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Influence of Irrigation, Nitrogen and Phosphorus Levels on Onion (*Allium cepa*)

S. G. Sadaria, D. D. Malavia, V. D. Khanpara, M. G. Dudhatra, M. N. Vyas and R. K. Mathukia

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ABSTRACT

An experiment was conducted during the winter (*rabi*) seasons of 1991-92 to 1993-94 to study the response of onion (*Allium cepa* L.) to different levels of irrigation, nitrogen and phosphorus. Irrigation at 1.4 IW/CPE ratio significantly increased bulb yield. The maximum net return was realised with 1.4 IW/CPE schedule, while the maximum WUE was registered with 1.2 IW/CPE ratio. Application of 75 kg N/ha was found to be the optimum dose in respect of bulb yield, net return and WUE. Though the effect of P on bulb yield was found non-significant, 37.5 kg P_2O_5 /ha registered numerically higher bulb yield, net return and WUE.

(Received on 14th Nov., 1996)

INTRODUCTION

In the recent past onion (*Allium cepa* L.) has become important commercial crop in South Saurashtra region of Gujarat. Increasing popularity of onion necessitated to increase its production by proper schedule of irrigation and optimum nutrient dose as these are the most scarce and costly inputs in the region. The present study, therefore, was undertaken to evaluate the response of onion to irrigation, nitrogen and phosphorus.

MATERIALS AND METHODS

The field experiment was conducted during the *rabi* seasons of 1991-92 to 1993-94 at the Instructional Farm, College of Agriculture, Gujarat Agricultural University, Junagadh. The soil of the experimental site was clayey in

texture with pH 8.2 and 0.30 dS/m EC having 0.42% organic carbon, 21 kg/ha available P and 270 kg/ha available K. The soil had 60.55% saturation point with 1.42 g/cm³ bulk density. The treatments comprised 3 levels each of irrigation (1.0, 1.2 and 1.4 IW/CPE ratios) as main plots, nitrogen (50, 75 and 100 kg N/ha) and phosphorus (25, 37.5 and 50 kg P_2O_5 /ha) as sub plots were tried in split plot design and replicated thrice. Onion variety "Junagadh Local" (Pilipatti) was transplanted at spacing of 10 cm X 10 cm. Treatment-wise full P in the form of single super phosphate and half N as urea were applied at basal dose, and the remaining half N in form of urea was top-dressed at 30 days after transplanting. A uniform dose of 50 kg K_2O /ha was given to the crop. Initial two irrigations were applied uniformly to achieve better establishment of seedlings.

TABLE 1

Bulb yield, net return and WUE by onion as influenced by irrigation, nitrogen and phosphorus.

Treatments	Bulb yield (q/ha)			Mean net return (Rs/ha)	Water use efficiency (q/ha-cm)		
	1991-92	1992-93	1993-94		1991-92	1992-93	1993-94
			Pooled				Mean
Irrigation (IW/CPE)							
1.0	229.4	209.6	201.8	213.6	5000	4.17	4.19
1.2	287.5	259.0	246.2	264.3	9520	4.42	4.32
1.4	307.3	285.9	285.9	293.1	11940	4.10	4.08
C. D. (P = 0.05)	39.4	43.4	33.2	17.6	—	—	—
Nitrogen (kg/ha)							
50	263.2	247.3	239.9	250.1	8345	4.05	4.12
75	274.7	254.3	249.4	259.5	9117	4.23	4.24
100	284.5	252.9	244.6	261.4	9190	4.38	4.22
C. D. (P = 0.05)	10.3	NS	NS	6.2	—	—	—
Phosphorus (kg P₂O₅/ha)							
25	257.2	248.7	243.9	250.0	8194	3.96	4.15
37.5	281.1	254.7	246.5	260.8	9091	4.32	4.25
550	285.8	251.3	243.5	260.2	8787	4.40	4.19
C. D. (P = 0.05)	10.3	NS	NS	NS	—	—	—

RESULTS AND DISCUSSION

Irrigation

Scheduling irrigation at 1.4 IW/CPE ratio significantly increased the bulb yield of onion during all the three years and in pooled results too, but remained at par with irrigation at 1.2 IW/CPE ratio during 1991-92 and 1992-93. The maximum net return of Rs. 11940/ha was realised with irrigation at 1.4 IW/CPE ratio, while the maximum WUE was recorded with irrigation at 1.2 IW/CPE ratio during all the three years. The results are in accordance with those of Patel *et al.* (1992) and Rana and Sharma (1993).

Nitrogen

Application of N did not cause significant variation in bulb yield during 1992-93 and 1993-94, however, application of 100 kg N/ha, being at par with 75 kg N/ha, recorded significantly the highest bulb yield during 1991-92 and in pooled results. N @ 100 kg/ha gave higher net return of Rs. 9190/ha and

WUE of 4.23 q/ha-cm, though not so much higher compared with 75 kg N/ha. The results confirm the findings of Porwal and Singh (1993) and Vachhani and Patel (1993).

Phosphorus

Application of graded levels of P did not show any significant increase in bulb yield during 1992-93, 1993-94 and in pooled results. During 1991-92, application of 50 kg P_2O_5 /ha recorded significantly the highest bulb yield but found at par with that of 37.5 kg P_2O_5 /ha. The higher net return of Rs 9091/ha and WUE of 4.23 q/ha cm were registered with application of 37.5 kg P_2O_5 /ha. Patel *et al.* (1992) and Vachhani and Patel (1993) observed positive response of onion to applied P.

It was concluded that irrigation at 1.4 or 1.2 IW/CPE ratio alongwith application of 75 kg N + 37.5 kg P_2O_5 /ha to onion crop would be beneficial to obtain higher yield, monetary return and WUE under south Saurashtra agro-climatic conditions.

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Effect of Organic Manures and Chemical Fertilizers on Wheat (*Triticum aestivum* L.) and Their Residual Effect on Green Gram (*Phaseolus radiatus* L.)

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ABSTRACT

In a field experiment conducted during 1992-93 and 1993-94 on clayey soil at Junagadh, the direct effect of organic manures (FYM and castor cake) and chemical fertilizers, alone and combined, on wheat (*Triticum aestivum* L. emend. Fiori & Paol.) and their residual effect on green gram (*Phaseolus radiatus* L.) were studied. Combined application of castor cake @ 5 t/ha or FYM @ 15 t/ha along with recommended NP dose to wheat recorded significantly higher grain and straw yield of wheat. Higher grain and fodder yield of green gram were recorded due to residual effect of 15 t FYM + 120 kg N + 60 kg P_2O_5 /ha applied to preceding wheat crop. Application of 15 t FYM + 120 kg N + 60 kg P_2O_5 /ha to wheat also recorded higher net return and B : C ratio from wheat and green gram and thereby from wheat green gram crop sequence.

(Received on 24th Nov., 1995)

INTRODUCTION

Addition of organic manures increase crop yield and exert significant influence on physical, chemical and biological properties of soil (Acharya *et al.*, 1987 and Bahadur *et al.*, 1990). But its use alone is not sufficient to meet the nutrient requirement of crop. Therefore, use of both organic manures and chemical fertilizers in appropriate proportion assume special significance as complementary and supplementary to each other in crop production. Due to slow release of nutrients and longer lasting effects of organics, succeeding crops have some benefit. In view of this, an experiment was undertaken to study

the direct effect of organic manures and chemical fertilizers, alone and combined with each other, on wheat (*Triticum aestivum* L. emend. Fiori & Paol.) and their residual effect on succeeding green gram crop (*Phaseolus radiatus* L.).

MATERIALS AND METHODS

The field experiment was conducted on a clayey soil (pH 8.1, E.C. 0.32 dS/m, available N 214 kg/ha, available P_2O_5 34 kg/ha and available K_2O 303 kg/ha) during 1992-93 and 1993-94 at the Instructional Farm, College of Agriculture, Junagadh. Experiment was laid out in randomised block design with 4

TABLE 1
Effect of different treatments on grain and straw yields of wheat and their residual effect on grain and fodder yield of green gram.

Treatments	Wheat				Green gram			
	Grain yield (q/ha)		Straw yield (q/ha)		Grain yield (q/ha)		Fodder yield (q/ha)	
	92-93	93-94	Pooled	92-93	93-94	Pooled	92-93	93-94 Pooled
T ₁ FYM	35.42	35.93	35.68	48.98	47.36	48.17	7.16	8.93 8.05 25.76 28.63 27.20
T ₂ CC	46.91	41.40	44.16	59.96	48.13	54.05	5.55	6.89 6.22 24.81 27.41 26.11
T ₃ FRD	46.37	39.63	43.00	58.18	47.51	52.85	4.44	5.12 4.78 22.82 24.29 23.56
T ₄ HRD	36.65	27.29	41.97	51.46	36.25	43.86	2.95	5.03 3.99 21.86 23.77 22.81
T ₅ Eq. NPK of FYM	44.96	34.94	39.95	57.10	47.21	52.15	4.58	6.04 5.31 24.29 25.16 24.72
T ₆ Eq. NPK of CC	47.07	41.50	44.29	60.73	53.73	57.13	5.03	6.77 5.90 24.64 26.72 25.68
T ₇ FYM + FRD	47.23	46.42	46.83	61.40	56.77	59.09	8.30	9.91 9.11 26.20 33.83 30.01
T ₈ FYM + HRD	39.74	39.80	39.77	53.36	50.29	51.83	7.51	9.56 8.54 26.02 33.66 29.84
T ₉ CC + FRD	51.70	49.06	50.38	66.54	64.33	65.44	5.81	7.48 6.65 25.33 28.11 26.72
T ₁₀ CC + HRD	49.39	47.74	48.57	64.88	63.87	64.38	5.73	7.15 6.44 24.98 27.76 26.37
T ₁₁ Control	19.89	18.73	19.31	28.56	27.62	28.09	2.91	3.64 3.28 20.82 19.09 19.95
T ₁₂ FRD to G. gram	20.40	17.51	18.96	30.35	25.46	27.91	7.10	8.57 7.84 25.68 28.45 27.07
C. D. at 5%	4.39	6.73	5.62	5.10	8.21	7.46	1.21	1.56 1.32 2.12 7.82 4.04

replications and 11 treatments viz., T_1 – farmyard manure (FYM) @ 15 t/ha, T_2 – castor cake (CC) @ 5 t/ha, T_3 – full recommended NP dose (FRD) i.e. 120 kg N + 60 kg P_2O_5 /ha, T_4 – half recommended NP dose (HRD) i.e. 60 kg N + 30 kg P_2O_5 /ha, T_5 – equivalent NPK of FYM i.e. 111 kg N + 66 kg P_2O_5 + 98 kg K_2O /ha, T_6 – equivalent NPK of castor cake i.e. 186 kg N + 66 kg P_2O_5 + 59 kg K_2O /ha, T_7 – FYM @ 15 t/ha + full recommended NP dose, T_8 – FYM @ 15 t/ha + half recommended NP dose, T_9 – castor cake @ 5 t/ha + full recommended NP dose, T_{10} – castor cake @ 5 t/ha + half recommended NP dose, and T_{11} – control (no manures and no fertilizers) for wheat crop and additional treatment T_{12} – recommended NP dose i.e. 20 kg N + 40 kg P_2O_5 /ha to green gram (no manures and no fertilizers to wheat). Wherat variety GW-496 (96-113 days duration) was sown in rows of 22.5 cm apart during *rabi* seasons and green gram variety K-851 (65-70 days duration) was sown in rows of 30 cm spacing during succeeding summer seasons. Treatment-wise FYM (0.74% N, 0.44% P_2O_5 and 0.65% K_2O) and castor cake (3.71% N, 1.32% P_2O_5 and 1.18% K_2O) were applied before sowing, whereas half N and full P and K in form of urea, single super phosphate and muriate of potash, respectively were applied as basal and remaining half N was top-dressed in form of urea at 30 days after sowing. In case of treatment T_{12} , entire NP dose as urea and single super phosphate was applied as basal to green gram crop only. Wheat was sown on November 13, 1992 and November 18, 1993 and harvested on February 20, 1993 and March 1, 1994, while green gram was sown on February 25, 1993 and March 6, 1994 and harvested on May 8, 1993 and May 14, 1994. Total 10 irrigations to

wheat and 8 irrigations to green gram were given as per recommended schedule.

RESULTS AND DISCUSSION

Different manurial treatments exert significant influence on grain and straw yields of wheat during both the years and in pooled results (Table 1). Higher yields were recorded with application of castor cake @ 5 t/ha + full recommended NP dose (T_9) which was at par with castor cake @ 5 t/ha + half recommended NP dose (T_{10}) during 1992-93 and also with FYM @ 15 t/ha + full recommended NP dose (T_7) during 1993-94 and in pooled results. The results are in accordance with those of Tripathi (1982) and Patel *et al.* (1992). On an average, these three treatments increased 13 and 152% grain yields as well as 19 and 124% straw yield of wheat over full recommended NP dose and control, respectively.

Various treatments showed a significant residual effect on grain and fodder yield of green gram (Table 1). Significantly the higher grain yield of green gram was recorded due to FYM @ 15 t/ha + 120 kg N + 60 kg P_2O_5 /ha (T_7) which was at par with FYM @ 15 t/ha (T_1). However the latter was at par with 20 kg N + 40 kg P_2O_5 /ha (T_{12}) during both the years and in pooled results. Similarly, application of FYM @ 15 t/ha + full recommended NP dose to wheat (T_7) recorded significantly higher fodder yield of green gram over recommended NP dose (T_3), half recommended NP dose (T_4) and control (T_{11}). The results corroborate the findings of Rao and Bhardwaj (1980) and Sharma (1981). Application of FYM @ 15 t/ha + 120 kg N + 60 kg P_2O_5 /ha to wheat residually increased 16 and 177% grain yield as well as 11 and 50% fodder yield of green gram over recommended NP dose to green gram (T_{12}) and control (T_{11}), respectively.

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Treatments	Mean net return (Rs/ha)			mean cost (Rs/ha)			Mean B:C ratio		
	Wheat	G.gram	Combined	Wheat	G.gram	Combined	Wheat	G.gram	Com- bined
T ₁ FYM	12817	6139	18956	7773	4139	11912	1.65	1.48	1.59
T ₂ CC	8878	3857	12735	16418	4139	20557	0.54	0.93	0.62
T ₃ FRD	17564	2035	19449	7158	4139	11297	2.45	0.49	1.72
T ₄ HRD	11625	1072	12697	6718	4139	10857	1.73	0.26	1.17
T ₅ Eq. NPK of FYM	15291	2717	18008	7580	4139	11719	2.01	0.66	1.54
T ₆ Eq. NPK of CC	17499	3463	21212	7829	4139	11968	2.24	0.84	1.77
T ₇ FYM + FRD	18122	7479	25601	8803	4139	12942	2.06	1.81	1.94
T ₈ FYM + HRD	14597	6778	21375	8313	4139	12452	1.76	1.64	1.72
T ₉ CC + FRD	11536	4396	15933	17448	4139	21587	0.66	1.06	0.74
T ₁₀ CC + HRD	11019	4134	15153	16958	4139	21097	0.65	0.99	0.72
T ₁₁ Control	4989	133	5122	6178	4139	10317	0.81	0.03	0.50
T ₁₂ FRD to G.gram	4768	5375	10143	6178	4635	10813	0.77	1.16	0.98

Application of FYM @ 15 t + 120 kg N + 60 kg P_2O_5 /ha (T_7) recorded the maximum net return from wheat, green gram and crop sequence (Table 2). Fertilizing wheat crop with full recommended NP dose resulted in the

maximum B:C ratio in wheat, while application of FYM @ 15 t/ha + full recommended NP dose to wheat recorded the maximum B:C ratio in green gram and crop sequence.

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Variability Parameters in Diploid Cotton

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ABSTRACT

The investigation was carried out with seven parent/varieties and their 21 hybrids to know pattern of genetic variability for eight yield and quality traits. The genotypes showed significant differences for all the traits. High estimates for GCV, heritability and expected genetic advance were obtained for seed cotton yield/plant and bolls/plant indicating the role of additive gene action controlling these traits. Conversely mean fibre length, 2.5% span length, fibre fineness and uniformity ratio showed high heritability but low to medium genetic advance.

(Received on 24th Nov., 1994)

INTRODUCTION

The nature and magnitude of genetic variability present in the population is a prerequisite for any successful crop improvement programme. Heritability on important genetic parameter measures the relative degree to which a character is transmitted from parent to progeny.

Genetic coefficient of variability together with heritability estimates provide the extent of genetic advance expected from selection. The present investigation was conducted to study these aspects for different yield contribution characters and fibre traits in asiatic cottons.

MATERIALS AND METHODS

The experimental materials comprised 7 parents viz., V-82/1044, Bhav-38, (69-2-3 x

Dig)/2441, (2233 x 1477) 388 BK, 733, 824 and G-27 strains/varieties of asiatic cotton and their 21 diallel crosses excluding reciprocal. In all, 31 genotypes were evaluated in two sets in single row plots of 4.5 m length keeping row to row and plant to plant distances of 120 and 45 cm respectively in randomized block design with three repeats at Bharuch during 1989-90. Five randomly selected competitive plants were chosen in both the sets from each row to record data on yield/plant, boll number, ginning percentage, mean fibre length, 2.5 per cent span length, fibre fineness, uniformity ratio and fibre 37 maturity coefficient. Average values were used in statistical processing for the analysis of variance and to estimate genetic variability, heritability (broad sense) and expected genetic advance (GA) as percentage of the mean, by using the method given by Allard (1960). The heritability

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TABLE 1

Analysis of variance for different characters in diploid cotton.

Source of	d.f.	Yield/ plant (g)	Bolls/ plant	G.P. (%)	M.F.L. (mm)	2.5 % span length	LUR	Fibre fine- ness (mv)	Maturity Co-eff- icient
Replication	02	14.09	13.09	1.03	0.25	4.40	2.03	0.38	0.00
Genotypes	27	2411.22**	382.71**	2.19	8.94	13.04	5.01	1.54**	0.00
Error	54	17.18	09.46	02.06	0.76	1.13	2.07	0.26	0.00

** = Significant at 1% levels respectively.

Genotypic coefficient of variability (GCV), phenotypic coefficient of variability (PCV) heritability (h²) and expected genetic advance (GA) for eight characters in diploid cotton.

Character	Mean	Range		PCV	GCV	Heritability	GA as % of mean
		From	To				
Yield/plant (g)	61.7	28.6	— 124.6	45.511	45.027	97.886	91.770
Bolls/plant	27.8	34.4	— 52.6	41.373	39.848	92.765	79.063
Ginning percentage (%)	35.8	33.5	— 37.2	04.026	00.540	01.798	00.149
Mean fibre length (mm)	20.9	18.0	— 24.9	08.773	07.761	78.253	14.142
2.5 % span length	22.5	19.6	— 27.3	09.852	08.692	77.833	15.797
Uniformity ratio (%)	51.2	49.2	— 53.3	03.353	01.885	31.606	02.183
Fibre fineness (mv)	04.4	03.3	— 06.1	18.503	14.757	63.606	24.244
Maturity coefficient	00.78	00.7	— 00.8	03.025	01.019	11.353	00.708

estimates obtained were categorised according to Robinson (1966) as low (up to 10 per cent), medium (10 to 30 per cent) and high (above 30 per cent).

RESULTS AND DISCUSSION

The analysis of variance (Table-1) showed highly significant difference among progenies for yield/plant, bolls/plant and fibre fineness. The results are in agreement with the observations of Avtar *et al.* (1992). The mean values of phenotypic and genotypic coefficient, heritability and genetic advance expressed as per cent of the mean given in Table-2 were invariably higher than their respective genotypic coefficients. The estimates of phenotypic coefficients of variation were comparatively high for yield/plant (45.51) and bolls/plant (41.37). Similar results were reported by Patel *et al.* (1992). Where as moderate value was obtained for fibre fineness (18.50) and lower values were recorded for 2.5% span length (9.85), mean fibre length (8.77), ginning percentage (4.02), uniformity ratio (3.35) and lowest being for maturity coefficient (3.02). Moderate to low estimates were also obtained by Singh *et al.* (1980), and Kalsy *et al.* (1973). The wide differences between the phenotypic and genotypic coefficient of variation for bolls/plant, ginning percentage, fibre uniformity ratio, fibre fineness and maturity coefficient indicated that these traits were influenced by the environmental fluctuations. Yield/plant, mean fibre length and 2.5% span length were least affected by the external factors, as indicated by the closeness of the estimates of the coefficients for these traits.

The heritability estimates in broad sense were high for yield per plant (97.88), bolls

per plant (92.76), mean fibre length (72.35), 2.5% span length (77.84), fibre fineness (63.6) and uniformity ratio (31.60) whereas this estimate was moderate for maturity coefficient (21.35) and low for ginning percentage (1.79). Almost similar results have been reported by Patil *et al.* (1966), Singh *et al.* (1968), Singh *et al.* (1972), Kooner *et al.* (1981) and Avtar *et al.* (1992). The traits depicting close estimates of phenotypic and genotypic coefficient of variability also had high estimates of heritability. The highest genetic gain expressed as per cent of the mean and high estimates of heritability for seed cotton yield and boll number suggested that additive gene effects were probably more important for these characters. The results are in agreement with findings of Patel *et al.* (1992). It would, therefore, be feasible to affect improvement on these traits through simple selection procedure. Mean fibre length, 2.5% span length and fibre fineness exhibiting high heritability estimates with medium values of genetic advance offer the best possibilities of improvement through selection. Medium and low heritability coupled with low genetic advance for maturity coefficient and ginning percentage respectively indicated that the expression of these characters controlled by non-additive gene effects. This study indicated that the characters with high heritability may not necessarily possess high genetic advance as observed by Kooner *et al.* (1981). Therefore, it would always be worthwhile to estimate genetic advance to arrive at logical conclusion, because it taken in to account not only the heritability but also the magnitude of variability present in the materials.

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Genetic Diversity and Stability in Linseed

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ABSTRACT

Twenty strains of linseed (*Linum usitatissimum* L.) were grown over four environments. Pooled data of nine characters over environments were analysed for D^2 estimates. Mean sum of square for the most characters revealed highly significant differences due to strains environments and strain X environment interaction for all characters. Stability of individual strain was worked out on the basis of two stability parameters- regression coefficient (b_1) and deviation from regression (S^2d_1). Further 7 strains were selected with high seed yield/plant (higher than grand mean over environments) and stable for seed yield and for other yield contributing characters.

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INTRODUCTION

A stable variety for seed yield/plant with high mean value, is desirable for its commercial exploitation over a wide range of agroclimatic conditions. In self pollinated crops like linseed, development of hybrid varieties is costlier and unsuccessful. Therefore, it is important to choose divergent parent with stable performance for characters for hybridization and to achieve desirable segregant through selection in the advanced breeding generations. With this view, genetic diversity analysis was done to identify suitable parents on the basis of intra- and intercluster distances for desired recombinants and heterosis.

MATERIALS AND METHODS

The experiment was laid out in RBD with 3 replications with 6 rows plots of 4 m length

during winter 1989-90 in two environments (irrigated and rainfed) and one row plots of 4 m length during winter (1990-91) in two environments (irrigated and rainfed) alongwith 25 x 10 cm spacing. Data were recorded on five plants chosen at random for 9 quantitative characters i.e. number of capsules/plant, plant height (cm), number of primary branches/plant, number of secondary branches/plant, number of seeds/capsule, 1000 seed weight, days to 50% flowering, days to maturity and seed yield/plant (g). Generalised distance was done by D^2 statistics and clusters of strains were formed by Tocher's method Rao (1952). Estimates of divergence were estimated bases on pooled data of nine characters over 4 environments. Further, stability parameters were computed using the method of Eberhart and Russell (1966).

RESULTS AND DISCUSSION

Genetic divergence on the basis of D^2 values of pooled data formed only three clusters. Cluster I had the maximum, 18 strains. Cluster II and III included only one strain each (Table 1). Clustering showed that strains RL 75-6-1 and LCK 88072 were distinct from the others, these formed different clusters. Maximum inter-cluster distance was

observed between clusters I and III followed I and II and II and III (Table 2). Maximum intra-cluster distance was observed for cluster I. Cluster II and III had zero intra-cluster distance, since each of them was represented by single strain. On the basis of intra and intra-cluster distances, it is suggested that for creating maximum genetic variability, crossing between the strains of clusters I and III, I and II and II and III would be useful.

