis in certain crosses and low in other crosses revealed that the nature of gene action varied in hybrids depending upon the genetic architecture of parents involved. Considering present study the promising hybrids were Padra 18 5 / KS-312 and Punjab Selection / KS-312. These hybrids offer the best possibilities for their future exploitation in the development of high yielding varieties. The possible methodologies which could be adopted for thier future exploitation could be (1) production of further inbred lines from the identified crosses (2) Development of double cross hybrids from the single cross ones and (3) Conversion of parents involved in heterotic combinations into male sterile lines for commercial exploitation of heterosis. The end products of these scientific endures could be directly handed over to seed producers and farmers so as to organise commercial production.

REFERENCES

Changani, N. B. and P. T. Shukla, 1985. Heterosis and inbreeding depression for some yield components in Okra (*Abelmoschus esculentus* (L.) Moench). *Madras Agric. J.*, **72** : 276-280.

Dhillon, T. S. and B. R. Sharma, 1982. Interspecific hybridization in okra *(Abeloschus species). Genetica Agraria*, **36** : 247-255.

Elangovan, M., C. R. Muthukrishan and I. Irulappan, 1981. Hybrid vigour in bhendi (*Abelmoschus esculentus* (L.) Moench) for some economic characters. *South Indian Hort.*, **29** : 4-14.

Jalani, B. S. and K. M. Graham, 1973. A study of heterosis in crosses among local American varieties of okra *(Hibiscus esculentu* (L.) *Malaysian Agril. Res.*, **2** : 7-14.

Kulkarni, R. S. and K. Virupakshappa, 1977. Heterosis and inbreeding depression in okra. *Indian J. Agric Sci.*, **47** : 552-555.

Lal, S., C. Shekhar and J. P. Srivastav, 1975. Genetical studies in bhindi (*Abelmoscus esculentus* (L.) Moench). Gene effects and heterosis. *Indian J. Hort.*, **32** : 175-178.

Lal, S. and J. P. Srivastav, 1973. Hybrid vigour in bhindi. *Indian J. Hort.*, **30** : 542-545.

Maksoud, M. A. R. M. Helal and M. Mohmed, 1986. Studies on an intervarietal cross and hybrid vigour in okra. *Annals Agril. Sci* **29** : 431-438.

Partap, P. S. and B. S. Dhankhar, 1980. Heterosis studies in okra (*Abelmoschus esculentus* (L.) Moench). *Haryana Agri. Univ. J. Res.* **10** : 336-341.

Poshiya, V. K. and P. T. Shukla, 1986. Heterosis studies in okra (*Abelmoschus esculentus* (L.) Moench). *GAU Res. J.* **11** (2) : 21-25.

Raman, K. R. 1965. Studies on intervarietal cross and hybrid vigour in bhendi (Syn. okra. Gumbo) (*Abelmoschus esculentus* (L.) Moench). *Madras Agric. J.*, **52** : 305.

Sharma, B. R. and Y. P. Mahajan, 1978. Line x tester analysis of combining ability and heterosis for some economic characters in okra. *Scientia Hort.*, **9** : 111-118.

Swamy Rao, T. and P. M. Ramu, 1975. Genetic analysis of three pod characters in bhendi (*Abelmoschus esculentus* (L.) Moench). *Madras Agric. J.*, **62** : 331-337.

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Changes in Amino Acids and Phenols in Limabean (Phaseolus lunatus) Varieties Resistant and Susceptible to Stem Rot Disease (Macrophomina Phaseolina)

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ABSTRACT

Limabean plants resistant (PLJ-1) and susceptible (PLJ-5) to stem rot (Macrophomina Phaseolina) were grown in sick soil (inoculated with organisms) and leaves collected at pre-infectional, and late infectional stages were analysed for amino acids, phenols and their profile by paper chromatography and TLC respectively. Resistant variety (PLJ-1) exhibited lower levels of total amino acids and phenols except at pre-infectional stage. A continuous increase in free amino acids and phenols was observed in infected plants of susceptible (PLJ-1) variety from pre-infectional (I) to late-infectional stage (III) while reverse was true for amino acids in uninfected plants of resistent variety. At early infectional stage (disease initiation) the resistant plants had higher levels of cystine and arginine plus histidine. All the phenols were higher in resistant plants at pre-infectional stage (i). Catechol and chlorogenic acid were found to be higher in resistant plants at all stages.

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INTRODUCTION

In limabean an important pulse crop of Gujarat, Ashy stem blight or stem rot is one of major soil borne diseases causing extensive loss in yield. A severe outbreak of this disease was observed during 1987 at the Pulse Research Farm, GAU campus, Junagadh and in many farmer's fields in Junagadh district.

Phenolic compounds and amino acids are reported to be involved in resistance to fungal diseases (Satyavir and Grewal, 1975; Reddy and Rao, 1977) based on the differences in their concentrations in plant tissues between resistant and susceptible varieties (Murthy and Bagyaraj, 1978; Sindhan and Jaglan, 1987)and because of the changes in their levels around the onset and progress of disease (Srivastava and Dhavan, 1985; Singh and Srivastava, 1988). The present experiments describe preliminary studies on the phenolics and amino acids in leaf tissues of limabean plants in response to stem rot caused by Macrophomina phaseolina at different disease stages.

MATERIALS AND METHODS

The seeds of limabean varieties resistant (PLJ-1) and susceptible (PLJ-5) to stem rot were sown in pots where the soil has been inoculated with Macrophomina phaseolina. It was reported that fungal growth appears within 10-12 days of sowing and that within another 6-8 day period the infection spreads leading to wilting and death of the plant (Jadeja, 1989). The leaf samples were therefore collected at pre-infectional (8 days after sowing; DAS) early infectional (10 DAS) and late infectional (14 DAS) stages. The leaf samples were extracted in 80% alchohol and partially purified by extraction with chloroform to remove the pigments. The free amino acids in this extract were estimated by ninhydrin method (Lea and Takahashi, 1966) and total phenols by folin's method(Mahadevan and Shridhar, 1986) respectively. Amino acid

profile was screened by paper chromatography (Block and Zweig, 1958) and phenol profile was screened by thin layer chromatography (Harborne, 1973).

RESULTS AND DISCUSSION

Resistant variety (PLJ-1) of limabean had higher levels of free amino acids at the pre-infectional stage compared to susceptible (PLJ-5) variety (Table1). In the infected plants of susceptible variety the amino acid concentration increased while in uninfected resistant plants there was a fall in the same. Higher levels of free amino acids in diseased plant tissues have been reported by other workers (Vidhyasekaran, 1977) and same may be for utilisation by the fungus.

The concentration of total phenolic compounds were more or less similar at the pre-infectional stage in both the varieties (Table 1). The same decreased during infection in susceptible plants while in resistant plants there was a fall during early infectional stage alone. There are many reports (Sharma, 1983; Saxena *et al.*, 1987) of increased levels of phenolic compounds in resistant plants and hardly any reports of a decrease in phenols in resistant plants. It might be that more phenols are produced by the susceptible plants or released by fungal glycosidases while the disease is in progress.

A screening of the selected phenolics in the leaf extract indicated (Table 2) that all the phenols were higher in resistant plants at pre-infectional stage. They also had higher levels of chlorogenic acid at early infectional and late infectional stages, while susceptible plants registered an increase in caffeic acid and resorcinol plus orcinol during late infectional stage. These results indicate that quantitative studies on the individual phenolics may throw light on the involvement of specific phenols in disease resistance.

The data on levels of individual amino acids in leaf tissues (Table 3) showed that generally all the amino acids were present in higher concentrations in the resistant plants at the pre-infectional stage except cystine. At both the early and late-infectional stages the reverse was true i.e. higher levels of all the amino acids were seen in susceptible plants except cystine and arginine plus histidine at early infectional stage.

TABLE 1

Leaf free amino acids and phenols in stem rot resistant and susceptible varieties of limabean.

Stages of disease	*Resistant variety PLJ-1*	*Susceptible variety PLJ-5*
	Free amino acids (mg/g fresh leaf)	
I	4.69	2.67
II	3.14	3.60
III	2.28	3.94
	Phenols (mg/g fresh leaf)	
I	0.673	0.611
II	0.560	0.654
III	0.580	0.756

Values are means of two daplicate analysis.

I Pre-infectional stage. II Early-infectional stage.

III Late-infectional stage.

TABLE 2

Relative amounts (abundance) of phenols in stem rot resistant and susceptible varieties of limabean.

	Stages of disease	*Resistant variety PLJ-1*	*Susceptible variety PLJ-5*
Caffeic	I	++	---
acid	II	+	+
	III	+	+++
Resorcinol	I	++	-
+	II	+	++
orcinol	III	+	+++
Catechol	I	++	---
	II	++	+
	III	++	++
Chlorogenic	I	+++	---
acid	II	+++	++
	III	++	+

+++ = much; ++ = less; + = least; -- = absent

I Pre - infectional stage II Early-infectional stage

III Late-infectional stage.

The levels of amino acids increased from pre-infectional to early infectional stage in resistant plants except cystine. From early to late-infectional stage all the amino acids increased in susceptible plants. The reverse was noticed in resistant plants except for tryptophan and phenylalanine. Thus during the late stage of disease the pattern of changes in the individual amino acids differed in both the varieties. At late infectional stage most of the amino acids were present in higher concentration in susceptible plants.

Earlier studies on wilt in chickpea (Mandavia and Parameswaran, 1991) showed that cystine was higher in leaves of resistant plants than that in susceptible plants especially at the early infectional period. In the present studies also levels were higher in resistant plants compared to susceptible plants at early infectional stage. In susceptible plants cystine levels were higher at pre-infectional stage. This fell down to very low levels during early infectional stage followed by an increase in the later period. These changes may be related to the infection process as such changes were not observed in resistant plants. Other workers have suggested roles of cystine in disease resistance to gram blight (Satyavir and Grewal, 1975b), and cystine to fusarium wilt in a Cajanus cajan (Murthy and Bagyaraj, 1978b), and to Helminthosporium nodylosum in finger millet (Vidhyasekaran, 1977).

The amino acids cystine and arginine plas histidine were higher in resistant plants at early infectional stage and may be contributing in disease resistance.

TABLE 3

Individual amino acids in leaves of stem rot resistant and susceptible varieties of limabean (Micromoles/g. fresh leaf).

	Stages of disease	*Resistant variety PLJ-1*	*Susceptible variety PLJ-5*
(a) Aromatic amino acids :			
Tyrosine	I	3.46	0.35
	II	1.30	2.44
	III	0.80	4.76
Tryptophan	I	1.60	0.29
	II	0.23	0.92
	III	1.44	2.60
Phenylalanine	I	0.92	0.12
	II	0.19	0.39
	III	0.65	1.66
(b) Sulphar containing amino acids :			
Cystine	I	2.57	8.03
	II	2.81	1.88
	III	1.96	4.39
Methionine	I	1.13	0.25
	II	0.27	0.50
	III	0.30	1.05
(c) Other amino acids :			
Arginine	I	1.4	0.30
+	II	1.3	0.86
histidine	III	0.58	2.37
Aspartic acid	I	3.40	0.99
	II	1.41	2.42
	III	0.77	5.08
Glutamic acid	I	1.60	0.41
	II	0.74	1.15
	III	0.39	2.45
Leucine	I	0.42	0.11
	II	0.076	0.24
	III	0.11	0.30

Each value is means of two observations.

I Pre - infectional stage II Early-infectional stage

III Late-infectional stage.

REFERENCES

Block and Zwein, (1958). A manual of paper chromatography and paper electrophoresis, academic press. Inc., New York, pp. 710.

Harborne, J. B. (1973). Phytochemical methods, Halsteld press, Inc., New York, pp. 44.

Jadeja, R. G. (1989). Investigation on Macrophomina Phaseolina (Tassi) Goid, causing Ashy stem blight or stem rot of limabean. M.Sc. Thesis, Gujarat Agricultural University, Junagadh.

Lea, Y. P. and Takahashi, T. (1966). An improved colourimetric determination of amino acids with the use of ninhydrin, Analytical Biochemistry, **14** : 71-76.

Mahadevan, A. and Shridhar, R. (1986). Methods in physiologycal plant pathology, pp. 208, 218.

Mandavia, M. K. Bhalani, P. A. and Parameswarn M. (1991). Biochemical studies on disease resistance in chickpea (Cicer arietinum) varieties resistant and susceptible to wilt disease (Fusarium oxysporium). Proc. Indian Sci. Congress 78th Congr., Part III, 4-5.

Murthy, G. S. and Bagyaraj, D. J. (1978). Free amino nitrogen and amino acids in Cajanus cajan in relation to fusarium wilt resistance. *Indian Phytopathol.* **31** : 482-484.

Reddy, M. N. and Rao, A. S. (1977). The role of phenolic substances in Damping off of groundnut caused by Rhizoctonia solani. Symposium on physiology of host pathogen interaction, 105-113.

Satyavir and Grewal, T. S. (1975). Role of free amino acids in disease resistance to gram blight. *Indian Phytopathol.* **28** : 206-208.

Saxena, A. K., Sharma, A. K., Nityagopal, A. and Bakshi, A. K. (1987). Changes in total phenolics and sugars in relation to P. recondita (Brown rust) of some wheat varieties. *Punjab Agric. Uni. J.* **24** : 359-62.

Sharma, S. G. (1983). Role of phenolic compounds in resistance of maize to leaf blight caused ⊛by Drechshera state of cochlio bolus Heterostrophus. *Indian Phytopathol.* **36** (1) : 43-46.

Sindhan, G. S. and Jaglan, B. S. (1987). Role of phenolic compounds and carbohydrates in resistance of groundnut to tikka leaf spot. *Indian J. Mycol. Pl. Pathol* **17** (2) : 141-142.

Singh, S. K. and Srivastava, H. P. (1988). Phenolic changes in Moth bean (Vigna aconitifolia (Jaca) Marechan) during Macrophomina Phascolina infection. *Indian J. Mycol. Pl. Pathol.* **18** (3) : 314-316.

Srivastava, S. K. and Dhavan, S. (1985). Free amino acid composition of Brassica juncea stem base and roots infected by Macrophomina Phaseolina. *Indian J. Mycol. Pl. Pathol.*, **15** (1) : 90-93.

Vidhyasekaran, P. (1977). Role of amino acid and amides in Helminthosporiose disease incidence in finger millet. *Indian Phytopathol.* **30** : 41-44.

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Correlation Studies Among Floral and Yield Characteristics in Coconut Variety Dwarf Green*

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ABSTRACT

Thirtyone correlation coefficients were worked out between floral and yield traits in coconut variety 'Dwarf Green'. The nut yield was found to be significantly and positively correlated with number of spadices and duration of female phase, whereas number of leaves produced and length of spadix exhibited significant positive correlation with number of spadices. It is therefore, suggested that number of spadices and duration of female phase should be considered as selection criteria for nut yield improvement in coconut variety 'Dwarf Green'.

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INTRODUCTION

Coconut (*Cocos nucifera* L.) is a highly cross pollinated crop, which results in a greater variation in its yield potential. Possibly desirable variation can be resorted by upgrading the genetic make up for better yield, which may be achieved through hybridization as well as selection. In the recent years, there has been a good progress in coconut improvement by exploiting the genetic potential of Tall x Dwarf and Dwarf x Tall hybrids. A knowledge of the associations among floral vegetative characters and yield of nuts is a prerequisite for any selection programme. A study was, therefore, initiated on coconut variety 'Dwarf Green' to estimate the extent of correlations between different quantitative characters and yield.

MATERIALS AND METHODS

The experiment was conducted at the Plantations Crops Research Station, Gujarat Agricultural University, Mahuva. Thirty palms of 'Dwarf Green' cultivar of coconut were randomly selected out of 192 palms during 1984-85. All these palms had uniform growth and age (10 years). Detailed observations were recorded on nineteen floral characters, vegetative characters and yield on individual palm. These characters were (i) Number of leaves produced, (ii) Interval between successive leave produced, (iii) Number of spadices produced, (iv) Interval between successive spadices produced, (v) Number of open spadices, (vi) days to opening of spadix i.e. interval between emergence to opening of spadix, (vii) Inter between leaf and spadix produced, (viii) length of spadix, (ix) duration of female phase, (x) duration of male phase, (xi) Number of female flowers, (xii) number of female flowers having spiklets, (xiii) number of female flowers per spadix, (xiv) total fruit drop, (xv) fruit setting percentage, (xvi) number of spikelets per spadix (xvii) length of spiklets (xviii) number of spikelets bearing female flowers and (xix) number of nuts per palms. Thirtyone correlation coefficients were worked out between floral/vegetative and yield

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characters as per standard statistical procedures (Panse and Sukhatme, 1961).

RESULTS AND DISCUSSION

Thirtyone correlation coefficients were workedout between floral and yield characteristics as well as among themselves to study the nature and extent of associations so as to findout a suitable selection criterion in coconut. Such type of studies are meagre in the literature (Nair and Satyabalan, 1968; Satyabalan *et al.*, 1972; Satyabalan and Mathew, 1984).

In the present studies, nut yield was found to be significantly and positively correlated with number of spadix produced (+0.400), and duration of female phase (+0.363). However, a significant negative correlation (-0.498) was apparent between yield and interval between leaf and spadix produced. The number of spadices exhibited a significant positive correlation with number of leaves produced (+0.503) and length of spadix (+0.476) while it had significant negative correlation with interval between spadix produced (-0.776). The number of leaves produced showed significant negative correlation with total periodical fruit drop. Number of female flowers per spadix had significant positive correlation with length of spadix (+0.641), number of open spadices (+0.586), spikelet bearing female flowers (+0.770). This character also had a weak positive correlation with nut yield (+0.289). Number of open spadices showed a significant positive association with fruitset (+0.546). Number of spikelets had a significant positive correlation with average length of spikelets (+0.538). Rest of the associations between different pairs of traits were statistically not significant.

The study, therefore, revealed that number of spadix and duration of female phase were important yield components in coconut variety 'Dwarf Green' while number of leaves produced and length of spadix had significant positive association with yield component i.e. number of spadix. Therefore, these characters should be considered as selection criterion for yield improvement in coconut variety 'Dwarf Green'.

TABLE 1

Correlations coefficients between pair of characters.

Sr. No.	*Characters*	*Correlation Coefficients*
1.	Number of leaves produced x Number of spadix produced	+ 0.570**
2.	Number of leaves produced x Total periodical fruit drop	0.470**
3.	Number of leaves produced x Number of open spadices.	+ 0.503**
4.	Number of leaves produced x Yield.	- 0.205
5.	Number of spadix produced x Length of spadix.	+ 0.476**

1	2	3
6.	Number of spadix produced x Interval between spadix produced	0.776**
7.	Number of spadix produced x Yield.	+ 0.400*
8.	Days to opening of spadix x Yield.	- 0.219
9.	Length of spadix x No. of female flowers/spadix.	+ 0.641**
10.	Length of spadix x Yield.	+ 0.275
11.	Duration of female phase x Yield.	+ 0.363*
12.	Duration of male phase x Yield.	+ 0.001
13.	No. of female flowers x Total periodical fruit drop.	-0.098
14.	Number of female flowers x Fruit set (%)	+ 0.124
15.	No. of female flowers x No. of open spadices	+ .586**
16.	No. of female flowers x Spiklets bearing female flowers.	+ 0.770**
17.	No. of female flowers x Yield.	+ 0.289
18.	Total periodical fruit drop x Yield.	- 0.016
19.	Fruit set (%) x Yield.	- 0.020
20.	No. of open spadices x Fruit set (%)	+ 0.546**
21.	No. of open spadices x Yield.	+ 0.319

1	2	3
22.	No. of spikeletes x Average length of spikelets	+ 0.538**
23.	No. of spikelets x Spikelets bearing female flowers	-0.869**
24.	No. of spikelets x Yield.	+ 0.315
25.	No. of female flowers x Yield.	+ 0.242
26.	Average length of spikelets x Yield.	+ 0.318
27.	Spikelets bearing female flowers x Yield	+ 0.151
28.	Percentage of female flowers/spadix x Yield.	- 0.159
29.	Interval between successive leave produced x Yield	+ 0.169
30.	Interval between successive spadix produced x Yield	- 0.333
31.	Interval between leaf and spadix produced x Yield	- 0.498**

* = Significant at P= 0.05.
** = Significant at P = 0.01.

REFERENCES

Panse, V. G. and Sukhatme, P. V. (1961). Statistical Methods for Agricultural workers. I.C.A.R. New Delhi.

Nair, R. and Satyabalan K. (1968). Comparative study of fibre from some cultivars of coconut in relation to certain characters of the nut. *Indian J. Agric. Sci.* **38** : 978-985.

Satyabalan, K. Sankar. N and Ratnam T. C.(1969). Studies on the bearing tendency of the coconut palm. *Trop. Agric.* **46** (8): 533-37.

Satyabalan, K. Mathew, J. and Radhakrishan V. (1972). Yield variation and its relationship with age and growth of an under planted coconut palms *oleagineux* **27** : 257-260.

Satyabalan, K. and Mathew J. (1984). Correlation studies on the nut and copra characters of West Coast Tall coconut harvested during different months of the year *J. Plants Crops.* **12** : 17-22.

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Phenophasic and Seasonal Water Requirement of Major Kharif Crops in Different Agroclimatic Zones of Gujarat State*

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ABSTRACT

The average seasonal water requirements for pearlmillet ranges from 292 to 336 mm, for sorghum crop 329 to 380, for groundnut 347 to 402, for cotton 603 to 666 and for rice 606 to 625 mm at seven agricultural research stations representing five different agroclimatic zones of Gujarat State. The reference crop evapotranspiration was estimated by using Radiation method. The water requirement values for the crops was found to be the lowest at Junagadh in South Saurashtra and the highest at Sardar Krushinagar in North Gujarat agroclimatic zones. Water requirement for each growth stage of the crops are also estimated and discussed.

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INTRODUCTION

The water requirements during the crop growth period in any given season and region is useful for day to day work on the farm and enable the soil moisture deficit to be kept within acceptable limits. The pattern of crop water requirement is essential to make the best use of the available rainfall.

A wide range of crops as diverse as pearlmillet to rice are generally taken up in all the agroclimatic zones of the Gujarat State. However, the agroclimatic information especially in the format useful for improving the cropping pattern and developing production technology is lacking. Keeping these points in view, seasonal water requirement of the major kharif crops with particular reference to phenological stages were computed and presented in this paper.

MATERIALS AND METHODS

Daily meteorological data between 1958 to 1989 recorded at agrometeorological observatories in respect of seven agricultural research stations representing five agroclimatic zones of the Gujarat State (Fig. 1) have been utilized in this study. Reference crop evapotranspiration (ETo) was computed by using Radiation method (Doorenbos and Pruitt, 1979) as follows :

$$ETo = C\ (W.\ Rs.)\ mm/Day$$

Where ETo = Reference crop evapotranspiration in mm/day

Rs = Solar radiation equivalent to evaporation in mm/day

W = Weighting factor reflecting the effect of temperature and altitude of the station

C = Is the adjustment factor reflecting the effects of mean relative humidity and day time wind at 2 m height above the soil surface.

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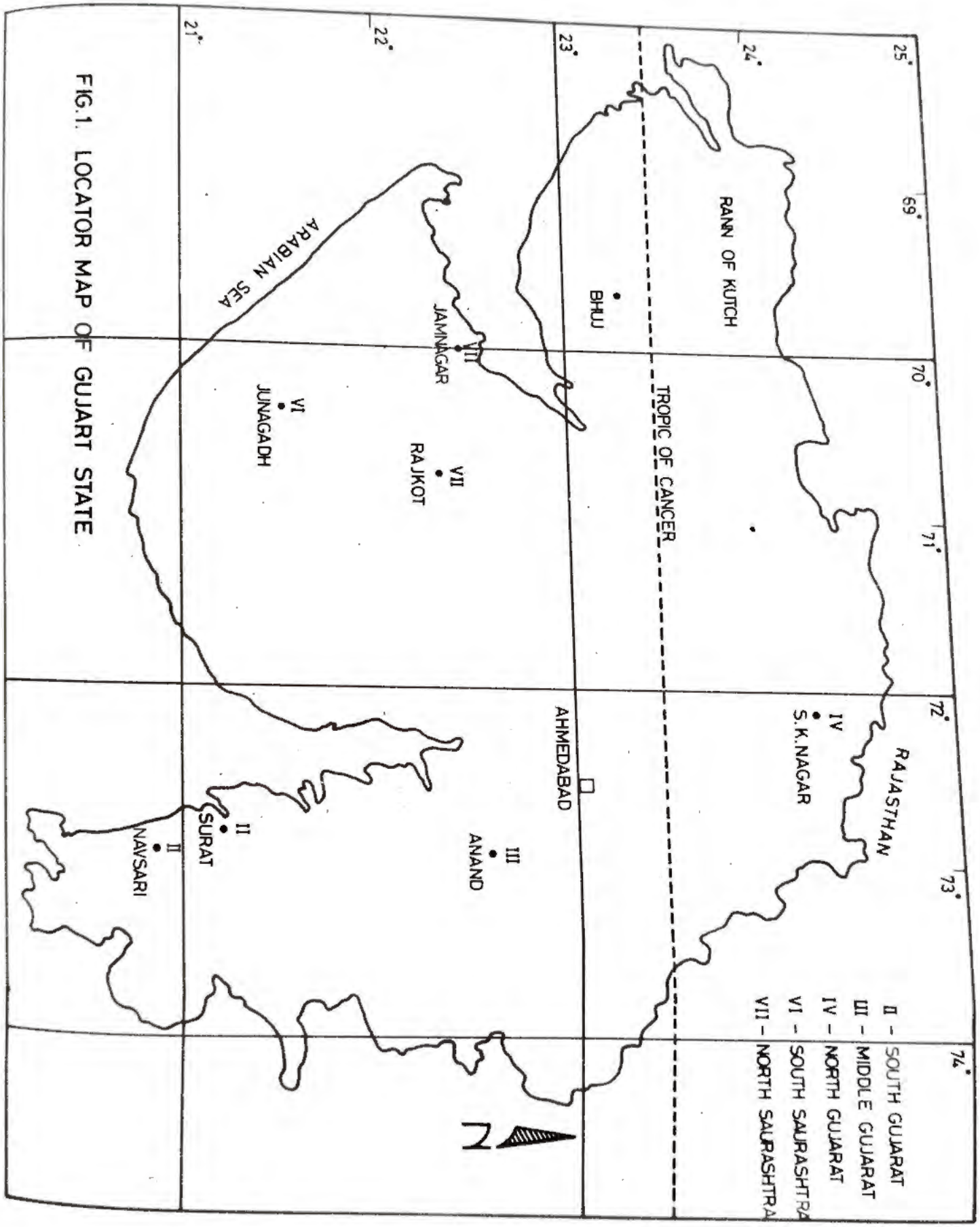

FIG.1. LOCATOR MAP OF GUJART STATE

FIG-1

Solar radiation (Rs) values were estimated by using the relationship, Rs.=Ra (0.42 + 0.30 n/N).

The weekly crop coefficients for individual crops except sorghum (Rathore, 1986) were adopted from Doorenbos and Kassam (1986). The water requirement of each crop for all the seven stations were computed on weekly basis for individual years. These weekly values were used to estimate water requirement for individual growth phases and for the whole season.

The crop life period for pearlmillet, sorghum, groundnut, rice and cotton was considered as 13, 14, 16, 16 and 22 weeks at all the stations.

RESULTS AND DISCUSSION

Rainfall and water requirement during cropping season

The total amount of precipitation received during the length of growing season and water requirements for each crop and for each kharif season was worked out and the average values for individual crops at each station are estimated and the average values for individual crops at each station are presented in Table 1. The choice of the starting period for accumulation of rainfall was based on the method proposed by Frere and Popov (1979) namely; the week at the beginning of the monsoon season when rainfall exceeded the estimated water requirement of the particular crop under consideration.

It is seen from the Table that the average rainfall corresponding to different cropping seasons was different, for example, for pearlmillet crop it ranged from 460 mm at Rajkot to 722 mm at Junagadh. This reflects a wide variation in seasonal rainfall in different agroclimatic zones of Guarat State.

The coefficient of variation of rainfall in the crop periods was higher of the order of 44 to 53% at Rajkot and Junagadh stations followed by Jamnagar, Anand and Surat (37 to 43%). At S. K. Nagar station both the seasonal rainfall and the CV were the lowest (18 to 23%) signifying relatively higher reliability of a low amount of rainfall at the station.

A similar trend in case of water requirement of crops was observed even though the duration of crops at different stations was considered same. The seasonal crop water requirements for pearlmillet ranges from 292 to 336 mm at different stations. Of all the stations considered, the water requirement for the four crops studied are the lowest at Junagadh station and at SK Nagar in North Gujarat region, the requirements are the highest. The seasonal water requirements reported here for pearmillet, sorghum and groundnut crops are lower than those estimated by Raheja (1961) and Gopani(1963) for Gujarat State. The differences are attributable to the fact that they employed pan-evaporation or penman methods for this purpose, which was found to give over estimation in some regions. For sorghum (Rathore, 1989), groundnut (Reddy, 1988), for cotton (Kaliappa *et al.*, 1974 and Doorenbos and Pruitt, 1979) at different localities reported values in the range commensurate with the values obtained in the present investigation.

The average seasonal rainfall exceeded the mean water requirement of crops at all the stations except for cotton at Jamnagar and Rajkot.

Phenophasic water requirement of kharif crops

Water requirement for each growth stage of the crops under study for seven stations are presented in Table 2. The duration of the crop phase and the crop coefficient for the phase being same for a crop at all the stations, the water requirement values were found to differ at different stations. For example, for sorghum crop, the water requirement for 2 weeks duration of sowing and establishment stage (i.e. stage I) ranged from 38 mm at Junagadh to 43 mm at

TABLE 1

Mean seasonal rainfall (mm) and water requirement (mm) for major kharif crops in Gujarat State.

Station	Pearlmillet		Sorghum		Groundnut		Cotton		Rice	
	Rainfall	WR	Rainfall	WR	Rainfall	WR	Rainfall	WR	Rainfall	WR
Anand	701	312	724	355	696	372	777	623	755	608
	(40)	(15)	(41)	(9)	(37)	(8)	(43)	(6)	(42)	(7)
Jamnagar	524	332	542	375	544	394	553	666	---	---
	(39)	(9)	(41)	(1)	(40)	(1)	(42)	(1)		
Junagadh	722	292	743	329	765	347	910	603	---	---
	(44)	(4)	(44)	(4)	(44)	(4)	(52)	(4)		
Navsari	---	---	1337	357	1471	372	1485	628	1471	606
			(23)	(5)	(33)	(4)	(37)	(5)	(33)	(6)
Rajkot	460	328	501	370	491	386	592	662	---	---
	(46)	(9)	(47)	(10)	(47)	(9)	(53)	(9)		
SK Nagar	474	336	487	380	504	402	---	---	---	---
	(18)	(8)	(23)	(7)	(22)	(6)				
Surat	---	---	1079	370	1123	388	1138	635	1122	625
			(40)	(1)	(39)	(2)	(38)	(1)	(38)	(2)

CV % is shown in paranthesis, WR = Water requirement.

TABLE 2

Mean phenqphasic water requirements (mm) of major kharif crops in Gujarat State.

Station	*Pearlmillet*				*Sorghum*				*Rice*		
	I	*II*	*III*	*IV*	*I*	*II*	*III*	*IV*	*I*	*II*	*III*
Anand	40	105	60	107	40	74	125	116	381	80	147
	(15)	(16)	(16)	(10)	(15)	(16)	(14)	(11)	(8)	(11)	(8)
Jamnagar	43	109	66	114	43	77	130	125			
	(9)	(4)	(7)	(4)	(7)	(5)	(5)	(2)			
Junagadh	38	96	60	98	38	67	117	107			
	(12)	(7)	(7)	(5)	(11)	(8)	(5)	(5)			
Navsari	---	---	---	---	42	75	127	113	385	75	146
					(10)	(7)	(8)	(4)	(6)	(5)	(8)
Rajkot	43	109	64	112	43	77	128	122			
	(11)	(10)	(14)	(9)	(11)	(11)	(12)	(10)			
SK Nagar	41	103	71	121	41	71	139	129			
	(12)	(11)	(16)	(10)	(12)	(12)	(14)	(7)			
Surat	---	---	---	---	39	75	137	120	402	81	142
					(15)	(4)	(1)	(2)	(2)	(3)	(3)

TABLE -2 **(Contd.)**

Station	Groundnut				Cotton				
	I	*II*	*III*	*IV*	*I*	*II*	*III*	*IV*	*V*
Anand	81	99	94	98	29	90	340	136	28
	(15)	(15)	(13)	(9)	(11)	(27)	(7)	(8)	(10)
Jamnagar	82	103	103	106	29	89	377	141	30
	(4)	(4)	(4)	(2)	(6)	(4)	(1)	(2)	(1)
Junagadh	72	94	86	95	26	77	329	139	32
	(8)	(5)	(6)	(7)	(9)	(6)	(5)	(6)	(9)
Navsari	79	101	92	100	28	84	348	138	39
	(7)	(8)	(6)	(8)	(11)	(13)	(4)	(9)	(16)
Rajkot	82	102	98	104	30	87	369	145	31
	(11)	(11)	(11)	(12)	(13)	(12)	(10)	(9)	(4)
SK Nagar	81	106	105	110	---	---	---	---	---
	(10)	(12)	(12)	(6)	---	---	---	---	---
Surat	82	108	100	98	29	90	361	129	26
	(3)	(2)	(2)	(2)	(7)	(2)	(2)	(2)	(3)

Rajkot. The similar trend can be observed for other stages and for other crops also. The values were comparatively less for the stations like Anand, Surat, Navsari and Junagadh because the seasonal rainfall in these stations were higher (Table 1) as compared to other stations like Jamnagar, Rajkot and SK Nagar. The coefficient of variation worked out considering the water requirement at individual growth stage of different crops show that, generally it is of the order of 10 to 15 per cent. The CV at Surat station is the lowest, while it is highest at the Anand station. Thus the water requirement and the rainfall pattern during the growth period of the crops will help in planning the cropping pattern of a region.

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REFERENCES

Doorenbos, J. and A. H. Kassam, 1986. Yield response to water. Irrigation and Drainage paper 33. FAO, Rome.

Doorenbos, J. and W. O. Pruitt, 1979. Guidelines for predicting crop water requirements. Irrigation and Drainage paper 24, FAO, Rome.

Frere, M. and G. F. Popov, 1979. Agrometeorological crop monitoring and forecasting. Plant production and protection paper No. 17 FAO, Rome.

Gopani, D. D. 1963. Optimum requirements and utilization of water for irrigated crops in Gujarat State. Proc. Symp. optimum requirement and utilization of water of irrigated crops. Central Board of irrigation and power, New Delhi.

Kaliappa, R.; S. Venkatachalam, K. M. Nachappan, K. V. Selvaraj, M. Manoharan and S. Rajaram 1974. A study on the water requirement of cotton. *Madras agric. J.*, **61** : 850-51.

Raheja, P. C. 1961. Water requirements of Indian field crops Res. Ser. 28, ICAR, 25 pp. CAZRI, Jodhpur.

Rathore, L. S. 1989. Water requirements and water use efficiency of some crops in India. INDO-FRENCH Workshop on Bioclimatology held at Mukteshwar, India.

Reddy, P. S. 1988. Groundnut, published by ICAR, New Delhi.

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Estimate of Optimum Plot Size From Uniformity Data of Mustard for North Gujarat

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ABSTRACT

Uniformity trial was conducted at the Regional Research Station, Gujarat Agricultural University, Sardar Krushinagar during *rabi* season of 1986-87 to find out optimum plot size and number of replications for field experiment on mustard crop Cv Varuna T. 59. The crop was raised at a spacing of 30 cm. x 10 cm. The grain yield data were obtained for 1600 basic units, the dimension of each baisc unit was single row of 1 meter length. The coefficient of variation and soil heterogeneity index were used for determining optimum plot size, which was worked out to be of 16 units, i.e. 8 rows each of 2 meter length (2.4 m x 2.0 m). For normal field experiment 5 replications was adequate.

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INTRODUCTION

In agricultural research efficient planning of field experiments apart from other consideration like randomization, replication and local control, also depends upon suitable size and shape of plot. Each experimental site has an inherent variation i.e. soil variability which could be assessed through uniformity trial. The study and such variation helps in proper choice in size of shape of plots and blocks, experimental design, number of replications etc. Such studies based on uniformity trials under Indian conditions were undertaken with various annual crops like Safflower (Widemann and Leininger ; 1963), Paddy (Agrawal and Deshpande; 1967), Bajri (Patel and Patel; 1967), Tobacco (Prajapati and Patel; 1984), Mustard (Kumar *et al.*,; 1986), Sorghum (Ramnath and Narayana; 1987) and Mangbean (Singh and Singh; 1989).

However, there is no information on optimum plot size for mustard, for North Gujarat, being predominantly irrigated mustard growing area. Mustard, being an important annual cash crop where grain is economical product. The field experiment (uniformity trial), therefore, was conducted on mustard crop at the Regional Research Station (RRS), Gujarat Agricultural University, Sardar Krushinagar during rabi season of 1986-87.

MATERIALS AND METHODS

The most popular mustard variety "Varuna T. 59" was raised at a spacing of 30 cm. x 10 cm., covering an area of 0.5 hectare. All the recommended practice in vogue were followed. A block of 40 rows of 40 meter length was harvested and grain yield data were obtained seperately for 1600 basic units, the dimension of each basic unit was single row of

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one meter length. The dimensions of the smallest unit were 1 meter length and 30 cm. width (0.30 sq. m.). Contiguous plots were then combined in 36 different combinations and the different sized plots of size 1, 2, 4, 5, 8, 10, 16, 20, 25, 40, 50, 80 and 100 units were formed by combining neighbouring units both lengthwise and widthwise. The coefficient of variation (C.V. %) for each such arrangement was calculated independently and optium plot size was determined using maximum curvature method (Federer, 1955) and soil heterogeneity index 'b' (Smith; 1938). The minimum number of replications (r) and area required for 5 per cent standarad error of mean for different plot size was calculated by the following formula (Nigam and Gupta, 1979).

$$r = (C.V.\ \%)^2 / (5\%\ SE)^2$$

RESULTS AND DISCUSSION

The comparisons were made among different sizes and shapes of plots using C.V.%. The C.V.% decreased steadily either with increase in length of the row or an increase in the number of rows are presented in Table-1 and graphically depicted in Figure-1. The decrease in the C.V.% with an increase in the plot size is in agreement with the finding of Patel and Patel in Bajra (1967), Agrawal and Deshpande in paddy (1967), Prajapati and Patel in tobacco (1984) and Singh and Singh in mungbean (1989). The decrease however was more rapid when number of rows were increased, but beyond 8 rows the decrease in C.V.% was very low. Among varying length of 8 rows, a plot length of 2 meter is ideal, because thenafter reduction in C.V.% was marginal.

Among various combinations, the C.V.% decreased progressively with an increase in plot size up to 16 units (Table 2). The difference between C.V.% of the consecutive points (plot size) may help to estimate per unit decrease in C.V.% and thereby point of maximum curvature (Federer, 1955). The per unit decrease in C.V.% decrease with increase in plot size up to 20 units plot (Table 2). But beyond 16 units plot size the per unit decrease in C.V.% was not proportional to the amount of land used in forming large sized plot. Therefore, 16 units plot size could be considered as an optimum plot size for mustard.

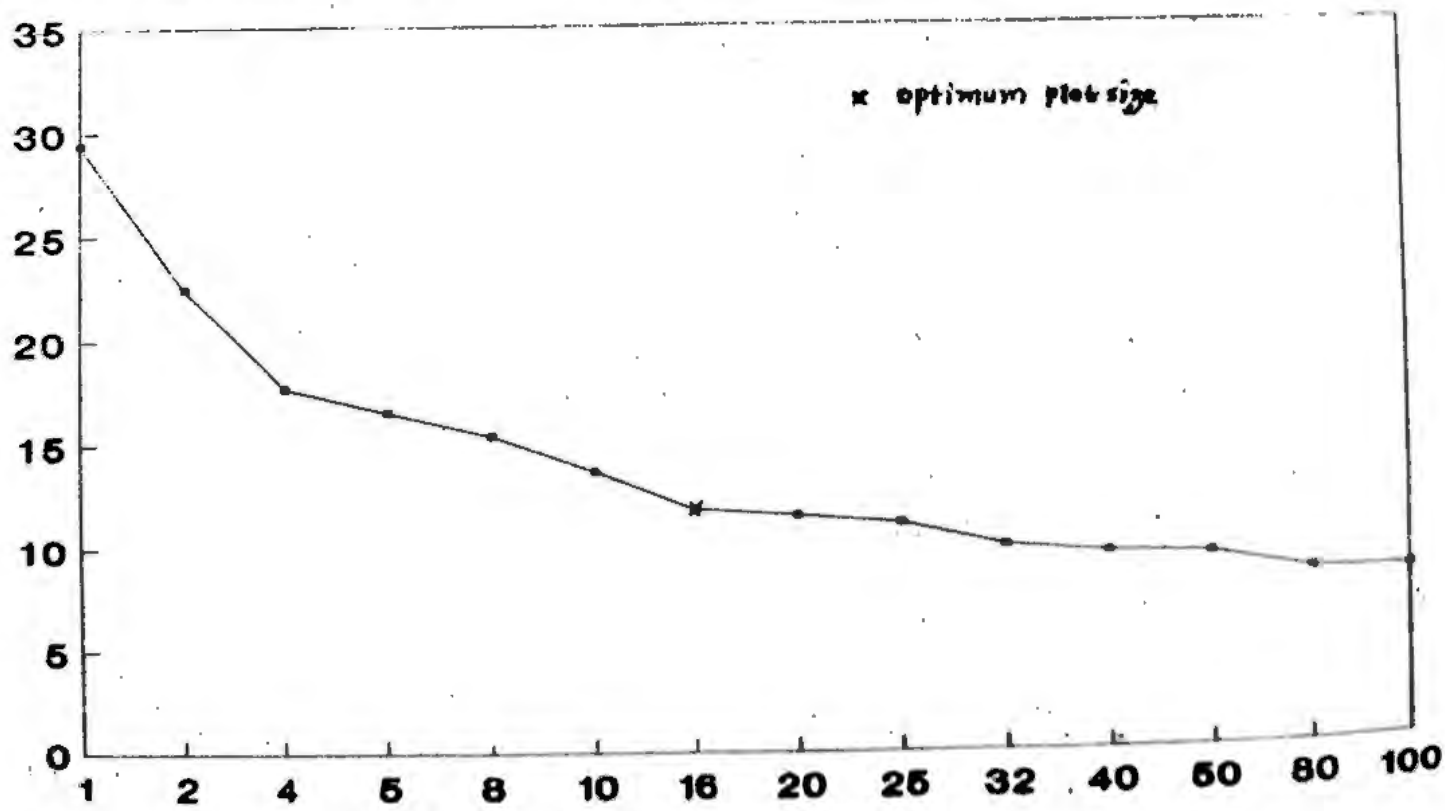

Fig. 1 : Coefficient of variability for different sized plots.

TABLE 1

Average coefficient of variation in per cent with plots of different sizes and shapes.

Breadth (m.)	*No. of rows*	*Length (cm.)*					
		1	*2*	*4*	*5*	*8*	*10*
0.30	1	29.39	23.05	19.00	17.52	16.96	15.03
0.60	2	21.78	17.23	15.35	13.75	12.18	11.67
1.20	4	16.75	14.65	11.59	11.31	10.07	9.96
1.50	5	15.30	12.90	10.96	10.92	9.75	9.49
2.40	8	12.97	11.12	9.51	9.51	8.67	8.43
3.00	10	12.28	10.53	8.91	9.11	8.41	8.29

TABLE 2

Per unit decrease in coefficient of variation for different plot size.

Unit	*Plot size (m^2)*	*Average C.V.%*	*Difference in C.V.%*	*Per unit decrease in C.V.%*
1	0.30	29.39	---	---
2	0.60	22.42	6.97	6.97
4	1.20	17.66	4.76	2.38
5	1.50	16.41	1.25	1.25
8	2.40	15.23	1.18	0.39
10	3.00	13.49	1.74	0.87
16	4.80	11.63	1.86	0.31
20	6.00	11.32	0.31	0.08
25	7.50	10 92	0.40	0.08
32	9.60	9.79	1.13	0.16
40	12.00	9.42	0.37	0.05
50	15.00	9.30	0.12	0.01
80	24.00	8.42	0.88	0.01
100	30.00	8.27	0.15	0.002

The well known Smith (1938) equation $Y-a. X^{-b}$ was fitted between plot variance and plot size for various length of plot and the equations are given in Table 3. The values of 'b' varied from -0.601 to -0.621 indicating existence of correlation between neighbouring plots. It also showed that the C.V.% decreased as the length of the plot and number of rows increased.

TABLE 3

Smith's equation for different lengths.

Length of plot (m.)	*Smith's equation*
1	$Y=2.658 * x^{-0.621}$
2	$Y=2.656 * x^{-0.613}$
4	$Y=2.653 * x^{-0.610}$
5	$Y=2.650 * x^{-0.608}$
8	$Y=2.647 * x^{-0.603}$
10	$Y=2.645 * x^{-0.601}$

From the estimates of C.V.% (Table 2), the minimum number of replications and area required for 5% standard error of mean for different plot size was calculated and are given in Table 4. The number of replications required for a given level of accuracy decreased with an increase in the plot size, which indicates greater efficiency of smaller plots. But small plots were not economical and convenient for various agronomical operations. Similarly, very large plots, which requires less number of replications, were unwieldy for field operations.

Among all combinations of 16 units plot, a plot of 8 rows each of 2 meter length had lowest C.V.%. Taking into considerations the requirement of agronomical operations and handling of experimental materials 8 rows each of 2 m. length (2.4 m. x 2.0 m.) is an optimum net plot size with 5 replications being adequate for conducting mustard trial.

TABLE 4

Number of replications and the area required for 5% SEm. ±.

Unit	*Plot size (m^2)*	*No. of Replications*	*Area required (m^2)*
1	0.30	35	10.50
2	0.60	20	12.00
4	1.20	12	14.00
5	1.50	11	16.50
8	2.40	9	21.60
10	3.00	7	21.00
16	4.80	5	24.00
20	6.00	5	30.00
25	7.50	5	37.50
32	9.60	4	38.40
40	12.00	4	48.00
50	15.00	3	45.00
80	24.00	3	72.00
100	30.00	3	90.00

REFERENCES

Agrawal, K. N. and Deshpande, M. R. (1967). Size and shape of plots and blocks in field experiments with dibbled paddy. *Ind. J. Agric. Sci.*, **37** (6) : 445-55.

Federer, W. T. (1955). Experimental design, theory and application. Mac Millan Co., New York 2nd ed., p. 58.

Kumar, P. R. and Singh, N. P. (1986). Analysis of uniformity trial data with mustard. *J. Ind. Soc. Agri. Stat.*, **38** (3) : 310.

Nigam, A. K. and Gupta, V. K. (1979). Handbook on analysis of Agricultural Experiments. First Edition, I.A.S.R.I. Publication, New Delhi. pp. 3.

Patel, N. M. and Patel, R. M. (1967). Plot technique in Bajri. (*Pennisetum typhoides* S. & H.), B. A. Coll. Mag., GAU, p. 89-97.

Prajapati, B. H. and Patel, N. M. (1984). Estimate of optimum plot size from uniformity data of bidi tobacco. *GAU Res. J. 1984*. **9** (2) : 36-39.

Ramnath, C. K. and Narayana, R. M. (1987). Optimum size, shape and orientation of experimental plots with dryland sorghum. *Ind. J. Agric. Sci.*, **57** (9) : 653-658.

Singh, H. P. and Singh, D. P. (1989). Optimum plot size for field experiment in mungbean. *Narendra Deva J. Agric. Res.*, **4** (1) : 61-64.

Smith, H. F. (1938). An emperical law describing heterogeneity in the yields of agricultural crops. *Ind. J. Agric. Sci.*, **28** : 1-23.

Widemann, A. M. and Leininger, L. N. (1963). Estimation of optimum size and shape for safflower yield trials. *Agron. J.*, **55** (2) : 222-225.

GAU Res. J. 1993. 18 (2) : 40-48

Effect of Depth and Frequency of Saline Well Water Irrigation and FYM on Yield of Wheat-Maize-Groundnut/Paddy Cropping Sequence on Two Calcareous Sodic Soils of Coastal Belt

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ABSTRACT

A field experiment was conducted on fixed plots on shallow red soil of the Shil farm and medium black soil of the Metra farm, located on the coastal belt of Junagadh district in Gujarat to study the effect of frequency (D_1-12 days and D_2-8 days) and Depth L_0-4 cm and L_1-6 cm at Shil farm and 8 cm at Metra farm) of poor quality well waters (EC 4.4 to 5.9 dSm^{-1} at Shil farm and 4.9 to 6.4 dS m^{-1} at Metra farm) in conjunction with FYM(F_0-0 and F_1-25 Mg ha^{-1} FYM) on yields of wheat (Rabi), maize fodder (Summer) and groundnut at Shil/Paddy at Metra (kharif) grown in a sequence and on soil properties. The mean of the three years results showed that frequent irrigation (i.e. after 8 days) of larger depth (i.e. 6 cm) in the presence of FYM (25 Mg ha^{-1}) significantly increased grain and straw yield of wheat and fodder yield of maize over less frequent irrigation (i.e. after 12 days) of shallower depth (i.e. 4 cm) in the absence of FYM at the Shil farm. The D_2L_1 treatment not only produced maximum yield of these crops but also sustained the productivity of the succeeding kharif crops of groundnut at Shil and paddy at Metra farm.

The larger depth of irrigation significantly reduced the EC of the subsoil layers. FYM also produced same effect after monsoon at Metra farm. However, application of FYM significantly increased ESP of surface layer after monsoon at Shil farm.

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INTRODUCTION

Ingress of sea water in the ground water along the coastal belt of Saurashtra region of Gujarat State posed a serious problem of poor quality of well waters (Anon, 1986). The productivity of both the soils and crops of these areas has been declining with the continuous use of these poor quality well waters. The effectiveness of the ameleorative measures for use of such waters varies with quality of water, type of soil, crop, management practices and climatic conditions. Hence the suitability of particular water varies with location to location depending on the above factors. Therefore, it is essential to develop a location specific technology. The good management for the use of saline well waters in right quantity and frequency alongwith use of amendments help in sustaining the productivity of both the soil and crop (Manchanda *et al.*, 1985, Keshwa and Singh, 1988). Keeping this in view a field experiment was conducted during 1981 to 1983 at two locations of the coastal belt area of Saurashtra to study the effect of depth and frequency of irrigation with poor quality well

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waters and FYM on yield of different crops grown in rotation and soil properties.

MATERIALS AND METHODS

The soil of the Shil farm was shallow, stony, red and well drained (Entisol), while that of Metra farm was medium black (Inceptisol) calcareous fine alluvium moderately drained. The properties of the experimental soils and the periodic quality of well waters used are reported in tables 1 and 2, respectively. The eight treatment combinations consisted of three factors each of two levels, viz., frequency (D_1-12 and D_2-8 days for wheat and D_1-15 and D_2-10 days for maize fodder) in the main plots and depth (L_0-4 cm and L_1-6 cm at Shil and 8 cm at Metra) of irrigation waters in the sub plots and FYM (F_0-0 and F_1-25 Mg ha^{-1}) in the sub-sub plots were replicated 4 times in a split-split-plot design. Crop rotations wheat-maize-groundnut at Shil and wheat-maize- paddy at Metra were followed. Farmyard manure was applied every year to wheat (J 24) crop before sowing. The residual effect of FYM was studied with irrigation treatments on maize (Ganga Safed 2) in summer and that of all the treatments on groundnut (GAUG 10) and Paddy (IET 6278) in kharif.

The recommended agronomic practices (seed rate, spacing, fertiliser dose etc.) were followed for the respective crop. The irrigation schedule as per the treatments was followed for irrigating wheat and maize. Groundnut and paddy were rainfed. However, one or more protective irrigations were given to these

TABLE 1

Initial physico-chemical properties of the experimental soil.

Characteristic	*Depth of soil (cm)*				
	METRA FARM			*SHIL FARM*	
	0-15	*15-30*	*30-45*	*0-15*	*15-30*
Physical					
Stone (%)	10.3	6.8	13.5	16.1	62.1
Sand (%)	26.5	33.7	35.0	22.0	14.6
Silt (%)	18.5	14.2	2.4	19.6	19.7
Clay (%)	55.0	52.1	52.6	58.4	65.7
Textural class	Clay	Clay	Clay	Clay	Clay
Bulk density (g cm^{-3})	1.51	1.50	1.66	1.3	---
Chemical					
Lime (%)	48.3	58.3	67.5	8.8	15.5
Organic C. (%)	0.78	0.33	0.36	0.78	0.70
CEC (C mol (P^+) kg^{-1})	46.5	38.6	37.4	40.4	42.1
pHs	8.5	8.3	8.2	7.9	8.1
pH (1:2.5)	7.6	7.6	7.6	7.2	7.1
ECe (dS m^{-1})	1.9	1.8	1.9	3.1	2.4
EC (1:2.5) (dS m^{-1})	0.64	0.47	0.45	0.59	0.47
Exchangeable cation (C mol $(P)^+$ kg^{-1})					
Ca	18.20	13.74	13.22	22.25	22.43
Mg	8.23	6.93	5.85	7.19	9.02
Na	19.23	17.51	17.85	10.18	10.05
K	0.84	0.46	0.45	0.76	0.64
ESP	41.36	45.31	47.46	25.21	23.84

TABLE 2

Quality of saline well water used for irrigation during Nov. 1980 to May 1983

Characteristic	Metra farm	Shil farm
EC (1:2.5) (dS m^{-1})	4.9 - 6.4	4.4 - 5.9
pH (1:2.5)	7.1 - 8.7	7.2 - 8.3
SSP	64.2 - 80.0	34.3 - 48.0
SAR (C mol kg^{-1})	10.6 - 20.0	3.9 - 7.0

SSP - Soluble sodium percentage.

crops depending on rainfall conditions. In the first year, moog was taken in summer at both the places but due to its failure, it was substituted by maize in the subsequent two years. The yield of paddy crop for the third year was not included for statistical analysis as this crop was demaged by the cyclone. The annual rainfall was 1066, 617 and 1794 mm during the years 1981, 1982 and 1983, respectively.

The composite soil sample were collected before the start of the experiment as well as after harvest of each crop from different depths (0-15 and 15-30 cm at Shil and 0-15, 15-30 and 30-45 cm at Metra). The well water samples were collected periodically. The soil samples were analysed for their physico-chemical properties and water samples for EC, pH, anions and cations as per the methods discribed by Piper (1950) and Richards(1954).

RESULTS AND DISCUSSION

Effect on crop yield

Main effect : The data (Table 3) for individual years as well as pooled yield of all the crops of both the sites revealed that, in general, the average yields of both the irrigated crops grown on shallow red soils at Shil farm were significantly affected by all the main effects, except FYM. On the other hand in the medium black soil at Metra farm, irrigation frequency and FYM have significantly affected the mean straw yield of wheat and green fodder yield of maize. The pooled data revealed that the crops irrigated at shorter interval than longer interval, with greater depth than lower depth and with FYM (@ 25 Mg ha^{-1}) against no FYM produced significantly higher yields.

The frequency as well as depth of irrigation did not produce any adverse effect on the yield of paddy at the Metra farm and groundnut at Shil farm. Similarly, FYM also failed to produce any significant effect on these crops, except pod yield of groundnut at Shil farm where it was increased significantly with the FYM (Table 4).

The beneficial effect of more frequent and deeper depth of irrigation with saline waters in wheat is attributed to better moisture regime and low accumulation of salts in the root zone particularly in shallow red soils at the Shil farm. Though, frequent irrigation to maize did not increased mean green fodder yield significantly in individual years, but its average effect was found significant at both the sites. The favourable residual effect of FYM on groundnut yield is ascribed to better physical conditions of fruiting zone soil resulting in increased water holding capacity (Biswas *et al.*, 1969) which help in easy peg penetration and better pod development. Unlike other field crops, groundnut being geotropism, needs soft and moist soil conditions in the fruiting zone. The nonsignificant residual effect of irrigation treatment on kharif crops could be due to leaching of salts from the root zone leading to almost normal conditions as before the start of the experiment. This is also evident from Fig. 1.

TABLE 3

Effect of frequency and depth of irrigation water and FYM on the yearwise and pooled yields (Mg ha^{-1}) of wheat and maize.

Treatment	Wheat grain yield				Wheat straw yield				Maize green fodder yield		
	1980-1981	1981-1982	1982-1983	Mean	1980-1981	1981-1982	1982-1983	Mean	1982	1983	Mean
					METRA FARM						
D_1	2.63	3.73	3.36	3.24	3.13	4.42	4.35	3.96	13.9	9.5	11.7
D_2	3.16	3.80	3.56	3.51	3.84	4.71	4.96	4.50	17.1	14.4	15.8
C. D. (0.05)	0.20	NS	NS	NS	0.40	NS	NS	0.26	NS	NS	3.1
L_0	2.79	3.72	3.51	3.34	3.38	4.44	4.78	4.20	14.2	11.2	12.7
L_1	2.99	3.81	3.41	3.41	3.59	4.69	4.57	4.27	16.8	12.7	14.8
CD (0.05)	0.20	NS	NS	NS	0.22	NS	0.23	NS	NS	NS	NS
F_0	2.85	3.75	3.46	3.35	3.36	4.41	4.59	4.12	14.3	10.6	12.5
F_1	2.95	3.77	3.46	3.39	3.61	4.72	4.72	4.35	16.8	13.3	15.0
CD (0.05)	NS	NS	NS	NS	0.23	NS	NS	0.19	2.2	2.1	1.5
					SHIL FARM						
D_1	2.32	3.62	2.16	2.70	2.62	4.23	3.56	3.47	4.81	6.16	4.98
D_2	3.24	4.15	3.04	3.47	3.46	4.56	4.56	4.20	6.27	9.22	8.25
CD (0.05)	0.40	0.31	0.20	0.59	0.60	NS	0.58	0.23	NS	1.89	1.92
L_0	2.47	3.79	2.44	2.88	2.71	4.36	3.79	3.62	4.49	4.73	4.62
L_1	3.09	4.00	2.77	3.28	3.37	4.44	4.34	4.05	6.59	10.68	8.61
CD (0.05)	0.41	NS	0.15	0.15	0.50	NS	0.45	0.25	1.98	1.38	1.9
F_0	2.69	3.78	2.49	2.99	2.96	4.26	3.96	3.73	5.29	6.39	5.84
F_1	2.87	3.96	2.72	3.18	3.12	4.59	4.16	3.94	5.79	8.99	7.39
CD (0.05)	0.13	NS	NS	0.12	NS	0.22	NS	0.21	NS	1.52	NS

TABLE 4

Residual effect of frequency and depth of irrigation water and FYM on the yearwise and pooled yields (mg ha^{-1}) of paddy and groundnut.

Treatment	Paddy yield (Metra farm)						Groundnut yield (Shil farm)							
	Grain			Straw			Pod				Haulm			
	1981	1982	Mean	1981	1982	Mean	1981	1982	1983	Mean	1981	1982	1983	Mean
D_1	3.02	2.63	2.83	2.89	2.65	2.77	1.34	1.00	1.24	1.19	2.66	1.53	2.52	2.24
D_2	2.85	2.46	2.66	2.80	2.57	2.68	1.39	1.03	1.22	1.21	2.68	1.49	2.38	2.19
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
L_0	2.84	2.51	2.68	2.81	2.54	2.67	1.32	1.00	1.20	1.17	2.60	1.58	2.39	2.19
L_1	3.03	2.58	2.81	2.88	2.69	2.78	1.41	1.03	1.26	1.23	2.74	1.43	2.52	2.23
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
F_0	2.77	2.44	2.61	2.60	2.65	2.63	1.32	0.92	1.15	1.12	2.26	1.52	2.27	2.15
F_1	3.10	2.66	2.88	3.09	2.57	2.83	1.41	1.12	1.32	1.18	2.68	1.50	2.64	2.28
CD (0.05)	NS	NS	NS	0.30	NS	NS	NS	0.18	0.16	0.08	NS	NS	0.18	NS

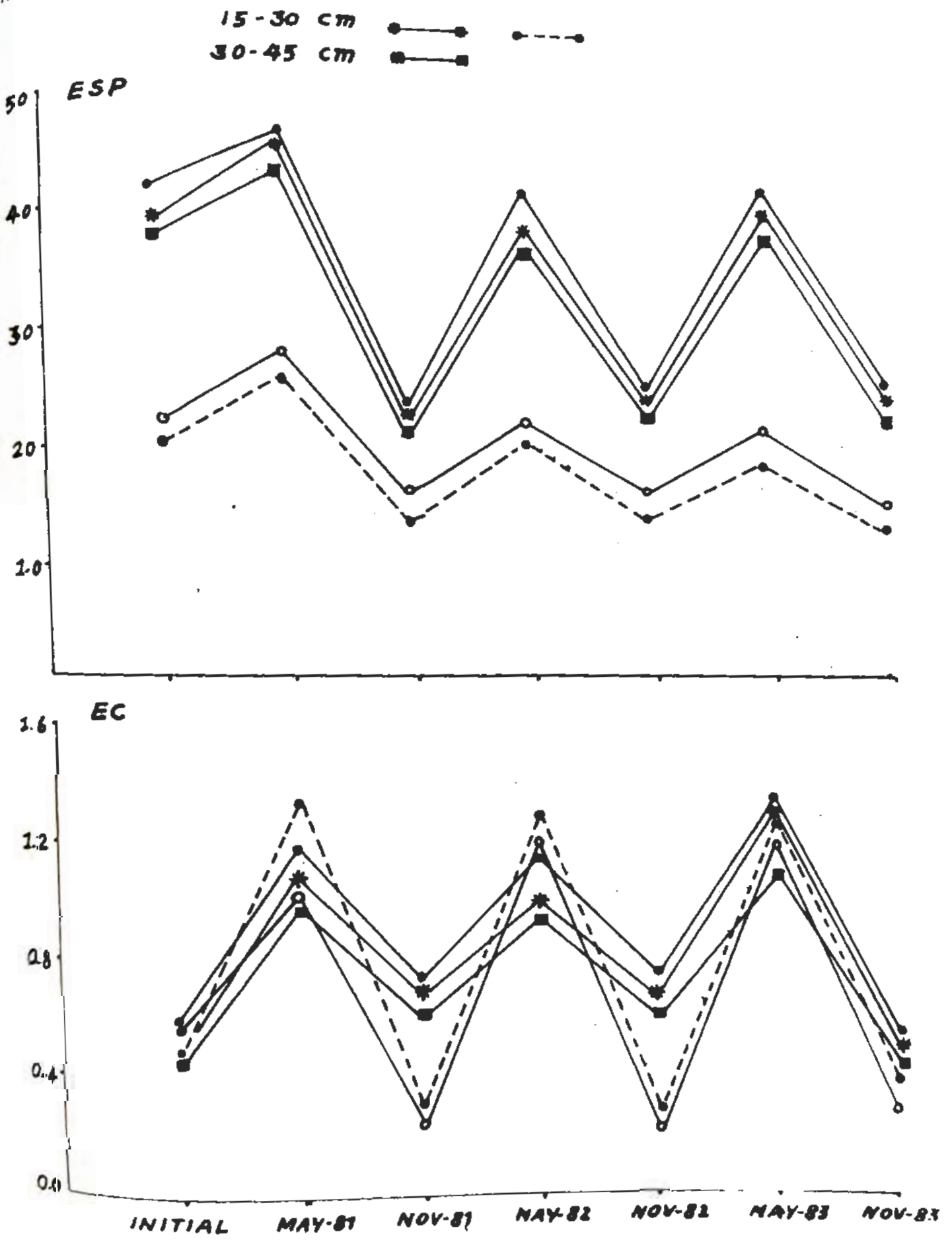

Fig. 1 : Periodic change in EC and ESP during 1981 8?

Interaction effect : The interacting effect of frequency and depth of irrigation water (D x L) was found significant on grain yield of wheat and of maize green fodder at Shil farm (Table 5). The highest grain yield of wheat (3.51 Mg ha^{-1}) and green fodder yield of maize (10.95 Mg ha^{-1}) were recorded in D_2L_1 treatment combination. This could be due to continuous moisture supply and removal of salts from the root zone in the shallow red well drained soil of Shil with this treatment combination (Table 7). On the other hand, in the medium black soil, at the Metra farm, this treatment combination failed to produce any significant impact directly on the irrigated crops. This may probably due to sufficient rootmass of these crops in this soil which can utilise the moisture for the crop growth even where the crop is less frequently (D_1) irrigated with lower depth of water (L_0). However, in this soil the residual effect of this interaction (D x L) significantly affected the kharif paddy crop. The treatment combination D_1L_1 recorded significantly higher grain yield of paddy (3.04 Mg ha^{-1}) than D_2L_1 (2.57 Mg ha^{-1}).

Effect on soil properties

Periodic effect : Irrespective of treatments, overall mean values of EC and ESP of the soil analysed periodically (Fig. 1) revealed that, in general, irrigation with saline waters tended to increase the values of both these soil parameters and reached to the higher peak at the end of the harvest of maize i.e. at the end of May but these values came down to the lowest peak even below the initial values after the harvest of monsoon crops i.e. at the end of October at both the locations. It is seen that whatever salts accumulated in the soils through saline irrigation waters were definitely leached out from the root zone of the soil during monsoon in each year.

Main effect : The treatmentwise soil analysis for EC and ESP in 1983 (Table 6) revealed that the main effects of irrigation and FYM treatments on the soil EC and ESP were negligible both before and after monsoon at both the locations. No beneficial effect of FYM on EC and ESP of soil may be ascribed to the initial highly saline-sodic conditions of the two soils.

Interaction effect : The EC and ESP values of surface and subsurface were significantly affected by D x L, D x F and L x F interactions (Table 7) only after monsoon but they were absent before monsoon i.e. in irrigated conditions. The highest values of EC (0.24 dS m^{-1}) and ESP (15.7) were recorded with D_2L_0 and D_2L_1 and the lowest values (i.e. 0.20 dS m^{-1} and 12.3) in D_2L_1 and D_1L_1 treatment combinations, respectively, in the shallow red soil at Shil farm.

TABLE 5

Interaction effect of frequency (D) and depth (L) of irrigation on yield (Mg ha^{-1}) of different crops.

Treatment combinations	*Metra farm*	*Shil farm*	
	Paddy grain	*Wheat grain*	*Maize green fodder*
D_1L_0	2.61	2.35	3.49
D_1L_1	3.04	3.06	6.27
D_2L_0	2.75	3.42	5.54
D_2L_1	2.57	3.51	10.95
CD (0.05)	0.36	0.21	1.52

TABLE 6

Main effect of different treatments on EC $_{1:2.5}$ (dS m^{-1}) and ESP of the soil before (B) and after (A) monsoon in 1983.

	Soil depth (cm)									
	Metra farm						*Shil farm*			
	0-15		*15-30*		*30-45*		*0-15*		*15-30*	
	B	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*	*A*
Electrical conductivity (EC)										
D_1	1.25	0.40	1.04	0.40	1.00	0.40	1.26	0.22	1.37	0.24
D_2	1.15	0.40	0.98	0.39	0.93	0.39	1.21	0.22	1.24	0.25
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
L_0	1.25	0.39	1.09	0.39	1.05	0.39	1.38	0.23	1.43	0.26
L_1	1.15	0.41	0.93	0.40	0.88	0.40	1.15	0.21	1.18	0.23
CD (0.05)	NS	NS	0.09	NS	0.16	NS	NS	NS	NS	NS
F_0	1.17	0.42	1.03	0.45	0.99	0.42	1.29	0.20	1.38	0.22
F_1	1.22	0.39	0.99	0.38	0.94	0.37	1.24	0.25	1.23	0.27
CD (0.05)	NS	NS	NS	0.04	NS	0.04	NS	NS	NS	NS
Exchangeable sodium percentage (ESP)										
D_1	46.8	23.7	46.7	25.8	52.1	24.7	23.9	13.9	24.7	13.2
D_2	45.8	24.1	45.9	26.3	51.7	25.5	24.2	14.9	23.4	13.3
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
L_0	46.6	24.2	46.5	26.7	52.6	24.8	24.3	15.3	23.1	13.8
L_1	46.6	23.7	46.0	25.4	51.2	25.3	23.7	13.6	24.4	12.8
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
F_0	45.8	23.8	46.2	26.5	51.7	25.6	23.7	12.9	24.4	13.1
F_1	46.8	24.1	46.3	25.6	52.1	24.5	24.3	15.9	23.2	13.5
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	1.0	NS	NS
Initial value (B)										
EC	0.64		0.47		0.45		0.59		0.47	
ESP	41.4		45.3		47.5		25.2		23.8	

NS= Nonsignificant

TABLE 7

Interaction effect of frequency (D) x depth (L), frequency x FYM (F) and depth x FYM, on EC 1:2.5 (dSm^{-1}) and ESP of two soil types.