TABLE 1

Distribution of 20 strains in clusters in linseed.

Cluster	No. of genotypes	Genotypes
I	18	NL 40, NL 48, RLC 27, RL 33-5, RL 33-4, RL 58-3, RL 75-4-1, RL 75-6-2, LW 8286, LW 8289, LW 8281, LW 28-9-5, LCK 88061, LCK 88311, LCK 88512, Sweta, Shubhra, T 397
II	1	RL 75-6-1
III	1	LCK 88062

Stability analysis : The analysis of variance for strains x environments interaction is presented in Table 3. Mean squares for strains were significant for the most characters indicating the presence of variability among strains. The mean squares for S x E interaction was significant for the most characters, indicating that the strains showed differential response in different environments with respect to these characters. It is obvious from Table 3 that the linear components of S x E

interaction were relatively greater than the non-linear components for all characters except days to 50% flowering and maturity where non-linear component, was greater indicating that the performance of strains for all the characters except 1000 seed weight, days to 50% flowering and days to maturity could be predicted. These results are accordance with the earlier reports of Finlay and Wilkinson (1963), Breese (1969), Yates and Cochran (1938), Rao and Singh (1984) and

TABLE 2

Mean intra and inter-cluster distances (D^2 values) in linseed over environments.

Clusters	I	II	III
I	17.916	27.464	44.672
II		0.0	24.073
III			0.0

TABLE 3

Pooled analysis of variance for different characters in linseed.

Source	df	No. of capsules	Plant height	No. of primary branches	No. of secondary branches	No. of seeds/capsule	1000 seed weight	Days to 50% flowering	Days to maturity	Seed yield/plant
Strains (S)	19	327.47**++	40.02**++	0.98**++	15.21**++	0.98**++	15.42**++	28.40**	39.34++	0.30*++
Environments (E)	3	4503.50**++	225.02**++	16.18**++	232.74**++	1.32**++	8.68**++	44.16**++	66.32++	3.24**++
S X E	57	156.97**++	18.96**++	0.49++	5.45	0.32++	3.47	12.52++	18.29++	0.07++
Env. (linear)	1	13510.51**++	675.05**++	18.54**++	698.29**++	0.369+	8.04	32.48**++	18.97++	9.71**++
S X E (linear)	19	258.73**++	38.89**++	0.55+	7.59**++	0.44++	2.72	11.48++	14.18++	0.09++
Pooled deviation	40	87.96	8.54+	0.32+	4.15	0.26++	3.66	12.38++	19.34++	0.06++
Pooled error	160	100.21	4.82	0.19	3.38	0.08	5.52	0.31	0.59	0.02

*, ** Significant at 5% and 1% on pooled deviation.

+., ++ Significant at 5% and 1% on pooled error.

TABLE 4
High yielding strains stable for various characters.

Variance	Characters						
	Plant height	No. of capsules	No. of primary branches	No. of secondary branches	No. of seeds/capsule	1000 seed weight	Days to 50% flowering
Cluster I							
NL 40			+		+		
NL 48			+		+		
RLC 27		+	+	+	+	+	+
RL 33-5			+		+		+
RL 75-6-2	+				+		
LCK 88061						+	
LCK 88512	+	+					
LCK 88311	+						
Shubhra		+					
Cluster II							
RL 75-6-1		+	+	+	+	+	+
Cluster III							
LCK 88062		+		+	+	+	+

Singh and Singh (1989) in a wide range of plant materials. However, predictions of $S \times E$ interaction in individual line for 1000 seed weight, days to 50% flowering and days to maturity were also made on the basis of their b_1 and S^2d_1 values. Stability parameters showed that out of 20 strains II were stable for seed yield/plant with high mean performance. These were NL 40, NL 48, RLC 27, RL 33-5, RL 75-6-2, LCK 88062,

D² and stability : The 7 strains sorted out on the basis of stability and higher mean for seed yield belong to different clusters i.e. 5 belong to cluster I, each to cluster II and III, respectively (Table 5). Therefore considering the D² analysis and stability of yield and yield contributing characters, making crosses among the selected strains of cluster I (RLC 27, Shubhra, LCK 88512, RL 75-6-2, and RL 33-5) with the strains of cluster II (RL 75-6-1) and

TABLE 5

High yielding strains stable for seed yield/plant forming different clusters on the basis of D² analysis.

Cluster	Strains	Mean	b_1	S^2d_1	No. of other stable characters
I	RLC 27	0.95	1.13	-0.01	6
	RL 33-5	0.95	1.28	-0.01	6
	RL 75-6-2	0.91	1.26	-0.00	4
	LCK 88512	0.85	0.88	0.12	6
	Shubhra	0.89	0.86	0.02	6
II	RL 75-6-1	0.64	0.83	0.02	6
III	LCK 88062	0.86	1.10	0.01	7

LCK 88311, LCK 88512, Shubhra, RL 75-6-1, and LCK 88061. Out of these 11 strains 7 were selected having higher yields and stable for most of the yield contributing characters, (Table 4).

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cluster III (LCK 88062) is recommended. Crosses in the above combinations are expected to provide enough genetic variability to select for high yielding and stable segregants in the segregating generations.

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Combined Mutagenesis in Groundnut (*Arachis hypogaea* L.)

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ABSTRACT

To measure the degree and direction of genetic variation induced in five important quantitative characters viz. height of main axis, number of primary branches, number of secondary branches, number of matured pods and pod yield/plant due to gamma rays solo and in combination with EMS/Colchicine was studied in M_1 generation of groundnut (*Arachis hypogaea* L.). Higher variances were recorded for most of the characters. Shift in mean value was towards lower side for characters height of main axis, number of primary and secondary branches. The pod yield per plant had the shift towards higher side towards both direction for character number of matured pods per plant. The increase in variance for character number of matured pods per plant due to mutagenesis was found to be 3.5 fold as compared to control. The combined mutagenic treatments were more effective to enlarge the variation in all the above quantitative characters.

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INTRODUCTION

Since groundnut has a relatively well developed embryo in the dormant kernel, direct effects of mutagenic treatments in M_1 generation are readily observable. The central objective behind the use of mutagenesis is to increase in the magnitude and spectrum of genetic variation and appearance of novel mutants of positive values in the population. The degree and direction of variations induced are required to be investigated in M_1 generation itself as a prerogative to use of mutagenesis for induced genetic tailoring of crop plants.

MATERIALS AND METHODS

Freshly decorticated, dry, dormant, healthy, physically and practically uniform kernels of groundnut cultivar AK 12-24 were irradiated with five different doses 5, 10, 15, 20 and 25 Kr of gamma rays and 50 per cent of pre-irradiated kernels were soaked in freshly prepared 0.05 per cent solution of Colchicine and 0.20 per cent solution of EMS separately for 16 hours. On completion of these treatments kernels were thoroughly washed in distilled water for 30 minutes and air dried under shade for 8 hours. The treated samples were sown in RBD with four replications alongwith control.

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TABLE 1

Effects of mutagenic treatments on five quantitative characters of groundnut.

Sr. No.	Treatments	Height of main axis (cm)		Branching/plant		No. of matured pod/plant		Pod yield/plant (in g)					
		M		Primary		Secondary		M		Fresh		Dry	
				M	V	M	V			M	V	M	V
1.	Control	37.4	3.77	8.83	0.59	22.24	5.88	29.2	4.14	35.25	29.85	19.7	8.95
2.	Gamma rays 5 kr	34.2	14.66	6.24	4.37	19.63	52.08	36.6	48.75	46.10	170.39	23.1	15.05
3.	10 kr	35.3	17.51	6.05	3.76	20.77	25.08	31.0	79.00	40.59	115.94	19.6	26.31
4.	15 kr	34.1	50.07	4.86	3.70	18.26	86.92	32.4	33.60	35.21	264.52	16.3	88.26
5.	20 kr	39.7	29.89	6.28	9.62	17.58	19.08	23.8	43.92	28.30	66.84	11.3	23.11
6.	25 kr	37.6	11.89	6.01	3.35	18.84	30.98	24.3	63.40	27.36	84.14	11.9	16.30
7.	0 kr + col. 0.05%	30.6	10.56	4.94	7.04	17.72	73.73	24.6	85.94	30.04	184.19	12.6	37.92
8.	5 kr + col. 0.05%	34.1	8.26	4.87	0.76	19.81	38.08	30.5	25.10	36.89	104.39	16.2	57.65
9.	10 kr + col. 0.05%	31.8	7.80	4.27	1.25	21.12	51.17	23.8	14.02	31.23	10.04	13.0	5.27
10.	15 kr + col. 0.05%	32.1	15.18	4.87	3.37	25.71	63.57	22.2	19.89	29.75	50.84	11.8	25.63
11.	20 kr + col. 0.05%	34.1	12.77	4.26	0.91	17.89	43.80	28.8	17.41	28.96	12.30	12.8	5.07
12.	25 kr + col. 0.05%	31.3	11.45	6.78	7.06	20.44	84.82	23.6	15.70	39.65	699.04	11.2	57.29
13.	0 kr + EMS 0.20%	33.9	13.14	6.06	4.99	19.51	80.32	31.7	58.70	38.53	114.89	17.4	14.16
14.	5 kr + EMS 0.20%	33.7	11.47	5.18	3.56	18.49	39.49	27.5	10.58	29.65	20.77	14.2	20.26
15.	10 kr + EMS 0.20%	30.6	16.06	5.16	1.95	18.10	35.56	27.6	27.42	31.91	44.57	14.3	23.17
16.	15 kr + EMS 0.20%	37.2	14.58	4.72	1.00	18.40	17.34	30.1	19.38	31.43	4.95	14.3	3.24
17.	20 kr + EMS 0.20%	32.1	14.44	4.43	0.96	16.42	12.23	22.9	34.28	24.60	44.89	8.7	21.82
18.	25 kr + EMS 0.20%	34.9	10.61	4.32	0.98	18.48	12.30	23.6	85.06	27.00	175.50	10.5	33.41

where, M = Mean and V = Variance.

Variability induced in mutagenized population for five quantitative characters viz. height of main axis, number of primary branches, number of secondary branches, number of matured pods and pod yield per plant were studied.

RESULTS AND DISCUSSION

Height of main axis

In general, the mean value was relatively lower in treated population, except at treatment 20 Kr, where it was higher (39.7 cm). The lowest (30.6 cm) mean value amongst the treated population was recorded in treatment Colchicine 0.05 per cent and gamma rays 10 Kr + EMS 0.20 per cent (Table 1). The combined treatments have affected the plant height more than gamma rays solo. The shortening of plant height due to mutagenesis in M_1 may be mainly attributed due to disturbance or inhibition of physiological activities of plants. The present finding is amply corroborated by the similar results by Sinha (1991) in Urd bean.

Number of branches per plant

In the present experiment, treated population have registered highly significant variation in number of primary and secondary branches per plant. Amongst the treatments, higher variation for number of primary branches per plant was noticed in combined treatments of gamma rays + Colchicine. The mean value decreased in treated population as compared to that of control for the trait

branches. The present finding of decrease in mean value associated with significant variation is well supported by the findings of San and Srivastava (1991) in Pea and Vandana and Dubey (1988) in *Vicia faba*.

Number of matured pods per plant

Highly significant variation was observed in number of matured pods per plant. The mean value has shifted on both direction but towards lower side in majority of the treatments (Table 1). Significant variation associated with higher mean value was more pronounced in solo treatments gamma rays when the dose did not exceed 15 Kr. Similar trend has been reported by Patil (1972) in groundnut and Sah and Srivastava (1991) in Pea.

Pod yield per plant

In the treated population, the character fresh and dry pod yield was found to be affected one or the other way by mutagenesis. The mean value was lower in the most of the treatments. Amongst treatments the combination of gamma rays with EMS was found to be more effective in creating higher variability in the character dry pod yield, followed by the treatments gamma rays + Colchicine, and then gamma rays. Decrease in pod yield due to mutagenesis has been reported by Gregory (1968) in groundnut. Increase in pod yield as a result of mutagenic treatments was reported in groundnut by Pathirama *et al.* (1986). Patil (1978) which amply corroborated the present finding in groundnut.

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Divergence Analysis in Chickpea (*Cicer arietinum* L.)

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ABSTRACT

Genetic divergence using Mahalanobis D^2 statistic of 70 chickpea genotypes of different ecogeographic regions revealed considerable diversity and were grouped into 16 clusters indicating that the geographic distribution and genetic diversity were not related. Seed yield per plant, number of pods per plant and 100-seed weight contributed maximum to genetic diversity. The cluster XII showed high genetic divergence with cluster XVI and VIII.

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INTRODUCTION

Multivariate analysis by means of Mahalanobis D^2 statistic has been recognised as a powerful tool in the hands of breeders to quantify the degree of divergence between genotypes. The present investigation in chickpea has been undertaken to assess the extent of genetic diversity in 70 genotypes. It will help in selection of suitable parents for crosses.

MATERIALS AND METHODS

Seventy geographically diverse genotypes were planted in *rabi* 1992 at Instructional Farm of Agriculture College, Junagadh. The material was sown in single row plots of 5 m length with inter and intra-row distance of 30 and 10 cm, respectively, in a randomised block design with three replications. Five competitive plants, selected

at random from each plot, were used for recording observations on 10 quantitative characters (Table 3). The data were subjected to Mahalanobis D^2 statistic to measure genetic divergence as suggested by Rao (1952). On the basis of magnitude of D^2 values varieties were grouped into different clusters by Tocher method.

RESULTS AND DISCUSSION

The analysis of variance revealed highly significant divergence among the varieties for all the characters studied. The 70 genotypes were grouped into 16 clusters (Table 1). The magnitude of D^2 values suggested considerable diversity among the genotypes. The cluster II was the largest which consisted of 20 genotypes from Gujarat, Rajasthan, Andhra Pradesh, Bihar, Maharashtra, Uttar Pradesh and New Delhi. Cluster III was second largest accommodating 16 genotypes from Gujarat,

1.	2.	3.	4.
V	JCP 274, JCP 270, JCP 89, JCP 245, ICCC 820499 ICC 81098-1 AKG 46 HR 86	4 2 1 1	Gujarat Andhra Pradesh (ICRISAT) Maharashtra Haryana
	Total	8	
VI	ICCC 10539	1	Andhra Pradesh (ICRISAT)
VII	Chaffa HR 2-236	1 1	Maharashtra Haryana
	Total	2	
VIII	BM 76 K 850	1 1	New Delhi (IARI) Uttar Pradesh
	Total	2	
XI	H 89 - 18 PDG 83-13 JG 315	1 1 1	Haryana Uttar Pradesh Madhya Pradesh
	Total	3	
X	PG 88-6	1	Uttar Pradesh
XI	GL 88395	1	Punjab
XII	DGM 127	1	Rajasthan
XIII	H 87-65, H 89-11	2	Haryana
XIV	ICCV 81-201	1	Andhra Pradesh (ICRISAT)
XV	ICCV 10	1	Andhra Pradesh (ICRISAT)
XVI	ICCV 820065	1	Andhra Pradesh (ICRISAT)

Maharashtra, Punjab, Andhra Pradesh, New Delhi and Uttar Pradesh. Cluster V had eight genotypes, whereas, cluster IV had seven genotypes originating from Gujarat, Andhra Pradesh, Maharashtra and Haryana and Punjab, Rajasthan and New Delhi. Cluster I and IX included three genotypes. The clusters VII, VIII and XIII possessed two genotypes from

Maharashtra, Haryana, New Delhi and Uttar Pradesh. The cluster VI, X, XII were single variety clusters which included varieties from Andhra Pradesh, Uttar Pradesh, Punjab and Rajasthan, respectively whereas, cluster XIV, XV and XVI had also single genotype each from Andhra Pradesh. Thus, the distribution of genotypes was not as per their geographical

Cluster means for different characters in chickpea.

Cluster	Seed yield per plant (g)	Days to 50 per cent flowering	Days to maturity	Plant height (cm)	Plant spread (cm)	Number of primary branches per plant	Number of pods per plant	Number of seeds per pod	100-seed weight (g)	Harvest index (%)
I	5.53	62.00	108.33	35.71	29.87	3.44	31.37	1.78	13.78	50.47
II	6.80	51.98	97.65	35.06	35.27	3.63	37.28	1.25	20.00	48.51
III	5.25	53.04	99.77	34.83	33.22	3.07	25.22	1.31	19.57	45.17
IV	3.42	78.52	114.71	34.05	29.17	2.69	22.09	1.44	13.41	42.81
V	6.44	50.79	98.29	32.51	31.92	3.56	27.71	1.13	24.08	50.00
VI	6.22	55.33	107.00	31.93	32.20	2.20	38.40	1.42	13.67	51.91
VII	3.66	45.33	89.83	28.43	33.50	2.77	28.06	1.29	13.48	46.35
VIII	10.56	57.33	103.66	35.93	32.70	4.22	45.10	1.23	32.56	57.32
IX	6.93	63.89	104.67	41.89	33.00	3.89	36.01	1.39	19.70	48.64
X	6.72	62.00	107.00	42.40	41.80	2.87	33.67	1.14	16.47	45.28
XI	1.25	73.67	103.67	29.93	22.50	2.03	8.23	1.30	13.07	39.42
XII	2.25	82.00	113.33	33.27	29.70	2.40	13.13	1.70	12.30	26.87
XIII	1.93	80.16	116.50	42.05	28.60	2.10	12.42	1.22	17.88	22.22
XIV	3.68	48.33	88.00	29.93	31.50	2.67	18.20	1.65	18.77	48.16
XV	5.66	53.00	94.33	31.40	33.10	3.37	29.20	1.95	17.33	48.96
XVI	4.34	44.00	80.33	29.60	26.10	3.21	15.40	1.31	30.20	39.74
Overall Mean	5.04	60.09	101.69	34.31	31.51	3.01	26.34	1.41	18.52	44.49
S. Em. ±	0.59	3.11	2.51	1.12	1.05	0.16	2.66	0.06	1.50	2.25
C. D. at 5%	1.64	8.62	6.96	3.10	2.91	0.44	7.37	0.17	4.16	6.24
C. V. (%)	46.58	20.73	9.87	13.08	13.32	21.59	40.46	17.01	32.43	20.23

origin as the varieties of same geographic areas were grouped in different clusters and that of different areas in the same cluster which is in accordance with the finding of Vijay Kumar *et al.* (1991), Yadav *et al.* (1991) and Kumar and Arora (1992). Such clustering pattern may be because of genetic drift and selection in different environments resulting in considerable diversity than the geographical isolation (Murthy and Arunachalam, 1966).

The inter clusters distance (Table 2) was maximum ($D = 64.00$) between cluster XII and XVI followed by cluster VIII and XII ($D = 63.84$), suggesting wide diversity between them. It was minimum ($D = 17.61$) between cluster III and VII, indicating relative closeness of genotypes of these clusters. The intra-cluster distance ranged from 00.00 to 16.76 which was the highest in cluster V and the lowest in cluster I ($D = 8.81$). Cluster VI, X, XI, XII, XIV, XV and XVI had no intra-clusters value and such clusters are supposed to have maximum diversity with the other varieties.

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The cluster means of various clusters presented in Table 3 denoted high co-efficient of variation for the traits like seed yield per plant, number of pods per plant and 100-seed weight, indicating wide diversity for these characters between clusters. Cluster VIII had high mean values for seed yield per plant, number of primary branches per plant, number of pods per plant, 100-seed weight and harvest index. Therefore, genotypes of the cluster VIII should be included in breeding programme for getting best/superior segregants to improve seed yield in chickpea. Cluster X was good for plant height and plant spread, while cluster XVI was desirable in respect of days to 50 per cent flowering and days to maturity. The genotype ICCV 820065 could be included in selection for getting early types. High mean value for number of seeds per pod was observed in cluster XV. In the present case, crosses between genotypes from clusters XII and XVI, VIII and XII should be attempted as these crosses are expected to generate combinations of desirable characters for high seed yield in chickpea.

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Influence of Various Cropping Systems on Profile Water Storage and Crop Yields

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ABSTRACT

The field experiment was conducted at the College Agronomy Farm, Gujarat Agricultural University, Anand Campus, Anand to study the impact of different cropping systems on periodical soil profile water and yield. There were ten treatments consisted of sole crop of pearl millet, pigeonpea, bidi tobacco and groundnut and their intercropping systems including cultivated and absolute fallow treatments.

The results revealed that incorporation of groundnut as intercrop with pearl millet, pigeonpea and bidi tobacco crops increased the soil water storage and thereby yield, monetary returns and pearl millet equivalent yield that from corresponding sole crops, respectively.

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INTRODUCTION

Assuring adequate supply of water is crucial not only for achieving greater production of agricultural crops but also for stabilising production under uncertain weather conditions. In Gujarat, only 23.4 per cent area is under irrigation (Anon. 1989) and after harnessing all the irrigation potentials and implementation of Sardar Sarovar Project, about 48 per cent area would remain under rainfed agriculture (Anon. 1991). Agriculture in dry lands is highly affected by aberrant rainfall. Precipitation is the only source of water for crop growth in this region. Thus, in order to sustain agricultural productivity in the arid and semi arid regions, every efforts should be made to conserve as much rain water as possible at a place

where it falls. The most efficient way of doing this is to protect soil through vegetation cover, which improve water conservation by increasing infiltration and reducing evaporation (Ghildyal and Sharma, 1969). In view of this, the present study regarding the influence of different cropping systems on the soil profile water storage and crop yields was carried at the College Agronomy Farm, GAU, Anand.

MATERIALS AND METHODS

The field experiment was conducted on loamy sand soils with ten cropping systems consisted of sole crop of pearl millet (SPM), pigeonpea (SPP), bidi tobacco (SBT) and groundnut (SGN) and their intercropping (PM + GN, PP + GN, BT + GN and PM + PP)

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including cultivated (CF) and absolute fallow (AF) with four replications in a randomised block design (plot size : 6.25 m x 2.4 m). The soil was loamy sand in texture (86.6% sand, 6.3% silt, 4.8% clay). It had bulk density 1.51 Mg m^{-3} , infiltration rate 3.4 cm hr^{-1} , field capacity 17.6% (w/w basis, pH (1:2.5) 7.7, EC (1:2.5) 0.11 dSm^{-1} , organic carbon 0.152%, Olsen's P 20.5 mg kg^{-1} and available K 115 mg kg^{-1} . There were 672 mm rainfall and 37 rainy days during 1992. The corresponding values during 1993 were 774.8 and 29, respectively.

Periodically, soil samples were collected in depth increments of 0-15, 15-30, 30-45, 45-60 and 60-75 cms with screw auger from each of the plots. The moisture content of soil

samples was determined gravimetrically and soil water storage (0-75 cm depth) expressed in terms of mm. Plot-wise grain/pod/sured leaf and stalk/straw haulm yields were recorded at harvest. Yields of different crops were converted into pearl millet equivalent based on the prevailing prices of different crops in respective years.

RESULTS AND DISCUSSION

Profile water storage

Results revealed that mean values of soil-water storage over cropping systems at various dates of sampling were found significant in both the years (Table 1) due to dry and rainy spell in seasonal rainfall distribution.

TABLE 1

Soil profile water storage (mm) at various time intervals under different cropping systems.