	Shallow red soil						*Medium black soil*	
	EC (dSm^{-1})		*ESP*		*ES (dSm^{-1})*	*ESP*		*ESP*
	(0-15)	*(15-30)*	*(0-15)*		*(0-15)*			*(0-15)*
	L x F				D x L			D x F
L_0F_0	0.20	0.21	13.2	D_1L_0	0.21	15.7	D_1F_0	22.7
L_0F_1	0.26	0.31	17.4	D_1L_1	0.23	12.3	D_1F_1	24.8
L_1F_0	0.20	0.24	12.8	D_2L_0	0.24	14.9	D_2F_0	24.7
L_1F_1	0.23	0.23	14.5	D_2L_1	0.20	15.7	D_2F_1	23.5
CD (0.05)	0.02	0.05	1.5	---	0.02	1.3	---	2.0

The D x F interaction had significantly influenced the ESP only in the surface layer of the medium black soil at Metra farm. The highest (24.8) and the lowest (22.7) values were recorded with D_1F_1 and D_1F_0 treatment combinations, respectively. The highest values of ESP (17.4) and EC in surface (0.26 dS m^{-1}) and the subsurface (0.31 dS m^{-1}) layers in shallow red soil were recorded with treatment combination L_0F_1, whereas the corresponding lowest values (12.8 and 0.20 dS m^{-1}) were noted with L_1F_0 (Tabel 7). The results indicated that extra water provided for leaching in the shallow red soil was effective in reducing salinity (EC) and sodicity (ESP) from rootzone only in the presence of organic matter.

REFERENCES

Anonymous (1986). Annual Research Report of National Agricultural Research Project (Salinity), Department of Agricultural Chemistry and Soil Science, Gujarat Agril. University, Junagadh.

Biswas, T. D., Ingole, B. M. and K. K. Jha (1969). Change in the physical properties of the soil by fertilizer and manure application. *Fert. News.* **14** (7) : 23-25.

Keswa, G. L. and G. D. Singh (1988). Effect of soil amendments and phosphate fertilization on soil properties and nutrient uptake by wheat in saline sodic soil. *Curr. Agric.* **12** : 65-70.

Manchanda, H. R. Grag, R. N., Sharma, S. K. and J. P. Singh (1985). Effect of the continuous use of sodium and bicarbonate-rich irrigation water with gypsum and FYM on soil properties and yield of wheat in a fine loamy soil. *J. Indian Soc. Soil Sci.*, **33** : 876-83.

Piper, C. S. (1950). *Soil and Plant Analysis*, University of Adelaide, Australia.

Richards, L. A. ed. (1954). *"Diagnosis and improvement of saline and alkali soils"*. U.S.D.A.; HB No. 60.

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Yield and Nutrient Uptake by Rice as Influenced by Nitrogen Management

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ABSTRACT

Field experiment was conducted in split plot design with three replications at Model Agronomy Farm, Navsari (South Gujarat). There were 18 treatment combinations comprising 5 different N managements with 3 levels of N(40, 80 and 120 kg/ha) alongwith 3 controls using rice Cv. Ratna as test crop. From the results it was observed that the T_5 treatment i.e. urea briquettes application at the time of transplanting produced significantly higher grain (47.78 q/ha) and straw (63.48 q/ha) yields as compared to other treatments. The level N_3 (120 kg N/ha) also recorded higher yields of grain (46.41 q/ha) and straw (63.51 q/ha) than those observed with N_1 and N_2. The nutrient uptake also followed the similar trend as was observed with dry matter production, except P uptake wherein treatment T_3 i.e. urea coated with rock phosphate recorded higher uptake (17.82 kg/ha). The combination of T_5 N_3 found to increase grain production to the tune of 25 per cent over control. The positive interaction effect was noticed in the case of dry matter production, while it was not so with nutrient uptake.

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INTRODUCTION

Nitrogen is a single dicisive factor monitoring the rice production. When rice grown in lowland condition, certain nitrogen loss mechanisms viz., volatilization and denitrification becomes more operative. In order to increase the nitrogen fertilizer use efficiency number of ways have been tried. But by all means, the efficiency seldomly exceeds 40 to 60 per cent (Azam *et al.*, 1985, Sarkar and Uppal, 1988). Some ways of increasing efficiency, comprises split application, coating of urea with some indigenous materials and by increasing particle size of urea i.e. urea briquettes. In view of the paucity of date for the rice growing tract of South Gujarat (Chromustert of Eru soil series), present investigation was planned and the results are reported here.

MATERIALS AND METHODS

A field experiment was conducted in split plot design with three replication, at Model Agronomy Farm, Navsari (South Gujarat).

The treatments were :

T_1 : Full dose of N applied at the time of transplanting (T.P.)

T_2 : N applied in two equal splits through urea (II split after 50 days of trasplanting).

T_3 : Rock phosphate coated urea applied at the time of transplanting.

T_4 : Urea gypsum (30% N) applied at the time of transplanting.

T_5 : Urea briquettes (46% N) applied by making hole near hill below 6 cm at the time of transplanting.

T_6 : Control (N_0 nitrogen)

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These treatments were tried with three levels of N viz., N_1 = 40, N_2 = 80 and N_3 = 120 kg N/ha. In all there were 18 treatment combinations i.e. treatments (T_1 to T_5) with 3 levels of N (3 x 5=15) and three control.

An experimental soil was clayey in texture (62.3% clay), alkaline in reaction (pH=7.6), normal with respect to salinity (EC = 0.38 dSm^{-1}), low in N, medium in available P and high in available K content. The grain and straw samples (Cv : Ratna) were collected at harvesting and subjected to chemical analysis for N, P and K content by using standard procedures.

RESULTS AND DISCUSSION

Dry matter production : The data reported in Table-1 show that the grain and straw yields of rice were significantly affected by the N management (T) and its levels (N) along with the interaction effect. The dry matter production was found to increase with the levels of N application and N_3 level recorded significantly higher drymatter than those obtained with N_1 and N_2. Among the different treatments, application of urea vriquettes (T_5) produced significantly higher yields of grain (47.78 q/ha) and straw (63.48 q/ha). The combination T_5 N_3 produced higher drymatter as compared to other combinations.

The higher yields of rice grain and straw could be due to the fertilizer responsive property of the rice crop in general and high yielding variety Ratna in particular. Similar beneficial effects of N application to rice were also reported by George (1980). The higher drymatter production under T_5 i.e. urea briquettes application at a depth of 6 cm might presumably due to the better availability of N through-out the growing period of rice. The results of present investigation are in close agreement with those reported earlier by Craswell and De Datta (1980) and Chen and Zhu (1982).

Nutrient uptake

The results pertaining to N, P and K uptake through grain and straw, are presented in tables 2, 3 and 4, respectively. The data clearly indicated that, the treatment as well as N levels individually significantly affected the nutrient removals. Whereas, the interaction effect was found to be non-significant in most of the cases. The N and K uptake by rice grain and straw followed an identical pattern as was observed for dry matter production. On the other hand the P uptake was higher in T_3 treatment i.e. rock phosphate coated urea. This might be due to addition of P and S through rock phosphate. Total uptake (grain + straw) of N by rice was of the order of 139.02 kg N/ha under T_5 treatment. Similarly, the combination T_5N_3 could derive 154.73 kg N/ha. The results are in accordance with the results of Prasad and Prasad (1980). In case of P and K uptake, the beneficial effect of coating of urea with rock phosphate were also reported by Singh and Modgal (1978).

From the results of present study, it is quite clear that N application to rice is a must. It is also evident from the increase in grain yield to the tune of 27% in case of T_5 treatment over control. Further, an application of N @ 120 kg/ha as urea briquette found superior to split application or coating of urea with rock phosphate or gypsum under lowland condition.

TABLE 1

Grain and straw yield of rice (q/ha) as affected by nitrogen management.

Treatment	Grain				Straw			
	Levels of Nitrogen				Levels of Nitrogen			
	N_1	N_2	N_3	Mean	N_1	N_2	N_3	Mean
T_1	35.98	38.75	47.17	38.96	48.66	53.02	60.64	54.10
T_2	39.20	43.06	45.83	42.69	53.56	55.91	63.91	57.80
T_3	40.16	42.74	45.54	42.82	55.01	58.82	64.45	59.43
T_4	39.69	44.13	45.11	43.24	54.47	58.70	61.91	58.16
T_5	46.19	48.75	48.40	47.78	57.19	66.63	66.63	.63.48
T_6	---	---	---	34.79	---	---	---	46.30
Mean	40.24	43.49	46.41	---	53.78	58.62	63.51	---
	Treat	N Levels	T x N		Treat	N Levels	T x N	
C.D. at 5%	3.1	0.63	1.53		3.0	0.28	4.72	

TABLE 2

Nitrogen uptake (kg/ha) by grain and straw as affected by nitrogen management.

Treatment	Grain				Straw			
	Levels of Nitrogen				Levels of Nitrogen			
	N_1	N_2	N_3	Mean	N_1	N_2	N_3	Mean
T_1	49.73	54.58	64.59	56.31	42.35	51.58	62.32	52.04
T_2	58.57	68.31	74.00	66.99	52.06	57.45	69.16	59.56
T_3	59.22	66.19	73.90	66.44	52.37	57.58	68.00	59.32
T_4	57.25	66.46	73.49	65.73	58.81	59.65	66.34	59.60
T_5	68.57	77.27	79.91	72.25	57.07	68.41	74.83	66.77
T_6	---	---	---	46.63	---	---	---	39.46
Mean	58.67	66.56	73.18	---	52.53	58.91	68.13	---
	Treat	N Levels	T x N		Treat	N Levels	T x N	
C.D. at 5%	7.34	2.74	NS		4.74	5.10	NS	

TABLE 3

Phosphorus uptake (kg/ha) by grain and straw as affected by nitrogen management.

Treatment	Grain				Straw			
	Levels of Nitrogen				Levels of Nitrogen			
	N_1	N_2	N_3	Mean	N_1	N_2	N_3	Mean
T_1	27.80	31.41	35.50	31.57	13.08	14.93	17.72	15.25
T_2	31.00	35.42	39.86	35.50	14.39	16.12	18.67	16.40
T_3	31.64	35.97	37.58	35.07	15.21	19.02	19.21	17.82
T_4	30.98	35.16	38.19	34.78	14.58	16.55	18.12	16.42
T_5	35.65	39.54	41.90	39.03	15.38	18.18	19.21	17.59
T_6	---	---	---	26.50	---	---	---	12.76
Mean	31.41	35.50	38.61	---	14.53	16.96	18.59	---
	Treat	N Levels	T x N		Treat	N Levels	T x N	
C.D. at 5%	3.37	1.21	2.98		1.29	1.08	NS	

TABLE 4

Potassium uptake (kg/ha) by grain and straw as affected by nitrogen management.

Treatment	Grain				Straw			
	Levels of Nitrogen				Levels of Nitrogen			
	N_1	N_2	N_3	Mean	N_1	N_2	N_3	Mean
T_1	17.94	19.30	21.55	19.60	98.88	111.78	128.99	113.21
T_2	18.57	21.97	22.83	21.12	107.57	117.94	136.90	120.80
T_3	20.49	21.80	22.75	21.61	110.59	132.41	135.82	126.32
T_4	20.32	22.00	22.35	21.56	118.80	121.23	132.68	121.90
T_5	22.40	24.28	22.95	23.21	115.53	138.26	141.24	131.67
T_6	---	---	---	17.74	---	---	---	91.15
Mean	19.94	21.87	22.49	---	110.27	124.32	135.13	---
	Treat	N Levels	T x N		Treat	N Levels	T x N	
C.D. at 5%	2.38	1.03	NS		5.25	4.86	10.75	

REFERENCES

Azam, F; K. A. Malik, M. I. Sajjad (1985). Transformation in soil and availability to plant of N^{15} applied as inorganic fertilizer and legume residues. *Plant Soil*, **86** : 3-13.

Chen Rong-Ye and Zhu Zhao-Liang (1982). Characteristics of the fate and efficiency of nitrogen in super grains of urea. *Ferti. Res.* **3** (1) : 63-71.

Craswell, E. T. and S. K. De Datta (1980). Recent development in research on nitrogen fertilizers for rice. *Irri. Res. Series* **49** (5).

George I, Ghobrial (1980). Effect of levels, time and splitting of urea on the yield of irrigated direct seeded rice. *Plant Soil*, **56** : 209-15.

Prasad Mangal and Prasad Rajendra (1980). Yield and nitrogen uptake by rice as affected by variety, method of planting and new nitrogen fertilizers. *Ferti. Res.* **1** : 207-13.

Sarkar, M. C. and K. S. Uppal (1988). Nitrogen balance studies in wheat-maize cropping system using N^{15} tracer measurement by mass spectrometry. Proc. IV National Symp. on 'mass spectrometry' Indian Institute of Sci. Bangalore. pp. Ac-1 : 1-4.

Singh, B. K. and S. C. Modgal (1978). Drymatter production, phosphorus and potassium uptake as influenced by levels and method of nitrogen application in rainfed upland rice. *Plant Soil* **50** : 691-701.

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Effect of Temperature, Vapour Pressure and Thermal Time on Population of Cabbage Aphid, *Lipaphis erysimi* Kaltenbach Infesting Cabbage

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ABSTRACT

Field experiments conducted on population build up of cabbage aphid, Lipaphis erysimi kaltenbach revealed that it population at Anand increased when the maximum temperature reached around 30°C during winter months with constant increase in minimum temperature, vapour pressure and sunshine hours but it was reduced with decreased in minimum temperature eventhough, there was a increase in vapour pressure and sunshine hours. The increase in 1°Cd weekly thermal time increased 4 aphids per leaf.

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INTRODUCTION

Lipaphis erysimi is an important pest of cabbage affecting the yield. The pest remains active on cabbage during December to March. However, the severity of infestation varies considerably from year to year due to effect of abiotic factors. Amongst abiotic factors, temperature influences the population of *L.erysimi* the most. Bakhetia and Sidhu (1983) have reported as 20 to 30° C temperature is the most favourable temperature for reproduction and development of *L. erysimi* on mustard in Punjab. Whereas, Atwal *et al.*, (1971) have reported adverse effect of sub-zero winter temperature on the subsequent build up of aphid populations. Since no informations on effect of other abiotic factors viz., vapour pressure and sunshine hours on activity of *L. erysimi* is available, study was undertaken to understand the role of these abiotic factors on the population density of this aphid on cabbage in Gujarat.

MATERIALS AND METHODS

Experiments to study population build up of *L. erysimi* were laid out at Anand (Gujarat) during rabi 1982-83, 1984-85 and 1988-89 in randomised block design with four replications, using cabbage variety sutton Express. The plot size was 9.00 x 3.60 m. The row to row and plant to plant distance of 45 cm was maintained. Crops were transplanted on five different times at 15 days interval during October to December.

The aphid population was recorded at weekly intervals between 8 to 10 h of the day by counting number of nymphs and adults on three leaves from each of the five rendomly selected plants from each plots with the appearance of aphid to the harvesting of the crop. Yield of marketable cabbage heads were recorded plot wise. The data were subjected to analysis of variance and presented in Table-1.

The meteorological parameters were monitored daily in the Agrometeorological observatory which was 100 m away from the

experimental plot. To calculate Thermal Time (Heat Units) for each day the following equation expressed in centigrade thermal time (°Cd) was employed

$$THI = \frac{T\max + T\min}{2} - T \text{ threshold}$$

T max, T min and T threshold are maximum, minimum and threshold temperature. The threshold temperature was considered zero (Atwal *et al.*, 1971). Vapour pressure was calculated with the help of psychrometric equation by using dry and wet bulb temperatures. The simple graphical representations were performed for analysis and statistical tests for determining the appropriateness of thermal time on the γ square of overall equation.

RESULTS AND DISCUSSION

The aphid, *L. erysimi* and yield data (Table 1) revealed that in the year 1984-85 maximum number of aphids per leaf on cabbage transplanted in the 4th week of November and 2nd week of December were during 8th and 6th week of transplanting, respectively. Whereas during 1988-89 on 2nd and 4th week of November as well as 2nd week of December transplanted crops, maximum aphid populations were found during 15th, 13th and 11th week of transplanting respectively. This late transplanted crops were heavily infested with aphids during the study period. The pooled data revealed negative correlation between aphid populations and yield, especially in the crops transplanted in November and December. The high aphid density in the early stage of the late transplanted crops reduced the yield. In view of this finding to study the effect of weather parameters on population build up of aphid, *L. erysimi* data of 2nd week of November and 2nd week of December transplanted crops for the year 1982-83, 1984-1985 and 1988-89 were used for further statistical analysis.

The aphid population build up was comparatively high on 1988-89 cabbage crop as compared to rest of the two years crops (Table 2, 3 and 4). During 1988-89 aphid population increased with increase in minimum (10 to 30° C) and maximum (27.9 to 33.7°C) temperature as well as vapour pressure (3.9 to 5.1 mm of Hg) and sunshine hours (10.4 to 10.7) (Table 4). Whereas, during 1984-85 in the later stage of the crop growth inspite of maximum temperature being more than 30°C and constant increase in the vapour pressure (3.4 to 4.5 mm of Hg) and sunshine hours (10.1 to 10.5) aphid population decreased with decrease in minimum temperature (12.0 to 8.8°C) on 2nd week of November (D_3) as well as 2nd week of December transplanted crops (Table 3). Bakhetia and Sidhu (1983) have also reported rapid development of *L. erysimi* on mustard at 30°C.

Moreover to temperature, thermal time has also effect on aphid population build up. It was found on both the crops (D_3 and D_5) during all the three years that during the week when thermal time was more than 143° Cd, aphid populations remained higher than rest of the period of crop life. The cummulative thermal time since the week of first appearance of aphid to the week when aphid population reached to it's peak were 729 to 1980° Cd. If we consider the period required to have a maximum aphid, *L. erysimi* population on cabbage crop it could be 5 to 6 weeks after the first appearance of aphid (Table 2, 3 and 4).

The cummulative weekly thermal time with their respective aphid population in that week were regressed to obtain the linear regression equation line (1 :1 line). The date-wise relation were significant and the resultant equation was $Y=510.7113 + 3.9024 x$ with $R^2 = 053^*$ for 2nd week of November (D_3) planting and $Y= -550.36 + 4.2966 x$ with $R^2 = 54^*$ for 2nd week of December (D_5) planting. Where 'Y' represent aphid population

TABLE 1

Population build up of cabbage aphid, *L. erysimi* in relation to temperature, vapour pressure and sunshine and its effect on yield of healthy cabbage heads, transplanted in different dates times.

Transplanting time month	Week	1982-93 Popn./ leaf	1982-93 Yield q/ha	1984-85 Popn./ leaf	1984-85 Yield q/ha	1988-89 Popn./ leaf	1988-89 Yield q/ha	Pooled Popn./ leaf	Pooled Yield q/ha	Temp. °C. Max.	Temp. °C. Min.	V.P. mm of Hg	Sun-shine h
October	II	6.7	51.4	18.2	104.6	4.3	97.2	9.7	84.4	27.5	10.7	9.2	10.0
(D_1)		(15)		(14)		(16)							
October	IV	20.4	43.8	38.6	104.9	2.6	148.8	20.5	99.0	27.5	10.7	9.2	10.0
(D_2)		(13)		(12)		(14)							
November	II	69.3	58.6	29.1	83.3	249.1	179.9	115.8	107.3	29.7	11.7	7.9	10.1
(D_3)		(12)		(10)		(15)							
November	IV	30.1	41.5	94.6	97.3	277.0	137.6	133.9	92.1	29.7	11.7	7.9	10.1
(D_4)		(10)		(8)		(13)							
December	II	54.1	10.43	148.2	56.3	218.7	109.4	140.3	58.7	29.7	11.7	7.9	10.1
(D_5)		(8)		(6)		(11)							
S. Em. ±			5.0		7.6		24.8						
C. D. 0.05%			15.4		23.4		NS						
C. V. %			24.3		17.0		36.90						

Figures in parentheses indicate age of the crop in weeks.

TABLE 2

Aphid population build up in relation to weather parameters in cabbage transplanted during different time (1982-83).

Av. No. of aphid per leaf		*Temperature °C*		*Vapour pressure*	*Sunshine*	*Thermal time °Cd*	
D_3*	D_5**	*Min*	*Max*	*mm. of Hg.*	*h*	*Weekly*	*cummulative*
9.20 (6)	0.02 (2)	14.4	29.8	3.3	9.8	154	154
27.60 (7)	1.78 (3)	10.1	28.4	2.9	10.0	134	289
24.47 (8)	6.79 (4)	9.8	26.4	2.9	9.7	127	417
28.72 (9)	6.17 (5)	9.3	27.4	3.0	9.6	128	545
36.40 (10)	41.66 (6)	14.0	30.7	3.3	9.2	156	702
18.49 (11)	29.03 (7)	10.3	27.2	3.5	9.6	131	833
69.29 (12)	54.08 (8)	13.3	28.8	4.2	8.2	147	980

* II week of November ** II week of December

Figures in parentheses indicate age of the crop in weeks.

TABLE 3

Aphid population build up in relation to weather parameters in cabbage transplanted during different time (1984-85).

Av. No. of aphid per leaf		*Temperature °C*		*Vapour pressure*	*Sunshine*	*Thermal time °Cd*	
D_3*	D_5**	*Min*	*Max*	*mm. of Hg.*	*h*	*Weekly*	*cummulative*
2.93 (5)	0.00 (1)	10.4	30.1	3.1	9.9	141	141
3.14 (6)	5.03 (2)	10.8	28.8	2.5	9.7	138	280
20.07 (7)	12.32 (3)	10.6	26.6	3.4	9.8	130	410
14.70 (8)	35.25 (4)	11.0	27.9	3.1	9.7	136	546
19.53 (9)	100.62 (5)	12.2	28.9	3.6	9.5	143	690
29.05 (10)	148.19 (6)	12.0	29.0	3.4	10.1	143	833
18.32 (11)	123.02 (7)	9.9	30.5	4.0	9.6	141	975
7.80 (12)	43.97 (8)	8.8	31.1	4.5	10.5	139	1114

* II week of November ** II week of December

Figures in parentheses indicate age of the crop in weeks.

TABLE 4

Aphid population build up in relation to weather parameters in cabbage transplanted during different time (1988-89).

Av. No. of aphids per leaf		Temperature °C		Vapour pressure	Sunshine	Thermal time °Cd	
D_3*	D_5**	Min.	Max	mm. of Hg.	h	Weekly	cummulative
1.82	3.24	10.0	27.9	3.9	10.4	132	132
(11)	(7)						
2.90	6.10	10.0	27.9	3.9	10.4	132	265
(12)	(8)						
13.77	19.58	10.1	30.4	4.7	10.4	141	407
(13)	(9)						
96.53	104.33	12.7	32.8	5.1	10.7	159	566
(14)	(10)						
249.08	218.75	13.0	33.7	5.1	10.7	163	729
(15)	(11)						

* II week of November ** II week of December

Figures in parentheses indicate age of the crop in weeks.

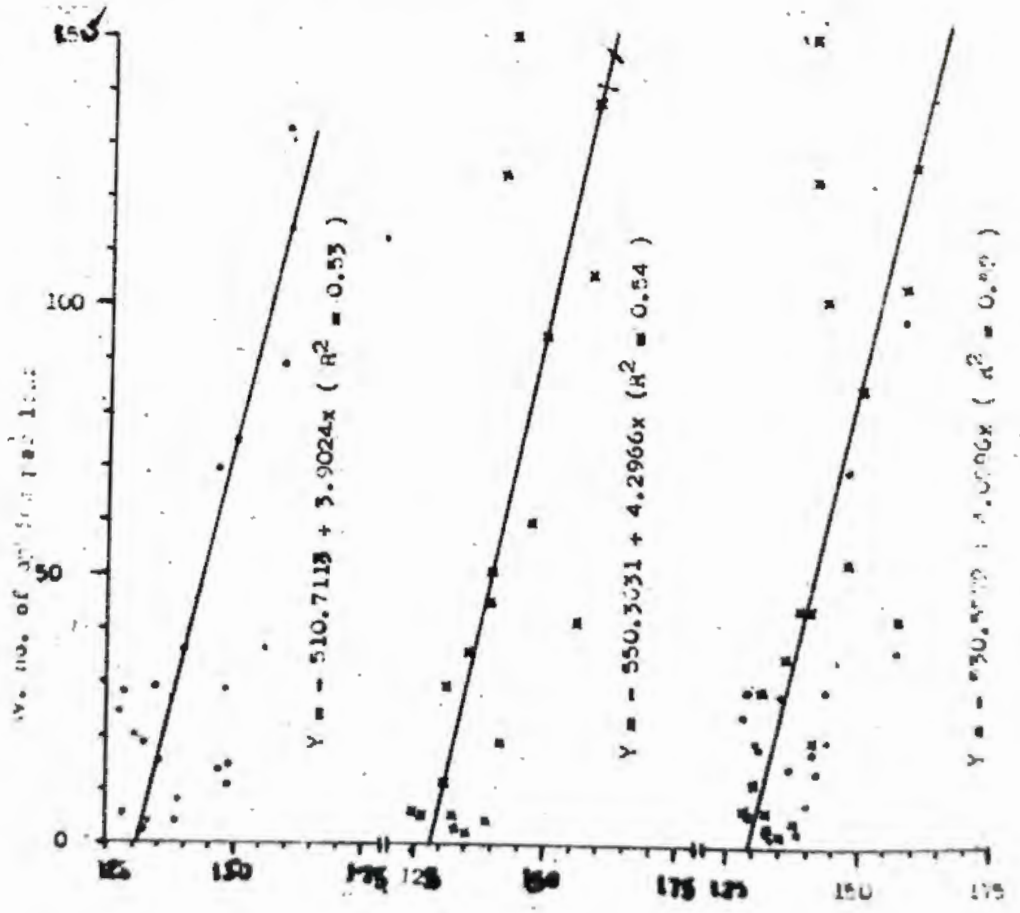

Fig. 1 : Effect of thermal time on aphid, *L. erysimi* populations in cabbage transplanted in the 2nd week of November (D_3) and 2nd week of December (D_5).

and 'x' being thermal time in °Cd (Fig 1). As the value of intercept are significant combined equation were developed for aphid population and thermal time in the form of : Y= -530.5572 + 4.0996 x with R^2 052* which is also highly significant (Fig. 1). It revealed from this study that with increase in 1° Cd weekly thermal time 4 aphids per leaf is increasing.

REFERENCES

Atwal, A. S., Chaudhary, J. P. and Ramzan, M. (1971). Mortality factors in the natural population of cabbage aphid, *Lipaphis erysimi* (Kait). (Aphididae : Homoptera) in relation to parasites, predators and weather conditions. *Indian J. Agric. Sci.* 41 (5) : 507-510.

Bakhetia, D.R.C. and Sidhu, S.S. (1983). Effect of rainfall and temperature on the mustard aphid, *Lipaphis erysimi* (Kaltenbach). *Indian J. Ent.*, 45 (2) : 202-205.

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Studies on Phytotoxicity of Carbaryl on Pigeonpea (*Cajanus cajan* (L.) Millsp.) and its Impact on Grain Yield

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ABSTRACT

Studies on phytotoxicity of carbaryl on pigeonpea were made in field conditions at Agricultural Research Farm, Gujarat Agricultural University, Navsari during 1984 kharif season. Results revealed that carbaryl both in spray and dust formulations exhibited phytotoxic symptoms on foliage. Phytotoxic symptoms started developing from first week after treatment and were fairly evident after 2nd week of the treatment. However, there was recovery in affected leaves as recorded after 4th week's of treatment. Although higher doses *viz.*, Carbaryl 0.43%, 0.22% and 0.1% of Carbaryl 50 WP and 10% dust formulation of carbaryl have caused phytotoxicity on leaves but recorded higher yield may be due to protection given by the pesticide against pest complex infesting pods.

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INTRODUCTION

Among pulses, pigeonpea (*Cajanus cajan* (L.) Millsp.) occupies a very important place in the Indian food pattern, being next to chickpea in the area and production. It suffers great losses due to many insect pests particularly *Melanagromyza obtusa* Mall., *Heliothis armigera* Hb., *Exelastis atomosa* W. and *Clavigralla gibbosa* Spin. during later growth stage of the plant in the area. A number of insecticides have been tested against pest complex of pigeonpea and carbaryl has been found promising (Chelliah *et al.*, 1978; Rajendran *et al.*, 1979 and Sundararaju *et al.*, 1986). But, there have been some reports of its phytotoxicity on this crop (Chari and Patel, 1971; Thakur *et al.*, 1986 and Kabaria *et al.*, 1988). Considering this, the present work was undertaken to confirm the phytotoxicity of carbaryl dust and wettable powder having all possible range from lower to higher dosage and its effect on yield potential of the crop as compared to untreated control.

MATERIALS AND METHODS

Field experiment was conducted at Agricultural Research Farm, Gujarat Agril. University, Navsari during 1984 in *kharif* season to test the phytotoxic effect of carbaryl wettable powder (from lower to higher doses) and dust on pigeonpea crop with five replications and seven treatments including control (water spray) as per detail given in Table 1. All the treatments were applied at 50% flowering stage. One line having 25 tur plants was considered for one treatment. In case of carbaryl 10% dust @ 50 gram per plant was given with the help of musline cloth to ensure full coverage. For the purpose of investigation, five plants were randomly selected from each treated line considering one plant as one replication. Three branches

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from each of previously marked five plants were randomly selected and stagged with luggage lable. The observations on the number of leaves having phytotoxic effect were made only on three tagged branches per plant at 2nd and 4th weeks after treatments. The mean percentage of affected leaves per plant were worked out based on total number of leaves including healthy and affected leaves per three branches per plant. The data on per cent leaves having phytotoxic effect were subjected to statistical analysis using completely randomized design after transformation. At maturing, the yield per plant was also taken into account and analysed statistically using same design.

RESULTS AND DISCUSSION

The data on mean percentage of leaves having phytotoxic effect due to different treatments and the respective grain yield are presented in Table 1. Results revealed that carbaryl both in spray and dust formulations exhibited phytotoxic effect on foliage. The phytotoxic injury symptoms started developing one week after an application of the treatments. It consisted of burning, yellowing and bronzing of leaves and finally the affected leaves defoliated. The branches were seen more spreaded in the treatments where phytotoxic effect was recorded. After two weeks of treatments, the phytotoxic symptoms on foliage were fairly evident and it increased with increasing concentration. It was highest in the treatment of carbaryl 0.43% (81.39%) and differed significantly with rest of the treatments. The treatment of carbaryl 0.01% recorded the lowest percentage of phytotoxic effect(2.38%) and was at par with control. The treatments of carbaryl 0.22%

TABLE 1

Phytotoxicity of carbaryl on pigeonpea and its effect on grain yield.

Sr. No.	*Treatment*	*Average percentage of phytotoxic leaves after indicated period of treatment*		*Yield per plant (gram)*
		After II week	*After IV week*	
1.	Carbaryl 10% dust	32.29 bc (28.53)	24.98 bc (17.84)	42.8 ab
2.	Carbaryl 50 WP @ 0.01%	08.87 d (02.38)	03.76 d (00.43)	31.a bcd
3.	Carbaryl 50 WP 0.05%	24.71 c (17.48)	11.03 cd (03.66)	29.8 cd
4.	Carbaryl 50 WP 0.1%	31.58 bc (27.43)	21.36 bc (13.27)	50.6 a
5.	Carbaryl 50 WP 0.22%	40.59 b (42.33)	31.50 ab (27.30)	32.6 bc
6.	Carbaryl 50 WP 0.43%	64.42 a (81.39)	42.60 a (45.82)	38.6 ab
7.	Control (water spray)	07.52 d (01.70)	04.47 d (00.61)	18.2 d
	S. Em. ±	04.69	05.05	03.90
	C. D. (P= -0.05)	13.56	14.59	13.42
	C. V. %	52.57	37.62	25.00

Note : 1. Figures in parentheses are arcsin retransformed values

2. Figures with same letter(s) are not significantly different at 5% level of significance.

W.P. was at par with the treatments of carbaryl 0.1% W.P. and carbaryl 10% dust. However, carbaryl 10% dust was at par with the treatments of carbaryl 0.08% W.P. After 4 weeks of the treatment, the percentage of phytotoxic leaves decreased in all the treatments as compared to that of two weeks after treatments indicating the recovery in phytotoxic effect. However, the treatments of carbaryl 0.43% recorded highest per cent of phytotoxic leaves (42.82%) and was at par with carbaryl 0.22% (27.30%), while it differed significantly with rest of the treatments. The treatment of carrbaryl 0.01% recorded lowest percentage of phytotoxic leaves (0.43%) and was at par with the treatments of carbaryl 0.05% and control.

Inspite of an apparent phytotoxic effect, yield remained unaffected and different treatments of carbaryl recorded increase in yield as compared to control. The higher yield in various treatments seems mainly due to their better effectiveness in controlling different pests damaging pods. During the study, the crops were observed to suffer from a considerable attack of insect pests mainly *Malanagromiza obtusa, Heliothis armigera, Exalastis atomosa* and *Clavigralla gibbosa* during the reproductive stage of the crop. The treatment of carbaryl 0.1% recorded highest yield (50.6 gm./plant) and was at par with carbaryl 10% dust and carbaryl 0.43%, while it was significantly superior over rest of the treatments. The lowest yield (18.29 gm/plant) in untreated control treatment may be attributed to the pests infesting pods as they were not protected. However, it was at par with carbaryl 0.1% and carbaryl 0.05%.

Thus, it can be concluded that though various higher doses *viz.*, 0.43%, 0.22% and 0.1% of carbaryl 50 WP as well as 10% dust formulation of carbaryl have led to the phytotoxic effect on foliage but recorded higher yield by protecting the pest complex infesting pods. Similarly, Thakur *et al.*, (1986) found carbaryl both in spray (0.2% and 0.4%) as well as dust exhibiting phytotoxic effect on foliage of pigeonpea and reported that the slight to moderate phytotoxic effect did not have a profound effect on the yield potential of the crop. Carbaryl dust formulation has been reported highly phytotoxic to the pigeonpea plant resulting into yellowing and bronzing of leaves and finally the plant defoliated (Chari & Patel, 1971; Kabaria *et al.*, 1988).

REFERENCES

Chari, M. S. and H. K. Patel (1971). Studies on phytotoxic action of carbaryl on pigeonpea. B.A. College of Agriculture, Anand, 1970-71, pp. 47-48.

Chelliah, S.; T. Surulivelu; G. Balasubramanian and P.P. Vasudeva Menon (1978). Studies on the control of red gram *Cajanus cajan* L. pod borers. *Madras Agril J.*, **65** (3) : 1983-87.

Kabaria, B. B.; N. Goyal, C. B. Patel and V. T. Jose (1988). Bioefficacy of carbaryl against *Heliothis armigera* Hb. and its phytotoxic effect on pigeonpea. *Pestology* **12** (11) : 14-17.

Rajendran, R. M.; M. Gopalan; N. R. Mahadevan (1979). A note on the control of red gram pod borers with dust formulation. *Pesticides*, **13** (6) : 55.

Sundar, Raju, D. Kalaichelvan and V. Rangarajan (1986). Control of red gram pod borers with insecticidal dusts. *Pestology*, **10** (3) : 17-18.

Thakur, R. C.; S. M. Vaishampavan and R. R. Rawat (1986). Phytotoxicity of carbaryl on soyabean *Glycine max* L. and arhar *Cajanus cajan* L. and its effect on yield. *Pesticides*, **20** (7) : 39-41.

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Effect of Spray Deposition on Bollworm (*Earias vittella* Stoll) Damage and Yield in Hybrid 6 Cotton

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ABSTRACT

Studies on the effect of spray deposition by different sprayers(Electrodyn, Kanpsack (Hydraulic, Mistblower and Heli) on bollworm damage and yield indicated a positive correlation between spray deposition and yield and it was negative with bollworm damage. The regression coefficient was also positive and significant, indicating that an increase of unit deposition in upper surface and lower surface of upper leaves and total deposition increases in yield by an amount of 22.92, 22.95 and 11.09 kgs/ha. respectively.

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INTRODUCTION

Cotton is one of the most important cash crops of Gujarat, which is subjected to attack by various insect pests through out the crop period. The farmers are using large quantities of new chemicals to overcome the pest menace and this is a major crop on which a large proportion of the insecticides produced in the world is used. Of the total quantity of different pesticides produced in India, about 40.5% is consumed by this crop alone which is valued at Rs. 139 crores (Banerjee, 1981). The effective application method play a key role in increasing the efficacy of the chemical. In the present application method, only less than 10% of sprayed fluid reaches the target pests (Pawar and Kadam 1986). The other 90% of the spray fluid will either fall on the ground or lost in the atmosphere and thus a wastage. Any effective system of spraying which can minimise the wastage would save our precious chemical, time and energy, and increase the bioefficacy of pesticides

Electrostatic spraying systems, which involves the deposition of electrically charged spray droplets on the surface of the pests and crop, which create an attraction between the spray particles and the surfaces, thereby, increasing the percentage of droplets that impinge on the plants, improving the coverage and spray deposition. Heli sprayer is control droplets sprayey (c.d.s.), consists of a spray head (including spinning disc) and a handle to hold it. The energy required for running the motor is produced from seperate power packer unit of 6 volt dry battery. In this sprayer the controlled droplet application is achieved due to centrifugal force generated by the spinning disc. The superiority of electrodyn sprayer over conventional sprayers(Knapsack Hydraulic, Mistblower and Heli) in cotton pest management is well known both abroad and in India. (Brasher *et al.*, 1971, Coffee, 1981, Herzog *et al.*, 1983, Manley, 1982, Pasupathy and Venugopal, 1986, Pawar and Kadam 1986 and Muralidharan, 1987). In the present study, an attempt was made to find out the impact of increased spray deposition on bollworm damage and yield of seed cotton.

MATERIALS AND METHODS

The experiment was conducted during 1983-86 at Anand campus of Gujarat Agricultural University (Variety : Hybrid 6-Cotton, Spacing : 1.2 m x 0.6 m; plot size : Gross : 18.0 m x 4.8 m = 86.4 m^2, Net : 15.6 x 2.4 m = 37.44 m^2). The electrodynamic formulations of cypermethrin (Cymbush 25 ED) was applied through Electrodyn sprayer, which was compared with EC formulation of cypermethrin (Cymbush 25 EC) applied through Knapasak (Hydraulic)(cypermethrin 100 ppm), Mistblower (cypermethrin 200 ppm) and Heli (cypermethrin 50 gm a.i./h) sprayers. The observations on *Earias* damage to buds, bolls and loculi were recorded from 10 tagged plants and yield of seed cotton was recorded from a net plot. The spray deposited by these sprayers on a unit area and spray drift to soil was also determined during 1986-87 using a fluorescent tracer. Uvitex-OB and methodology described by Arnold *et al.*, (1984). The spray deposited by these sprayers on upper and lower surfaces of upper leaves and total deposition was correlated with bollworm damage and yield and regression equations were also worked out.

RESULTS AND DISCUSSION

The percentage infestation to buds, bolls and loculi and yield of seed cotton in different treatments are shown in figure-1. (Pooled result for the years 1983-84, 1984-85 & 1985-86). Persual of the data shows that bollworm damage to buds, bolls and loculi was least in plots sprayed with ED sprayer, followed by Knapsack, Heli and Mistblower sprayed plots. The highest yield of seed cotton (1977 kgs/ha) was recorded in plots sprayed with ED sprayer, followed by plots sprayed with Knapsack (1739 kgs/ha.), Heli (1686 kgs/ha.) and Mistblower (1556 kgs/ha.). Spray deposited by different sprayers in unit area is depicted in fig. 2. It indicates that a significantly high deposition on upper and lower surfaces of upper leaves was recorded in ED sprayer(15.16 & 11.69 ng/cm^2) followed by Knapsack(1.64 and 0.66 ng/cm^2). Heli(1.43 and 0.40 ng/cm^2), and Mistblower (0.89 and 0.36 ng/cm^2). The highest total deposition was also observed in ED sprayer (31.51 ng/cm^2) followed by Mistblower (7.16 ng/cm^2), Knapsack (4.39 ng/cm^2). and Heli (4.08 ng/cm^2) sprayers. The maximum spray drift to soil was observed in Knapsack sprayer followed by Mistblower and Heli. It was least in case of ED sprayer. The spray deposited by different sprayers on upper and lower surfaces of upper leaves and total deposition was correlated with bollworm damage and yield and the regression equation determined are given in Table 1. From the table it can be seen that the spray deposition is significantly and positively correlated with yield which means that an increase in spray deposition has significantly contributed in increasing the yield. The association between the deposition with percentage buds, bolls and loculi damage had shown a negative correlation indicating a decrease in percentage infestation by *E. vittella* to flowerbuds, bolls and loculi due to increase in spray deposition.

The regression coefficient of the linear regression equation is positive and significant (Table-1). It indicates that an increase of unit deposition in upper and lower surfaces of upper leaves and total deposition increased the yield by an amount of 22.92, 27.95 and 11.09 kgs/ha. respectively.

The increased deposition by ED sprayer was reported earlier by Law and Mills (1980), Arnold and Pye (1981) and Mortan (1982) which confirm the present observation. As there is a high degree of positive correlation between spray deposition and yield and also between spray deposition and bollworm damage, it can be concluded that any spraying system which results in more spray deposition on plant can effectively control the bollworm with a resulting increase in seed cotton yield. From the study, it has been observed that ED sprayer deposited more toxicant and recorded

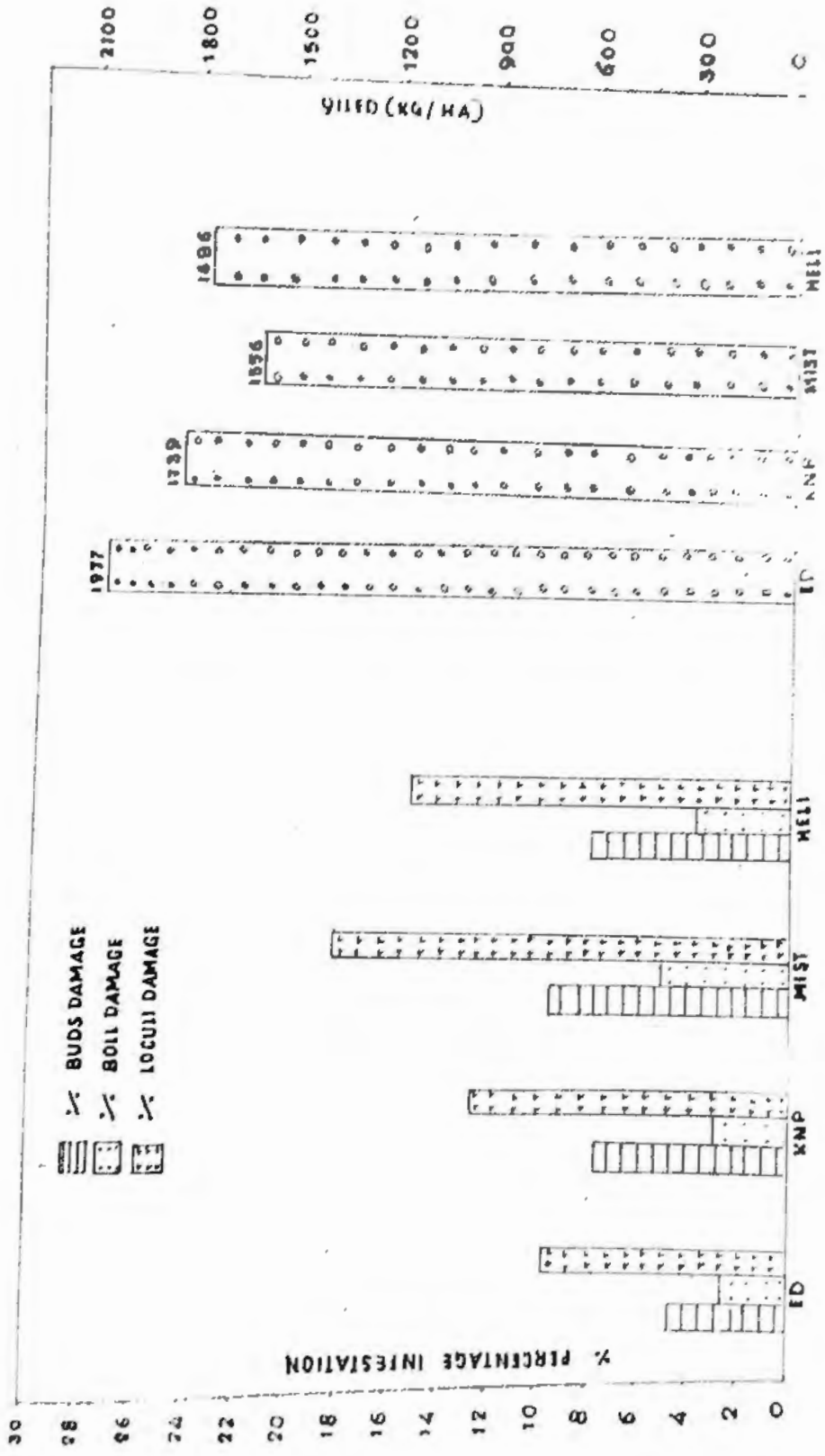

Fig. 1 : Per cent damage due to Earias and yield of seed cotton/HA (Pooled for the years 1983-84, 1984-85 and 1985-86)

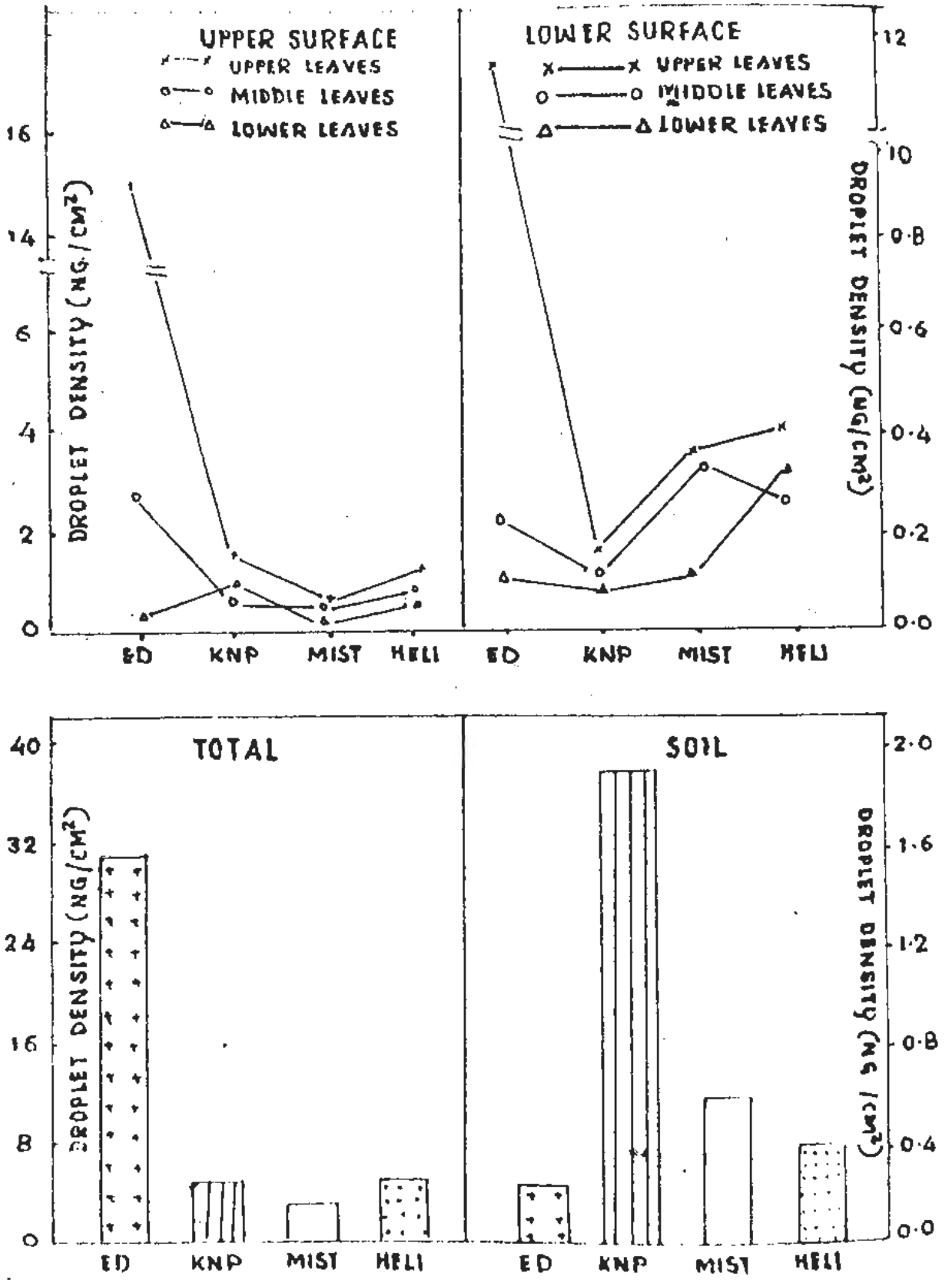

Fig. 2 : Droplet deposition (NG/CM^2) by different sprayers at various levels of cotton

TABLE 1

Correlation and regression equations between spray deposition and yield and bollworms damage.

(A) Correlation equation

Spray deposition	*Yield*	*BOLL WORMS DAMAGE*		
		% Bud damage	*% Boll damage*	*% Locuti damage*
Upper leaves :				
(a) Upper surface	0.7517**	-0.4648	-0.2573	-0.2202
(b) Lower surface	0.7227**	-0.04591	-0.02514	-0.0215
(c) Total	0.6762*	-0.4319	-0.2208	-0.1908

(B) Regression euqation

Dependent	Variable	Linear regression equation.		R^2
Yield	Y	1631.85 + 22.92**	X_1	53.54
	Y	1649.80 + 27.95 **	X_2	52.20
	Y	1610.64 + 11.09*	X_3	45.72

** Significant at 1% level.

* Significant at 5% level.

X_1 Deposition on upper surface of upper leaves.

X_2 Deposition on lower surface of upper leaves.

X_3 Total deposition.

less boloworm damage and higher yield compared to conventional sprayers which also confirms the importance of spraying system to increase the bio-efficacy of the chemical.

REFERENCES

Arnold, A. J., G. R. Cayley, Y. Dunne, P. Etheridage, D. C. Griffiths, F. T. Phillips, B. J. Pye, G. C. Scott and R. R. Vojvodic, 1984. Biological effectiveness of electrostatically charged rotary atomisers. Trials on field beans and barley. *Annal Appl. Biol.*, **105** 353-59.

Arnold, A. J. and B. J. Pye, 1981. Electrostatic spraying of crops with APE 80. *Proc.* 1982 Br. *Crop. Prot. Conf. Weeds* : 1033-1038.

Banerjee, A. K., 1981. Outlook for pesticides. Lessons from abroad. *Pesticides annual* : 3-7.

Brasher, C. J. A. Mullins and S. E. Bennett, 1971. Electrostatic ULV spraying for control of boll weevil. *J. Econ. Ent.*, **64** (6) : 1537-41.

Coffee, R. A., 1981. Electrodynamic crop spraying. *Outlook on Agriculture*, **10** (7) : 350-356.

Herzog, G. A., W. R. Lamberti, S. E. Law, W. E. Seighler and D. K. Giles, 1983. Evaluation of an electrostatic spray application system for control of insect pests in cotton. *J. Econ. Ent.* **76** (3) : 637-40.

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Law S. E. amd H. A. Mills, 1980. Electrostatic application of low volume microbial insecticide spray on broccoli plants. *J. Am. Soc. Hort. Scien.* **105** (6) : 774-777.

Manley, D. G., 1982. Use of electrostatic sprayer for cotton insect control. *J. Econ. Ent.* **75** (4) : 655-656.

Morton N., 1982. The electrodyn sprayer, first studies of spray coverage in cotton. *Crop. Prot.*, **1** (1) : 27-54.

Muralidharan, C. M., 1987. Evaluation of electrostatic spraying system(Electrodyn) in cotton pest management. *M. Sc. thesis, Gujarat AgriculturAl University*, Sardar Krushinagar.

Pasupathy, S. and M. S. Venugopal, 1986. Evaluation of Cymbush[R] electrodyn formulation with electrodyn sprayer for the control of cotton pests. *Indian. J. Pl. Prot.*, **14** (1) : 1-19.

Pawar, V. M. and B. S. Kadam, 1986. Evaluation of different spraying systems for the control of cotton pests. *Abst. Nat. Sem. on Pl. Prot. in Field Crops, CPPTI, Hyderabad*, 29-31 January, 1986-pp20.

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Evaluation of Effective Dose of Monocrotophos Against *Nephantis serinopa* Meyrick by Trunk Injection Technique and It's Comparison to Foliar Spray*

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ABSTRACT

An experiment to evaluate effective dose of monocrotophos against *Nephantis serinopa* Meyrick, incorporated by trunk injection technique and foliar spray was carried out on the farm of N. M. College of Agriculture, Navsari, during 1980-81 and 1981-82. West coast tall, a commonly grown variety of coconut in South Gujarat was used for the experiment. The results revealed that the monocrotophos when applied through trunk injection technique at 10 ml (3.6 g.a.i.) and 20 ml (7.2 g.a.i.) per palm of 8 years age, was found to be effective upto 60 and 90 days respectively fo t e control of the pest in comparison to foliar spray.

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INTRODUCTION

The coconut (*Cocus nucifera* L.) is the most useful palm of tropical region, because every part of tree is exploited commercially. This important palm is reported to be infested by more than 100 insect pests (Nirula, 1955) in various countries. Hutson (1920) reported some important pests like *Nephantis serinopa* Meyr., *Rhynchophorus ferrugineus* F., *Oryctus rhinoceros* L., *Herculia nigrivitta.*, *Erechthias pachygramma* Meyr., *Erechthias lampadacma* Meyr. etc. to be attacking the coconut palms. The first mentioned insect *N. serinopa* is one of the most serious pests of coconut.

The insecticides viz. Paris green, DDT, Toxaphane, Lead arsenate, Malathion and dieldrin were commonly used to control *N.serinopa* before 1970. Over the periods, DDT and dieldrin (Sathiamma and Kurian, 1972) monocrotophos (Anjaria *et. al.*, 1975), DDT and BHC (Rangaswami, 1977 and Thampan, 1981), BHC and Trichlorphon (Butani, 1979), diflubenzuron (Sundarmoorthy, 1980) were recommended as foliar spray for the control of this pest. However since coconut tree is very tall it is combersome to spray the above said insecticides from the ground. To overcome this, trunk injection technique was introduced and it was reported to be effective for the control of various coconut pests viz., stick insect, *Graeffea crouanii* Le. Guilloy in western samoa (Stelzer, 1970), caterpillar *Brassolis. sophorae* L. and moth borer *Castnia deadalus* cramer in Gayana (Rai, 1973), bag worm, Metisa plana WLK. (Wood *et al.*, 1974) and leat moth *Artona cataxantha* Hamps (Ooi *et al.*, 1975). In India Nadarajan and Channa Basavanna (1978), Pillai (1979), Mithyantha *et al.*, (1980) and Nadarajan *et al.*, (1980) have reported that trunk injection of monocrotophos was the most effective for the

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control of *N. serinopa*. In Gujarat Anonymous (1981) have reported monocrotophos @ 9-18 ml. per palm according to the age of coconut plam to be effective against *N. serinopa* Meyr.

The present paper deals with the evaluation of effective dose of monocrotophos applied by trunk injection Technique for effective control of *N. serinopa* Meyr. and it's comparison is made with the foliar application.

MATERIALS AND METHODS

An experiment on control of black headed caterpillar *N. serinopa* of coconut by truck injection technique in comparison to foliar spray was carried out at the Horticulture farm, N. M. College of Agriculture, Navsari during the year 1980-81 and 1981-82. West coast tall, a commonly grown variety in South-Gujarat was used for the experiment. Monocrotophos (Nuvacron 36% w/w) @ 5, 10 and 20 ml. per palm, was used for the trunk injection, while monocrotophos 0.05% was used for foliar spraying.

Experimental Field Layout and Treatments

Eight years old 25 coconut palm were selected for the first year trial (1980-81) as well as second year trial (1981-82). The experiment was laidout in complete randomized design with different treatment given below :

Sr. No.	Treatments	No. of palms/ Replicate
1.	Monocrotophos 36% w/w @ 5 ml (1.8 g.a.i.) per palm by Trunk Inection technique (T.I.T.)	5
2.	Monocrotophos 36% w/w @ 10 ml (3.6 g.a.i.) per palm by T.I.T.	5
3.	Monocrotophos 36% w/w @ 20 ml (7.2 g.a.i.) per palm by T.I.T.	5
4.	Monocrotophos 36% w/w @ 0.05% by foliar spraying.	5
5.	Control (Untreated)	5

Spraying Technique

For injecting the insecticides in the trunk of coconut, a carpenter's auger (Gilmet) with outer diameter of 2 cm. was utilized. The auger was inserted into the stem at a height of 100 cm above ground level at 45 degree angle by rotating it in a clock wise direction to a sufficient depth to hold the amount of the insecticides applied. The measured quantity of insecticides was poured into the hole by using 'Leaf funnel" to direct the liquid into the hole. After introducing the insecticide, the mouth of the hole was smeared with the solution of copper oxychloride (10 grams blue copper 50% added in 100 ml. of water) to prevent the fungal infection. The hole was closed with the cotton plug and then it was plastered with wax so as to prevent the pozing thereafter.

Method of evaluating the treatment

So as to evaluate the effect of different dose of insecticides on *N. serinopa* applied through different techniques tried in the experiment, the measurement of length of galleries made by the larvae ws taken at 15 days interval in both the year. Randomly three leaves per tree and ten leaflets per leaf were selected and tagged. Further, one gallery per each leaflet (tagged) was observed for its increase in length at 15 days interval. The two end of the galley were marked with the stapler pin such a way that any increase in the length at 15 days interval can be traced out easily and clearly. It was observed that pinning with stapler pin had on adverse effect on leaf structure and its normal growth and further no drying of leaflets was observed because of this procedure of pinning.

RESULTS AND DISCUSSION

The data of the trial undertaken during 1980-81 are presented in table 1. The data revealed that the difference in mean length of galleries before the application of different treatment was non-significant indicating the uniformity of the infestation. On 15th and 30th day after application of different treatment the mean length of gallery in the

TABLE 1

Mean length of gallery mined by *N. serinopa* Meyr. before and after application of monocrotophos (1980-81).

Sr. No.	*Details of treatment of monocrotophos 36% w/w*	*Mean length of gallery (cm.)*					
		Before treatment	*Days after treatment*				
			15	*30*	*60*	*90*	*105*
1.	5 ml/palm by T.I.T.*	14.70	17.93b	19.21b	19.21b	19.21b	19.92
2.	10 ml/palm by T.I.T.	15.66	15.68 ab	15.71 ab	15.71ab	18.15b	19.32
3.	20 ml/palm by T.I.T.	13.31	13.31a	13.61a	13.61a	13.89a	17.68
4.	0.05% by foliar spray	14.07	14.20a	14.54a	19.44c	19.44b	19.66
5.	Control (untreated)	15.11	17.43b	19.21b	20.63c	20.81b	21.00
	S. Em ±		1.025	1.283	1.45	1.42	
	C. D. at 5%	N.S.	3.01	3.77	4.26	4.17	NS
	C.V. %		14.59	17.64	18.72	17.50	

* Trunk Injection Technique.

treatment of 20 ml monocrotophos per palm by T.I.T. have remained lowest (13.31 cm. and 13.61 cm respectively) and was at par with the treatment of 0.05% monocrotophos foliar spray (14.20 cm and 14.54 cm respectively) and 10 ml monocrotophos per palm by T.I.T. (15.68 cm and 15.71 cm respectively). On 60th day the treatment of 20 ml monocrotophos per palm by T.I.T. had maintained its superiority by keeping the least mean length (13.61 cm) of gallery and was at par with 10 ml. monocrotophos per palm by T.I.T. (15.71 cm.) The treatments monocrotophos 10 ml. per palm by T.I.T. 5 ml. monocrotophos per palm by T.I.T. and control were inferior to the other treatments and at par on 15th and 30th day after injection. On 60th day the treatments 5 ml. monocrotophos per palm by T.I.T., 0.05% monocrotophos foliar spray and control were inferior to the other treatments and were at par with each other. On 90th day after stem injection, the treatment of monocrotophos 20 ml. per palm by T.I.T. had still maintained its, superority by keeping least mean length (13.89 cm) of gallery, while all the other treatments were at par and inferior. On 105th day after stem injection the difference among the mean length of gallery in different treatments was non-significant, suggesting the loss of effectiveness of monocrotophos 20 ml. per palm applied by T.I.T.

The data of the trial undertaken during 1981-82 are presented in table-2. The data revealed that the difference in mean length of gallery before the application of different treatment was non-significant indicating the uniformity of the infestation. On 15th day after application of different treatment, the mean length of gallery in the treatment of 20 ml monocrotophos per palm by T.I.T. was lowest (11.57 cm) and at par with the treatments of 10 ml. monocrotophos per palm by T.I.T., 0.05% monocrotophos foliar spray and control. The mean length of gallery in the treatment of 5 ml. monocrotophos per palm by T.I.T. was highest (17.20 cm) and at par with control suggesting its failure in checking the increase in infestation. On 30th day, the treatment of 20

TABLE 2

Mean length of gallery mined by *N. serinopa* Meyr. before and after application of monocrotophos (1981-82).

Sr. No.	Details of treatment of monocrotophos 36% w/w	Mean length of gallery (cm.) Before treatment	Days after treatment 15	30	60	90	105
1.	5 ml/palm by T.I.T.*	13.12	17.20b	20.22cd	21.68c	31.07b	32.57
2.	10 ml/palm by T.I.T.	11.73	11.73a	12.71a	15.61b	26.97b	28.56
3.	20 ml/palm by T.I.T.	11.57	11.57a	11.57a	11.57a	21.34a	28.27
4.	0.05% by foliar spray	11.03	12.87ab	15.05ab	21.22c	26.93b	28.37
5.	Control (Untreated)	10.86	14.94ab	17.68bc	24.63c	30.70b	32.18
	S. Em ±		1.16	1.33	1.33	1.62	
	C. D. at 5%	N.S.	3.42	3.92	3.91	4.77	NS
	C.V. %		18.69	19.21	15.64	13.19	

* Trunk Injection Technique.

ml. monocrotophos per palm by T.I.T. was again superior and at par with the treatments of 10 ml. monocrotophos per palm by T.I.T. and 0.05% monocrotophos by foliar spray. On 60th day the treatment of 20 ml. monocrotophos per palm by T.I.T. was agian found superior, and the treatment of 10 ml. monocrotophos per palm by T.I.T. was remained second. All the other treatments including control were at par and inferior. On 90th day, 20 ml. monocrotophos per palm by T.I.T. was only the superior treatment as the mean length of gallery was lowest (21.34 cm) in it, while all other treatments were iinferior and at par among themselves and with control. On 105th day after trunk injection, the difference among the mean length of gallery in different treatment was non-significant suggesting the loss of effectiveness of monocrotophos 20 ml. per palm applied by T.I.T.

Nadarajan *et al.*, (1980) have screened several insecticides for the control of black headed caterpillar, N. serinopa and Red palm mite Raoiella indica Hirst. In coconut palm through the trunk injection technique. They found 3.5 g.a.i. (i.e. 9 ml of 40 EC) monocrotophos per palm by T.I.T. to be effective upto 90 days in younger palm (five years old) and 7 g.a.i. (i.e. 17.5 ml of 40 EC) monocrotophos was effective 60 days in 9 to 10 years old palms. Similarly, Anonymous (1981) have observed 70% and 100% larval mortality from third and sixth day respectively after trunk injection with 9 to 18 ml. monocrotophos per palm.

On the basis of overall results of two years trial, it can be concluded that monocrotophos 20 ml. per palm by T.I.T. was the best treatment as it can check the infestation upto 90 days.

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REFERENCES

Anjaria, P. I., K. P. Kikani, A. H. Shah and V. J. Vora (1875). Studies on the effect of some commonly used insecticides against coconut black headed caterpillar (*N. serinopa*) Meyr.) *Coconut Bulletin* **6** (5) : 1-2.

Anonymous, (1981). Report on the entomological activities of the Department of Entomology, College of Agriculture, Junagadh. Presented in 12th plant Protection Sub-Committee meeting of Agril. Res. Council of GAU, held at Surat on 7-8 May, 1981 (Unpublished)

Butani, D. K. (1979). *Insects and fruits*. Periodical expert book agency, Delhi, I edition. P. 208-209.

Hutson, J. C. (1920). Report of the Entomologist *Rept. Ceylon Dept. Agric.* 1920. Paradaniya, 1921, P. C. 15-17 (Fide. Rev. appl. Ent. 10 : 165).

Mithyantha, M. S. G. P. Channa Basavanna and B. K. Nagesh chandra (1980). Studies on residues of some systemic insecticides in coconut water and copra. Pesticides Residue in the environment in India. *UAS. Tech. Series.* **32** : 295-298 Bangalore.

Nadarajan, L. and G. P. Channa Basavanna (1978). Control of black headed caterpillar *N. serinopa* Meyrick. (Lepidoptera : cryptophasidae) by stem injection of systemic insecticides *Curr. Res.* **7** : 25-26.

Nadarajan, L. ; G. P. Channa Basavanna and B. K. Nageshchandra (1980). Control of coconut pests through stem injection of systemic insecticides. *Mysore Jr. Agric. Sci.* **14** (3) : 355-364.

Nirula, K. K. (1955). Investigation on the pests of coconut palm part-I. *Indian Coconut Jour.* **8** (3) : 188-230.

Ooi, A. C., Peter, Ahmed Yunush, K. G. Gosh and A. Balasubrahanian (1975). Control of coconut leaf moth *Artona catazantha* Hamps by trunk injection technique. *Malaysian Agric. Jr.* **50** : 159-168.

Pillai, G. B. (1979). Finding of the Tamil Nadu Agricultural University regarding trunk injection for coocnut for killing of Nephantis larvae. *Tamil Nadu Agril. Univ. News letter* June, 1979.

Rai, B. K. (1973). *Brassolis sophorae* and *Castnia daedalus* : Chemical control of these major pests of coconut in Gayana. *Jr. Econ. Ento.* **66** (1) : 177.

Rangaswami, G.(1977). Coconut Palm Pests. *Outlook* of *Agriculture* **2** (4) : 167-173.

Sathiamma, B. and C. Kurian (1972). Note on laboratory evaluation of insecticides against the coconut leaf eating caterpillar (*N. serinopa*) *Indian Jr. Agric. Sci.* **42** (7) : 640-641.

Stelzer, M. J. (1970). Preliminary studies on the control of coconut stick insect *Graeffa crouanii* with systemic insecticides. *Bull. Entomol. Res.* **60** (1) 49.

Sundaramoorthy, V. T. (1980). Effect of Diflubenzuron on a field population of the coconut black headed caterpillar, *N. serinopa* and its parasite, *Parasierola nephantidis* in India. *Bull of Entomological Research* **70** (1) : 25-31.