Cropping system	Sampling date				Mean
	4-7-92	26-7-92	16-8-92	9-9-92	
1992					
Date of previous rainfall	22-6-92	25-7-92	14-8-92	7-9-92	
CF	120.0	123.9	139.5	137.2	130.1
AF	95.7	139.9	162.1	149.1	136.7
SPM	81.7	137.5	157.9	151.4	132.1
SPP	110.5	127.7	147.4	144.3	132.4
SBT	116.9	121.2	145.2	142.6	131.5
SGN	96.2	143.4	162.0	159.3	140.2
PM + GN	88.8	140.0	155.9	151.2	134.0
PP + GN	100.8	149.8	153.2	148.7	138.1
BT + GN	105.4	151.9	151.9	147.6	139.2
PM + PP	90.7	142.3	151.1	145.6	132.4
Average	100.7	137.8	152.6	147.7	—

1.	2.	3.	4.	5.	6.
1993					
	14-7-93	3-8-93	26-8-93	28-9-93	
Date of previous rainfall	11-7-93	20-7-93	24-8-93	25-9-93	
CF	141.9	119.4	126.4	108.0	123.9
AF	160.1	94.0	153.4	96.1	125.9
SPM	163.1	77.6	140.3	78.3	114.8
SPP	149.9	99.9	129.4	93.8	118.2
SBT	148.3	116.2	127.1	95.0	121.6
SGN	165.0	94.4	148.3	85.5	123.3
PM + GN	159.2	83.7	144.6	88.1	118.9
PP + GN	157.2	98.7	144.0	89.5	122.3
BT + GN	155.7	104.7	139.7	92.3	123.1
PM + PP	154.8	87.8	137.2	88.5	117.1
Average	155.5	97.7	139.1	91.5	—
		S. Em.	C. D. 5%	C.V.%	
		1992			
Treatment		1.38	4.41	2.91	
Sampling		1.23	3.55	4.09	
Interaction		3.89	11.21	4.09	
		1993			
Treatment		0.71	2.27	3.19	
Sampling date		1.38	3.98	4.34	
Interaction		5.25	15.31	4.34	

Irrespective of sampling dates, soil water storage was significantly affected by different cropping systems in both the years (Table 1). Average soil-water storage was higher under

cropped plots than cultivated fallow plots during both the years. This might be due to that growing crops maintained higher infiltration rate by dissipating energy of falling

raindrops resulting into reduced surface sealing and runoff velocity. Karad *et al.* (1991) also reported that cropping practices help in reducing runoff losses by intercepting raindrops and increasing water intake due to improvement in soil structure. The differences in soil water storage among cropping systems could be attributed to the ability of crops to intercept the raindrops

and infiltrate the water into soil. This depends upon the types of crop and number of plants, per unit area. These results confirmed the findings of Ghildyal and Sinha (1969) and Bhatia and Srivastava (1976).

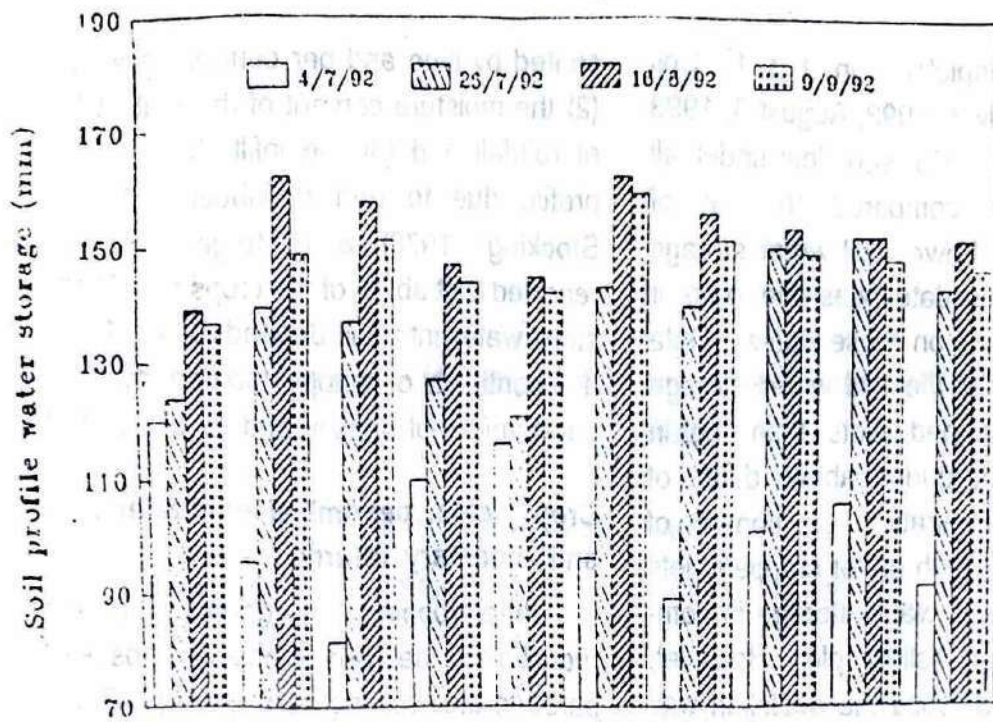
Interaction effect of cropping systems and date of sampling on soil water storage was found significant during both the years

TABLE 2

Yield monetary returns and pearl millet equivalent yield under different cropping systems.

Cropping systems	Yield(kg/ha)		Pearlmillet equivalent yield (kg/ha ⁻¹)	Net realization (Rs ha ⁻¹)
	Main product	By product		
SPM	2821	5115	2821	6205
SPP	863	2708	2784	5229
SBT	1724	359	3978	6270
SGN	1233	2955	3980	8066
PM + GN	2422 (244)*	4494 (671)	3206	6814
PP + GN	626 (622)	2145 (1691)	4027	7877
BT + GN	1132 (707)	240 (1977)	3858	7168
PM + PP	1812 (223)	4246 (889)	3033	6442
S. Em. ±	—	—	169	525
C. D. 5%	—	—	497	1541
C. V.%	—	—	19.6	12.3

*Figures in parenthesis indicate yield of intercrops.



1993

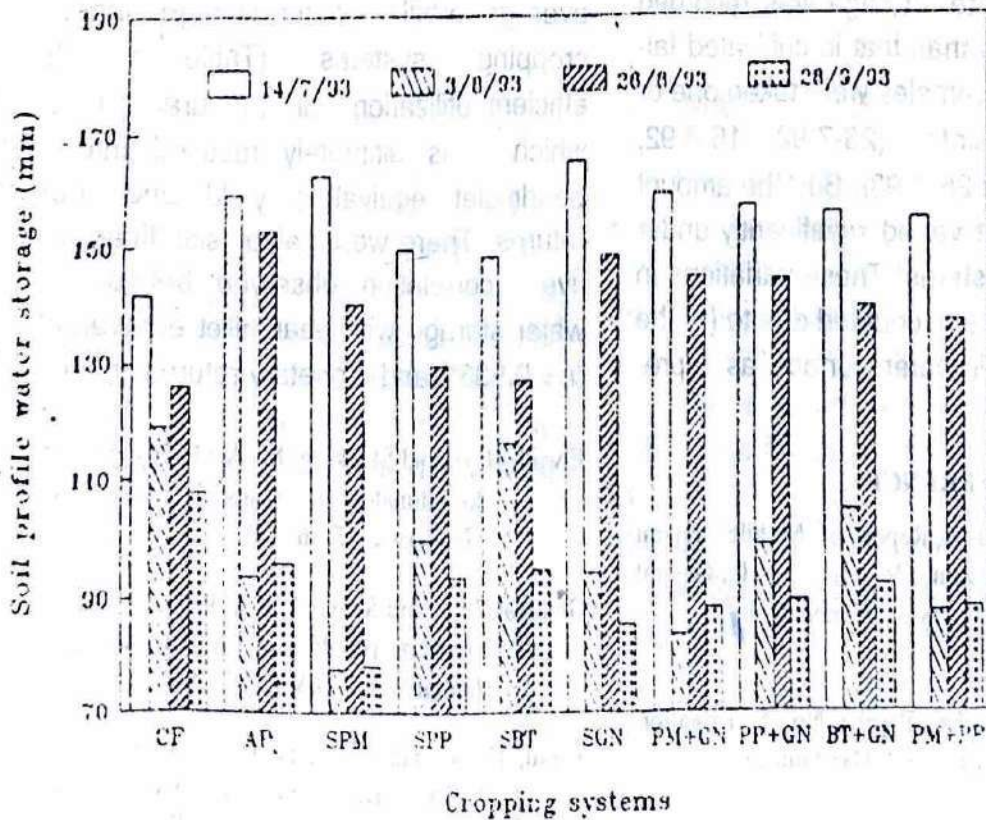


Fig. 1 : Soil profile water storage at various sampling dates.

(Table 1) and depicted in Fig. 1. Soil water storage on July 4, 1992; August 3, 1993 and September 28, 1993 were low under all the treatments as compared to rest of the sampling dates. Lower soil water storage during these particular dates was due to no or less rainfall occurred on those dates. Data further revealed that the soil water storage was lower under cropped plots than that in cultivated fallow plot during above dates of sampling. The transpiration component of evapotranspiration is high under cropped plots which reduced the soil water storage in comparison to cultivated fallow plot. However, among different field crops the depletion was more pronounced in sole pearl millet and pearl millet based intercropping plots which could be attributed to evapotranspiration losses from these plots on account of morphological characteristics of this crop.

Higher soil water storage was recorded under cropped plots than that in cultivated fallow plots when soil samples were taken one or two days after rainfall (26-7-92, 16-8-92, 9-9-92, 14-7-93 and 26-8-93). But, the amount of soil water storage varied significantly under various cropping systems. These variations in soil water storage are accounted due to (1) the condition of the soil water surface as repre-

sented by type and per cent of canopy cover, (2) the moisture content of the soil at the time of rainfall and (3) the infiltrability of the soil profile due to root distribution. Elwell and Stocking (1976) and Morgan (1979) also reported that ability of the crops to infiltrate and store water into soil depends upon the height and continuity of canopy, the density of canopy cover and root density and its distribution.

Crop yields, pearl millet equivalent yield and monetary returns

Intercropping, in general, caused a reduction in the yield of based crops as compared to their respective sole crops (Table 2). This might be due to lesser area occupied by base crop under intercropping systems. However, pearl millet equivalent yield and monetary returns were higher under intercropping systems than that from corresponding sole crops. This could be attributed to higher average profile water storage under intercropping systems (Table 1) thereby efficient utilization of natural resources which is ultimately resulted into higher pearl millet equivalent yield and monetary returns. There were also significantly positive correlation observed between profile water storage with pearl millet equivalent yield ($r = 0.533^*$) and monetary returns ($r = 0.612^*$).

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Changes in Composition of the Seed in Bajra During Seed Development

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ABSTRACT

Bajra seeds were harvested at 15, 18, 21, 24 and 27 days after full stigmatic stage (DAFSS) and also at 33 DAFSS at normal maturity. Mean dry seed weight and the content of protein, total carbohydrates, total soluble sugars and reducing sugars increased throughout seed development parallel to the decline in moisture per cent. DNA and RNA in the seed increased upto 24 DAFSS and then declined. At 24 DAFSS the seed had 97 per cent of dry weight, 89 per cent of protein and 88 per cent of total carbohydrate. The seeds harvested at this stage was already in the desiccation phase and had cent per cent germination.

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INTRODUCTION

The bajra crop is normally harvested at 90-100 days after sowing which roughly corresponds to 30-35 days after full stigmatic stage (anthesis) in most of the earheads in 50 per cent of the plants in the field. Harvesting the crop earlier may be advantageous to the breeder for germplasm collections. Harvesting early might also help to prevent loss due to bacterial and fungal diseases and bird damage which are common in bajra. In the present experiment we harvested bajra seeds at different intervals during seed development to see how early the seeds can be harvested so that the seed has good germination and at the same time, it has accumulated more than 90 per cent of all reserve materials. Results clearly showed that early harvest is possible without much loss of seed components.

MATERIALS AND METHODS

Bajra variety GHB-30 was grown during *kharif* 1990 under normal cultural practices in the Agronomy Farm, Gujarat Agricultural University, Junagadh.

The earheads were tagged at full stigmatic stage (FSS) and harvested at 15, 18, 21, 24 and 27 days after full stigmatic stage (DAFSS). The earheads were also collected at 33 DAFSS. The harvested earheads were air dried for 5-6 days and then seeds in the one third of middle portion of the earheads were collected, cleaned of extraneous matter and used for compositional analysis.

The seeds were dried at 110° C for 5 hours and the loss of weight was expressed as moisture content. The nucleic acids were

extracted by the method of Smillie and Krotkov (1960), and DNA was estimated by the diphenylamine reaction (Abraham *et al.*, 1972), while RNA was estimated by the orcinol reaction. (Volkin and Cohn, 1954). Total nitrogen was estimated by the microkjeldahl method (A.O.A.C. 1965) and crude protein content was calculated ($N \times 6.25$). From an alcoholic extract of the tissue free amino acids were estimated by ninhydrin method (Lee and Takahashi 1966). Total carbohydrate content was estimated following the acid hydrolysis method (Dreywood (1946) and Bruyn *et al.*, (1968)). The total soluble sugars were estimated by phenol sulphuric acid method (Dubois *et al.*, 1951), while reducing sugars were estimated using the arsenomolybdate reagent (Nelson, 1944). The non-reducing sugar content was calculated by the difference between total soluble sugars and reducing sugars.

RESULTS AND DISCUSSION

The mean dry seed weight increased throughout the seed development period as the per cent moisture declined (Fig. 1a). The water content of the seed increased during 15 to 18 DAFSS and then declined continuously (Fig. 1a). This period i.e., 15 to 18 DAFSS witnessed higher rates of RNA accumulation in the seeds. The DNA content per seed increased during 15 to 18 as well as 18 to 21 DAFSS indicating that the DNA synthesis continued longer than the active RNA synthesis (Fig. 1B). Since active cell division must be taking place either before or concurrent with RNA synthesis these data suggest that the bajra seed makes more DNA than needed for cell division. A similar trend was observed in wheat (Kapoor and Heiner, 1976), sorghum (Johari *et al.* 1977) and in

bajra (Tulsidharan, 1985). Tulsidharan (1985) has also reported that the peak of RNA levels occurred earlier than that of DNA in bajra which supports the present experimental results.

The protein content of the seed increased continuously, although the rate of accumulation was maximum during 18 to 21 DAFSS i.e., immediately following maximum RNA accumulation (Fig. 1c). In maize (Ingle *et al.* 1965) sorghum (Johari *et al.*, 1977), bajra (Tulsidharan, 1985) and in rice (Li and Okita, 1993), protein content increased throughout seed development period. Sahee and Das (1991) have also observed same trend in four varieties of rice.

The content of amino acids increased gradually from 15 to 24 DAFSS followed by a decline, which suggest that these amino acids were utilized in protein synthesis. Similar trend was observed in maize endosperm (Ingle *et al.*, 1965).

The carbohydrate compositional changes (Fig. 1d) showed that total carbohydrates, total soluble sugars (including reducing and non reducing) increased throughout seed development, 90% of which had accumulated by 24 DAFSS. But maximum changes occurred during 15 to 18 DAFSS for total carbohydrates which coincided with maximum increases in water and RNA content. Maximum increases for soluble sugars occurring during 21-24 DAFSS coincided with the maximum increases in free amino acids. The occurrence of higher rate of sugar and free amino acids after the higher rate of accumulation of total carbohydrates and proteins in the developing seed, may be due to a

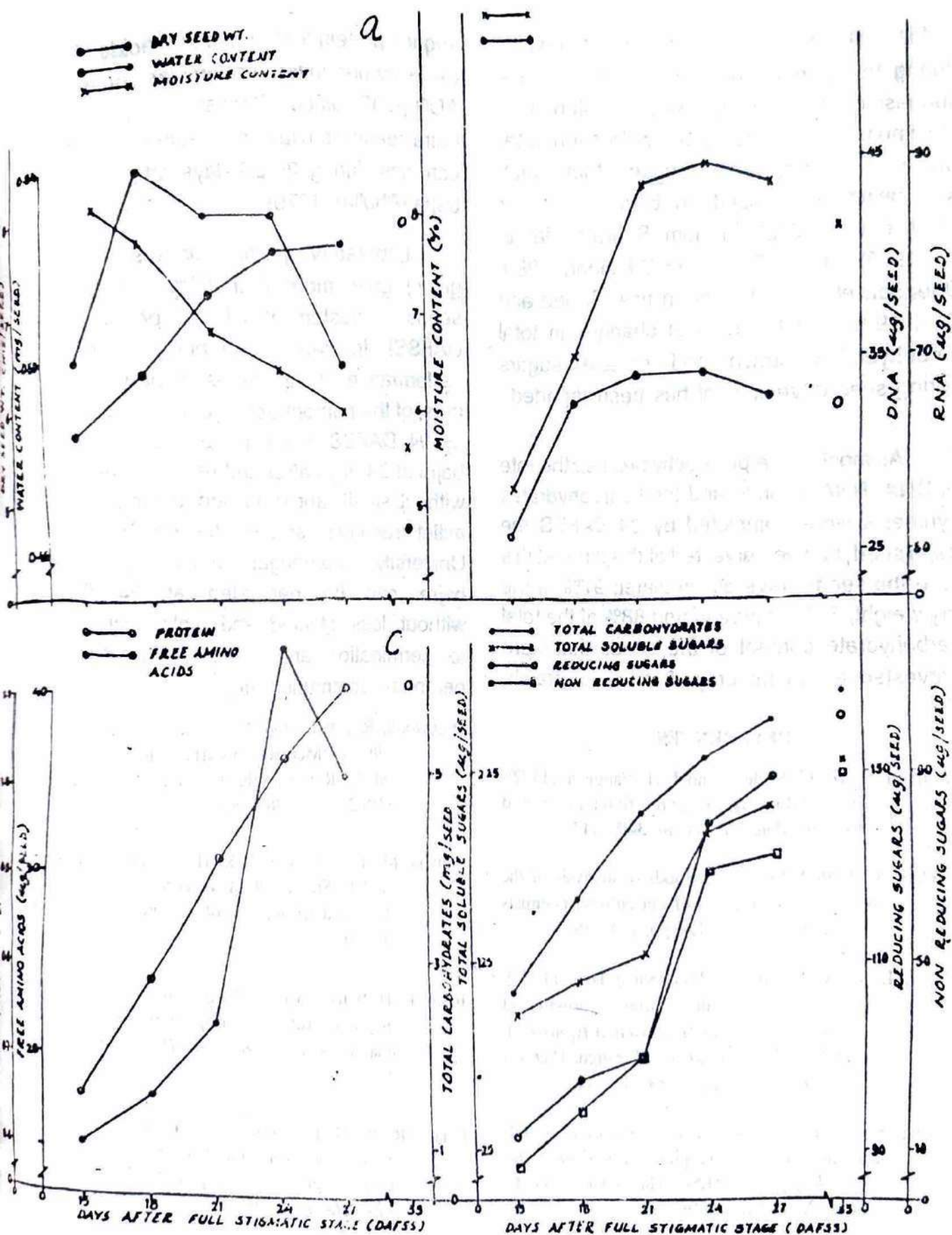


Fig. 1 : Compositional changes during seed development in bajra.

sudden fall in the synthesis of macro molecules during this period. Ingle *et al.*, (1965) have suggested that in maize sugar content was maximum at 20 days after pollination after which it decline, which suggest that starch was being synthesized. In bajra and jowar (Bhatia *et al.*, 1972) sorghum (Subramanian *et al.*, 1983) wheat (Tahir and Sikandar, 1989; Obendorf *et al.*, 1993) and in rice (Sahee and Das, 1991), similar trend of changes in total carbohydrates starch and soluble sugars during seed development has been reported.

As most of the peak activities i.e., the rate of DNA, RNA, protein and total carbohydrates synthesis were completed by 24 DAFSS the bajra seed may be harvested at this time. At this time the seeds have accumulated 97% of the dry weight, 89% of protein and 88% of the total carbohydrate content of the seeds that were harvested at full maturity. A study of starch,

sugars, protein and free amino acids along with the enzymes invertase, amylase and sucrose ADP (UDP) glucosyl transferase in developing bajra seeds also gave plateauing of content and activities during 20-25 days after anthesis in bajra (Bhullar, 1979).

Laboratory germination tests (data not given) gave more than 95% germination in seeds harvested at all the periods (15-27 DAFSS). In view of the normal germination performance at all harvest schedule and as most of the nutrient accumulation is completed by 24 DAFSS it will be possible to harvest bajra at 24 days after anthesis for use as seed without significant reduction in yield. Work at millet research station, Gujarat Agricultural University, Jamnagar have indicated that bajra can be harvested at 24 DAFSS without loss of yield and quality with respect to germination and storability (A. K. Joshi, personal communication).

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Varietal Resistance in Aonla, *Emblica officinalis* L. to Gall Forming Black Caterpillar, *Betousa stylophora* Swinhoe

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ABSTRACT

Gall forming black caterpillar, *Betousa stylophora* Swinhoe is an important pest of aonla, *Emblica officinalis* L. Among the fourteen aonla varieties screened for their resistance to this pest at Anand, aonla varieties Faizabad and Kanchan are found less susceptible to *B. stylophora* than local varieties Gujarat Amla-1, Anand-1 and Anand-3.

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INTRODUCTION

Aonla, *Emblica officinalis* L. is an important fruit crop of arid and semi-arid tropics. It's cultivation is increasing in middle and north Gujarat. It is a rich source of vitamin C and used in various ayurvedic medicines. The aonla orchards are found severely infested with gall forming black caterpillar, *Betousa stylophora* Swinhoe (Thyrididae : Lepidoptera) in middle Gujarat. It forms gall on tender shoot and twig hence, growth remains restricted. (Wadhi & Batra, 1964). To overcome the pest problem, selection of resistant variety is preferable. No information on resistant variety of aonla to *B. stylophora* is available, therefore, the present investigation on aonla varietal screening against gall forming black caterpillar, *B. stylophora* was carried out during 1991 to 1993.

MATERIAL AND METHODS

To study vatietal resistance against gall forming black caterpillar, *B. stylophora*, a field experiment was planned with fourteen different aonla varieties including the local three varieties viz., Anand-1, Anand-3 and Gujarat Amla-1 (Table 1) at Horticultural farm of the B. A. College of Agriculture, Anand. Five year old, uniformly planted at a distance of 8 m X 8 m aonla orchards of each variety were selected for screening purpose. Each variety was replicated thrice. To assess the degree of infestation, 10 tender twigs were randomly selected from each tree and number of galled and healthy twigs were recorded at monthly interval starting from April to November in unprotected aonla orchards. Among the infested twigs number of galls per twig was also recorded. The data were subjected to analysis of variance and are presented in the Table 1.

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TABLE 1

Varietal resistance in aonla to *B. stylophora* (1991-93).

Variety	Galled formed twlg (%)		Av. No. of galls per twlg	
Gujarat Amla-1	3043*	(26.81)	1.36**	(1.40)
Anand-1	29.42	(25.85)	1.35	(1.45)
Anand-3	27.35	(23.21)	1.30	(1.35)
LS-1	21.35	(16.03)	1.17	(0.96)
LS-2	18.45	(13.56)	1.12	(0.87)
LS-3	21.47	(17.30)	1.18	(1.00)
LS-4	20.75	(16.61)	1.13	(0.92)
LS-5	22.93	(18.39)	1.19	(1.00)
LS-6	24.76	(20.32)	1.22	(1.10)
Krishna	20.44	(14.49)	1.15	(0.88)
Banarsi	22.00	(18.14)	1.14	(0.90)
Chakaiya	19.00	(14.25)	1.09	(0.81)
Kanchan	17.16	(12.19)	1.06	(0.74)
Faizabad	16.47	(11.64)	1.05	(0.72)
S. Em.	1.29		0.03	
C. D. at 5%	3.59		0.09	
C. V. %	32.52		18.69	

*ARC sin transformed values.

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

Figures in the parentheses are original values.

RESULTS AND DISCUSSION

It is found from the three yrs results (Table 1) on the susceptibility of aonla varieties to gall forming black catbillar, *B.*

stylophora that none of the variety was free from the infestation of this pest during study period. However, considering the per cent gall formed twigs, aonla varieties Faizabad and Kanchan were found considerable less

TABLE 1

Relative efficacy of granular and emulsifiable concentrates of different insecticides for the control of whitefly (Rainy season (late) of 1987, 1988 and (rainy season 1988).

Tr. Treatments	Average No. of whitefly adults/20 leaves																			
	Days after germination						Days after foliar application													
	7	14	21	3	7	15	3	7	15	25	late									
1987-1988	1988	1987	1988	1988	1987	1988	1988	1987	1988	1988	1987	1988	1988	1987	1988	1988	1987	1988	1988	late
late	late	late	late	late	late	late	late	late	late	late	late	late	late	late	late	late	late	late	late	late
1. Phorate 1.0 G	0.33	0.33	0.50	1.00	3.33	1.50	3.00	8.00	2.50	0.00	0.75	0.33	1.33	2.00	3.33	2.67	1.50	1.83	1.83	1.50
kg a.i./ha +	(0.83)	(0.83)	(1.00)	(1.50)	(2.00)	(0.50)	(0.50)	(0.50)	(1.25)	(0.83)	(0.50)	(0.83)	(0.83)	(1.25)	(0.83)	(0.83)	(0.83)	(0.83)	(0.83)	(0.83)
Triazophos 40																				
EC 0.25 kg																				
a.i./ha																				
2. Phorate 10 G	0.00	0.33	0.25	0.67	2.67	1.25	2.33	5.67	2.00	0.00	0.75	0.33	1.33	2.00	3.33	2.67	1.75	1.83	1.83	1.50
1.66 kg	(0.50)	(0.83)	(0.75)	(1.17)	(1.75)	(1.75)	(1.75)	(1.75)	(1.75)	(0.50)	(0.50)	(0.83)	(0.83)	(1.25)	(0.83)	(0.83)	(0.83)	(0.83)	(0.83)	(0.83)
a.i./ha +																				
Acephate 75																				
sp 0.5 kg a.i./ha																				
3. Carbofuran	0.33	0.33	0.50	1.00	3.33	1.50	3.00	5.67	2.25	0.33	0.33	1.00	0.33	1.00	1.25	3.00	2.00	1.25	1.17	1.67
3 G 0.5 kg	(0.83)	(0.83)	(1.00)	(1.50)	(2.00)	(2.00)	(2.00)	(2.00)	(2.00)	(0.83)	(0.83)	(1.50)	(0.83)	(0.83)	(1.25)	(0.83)	(0.83)	(0.83)	(0.83)	(0.83)
a.i./ha +																				
Deltamethrin																				
2.8 EC 0.1 kg																				
a.i./ha																				
4. Carbofuran	0.00	0.00	0.25	0.67	2.67	1.00	1.00	3.67	1.50	0.67	0.33	0.50	33	1.00	1.25	2.67	1.67	1.25	1.17	1.67
3 G 1.0 kg	(0.50)	(0.50)	(0.75)	(1.17)	(1.17)	(1.50)	(1.50)	(1.50)	(1.50)	(1.17)	(0.83)	(1.00)	(0.83)	(0.83)	(1.25)	(0.83)	(0.83)	(0.83)	(0.83)	(0.83)
a.i./ha +																				
Fenvalinate																				
20 EC 0.1 kg																				
a.i./ha																				
5. Mephosfolan	1.33	1.33	1.25	1.67	5.67	4.00	4.00	9.67	3.00	1.33	0.33	1.75	1.33	2.00	2.25	4.00	3.00	2.25	3.17	1.83
5 G 1.0 kg	(1.83)	(1.83)	(1.75)	(2.17)	(4.50)	(4.50)	(4.50)	(4.50)	(4.50)	(1.83)	(0.83)	(2.25)	(1.83)	(2.00)	(2.25)	(4.00)	(3.00)	(2.25)	(3.17)	(1.83)
a.i./ha +																				
Methyl demeton																				
25 EC 0.15 kg a.i./ha																				

Figures in parentheses are $X + 0.50$ Values. H = Higher dose L = Lower dose

operations were followed to prepare the experimental plots. Fresh seeds of cowpea 779 were used for the trials.

In all seven treatments, combination of granular and emulsifiable concentrate insecticides were tested, the detail of which is given in table 1.

Method of application of insecticides

Seed treatment

Cowpea seeds of 100 gm were treated with 20 gm carbosulfan 25 SP using *Acasia* gum solution as an adhesive material. The seed treatment (ST) was done one day before sowing.

Weighed quantity of the granular insecticides was applied uniformly in furrows and mixed with the soil to avoid direct contact of the seed with the insecticide. The spray fluid was prepared by mixing measured quantity of water and the insecticides were sprayed 30 days after germination (DAG).

Pre and post treatment observations were recorded on the population of whitefly from 20 randomly selected plant (One trifoliate leaf/plant) to evaluate the efficacy of the treatments. Whiteflies were counted during early morning without disturbing the plant. To evaluate the efficacy of granular insecticides and carbosulfan (ST), observations on whitefly were recorded 7, 14 and 21 days after germination. Whitefly population was recorded 3, 7, 15 and 25 days after spraying to evaluate the efficacy of emulsifiable concentrate insecticides. Number of diseased and total number of plants per plot was recorded 30, 45 and 60 DAG and percentage of disease incidence was calculated. Grain yield per plot was recorded from net plot area and converted to q/ha.

During rainy season (late) of 1987 grain yield was not recorded.

Correlation between mean number of whiteflies per 20 leaves (cumulative value) and per cent disease incidence (60 DAG) was worked out. Similarly, correlation between whitefly population and grain yield and per cent disease incidence and grain yield were also worked out for each trial. From grain yield data the avoidable loss and increase in yield over control were calculated for each treatment.

RESULTS AND DISCUSSION

From the table 1 it is seen that phorate (H) and carbofuran (H) were found more effective in controlling whitefly as compared to carbofuran (L) and phorate (L) as well as carbosulfan 5% (ST) 7, 14 and 21 DAG in rainy season (late) of 1987, 1988 and rainy season 1988. Whitefly population was 0.0 to 0.33, 0.67 to 2.67 and 2.0 to 5.67 in phorate (H), 0.0 to 0.25, 0.67 to 2.67 and 1.0 to 3.67 in carbofuran (H), while in control it was 1.67 to 2.33, 3.67 to 6.67 and 3.75 to 13.33 whiteflies per 20 leaves on 7, 14 and 21 DAG, respectively during all the seasons. Mephosfolan 1.0 kg a.i./ha was found to be least effective in reducing whitefly population. Earlier workers also found the effectiveness of carbofuran and phorate than mephosfolan in reducing whitefly population (Kapoor et al. 1986, Rataul and Singh, 1976). Vadodaria and Vyas (1987) observed that basal application of phorate 10 G @ 1 kg a.i./ha was found most effective in controlling whiteflies in greengram.

Insecticides applied 30 DAG provided good protection against whitefly infestation. Maximum whitefly population (2.50 to 5.0) was recorded in control and it increased gradually after foliar application. Triazophos (0.0 to 2.0

whiteflies/20 leaves) and acephate (0.0 to 2 whiteflies/20 leaves) were found to be effective upto 7 days after spraying in controlling the whitefly population, while deltamethrin (0.33 to 2.00 whiteflies) and fenvalerate (0.33 to 2.67 whiteflies) gave good results upto 15 days after spraying during rainy season (late) of 1987 and 1988 and rainy season 1988. Methyl demeton and endosulfan were almost equally effective but average population of whitefly was less in methyl demeton while, neem oil was found to be least effective in reducing whitefly population. None of the insecticide treatments was effective in controlling whitefly population 25 days after spraying during all the seasons. Mishra (1984) reported the effectiveness of deltamethrin and fenvalerate in tomato while, Satyavir (1983) reported that endosulfan was inferior to methyl demeton in controlling whitefly in moth bean. Similarly, Vadodaria and Vyas (1987) reported that acephate 0.1 per cent effectively controlled whitefly in green gram. Thus the present findings are in close agreement with the earlier studies.

From the table 2 it is seen that all the insecticidal treatments were found significantly superior to control. Percentage of diseased plants was low (3.81 to 7.10) in carbofuran (H) + fenvalerate followed by phorate (H) + acephate (5.00 to 10.54) as compared to control (25.0 to 34.18) on 60 DAG during rainy season (late) of 1987, 1988 and rainy season 1988. Amongst insecticidal treatment maximum disease incidence (22.25 to 28.95) was recorded in mephosfolan + methyl demeton on 60 DAG. Similar observations were recorded by Rataul and Singh (1976), Sharma and Verma (1982) and Reddy and Verma (1986).

Maximum grain yield of cowpea (13.10 q/ha) was recorded in the treat-

ment of carbofuran (H) + fenvalerate during rainy season (late) of 1988 while it was 11.21 q/ha in the treatment of phorate (H) + acephate followed by carbofuran (H) + fenvalerate (10.97 q/ha). Mephosfolan + methyl demeton and carbosulfan (ST) + Neem oil were less effective in increasing the grain yield during rainy season (late) of 1988 and rainy season 1988. Kooner *et al.*, (1986) reported that when phorate and carbofuran were applied @ 2.0 kg a.i./ha in two split doses to soybean crop, the grain yield was increased. Similarly Rataul and Singh (1976) reported that carbofuran treatment gave the higher yield in soybean as compared to aldicarb.

Negative and highly significant correlation was observed between whitefly population and grain yield where the correlation coefficient (r) was -0.897 and -0.940 during rainy season 1988 and rainy season (late) of 1988, respectively. Similarly, negative and highly significant correlation was observed between disease incidence and grain yield, where the correlation coefficient (r) was -0.934 and -0.96 during rainy season 1988 and rainy season (late) of 1988, respectively. Positive and highly significant correlation was noticed between whitefly population and disease incidence where the value of ' r ' was 0.95, 0.98 and 0.95 during rainy season (late) of 1987, 1988 and rainy season 1988, respectively. Yellow mosaic disease of horsegram and greengram was closely related to size of the vector population. Muniyappa *et al.* (1978). Gangadharan and Jayarajan (1986) and Singh and Sharma (1981) reported that YMV had negative and significant correlation with yield.

Maximum per cent increase in grain yield over control (69.34) was obtained in the treatment phorate (H) + acephate during

and rainy season (late) of (1988), respectively (Fig. 1 and 2). Sharma and Verma (1982) reported that maximum yield reduction (69 to

78 per cent) occurred when greengram plants were infected by YMV within two weeks after germination.

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Chemical Control of Aphids (*Aphis gossypii* Glover) on Coriander*

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ABSTRACT

Studies were conducted at the College Farm, College of Agriculture, Junagadh, during *rabi* season of 1990-91 to determine the relative efficacy of different insecticides for the control of aphids of coriander. The results of eleven insecticides showed that the treatments of methyl-o-demeton 0.03 per cent, dimethoate 0.03 per cent, monocrotophos 0.036 per cent and endosulfan 0.07 per cent gave excellent mortality of *A. gossypii* on coriander. The higher yield of coriander seeds was also recorded from the plots treated with methyl-o-demeton 0.03 per cent (432.0 kg/ha), followed by dimethoate 0.03 per cent (412.5 kg/ha), endosulfan 0.07 per cent (402.5 kg/ha) and monocrotophos 0.036 per cent (363.5 kg/ha).

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INTRODUCTION

The aphid, *Aphis gossypii* Glover was reported as pest of coriander for the first time under Gujarat conditions (Ghetiya and Butani, 1995). However, it has been reported as pest of cumin under Rajasthan conditions (Anonymous, 1970) and as a pest of umbeliterous crop under Indian conditions (Blackman and Eastop, 1984). Owing the high rate of reproduction of this pest and continuous desapping of the flowers, the grain formation is very much affected. In case of severally infested umbels, the seeds are poorly developed. Secondly, they excrete honey dew like substance which led to the growth of sooty mould and inhibit the photosynthetic activity of the plants. Thus, it poses a threat to coriander production under Gujarat conditions. The present investigation was, therefore, carried

out to know the efficacy of different insecticides against aphid and yield of coriander.

MATERIALS AND METHODS

The investigation was carried out on chemical control of aphids at College Farm, College of Agriculture, Junagadh during *rabi* season of 1990-91. The trial was conducted in a randomized block design, replicated four times in a plot size of 5.0 m X 3.6 m. The variety used was Gujarat-1. Insecticides were applied with the help of knapsack sprayer fitted with a high volume nozzle. Spraying was initiated when the aphids started to build up their populations. The second spray was given 20 days after the first spray. The check plot was sprayed with water only. The population of aphids was estimated by adopting zero to four grade through the observations made on

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leaves, twigs and umbles. The following indices were fixed for estimation of population.

Indices	Description
0	Plant free from aphids
1	Aphids present but colonies did not build up. (No injury due to pest apparent on the plant)
2	Small colonies of aphids were present
3	Large colonies of aphids were present on tender parts
4	Entire plants were covered by aphids

The average aphid grade was worked out by the following formula :

$$\text{Average aphid} = \frac{0N + 1N + 3N + 4N}{\text{Total number of plants}}$$

observed grade per plant

Where 0, 1, 2, 3, 4 are the aphid indices

N = Number of plants showing respective aphid index

The coriander seeds harvested from net plot (4.00 x 1.80 sq. m.) were weighed. The yield was converted on hectare basis. The per cent increased in yield over control was calculated by using the following formula :

Yield increase

$$\text{over control (\%)} = \frac{T - C}{C} \times 100$$

Where T = Yield of respective treated plots (kg/ha)

(C = Yield of check plot (kg/ha))

Similarly, the effect of different insecticides on weight of 300 seeds was also worked out. The 300 seeds were randomly selected from each of the treatments and weighed with the help of electrical balance.

RESULTS AND DISCUSSION

The results of the sprayings of different insecticides tested against aphids on coriander showed that the treatments of methyl-o-demeton 0.03 per cent, dimethoate 0.03 per cent, monocrotophos 0.036 per cent and endosulfan 0.07 per cent were proved more effective for the control of *A. gossypii* on coriander as compared to rest of the insecticides. The treatments of thiometon and quinalphos both at 0.05 per cent were found moderately effective for the control of population of aphids. Synthetic pyrethroids applied at the normal doses had little effect on aphid population. The botanical pesticides viz., neem guard and repelin were proved ineffective against aphids on coriander (Table 1).

The monocrotophos 0.02 per cent (Singh *et al.*, 1974) and monocrotophos 0.05 per cent (Sontake *et al.*, 1990) were found to be the most effective against the *A. gossypii* on cotton. David and Kumaraswami (1982) reported that spraying of demeton-o-methyl 0.025 per cent, dimethoate 0.03 per cent and monocrotophos 0.04 per cent gave effective control of *A. gossypii* on cotton. Tiwari and Moorthy, (1982) claimed that all the synthetic pyrethroids were less effective against *A. gossypii* were as endosulfan was found superior. Thus, the present findings are in close agreement with the work of earlier scientists.

TABLE 1
Comparative efficacy of different insecticides against *A. gossypii* on coriander crop.

Sr. Treatment No.	Concentration (%)	Population of <i>A. gossypii</i> (Grade/plant)														
		First spraying					Second spraying									
		1	3	5	9	15	1	3	5	9	15	1	3	5	9	15
1. Dimethoate	0.03	0.788	0.225	0.188	0.500	0.800	0.975	0.350	0.225	0.438	0.700					
2. Methyl-o-demeton	0.03	0.825	0.175	0.150	0.487	0.788	1.000	0.388	0.200	0.425	0.662					
3. Monocrotophos	0.036	0.638	0.275	0.200	0.537	0.825	0.650	0.325	0.275	0.563	0.725					
4. Endosulfan	0.07	0.775	0.288	0.255	0.550	0.838	0.937	0.325	0.325	0.663	0.775					
5. Thiometon	0.05	0.638	0.325	0.325	0.587	0.875	0.613	0.325	0.325	0.700	0.813					
6. Guinalphos	0.05	0.637	0.300	0.313	0.562	0.888	0.825	0.425	0.325	0.725	0.850					
7. Cypermethrin	0.002	0.550	0.213	0.375	0.662	0.938	0.575	0.213	0.438	0.937	0.912					
8. Fenvalerate	0.012	0.650	0.300	0.375	0.675	0.925	0.775	0.300	0.462	1.025	1.025					
9. Fluvalinate	0.02	0.575	0.200	0.350	0.637	0.913	0.612	0.200	0.325	0.825	0.900					
10. Neemguard	0.5	0.950	0.665	0.425	0.787	1.250	1.225	1.150	0.975	1.050	1.075					
11. Repelin	0.5	0.838	0.537	0.412	0.737	1.100	1.225	1.200	0.975	1.000	1.025					
12. Control	—	0.962	0.750	0.850	1.100	1.463	1.613	1.575	1.675	1.825	1.450					
S. Em. ±	0.03	0.035	0.02	0.02	0.04	0.03	0.04	0.03	0.04	0.05	0.06					
C.D. at 5%	0.096	0.101	0.050	0.118	0.096	0.096	0.118	0.096	0.102	0.13	0.158					
C.V. %	9.11	12.05	9.98	9.69	12.54	12.54	9.017	12.32	13.18	10.84	12.16					

TABLE 2

Effect of different insecticidal treatments on the yield of coriander.

Sr. No.	Treatment	Con- centration (%)	Yield kg/ha	Yield Increase over control (%)	Weight of 300 seeds (gms)	Weight Increase over control (%)
1.	Methyl-o-demeton	0.03	432.000	300.00	5.386	63.41
2.	Dimethoate	0.03	412.500	281.94	5.287	60.41
3.	Endosulfan	0.07	402.500	272.69	5.026	52.49
4.	Monocrotophos	0.36	393.500	264.35	5.237	58.89
5.	Thiomethon	0.05	351.750	225.69	4.662	41.44
6.	Quinalphos	0.05	342.000	216.67	4.501	36.56
7.	Fluvalinate	0.02	290.750	169.21	4.082	23.85
8.	Cypermethrin	0.002	285.250	164.12	3.930	19.28
9.	Fenvalerate	0.012	280.000	159.26	4.087	24.00
10.	Repelin	0.5	188.250	74.31	3.814	15.72
11.	Neemguard	0.5	174.000	61.81	3.651	10.77
12.	Control	Water spray only	108.000	—		
	S. Em. ±		14.98		0.128	
	C. D. at 5%		48.825		0.369	
	C. V. %		9.82		10.06	

On the basis of yield data recorded (Table 2) it was found that all the treatments proved to be highly significant over control and the treatments of methyl-o-demeton (432.00 kg/ha), dimethoate (412.50 kg/ha), endosulfan (402.50 kg/ha) and monocrotophos (393.50 kg/ha) were found to be superior over other treatments. According to Narke and

Suryawanshi (1987), the maximum yield of okra fruits was recorded from the plots treated with monocrotophos 0.04 per cent (7.30 t/ha) and endosulfan 0.05 per cent (6.434 t/ha).

The results of weight of 300 seeds of coriander (Table 2) showed that the methyl-o-demeton 0.03 per cent recorded the

highest weight of 300 seeds of coriander (5.386 g) followed by dimethoate (5.287 g), monocrotophos (5.237 g) and endosulfan (5.026 g). The weight of 300 seeds of coriander was increased by 63.41 per cent in the treatment of methyl-o-demeton followed by dimethoate, monocrotophos, endosulfan, thiometon, quinalphos, fenvalerate, fluvalinate, cypermethrin, repelin and neemguard.

The information on the effect of different insecticides on weight and quality of coriander seeds through control of aphids is lacking. Thus present findings become a source of

information for further investigations on control of aphids on coriander to get higher yield of good quality seeds.

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Biology and Predator Potential of *Serangium parcesetosum* Sci. (Coleoptera : Coccinellidae), of Sugarcane Whitefly (*Aleurolobus barodensis* Mask.)

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ABSTRACT

The biology and feeding potential of *Serangium parcesetosum* Sci., coccinellid predator of sugarcane whitefly (*Aleurolobus barodensis* Mask.) were studied in laboratory of Department of Entomology, Gujarat Agricultural University, Navsari during August to October, 1993 at room temperature (Av. 27 ± 1 and $75 \pm 1\%$ RH). The details on biology, duration, behaviour etc. are described. The average developmental period for incubation, I, II, III, IV instar larvae and adult were found to be 2.64 ± 0.49 , 1.2 ± 0.41 , 1.12 ± 0.33 , 1.08 ± 0.28 , 3.76 ± 0.66 and 29.80 ± 6.445 days, respectively. A total number of 670.96 ± 103.87 whiteflies (nymph and pupae) were consumed in its total larval period of 7.12 ± 0.73 days by the predator, whereas feeding rate of adult beetle was 98.72 ± 12.09 whiteflies per day. Larvae fed the prey by alternate sucking and regurgitation, while adult beetles completely devour the prey.

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INTRODUCTION

Recently, sugarcane whitefly, *Aleurolobus barodensis* Mask, has become a serious pest of sugarcane in South Gujarat due to several reasons. Environmental concern necessitates a need for exploring effective indigenous natural enemies and informations on several natural enemies of sugarcane whitefly have been extensively reviewed by David *et al.* (1986). Among the various natural enemies surveyed in the region, especially a coccinellid predator, *Serangium parcesetosum* Sci. has been observed to be highly specific and feeding voraciously on different stages of the pest. It was first reported in India from Gujarat as a

predator of *A. barodensis* by Shah *et al.* (1986). Timofeeva and Hoang (1978); Avidzba (1983) and Natarajan (1990) have reported the incidence but no such information is available on the biology and feeding potentials of *S. parcesetosum*. With this in view, studies were undertaken on this predator to know the feasibility for management of sugarcane whitefly.

MATERIALS AND METHODS

Stock culture

Adults of *Serangium* were collected from sugarcane field of the Agriculture Research Farm, Gujarat Agricultural University, Navsari during August, 1993. These were reared in

laboratory on nymphs and pupae of sugarcane whitefly. The stock culture was maintained in iron cages (45 cm height and 30 cm diameter). For the purpose, pieces of whitefly infested sugarcane leaves (all stages preferably nymph and pupa) were kept vertically in battery jar having moist sand to avoid leaf deterioration to provide food for predator's multiplication in the cages. While changing food from the cages, leaves were observed critically once a day for the presence of predator's eggs. The leaves having predator eggs were retained as such in the cages for 5-6 days. After hatching, larvae were transferred to new fresh food with the help of fine camel hair brush. Larvae themselves also crawled to new fresh food. With this procedure, beetles were maintained/raised in laboratory.

Biology and feeding efficiency of *S. parcesetosum*

The detail biology and feeding potential of *S. parcesetosum* was studied under the laboratory conditions ($27 \pm 1^\circ\text{C}$ av. temp. $75 \pm 1\%$ av. RH.) during September-October, 1993. The eggs of predator were taken from stock culture. To begin with, pieces of leaf were clipped along with predator's eggs of known age and kept on pad of wet cotton in petri dishes for hatching. After hatching, larvae were reared singly on known number of nymphal and pupal stages of sugarcane whitefly. The feeding rate was assessed by means of recounting the number of nymphs and pupae of whitefly provided and the observations were recorded daily. Thus, the feeding efficiency of 50 beetles including their behaviour etc. from first larva to the death of adult were assessed individually and the mean was worked out. Size of various stages of beetles was measured with

the help of ocular micrometer.

RESULTS AND DISCUSSION

The data on measurement of various stage of *S. parcesetosum*, their duration and feeding rate are given in Table 1.

Description of developmental stages

Egg : Eggs were laid singly and found mostly in the vicinity of host eggs. They are oval in shape. Freshly laid eggs are translucent and creamy white in colour, later turns to transparent prior to hatching. It measures 0.525 ± 0.028 mm in length and 0.299 ± 0.0165 mm in breadth on an average. Incubation period varied from 2 to 3 days with an average of 2.64 ± 0.49 days.

Larva : Beetles in its development passes through four distinct larvae instars of compodeiform type.

1st instar : The newly emerged larvae are creamy white. The body gradually tapers posteriorly. The larvae possess bristles on the body. (It measures 0.886 ± 0.023 mm in length and 0.316 ± 0.0217 mm in breadth on an average). They fed the whitefly (nymph & pupa) by piercing mandibles into body of the host and by a process of alternate sucking and regurgitation. Larva consumed 73.24 ± 26.04 whitefly (nymph & pupa) within an average duration of 1.2 ± 0.41 days.

IInd instar : Body colour and feeding behaviour of the larvae remained essentially the same except for sizes. It measures on an average 1.386 ± 0.0256 mm in length and 0.393 ± 0.0151 mm in breadth. It consumed on an average 98.84 ± 25.65 whitefly within an average duration of 1.12 ± 0.33 days.