Thampan, P. K. (1981). *Handbook on coconut palm*. I edition Oxford and IBH Publishing Co., New Delhi, 169 P.P.

Wood, B. J.; S. S. Lian and J.C.X. Knecht (1974). Trunk injection of systemic insecticides against the bag worm *Metisa plana* on oil palm. *Oleagieux* **29** : 499-505 P.P.

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Constraints in Adoption of Improved Cotton Cultivation Technology in Tribal Area

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ABSTRACT

The studies carried out during 1989 in tribal area of Kinwat Block (Maharashtra State). The purpose of the study is to identify the major constraints in adoption of improved cotton cultivation technology in tribal area. The results of the studies revealed that tribals facing major cosntraints were more costly seeds, lack of finance, high cost of irrigation, high cost of chemicals, non-availability of irrigation facility, high rate/prices of fertilizers, etc. In order to overcome these constraints, they should provide atleast seeds, fertilizers and plant protection chemicals on subsidised rate through co-operatives on time.

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INTRODUCTION

The tribals are away from the main stream of national development and they have their unique problem such as (i) problem of exploitation (ii) the problem of cultural crisis, (iii) accessibility problems of the areas inhabiting the tribals i.e. (a) majority live in hilly and forest areas having lack of infrastructure facilities i.e. means of communication, transport, marketing and (b)sparce population of the villages and dispersed habitats seriously limiting the possibility of social, cultural and economic development, (iv) lack of education, economic development, problems of health,. nutrition, housing etc.

Constraints are circumstances or causes which prohibit the farmers from adopting improved farm practices. Operationally constraints are defined as the degree of restriction by which the adoption of technology is either restricted or partially adopted by the farmers. A study of constraints is useful to know the impact of the transfer of technologies, which is considered to be the prime mover in the process of agricultural development.

Studies conducted in past by Sadamate (1978), Kulkarni (1979) and Gholve (1986) found that extent of adoption of technology in tribal area is quite low to medium level. Inspite of legislative efforts by the extension workers, researchers and the administrators, the adoption of technology among tribal farmer remained lower as compared to non-tribal farmers. Many scientists reported different constraints which are responsible for decreasing the rate of adoption of technology. Scattered settlements, un-economic holdings, traditional beliefs were reported causing high technological gap Kulkarni(1973) and Mishra (1974). Marketing, lack of irrigation and inadequate credit facilities are important constraints reported by Sadamate (1978). Kulkarni (1979) found that for both tribal and non-tribal farmers cosntraints like non-compatibility of technology, inefficient input and credit service and lack of knowledge about technology were responsible for

increasing the technological gap. The study was conducted with a purpose to identify the constraints faced by tribal farmers in adopting selected improved practices and to know the suggestions made by the tribal farmers to overcome the constraints in adoption of selected improved practices.

MATERIALS AND METHODS

The study was conducted in tribal area in Kinwat block of Nanded district of Maharashtra State. In all, 210 cotton growers were identified randomly. Constraints were measured by taking into consideration all the possible difficulties arising while adopting selected agricultural technology of cotton crop. Twenty six statements pertaining to constraints were listed. Each respondents was asked to indicate the constraints and the answer of the respondents to each statement was marked Yes/No. The score of 'one' and 'zero' was assigned to 'Yes' and 'No' answers to each item, respectively,. The scores on each statement were summated. Final score was calculated by covering the score into percentage. In the same procedure remedial measures suggested by the respondents in tackling these constraints were computed.

RESULTS AND DISCUSSION

Information pertaining to constraints faced by the tribal farmers while adopting selected improved technology of cotton crop is presented in Table 1.

TABLE 1

Distribution of respondents according to their cosntraints in adopting selected improved practices of cotton crop.

(N=210)

S. No.	*Constraints*	*Frequency*	*Percentage*
1.	Soil is not suitable for cotton cultivation	25	11.90
2.	Lack of awareness-knowledge of hybrid cotton seeds	102	48.57
3.	Non availability of pure and quality seeds	84	40.00
4.	More costly seeds	171	81.42
5.	Cotton seeds is susceptible to pests and diseases	82	40.47
6.	Improper germination of seed	88	41.90
7.	Lack of knowledge about the merit of using fertilizers	112	53.33
8.	Fertilizers availability is difficult	72	34.28
9.	High rate prices of fertilizers	151	71.90
10.	Fertilizers spoils the structure of soils	92	43.80
11.	Introduction of diseases and pests through application of heavy dose of fertilizers.	118	56.19
12.	Diversion of fertilizers to irrigated plots	65	30.95
13.	Lack of awarness-knowledge of plant protection measures.	150	71.42
14.	High cost of chemicals	161	76.66
15.	Application of plant protection is complicated technique.	142	67.71
16.	Non-availability of plant protection implements.	95	44.76
17.	Non availability of plant protection chemicals.	78	37.14
18.	Plant protection practices are against social customs.	137	65.23
19.	Labour requirement is high	104	49.52
20.	High cost of irrigation	165	78.57
21.	Non-availability of irrigation facility	155	73.80
22.	Lack of finance	167	79.52
23.	Non-availability of finance on time	153	72.85
24.	Lack of technical advice	145	69.04
25.	Non-availability of improved implements on time	138	65.71
26.	Lack of incentives from Government	119	56.66

It was evident from the Table 1 that a majority of the tribal farmers have experienced that they were facing various problems while adoption of improved agricultural practices of cotton crop. The major constraints identified were more costly seeds (81.42 per cent), lack of finance (79.52 per cent), High cost of irrigation (78.57 per cent), high cost of chemicals (76.66 per cent), non-availability of irrigation facility (73.80), non availability of finance on time (72.85 per cent), high rate/prices of fertilizers (71.90 per cent), lack of awarness-knowledge of plant protection measures (71.90 per cent) and lack of technical advice (69.4 per cent). Further they indicated application of plant protection was complicated technique as well as against social custom (67.61 and 65.23 per cent) and non-availability of improved implements on time (65.71 per cent).

Constraints like non-availability of plant protection implements (44.76 per cent) non-availability of plant protection chemicals (37.14 per cent) and non-availability of chemical fertilizers (34.28 per cent) were also expressed by the respondents.

The suggestions given by the respondents to overcome these constraints are mentioned in Table 2.

It was observed from the Table 2 that a majority of the tribal farmers had indicated constructive suggestions to overcome these constraints faced by them in adopting improved agricultural practices of cotton crop. The most important suggestions given by them were pure seeds, fertilizers and plant protection measures should be supplied through co-operative on time (80.95 per cent), followed by subsidy for purchase of improved seeds, fertilizers and plant protection chemicals (71.01 per cent), irrigation facilities should be made available by the government (75.23 per cent), farmers should be provided knowledge about seeds, fertilizers and plant protection measures (71.42 per cent), technical guidance at all levels should be provided timely through extension personnel working in the area (68.57 per cent).

TABLE 2

Distribution of respondents according to their suggestions to overcome the constraints.

(N=210)

S.No.	*Suggestions*	*Frequency*	*Per cent*
1.	Farmers should be provided knowledge about improved seeds, fertilizers and plant protection measures.	150	71.42
2.	Quality seeds, fertilizers and plant protection measures should be supplied through co-operative on time.	170	80.95
3.	Subsidy for purchase of improved implements.	127	60.47
4.	Subsidy for purchase of improved seeds, fertilizers and plant protection chemicals	163	77.61
5.	Preference to cotton growers in getting electric line.	115	54.76
6.	Irrigation facilities should be made available by government	158	75.23
7.	Cotton price should be fixed after studying the cost of cultivation and average production of area.	91	43.33
8.	Payment of cotton produce should be immediate.	102	48.57
9.	Technical guidance at all levels should be provided timely through extension personnal working in the area.	144	68.57
10.	Timely short duration training to the tribal farmers.	135	64.28

Besides, tribal farmers also expressed that they should provide timely short duration training, subsidy for purchase of improved implements, preference to cotton growers in getting electric line, immediate payment of produce and adequate cotton price to be fixed on the basis of average production of the area.

Tribals facing constraints like economical, situational, administrative, lack of irrigation facilities, inefficient input supply etc. hence they should provide at least seeds, fertilizers and plant protection chemicals on subsidised rate through co-operative on time. They should provide sufficient credit, timely service and skill training. The panchayat should be the unit of planning and implementation to be able to take into consideration the local resources and situational needs. Each panchayat should prepare detailed outline for farm planning. The extension agency and panchayat leaders should jointly implement the programme.

REFERENCES

Gholve, M. A. 1986. Socio-cultural and psychological correlates of tribal development in Kinwat block of Nanded district of Maharashtra State. Unpublished Ph. D. Thesis Parbhani, M.A.U.

Kulkarni, M. G. 1973. Problems of tribal development : A case study Pune : Gokhale Institute of Politics & Economics.

Kulkarni, R. R. 1979. An analysis of technological gap in tribal economic system. Unpublished Ph.D. Thesis, Parbhani, M.A.U.

Mishra, R. K. 1974. Co-operative sector as an instruments of economic change in tribal and hill areas. *Indian Cooperative Review*, **12** (2) : 115.

Sadamate, V. V. 1978. A study of tribal farming system and technological gap. Unpublished Ph. D. Thesis New Delhi : I.A.R.I.

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A Scale to Measure Farmers' Attitude Towards Sprinkler Irrigation System

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ABSTRACT

A 20 item 'Scale Product Method' type scale has been constructed and standardized to measure the attitude of farmers towards Sprinkler Irrigation System. The coefficient of reliability was 0.833.

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INTRODUCTION

Sprinkler Irrigation System (SIS) is one of the best method which can counter many of the problems faced by conventional method of flood irrigation. Government of India and some State Governments have taken efforts to popularise this new method and are also supporting it by providing capital subsidy to farmers. However, its success or failure depends largly upon farmer's attitude towards it, that is, what farmers think and feel about SIS.

As the SIS is a very new method of irrigation, there is hardly any study available on attitude of farmers towards this irrigation system. Hence, it was felt necessary to develop a scale to measure the attitude of farmers towards SIS which could be used by researchers and extension personnel as well.

MATERIALS AND METHODS

Construction of Attitude Scale

In the present study, an attempt has been made to develop a scale which can scientifically measure farmers' attitude towards SIS. Among the techniques available for construction of scales, the Thurston's Equal Appearing Interval Technique (1928) and the Likert's summated Rating Technique (1932) are quite well known. But both the methods suffer from limitations the first one is getting discriminating response and second one in selection of items. Thus, the technique chosen to construct the attitude scale was of the "Scale Product Method" which combines the Thortone's technique of equal appearing interval scale for selection of items and Likert's technique of summated rating for ascertaining the response on the scale as proposed by Eysenck and Crown (1949).

Steps Involved in Construction of Attitude Scale

(a) Item Collection

In initial stage of developing the scale, 52 attitudinal statements about SIS were collected from relevant literature, experts in the field and extension workers. The statements, thus, selected were edited on the basis of the criteria shown by Edward (1957).

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(b) Judge's Rating of Attitudinal Statements

In order to judge the degree of 'Unfavourableness-favourableness of each statement on the seven point equal appearing interval continuum a panel of 100 judges was selected. The judges selected for this study comprised of irrigation specialists and Professors from Agricultural Engineering and Technology College, GAU, Junagadh, Professors of the Department of Extension Education of all four Agricultural Colleges of GAU, and other persons with considerable experience in SIS. The letter of instructions was sent alongwith statements. Out of thses hundred judges forty five judges replied, and were considered for the analysis.

(c) Determination of scale and Q values

The seven points of the rating scale were assigned scores ranging from 1 (for most unfavourable) to 7 (for most favourable). Then based on the judgement, the scale i.e. median and Q value for each of 52 statements were calculated. The following formula was employed to calculate the scale and Q values :

$$S = L + \frac{(0.50 - pb)}{pw} \times i$$

Where,

S = The median or scale value of the statement.

L = The lower limit of the interval in which the median falls.

pb = The sum of the proportions below the interval in which the medin falls.

Pw = the proportion within the interval in which the median falls.

i = the width of the interval and is assumed to be equal to 1.00.

The inter-quartile range $Q=Q_3-Q_1$ for each statement was also worked out for determination of ambiguity involved in the statement.

RESULTS AND DISCUSSION

(a) Final Statements for Attitude Scale

When there was a good agreement among the judges in judging the degree of favourableness or unfavourableness of a statement, Q was small compared to the value obtained when there was a relatively little agreement among the judges. Only those items were selected whose median (Scale) values were greater, than Q-values. However, when a few items had the same scale values, items having lowest Q values were selected. Based on the median and Q values 20 statements were finally selected to constitute the attitude scale.

(b) Method of Scoring

The selected 20 statements for the final format of the attitude scale were randomly arranged to avoid response biases which might contribute to low reliability and deteraction from the validity of the scale. Against each of 20 statements, there were five columns representing a five-point continuum of agreement and disagreement to the statements as followed by Likert (1932) in his summated rating technique of attitude measurement. The points on the continuum were strongly agree, undecide agree. disagree and strongly disagree with weight of 5, 4, 3, 2 and 1 respectively for a favourable statement; and with weight 1, 2, 3, 4 and 5 respectively for an unfavourable statement.

The weights of Likert's technique and the scale values of Thurstone's technique were combined in form of a product and the total score for an individual was the sum of the product. The final format of the scale is presented below :

Sr. No.	Statement	SA	A	U	DA	SD
1.	Crop matured early in sprinkler irrigation (3.9)					
2.	Field preparation in next season becomes difficult in sprinkler irrigation plot (4.9)					
3.	Dealers of sprinkler irrigation set provide good maintenance service (4.4)					
4.	Sprinkler irrigation adversely affects the soil fertility (3.7)					
5.	Weed infestation is less in sprinkler irrigation (5.7)					
6.	Sprinkler irrigation reduces the possibility of pests diseases in the crop (4.8)					
7.	The performance of interculturing operations is inconvenience in sprinkler irrigation (4.5)					
8.	Short duration training will increase the efficiency for operation of sprinkler irrigation system (6.3)					
9.	More quntity of fertilizer is required in sprinkler irrigation plot (5.6)					
10.	Sprinkler irrigation prevents frost damage to crop (5.0)					
11.	Sprinkler irrigation facilitates high seed germination (5.8)					
12.	Quality of water should be clean for sprinkler irrigation system compared to traditional system (6.0)					
13.	Chemical fertilizer gives better results with sprinkler irrigation (5.9)					
14.	Loss of water is high in sprinkler irrigation during summer season (5.5)					
15.	Soil moisture can be maintained at optimum level by sprinkler irrigation (6.1)					
16.	Wind velocity reduces the efficiency of sprinkler irrigation (6.4)					
17.	Sprinkler irrigation is benedictory to farmers (6.5)					
18.	Sprinkler irrigation system restricts the farm operation through farm machinery (4.6)					
19.	I don't prefer sprinkler irrigation system at my farm (6.7)					
20.	Government favours the sprinkler irrigation system (6.6)					

SA = Strongly agree
A = Agree
U = Undecided
DA = Disagree
SD = Strongly disagree

Reliability of the Sacle

The split-Half-Technique was used to measure the reliability of the scale. The 20 statements were divided into two equal halves with 10, odd-numbered in one half and the 10 even-numbered statement in the other. These were administered to 20 respondents. Having obtained the two scores for each of the 20 respondents, co-efficient of reliability between the two sets of scores was calculated which was 0.833.

Reliability co-efficient was calculated by Rulon's formula (Guilford, 1954):

$$r_{tt} = \frac{1 - 6^2d}{6^2t}$$

Where

r_{tt} = Coefficient of reliability

d = Difference between two half score of respondents

6^2 d = Variance of those differenc s

6^2t = Variance of total scores

REFERENCES

Edward, A. L. (1957). Tecniques of Attitude scale construction. Applecton Century Crofts. Inc.

Guilford, J. P. (1954). Psychometric Methods. Tata McGraw Hill Publishing Co. Ltd. Bombay : 9-379

*Likert, R. A. (1932). A Technique for Measurement of Attitude Scales. Arch. Psychol. (140).

*Thurstone, L. L. and E. G. Chave, (1928). The Measurement of Opinion. *J. of Abnormal Social Psychology* **22** : 215-430.

* Cited from secondary sources.

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Short Communications

Heat Indices of Soybean as Influenced by Shallow Ground Water Table

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Glycine max (L) Merril is a major crop of Barna Command, occupying 30% culturable command of 54000 hectares. In upper reaches of command water table rises upto critical root zone depth which adversely affects the crop growh. Soybean crop is highly sensitive to photoperiod, temperature and shallow ground water table depths. The day length required to initiate flowering is specific on certain water table depth (Thurlow 1971).

The study was conducted on clayey soil of Barna Command at JNKVV Research Station, Bari District Raisen. The soybean variety JS 72-44 was planted on 1st to 7th July during 1986 to 1989 on cultivators field under the influence of existing ground water table depth 0-80 cm and below 80 cm from ground surface. The water table were recorded in each plot by the auger hole. The flowering and maturity characteristics were determined by visual observations. Dates were recorded for emergence (S_1), beginning of flowering (S_2), flowering completion (S_3), pod development (S_4) and maturity (S_5) for corresponding water table depths. The growing degree days (GDD) were calculated using 5°C as base temperature and accumulated over the different stages under consideration. Photothermal units (PTU), Phenothermal index and Heat use efficiency were calculated by following Rajput and Sashtry (1985).

Data pertaining to occurence of phenological events in case of soybean under varying water table depths have been presented in Fig. 1a, b, c and d. It is evident from the data that the higher number of days were taken for emergence, flowering and crop maturity under the influence of ground water table depth 0-80 cm. Both calender days and GDD for various growth phases were higher under the influence of ground water table depth 0-80 cm. The difference between planting to maturity was observed to be 7.5 days. The flowering initiation required 875.66 GDD when soybean crop was grown under deeper water table depths (Iruthayaraj and Morachan 1978). The same trends in photothermal units (PTU) were also observed (Fig. 1c).

The phenothermal indices ranged between 20.2 to 24.18 during different phenological events with an average value of 22.60 and yielded a coefficient of variation 7.94 %.

The heat use efficiency (HUE) have been presented in Table 1. The HUE values were more under the influence of deeper water table (below 80 cm) for both grain and biomass showing better adoptability of soybean JS 72-44.

The average water table depths and yield of soybean crop are presented in Table 2. It is evident from the data that the extent of yield reduction varied from 24.4 to 32.9% due to rise of ground water table.

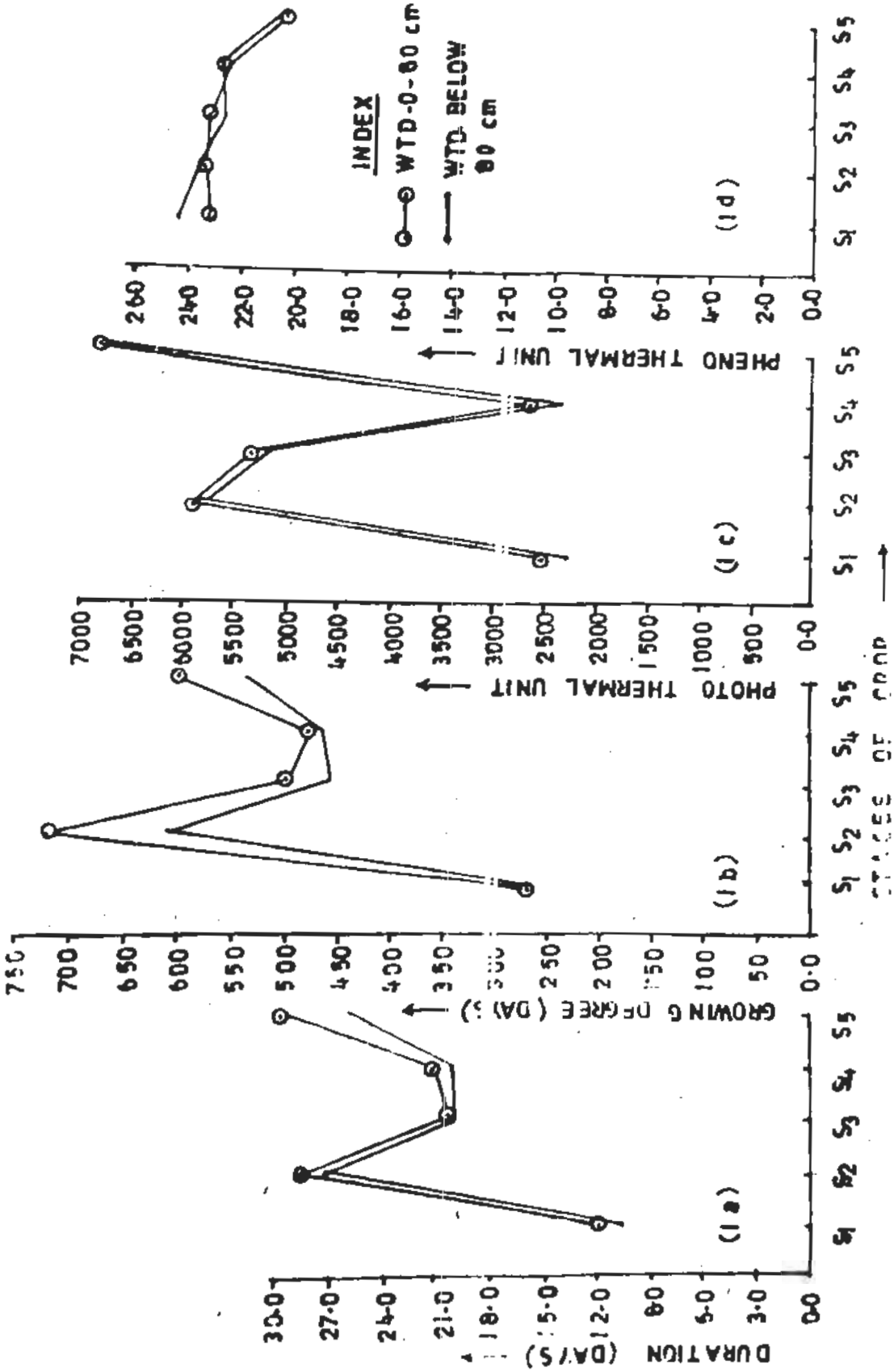

Fig. 1 : [a] Duration of Occurrence [b] Growing Degree Days (GDD)
[c] Photo Thermal Unit [d] Pheno Thermal Unit

TABLE 1

Heat use efficiency (q/ha/degree days x 10^3) of soybean JS 72-44 under varying water table depths.

Phenological stages	*Water table depths from GS (cm)*			
	0-80		*Below 80*	
	Biomass	*Grain*	*Biomass*	*Grain*
Sowing to maturity	14.58	5.12	17.56	6.58
Flowering initiation to maturity	21.69	7.62	27.58	10.31

TABLE 2

Mean water table depths from ground surface (cm) during entire crop season and yield of soybean.

Auger hole No.	*Water table depths from ground surface (cm)*			
	0-80		*Below 80*	
	WTD cm	*Yield q/ha*	*WTD cm*	*Yield q/ha*
1.	55.00	12.50	82.00	16.20
2.	62.00	12.80	85.00	15.00
3.	65.00	12.80	87.00	15.20
4.	48.00	11.70	95.00	15.70
5.	45.00	11.90	93.00	15.90
Mean	55.00	12.33	88.40	15.60

TABLE 3

Correlation coefficient (r).

S. No.	*Particulars*	*'r' value*
1.	Total GDD x Biomass	0.931*
2.	Total GDD x Grain yield	0.933*
3.	Total GDD x number of days sowing to maturity	0.808**
4.	Water table depths x grain yield	0.99*

* = Significant at P=0.01
** = Significant at P=0.05

The significant correlation coefficient 0.80 and 0.93 were observed in between GDD and number of days taken for maturity, grain and biomass yield respectively (Table 3). The significant correlation 0.99 was also observed in between water table depth and grain yield of soybean.

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REFERENCES

Iruthayaraj, M. R. and Y. B. Morachan (1978). Relationship between evaporation from different evaporimeters and meteorological parameters. *Agril. Meteorol.* **19** : 93-100.

Rajput, R. P. and P.S.N. Sastry (1985). Comparative performance of three varieties of rainfed soybean in a monsoon climate. Response to thermal environment. *Proc. Int. Symp.* on catac held at Waltair, March 18-21 P-88.

Thurlow, D. L. (1971). Varieties and dates of planting soybean production, recent research findings. *Bul.* 413, *Auburn Univ. Agril. Exp. St.* **00** : 17-27.

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Effect of Nitrogen and Phosphorus on Nitrogen Uptake and Protein Percentage of Forage Sorghum

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A field experiment was carried out on clayey soils of College Farm, Gujarat Agricultural University, Navsari Campus, Navsari during *rabi* 1986-87 to study the effect of nitrogen and phosphorus on nitrogen uptake and protein percentage of forage sorghum. Treatments comprising of four levels each of nitrogen (0, 40, 80 and 120 kg N/ha) and phosphorus (0, 20, 40 and 60 kg P_2O_5/ha) were tried in a factorial randomized block design. All treatments were replicated four times. Urea and single superphosphate were used as the source of nitrogen and phosphorus, respectively. The common variety Sundhia Jowar (S-1049) was sown on October 10, 1986 and harvested on December 10, 1986. The soil of experimental plot was clayey in texture having 7.8 pH, 0.72% organic carbon, 0.063% total nitrogen, 30 kg/ha phosphorus and 356 kg/ha potash.

Tha data presented in Table-1 indicate that nitrogen fertilization significantly increased the nitrogen uptake upto 120 kg N/ha. The differences due to successive doses of nitrogen were found significant. The crop removed 83.72, 76.72, 50.13 and 37.80 kg N/ha under 120, 80, 40 and 0 kg N/ha, respectively. This increase with nitrogen fertilization was due to the fact that soil was unable to supply required quantity of nitrogen for optimum growth therefore, application of nitrogen fertilizer made up this deficiency which was ultimately reflected in improvement of nitrogen status of the plant. Since nitrogen application increased the dry matter accumulation, increasing nitrogen rates enhanced the total uptake of the nutrient. Similar results have been obtained by Purohit (1960). Protein percentage increased significantly with increasing nitrogen levels upto the highest level. Maximum protein yield at harvest (5.21 q./ha) was obtained under 120 kg N/ha. followed by 80, 40 and 0 kg N/ha in the descending order with significant differences among them. Our results confirm the results of Purohit (1960). Increase in protein content could be ascribed to increase nitrogen uptake in nitrogen fertilised plots. These findings are in accordance with those of Srivastava and Chatterjee (1970). The increase in total protein yield was due to additive effect of increased dry matter and protein content.

Different levels of phosphorus applied did not influence the nitrogen uptake and protein content of forage sorghum. Similar results in case of protein content were recorded by Abhichandani *et al.*, (1971).

Basad on the above results it can be inferred that nitrogen application upto 120 kg/ha considerably improved the forage sorghum as reflected in increased nitrogen uptake, protein percentage and total protein yield.

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TABLE 1

Effect of nitrogen and phosphorus on nitrogen uptake and protein content of forage sorghum.

Treatment	*Nitrogen uptake (kg/ha)*	*Protein content (%)*	*Protein yield (kg/ha)*
Nitrogen (kg/ha)			
0	37.88	4.70	231.80
40	50.13	5.54	312.94
80	76.72	6.09	462.60
120	83.72	6.50	520.60
CD at 5%	4.60	0.14	31.32
Phosphorus (kg/ha)			
0	62.84	5.78	388.25
20	60.63	5.73	375.68
40	60.05	5.62	367.31
60	64.92	5.68	398.75
CD at 5%	NS	NS	NS

REFERENCES

Abhichandani, C. T. Gill, A. S., Sreenath, P. R. and Mannikar N. P. (1971). Nitrogen and Phophorus fertilization of summer sown fodder sorghum M. P. Chari (Sorghum bicolar) in relation to number of cuts under irrigation conditions. *Indian J. Agric. Res.* **5** (4) : 219-226.

Purohit, H. P. (1960). Effect of irrigation and fertilization on yield and protein content of forage sorghum. Unpublished M.Sc. (Agri). thesis, S. P. University, Anand.

Srivastav, V. C. and Chatterjee, B. N. (1970). Effect of different levels of nitrogen and seeding rates of jowar on dry matter production and protein content at selective stages of plant development. *Indian J. Dairy Sci.* **23** : 174-178.

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Cutting and Nitrogen Management Studies in Different Genotypes of Oats

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Oats being a graminaceous fodder crop responds well to N fertilization. To study the period of forage availability of oats for milkshed areas of the State and to see the response of nitrogen for higher production of forage, a field trial was conducted at Forage Research Farm,Guarat Agricultural University, Anand during rabi season of the year 1989-90 with four genotypes (AKS-4, AKS-8, JHO-822 and Kent), three cutting managements (one cut at 50% flowering, two cuttings; first 50 DAS and second at 50% flowering and three cuttings; first at 50 DAS second at 80 DAS and third at 50% flowering) and four N levels (0, 40, 80 and 120 kg/ha). The experiment was laid out in split plot design with three replications on Sandy loam soil, low in available N and medium in available P_2O_5 and available K_2O. The oats crop was sown with recommended package of practices on November, 18 in 1989. A common dose of 30 kg P_2O_5/ha 25 kg K_2O/ha and half of N in one cut and two cut treatments and 25% of N in three cut treatment were applied as per treatments just before sowing. The remaining dose of N was applied in one, two and three splits in one cut, two cut and three cut treatments, respectively in form of urea as top dressing.

The results indicated that there was no significant effect of genotypes on green forage and dry matter yields. However, oats genotypes kent and AKS-8 produced the highest green forage and dry matter yields, respectively. Oats genotype AKS-8 also produced the highest crude protein yield(8.84 q/ha). These results are in conformity with those of Anonymous (1988-89).

There was significant effect of cutting management practices on forage production of oats. One cut of oats crop gave significantly higher green forage (414 q/ha) and dry matter (61.1 q/ha) yields than three cuts. Two cuts of oats being at par with one cut, produced significantly higher dry matter yield than the practice of three cuts. Two cut system produced maximum crude protein yield, while crude protein content was maximum in three cuts followed by two cutting practice. The higher forage production in one cut may be due to higher plant height and more no. of leaves/tiller. Bokde (1968a) also obtained higher green fodder and dry matter yields in one-cutting than that in two cutting treatment. One cut and two cutting management gave significantly higher green forage yield than three cuts of oat at Ludhiana (Anonymous, 1988-89).

An increase in nitrogen application from 0 to 40, 80 and 120 kg/ha increased the green forage yield significantly, while dry matter yield increased up to 80 kg N/ha only. An increase in nitrogen application from 0 to 40 and 80 or 120 kg/ha increased the dry matter yield significantly. Gill *et al.* (1977), Tripathi *et al.* (1979), Gill and Malik (1983) and Joon *et al.* (1988) have also recorded an increase in yield of fodder oats upto 120 kg N/ha. Crude protein content and yield were increased linearly with an increased in nitrogen

TABLE 1

Green forage, day matter and crude protein yields, crude protein content and other ancillary observations of oats genotypes as influenced by cutting management and nitrogen levels.

Treatments	Yield (q/ha)			Crude protein content (%)	Tillers m.	Plant height (cm)	No. of leaves/ tiller	Leaf stem ratio
	Green forage	Dry matter	Crude protein					
Genotype								
AKS-4	396	54.3	8.54	15.57	74.3	73.7	6.2	2.67
AKS-8	386	57.9	8.84	15.07	64.4	77.4	6.1	3.26
JHO-822	368	51.7	6.37	12.62	72.6	68.1	6.1	3.12
Kent	405	53.8	8.11	15.18	70.8	71.6	6.1	2.55
S. Em. ±	15	2.2						
C. D. at 5%	NS	NS						
Cutting managements								
One cut	414	61.1	7.43	12.02	69.0	97.9	6.8	0.98
Two cut	402	55.1	8.38	14.73	74.3	74.2	6.3	2.75
Three cut	351	47.0	8.09	17.08	68.5	62.2	5.7	3.64
S. Em. ±	13	1.9						
C. D. at 5%	37	5.5						
Nitrogen levels (kg/ha)								
0	284	42.9	5.39	12.45	68.0	67.7	6.0	2.97
40	379	55.3	7.73	14.09	69.9	73.8	6.1	2.50
80	432	59.9	9.05	15.21	71.3	75.5	5.5	3.31
120	461	59.6	9.80	16.69	73.0	73.9	6.2	2.62
S. Em. ±	7	1.1						
C. D. at 5%	21	3.1						

application and application of 120 kg N/ha produced the maximum crude protein yield (9.80 q/ha) and crude protein content (16.69%). Gill *et al.* (1977) have also recorded an increase in crude protein yields with increaseing the rates of nitrogen from 0 to 120 kg/ha.

The improvement in forage production with higher levels of nitrogen i.e. 80 and 120 kg N/ha may be attributed to higher no. of tillers/m row length and higher plant height.

From the above results it can be concluded that one cutting or two cutting management alongwith 80 to 120 kg N/ha were found effective for higher forage production of oats.

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REFERENCES

Anonymous, (1988-89). Annual progress report of AICRPP on Forage Crops. Indian Grassland and Fodder Research Institute, Jhansi : 78-88.

Bokde (1968 a). Effects of different levels of nitrogen application and cutting intervals on growth, yield and quality of two variteties of oat. I. Oat grown for fodder. *Indian J. agric. Sci.*, **38** : 887-909.

Gill, A. S., J. J. Karnani and R. K. Maura (1977). Performance of Oats varieties under different fertility conditions and dates of sowing for fodder yield. *Indian J. Agron.* **22** : 217-223.

Gill, P. S. and B. S. Malik (1983). Response of oat varieties to soil moisture regimes and nitrogen levels. *Forage Res.*, **9** : 151-154.

Joon, R. K., K. P. Singh and A. S. Faroda (1988). Effect of irrigation and nitrogen on fodder yield of Oat (*Avena sativa* L.). *Forage Res.*, **14** : 29-37.

Tripathi, S. N., A. P. Singh, R. B. Mathur and A.S. Gill (1979). Effect of nitrogen and phosphorus levels on yield and quality of Oats. *Indian J. Agron;* **24** : 250-254.