TABLE 1
Measurements, duration and feeding potential of *Serangium parcesetosum*.*

Stages particulars	Larva							Pupae	Adult
	Egg	First instar	Second instar	Third instar	Fourth instar	Total			
Length (mm)	Min.	0.486	0.857	1.343	2.286	2.857	—	2.67	2.214
	Max.	0.542	0.943	1.426	2.514	3.030	—	2.92	2.614
	Av. $\pm$	0.525 $\pm$	0.886 $\pm$	1.386 $\pm$	2.387 $\pm$	2.936 $\pm$	—	2.86 $\pm$	2.573 $\pm$
	S.D.	0.028	0.02	0.0256	0.062	0.042	—	0.11	0.1134
Breadth (mm)	Min.	0.286	0.286	0.371	0.571	0.857	—	2.12	1.982
	Max.	0.343	0.343	0.428	0.714	0.971	—	2.27	2.14
	AV. $\pm$	0.299 $\pm$	0.316 $\pm$	0.393 $\pm$	0.615 $\pm$	0.908 $\pm$	—	2.09 $\pm$	2.05 $\pm$
	S.D.	0.0165	0.0217	0.0151	0.0475	0.0273	—	0.912	0.187
Duration (in days)	Min.	2	1	1	1	3	6	3	14
	Max.	3	2	2	2	5	8	4	42
	Av. $\pm$	2.64 $\pm$	1.20 $\pm$	1.22 $\pm$	1.08 $\pm$	3.76 $\pm$	7.12 $\pm$	3.44 $\pm$	29.80 $\pm$
	S.D.	0.49	0.41	0.33	0.28	0.66	0.73	0.51	6.45
Number of whitefly (nymph + Pupa) consumed/ day	Min.	—	51	61	76	79	—	—	90
	Max.	—	89	110	135	150	—	—	123
	Av. $\pm$	—	63.40 $\pm$	89.84 $\pm$	97.96 $\pm$	104.92 $\pm$	—	—	98.72 $\pm$
	S.D.	—	10.65	15.99	13.50	20.18	—	—	12.09
number of whitefly (nymph and pupa consumed/ total life	Min.	—	51	61	76	255	476	—	—
	Max.	—	164	184	210	584	879	—	—
	Av. $\pm$	—	73.24 $\pm$	98.84 $\pm$	105.72 $\pm$	393.16 $\pm$	670.96 $\pm$	—	—
	S.D.	—	26.04	25.65	30.70	96.13	103.87	—	—

*Based on 50 sets observations.

IIIrd instar : The distinct greyish black blotches on dorsolateral side of the body appeared from this stage. The body measured 2.387 ± 0.062 mm in length and 0.615 ± 0.048 mm in breadth. It consumed 105.72 ± 30.70 whitefly within 1.08 ± 0.28 days.

IVth instar : The full grown larvae measures on an average 2.936 ± 0.047 mm in length and 0.908 ± 0.027 mm in breadth. They have well developed thoracic legs with claws. Abdomen is made up of nine segments. Sternum and tergum are creamy coloured but later mottle with greyish black spots that contains number of short hairs. Larvae defaecate black coloured, pellets, cylindrical in shape by extending abdominal tip upward forming tubular structure. It consumed 393.16 ± 96.13 whitefly within an average duration of 3.76 ± 0.66 days. Thus, a total of 670.96 ± 103.87 whiteflies (nymphs and pupae) are consumed in its total larval period of 7.12 ± 0.73 days.

Quiscent behaviour

Larvae before moulting into next stage, entered quiscent stage by anchoring to leaf surface with the help of abdominal tip by secretion of sticky substances which solidify soon after coming in contact with air. Insects become sluggish, shrink in size and bend a bit.

Pupal stage

In the act of pupation, last instar quiscent larvae, start casting skins from head region and the pupa appear as bulging (boil-like). It is yellowish in colour having bristles all around with maximum towards anterior region. Later, it changes to brick red. The head region first gets tanned followed by development of

reddish tinge on thoracic and abdominal region.

Adult : Freshly emerged adult brickred in colour, remains motionless for a few hours just near the casted skin. Adults were observed to feed on all stages of whitefly and completely devour the pest. Feeding rate of the beetle was 98.72 ± 12.09 whiteflies per day. It measures 2.573 ± 0.1134 mm in length and 2.05 ± 0.187 mm in breadth. Duration varied from 14 to 22 days (29.80 ± 6.445 days). The antennae were lamellate type, with six segments in male and seven segments in female.

The perusal of literature indicate that very little work is done pertaining to *S. parcesetosum*, a common predator of citrus whitefly in India (Timofeeva and Hoang, 1978). The only record about this predator is that of Timofeeva and Hoang (1978) reporting successful introduction of these beetles from Indian into USSR on the Black Sea Coast of the Caucasus for the control of citrus whitefly, *Dialeurodes citri* (Ashm.) during 1973 which destroyed about 90 per cent colonies of whitefly and Avidzba (1983) reporting reduction of *D. citri* larvae from 48 larvae/cm^2 to 10 leaves/cm^2 after introduction of these beetles in USSR. In view of high feeding potential of these beetles to sugarcane whitefly, *S. parcesetosum* could be advantageously used for management of sugarcane whitefly.

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Determination of Economic Threshold Level for *Sogatella furcifera* (Horv) in Gujarat

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ABSTRACT

A field experiment to assess the economic threshold level (ETL) for white backed plant hopper (WBPH), *Sogatella furcifera* (Horv) was conducted during 1990-91, 1991-92 and 1992-93, at the Main Rice Research Station, GAU, Nawagam (Gujarat). The results revealed that the differences in grain yields were significant due to control measures adopted at different levels (0, 5-10, 11-25, 26-50, 51-100, 101-200 and more than 200 WBPH/hill) of infestation. Straw yield did not show any significant difference. Maximum grain yield was recorded when plant protection measures were initiated at zero population of WBPH/hill followed by when the measures were adopted at 5-10 and 11-25 WBPH/hill. Highest ICBR was recorded at the infestation level of 11-25 WBPH/hill (1:7.16) closely followed by 5-10 WBPH/hill (1 : 6.82). There was no statistical difference in grain yields recorded in both these treatments.

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INTRODUCTION

Paddy is an important cereal crop of Gujarat. The crop is mainly attacked by stem borer, leaf defoliators and hoppers. *Sogatella furcifera* (Horv) commonly called the white backed plant hopper (WBPH) is one of the important and yield limiting pests of paddy in middle Gujarat. With the introduction of high yielding paddy varieties under high fertility levels, the insect has assumed a major pest status in central parts of the State. The heavy tillering and dwarf varieties appear to have provided a favourable microhabitat for easy multiplication of the pest (Dhaliwal and Singh, 1983). In addition to direct damage by sucking the sap and injecting toxins into the plant, role as vector of virus diseases has also been

recognized (Pathak and Pawar, 1983). An endemic form of this pest causes complete crop failure. Saini (1984) estimated 10 to 14% yield losses due to this pest in Punjab.

In IPM, the main philosophy is to manage insect pests below economic threshold level and not to eradicate them. Economic threshold level (ETL) has been defined as that level of pest population where control measures have to be initiated to prevent insect causing economic losses. Although, tentative ETL of the pest has been suggested, these values need to be validated through actual experimental evidence in different paddy ecosystems. Very little work has been done of this aspect in India. None of the earlier workers of the State have tried to work-out ETL for WBPH in paddy.

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Therefore, it was planned to conduct field experiment to determine the ETL value for this valuable pest in middle Gujarat so that the farmers can be advised at which population level, control measures should be taken.

MATERIALS AND METHODS

The field experiment was carried out for three successive *kharif* seasons during 1990-91, 1991-92 and 1992-93, at the Main Rice Research Station, Gujarat Agricultural University, Nawagam (Gujarat). The experiment was laid out in Randomised Block Design with seven treatments (different levels of infestation) replicated thrice. The gross and net plot size was 6.9 m x 4.0 m and 5.7 m x 2.8 m respectively. The intra-replication gap between plots was 0.8 m and inter-replication gap was 1 m. The seeds of susceptible variety (GR. 11) of paddy were sown on 27.6.90, 29.6.91 and 26.6.92 and seedlings were transplanted at 20 cm x 15 cm. Spacing on 7.8.90, 8.8.91 and 4.8.92 during first, second and third year of experimentation respectively. The crop was fertilized with 100 kg N and 50 kg P_2O_5 per hectare. All the other recommended agronomic practices, except plant protection were followed for raising the healthy crop. Uniform plant population was maintained in all the experimental plots.

The WBPH population was surveyed in all the treatments at 3 days interval starting from 10 days after transplanting of the crop. For the purpose, number of WBPH present on 10 randomly selected plants from net plot area were recorded. Different levels (0, 5-10, 11-25, 26-50, 51-100, 101-200 and more than 200 WBPH/hill) of pest infestation were maintained by adopting plant protection measures. As soon as the WBPH population has reached at desired level in a particular treatment, suitable insecticidal applications were made at recom-

mended doses. The insecticides viz., Thimet (Phorate) 10 G and Carbaryl (Sevin) 50% W/P at 1.0 kg, carbofuran (Furadan) 3 G and quinalphos (Ekalux) 25 EC at 0.750 kg, monocrotophos (Nuvacron) 36 w/w, methyl parathion (Metacid) 50 EC, endosulfan (Thiodan) 35 EC and phosphamidon (Dimecron) 85 EC at 0.500 kg a.i./ha were used to suppress the WBPH population at desired level of infestation. The cost of plant protection required in each treatment during 1990-91, 1991-92 and 1992-93 was also calculated.

The crop was harvested on 14-11-90, 19-11-91 and 18-11-92 during three years of investigation i.e. 1990-91, 1991-92 and 1992-93, respectively. At the time of harvest, grain and straw yields corresponding to infestation levels were recorded from net plot area and converted in kg/ha. The yield data thus obtained were statistically analysed.

Economics of the insecticidal application was worked out based on the net income from yields and Incremental Cost Benefit Ratio (ICBR).

RESULTS AND DISCUSSION

To initiate control measures at a lowest (0 WBPH/hill) level of WBPH population, it was necessary to have 5 to 8 (Average 6) insecticidal applications, resulting in maximum (Rs. 2380.43) expenditure for crop protection as compared to other control measures adopted for different levels of WBPH population. The cost of plant protection decreased progressively with increase in infestation level (Table 1). The data indicated that the differences in grain yields were significant due to control measures adopted at different levels of WBPH populations (Table 2). However, straw yield did not reveal any significant

TABLE 1
Cost of plant protection measures followed at various threshold levels of WBPH.

Sr. No.	Treatments WBPH/hill (nos.)	Cost of insecticide (Rs./ha)				Average No. of insecticidal application required	Labour charge* (Rs./ha)*				Cost of plant protec- tion (Rs./ha)
		1990-91	1991-92	1992-93	Mean		1990-91	1991-92	1992-93	Mean	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
(1)	0	1607.94	1891.11	2922.23	2140.43	6.00	200	200	320	240.00	2380.00
(2)	5-10	882.94	940.00	894.00	905.65	2.67	160	80	80	106.67	1012.00
(3)	11-25	300.00	940.00	894.00	711.33	1.67	40	80	80	66.67	778.00
(4)	26-50	300.00	600.00	894.00	598.00	1.33	40	40	80	53.33	651.00
(5)	51-100	—	600.00	423.53	511.77	1.50	—	40	80	60.00	572.00
(6)	101-200	—	225.00	423.53	324.27	1.50	—	40	80	60.00	384.00
(7)	More than 200	—	—	—	—	—	—	—	—	—	—

*Labour charge Rs. 20.00/day.

TABLE 2

Effect of various threshold levels of WBPH on yield of paddy.

Sr. No.	Treatments WBPH/hill (nos.)	Grain yield (kg/ha)				Straw Yield (kg/ha.)			
		1990-91	1991-92	1992-93	Pooled	1990-91	1991-92	1992-93	Pooled
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
(1)	0	5934a	5169a	6078a	5727a	5157	4323	6842	5439
(2)	5-10	5777a	4273ab	4908b	4988b	5244	4261	6598	5376
(3)	11-25	5276ab	3947b	4647b	4624b	5182	4073	6159	5138
(4)	26-50	4493bc	3275c	4344b	4035c	4856	4010	6159	5013
(5)	51-100	3759c	3183c	3114c	3352d	4593	4135	6316	5019
(6)	101-200	3935c	3179c	3020c	3377d	4900	4261	5796	4988
(7)	More than 200	3872c	2398d	2924c	3064d	4449	4365	5952	4925
	S. Em. ±	298.31	214.01	368.91	180.88	—	—	—	—
	C. D. at 5%	919.12	659.40	1136.67	557.30	NS	NS	NS	NS
	C.V (%)	10.95	10.17	15.40	7.51	—	—	—	—

Means followed by the same letter in each column are not statistically different.

NS = Not Significant.

TABLE 3
Economics of threshold level of WBPH and ICBR.

Sr. No.	Treatments WBPH/hill (nos.)	Yield (kg/ha)		Gross income (Rs./ha)	Gross realization after deducting cost of plant protection (Rs./ha.)	Net realization over control (Rs./ha)	ICBR
		Grain	Straw				
1.	2.	3.	4.	5.	6.	7.	8.
(1)	0	5727	5439	25628	23248	8529	1:3.58
(2)	5-10	4988	5376	22640	21628	6909	1:6.82
(3)	11-25	4624	5138	21065	20287	5568	1:7.16
(4)	26-50	4035	5013	18647	17996	3277	1:5.03
(5)	51-100	3352	5019	15918	15346	627	1:1.10
(6)	101-200	3377	4988	16002	15618	899	1:2.34
(7)	More than 200	3064	4925	14719	—	—	—

Market price : Paddy grain Rs. 400/q.

Paddy straw Rs. 50/q.

difference. Maximum (5727 kg/ha) grain yield was recorded when plant protection measures were initiated at zero level population of WBPH/hill followed by when the control measures were adopted at 5-10 (4988 kg/ha) and 11-25 (4624 kg/ha) WBPH/hill. Reduction in grain yield was found to be 2.66 t/ha when population exceeds more than 200 WBPH/hill. This is in accordance with the earlier report of Anonymous (1990).

The regression equation $Y = 5019.55 - 13.89x$ was computed where 'Y' and 'X' indicate grain yield and pest population level, respectively. It explains that increases in WBPH population by one unit, would result in decrease in grain yield by 13.89 times.

In spite of maximum gross income (Rs. 23248) resulted from higher grain and straw yield, the high cost involved in plant protection resulted lower ICBR (1:3.58) in the treatment of zero WBPH/hill (Table 3). Maximum ICBR was recorded in the treatment when control measures were initiated at 11-25 WBPH/hill (1:7.16) closely followed by 5-10 WBPH/hill

(1:6.82). There was no significant difference in grain yields in both these treatments. Hence, based on productivity and economics, it is very clear that to harvest optimum and economical yield of paddy, control measures for WBPH should be initiated at the population of 5-10 WBPH/hill. The findings, therefore confirm the earlier results of Khatri *et al.* (1983), who reported the ETL for WBPH at or below 15 insects/hill in Madhya Pradesh. Similarly in case of brown plant hopper, Anonymous (1988) and Anonymous (1990), the ETL was found to be 5-10 insects/hill at Aduthurai (Tamil Nadu) and Maruteru (Andhra Pradesh), respectively. The report of Naba (1992) from Japan, is also in partial fulfilment of the present findings, who estimated 10-20 WBPH/hill as threshold value during panicle formation stage.

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Bioefficacy of Synthetic and Botanical Insecticides Against Aphid, *Lipaphis erysimi* Kalt and Diamond Back Moth, *Plutella xylostella* L. Infesting Cabbage

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ABSTRACT

Field experiments were conducted during *rabi* 1993-94 and 1994-95 to find out the effective and economical insecticide(s) for the control of aphid, *Lipaphis erysimi* Kalt and diamond back moth, *Plutella xylostella* L. on cabbage. Endosulfan 0.035% (1:37.08), chlorpyrifos 0.02% (1:34.08) and Neem Seed Kernel Suspension (NSKS) 3% (1:27.58) were found effective and economical for the control of aphid and diamond back moth.

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INTRODUCTION

Cabbage, (*Brassica oleracea* convar *capitata* var *capitata*) an important vegetable sole crop cultivated throughout India, is attacked by number of insect pests. Amongst them aphid, *Lipaphis erysimi* Kalt is the regularly occurring most serious pest. The cabbage plants heavily infested by *L. erysimi* in the early stage fail to have head formation (Ratanpara *et al.*, 1992). *Plutella xylostella* L. is another important pest which has acquired serious dimensions and become a limiting factor for the cultivation of cabbage and cauliflower during recent years. Borad *et al.* (1991) have reported the effectiveness of synthetic insecticides, monocrotophos and dimethoate against *L. erysimi* and *Helicoverpa armigera* infesting cabbage, but no information is available on botanicals. Considering the

seriousness of these two pests, the present investigation was undertaken to find out the effective synthetic and/or botanical insecticide(s) for their control.

MATERIALS AND METHODS

Field experiments were conducted in a randomised block design at college agronomy farm of Gujarat Agricultural University, Campus Anand with three replications using C. V. Sutton Express during the *rabi* 1993-94 and 1994-95. Four synthetic and three botanical insecticides were tested (Table 1). Insecticides were applied on appearance of aphid during 1993-94. Aphid counts were taken on the cabbage three leaves from randomly selected five plants in each plot prior and after 1 and 2 week(s) of spray. Due to very low infestation of *P. xylostella* in the field

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insecticides were sprayed on the cabbage plants in the field during 1994-95 and such treated leaves were brought to the laboratory and fed to diamond back moth larvae. Treated cabbage leaves with respective insecticides were given to the live larvae daily for feeding till 7 days after spray. Ten larvae were released on treated cabbage leaves for each treatment. It was repeated thrice. The observations on larval mortality were recorded after 1, 3 and 7 day(s) of spray. The data obtained were converted into percentage and subjected to analysis of variance and presented in this paper.

RESULTS AND DISCUSSION

The data on aphid populations (Table 1) revealed chlorpyrifos (0.02% and 0.04%) was most effective against aphid and showed superiority over quinalphos and three botanicals after 1 week of spray. Of course, endosulfan and phosphamidon remained equally effective as chlorpyrifos. Quinalphos showed equal aphicidal property as phosphamidon, endosulfan, Parasmani, Nimbecidine and Neem Seed Kernel Suspension (NSKS) after 1 and 2 weeks of spray. After 2 weeks of spray chlorpyrifos 0.04% did not show higher effectiveness than chlorpyrifos 0.02% but, considerably lower aphid population was observed when cabbage was sprayed with chlorpyrifos 0.04% in comparison to phosphamidon and endosulfan which were found equally effective as chlorpyrifos after 1 week of spray. Yadav *et al.* (1988) and Krishnaiah and Jagan Mohan (1983) reported the effectiveness of endosulfan and chlorpyrifos against cabbage aphid. Amongst three botanicals, Nimbecidine, Parasmani and NSKS, Parasmani could

effectively checked the aphid population like chlorpyrifos 0.02%, phosphamidon, endosulfan and quinalphos after 2 weeks of their spray. Nimbecidine and NSKS sprayed cabbage plants had almost equal aphid population as plants sprayed with quinalphos, endosulfan, phosphamidon and Parasmani after 2 weeks of spray.

The larval mortality of diamond back moth (Table 1) after 1, 3 and 7 days of treatment was considerably higher in all the synthetic and botanical insecticides than water spray. However, endosulfan gave higher larval mortality than Quinalphos, Phosphamidon, Parasmani and Nimbecidine after 1 day of their spray. Of course, chlorpyrifos and NSKS were found equally effective as endosulfan. After 3 days of spray all the insecticides including botanicals could give equal larval mortality as endosulfan. However, chlorpyrifos 0.04% showed higher effectiveness than phosphamidon and Nimbecidine. Nimbecidine remained less effective than Parasmani and quinalphos. Same trend was continued after 7 days of spray however, Nimbecidine and Parasmani were found at par. Endosulfan 0.7 kg a.i./ha and chlorpyrifos 0.5 kg a.i./ha gave effective kill of the pest at I.I.H.R., (Krishnaiah and Jagan Mohan, 1983), whereas NSKS was rated quite good against *P. xylostella* (Patel *et al.*, 1993).

The effectiveness of insecticide against aphid and diamond back moth were also reflected on yield. All the synthetic insecticides and Parasmani sprayed cabbage crop could give considerable higher yield than unsprayed crop as well as NSKS and Nimbecidine sprayed crop.

TABLE 1

Efficacy of synthetic and botanical insecticides against aphid and diamond back moth and their effect on cabbage yield.

Treatment	Av. No. of aphid/leaf spray		Larval mortality (%) of <i>P. xylostella</i> after days(s)				Yield of marketable cabbage head (q/ha)
	Before	After week(s)					
	1	2	1	3	7		
Chlorpyrifos 0.02%	3.65 (12.89)	1.34 (1.33)	2.82 (7.56)	43.06 (46.67)	63.90 (80.00)	66.61 (83.33)	200.82
Chlorpyrifos 0.04%	4.74 (22.44)	1.07 (0.67)	2.27 (4.89)	43.06 (46.67)	66.61 (83.33)	66.61 (83.33)	228.48
Endosulfan 0.035%	3.97 (15.55)	1.68 (2.33)	3.52 (11.89)	50.83 (60.00)	55.05 (66.67)	64.61 (80.00)	194.25
Phosphamidon 0.03%	4.33 (18.45)	1.57 (2.00)	3.07 (9.02)	32.20 (30.00)	49.20 (56.67)	58.98 (73.33)	200.17
Guinalphos 0.025%	4.26 (18.67)	2.19 (4.33)	3.60 (12.55)	34.21 (33.33)	55.76 (66.67)	57.68 (70.00)	181.07
Neem Seed Kernel Suspension (NSKS) 3%	3.94 (15.11)	2.48 (5.67)	3.71 (13.33)	41.14 (43.33)	50.83 (60.00)	58.98 (73.33)	164.61
Parasmani 0.3%	4.31 (18.44)	2.25 (4.67)	3.35 (11.22)	30.78 (26.67)	57.27 (70.00)	57.27 (70.00)	190.29
Nimbecidine 0.3%	4.05 (16.11)	2.25 (4.67)	3.77 (13.76)	28.07 (30.00)	38.84 (40.00)	43.06 (46.66)	138.93
Control (water with teepol)	3.54 (12.00)	4.41 (19.33)	4.83 (22.89)	0.99 (0.00)	0.99 (0.00)	0.99 (0.00)	123.79
S. Em. +	0.33	0.21	0.25	5.24	5.66	4.79	16.09
C. D. at 5%	NS	0.64	0.74	15.58	16.81	14.24	50.64
C. V. %	14.13	17.27	12.50	26.85	20.11	15.74	16.23

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

** Arc sin transformed values.

Figures in the parantheses are original values.

TABLE 2

Economics of various synthetic and botanical insecticides against aphid and diamond back moth infesting cabbage.

Treatments	Rate of insecticide (l or kg / ha)	Av. cost of the insecticide (Rs. / ha)	Total cost of plant protection (Rs. / ha)	Average yield (q / ha)	Net gain over control (q / ha)	Realization over control (Rs / ha)	ICBR
Chlorpyrifos 0.02%	0.4	126	226	200.82	77.03	7703	1:34.08
Chlorpyrifos 0.04%	0.8	251	351	228.48	104.69	10469	1:29.83
Endosulfan 0.035%	0.4	90	190	194.25	70.46	7046	1:37.08
Phosphamidon 0.03%	0.4	184	284	200.17	76.38	7638	1:26.89
Qhinalphos 0.025%	0.4	140	240	181.07	57.28	5728	1:23.87
NSKS 3%	12.0	48	148	164.61	40.82	4082	1:27.58
Parasmani 0.3%	1.2	216	316	190.29	66.50	6650	1:21.04
Nimbecidine 0.3%	1.2	180	280	138.93	15.14	1514	1:05.11
Control	—	—	—	123.79	—	—	—

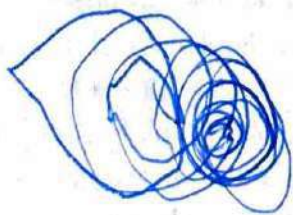
Note : Cost of labour for spraying Rs. 100 per ha.
Price of cabbage head Rs. 1.00 per kg.

Endosulfan gave the highest (1:37.08) cost benefit ratio followed by chlorpyrifos 0.02% (1:34.08), chlorpyrifos 0.04% (1:29.83) and NSKS (1:27.58). Considering

the effectiveness, economics and safety to bioagents of aphid and diamond back moth endosulfan 0.035% and NSKS 3% should be sprayed on cabbage crop.