Quality Studies in Niger (*Guizotia abyssinica*) in Relation to Nitrogen and Phosphorus

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A field experiment was conducted at the College farm of N. M. College of Agriculture, Guarat Agricultural University, Navsari during *kharif* 1987 in a randomised block design replicated four times with three levels each of N (0, 20 and 40 kg/ha) and P_2O_5 (0, 10 and 20 kg/ha). The niger variety IGP-76 (Sahyadri) with branching habit was sown at 45 x 10 cm apart. The soil was clayey having pH, 7.4; organic carbon, 0.53%; available N, 190 kg/ha; available P_2O_5, 40 kg/ha and available K_20, 63 kg/ha.

Content of N in haulm significantly increased with increasing levels of N from 0 to 40 kg/ha. The magnitude of increase over control was 26.2 and 53.2% with 20 and 40 kg N/ha, respectively. In seed, significantly higher N (4.20%) and protein (26.24) content were obtained at the highest level of 40 kg N/ha only. The increased N content in seed and haulm was due to the deficiency of N in soil. Protein content of seed also increased as it is the function of N content. Similar results were reported by Kachapur *et al.* (1981). N uptake in seed significantly increased up to 20 kg N/ha only, while in haulm it was significant up to 40 kg N/ha. These findings are in accordance with Kachapur *et al.* (1981). The increased N uptake with N fertilisation was due to increased N content and biological yield. N had no effect on oil content, for N is known to hinder the availability of carbohydrates for polymerization into fatty acids. Application of N increased the seed and oil yield up to 20 kg/ha only. Increase in oil yield was mainly due to increased seed yield. These findings are in agreement with those of Singh *et al.* (1986).

Application of P did not affect contents of N, protein and oil, N uptake and seed and oil yields.

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REFERENCES

Kachapur, M. D., Radder, G. D. and Birajdar, B. M. (1981). Quality studies in niger genotypes in relation to spacing and fertility levels. *Oilseed Journal* 11 : 38-41.

Singh, P. P. Singh, S., Singh, R. V. and Thakre, D. C. (1986). Effect of time of nitrogen application in niger. *Indian J. Agron.* 31 (2) : 162-164.

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TABLE 1

Quality characters of niger as influenced by nitrogen and phosphorus.

Treatment	N content (%)		N uptake (kg/ha)			Protein content (%)	Oil content (%)	Yield (kg/ha)	
	Seed	Haulm	Seed	Haulm	Total			Seed	Oil
N (kg/ha)									
0	3.91	0.80	7.65	19.44	27.09	24.47	35.38	195	69
20	4.06	1.01	11.00	32.02	43.02	25.39	35.14	270	95
40	4.20	1.23	12.07	43.17	55.24	26.24	34.86	287	100
C. D. (5%)	0.16	0.05	1.08	3.65	4.70	0.99	NS	19	9
P_2O_5 (kg/ha)									
0	4.04	1.02	10.11	31.20	41.31	25.26	35.12	249	87
10	4.06	1.03	10.23	31.63	41.91	25.38	35.15	250	88
20	4.07	1.00	10.38	31.75	42.13	25.46	35.11	253	89
C. D. (5%)	NS	NS	NS	NS	NS	NS	NS	NS	NS

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Nondestructive Method of Leaf Area Measurement in Forage Sorghum

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Leafiness appears to be the most important attribute at the morphological level which could help in the improvement of quantity and the quality of forage produced in sorghum and therefore it should form as one of the major criteria of selection in any forage breeding programme (Gupta, 1968; Dengi and Paroda, 1974; Meyear and Jones 1962; Pathak, 1982).

A rapid method for the estimation of leaf area without plucking the leaf will be of considerable importance for screening the large number of germplasm, and large segregating materials for this important morphological trait and also to see the association between leaf area and other economic and quality traits to bring about the simultaneous improvement in both yield and quality in forage sorghum.

Leaf area constants have been worked out by Montgomery (1911) in maize, Vishnu and Pandey (1966) in rice, Singh (1970) in dwarf wheat, Trehan *et al.*, (1974) in sunflower and Stickler *et al.* (1961) in grain sorghum. These workers estimated leaf area by multiplying length and width at maximum with a suitable constant. But such information seems to be lacking in forage sorghum. Therefore, the present investigation was undertaken with 26 diverse varieties of forage sorghum to findout a constant in forage sorghum so that the leaf area can be estimated easily, rapidly, inexpensively and without plucking the leaves.

The leaf materials for the present investigation consisted of 26 diverse genotypes of sorghum which were grown in a randomized block design replicated three times at Forage Research Station, Guarat Agricultural University, Anand Campus, Anand during kharif 1981. Five competitive plants were taken from each genotype and 5 leaves were taken at random from each plant for the estimation of leaf area. Their actual area (B) was obtained by plainimeter. The apparent leaf area (A) was obtained by multiplying length and width at maximum point. The value of constant (Z) was obtained by dividing actual leaf area with apparent leaf area (Z=B/A). By this method a mean constant of 0.798 was obtained (Tabel 1). Apparent leaf area when multiplied by constant 0.798 gave the estimated leaf area (C). The test of the sinificance of difference between actual and estimated area was done using paired "t-test". The correlation coefficient between actual and estimated leaf area and the regression of estimated area on actual leaf area were also worked out, following usual procedures.

The actual, apparent and estimated leaf area, the value of constant and the percentage increase or decrease over actual area for each genotype are presented in Table 1. The actual leaf area varied from 68.306 cm^2 to 322.704 cm^2 whereas the apparent leaf area ranged from 84.15 cm^2 to 403.55 cm^2. The highest leaf area constant was observed for IS 632, whereas it was the

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TABLE 1

Estimation of leaf area constant in forage sorghum.

Veriety	Apparent area (A) (cm^2)	Actual area (B) (cm^2)	Constant (B/A)	Estimated area (C)	(C-B)	% increase or decrease over B
2077A	202.10	164.694	0.815	161.276	- 3.418	-2.075
X 988	391.95	309.471	0.790	312.776	+ 3.305	+1.067
Improved Ramkel	206.02	161.429	0.784	164.404	+2.975	+1.843
M 31-2A	284.75	225.523	0.792	227.231	+1.708	+0.757
2219A	168.75	136.498	0.809	134.663	- 1.836	-1.345
3660 A	335.10	265.876	0.795	267.409	+1.534	+0.577
36 A	375.90	288.967	0.769	299.868	+ 11.001	+ 3.807
CK 60 A	245.85	193.302	0.786	196.188	+ 2.886	+ 1.493
IS 4776	315.28	248.460	0.788	251.589	+ 3.129	+ 1.259
IS 3287	279.70	228.816	0.818	223.201	- 5.615	-2.254
IS 3254	172.60	133.738	0.775	137.735	- 3.997	+ 2.949
IS 3353	125.55	102.171	0.814	100.189	- 1.982	- 1.939
IS 3223	341.33	271.120	0.794	272.383	+ 1.263	+ 0.466
IS 3301	142.98	116.521	0.815	114.094	- 2.427	- 2.082
IS 664	403.55	311.773	0.775	322.033	+ 10.260	+ 3.290
IS 644	316.30	249.860	0.790	252.407	+ 2.547	+ 1.019
IS 643	125.85	90.918	0.786	100.428	- 1.510	- 1.526
IS 632	290.80	238.680	0.820	232.058	- 6.622	- 2.277
IS 612	398.40	322.704	0.810	317.923	- 5.843	- 1.805
IS 606	252.00	206.644	0.820	201. 096	- 5.548	- 2.685
PC 6	311.93	255.709	0.819	248.916	- 6.793	- 2.657
Rio	312.55	239.100	0.765	249.415	- 10.314	- 4.314
Vidisha	357.08	290.646	0.814	284.946	- 5.700	-1.961
C 10-2	149-94	119.974	0.800	119.650	- 0.324	- 0.270
S 1049	84.15	68.306	0.812	67.152	- 1.134	- 1.682
IS 685	128.00	101.800	0.795	102.144	+ 0.344	+ 0.338
	Average		0.798			
Correlation between actual and estimated leaf Aarea (r)			1.00			
Regression coefficient between estimated and actual leaf area (B)			1.0098			
't' value			0.798 (ns)			

lowest for Rio. Apparent leaf area when multiplied by average constant 0.798 gave the estimated area which varied from 67.152 to 317.923 cm^2 with the difference of ± 0.270 to ± 4.314% than actual area.

The test ot significance indicated that the estimated area does not differ significantly from the actual area for various genotypes under study. Since highly diverse genotypes were utilized for estimating the constant, it can be utilized for estimating the leaf area in forage sorghum in general where more diversity is observed in respect to this trait.

The correlation coefficient between actual and estimated area was observed to be absolute (1.00). The regression of estimated area on actual areas was 1.0098 which indicated that there was complete regression of estimated areas on actual area.

Stickler *et al.* (1961) estimated leaf area constant in grain sorghum and reported that leaf length and breadth when multiplied with 0.76 can be used to measure the leaf area in grain sorghum. In our study the constant worked out was 0.798. The part of the variation observed might be due to the fact that Stickler *et al.* (1961) utilized only 8 varieties of grain sorghum for the estimation of leaf area constant, whereas in the present investigation 26 highly diverse genotypes of sorghum including grain, dual purpose and forage sorghum types were utilized.

It was, therefore, concluded that the leaf area of forage sorghum can be estimated as a product of leaf length leaf breadth and the constant 0.798. This information can be had rapidly, easily, inexpensively and without plucking the leaves.

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REFERENCES

Dangi, I. P. (1978). Studies on heterosis and combining ability in forage sorghum. Unpublished Ph.D. thesis, HAU, Hissar.

Dangi, O. P. and R. S. Paroda (1974). Correlation and pathcoefficient analyses in fodder cowpea (*Vigna sinensis* Endl.). *Expt. Agric* (Camb.,) **10** : 23-31.

Gupta, V. P. (1968). Basic concepts in the improvement of pearl millet. *Indian J. Genet.*, **28 A** : 287-294.

Hutton, E. M. (1975). Improvement of forages for increased animal production. *Forage Res.*, **1** : 87-97.

Meyer, J. H. and L. G. Jones (1962). Chemical composition and feeding value. *Herb. Abstr.*, **32** : 300.

Minson, O. J. (1975). Pasture management and animal nutrition. *Forage Res.*, **1** : 1-10.

Montogomery, E. C. (1911). Correlation studies of corn, 24th *Ann. Res. Nebraska Agri. Expt. Stn.*, 111-159.

Pathak, H. C. (1982). Genetic studies in forage sorghum (*Sorghum bicolor* (L.) Moench). Unpublished Ph. D. thesis submitted to Gujarat Agricultural University, Anand Campus, Anand.

Singh, B. P. (1970). Measurement of leaf area in dwarf wheats. *Madra agric. J.*, **57** (5) : 296-298.

Stickler, F. C. S. Wearden and A. W. Pauli. (1961). Leaf area determination in grain sorghum. *Agron. J.*, **53** : 187-188.

Trehan, K. B., Hira Chand and S. K. Mehta. (1975). Measurement of leaf area in sunflower. (*Helianthus annus* L.) *Sci. and Cult.*, **41** : 238-239.

Vishnu, M. B. and H. K. Pandey. (1966). Measurement of leaf area of rice. *Agron. J.*, **58** (4) : 454.

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Note on Effect of Frequency of P Application on Yield and Percentage Distribution of P Uptake in Plant Parts and P Uptake by Cotton

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A permanent field experiment was conducted at Main Cotton Research Station, Surat during 1984-88 under irrigated condition. The experimental soil had the following characteristics: pH 7.2, E.Ce 0=23 dsm^{-1} clay 63.3%, organic carbon 0.49%, available N, 220 kg N ha^{-1}, available P 24.62 kg P_2O_5 ha^{-1}, and available K, 432 kg K_2O ha^{-1}.

The experiment comprised of seven treatment of P application kg P_2O_5/ha viz., 0 kg (T_1), 60 kg every year (T_2), 60 kg alternate year starting from 1984 (T_3), 60 kg alternate year from 1985 (T_4), 60 kg at every third year starting from 1984 (T_5), 60 kg every third year starting from 1985 (T_6) and 60 kg at every third year from 1986 (T_7). The phosphorus was applied in the form of single super phosphate. The nitrogen was applied in the form of urea @ 240 kg N/ha common to all plots in four equal splits.

The treatments were replicated six times in R.B.D. The different chemical properties of the experimental soils were determined as per the procedures describes by Chopra and Kanwar (1980). The samples for plant analysis were collected at harvest and digested in tri-acid mixture. The total P was determined by the Vanadomolybdo phosphoric acid yellow colour method in HNO_3 system (1967). P uptake was calculated on the basis of content multiplied by total dry matter product.

TABLE 1

Effect of frequency P application on seed cotton yield (kg/ha).

Treatments	*1984-85*	*1985-86*	*1986-87*	*1987-88*	*Pooled*
T_1	2892	3189	2120	1675	2469
T_2	2572	3039	2204	1786	2400
T_3	2643	2926	2316	1587	2368
T_4	2835	3086	2181	1770	2468
T_5	2526	3070	2126	1707	2357
T_6	2416	2939	2103	1590	2262
T_7	2829	3037	2226	1832	2481
S. Em. ±	135	108	121	111	59
C. D. at 5%	NS	NS	NS	NS	NS

TABLE 2

Percentage distribution of P uptake in different plant parts of cotton (pooled mean of 4 years).

Treatments	Phosphorus uptake (kg/ha)		
	Stem %	Leaves %	Seed %
T_1	13.21	13.27	67.02
T_2	13.02	11.56	63.39
T_3	12.08	11.59	65.17
T_4	11.74	11.37	66.54
T_5	12.24	11.76	65.11
T_6	12.19	12.15	65.48
T_7	12.25	11.00	66.56

TABLE 3

Effect of frequency of P application on P_2O_5 uptake (kg/ha) in total plant.

Treatments	1984-85	1985-86	1986-87	1987-88	Pooled Mean
T_1	38.3	38.0	20.7	23.3	30.1
T_2	34.8	34.1	22.0	23.7	28.6
T_3	35.6	33.7	23.2	20.8	28.3
T_4	37.9	35.1	21.8	22.4	29.3
T_5	34.8	37.7	22.3	22.8	29.4
T_6	34.1	29.9	21.6	19.8	26.3
T_7	36.8	37.1	21.3	22.7	29.5
S. Em. ±	2.3	1.6	1.6	1.4	0.9
C. D. at 5%	NS	4.7	NS	NS	2.4

The data for individual year as well as pooled over four years (Table 1) revealed that treatments failed to produce any significant effect on seed cotton yield. However, maximum seed cotton yield (2481 kg/ha) was observed in the treatment T_7, where first P application was applied in 1986. Thus, application of P every year or alternate year of third year or no application at all had no significant effect on seed cotton yield. The results confirm the earlier findings of Patel *et al.* (1985).

The pooled mean over four years (Table 2) revealed that 63 to 67% of absorbed phosphorus by the cotton was retained in seed alone, with only 12 to 13% in stem and 11 to 13% in leaves indicating considerable translocation of P from stem and leaves to seed. Similar results in soyabean were also reported by Kumar *et al.* (1985). Among all the treatments, maximum percentage of distribution of P uptake were found in different plant parts with no application of P (T^1) due to more biomass production, where no P was applied.

Frequency of P application made significant changes in the uptake of P in total plant during 1985-86 as well as in pooled. The highest P uptake was recorded in the control plot (T_1) due to more biomass production, where no P was applied (Table 3). Even continuous application of P did not increase P uptake in total plant than no P at all. Similar results have been reported by Padhiyar *et al.* (1986).

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REFERENCES

Chopra, S. L. and Kanwar, J. S. (1980). Analytical Agriculture Chemistry, Kalyani Publishers, Ludhiana.

Jackson, M. L. (1967). Soil Chemical Analysis Prentice Hall of India, New Delhi.

Padhiyar, B. P. Vashi, R. G. Mehta, N. P. Kumar V. and Patel P. G. (1986). Proc.of National Seminar on effect of application of P to cotton, Surat 22-23 May, 1986.

Patel, P. G. Mehta, N. P. Patel, M. N. Patel, B. P. and Patel B. D. (1985). *A bulletin on fertilizer reserach in cotton.*

Kumar, V. Bhatia, B. K. and Singh, M. (1985). Yield response, uptake and distribution of nitrogen in some soybean varieties. *J. Indian Soc. Soil. Sci.* **33** (1) : 190-92.

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Effect of Different Physical Factors on the Production of Toxicity in Culture Filterate and Nature of *Phoma sorghina* the Causal Agent of Black Dots of Sorghum Grain*

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Phoma sorghina (Sacc.) Boerema, Dorenb. & Kest. causing black dots on sorghum grains and glumes was first observed in Rajasthan during 1978 from Udaipur (Rathore *et al.*, 1983). Various *Phoma* species are known to produce toxic metabolites in culture filterate (Rich *et al.*, 1974); Begum and Deshpande, 1978 and Hasija and Batra, 1981). The perusal of literature revealed that no work has been done with *Phoma sorghina*, hence present investigation was carried out to study the factors affecting the production of toxic metabolites and what effect these metabolites had on germinability and seedlings growth.

The causal organism was isolated, purified and ,maintained on PDA medium was identified from CMI (IMI No. 242593).

The monoconidial culture of *P. sorghina* was grown on Richard's solution (pH 6.7) and temperature (28 ± 1°C) except in pH and temperature studies where different pH levels and temperatures was maintained in B.O.D. incubator. After 24 days of incubation (barring age study), fungal mat was filtered through Whatman's filter paper No. 42 followed by sintered glass filter. The filterate thus obtained was used to study the effect of pH, temperature, heat, light, dilution and ageing on production of toxicity by *P. sorghina*. The toxicity of culture filterate was measured in terms of their effect on apparently healthy seeds germinability and/or on twenty day sold sorghum seedings after 36 h of dip. Host specificity studies was also made. Degree of symptoms or sorghum seedings were observed using following ratings.

H = Healthy seedling.

+1 = Slight chlorosis developed at the distal end of the leaf.

+2 = Moderate chlorosis developed throughout the leaf along the mid rib and light wilting of seedling occured.

+3 = Severe chlorosis developed throughout the leaf blade and moderate wilting and drying of the one fourth distal portion of the leaf.

+4 = Severe chlorosis throughout leaf blade and light necrosis and browning occurred along the ,mid rib with severe wilting and drying of upper half leaf.

+5 = Moderate necrosis and browning of the upper half leaf and chlorosis of lower half leaf with severe wilting and drying of the stem and leaf occurred.

+6 = Severe necrosis, browning, wilting and drying of whole seedling occurred.

On PDA the pathogen grew more or less flat to aerial and consists of vegetative mycelium hyaline or densely olivaceous to light brown, septate, branched and frequently anostomosed with adjacent hyphae thread lengthwise to form hyphal stands. Chlamydospores observed, particularly at low

*Part of M. Sc. (Ag.) thesis submitted by senior author.

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TABLE 1

Influence of pH on toxic metabolites production and its effects on seed germinability and seedling.

pH after autoclaving		*2.9*	*3.4*	*4.0*	*4.4*	*4.8*	*5.4*	*5.9*	*6.3*	*6.7*	*7.4*	*7.8*	*8.4*	*8.9*
Per cent seed germination inhibition	Var. CSV-2	100	100	100	100	100	100	100	100	100	100	100	100	100
	Var. Local	100	100	100	100	100	100	100	100	100	100	100	100	100
Degree of symptoms and		+1	+2	+3	+4	+5	+5	+5	+6	+6	+5	+4	+3	+2
time taken for complete drying of the seeding in hrs		75	70	60	55	48	48	48	40	40	48	55	65	70

TABLE 2

Influence of temperatures on toxic metabolites production and its effects on seedling.

Temperature (°C)	*12*	*16*	*20*	*24*	*28*	*32*	*36*	*40*
Degree of symptoms	H	+3	+5	+6	+6	+6	+2	H
and time taken for complete drying (hrs)	H	65	48	40	40	40	70	H

TABLE 3

Influence of age on toxic metabolites production and its effects on seedling.

Length of periods in days	4	8	12	16	20	24
Degree of symptoms	+2	+3	+4	+4	+5	+6
and time taken for complete drying (hrs)	70	65	55	55	48	40

TABLE 4

Influence of heating on toxic metabolites production and its effects on seedling.

Treatment of filtrate	*Unboiled*	*Boiled for 5 minutes*	*Boiled at 60°C for 15 minutes*	*Autoclaved at 15 lbs p.s.i. for 15 minutes*
Degree of symptoms	+6	+6	+6	+6
and time taken for complete drying (hrs)	40	40	40	40

TABLE 5

Influence of dilution on toxicity of metabolites and its effect on seedling.

Proportion of metabolites & water	*6:0*	*5:1*	*4:2*	*3:3*	*2:4*	*1:5*
Degree of symptoms	+6	+6	+5	+4	+3	+2
and time taken for complete drying (hrs)	40	40	48	55	65	70

TABLE 6

Influence of light on toxic metabolites production and its effect on seedling.

Treatment	*Degree of symptoms*	*Time taken for complete drying (hrs)*
Continuous light	+6	40
continuous darkness	+3	70

TABLE 7

Influence of toxic metabolites on different hosts, twigs, seedlings and leaves.

Sr. No.	*Name of host and its part taken*	*Degree of symptoms*	*Sr. No.*	*Name of host and its part taken*	*Degree of symptoms*
1.	Sorghum seedling	+6	10.	Tomato twig	+6
2.	Maize seedling	+6	11.	Pea twig	+6
3.	Barley seedling	+5	12.	Cowpea twig	+4
4.	Wheat seedling	+6	13.	Gram twig	+4
5.	Surgarcane leaf	+2	14.	Onion leaf	+5
6.	Potato leaf	+5	15.	Raddish leaf	+3
7.	Castor leaf	+6	16.	Sapota twig	+2
8.	Mustard twig	+6	17.	*Chenopodium alboatrum*	+1
9.	Cotton twig	+6	18.	*Convolunus aurvenis*	+6

temperature are sigly as well as catenates, intercalary or terminal, globose to subglobose and one celled. *P. sorghina* also produced numerous black dots like, mostly gregarious sometime scattered ostiolate pycnidia semiembedded in the substrate. Minute one celled conidia produced on conidiophore are exuded in mucilaginous mass in the form of pinkish ooze.

Toxic effect of culture filterate was observed at all the tested pH levels resulting in hundred per cent loss of seed germinability. Maximum activity was observed at pH 6.3 and 6.7 (Table 1). The present results are in conformity with the findings obtained in case of *P. insidiosa* infecting sorghum (Tripathi, 1974). Among temperatures 24°C to 32°C were best for production of toxic metabolites. At 12°C and 40°C no toxic metabolites production was observed (Table 2).

Production of toxic metabolite increased with increase in age of culture and it was maximum in 24 days old culture filterate (Table 3). Effect of heating at 60°C, 100°C and autoclaving at 1.05 kg/cm^2 steam pressure for 15 minutes have no effect on toxicity (Table 4). Suraj and Vaidehi (1980) while working with fungi associated with Phaseolus mungo reported that toxicity of culture filterate increased with advance in age of culture and both unboiled and boiled fractions of metabolites reduced the germination percentage. Complete drying with undiluted culture filterate took 30 hrs less as compared with five times diluted culture filterate (Table 5). Production of toxic metabolites was just doubled in continuous fluorescent light as compared to complete darkness (Table 6). The toxic metabolites were capable of causing chlorosis, necrosis, wilting and drying of different non host plant leaves/ seedlings/ twigs in varying degrees (Table 7). Bedi & Chohan (1986) obtained similar results while working with Aspergillus flavus.

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REFERENCES

Begum, S. and Despande, K. B., (1978). Toxic metabolites produced by *Phoma herbarum* in culture I. Phytotoxic effect of culture filterate and certain properties of the toxin. Marthwada Univ. Aurangabad, India, pp 371-379.

Bedi, J. S. & Chohan, J. S. (1986). Effect of culture filterates of toxigenic and nontoxigenic isolates of *Aspergillus flavus* on different crop plants and weeds. *Indian J. Mycol. Pl. Pathol.* **16** (1) : 48-54.

Hasija, S. K. & Batra, S. (1981) *In vivo* production of pectic enzyme by *Phoma destructiva*. *Indian Phytopath.* **34** (2) : 230-231.

Rathore, B. S., Mathur, Kusum and Nailk, S. M. P. (1983). Occurrence and Development of *Phoma* (Black Dots) on Sorghum Garin in Rajasthan. *Sorghum News Letter* **26** : 118.

Rich, C., Pascard, M. D. Gaudemer, A., Barbier, M. and Bosquet, J. F. (1974). Vrystalline and molecular structure of phomenon, a phytotoxin produced by *Phoma exigua* var. non *oxydabilis*. *Tetrahydron Letters No.* **32** : 2765-2866.

Saxena, A. and Gupta, R. C. (1986). Effect of fungal metabolites on germination and sprouting of seeds of *Eruca sativa*. *Indian J. Mycol. Pl. Pathol.* **16** (2) : 151-154.

Suraj, K. & Vaidehi, B. K. (1980). Effect of cultutre filterate on the seed germination and on root and shoot elongation *Phaseolus mungo*. *Indian J. Mycol. Pl. Pathol.* **10** (2) : XXII (Abstract).

Tripathi, R. K. (1974). Head fungi of sorghum, phytotoxins and their effects on seed germination. *Indian Phytopath* **27** (4) : 499-501.

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An Assessment of Methods of Estimating Reference Crop Evapotranspiration (ET_o) in Gujarat Region*

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Reference crop evapotranspiration (ET_o) is a key factor for estimating water requirement of crops. Actual evapotranspiration (AET is taken as a good measure of the water requirements of crop plants. As it is very difficult to get the data on AET it is generally assumed potential evapotranspiration (PET) to be the maximum water requirement of crop plants in all agrometeorological studies. For such studies, Doorenbos and Pruitt (1979) have proposed modifications for diurnal variation of temperature, humidity and wind to the methods developed earlier by Penman, Blaney-Criddle and Makkink. They have also suggested pan coefficients to convert the unscreened panevaporation data to be used as reference crop ET for agricultural conditions. The use of these modified methods have been tested in our country at a few centres by some workers (Reddy *et al.*, 1984; Sharma and Sharma, 1987 and Palaskar *et al.*, 1987. An attempt has been made in this paper in order to select a suitable method for the region.

Three methods such as (1 Radiation and (2) Panevaporation methods suggested by Doorenbos and Pruitt (1979) and (3) Thornthwaite method (1948) were adopted in this study to estimate reference crop ET. The daily meteorological data from 1957 to 1989 recorded at agrometeorological observatories in respect of seven main research stations representing different agroclimatic zones of the Gujarat State (Fig. 1) have been utilized to compute weekly values for kharif weeks from 22nd (28-3 June) to 44th (29-4 November) standard weeks. The MICROSTA package was used to compute intercorrelation of weather parameters and reference crop ET from the three methods.

TABLE 1

Mean daily reference crop ET (mm) by three methods and coefficient of variation (%) in Gujarat region.

Station	*ETo PAN*		*ETo RAD*		*ETo THW*	
	Mean	*CV*	*Mean*	*CV*	*Mean*	*CV*
Navsari	5.1	27	5.6	11	5.2	8
Surat	5.1	22	5.6	10	5.3	9
Anand	5.2	32	5.6	18	5.4	13
S. K. Nagar	7.9	36	6.2	18	5.7	13
Rajkot	7.8	32	6.0	19	5.5	12
Jamnagar	7.4	19	5.9	11	5.4	14
Junagadh	5.5	29	5.3	12	5.4	9

*A part of Ph.D. thesis submitted by the senior author to the IARI, New Delhi

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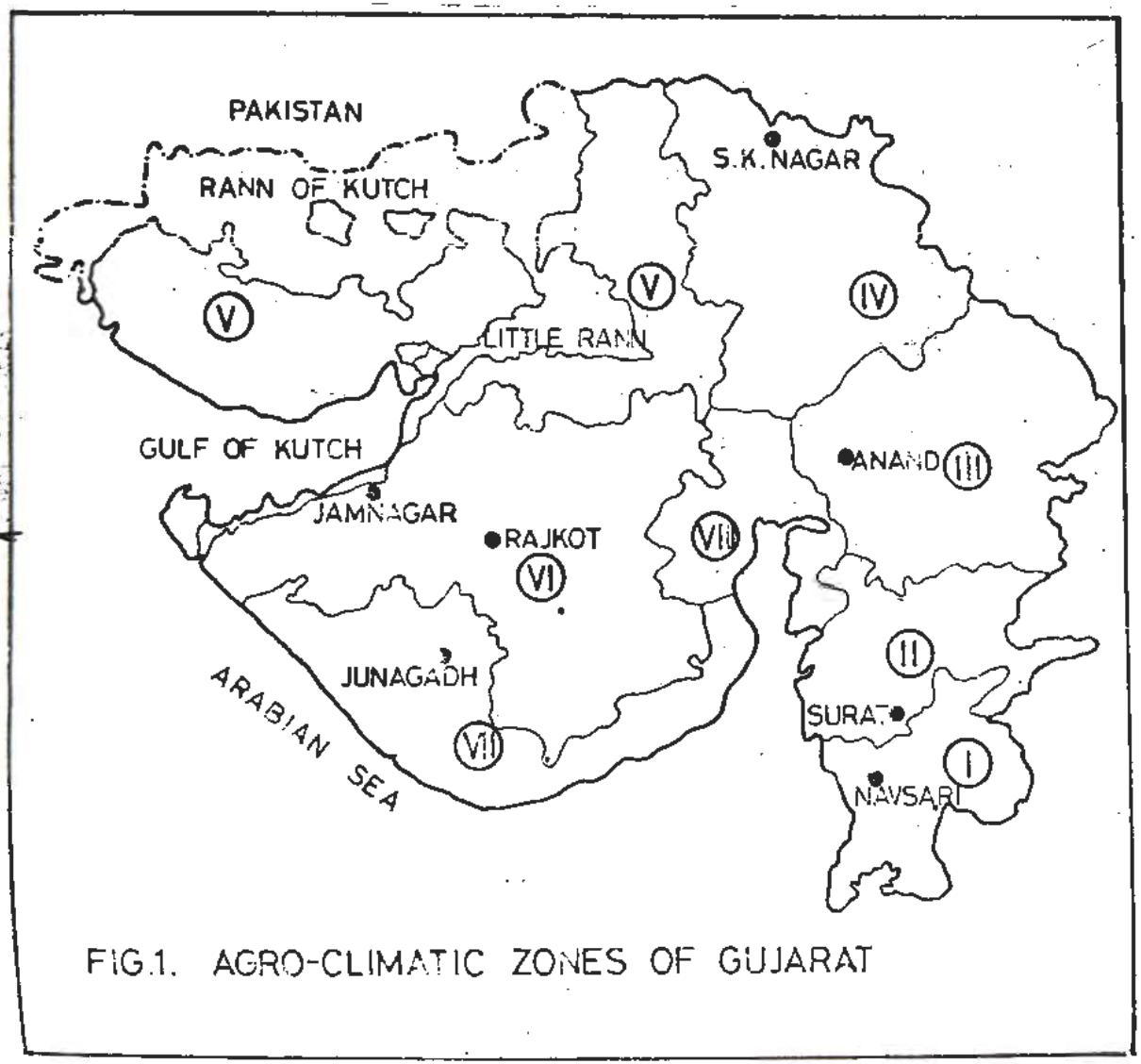

FIG.1. AGRO-CLIMATIC ZONES OF GUJARAT

LEGENO

I	SOUTH GUJARAT HEAVY RAINFALL AREA
II	SOUTH GUJARAT
III	MIDDLE GUJARAT
IV	NORTH GUJARAT
V	NORTH WEST ZONE
VI	NORTH SAURASHTRA
VII	SOUTH SAURASHTRA
VIII	BHAL & COASTAL AREA

TABLE 2

Correlation coefficients of ETo RAD with different parameters.

Stations	*Mean air temperature*	*Sunshine hours*	*Wind speed*	*Relative humidity*	*Rainfall*	*ETo PAN*	*ETo THW*
Navsari	.566**	.619**	.174	-.300	-.349	.858**	.468*
Surat	.663**	.549**	.483*	-.611**	-.181	.748**	.330
Anand	.863**	.515**	.364	-.665**	-.437*	.944**	.679**
S. K. Nagar	.809**	.640**	.281	-.479*	-.466*	.963**	.604**
Rajkot	.858**	.685**	.492*	-.643**	-.276	.937**	.692**
Jamnagar	.732**	.504**	.357	-.132	-.336	.854**	.565**
Junagadh	.834**	.677**	.230	-.544**	-458*	.885**	.560**

* Significant at 5% level.

** Significant at 1% level.

Table 1 shows mean daily reference crop ET and the coefficient of variation for kharif weeks estimated by the three methods. The results appraise that the rate of ETo PAN is higher at S. K Nager (7.9 mm) and Rajkot(7.8 mm) with the highest coefficient of variation (36%) at S. K. Nagar. Reference crop ET is relatively higher at Jamnagar, Rajkot (Saurashtra region) and S. K. Nagar (North Gujarat) stations. Highest variability of the order of 19 to 36% is observed in case of ETo PAN among all methods followed by ETo RAD (10 to 19%) and ETo THW (8 to 14%) methods. This difference in variability is attributable to the drier conditions prevailing in the north Gujarat and Saurashtra regions.

The summary of correlation coefficients of all the weather parameters with ETo RAD is shown in Table 2. The results reveal that at all the stations there exists positive and significant correlation between ETo RAD with mean air temperature and sunshine hours, while negative correlation is observed with rainfall and relative humidity. The negative and significant correlation of relative humidity and rainfall may be attributed to low evapotranspiration rate due to presence of more moisture in the atmosphere during the monsoon period. Except at Rajkot and Surat stations, wind does not seem to be a significant parameter.

ETo RAD shows the highest positive and significant correlation with ETo PAN at all the stations, the highest value (.963) being observed at S. K. Nagar followed by Anand (.944) and Rajkot (.937). Reddy *et al.* (1984) observed that Penman method was closer to pan evaporation. Radiation methods depends on energy balance and requires fewer parameters than those required by Penman method. The positive and highly significant correlation between ETo RAD, mean air temperature, sunshine hours and ETo PAN obtained in this study signifies the utility of Radiation method for derivation of reference crop ET and thereby water requirement of crops in the semi-arid climate of the Gujarat region.

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REFERENCES

Doorenbos, J. Pruitt, W. O. 1979. Guidelines for predicting crop water rquirements. Irrigation and Drainage paper 24, FAO, Rome.

Palasker, M. S., More, S. D., and Varade, S. B. 1987. Comparison of Panevaporation and modified Penman methods for the estimation of crop-water requirement. *Indian J. Agril. Sci.* **57** (3) : 169-175.

Reddy, P. R. Reddy, S. R. Subrahmanyam, M. V. R. Reddy, M. G. R. and Rao, P. G. 1984. Estimation of potential Evapotranspiration using prediction methods for Bapatla region. *The Andhra Agril. J.* **31** (1) : 23-28.

Sharma, R. B. and Sharma, S. D. 1987. Comparison of different methods for the estimation of reference crop evapotranspiration (ETo) for North Bihar, India. Beitrage zur Tropischen Landwirtsecht Und veterinarmedizin, Pusa, India.

Thornthwaite, C. W. 1948. An approach towards a rational classification of climate. Georg-Rev. 54-94.

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Effect of Farmyard Manure and NPK Fertilizers on Bulk Density of Deep Black Soil Under Rice-Wheat Green Gram Rotation

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The fertilizers constitute the king pin for agricultural production. However, their effects on soil physical properties on long term basis required careful consideration. Among different physical properties, porosity is the limiting property in black soil. The resistance to root penetration, root respiration and nutrient uptake, emergence of seedlings, oxygen diffusion, moisture retention and water transmission in the soil are governed by porosity and it can be measured by bulk density of the soil in the field. Investigations were conducted to evaluate the effects of F.Y.M. and N.P.K. fertilizers on soil bulk density in rice-wheat-green gram sequence after six years of cropping in Eru Serier (Vertic ustochrepts) at University Farm, Navsari. The soil is clayey in texture and dominating clay mineral being smectite (59% clay, organic carbon 0.70%, CEC 48 m.e./100 g. pH 7.1 bulk density 1.39 g/cm and particle density 2.61 g. cm.-3.

A randomized block design with ten different treatments (Patel *et al.*) (1989) and four replications were adopted for the study. Nitrogen was applied through urea, phosphorus through single super phosphate and potash through muriate of potash as per the treatments. The bulk density and porosity measured (Black, 1965) from each plot under treatment immediately after the harvest of each of the six crops of rice, wheat and green gram.

Effect of crops

The crops differed significantly in their effect on bulk density and porosity (Table-1). The maximum bulk density (1.46 g cm^3) and minimum porosity (44%) were observed after harvest of rice. The compaction of soil was probably due to puddling which is considered as an essential operation before transplanting of paddy to control weeds and making soil impervious to water for maintaining standing water in the rice field.

However, the bulk density was significantly reduced from 1.46 to 1.40 g/cm^3 after wheat which was slightly improved after green gram as indicated by non-significant differen ce between bulk density after wheat and green gram. Ploughing before sowing of wheat and green gram and drying and weting cycles due to irrigation probably helped in slaking of clods formed after rice, which has reduced the bulk density and increased porosity.

TABLE 1

Effect of crops on bulk density and porosity.

Crops	*B. D. g/cm^{-3}*	*Porosity (%)*
Rice	1.46	44
Wheat	1.40	46
Green gram	1.39	47
S Em.	0.05	---
C. D. at 5%	0.30	---

Effect of N Fertilizer

Application of nitrogen has significantly increased the bulk density from 1.41 to 1.44 g/cm³ and decreased porosity from 46 to 45 per cent (Table 2). Te effect of nitrogen on bulk density was aggravated with the increased in the dose of nitrogen. However, the effect was very small and 50 per cent and 100 per cent N levels were statistically at par but significantly higher over control.

TABLE 2

Effect of nitrogen levels on bulk density and porosity.

N levels	*B. D. (g/cm3)*	*Porosity (%)*
N_0	1.41	46
$N_{50\%}$	1.42	46
$N_{100\%}$	1.44	45
S. Em. +	0.01	---
C. D. at 5%	0.02	---

The increase in bulk density should be due to deterioration of soil structure with increasing levels of nitrogen (Biswas, *et al.* 1971, Sinha *et al.*, 1980).

Effect of FYM, N, P and K fertilizers

Application of phosphate along with nitrogen resulted in significant decrease in the bulk density, however the effect on porosity was very small (Table-3).

The lowest bulk density (1.36 g/cm³) and highest porosity (48%) was observed in the treatments receiving F.Y.M. The decrease in bulk density due to application of F.Y.M. could be due to improvement in soil aggregation. Similar effect was also reported by Ghosh *et al.*(1968), Pharande and Biswas (1968), Biswas and Ali (1969) and Sinha *et al.* (1980).

Addition of N alone resulted in increase in the bulk density over control but P and K when added along with N tended to counteract the increase bulk density. The lowering of bulk density with the application of phosphatic fertilizers was also reported by Biswas *et al.* (1971). Das *et al.* (1966) and Sinha *et al.* (1980).

The decrease in bulk density could be due to improvement in soil aggregation with phosphate fertilizers. The mechanism of soil aggregation by phosphate was also described by Lut *et al.* (1960, 1966).

It is clear from the above that the changes in bulk density and porosity were small, and were related to crop raised, application of F.Y.M. and level of N, P and K fertilizers applied. FYM increased bulk density and porosity and reverse was the effect when N alone was applied. Addition of P and K in conjuction with N has counteracted the adverse effected of N on bulk density and porosity.

TABLE 3

Effect of F.Y.M., N P and K on bulk density and porosity.

Treatment	*50% level*		*100% level*	
	B. D. g/cm³	*Porosity (%)*	*B. D. g/cm³*	*Porosity (%)*
Control	---	---	1.41	46
F.Y.M. (25 t/ha)	---	---	1.36	48
N	1.42	46	1.44	45
NP	1.40	46	1.42	46
NPK	1.41	46	1.43	45
S. Em. +	0.11		0.011	
C. D. at 5%	0.08		0.02	

REFERENCES

Biswas, T. D. & Ali, A. H. (1969). *Indian J. Agric. Sci.* **39** : 618.

Biswas, T. D. Jain, B. L. and Mandal, S. C. (1971). *J. Indian Soc. Soil Sci.* **19**, 31.

Black C. A. (1965). Methods of Soil Analysis (Part-1) Amm. Soc. Agron Madison, Wisconsin, U.S.A.

Das, B., Paindo, D. R., & Biswas, T. D. (1966). *Indian J. Agron.*

Ghosh, A. B. Bose, A., Datta, M. N. and Biswas, T. D. (1968). *Sci. Cult.* **34**, 307.

Lutz, J. F., Garica, Lagos, R. and Hilton, H. C. (1960). Trana, 7th Int. Congr. Soil Sci. 1, 241.

Lutz, J. F., Pinto, R. A. Garica Lagos and Hilton, H. G. (1966). *Proc. Soil Sci. Am.* **30**, 433.

Patel, M. L. Gami, R. C., Patel P. V. and Patel, N. K. (1989). *Gujarat Agricultural University Reserach Journal* **15** (1) : 1-10.

Pharande, K. S. and Biswas, T. D. (1968). *J. Indian Soc. Soil Sci.* **17**, 241.

Sinha, J. P., Prasad, B., and Ghosh, A. B. (1980). *J. Indian Soc. Soil Sci.* **28**, 516-518.

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Sex Determination of Pupae of Powder Post Beetle, *Dinoderus minutus* Fab. (Bostrichidae : Coleoptera), a Pest of Stored Rice

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The sex determination of different insect species is very important and pre-requisite for research in the laboraroty as well as field on various aspects viz., Bionomics, Mass-rearing, sex-attractant and sterility induction. The main characteristics for identification of both the sexes is based on the position and size of genital and anal opening, spiracles, colour and weight of the body. The sex determination studies for the pupae of stalk borer, codling moth, and gram pod borer were studied by different workers in India, Solomon (1962), Peterson (1967), Sithananthan and Subramaniam (1975), Narayanan *et al.* (1977) and Navrajan *et al.* (1979).

Detailed studies on bionomics of powder post beetle were made in the laboratory at Main Rice Research Station, Gujarat Agricultural University, Nawagam during 1979-80. For the purpose, large number of beetles were collected from storage godown of rice and reared on rice flour. The grubs which pupated inside and some cases out side the grain were used for pairing of male and female. The pupae were carefully and critically examined under microscope for sex detection. The pupae distined to be a female beetle had the projection at the caudal end which were long, stout and with a tendency to diverse, forming an angle.(Fig. B). The proections of the caudal end of the paupae destined to be a male beetle were short, parallel and closely associated (Fig. C). These projections, which were the extended parts of the genitalia slowly become retracted inside the body when the pupa was completely transformed into an adult. It is thus a temporary exhibition of the character of sex differentiation. The critical examination of pupae revealed some additional dimensional characters (Table-1). Based on measurements, female pupae were larger and stouter than male pupae.

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TABLE 1

Measurement of male and female pupa of (*Dinoderus minutes* Fab.).

Observed Pupae	*Length (mm)*		*Breadth (mm)*	
	Range	*Mean*	*Range*	*Mean*
Male (n=20)	2.160-2.740	2.550 ± 0.039	0.680-0.900	0.809 ± 0.013
Female (n=20)	2.720 - 2.840	2.771 ± 0.010	0.830-1.010	0.902 ± 0.0134

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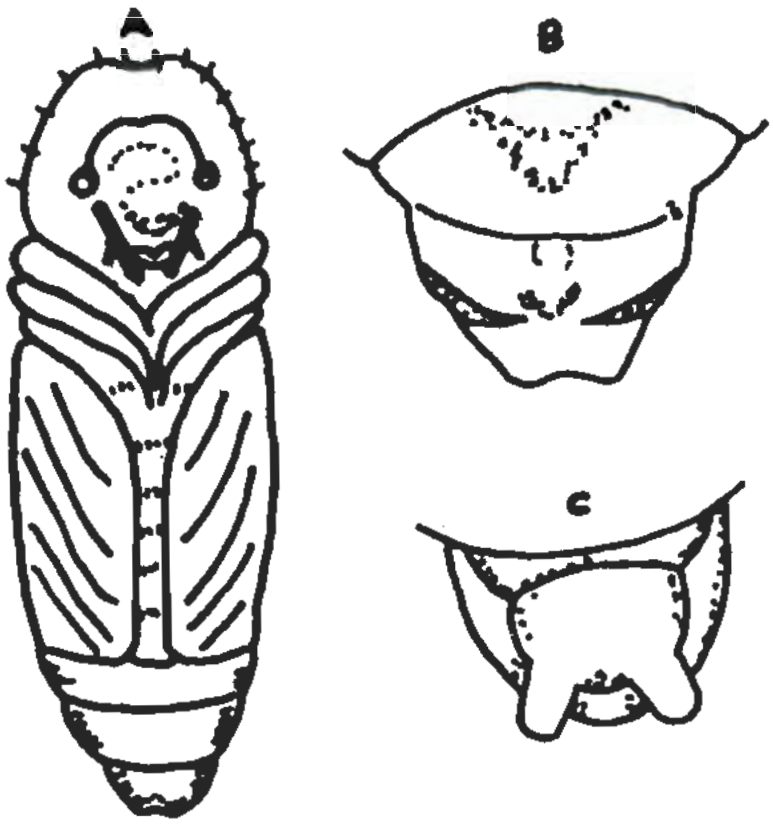

A - Front view of Pupa

B - Genital part of the male Pupa

C - Genital part of the female Pupa

Fig. 1 : Photographs showing the differences between male and female.

REFERENCES

Narayanan, K. : V. V. Ramamurthy; S. Govindrajan and S. Jayaraj (1977). Sexing the pupae of gram pod caterpiller, *Heliothis armigera* Hub. (Lepidoptera : Noctuidae) in relation to certain morphometric characters. *Curr. Sci.* **46** (6) : 192-193.

Navrajan, A. V. ; Ram Dass; and Baldev Prasad (1979). Sex determination of pupae of *Heliothis armigera* Hub. on gram. *Ind. J Ent.* **41** (3) : 285-86.

Peterson, D. (1967). A quick method for sex determination of Colding moth pupae. *J. Econ. Ent.* **58** : 576.

Sithananthan, S. and T. R. Subramaniam (1975). Sex determination of pupae of Stalk borer, *Chilo Zonellus* (S). *Madras Agric. J.* **62** : 62.

Solomon, J. C. (1962). Characters for determining sex in Elm Span Worm pupae. *J. Econ. Ent* **55** : 269-70.

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Bionomics of Groundnut Thrips, *Caliothrips indicus* Bagnall (Thysanoptera : Thripidae)

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Groundnut (*Arachis hypogaea* L.) is one of the important oilseed crops in India. In Gujarat State, it is grown in about 2.28 million hectares with an annual production of 1.99 million tonnes of groundnut pods (Anonymous, 1986). The crop is attacked by about 115 insect species, among which thrips, *Caliothrips indicus* Bagnall, is considered to be an important pest. The yield loss due to this pest in different varieties of groundnut is estimated to the tune of 17 to 40 per cent (Ghewande *et al.*, 1987). Biology of this pest species was studied by Saxena (1971) on onion in Rajasthan and Amin (1984) on groundnut in Andhra Pradesh. However, detailed information on the bionomics of this pest is not available on groundnut in Gujarat. An attempt was, therefore, made to study the biology of this pest at Junagadh (Gujarat).

In order to develop initial culture of the thrips, large number of adults were collected with the help of aspirator from the farm of College of Agriculture, Junagadh. The adults were released into glass vials (3 cm x 1 cm) held in an inverted position. The thrips moved upward and gathered at upper portion of the inverted vials. A young leaflet of the groundnut leaf was introduced into each vial and they were kept in B.O.D. incubator adjusted to 25 ± 1°C temperature for oviposition. The larvae emerged out from the leaflet were reared separately till the emergence of adults. The food was changed once after three days in the morning. The newly emerged adults were paired into glass vials containing a fresh young leaflets for oviposition. In order to study the egg period the leaflets were changed and collected daily and kept into other glass vial. As soon as the progenies emerged out from the leaflet the egg period was recorded. The newly emerged larvae were transferred with the help of a wet camel hair brush in other glass vials containing groundnut leaflets. The individual leaflet was examined under binocular microscope to confirm the moulting. Observations on number of instar, instar duration and total larval duration were recorded. The pupa, when formed was collected and kept individually into the glass vial for emergence of adults. The pre-pupal and pupal periods were recorded. The adults emerged from the pupae were paired on the same day. Each pair was introduced into the glass vial containing a fresh leaflet of the groundnut plant. The pre-oviposition, oviposition and post-oviposition periods alongwith the longevity of the adults were recorded. Measurements of different larval instars, pupae and adults were made with the help of ocular and stage micrometers.

The female thrips thrusted the eggs inside the leaf tissues with its minute pointed ovipositor. Since, the eggs were embedded into the leaf tissues they could not be studied. However, the number of eggs laid by a female

* A part of M. Sc. (Agri.) thesis submitted by senior author to Gujarat Agricultural University, Sardar Krushinagar.

was derived on the basis of larvae emerged out from the eggs. The incubation period was observed to be 6 to 9 days with an average of 8.10 ± 0.64 days (Table 1) at a constant temperature of 25 ± 1°C. Amin (1984) reported the egg period of 7 to 10 days on groundnut at a constant temperature of 25°C.

The larvae passed through two distinct instars. The newly emerged larvae (plate 1A) was tiny, delicate, starchy coloured and segmented worm with red eyes. There were small setae on the dorsal side of head and a pair of setae on each 2nd to 8th abdominal segments. Similar observations were also reported by Corbett(1920) and Saxena(1971), when the pest was reared on cotton and onion, respectively. The duration of first instar larva varied from 2 to 4 days with an average of 3.28 ± 0.68 days. The larval body length ranged from 0.54 to 0.56 mm with an average of 0.55 ± 0.007 m (Table 1).

The second instar larva (plate 1B) was whitish-yellow in colour and biggar than the first instar in size. There were three pairs of setae on 2nd to 8th abdominal segments. It measured on an average 0.85 ± 0.012 mm in body length. The duration of second instar larva ranged from 3 to 5 days with an average of 3.73 ± 0.78 days. Thus, the total larval period ranged from 5 to 9 days (average 7.01 ± 1.46 days) (Table 1). Saxena (1971) reared the pest on onion and the body length of first and second instar larvae was reported 0.66 and 1.05 mm, respectively. The total larval duration of 4 to 8 days was reported by Amin (1984) on groundnut. Thus the present findings are in close confirmation with earlier reports.

Pupation normally takes place inside the soil but it was observed that the larva easily pupated at the bottom of the rearing vials. Before pupation, the larva become dark and sluggish (Plate 1C). The antennae of pre-pupa were directed upward bending between 1st and 2nd antennal joints. The wing pads were partially developed and extended upto 3rd abdominal segment. Long and fine setae were found all over the body. The pre-pupal period was recorded to be 1 to 2 days with an average of 1.40 ± 0.50 days (Table 1).

In pupa (plate 1D), the antennae folded back over the head and wing pads were well developed. Darkening of the pupa before adult emergence was evident. The body length of pupa was measured on an average 0.76 ± 0.013 mm and this stage last for 1 to 2 days with an average of 1.72 ± 0.46 days (Table-1). Saxena (1971) reported the pupal length of 1.29 mm on onion. The difference in body length might be due to the difference in rearing conditions and hosts on which it was reared.

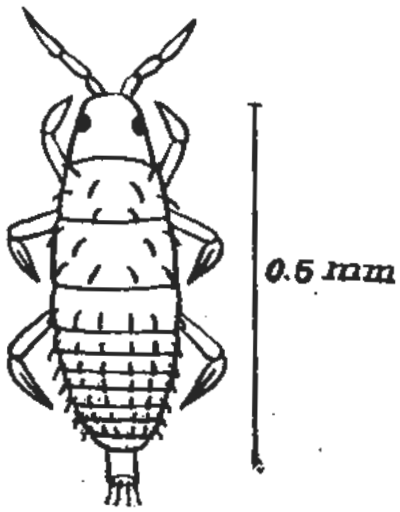
The adult female (Plate-2A) was observed to be dark black in colour with pointed abdominal tip, whereas male was comparatively paler and smaller than the female with bluntly rounded abdominal tip. The forewings and hind wings were fringed. It was observed that the forwings were marked with three narrow pale brown bands. The body length and width of the male thrips ranged from 1.01 to 1.04 mm (Average 1.017 ± 0.014 mm) and 1.48 to 1.50 mm (Average 1.486 ± 0.0092 mm) respectively, whereas the female thrips measured from 1.05 to 1.07 mm (Avegrage 1.054 ± 0.0081 mm) and 1.52 to 1.53 (Average 1.527 ± 0.0046 mm) in breadth. The male and female thrips lived for 17 to 21 days (Average 19.60 ± 1.14 days) and 18 to 24 days (Average 22.25 ± 1.99 days), respectively (Table 1). Almost similar observations were recorded by Amin (1984) on groundnut.

Pre-oviposition, oviposition and post-oviposition periods of this pest were 2 to 4 days (Average 3.23 ± 0.56 days), 11 to 17 days (average 14.23 ± 1.81 days) and 3 to 5 days (average 3.55 ± 0.76 days), respectively. The number of progeny produced per female varied from 36 to 90 with an average of 62.95 ± 11.76 (Table 1).

TABLE 1

Measurements and durations of different life stages of *C. indicus*.

Life stage	*Measurement (mm)*					*Duration (Days)*				
	Min.	*Max.*	*Av.*	±	*S.D.*	*Min.*	*Max.*	*Av.*	±	*S.D.*
Egg	---	---	---			6	9	8.10	±	0.64
Larva										
First instar	0.54	0.56	0.55	±	0.007	2	4	3.28	±	0.68
Second instar	0.85	0.87	0.85	±	0.012	3	5	3.73	±	0.78
Pre-pupa	---	---	---			1	2	1.40	±	0.50
Pupa	0.73	0.79	0.76	±	0.013	1	2	1.72	±	0.46
Adult										
Male										
Length	1.01	1.04	1.017	±	0.014	17	21	19.60	±	1.74
Breadth	1.48	1.50	1.486	±	0.0092					
Female										
Length	1.05	1.07	1.054	±	0.0081	18	24	22.25	±	1.99
Breadth	1.52	1.53	1.527	±	0.0046					



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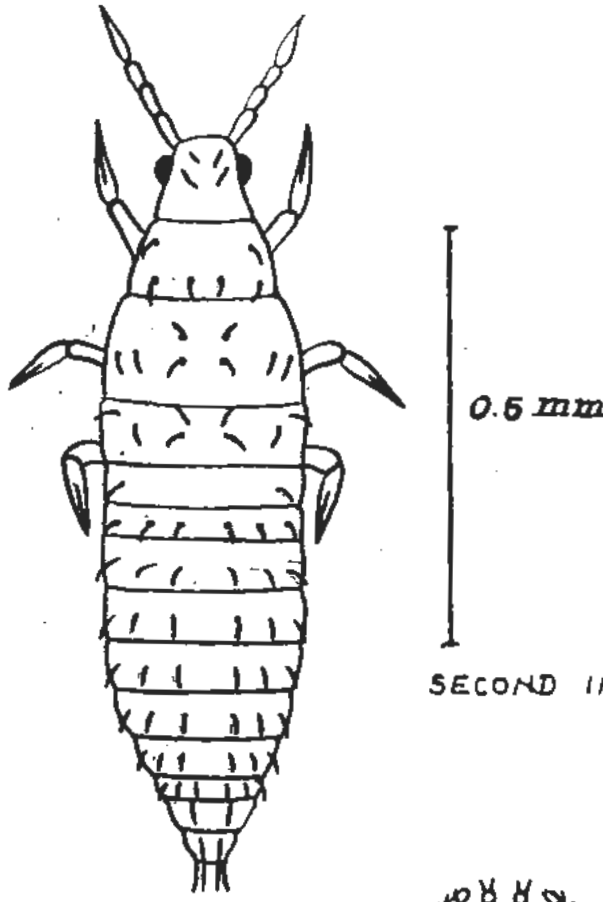

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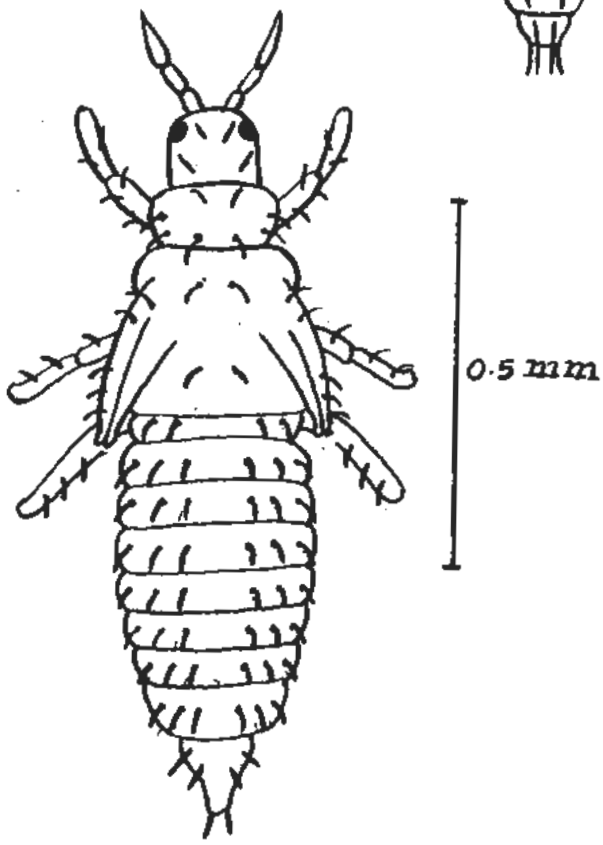

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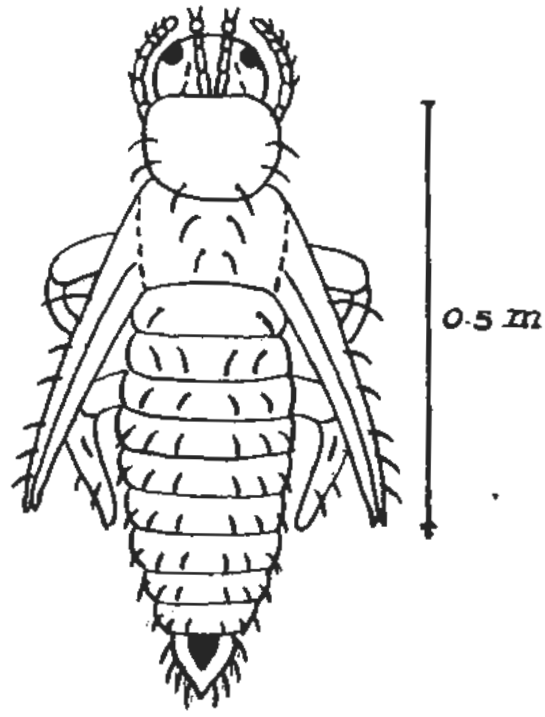
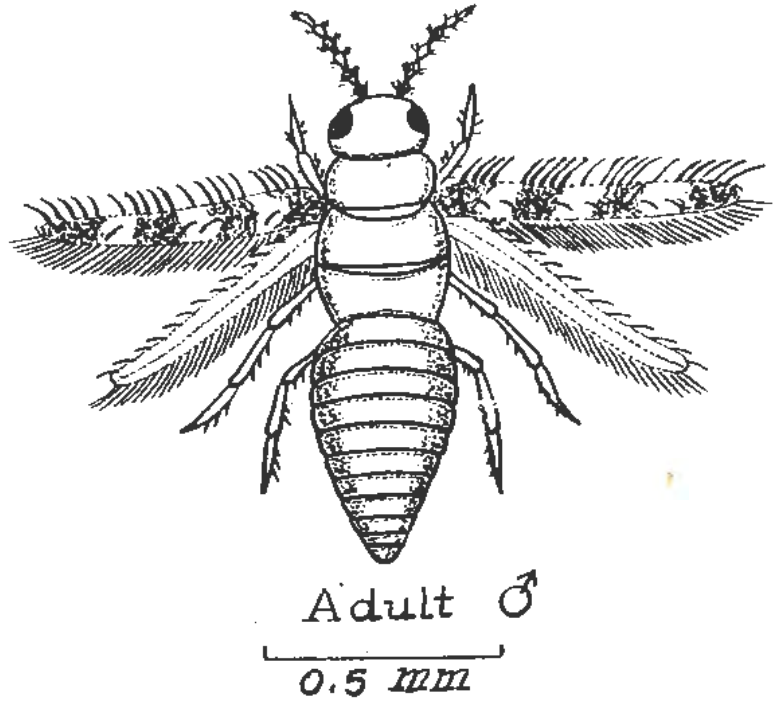


PUPA

Plate-1



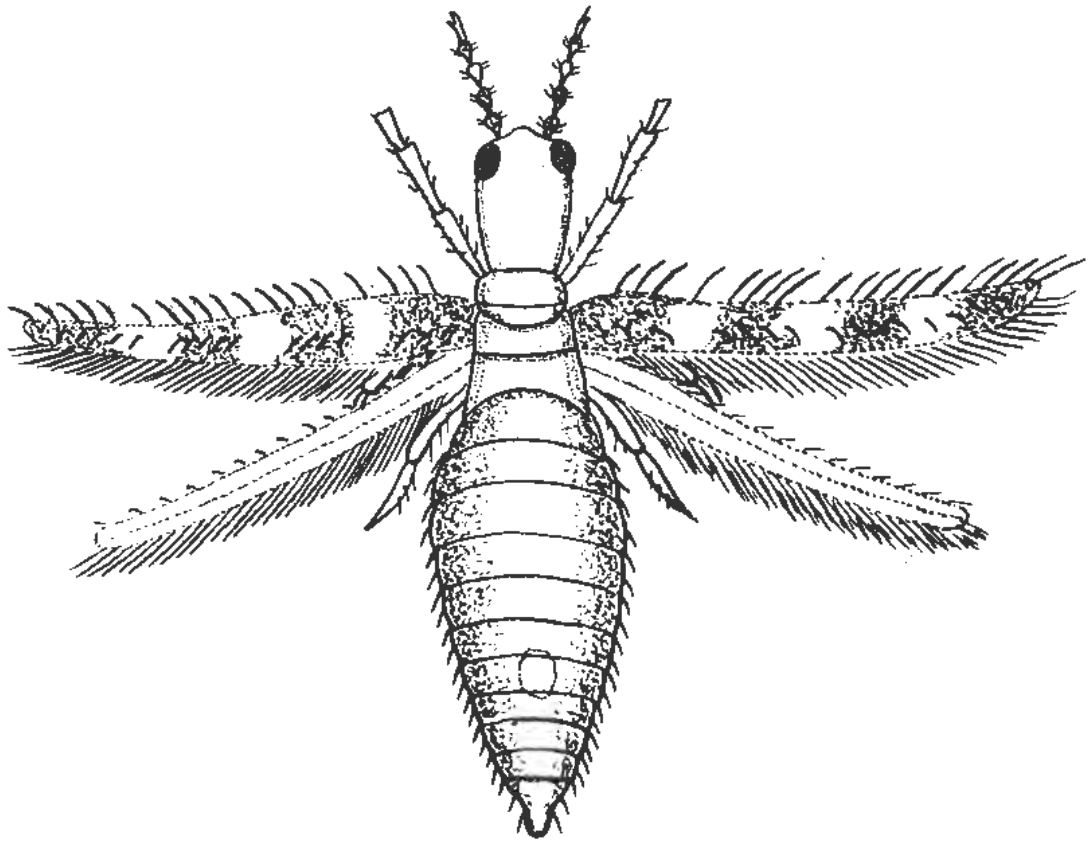


Plate-2

The sexes were determined on the basis of body colour, size and morphological characters of abdominal tips. It was observed that out of 218 adults, 78 were males and 122 were females giving a male to female ratio of 1:1.56.

The total life-span (from egg to death of adult) of male and female thrips varied from 29 to 41 days (Average 35.67 ± 4.03 days) and 30 to 44 (Average 38.32 ± 4.89 days), respectively. Thus, the female lived longer than the male. Alost similar observations were also reported by Amin (1984) on groundnut and Saxena (1971) on onion.

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REFERENCES

Amin, P. W. 1984. Studies on arthropod vectors of groundnut viruses, their ecology and control. Groundnut Improvement Program. ICRISAT, 1982 : pp. 166. Patancheru, Andhra Pradesh.

Anonymous 1986. "Districtwise area production and productivity of groundnut in Gujarat (from 1981-82 to 1984-85)". Seminar on strategies of oilseeds production in Gujarat State, 9-10th, May, 1986. Directorate of Research, GAU, Ahmedabad.

Corbett, G. H. 1920. Observations on cotton thrips in Gezira, Blue Nile Province, Sudan in 1918-19, *Bull. ent. Res.* **11** : 95-100.

Ghewande, M. P.; V. Nandagopal and P. S. Reddy 1987. Plant protection in groundnut N.R.C.G. (I.C.A.R.) Junagadh (Gujarat State). *Technical Bulletin* No. 1, pp. 25-35.

Saxena, R. C. 1971. Bionomics of *Caliothrips indicus* (Bagnall) infesting onion (Thripidae : Thysanoptera). *Indian J. Ent.* **33** (3) : 342-345.

GAU Res. J. 1993, 18 (2) : 120-121

Evaluation of Different Insecticides Against Aphid (*Aphis gossypii* Glov.) and Jassid (*Amrasca biguttula biguttula* Ishida) on Okra (*Abelmoschus esculentus* (L.) Moench)*

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Okra (*Abelmoschus esculentus* (L.) Moench), locally known as 'Bhindi' or 'Bhinda' also known as lady's finger is an important protein rich vegetable crop cultivated throughout India. It is a popular vegetable in Gujarat and is usually heavily infested by aphid, *Aphis gossypii* Glov. and jassid, *Amrasca biguttula biguttula* Ishida during the early stage of the crop. Nymph and adult aphids suck the sap from the plant at the initial stage of the crop as a result its growth is adversely affected (Butani and Verma, 1976). The jassid affected leaves crinkle and show the characteristic browning symptoms of hopper burn. According to Jotwani *et al.* (1966), jassid is found active in okra fields all the year round in overlapping generations and cause considerable damage to the crop. Krishnaiah *et al.* (1976) and Kisha (1978) reported that monocrotophos and fenthion were effective for the control of aphid. While, Rathore *et al.* (1974) and Patel *et al.* (1980) reported that 0.04 per cent monocrotophos was significantly superior to untreated control in checking the jassid infestation.

TABLE 1

Average number of aphid and jassid in different treatments per fifteen leaves of five plants.

Sr. No.	*Treatments*	*Pooled of 11 observations*	
		Aphid	*Jassid*
1.	Malathion 0.05%	81.25	19.78
2.	Fenthion 0.10%	00.45	02.58
3.	Chlorpyriphos 0.04%	01.15	11.85
4.	Phenthoate 0.02%	88.33	16.90
5.	Permethrin 0.02%	02.90	00.98
6.	Fenvalerate 0.01%	09.23	05.63
7.	Monocrotophos 0.03%	00.73	00.58
8.	Quinalphos 0.03%	13.68	15.10
9.	Phosalone 0.075%	05.43	23.70
10.	Endosulfan 0.075%	17.38	02.33
1.	Fenitrothion 0.05%	20.89	14.50
12.	Control (water spray)	245.13	47.33
	S. Em. ±	00.53	02.44
	C. D. at 5%	01.47	06.76

* Part of the M. Sc. (Agri.) thesis submitted by the first author to the Gujarat Agricultural University, Sardar Krushinagar in 1981.

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A field experiment was conducted on the farm of N. M. College of Agriculture, Navsari during the *kharif* season with twelve insecticidal treatments, replicated four times in a randomised block design. The plot size was 6.0 x 3.0 meteres. Spraying of the insecticides were done at an interval of 10 days starting from one month after sowing bhindi crop. Insect counts of aphid and jassid were recorded from three leaves viz., top, middle and bottom on five randomly selected plants in three middle rows of each plot, twice a week starting from first spraying till the completion of the crop, to evaluate the efficacy of the treatments. The data were subjected to statistical analysis.