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An Appraisal of Monsoon Rainfall at Anand, Gujarat

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ABSTRACT

Seasonal rainfall of Anand for 38 years (1957-94) has been studied for prognosis of monsoon rainfall during 1995. Use of statistical procedures like two way analysis of variance, Cramer's inequality and autocorrelation respectively indicated that (i) the time of withdrawal is not related to the time of onset (ii) 1974-79 received significantly high rainfall and (iii) significant relationship exists in the series at six and ten years lag. The study further indicated that random fluctuations prevailed in the length of growing season after the year 1980.

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INTRODUCTION

The Indian people are optimistic every summer that the ensuing monsoon would bring respite to his annual miseries. As such, the delay in the monsoon of 1995 has created aspersions in both the common man as well as the Government of the possible difficulties in the ensuing months, particularly towards drinking water scarcity and increase in prices of essential commodities. In such contingencies as this, it is useful to anticipate the possible behaviour of the monsoon, particularly the rainfall and the withdrawal of monsoon. With this background, an attempt has been made here to analyse the behaviour of the south-west monsoon during the past 38 years for which rainfall records are available for Anand (Lat. 22° 35'N, Long 72° 55'E) to guesstimate the monsoon of 1995.

MATERIALS AND METHODS

The daily rainfall data of the 38 years' record (1957-94) available since the inception of the agrometeorological observatory at the Gujarat Agricultural University, Anand Campus have been considered for analysis in the study. The criteria for the onset and the withdrawal of the southwest monsoon have been adopted from Anonymous (1988). According to anonymous (1988), June 15 is the normal date of onset at Anand. The onset being a dynamic and random phenomenon, it would be appropriate to assign onset 'period' rather than 'date'. Further, frequency analysis of the data of Anand showed that the 2nd and 3rd weeks of June experienced highest frequency of onset of the southwest monsoon. Also, Rao (1976) has indicated that Sept., 23rd is the normal date of withdrawal of the

southwest monsoon for the region. Keeping the rainfall distribution characteristics and considering one week as the cut-off limit

between early, normal and late categories, the following categorization logically emanates.

Category of period	Onset	Withdrawal
Very early (VE)	—	Before Sept., 1st
Early (E)	1st week of June	1st and 2nd week of Sept.
Normal (N)	2nd and 3rd weeks of June	3rd and 4th week of Sept.
Late (L)	4th week of June	After Sept., 30th
Very late (VL)	After June 30th	—

The data of seasonal rainfall amount and the periods of onset and withdrawal of monsoon have been subjected to appropriate statistical tests. Cramers's test (WMO, 1971) has been employed for evaluating the significance of rainfall in successive five-year periods during the last 35 years (1960-1994). Two-way analysis of variance (Korin, 1977) has been performed for evaluating the significant occurrences between different periods of onset and withdrawal of the monsoon. The auto correlation technique has been utilized to know whether any significant relationship existed within the historical rainfall series of Anand.

RESULTS AND DISCUSSION

Seasonal rainfall characteristics at Anand

Rainfed agriculture demands good seasonal rainfall for sustained productivity. Anand receives a mean monsoon seasonal rainfall of 836.7 mm with a coefficient of variation of 38%. The highest rainfall occurred in the year 1976 (1712 mm), while the lowest occurred in the year 1986 (286 mm). Analysis of Cramers's test statistic, t_k , (WMO, 1971)

presented in Table 1 suggests that the three periods covering the years 1970 to 1984 along with the last period (1990-94) experienced higher rainfall than the long term mean, while the remaining three periods received lower rainfall than the long term mean. However, in the period 1975-79 alone Anand received significantly higher seasonal rainfall while the rainfall in the period 1985-89 was very low and close to statistical significance at 5% level.

Onset of monsoon

Besides the amount of rainfall, the onset of monsoon determines crop production capability of the region. Seasonal rainfall occurrence in years of different periods of onset is portrayed in Fig. 1. It is seen that the monsoon onset was normal in 52.6% of years, while it was 15.8% in the remaining three categories. It is noticed that high and low rainfall occurrences alternated during the years of very late onset of monsoon. However, the variations in magnitude did not have any set pattern. The observations suggested that the rainfall during 1995 could exceed the rainfall of 1991, which was 643 mm, but post-facto, it is noticed that the seasonal rainfall for 1995 was 545.1 mm.

TABLE 1

Interperiodic variability of rainfall at Anand.

Periods	Mean	r_k	t_k	Significance
1960-64	715.60	-0.35	-0.82	NS
1965-69	699.20	-0.40	-0.94	NS
1970-74	841.80	0.05	0.11	NS
1975-79	1119.60	0.93	2.34	
1980-84	891.00	0.21	-1.73	NS
1985-89	600.80	-0.71	-1.73	NS
1990-94	911.60	0.27	0.63	NS
Overall mean :	825.66	SD : 317.70	CV = 38.5%	

*Significant at 0.05 level.

Withdrawal of monsoon

In unison with the onset, the time of withdrawal of monsoon determines the length of the growing season with respect to moisture availability and, therefore, plays a vital role in determining crop productivity. Fig. 2 represents the interannual variations of rainfall at Anand during different periods of withdrawal of the monsoon. Anand experienced normal withdrawal in 42.1% of the years under study. While early and late withdrawal was noticed in 23.7% of years each, very early withdrawal was noticed in 10.5% of years. It is further noticed that the monsoon and its intensity have shown increasing trend during years of very early withdrawal of monsoon. In the other categories, no specific trend was observed and the data length is not sufficient for statistical analysis.

Length of growing season

An attempt has been made to combine the occurrences of different periods of withdrawal with onset of the southwest monsoon in order to analyse the length of growing season in individual years. Fig. 3 clearly indicates that the length of the growing season fluctuated erratically after 1980. Further, it is important to note that all the four years of very early withdrawal occurred during this period. The two way analysis of variance (Korin, 1977) as shown in Table 1 indicated that the withdrawal of monsoon varied non-significantly with the onset monsoon at Anand, implying that the length of growing season does not have any significant relation with the onset.

Fig. 1 : March of rainfall in various periods of onset.

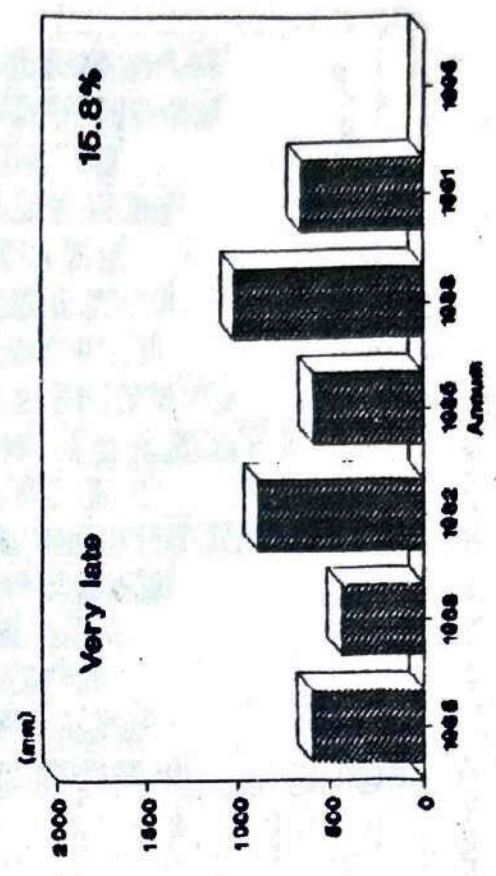
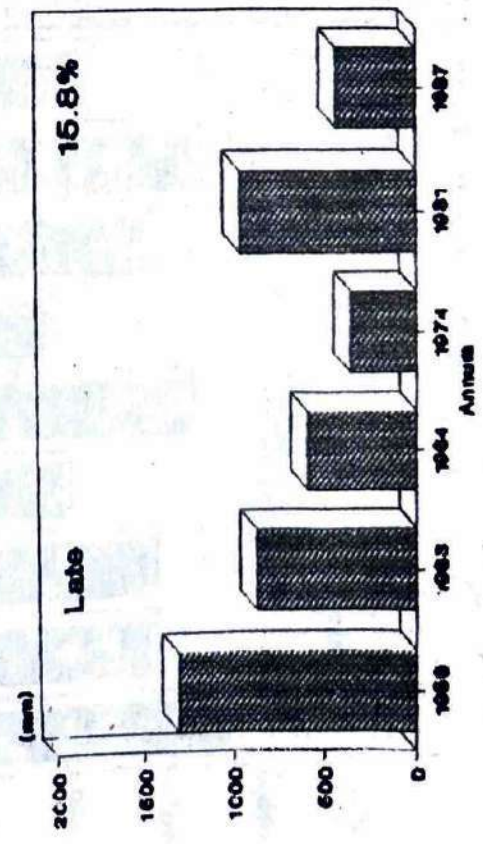
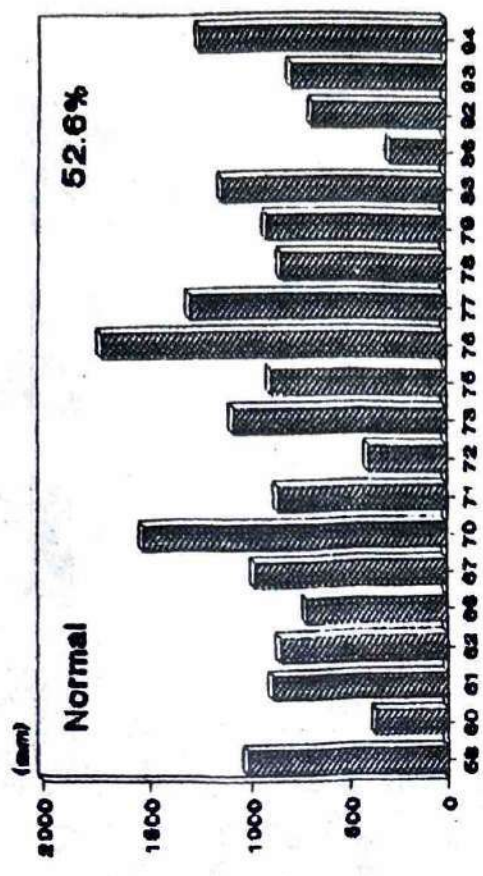
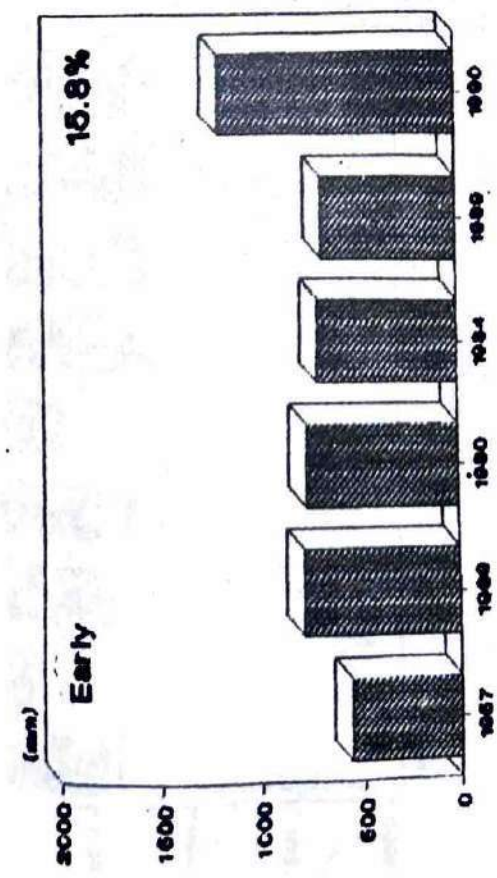


Fig. 2 : March of rainfall in various periods of withdrawal.

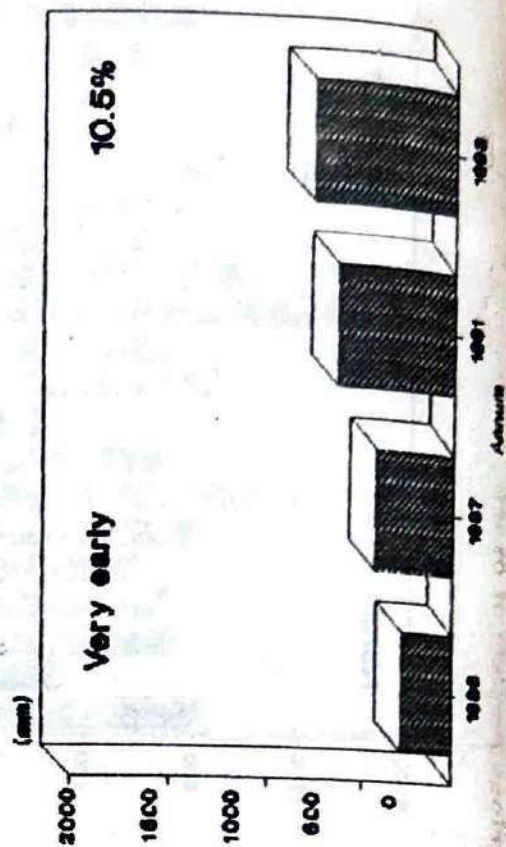
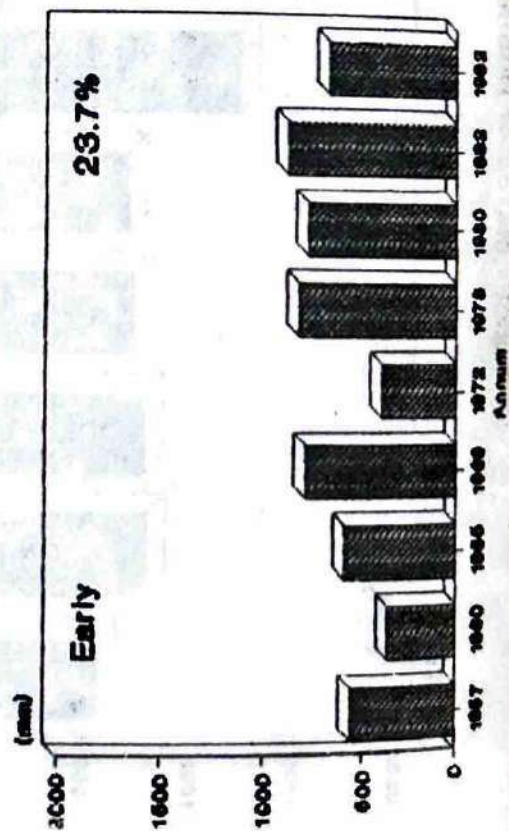
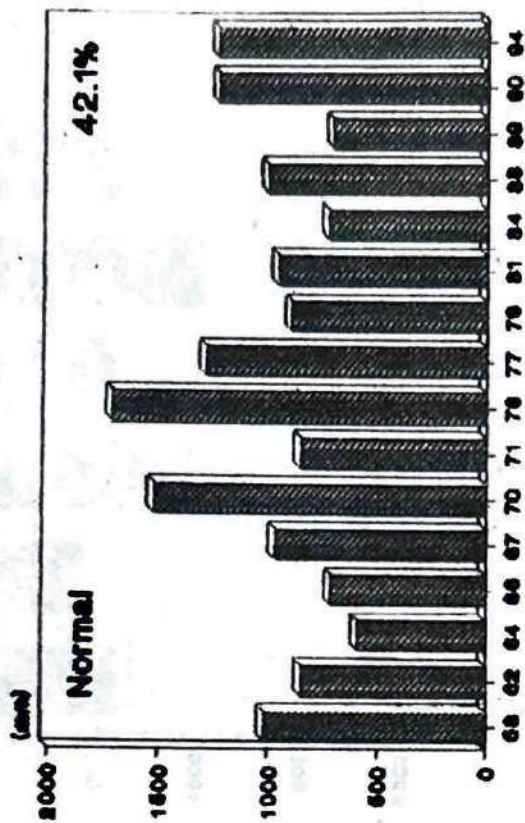
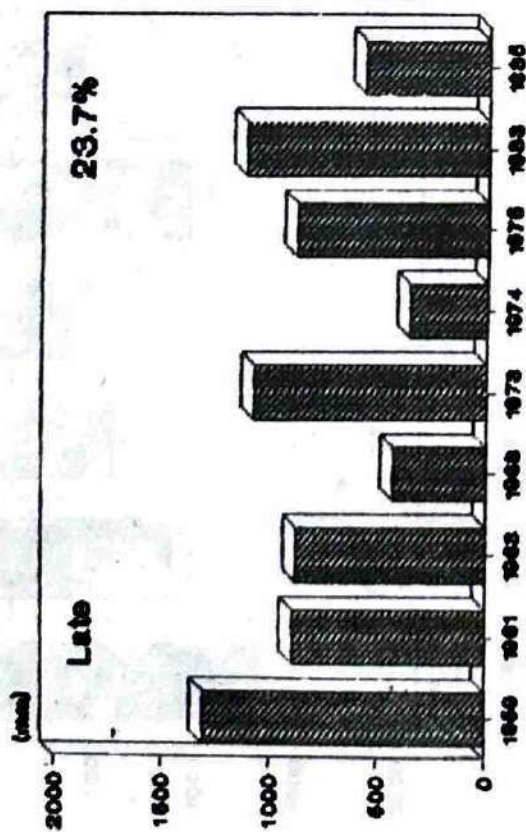


Fig. 3 : Comparative march of onset and withdrawal at Anand.

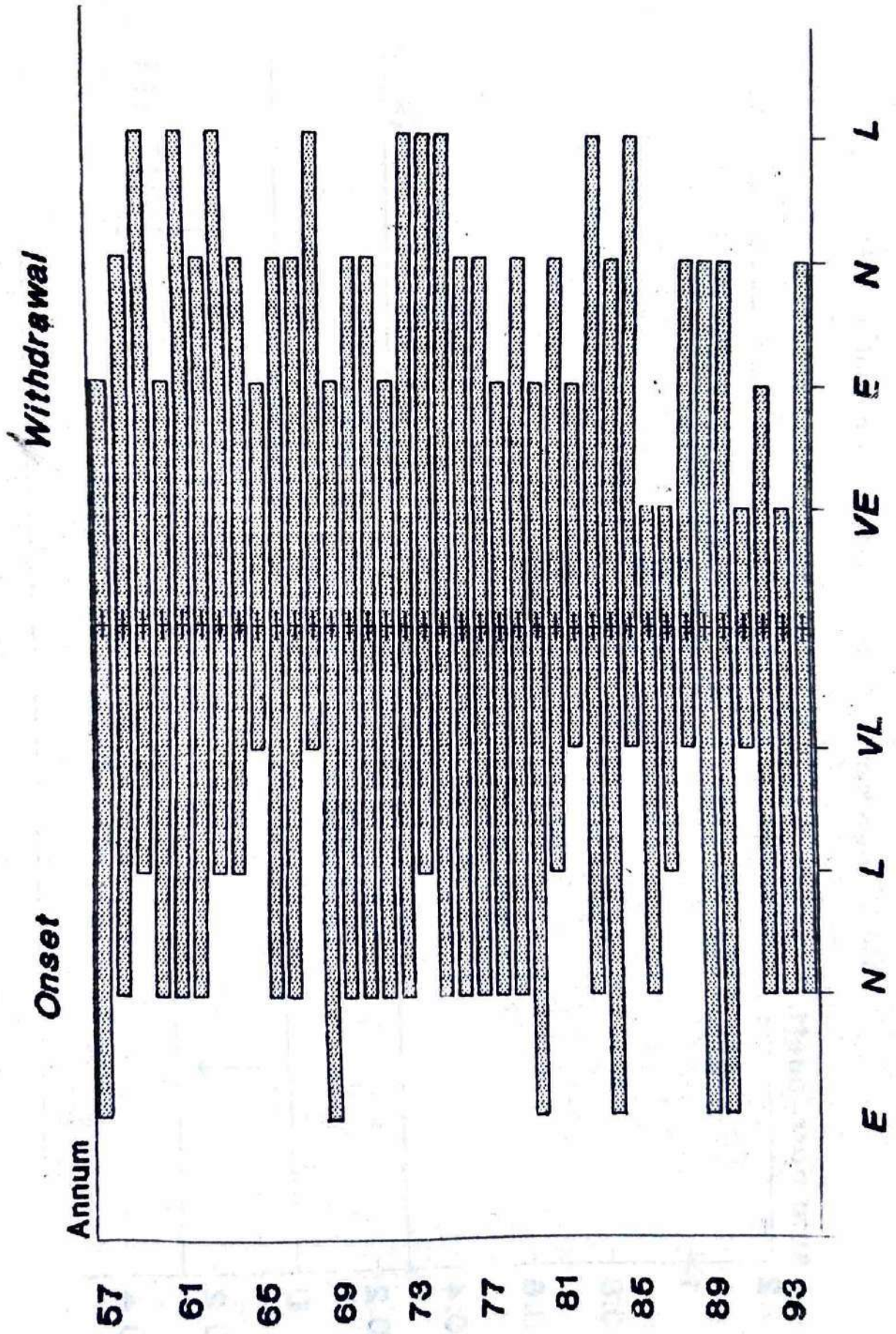


Fig. 4 : Correlogram of inter annual monsoon rainfall.

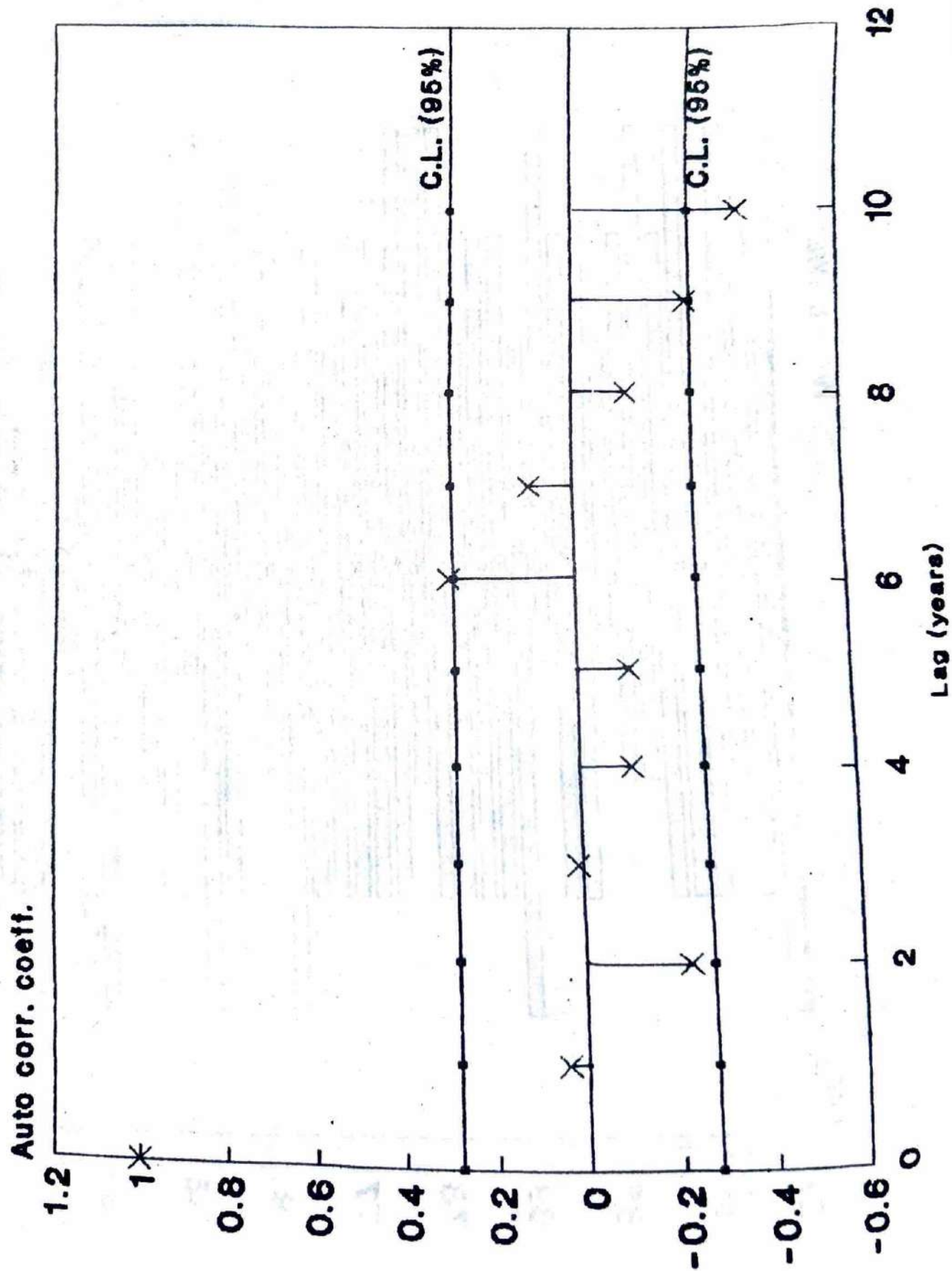


TABLE 2

Discriminability analysis of frequencies of different categories of onset and withdrawal of southwest monsoon at Anand (1957-94).