Pooled data on aphid population (Table-1) showed that, fenthion, monocrotophos and chlorpyriphos were found equally effective for the control of aphid. Significant difference was observed among the efficacy of permethrin, phosalone, fenvalerate, quinalphos, endosulfan, fenitrothion, melathion and phenthoate in chronological order of effectiveness as far as the control of aphid is concerned. In case of jassid, treatments of monocrotophos, permethrin, endosulfan and fenthion were found equally effective and at par with the treatment of fenvalerate and they were significantly superior to the rest of the treatments.

Based on the above findings, all the treatments were significantly superior to the untreated control. Fenthion and monocrotophos were the treatments effective for the control of both the pests of bhindi viz., aphid and jassid.

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REFERENCES

Butani, D. K. and Shashi Verma (1976). Insect pests of vegetables and their control-3 : Lady's Finger. *Pesticides*, **10** (7) : 31-37.

Jotwani, M. G. Sarup, P. : Sircar P. and Singh D. S. (1966). Control of jassid (*Empoasca devastans* Dist.) on okra seedlings by treatments of seeds with different insecticides. *Indian J. Ent.* **28** (4) : 477-81.

Kisha, J. S.A. (1978). Foliar sprays and Disulfoton Granules for the control of *Aphis gossypii* on okra. *PANS*, **24** (2) : 114-20.

Krishnaiah, K.; Tandon, P. L. and Mathur, A. C. (1976). Evaluation of insecticides for the control of major insect pests of okra. *Indian J. agric. Sci.*, **46** (4) : 178-86.

Patel, J. R. ; Patel, R. C. and Amin P. R. (1980). Field evaluation of some insecticides for the control of *Amarsca' biguttulla biguttula* Ishida and *Aphis gossypii* Glover on okra. *Indian J. Ent.*, **42** (4) : 776-79.

Rathore, H. S.; Despande, R. R.; Thakur, R. C. Sood, N. K. and Raghuwanshi, R. K. (1974). Control schedule against bhendi pests. *Pesticides*, **8** (6) : 39-42.

GAU Res. J. 1993, 18 (2) : 122-123

Bio-Efficacy of Various Insecticides Against Army Worm, *Mythimna separata* Wlk on Wheat

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Wheat is attacked by several species of insects (Nair, 1975) causing appreciable damage, which ultimately affect the yield. The outbreak of army worm, *Mythimna separata* on wheat was first time recorded in India from Delhi in 1968 (Sarup *et al.*, 1969). No work on chemical control of this pest on wheat particularly in middle Gujarat has been reported due to it's sporadic nature. Hence, the present investigation was undertaken to study bio-efficacy of various insecticidal formulations against *M. separata* infested wheat crop during rabi 1987-88.

The field trial was conducted at Hadgud village of Kheda district in randomised block design with ten treatments including control. It was replicated four times with plot size being 4.8 x 6.0 m. The insecticides were applied when larval population of army worm was found about 3 larvae/900 sq. cm. Number of larvae were recorded prior and 1, 2, 3 and 7 days after application of insecticides by observing randomly selected 5 spots of 900 sq. cm. area in each plot.

The larval population of *M. separata* in wheat (Table 1) show significant superiority of all the insecticidal formulations to control upto one week after their application. However, among the insecticides chlorpyriphos 0.04% gave maximum larval mortality after one day of it's application and proved significantly superior to monocrotophos 0.036%, carbaryl 0.2%, fenitrothion 0.05%, endosulfan 0.07% and dichlorvos 0.05%. Whereas, both (E. C. and E. W.) formulations of quinalphos 0.05% and malathion 0.05% were at par to chlorpyriphos. These three treatments alongwith monocrotophos gave cent per cent control of army worm within 2 days of their application and showed significant superiority to chlorpyriphos, fenitrothion, endosulfan, carbaryl and dichlorvos. However, chlorpyriphos remained significantly more superior to later four treatments. Fenitrothion and endosulfan were at par to quinalphos, monocrotophos and malathion after 3 days of application and gave cent per cent mortality of army worm along with carbaryl within one week. Bindra and Singh (1973) have also reported the effectiveness of fenitrothion and carbaryl against *M. separata* upto one week after their application. Chlorpyriphos treated wheat crop was not found completely free from army worm infestation even after one week of its spray, however army worm population was significantly lesser than malathion and dichlorvos. Dichlorvos was found to be least effective throughout the period of study.

Wheat crop sprayed with monocrotophos and E. C. or E. W. formulation of quinalphos was found completely free from army worm within 2 days and their effectiveness was continued upto one week after their application. However, considering the cost and effectiveness of the insecticides for the control of army worm, fenitrothion 0.05% was found to be the best insecticides followed by endosulfan 0.07% monocrotophos 0.036%, carbaryl 0.2% and quinalphos 0.05%.

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TABLE 1

Effect of various insecticidal formulation on reduction of army worm *M. separata* population infesting wheat crop during 1987-88.

Insecticidal formulation	*Number of larvae / 900 sq.cm. area*					*Cost of one spraytha (Rs.)*
	Before spray	*Day's after spray*				
		1	*2*	*3*	*7*	
Quinalphos (25 EW) 0.05%	5.94* (34.78)	1.72 (2.46)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	---
Quinalphos (25 EC) 0.05%	5.94 (34.78)	1.73 (2.49)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	157-00+
Monocrotophos (30 WSC) 0.036%	5.52 (29.97)	2.33 (4.93)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	119-00
Chlorpyriphos (20 EC) 0.04%	6.74 (44.93)	1.63 (2.16)	1.26 (1.09)	1.14 (0.88)	1.49 (1.72)	145-00
Carbaryl (50 WP) 0.2%	5.94 (34.78)	2.82 (7.45)	2.68 (6.68)	1.35 (1.32)	0.71 (0.00)	141-00
Malathion (50 EC) 0.05%	5.94 (34.78)	1.73 (2.49)	0.71 (0.00)	0.71 (0.00)	2.31 (4.84)	72-00
Endosulfan (35 EC) 0.07%	6.15 (37.32)	3.91 (14.79)	2.32 (4.88)	1.10 (0.71)	0.71 (0.00)	114-00
Dichlorvos 05 (76 EC) 0.05%	5.94 (34.78)	4.53 (20.03)	3.24 (10.00)	3.13 (9.30)	3.55 (12.10)	75-00
Fenitrothion (30 EC) 0.05%	6.15 (37.32)	3.56 (12.17)	1.73 (2.49)	1.06 (0.49)	0.71 (0.00)	105-00
Control	5.48 (29.53)	5.27 (27.27)	5.73 (32.33)	5.48 (29.53)	4.63 (20.94)	---
S. Em.	0.24	0.21	0.13	0.18	0.11	
CD at 5%	NS	0.61	0.37	0.51	0.33	
CV%	7.99	14.41	12.90	22.00	14.07	

* $\sqrt{x + 0.5}$ transformed values.

Figures in parentheses are retransformed values.

+ Labour charges Rs. 11-00 per day i.e. 11 x 3 = Rs. 33-00.

REFERENCES

Bindra, O. S. and J. Singh, 1973. Bionomics of the army worm, *Mythimna separata* (Walker) at Ludhiana, Punjab. *Indian J. agric. Sci.* **43** (3) : 299-303.

Nair, M. R. G. K. 1975. *Insect and mites of crops in India. Indian Council of Agricultural Research, New Delhi*, 16-17.

Sarup, P., K. M. Peswani, D. S. Singh, V. S. Srivastava and R. Lal. 1969. An unusual outbreak of army worm, *Pseudaletia separata* (Walker) at Delhi in 1968 and evaluation of pesticides against the larvae infesting wheat. *Indian J. Ent.* **31** (3) : 265-272.

GAU Res. J. 1993, 18 (2) : 124-125

A New Record of Grasshopper From Gujarat

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There is a new record of short horned grasshopper identified as *Aiolopus thalassinus tamulus* (Fabricius) (orthoptera : Acrididae) from Bhal areas of Dhandhuka taluka, Ahmedabad, Gujarat, India. Earlier records of this species are from Tennevelly and Maduva district of South India (Fletcher 1914), Egypt (Minshawy, Hinnawy, Hammad and Sawaf (1975), Pakistan (Baloch 1978) and Turkey (Tutkan 1979).

Both, adult and nymphs damaged wheat and rabi sorghum seedling severly by cutting the plant at tips or some time completely destroyed the seedlings leaving no trace of plants in the field. This required re-sowing. The maximum population of pest is observed in October, when its swarm moves from fields of newly grown Rabi crops. Its population starts declining in November and onwards. In December the movement of hoppers is not noticed on surface of soil. But it remains, though in low intensity, from 0.1 to 1.2 hoppers/m^2, hidden as adult in lose soil. Ayyar (1940) reported it from cotton in South India. Khalifa (1957) did not observe the occurence of diapause in Egypt indicating that the pest is active throughout the year. However under Bhal conditions in Gujarat, India the pest is not observed throughout the year but only during late Septemebr to March which indicates that the pest undergoes diapause in egg stage. During March when weather is hot the dead bodies of adults grasshopper are found within loose soil. Ibrahim (1965) observed six nymphal instars in Egypt. He noticed high mortality among young hoppers during dry hot weather as well as coldest months. Baloch (1980) listed Maize, Watermelon, Lucern and Berseem as its host plants in Pakistan. He observed five instars of nymphs and noticed four overlapping generations in a year, highest population being in July to October and lowest in February to March. Under Bhal conditions the highest population is observed in October and is never seen in April to August probably because of hot summer and rains. Irshad, Ali and Mohyuddin (1985) observed the abundance of *Mermis nigrescens* in *A. thallasinus* particularly during monsoon period.

REFERENCES

Ayyar, T. V. Ramkrishna (1940). Hand book of Economic Entomology for South India. Govt. Press Madras, pp 464.

Baloch, A. A. (1978). Some studies on nymphs of *Aiolopus thalassinus* (RAE, 1980 Vol. 68, pp. 232). *Turkiye Bitki Koruma Dergisi* (1978) **2** : (2) 115-124.

Fletcher, T. B. (1914). Some south Indian insects and other animals of importance. M/s. Bishen Singh Mahendra Pal Singh Dehrudun. pp. 524.

Ibrahim, M. M. (1965). Investigation on the biology of *Aiolopus thalassinus* (RAE, 1971 Vol. 59, pp. 621). *Bull. Soc. Ent. Egypt* (1965) pp. 415-22.

Irshad, M. Ali, R, Mohyuddin A. I. (1985). Notes on biology and ecology of nymphal and adult parasites of grass hopper in Pakistan (RAE, 1986, Vol. 74, Ref. 3318). *PAK Journal of Zoology (1985)* **17** (2) Karachi.

Khalifa, A. (1957). The development of eggs of some Egyptian species of grasshopper with a special reference to incidence of diapause in eggs (RAE, 1959, Vol. 47 pp.34) Bull. Soc. Ent. Egypt (1957) pp. 299-330.

Minshawy, A. M. Hinnawy, N. H. Hammad, S. M. and Sawaf, S. M. (1975). Population fluctuation of grass hopper and locust in Akenadria area, Egypt (RAE, 1979 Vol. 67 Ref. 3196). *Bull. Soc. Ent. Egypt (1975)*, pp. 83-89.

Tutkum, E. (1979). Occurence of *Aiolopus thalassinus* in Dumlupinar, Turkey (RAE, 1980, Vol. 68, pp. 232). *Turkiy Bitki Koruma Dergisi* (1979) 3 (2) 113-119.

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Estimation of Avoidable Lossess in Wagad Cotton (*Gossypium hirsutum*) in Gujarat

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In the part of Gujarat where Asiatic cotton (*G. herbaceum)*, popularly known as Wagad cotton, is grown under rainfed conditions with least plant protection measures. The major pests are aphids and bollworms. The information regarding the avoidable losses in this cotton which covers about 40 per cent of cotton area in Gujarat is not available and hence the experiment was conducted at Regional Cotton Research Station, Viramgam during three cotton seasons from 1982-83 to 1985-86 on Asiatic cotton variety i.e. G. Cot. 13 for assessing the losses due to sucking pests and bollworms.

The experiment was laid out in Randomized Block Design with five replications and four treatments *viz.*, (1) untreated control (2) control of sucking pests (3) control of bollworms and (4) control of sucking pests and bollworms. The plots allotted for control of sucking pests were sprayed either with phosphamidon 0.04% or dimethoate 0.03% to keep the crop free from this pest, while permethrin 0.015% was sprayed for the control of bollworms. For the control of both sucking pests and bollworms either phosphamidon or dimethoate was sprayed with permethrin whenever required. The per cent damage due to bollworms was worked out on the basis of open bolls and locules at the time of picking by observing total bolls and locules from five plants selected randomly from each net plot. The yield of seed cotton was recorded separately from each net plot. The data were subjected to pool analysis by using suitable transformation wherever necessary and presented in Table 1. The percentage of avoidable losses in yield were worked out by adopting following formulae :

Avoidable losses due to all pests $= \frac{D-A}{D} \times 100$

Avoidable losses due to sucking pests $= \frac{B-A}{D} \times 100$

Avoidable losses due to bollworms $= \frac{D-B}{D} \times 100$

Where,

A = yield obtained from untreated control

B = yield obtained from the plots wherein sucking pests were controlled

C = yield obtained from the plots wherein bollworms were controlled

D = yield obtained from the plots where in both bollworms and sucking pests were controlled

The data on avoidable losses due to sucking pests and bollworms are presented in Table 1.

The three years data (Table -1) showed by less incidence of bollworms in open bolls and locules and different treatments remained at par among themselves. However, the lowest bollworm infestation and the highest yield was obtained in the treatment wherein both the sucking pests and bollworms were controlled, whereas the highest bollworm infestation and lowest yield was occured in untreated control. The yield recorded in the treatment for the control of sucking pest ranked second in its performance.

TABLE 1

Bollworms infestation, yield of cotton and avoidable losses in different treatments.

Sr. No.	*Treatments*	*Per cent damage of bollworms*		*Av. yield of seed cotton (kg/ha)*	*Loss in yield (kg/ha)*	*Avoidable losses (%)*
		Open bolls	*Locules*			
1.	Untreated control	3.00 (9.84)	1.70 (7.54)	1210 A	272	18.40 (All pests)
2.	Control of sucking pests	2.80 (9.64)	1.60 (7.37)	1411 B	72	13.55 (Sucking pests)
3.	Control of bollworms only	1.30 (6.54)	0.84 (5.27)	1246 C	237	4.85 (Bollworms)
4.	Control of sucking pests and bollworms	0.82 (5.19)	0.57 (4.34)	1483 D	---	
	S. Em. ±	1.77	1.10	57		
	C. D. at 5%	NS	NS	162		
	C. V. %	59.98	68.14	16.80		

It is also evident from the Table-1 that avoidable losses due to all pests were 18.40 per cent, while the avoidable losses due to sucking pests and bollworms were 13.55 and 4.85 per cent, respectively. In general the damage due to sucking pest was higher than the damage caused by bollworms. The bollworms are known to be the serious pests of cotton than sucking pests (Anonymous 1984). The losses due to bollworms to Hybrid-4 cotton were estimated to the tune of 89 per cent in Gujarat (Rote *et al.* 1988); 88 per cent in Tamil Nadu (Murugesan *et al.*, 1985); 75 per cent in Andhra Pradesh (Anonymous,1976) which is just reverse to these findings as discussed above.

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REFERENCES

Anonymous. 1976. Annual progress report (Entomology) of Andhra Pradesh Agricultural Unieversity, 1976-77 : pp 3-5.

Anonymous. 1984. Annual Research Report, Fibre crops, AICCIP, Main Cotton Research Station, Gujarat Agricultural University, Surat, 1984-85 : pp. 4-6.

Murugesan, N. P. Veluswamy and A. D. Davotta. 1985. A note on loss due to bollworms in rainfed *G. hirsutum*. *Cotton Dev.*, **15** (2 & 3) : 59-60.

Rote, N. B., B. K. Patel, N. P. Mehta and A. H. Shah, 1988. Estimation of crop losses due to different pests on Hybrid-4 cotton. *Cotton Dev.*, **18** : 31-31.

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Clinico-Biochemical Studies of Experimental Nitrite Toxicity in Buffalo Calves

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The principal hazardus to the livestock from nitrates arise due to the consumption of certain nitrate rich plants such as barley, oats, maize, rye etc. by which plant nitrate converts to nitrite in the alimentary tract and on absorption it transforms haemoglobin into mathaemoglobin causing anoxia and death. (London *et al.* 1967; Clarke *et al.* 1981). In the present study biochemical and histopathological changes of experimental nitrite toxicity in buffalo calves were evaluated and placed on record.

Three apparently healthy male buffalo calves aged 6 to 8 months and weighing about 50 kg were obtained. Freshly prepared 5 per cent aqueous solution of sodium nitrite Sarabhai Chemicals -Baroda) was administered slowly by intravenous route at the rate of 100 mg per kg body weight to each experimental calf and the ensuing clinical signs were monitered as per the standard protocol. Blood and Cerebrospinal fluid were collected before and after the administration of the nitrite solution for estimation of glucose (Frankel *et al.* 1970); plasma proteins (Varley, 1963); nitrite concentrations in blood and CSF (Diven *et al.*, 1962) and CSF globulins (Sastry 1983). Following death, systematic and detailed necropsies were conducted to record the pattern of gross pathological lesions and representative samples of tissues were collected for histopathology.

The sequences of clinical signs observed in all these experimental animals were serous nasal discharge; lacrimation; dyspnoea ; acute adborninal pain, frothy salivation, brownish discolouration of conjunctival vasculature and convulsions. Similar signs were documented by Clarke *et al.* (1981) and Blood *et al*. (1983) in the instances of nitrite toxicity. All the calves of the present study had succembed within 45 minutes following administration of nitrite solution suggesting acute systemic toxic potentials of the chemical.

The concentrations of glucose in blood as well as CSF were found decreased from 80.6 mg/dl to 46.6 mg per dL and 71.6 mg per dL to 61.6 mg/dL respectively. The plasma protein levels varied from 7.5 g/dl to 7.3 g/dl. However, CSF globulins did not elevate to detectable levels ruling out inflamatory changes in the central nervous system. Prasad (1987) had also reported negative Pandy's test for CSF globulins. The concentrations of nitrite was of the order of 176 ug/dl in blood and 3 mg dl CSF samples collected in the terminal stages. The record of significantly lower levels of nitrite could be attributed to the slower diffusion of nitrite from blood to CSF. However, relatively higher concentrations of nitrite were recorded in CSF. 8 h post infusion by Prasad (1987) indicating that the rate of diffusion was a function of time. Histopathological assessment of liver and kidney sections revealed mecrotic foci.

Carnowski and Zoltoriska (1971) reported that necrotic changes in the liver, kidney and myocardium though deemed nonspecific could be useful in the differential diagnosis of actue and chronic types of nitrite toxicity.

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REFERENCES

Blood, D. C., Radlstits, O. M. ; Henderson, J. A. Arundel, J. H. and Gay, C.C. (1983). Veterinary Medicine. 6th edn., Bailliere Tindall, London.

Clarke, M. L. Harvey, D. G. and Humphreys, D. J. (1981). Veterinary Toxicology, 2nd edn., Baillare and Tindall. London.

Czarnowski, A. and Zoltoriska, A. (1971). Value of histological examination in nitrate and nitrite poisoning in animals. *Medycyna Weterynarvina* **27** (7) : 413-414. (*Vet. Bull.* **42** : 5972).

Diven, R. H. Pistor, W. J. Reed, R. E. Trautman, R. J. and Watts, R. E. (1962). The determination of serum or plasma nitrate and nitrites. *Am. J. Vet. Res.* **23** (94) : 497-499.

Frankel, S.; Reitman, S. and Sonnenwirth, A. C. (1970). Gradwohl's clinical laboratory methods and Diagnosis. 7th edn. C. V. Mosby Company, Saint Louis.

London, W. T., Henderson, W. and Cross, R. T. (1967). An attempt to produce chronic nitrite toxicosis in swine. *J. Am. Vet. Med. Assoc.* **150** : 398.

Prasad, B. (1987). A note on CSF in experimental acute nitrite poisoning in buffalo calves. *Indian J. Vet. Med.* **7** (2) : 144-145.

Sastry, G. A. (1983). Veterinary Clinical Pathology, 3rd edn, CSB Publishers and Distributors, Delhi.

Varlay, H. (1963). Practical clinical Biochemistry, 3rd edn. William Heithemann. Medical Book Ltd., London.

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Certain Haematological and Biochemical Changes with Corticosteroides in Experimental Buffalo Calves

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Certain haematological and biochemical studies with administration of different corticosteroides induced slight to moderate leucocytosis and moderate to mild neutrophilia within 24 hours post-treatment in buffallo calves. Nonsignificant (P/0.05) eosinopenia, no change in haemoglobin concentration and monocyte numbers were also recorded. Significant (P/0-0.05 hyperglycaemia were persisted for 48, 96 and 24 hrs after prednisolone, triamcinolone and dexamethasone injection respectively. Total plasma protein level remain unaltered.

The magnitude of haematological and biochemical variation during disease or after corticosteroid thereby varies with the species. To assess certain haematological and biochemical response with different corticosteroids, the present investigation was conducted on five clinically normal male Surti buffalo calves of six to seven months old and 75 to 100 kg body weight. Five mililitres (ml) of blood was collected from each calves in sodium EDTA (2 mg/ml of blood) containing vials to estimate haemoglobin (Hb), total leucocyte count (TLC) and differential leucocyte count (DLC) as per Jain (1986). Blood glucose (Frankle *et al.* 1970) and total plasma protein by Biurate methods (Varley 1967) were also studied over a 24 hrs period before various experiments to determine normal control values.

Each calves were given 10 mg (1.0 ml) prednisolone acetate (Hostacortin-H) intramuscularly. Five days after the completion of prednisolone experiment, 5 mg (0.5 ml) triamcinolone acetonide (Vetalog) was injected intramuscularly to each calves. After ten more days, each calf was similarly injected 5 mg. (1.25 ml) dexamethasone sodium phosphate (Dexavet). During these experiments EDTA blood was collected at an interval of 24, 48, 72, 96 and 120 hrs post-injection of corticosteroids for haematological and biochemical estimation.

Prednisolone and triamcinolone induced significant (P*L*0.05) increase in TLC from 9.05 ± 0.62 thousand/cumm to 12.18 ± 0.74 thousand/cumm and 10.46 ± 0.31 thousand/cumm to 12.60 ± 0.66 thousand/cumm at 48 hrs respectively, while dexamethasone induced significant (P*L*0.05) increase in TLC from 9.92 ± 1.34 thousand/cumm to 12.26 ± 0.86 thousand/cumm with in 24 hrs. Normal total leucocyte count were found by 72 hrs after prednisolone and triamcinolone and 120 hrs after dexamethasone. Present results are in coinfirmity with earlier report (Schillinger and Bucher, 1980). Differential leucocyte count indicated significant (P*L*0.05) neutrophilia at peak level from 29.40 ± 3.08% to 38.00 ± 4.26%, 30.80 ± 1.65% to 40.00 ± 1.82% and 36.20 ± 3.95% to 45.60 ± 2.71% respectively for prednisolone, triamcinolone and dexamethasone. Lymphopenia and eosinopenia were noticeable by 24 hrs in all three experiments. In consistent changes were found in haemoglobin level and for monocyte number. Jain (1986) reported atypical response to corticosteroid in most species

includes leucocytosis, neutrophilia and lymphopenia. Bishop (1968) studied the steroid induced effect in animals and concluded that leucocytosis is primarily due to release of mature neutrophils from bone marrow reserve and diminished rate of thier removal from blood. In the present study progressive increase in glucose level in 24 hrs with all three corticosteroids were found, significant (P<0.05) hyperglycaemia from 44.54 ± 5.99 mg% to 80.90 ± 7.24 mg%, 58.17 ± 3.91 mg% to 73.63 ± 3.34 mg% and 54.54 ± 5.92 mg% to 76.35 ± 3.33 mg% were persisted for 48, 96 and 24 hrs after prednisolone, triamcinolone and dexamethasone injection respectively. Mc Donald (1981) mentioned the mechanism of hyperglycaemia with corticosteroids.

The present results of unaltered total plasma protein level are in confirmity with earlier report (Jain, 1989).

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REFERENCES

Bishop, L. R. (1968). Leucokinetic studies XIII. A non-steady state kinetic elevation of the mechanism of cortisone induced granulocytosis *J. Clin. Invest.* **47** : 249-260.

Frankel, S. Reitman, S. and Sonnenwirth, A. C. (1970). *Gradwohl's Clinical Laboratory Methods and Diagnosis.* 7th ed. The C. V. Mosby Company, Saint Louis, 83.

Jain, N. C. (1986). *Schalm Veterinary Haematology.* 4th ed. Lea and Febiger, Philadelphia, pp 198-207, 685-695 and 821-829.

Jian, N. C., Vegad, J. L.: Shrivastava, A. B, Jain, N. K. Grag, U. K. and Clote, G. N. (1989). Haematological changes in buffalo calves inoculated with E. coli endotoxin in corticosterodis. *Res. Vety. Sci.* **47** (3) : 305-308.

Mc Donald, L. E. (1981). Hormone influencing metabolism in Jones, L. M.: Booth, N. and Mc Donald, L. E. (eds) *Veterinary Pharmacology and Therapeutics.* 5th ed. Oxford and IBH Publishing Company, New Delhi. 556.

Schillinger, D. and Bucher, W. (1980). Unter suchungen uber den einfluss von Glukokortikoiden und von ACTH auf das Blutbil: des Rindes. Tierat. cited from Jain (1986).

Varley, H. (1967). Practical Clinical Biochemistry. 3rd ed. William Heithemann Medical Books Ltd. London-236.

Abstracts of Ph. D. Thesis

Age Related Changes in the Productivity of Patanwadi Sheep

Submitted to Gujarat Agricultural University

Name of Student *P. M. Desai*

Name of Major Advisor *K. P. Shukla*

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The present study was undertaken with the objective of knowing the age-specific production performance in the Patanwadi sheep. The data on 1038 lambings and 2150 wool production records belonging to Patanwadi flock. Government Sheep Breeding Farm, Patan, Gujarat State, from 1972 to 1980 were used.

The results indicated that age differences were non-significant for number of ewes tupped per ewe joined; number of ewes lambed per ewe joined per ewe bred, per ewe joined at lambing : number of lambs born per ewe lambing, number of lambs born per ewe joined, per ewe bred and per ewe joind and present at lambing : number of lambs weaned per lamb born : number of lamb weaned per ewe joined per ewe bred, per ewe joined and present at lambing and per ewe lambed. The peak performance was observed at 4 years of age for most of the characteristics. Year effect, was highly significant ($P<0.01$) for most of the characteristics. On an average for every 1000 ewes mated 752 ewes lambed, 778 lambs were born, 741 lambs weaned and 356 ewe lambs survived to joining age. Net reproduction rate reached unity (1.114) at 5 year of age. A flock of 1000 Patanwadi ewes would increase to 1000×1.032^5 (=1170) in five tears if all ewe offspring entered the breeding flock but were cast after lambing at 5 years of age. Permissible culling percentage were 23.79 for the flock under study. The flock strength was not maintained unless the ewes were kept till the fourth lambing. These results alongwith the culling levels indicated that the low reproductive efficiency may not lead to the danger of facing a negative population growth.

The weight of lamb born per ewe joined, per ewe bred, per ewe joined and present at lambing and per ewe lambing showed highly significant differences due to age of ewes as well as years ($P<0.1$). The peak in weight of lamb born per ewe lambing was at 6 years of age of ewe (2.965 kg), in other characteristics it was 4 years of age. The weight of lamb weaned per ewe joined, per ewe joined and present at lambing and also per ewe mothering showed significant differences due to the age of ewes and the years also. The peak weight of lamb weaned per ewe joined (13.631 kg) was observed at 4 years of age. The peak occured at 4 to 5 years of age in other measures of weight of lamb weaned per ewe. The annual greasy fleace weight was the highest (1265 ± 10.42 g) at 2 years of age and declined continuously to 7 years of age. The age and year differences were highly significant ($P<0.01$). The premating body weight attatned the peak at 4 1/2 years of age (34.988 ± 0.286) and had highly significant effect of age and years ($P<0.01$). Production indices viz. ILCA index 2 and Ewe Productivity Index (EPI) showed declining trend with advancing age. The age effect and the year effect were highly significant for EPI ($P<0.01$).

Culling rate showed significant age effect ($P<0.01$) whereas mortality showed significant year effect ($P< 0.01$). The total losses showed both age and year effect significant ($P<0.01$).

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Effect of Body Cooling During Summer on Milk Production and Physiological Aspects in Mehsana Buffaloes and Kankrej Cows

Submitted to Gujarat Agricultural University

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The study was undertaken at the Livestock Reserach Station, Sardar Krushinagar to study the effect of body cooling in addition to shelter by splashing with tap water daily during 12.30 to 14.30 hours in summer on milk production and physiological aspects in Mehsana buffaloes and Kankrej cows. The treatments were (1) providing shelter as well as body cooling by splashing with tap water daily during 12.30 to 14.30 hours and (2) providing shelter under shed only.

Overall average maximum and minimum temperature (°C) in open during the period of study was 40.16 ± 0.37 and 22.35 ± 1.40 respectively, whereas, overall temperature-humidity-index (per cent) at 7.30 and 14-30 hours was 75.10 ± 1.42 and 83.57 ± 0.74, respectively.

The treatments significantly reduced the respiration rate per minute (23.49 ± 0.50 V 33.86 ± 0.91) in Kankrej cows under T-1 and pulse rate per minute (62.45 ± 0.46 V 69.07 ± 0.71) in Mehsana buffaloes under T-1 recorded at 14.30 hours after splashing treatments. Body cooling in addition to sheltering has not significantly affected the blood constituents in definite order in both the species except significantly higher haemoglobin (9.47 ± 0.17 V 9.18 ± 0.24, g/100 ml) and haematocrit (37.08 ± 0.23 V 34.95 ± 0.32, per cent) in Kankrej cows under T-1 and significantly lower serum sodium(135.84 ± 5.39 V 141.83 ± 5.52, m Eq/L) in Mehsana buffaloes under T-1 and singnificantly lower serum potassium (3.69 ± 0.18 V 3.89 ± 0.20 mEq/L) in Kankrej cows under T-1.

Overall average daily total dry matter intake was significantly higher (14.76 ± 0.22 V 13.86 ± 0.23, kg/day) in Mehsana buffaloes and (9.84 ± 0.11 V 9.24 ± 0.75, kg/day) in Kankrej cows under T-1.

Overall average daily total water intake was significantly reduced (52.35 ± 2.24 V 54.99 ± 1.14, litres/day) in Mehsana buffaloes and (33.23 ± 1.86 V 36.91 ± 1.25, litres/day in Kankrej cows under T-1.

Body cooling in addition to sheltering has significantly increased daily total milk production (6.03 ± 0.17 V 5.70 ± 0.12, kg/day/buffalo) only in Mehsana buffaloes under T-1. However, it was not true in case of Kankrej cows.

Maximum temperature and temperature-humidity-index at 14.30 hours were related with different attributes studied

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Effect of Feeding Management and Age at Handling on Reproduction and Production in Kankrej Heifers

Submitted to Gujarat Agricultural University

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The effect of feeding management and age at handing on age at first calving (AFC) in Kankrej heifers was studied. In all 36 heifers were divided into three main groups of feeding treatments and each was further divfided into two sub-groups of age at handling. The initial age (average 608 days) and body, weight(average 196.4 kg) was similar in the main groups. The heifers were fed individually according to three different feeding schedules upto calving, irrespective of age and body weight. The feeding schedules were (1) one kg concentrate mixture + 6 kg green forage(FS-A), (2) 1.5 kg concentrate mixture + 8 kg green forage (FS + B) and (3) 2.0 kg concentrate mixture + 10 kg green forage. The dry fodder was provided *ad libitum*. The two levels for age at handling were early handling (EH) and late handling (LH). The range of age of EH and LH heifers was 336 to 586 and 600 to 892 days, respectively. All the heifers were groomed daily and let loose thrice daily for heat detection by two bulls alternately. The heifer in estrus was served naturally.

The body weight of 250 kg was found essential for sexual rhythmicity. The EH heifers attained this weight earlier by 163 days than LH group (P<0.01).

The average age and weight at first calving was 1203 ± 23 days (40.10 months) and 374.8 ± 5.2 kg respectively. The age at first estrus, conception and calving was not affected by feeding schedules, while age at handling had significant effect (P< 0.01). The average weight at first estrus, conception and calving was not influenced either by feeding or age treatments. The early handling reduced AFC by 126 days. In comparison with the farm bred Kankrej heifers the AFC in experimental heifers was reduced by 344 days (P≤0.01). The reduction in AFC did not affect first lactation production and subsequent reproduction.

The average total (daily) DM intake upto calving was 5.91 ± 0.13 kg. Feeding schedules as well as age at handling had a significant effect on DM intake. The daily per cent DM intake was 2.08 ± 0.05. Feeding schedules affected the per cent DM intake significantly (P≤0.05) while the age had no effect.

The daily average expenditure on feeding was Rs. 5.09 ± 0.12 per head. The feeding expenditure increased due to levels of feeding as well as due to age groups significantly. The average cost of feeding per day in FS-A was Rs. 4.30 ± 0.06. The average cost of feeding EH heifers was Rs. 4.96 ± 0.18. The least cost of feeding was Rs. 4.17 ± 0.06 in EH heifers raised on FS - A.

The ADG in body weight was 131.3 ± 9.2 gm during the experiment and it was not influenced either by feeding or age treatments.

The feeding schedules and handling age did not alter blood levels of Hb, PCV, glucose and TSP. However, at estrus conception and calving, most of these constituents increased significantly over the pre-experimental level (P≤0.01).

It appears that 1 kg concentrate mixture + 6 kg green forage with *ad libitum* dry fodder from 15 months of age till calving will reduce AFC without affecting production and subsequent reproduction in Kankrej heifers.

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(See Rule 8)

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I, Dr. S. K. Waghmare hereby declare that the particulars given above are true to the best of my knowledge and belief.

Dated the 30th January, 1993

S. K. Waghmare
Signature of Publisher