Onset	Withdrawal				Total
	Very early	Early	Normal	Late	
Early	0	3	2	0	5
Normal	2	5	10	4	21
Late	1	0	2	3	6
Very late	1	2	1	2	6
Total	4	10	15	9	38

Anova Table

Period	d.f.	Table 'F' at 1% level	S. Em.	Cal. 'F'	Test
Onset	3	6.99	14.75	4.12	NS
Withdrawal	3	6.99	5.08	1.42	NS
Error	9		3.58		

Interannual relationship of monsoon rainfall

The time series of monsoon rainfall at Anand has been studied for analyzing the interdependence of rainfall with those of the previous years. The auto correlation coefficient (r_k) at different lags (k) has been used for this purpose. The analysis showed positive (0.29) and negative (-0.39) significant relationships at six and ten years apart respectively, while the

negative relationship at lag 9 (-0.27) was very close to the 95% level confidence limit (Fig. 4). Looking at the rainfall amounts in 1989 (706 mm), 1986 (286 mm) and 1985 (574 mm), which correspond to lags of 6, 9 and 10 years respectively, it may be inferred that Anand would not experience poor rainfall during 1995. Simple averaging of rainfall these three years gives a rainfall value of 522 mm for 1995. This is comparable with the actual rainfall (545.1 mm).

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A Scale to Measure Attitude of Research Scientists Towards their Research Work

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ABSTRACT

Research has crucial role in agricultural development of our nation. Research Scientists are the backbone persons performing lot of important functions at different stages of research. Among all factors, attitude of the scientists towards his research work is an important factor that motivate a scientist to put his assets and abilities to maximum use for the advancement of research. Hence, there is great need to measure attitude, but the assessment of the attitude would be impossible without standard devices. Therefore, an effort was made to develop an instrument. The scale developed could be used to measure the attitude of research scientists working in Agricultural University as well as at other places with partial modifications.

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INTRODUCTION

Research has a significant role in agricultural development in country. By improving the quality and yield potential of different crops, research upgrades the economical condition of farmers which ultimately affects the development of society, state and nation.

Research scientists working as head of the department/station/project/scheme are the backbone persons having responsibility of performing lot of important tasks at different stages of research work. He has to initiate new research projects.

He has to discuss problems of his co-workers and provide maximum help and

encouragement by supplying satisfactory solutions to them. But among all factors that motivate a scientist to put his assets and abilities to maximum use for the advancement of research work, his attitude towards his research work is of prime importance. Hence, the quality and quantity of research carried out in the department/station/project/scheme are mainly depending on the attitude of the scientist working as head towards their research work. Therefore, the present study was conducted to develop a scale to measure the attitude of Research Scientists of GAU towards their research work (in GAU).

According to Allport (1935), 'an attitude is a mental and neural state of readiness,

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organised through experience exerting a directive of dynamic influence upon the individual's response to all objects and situations with which it is related'. It refers as 'the degree of positive or negative effect associated with some psychological object' (Thurstone, 1946).

MATERIALS AND METHODS

The technique chosen to construct the attitude scale was 'scale product method' which combines the Thurstone'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 Eysenek and Crown (1949).

(1) Collection of attitude statements

The objective was to select a set of items in such a manner that the acceptance or rejection of each one will imply a different degree of favourable or unfavourable attitude of research scientists working as head of department/station/project/scheme toward their research work. As such, 21 statements were collected from relevant literature and experts.

The statements thus collected were carefully examined in the light of 14 criteria suggested by Edward and Kilpatrick (1984) for screening the items. As a result, 15 of the 21 statements were retained.

(b) Item analysis

The selected statements were so recorded as to express positive or negative attitudes. All the statements were typed in a random sequence and presented to 53 extension experts in order to judge the degree of 'unfavourableness-favourableness' of each. They were also asked to check as to the

specificity, ambiguity, generality, different interpretations and understandability of the statements.

(c) Determination of Scale and 'Q' values

The seven points of the rating scale were assigned scores ranging from 1 (for strongly unfavourable) to 7 (for strongly favourable). Based on the judgement, the medium value of the distribution, the 'Q' value for the statement concerned was calculated with the help of following formula (Edward, 1957).

$$S = L + \left(\frac{0.50 - E_{pb}}{P_w} \right) \times i \quad \text{Formula - 1}$$

$$Q_2 = L + \frac{0.25 - E_{pb}}{P_w} \times i \quad \text{Formula - 2}$$

$$Q_3 = L + \left(\frac{0.75 - E_{pb}}{P_w} \right) \times i \quad \text{Formula - 3}$$

where,

S = the median or scale value of the statement.

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

E_{pb} = the sum of the proportions below the interval in which the median falls.

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

i = the width of the interval and is assumed to be equal to 1.0

Q₂ & Q₃ = interquartile.

The interquartile range $Q = Q_3 - Q_2$ for each statement was also worked out for determination of ambiguity involved in the statement, with the use of formula 2 and 3.

(d) Method of scoring

The selected 13 statements for final format of the attitude scale were randomly arranged to avoid response bias that might contribute to low reliability and detract from validity of the scale. Against each of 13 statements, there were five response column representing a 5 point agree-disagree continuum as followed by Likert (1932) in his summated rating technique. The point on the continuum were strongly agree, agree, undecided, disagree and strongly disagree with weights of 5, 4, 3, 2 and 1 respectively for positive items and 1, 2, 3, 4 and 5 respectively for negative items.

The weightages 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.

(e) Reliability of the scale

To know the reliability of the scale split-half method was used. The scale was administered to 20 research scientists who were neither previously used as judge nor had chance to come in the final sample. The scores for the alternate items were separated and two sets were prepared. The coefficient of correlation between the two sets of scores was found

0.648 (r-value) which significantly indicated the stability of the scale.

(f) Validity of the scale

The content validity of the scale was computed by two ways. Firstly the component/sub-component selected for inclusion in the scale was based on an extensive and exhaustive literature reviewed and secondly, the opinion of the panel of 53 judges were obtained to know whether the components and sub-components suggested were suitable for inclusion in the scale. Only those items positively responded by 75 per cent judges were selected.

RESULTS AND DISCUSSION

For determination of ambiguity involved in the statement, the interquartile range (Q) for each statement was calculated. When there was a good agreement among the judges in judging the degree of favourableness or unfavourableness of a statement, Q-value was small as compared to the S-value. When there was a relatively little agreement among judges, the Q-value was higher than S-value. Only these items were selected whose median (scale) values (S-values) were greater than Q-values. On the basis of scale and Q value, 13 statements were selected for final format of the attitude scale as per Table 1.

TABLE 1
Final format of the scale to measure attitude of research scientists towards their research work.

Sr. No.	Statement	Scale value	Strongly Agree	Undecided	Diss-agree	Strongly disagree
1.	I have never regretted decision to join research work.	4.7				
2.	Research work is a waste of time.	1.2				
3.	Research work is related to my interest	6.2				

Sr. Statement No.	Scale value	Strogly agree	Agree	Undecided	Diss- agree	Strongly disagree
4. I am well adjusted with research work	5.6					
5. Research work is too hard a job to do	4.5					
6. Research work offers social status	4.8					
7. I accepted research work job because of the non-availability of any other job.	3.1					
8. Research work gives me great deal of pleasure	6.1					
9. Money spent on research work is just a wastage	1.1					
10. I am proud that I am engaged in research work	6.3					
11. Honestly speaking. I hate research work.	1.0					
12. Research work is the need of the hour.	6.6					
13. I would not mind to work even for seven days for research.	4.9					

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Infrastructural Facilities Available to TRYSEM Beneficiaries

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ABSTRACT

The study was undertaken to know the facilities provided to the TRYSEM beneficiaries at the training centres, after training and the problems faced by them. The tribal and non-tribal beneficiaries of the selected trades reported that during training, none of the instructor have used the AV aids to explain the subject matter efficiently. Further, they reported that lack of boarding facilities at the training centres wastes their time and creates economic problems for the youth. TRYSEM trainees also viewed that most of them were not provided stipend timely and fully.

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INTRODUCTION

Training is required as a major input and it will be possible through institutional infrastructure, better co-ordination and developing productive linkages between other schemes and institutions and tapping new potentialities and innovations to meet emerging demands. The outcome of the training in terms of acquired skill and knowledge in specific trade under TRYSEM programme is directly related to the learning environment provided to the participants by the training institutions or the master craft men. It is envisaged in the draft outline of the TRYSEM programme that strong and planned infrastructure for training has to be created to get the desired results in terms of gainful self employment for the trainees. In the absence of a favourable learning situation, the desired skill and knowledge could not be acquired by the trainees which in turn affect

the acceptance of the trade and getting gainful employment through particular trade. The aim of present study is to know whether the participants were satisfied with the facilities made available to them at the training institutions or with the master craftsmen. The specific objectives are as under :

- (i) To know about the training facilities provided to trainee youth at the different stages of the trainings.
- (ii) To record the problems faced by the beneficiaries during different stages of the trainings.

MATERIALS AND METHODS

The present study was conducted in Udaipur, Rajsamand, Chittorgarh, Banswada and Dungarpur districts of Udaipur division. 14 Panchayat Samities (9 tribal and 5 non-tribal)

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TABLE 1

Rank order of facilities provided during training period to the beneficiaries of the selected trades of TRYSEM.

Sr. No.	Facilities provided during training period	Name of the trades								EMR + WM + CRRD (N=318)
		EMR (N=50)		WM (N=50)		CARP (N=218)				
		Tribal (N=13)	Non-tribal (N=37)	Tribal (N=22)	Non-tribal (N=28)	Tribal (N=159)	Non-tribal (N=59)	Tribal (N=194)	Non-tribal (N=124)	
		M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	
1.	Location of the training centre	2.30 (6.5)	2.17 (4)	2.22 (7)	2.07 (4.5)	1.89 (9)	2.03 (7)	1.95 (9)	2.08 (5.5)	
2.	Space provided during training period	2.61 (2.5)	2.21 (2)	2.36 (3.5)	2.25 (10)	1.95 (8)	2.11 (5)	2.04 (8)	2.17 (3)	
3.	Method of teaching followed	2.53 (4.0)	2.18 (3)	2.31 (5)	2.03 (5)	2.12 (7)	2.30 (2)	2.65 (1)	2.20 (2)	
4.	Time provided for skill practice	2.30 (6.5)	1.89 (8)	2.36 (3.5)	2.03 (7)	2.24 (6)	2.22 (3.5)	2.26 (7)	2.08 (5.5)	
5.	Technical Competency of the Instructor	2.61 (2.5)	1.94 (5.5)	2.27 (6)	2.14 (2)	2.64 (1)	2.22 (3.5)	2.59 (2.5)	2.12 (4)	
6.	Behaviour of Instructor	2.76 (1.0)	2.24 (1)	2.50 (1.5)	2.10 (3)	2.59 (2)	2.33 (1)	2.59 (2.5)	2.25 (1)	
7.	Level of teaching (under standing level)	2.38 (5)	1.83 (9)	2.50 (1.5)	2.07 (4.5)	2.47 (3)	2.10 (6)	2.47 (4)	2.01 (7)	
8.	Tool/equipments provided to the trainees for practice	2.15 (9)	1.94 (5.5)	2.09 (8.5)	2.03 (7)	2.45 (4)	1.93 (8.5)	2.39 (5)	1.96 (8)	
9.	Time devoted by the instructor for the practical purposes	2.23 (8)	1.91 (7)	2.09 (8.5)	1.85 (9)	2.33 (5)	1.93 (8.5)	2.29 (6)	1.91 (9)	

1.	2.	3.	4.	5.	6.	7.	8.	9.
10. AV aids used during the training period	1.76 (10.5)	0.83 (10)	1.77 (10.5)	1.03 (10)	— (11)	— (11)	0.32 (10.5)	0.48 (10)
11. Skill of instructor in handling the AV aids	1.76 (10.5)	0.72 (11.5)	1.77 (10.5)	1.00 (11)	— (11)	— (11)	0.32 (10.5)	0.44 (11)
12. Boarding facility	0.53 (12)	0.72 (11.5)	0.22 (12)	0.50 (12)	— (11)	— (11)	0.06 (12)	0.33 (12)
Overall	2.16	1.72	2.41	1.76	1.72	1.59	1.83	1.67
Rank correlation coefficient	0.82		0.78		0.66		0.74	
Test of significance	4.54		3.92		2.79		3.49	

Figures in parentheses showing rank.

having maximum number of trainees and similarity in trades were selected. Three trades i.e. electric motor rewinding, wiremen and carpentry (out of 19) which were common and comparable in the selected tribal and non-tribal panchayat samities of Udaipur division were included. A total of 420 youth were trained in carpentry, wireman and electric motor rewinding trades. Out of 420 trainees, 318 trainees (194 tribal and 124 non-tribal) were selected on random basis in 114 villages of selected panchayat samities. The data were collected by personal interview technique at their farm or home.

RESULTS AND DISCUSSION

(a) Facilities provided to trainees during training period

The responses are recorded in table 1. The table reveals that tribal as well as non-tribal beneficiaries of the electric motor rewinding trade (EMR) are quite satisfied with the behaviour of the instructor during the training. They found the instructor was sympathetic and ranked him first in the given categories of above table. Further, participants of the same trade did not face any problem with regard to working space available at the training institutions. AV aids used by the instructor and provision of boarding facilities were ranked last.

Rank order correlation was also calculated to find out the correlation between ranks assigned by tribal and non-tribal beneficiaries of the electric motor rewinding trade to each statements. The calculated value of 't' was higher as compared to tabulated value. It implies that, there was difference in ranking of the statements by tribal and non-tribal participants.

Behaviour of the instructor and level of teaching (at the understanding level of trainees) aspects were given equal weightage and both were ranked at 1.5 by tribal beneficiaries of the wireman (WM) trade. We could concluded that the tribal participants with respect to these aspects were more satisfied as far the overall performance of the instructor was , concerned. Whereas, non-tribal beneficiaries of the same trade reported that sufficient space was available for the practice at the training institution and was ranked first by them. Second rank was assigned to 'Competency of the Instructor'. Beneficiaries opinion that the instructors were competent to discuss the subject matter technically perfect. Here also lower ranks were assigned to use of AV aids and their handling by both the categories of the participants.

For rank order, correlation coefficient (r) was calculated and value of 't' was also higher with that of tabulated value. So it could be inferred that both the categories of participants of wireman trade ranked the selected statements differently.

The tribal beneficiaries of the carpentry trade (CARP) had placed the highest weightage to the aspects - technical competency and behaviour of the instructor and ranked them first and second in selected aspects. It could be concluded that instructor was technically sound in teaching the subject matter at the understanding level of the trainees, besides, he was sympathetic and cooperative with the trainees too. Whereas, by non-tribal beneficiaries 'behaviour of the instructor' was ranked first and second rank was assigned to the teaching methods used by the instructor. Both the categories of trainees had assigned lower ranks to the aspects like -

skill of handling AV aids and boarding facilities provided to them.

Rank order correlation coefficient was also calculated and value of 't' was found significant. It could be inferred that the participants of both the categories ranked the selected aspects differently.

Tribal and non-tribal beneficiaries of the three trades were combined and their mean scores were calculated. It was found that method of teaching used and technical competency of instructor got the highest mean score (2.5) and were ranked first by tribal beneficiaries. It shows that tribal participants were highly satisfied with technical competency and behaviour of the instructor aspects included in the infrastructural facilities. The non-tribal beneficiaries however ranked these statements otherwise. Boarding facilities provided to trainees were

placed last in the ranking order by tribal and non-tribal beneficiaries.

Significant difference was observed in assigning ranks for the selected statements by both the categories of the beneficiaries.

(b) Post training facilities : After imparting training, follow up measures are of vital importance for the success of the programme. It is the post training facilities, which provides incentives and confidence to the participants in joining any scheme. If the trained persons under the scheme do not get follow-up support like- infrastructure, loan, credit, raw materials and marketing facilities, then, it will be difficult for youth to settle down thier own venture to earn livelihood. In this section effort was made to find out the extent of role played by institutions, master craft men, *DRDA's and banks etc. and the same has been presented in table 2.

TABLE 2

Frequency distribution of post training facilities provided to over-all tribal and non-tribal beneficiaries of the selected trades of TRYSEM.

Sr. No.	Post training facilities	Tribal		Non-tribal	
		N = 194		N = 124	
		F	%	F	%
1.	Govt. help in sanction of loan.	5	2.57	6	4.83
2.	Govt. help in purchase of machines/tools	—	—	—	—
3.	Timely supply of raw-materials by Govt. agencies at concessional rate (For carpentry)	—	—	—	—
4.	Govt. help in marketing the finished products (For Carpentry)	—	—	—	—
5.	Help in setting up of own job/trade	—	—	—	—
6.	Spot guidance provided for improvement of job	—	—	—	—

*DRDA - District Rural Development Agency.

The response of the beneficiaries about the post training phase was not much encouraging as form of facilities provided to them by concerned agencies. Data from the Table 2 indicate that only 5 tribal beneficiaries i.e. 4 of carpentary trade, one from wiereman trade (out of 194) and 6 non-tribals of carpentary trade were sanctioned loan for establishment of job. Whereas, the remaining beneficiaries after training were not cared by concerned agencies. 80 tribal and 74 non-tribal beneficiaries of the selected trades reported that they were interested to establish their own job and for that they made efforts to get financial assistance, but remained unsuccessful due to non cooperation of concerned officials of financial agencies. Thus, due to lack of finance, it was not possible for them to run their own trades independently and successfully which did not help in getting full employment.

The other aspects i.e. purchase of machines, raw materials, marketing of finished products and on the spot guidance by the experts for the carpentary trade were also not provided.

Hence, overall conclusion could be made that after training, the trainees were not fully attended by concerned agencies in establishing their jobs and for other purposes. These agencies were of the view that their job was over soon after providing training to the beneficiaries, which as per the norms of TRYSEM programme was not proper on their part. No job oriented training could be successful unless the post training phase is fully attended by the concerned authorities to provide required facilities to the trainees to establish their trade on sound footing.

(c) Problems faced by the trainee youth

An effort was also made to know the problems faced by beneficiaries at the 'training phase'

and at 'post training phase' and presented in table 3. This could help the implementing agencies to concentrate their efforts to reduce/lessen such problems.

The table shows that during training, more than half i.e. 125 tribal and more than two third i.e. 96 non-tribal youth complained that there had always been delay in payment of stipend. It was provided to them at the end of the training at some training institutions and with some master craftsmen. The trainees of village Semtal (Gogunda P.S.) and village Alsigard (Girwa P.S.) reported that they were not provided full stipend i.e. Rs. 250/- per month. The concerned master craftsmen reasoned this by saying, the amount was retained in lieu of the tool kit, but, actually it is given free of cost to the participants in the programme.

From the same table, it is also clear that master craftsmen were poor in their competency and did not pay adequate attention towards individual trainee, it was reported by 85 tribal and 60 non-tribal beneficiaries of the selected trades of TRYSEM.

51 tribal and 24 non-tribal (about one fourth trainees of both the categories) beneficiaries reported that behaviour of the unstructors was not cooperative during the training. 32 tribal and 22 non-tribals pointed out that training institutions and master craftsmen were lacking equipments/machines for providing skill practice and consequently the more time of trainees consumed.

A small number of trainees of both categories (28 tribal and 16 non-tribals) were of opinion that heterogeneous group had created problems for them during learning process.

TABLE 3

Frequency distribution of problems faced by overall tribal and non-tribal beneficiaries of the selected trades of TRYSEM.

Sr. No.	Problems faced by trainee youth	Tribal N = 194		Non-tribal N = 124	
		F	%	F	%
TRAINING PHASE					
1.	Stipend was not paid timely —	125	64.43	96	77.41
2.	Lack of proper attention by master craftsmen on individual trainees	85	43.81	60	48.38
3.	Behaviour of the instructors was not cooperative	51	26.28	24	19.35
4.	Lack of machines/equipments for skill practice and teaching	32	16.49	22	17.74
5.	Heterogenous group	28	14.43	16	12.90
Post Training Phase					
1.	Problem of job	92	47.42	70	56.45
2.	Loan was not sanctioned	80	41.23	74	59.67
3.	Lack of market for trades near by village	56	28.56	48	38.70
4.	Lack of guidance by concerned agencies of TRYSEM	46	23.71	38	30.64
5.	Tool kit was not provided to trainees	21	10.82	12	9.67
6.	Money was demanded by instructor to issue training certificate	4	2.06	12	9.67

Multiple Responses

When trainees were enquired about post training problems, 92 tribal and 70 non-tribal beneficiaries reported that there was problem of job after completion of the training. They remained unemployed, even

though they acquired skill in the particular trade. Further, 80 and 74 tribal and non-tribal beneficiaries respectively pointed out that they were not financed by the bank.

There was lack of job opportunities in the particular trade near by the village and they did not get job, it was reported by 56 and 48 tribal and non-tribal beneficiaries of the selected trades.

Guidance, which is necessary and important part of any career building, but unfortunately TRYSEM trainees were not provided by the concerned agencies after training. This had deprived them of getting full employment.

It is important to note that 21 tribal and 12 non-tribal beneficiaries of the selected trades were not provided tool kit at the end of the training. 4 tribal and 12 non-tribal participants of the selected trades (village Alsigarh and Nandashama) were displeased and complained with emphasis that master craftsmen demanded Rs. 100/- per trainee for issuing training certificate.

Conclusion : From the above discussion it could be concluded that during training, AV aids were not used by the instructor to the satisfactory level of the participants, followed

by lack of provision of barding facilities at the centres. Both the aspects almost ranked similarly by tribal and non-tribal trainees included under the study. At the post training phase, required facilities like - purchasing raw materials/machines/tools, marketing facilities and spot guidance for youth were also neglected by the concerned agencies.

TRYSEM authorities should ensure for timely payment of stipend and direct instructors to full attention towards trainees. So that, if not all but, majority of youth would learn skill perfectly. Moreover, bank authorities should have liberal attitude towards youth for financing, so that, beneficiaries could start their business independently and confidently.

Implications of the study : The results of the study will provide a strong basis for trainers of training institution to incorporate the appropriate use of AV aids with proper handling, provide boarding facilities to trainees at the centre. Besides, results also indicate that implementing agencies need to provide the required infrastructure to youth after training.

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Short Communications

Response of Maize (*Zea mays* L.) to Organic Manures and *Azotobacter* in Conjunction with Nitrogen Levels

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Maize is one of the most important food crops grown under rainfed conditions in tribal areas of Gujarat. Application of bulky organic manures make the soil rich in organic matter as well as improves the porous structure which ultimately provides conducive conditions for beneficial microbes in their functioning resulting in more availability of nutrients. But low content of nutrients and their poor rate of mineralization opened an alternative avenue for costly chemical fertilizers. However, its integration is must so as to maintain good soil health and also make it productive for longer time by harvesting residual benefits. The crop consumes huge quantity of nutrients which are generally supplied through chemical fertilizers. But its use become cost prohibitive today. Hence, it is deemed essential to increase its efficiency through management. Among several bio-agents, *Azotobacter* is known to fix atmospheric nitrogen and help increase about 10-15 per cent grain yield in maize (Reddy *et al.*, 1977). Therefore, it is a time to focus on practical and profitable flexibility of manurial

schedule in which organic manures and biofertilizers must be involved. Keeping these points in view, the field study was undertaken during *kharif* 1990 at the Agronomy Farm of Agricultural College, Gujarat Agricultural University, Anand Campus, Anand on loamy sand soil having good drainage and moderate moisture retentive capacity. The soil of the experimental site was low in total nitrogen (0.034%), medium in available phosphorus (43.5 kg/ha) and high in available potash (261.4 kg/ha) with pH 7.6. Eighteen treatments were embedded in factorial randomised block design with four replications. The details of the treatments are given in Table 1. Bio-culture *Azotobacter* was procured from the Bio-fertilizer Research Project, Gujarat Agricultural University, Anand Campus, Anand. The seeds of maize were treated with the culture having 10^7 viable cells/ml @ 5 ml/kg of maize seeds. The required quantity of well decomposed FYM (0.79% N) and gober gas manure (1.74% N) each @ 5 t/ha and one-third of the total quantity of nitrogen (urea) were applied as basal application in furrows as per treatments alongwith common dose of 30 kg P_2O_5 /ha (SSP). Remaining two-third quantity of total nitrogen was applied in two equal splits, one at knee high (30 days after sowing) and another at tasseling stage (62 days after sowing). The Gujarat Maize-1 was sown @ 20 kg seeds/ha by following 60 cm x 20 cm spacing in July

TABLE 1
Growth yield and quality of Gujarat maize-1 as influenced by different treatments.

Treatment	Plant height (cm)	Length of cob (cm)	Number of kernels / cob	Test weight (g)	Shelling (5%)	Grain yield (kg/ha)	Protein %	% barrenness / plot
Organic manures (M)								
No organic manure (M ₀)	108.3	14.7	229	174.4	73.8	1558	6.03	14.2
FYM @ 5 t/ha (M ₁)	117.3	17.1	260	195.0	77.0	1905	6.76	12.3
GGM @ 5 t/ha (M ₂)	115.6	16.9	261	199.5	76.4	1861	6.59	12.1
C. D. (P = 0.05)	2.3	0.6	8.3	2.0	2.2	59	0.16	NS
Azotobacter (E)								
No inoculation (E ₀)	113.9	16.1	246	187.3	75.7	1768	6.30	12.9
Inoculation (E ₁)	113.6	16.5	252	192.0	75.7	1781	6.61	12.8
C. D. (P = 0.05)	NS	NS	NS	1.7	NS	NS	0.13	NS
Nitrogen levels (N)								
30 kg/ha (N ₁)	105.7	12.7	212	163.0	73.7	1273	5.69	17.6
45 kg/ha (N ₂)	113.6	16.1	252	192.0	76.3	1895	6.80	11.3
60 kg/ha (N ₃)	121.9	19.9	283	214.0	77.2	2156	6.89	9.8
C. D. (P = 0.05)	2.3	0.6	8.3	2.0	2.2	59	0.16	1.4
Sig. interaction	—	M x N	M x N	M x N E x N M x E x N	—	M x N	M x E M x N E x N M x E x N	—

N.B.: FYM = Farm yard manure. GGM = Gobar gas manure.

1990 and harvested on Nov. '90. Data pertaining to growth, yield and economics are presented in Table 1 and 2.

Effect of organic manures

Different organic manures had exerted their significant influence on grain yield (Table 1). Treatment M_1 produced maximum grain yield (1905 kg/ha) but it was found to be at par with M_2 (1861 kg/ha). However, both these treatments were significantly superior over M_0 (1558 kg/ha). The magnitude of increase in grain yield under M_1 and M_2 was 22.27 and 19.44 per cent over that of M_0 . Almost similar trend was noticed in growth, yield attributes and protein per cent. Organic manures add nutrients, improve physical condition of soil and assist in better uptake of nutrients, might have induced growth and yield attributes resulting in higher yield under organic manures (Ponsica *et al.*, 1983 and Bar and Cheema, (1988). Cost

benefit analysis showed all most equal effectiveness of both these organic manures (Table 2).

Effect of azotobacter

Inoculation of seeds with *Azotobacter* did not influence the grain yield significantly. However, slight increase was observed in most of the yield attributes and yield due to seed inoculation (Table 1). Poor performance of *Azotobacter* might be due to lower growth of the organism as it is a heaviest breathing organism, requiring large amount of organic carbon for its growth which was perhaps not enough in the fixation of nitrogen released by the decomposition of organic matter inside the body of the micro-organisms. Also, this organism is a very poor competitor and therefore a slow grower in the soil which might not have fixed sufficient quantity of nitrogen to have any significant effect on yield and yield attributes (Goswami, 1976).

TABLE 2

Grain yield (kg/ha) and net realization (Rs/ha) of maize as influenced by different treatments.

Nitrogen (N) (kg/ha)	Organic manures (M)			
	M_0	M_1	M_2	Mean
N_1	940 (653)	1403 (1600)	1467 (1726)	1273 (1326)
N_2	1570 (2256)	2104 (3409)	2011 (3165)	1895 (2943)
N_3	2164 (3848)	2197 (3681)	2106 (3441)	2156 (3657)
Mean	1558 (2252)	1905 (2897)	1861 (2777)	—
Effect M x N				CD (P = 0.05) 102

Figures in parentheses indicate net realization (Rs/ha) under respective treatment.

Effect of Nitrogen

There were conspicuous differences in grain yield of maize among different levels of nitrogen. The yield was gradually increased with increase in the level of nitrogen. The treatment N_3 was topped in the list by recording significantly the highest grain yield of 2156 kg/ha followed by N_2 (1895 kg/ha) and N_1 (1273 kg/ha). The per cent increase in grain yield under N_2 was 13.77 and 69.36 over that of treatments N_0 and N_1 , respectively. The superiority of N_3 might be due to positive cumulative effect of yield attributes towards yield. Nitrogen is known to accumulate dry matter and translocate it to the reproductive parts in the plant might have resulted in significant increase in grain yield. Further, increased grain yield under higher level of nitrogen could be ascribed to the significant reduction in per cent barrenness at higher levels of nitrogen. These results are in conformity with those of Hegde *et al.* (1982). Cost benefit analysis (Table 2) showed the linear trend in net gains under increased levels of nitrogen.

Interactive effect

Interactive effect (Table 2) between organic manure and nitrogen was found to be

significant with respect to grain yield. The treatment combination M_1N_3 gave significantly higher grain yield (2197 kg/ha) than others except M_0N_3 (2164 kg/ha), M_2N_3 (2106 kg/ha) and M_1N_2 (2104 kg/ha). These results suggest that when fertilizer nitrogen is to be used for fertilizing maize, 60 kg N/ha is an optimum dose. However, under integration of nutrient management, the optimum requirement of N is 45 kg/ha + 5 t/ha of FYM or GGM. This implies that it is feasible to save 15 kg nitrogen (25 per cent of recommended dose of N) from inorganic source without much loss in quality grain yield by application of 5 t of FYM or GGM/ha. These results are akin to those reported by Nambiar and Abrol (1989).

Thus, it is concluded that maize crop fertilized either by FYM or GGM manure @ 5 t/ha coupled with 45 kg N/ha was found to be beneficial in view of fertilizer economy. By adopting this manurial schedule, it is feasible to save 15 kg N (25 per cent of the recommended dose of N) from inorganic source without much loss in quality grain yield.

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Economics of Different Sowing Dates, Plant Populations and Genotypes for Summer Grown Sunflower

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Sunflower being not as choicy for soil and climate as groundnut, is gaining prominence among the cultivators, owing to its photoperiodinsensitive nature, higher oil production per unit area and short duration. Sunflower, eventhough can be grown all the year round, it responds to the seeding time in

a particular season (Habeebullah *et al.*, 1933) and is creeping in the project areas and grown during summer under irrigated conditions. Therefore, an investigation was carried out to study the economics of growing summer sunflower genotypes at different sowing dates and plant populations.

A field experiment was carried out on black clay loam at the Agricultural College Farm, Dharwad during summer 1992. Two genotypes viz., Morden (V_1) and BSH-1 (V_2) were sown on three dates viz., January 15th (D_1), January 30th (D_2) and February 15th (D_3) at population levels of 0.83 (P_1) and 1.11 lakh plants per ha (P_2). A fertilizer dose of 62.5; 75;

TABLE 1

Economics of different sowing dates, plant populations and genotypes for summer grown sunflower.

Treatments	Gross Income (Rs/ha)	Cost of cultivation (Rs/ha)	Net Income (Rs/ha)	Benefit : Cost ratio
$D_1P_1V_1$	14,300.00	6,271.50	8,028.50	1.28
$D_1P_1V_2$	17,780.00	6,962.50	10,817.50	1.55
$D_1P_2V_1$	13,800.00	6,230.00	7,570.00	1.21
$D_1P_2V_2$	15,490.00	7,050.00	8,440.00	1.19
$D_2P_1V_1$	18,180.00	6,412.50	11,767.50	1.83
$D_2P_1V_2$	20,790.00	7,115.00	13,675.00	1.92

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1.	2.	3.	4.	5.
$D_2P_2V_1$	14.770.00	6,277.50	8,492.50	1.35
$D_2P_2V_2$	16.690.00	7,110.00	9,580.00	1.34
$D_3P_1V_1$	10.610.00	6,032.50	4,577.50	0.75
$D_3P_1V_2$	13.300.00	6,740.00	6,560.00	0.97
$D_3P_2V_1$	9,740.00	6,027.50	3,712.50	0.61
$D_3P_2V_2$	12,530.00	6,900.00	5,630.00	0.81

62.5: N; P_2O_5 ; K_2O kg per ha was applied uniformly and crop was irrigated at an interval of 13-15 days. Economics of each treatment combinations was worked out and data is presented in Table 1.

The highest net income of Rs. 13,675.00 per ha with the highest benefit : cost ratio was realised by growing hybrid BSH-1 (V_2), when sown on January 30th (D_2) at a population of 0.83 lakh plants per ha (P_1). The next best

combination was sowing of morden (V_1) on January 30th (D_2) at population of 0.83 lakh plants per ha (P_1) which gave a net income of Rs. 11,767.50 per ha with a benefit : cost ratio of 1.83. The lowest net return (Rs. 3712.50/ha with benefit : cost ratio 0.61) was recorded when Morden (V_1) was sown on February 15th (D_3) at a population of 1.11 lakh plants per ha (P_2) among all the treatment combinations.

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Effect of Nitrogen and Weed Control Under Varying Plant Population on Yield and Quality of Onion (*Allium cepa* L.) Bulb Crop

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Field experiment was conducted during *rabi* season of 1991-92 at the Instructional Farm, Gujarat Agricultural University, Navsari. Three plant population (1000×10^3 , 666×10^3 and 500×10^3 plants/ha i.e. 10 cm x 10 cm, 15 cm x 10 cm and 20 cm x 10 cm spacing, respectively), three nitrogen levels (60, 80 and 100 kg N/ha) and three weed control treatments (hand weeding at 20 + 40 DAT, pre-emergence application of oxadiazon @ 0.5 lit/ha and unweeded control) were tried in Factorial Randomized Block Design with three replications.

The soil of the experimental site was clay in texture (64.3% clay), high in total nitrogen (0.059%), medium in available phosphorus (39.90 kg P_2O_5 /ha) and fairly rich in available potash (394.0 kg K_2O /ha) having 7.67 pH. Two months aged old seedlings of onion Cv. Pusa Red were planted on 24th December '91 and the crop was harvested on 23rd April '92. Basal application

of 60 kg each of phosphorus and potash and half of 'N' as per treatment were made at the time of transplanting. Remaining half of N as per treatment was applied one month after transplanting. Herbicide application (as per treatment) was made 4 days after transplanting (DAT), using 500 lit. water per hectare. Eleven irrigations, in all, were given to the crop.

The data presented in Table 1 revealed that the different plant population treatments had significant effect on the bulb diameter, bulb weight, nitrogen content in bulb, black mould development at 90 days after harvest and bulb yield. The maximum values of bulb diameter (4.88 cm), bulb weight (49.52 g), Nitrogen content (1.13%) and black mould development (60.75%) were recorded with the 500×10^3 plant density treatment. Greater development of individual bulb in this plant density may be attributed to the better growth and development of individual plants, while in higher plant density i.e. 1000×10^3 , there might have been competition between roots of the neighbouring plants for uptake of nutrient and water, which would have restricted the growth of plants. Highest bulb yield (312.03 q/ha) was recorded with higher plant density treatment. Increase in the size of individual bulb could not make up the loss in yield under wider spacing (lower plant density i.e. 500×10^3) as compared to yield

TABLE 1

Effect of plant population, nitrogen and weed control treatments on yield and quality of onion bulb crop.

Treatment	Diameter of bulb (cm)	Weight of bulb (g)	Bulb yield (q/ha)	Nitrogen content in bulb at harvest (%)	Bulb weight losses at 90 DAH (%) (ASTV)	Black mould development at 90 DAH (%) (ASTV)
Plant population (000/ha)						
1000	4.59	42.20	312.03	0.807	16.47 (7.59)*	50.58 (59.26)
666	4.83	46.85	280.04	0.925	15.70 (6.92)	58.06 (70.37)
500	4.88	49.52	235.18	1.137	17.72 (8.70)	60.75 (72.96)
C. D. 5 %	0.12	2.45	20.27	0.002	NS	6.09
Nitrogen (kg/ha)						
60	4.78	46.13	267.18	0.955	16.58 (7.55)	54.84 (64.44)
80	4.74	45.46	271.39	0.0954	16.89 (8.25)	57.95 (70.37)
100	4.79	46.98	288.68	0.960	16.42 (7.41)	56.60 (67.78)
C. D. 5 %	NS	NS	NS	NS	NS	NS
Weed control treatments						
HW 20 + 40 DAT	4.83	48.06	294.65	0.994	18.13 (9.09)	58.00 (69.26)
Oxadiazon 0.5 lit/ha	4.82	46.67	284.25	0.961	17.61 (8.63)	55.64 (66.30)
Unweeded control	4.64	43.85	248.35	0.914	14.15 (5.50)	55.95 (67.03)
C. D. 5 %	0.12	2.45	20.27	0.022	2.30	NS
C. V. %	4.68	9.70	13.46	4.260	—	—

DAH = Days after harvest HW = Hand weeding

*Figures in parentheses refer to actual values.

ASTV = Arc since transformed value.

obtained under higher plant density. These results are supported by the finding of McGeary (1985).

Different yield attributes, quality parameters and yield were not affected significantly by different nitrogen levels. This may be due to higher amount of nitrogen content in the soil. These findings are in agreement with those of Rohal and Kalra (1986) but in contrast to that of Singh and Dhankhar (1988).

Results further indicated that weed control treatments had significant effect on the yield attributes viz., bulb diameter, bulb weight and bulb yield and quality parameter viz., nitrogen content and bulb weight losses. Hand weeding twice recorded significantly the highest bulb diameter (4.83 cm), bulb weight (48.06 g), nitrogen content in bulb (0.999%); bulb weight losses (18.13%) and bulb yield (294.65 q/ha) but not differing significantly from oxadiazon 0.5 lit/ha. Both the treatments controlled weed effectively,

reduced the competition in terms of vegetative growth and nutrient uptake from the soil by weed to a greater extent and thus helped in faster growth of onion crop, resulting in production of bigger size bulb and ultimately leading to enhanced bulb yield. These findings are in agreement with those of Mandal *et al.* (1992). Significantly higher weight losses under hand weeding (twice) and Oxadiazon treatments were due to higher available soil moisture in soil at the time of harvest in these plots than in unweeded control plot.

Different interaction effects on bulb yield was turn out to be non-significant. Thus it appears that for obtaining better yield and quality of onion bulb, the crop should be transplanted with 1000×10^3 plant density/ha, i.e. 10 cm x 10 cm spacing, with application of 60 kg N/ha, coupled with hand weeding at 20 + 40 DAT or pre-emergence application of oxadiazon 0.5 lit/ha, for soil having higher total nitrogen (0.059%) under South Gujarat condition.

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Heritability and Genetic Advance in Sunflower

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Improvement in sunflower yield depends on the nature and extent of genetic variability, heritability and genetic advance in the base population on which selection is exercised. Besides, the information on the nature of association between yield and its components helps in simultaneous selection for many

characters associated with yield improvement. In the present study, such analysis has been carried out in F_1 population of sunflower hybrids.

Forty hybrids were obtained by crossing between four male sterile lines and ten restorers of *Helianthus annuus*. Forty hybrids and parents were raised in randomised block design with three replications, and observations were recorded for nine biometrical characters. The co-efficient of variability (GCV, PCV) were calculated using the formulae given by Burton (1952).

TABLE 1

Estimation of genetic variability and heritability.

Characters	GCV	PCV	Heritability (per cent)	Genetic advance (percentage of mean)
Days to first flowering	7.47	7.54	98.28	15.27
Days to maturity	3.44	3.48	97.72	7.01
Diameter of the capitulum	12.41	12.74	94.80	3.62
Plant height	11.05	11.21	97.14	22.43
Number of leaves per plant	7.97	8.39	90.10	15.57
Thickness of the stem	16.45	16.76	96.22	33.22
100 seed weight	17.63	18.12	94.60	35.31
Yield per plant	24.35	25.13	93.83	48.57
Oil content	4.12	4.21	95.65	8.30

Heritability was worked out by following the method given by Singh and Chaudhary (1985). Genetic advance was estimated by Johnson *et al.* (1955) method.

The co-efficient of variability, heritability and genetic advance are presented in Table 1.

The extent of genetic variability in a base population is essential for subjecting the population for selection for achieving improvement in a particular trait. In the present investigation moderate genotypic and phenotypic co-efficient of variability were observed for diameter of the capitulum plant height, number of leaves per plant, thickness of the stem and 100 seed weight. As

compared to other characters high phenotypic and genotypic variability were observed yield per plant indicating the scope of selection of promising high yielding genotypes.

High heritability estimates were observed for all the characters studied. High heritability indicates the dependency of phenotypic expression which reflects the genotypes ability to transmit the genes to their off-springs. A combination of high heritability and genetic advance was noticed for plant height, thickness of the stem, 100 seed weight and yield per plant which shows that these characters are amenable for improvement by selection.

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Correlation Studies Among Weed Parameters, Yield Attributes and Nutrient Uptake in *Kharif* Groundnut

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The pod yield of groundnut is generally influenced by yield components viz., number of filled pods, pod weight and 100 kernels weight. Weed compete with plants in several ways and affect the yield components and consequently the pod yield. Information on association of growth and yield attributes and weed competition effect on pod yield in groundnut

under different weed control treatments is lacking for middle Gujarat Agro-climatic conditions. Keeping these objectives in mind, a field study was undertaken at Anand during *kharif* season 1992 on sandy loam soil to study the correlation between pod yield and its attributes and associated weeds. The soil had 7.7 pH, 0.034% total N, 44.4 kg available P_2O_5 ha^{-1} and 247 kg K_2O ha^{-1} . Sixteen different weed control treatments viz., alachlor 1.0 kg ha^{-1} PE (T_1) and its conjunction with IC at 45 DAS (T_2), fluchloralin 1.0 kg ha^{-1} PE (T_3) and its conjunction with IC at 45 DAS (T_4), pedimethalin 1.0 kg ha^{-1} PE (T_5) and its conjunction with IC at 45 DAS (T_6), Metolachlor 1.0 kg ha^{-1} PE (T_7) and its conjunction with IC at 45 DAS (T_8), oxyfluorfan 0.24 kg ha^{-1} PE (T_9) and its conjunction with IC at 45 DAS (T_{10}), fluazifop-p-butyl 0.25 kg ha^{-1} PO (T_{11}),

TABLE 1

Correlation between pod yield and yield attributes of groundnut.

Characters	Pod yield (kg ha^{-1})	Branches plant $^{-1}$	Matured pods plants $^{-1}$	100 kernels weight (g)
Pod yield (kg ha^{-1})	1.00			
Branches plant $^{-1}$	0.90*	1.00		
Matured pods plant $^{-1}$	0.89*	0.84*	1.00	
100 kernels weight (g)	0.94*	0.85*	0.86*	1.00
Plant height (cm)	-0.35	-0.42	-0.22	-0.49*

1.	2.	3.	4.	5.
Nodules plant ⁻¹	-0.76*	0.63*	0.80*	0.82*
N ₂ uptake (kg ha ⁻¹)	0.98*	0.94*	0.91*	0.93*
P ₂ O ₅ uptake (kg ha ⁻¹)	0.99*	0.91*	0.88*	0.95*
K ₂ O uptake (kg ha ⁻¹)	0.98*	0.94*	0.89*	0.93*
Dry weight of plant (g)	0.59*	0.69*	0.52*	0.61*

* Significant at 5% level of probability.

cycloxydim 0.15 kg ha⁻¹ PO (T₁₂), bentazon 1.0 kg ha⁻¹ PO (T₁₃), conventional method (2 HW + 2 IC) at 25 and 45 DAS (T₁₄), thrice hand weeding at 25, 45 and 60 DAS (T₁₅), and weedy check (T₁₆) relegated in randomized block design replicated four times. The crop was sown at 45 x 10 cm spacing by using 100

kg seeds ha⁻¹ on 13 July, 1992 and harvested on 13 November, 1992. It was fertilized with 12.5 kg N and 25 kg P₂O₅ ha⁻¹. Pre-emergence application of the herbicides was done a day after sowing the crop, while post-emergence herbicides were applied at 25 DAS using 500 litres of water.

TABLE 2

Correlation among weed parameters, pod yield and yield attributes.

Character	Pod yield (kg/ha ⁻¹)	Branches plant ⁻¹	Mature pods plant ⁻¹	100 kernels weight (g)	Shelling (%)
Total weeds at 25 DAS	-0.12	-0.36	-0.14	-0.14	-0.28
Total weeds at 45 DAS	-0.33	-0.27	-0.17	-0.34	-0.39
Total weeds at 60 DAS	-0.82*	-0.88*	-0.79*	-0.85*	-0.89*
Dry weight of total weeds at 25 DAS	-0.15	-0.38	-0.14	-0.14	-0.28
Dry weight of total weeds at 45 DAS	-0.49*	-0.44*	-0.50*	-0.63*	-0.62*
Dry weight of total weeds at 60 DAS	-0.82*	-0.86*	-0.74*	-0.85*	-0.89*
N uptake (kg ha ⁻¹) by weeds at harvest	-0.78*	-0.75*	-0.64*	-0.84*	-0.86*
P ₂ O ₅ uptake (kg ha ⁻¹) by weeds at harvest	-0.74*	-0.73*	-0.63*	-0.77*	-0.80*
K ₂ O uptake (kg ha ⁻¹) by weeds at harvest	-0.77*	-0.75*	-0.63*	-0.83*	-0.86*

* Significant at 5% level of probability.

Data presented in Table 1 revealed that number of branches plant⁻¹, filled pods plant⁻¹, 100 kernels weight, number of nodules plant⁻¹, N, P and K uptake by the crop and dry weight of plant had significant positive correlation with pod yield. However, uptake of nutrients and 100 kernels weight had strong positive correlation in production of pods. Negatively non-significant correlation was observed between plant height and pod yield indicated inverse relationship between these two parameters. Naidu et al., (1983) in their studies also observed similar results.

Results (Table 2) further showed that weed parameters viz., total weeds at 60 DAS, dry weight of total weeds at 45 and 60 DAS and nutrients uptake by weeds were negatively and significantly correlated with pod yield and most of the yield attributing characters. Among

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these, total weeds and its dry matter at 60 DAS and nutrients removal by weeds had significantly strong negative correlation with pod yield and yield attributing characters. Weed compete with crop during early growth stage i.e. upto 25 days after sowing had also negatively non-significant correlation with pod yield and yield attributes. These results showed that weed compete with groundnut upto 60 DAS due to acute crop-weed competition and heavily drained off nutrients which are most important for increasing pod yield. Rath and Sharma (1987) at Jodhpur also report similar results. These results indicate that critical period during which crop suffers the most from adverse effect of weeds was upto 60 DAS from sowing. Hence, weed growth should be effectively checked for improving N, P and K nutrition of the crop.

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Influence of Different Agro-Techniques on Germination, Growth and Yield of Summer Groundnut (*Arachis hypogaea* L.)

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In summer groundnut (*Arachis hypogaea* L.) germination is delayed due to cold winter if sown early, and if sown late, harvesting poses difficulty due to early monsoon rains. Attempt have been made to overcome these problems through use of soil ammendments, growth regulators and mulch.

A field experiment was conducted at the Instructional Farm, Gujarat Agricultural University, Navsari Campus during summer 1995 with ten treatments (Table 1) in randomized block design each replicated thrice. The soil of the experimental field was clayey in texture having organic carbon (0.41%), available P_2O_5 (29 kg ha^{-1}) K_2O (342 kg ha^{-1}) and pH 7.5. Summer groundnut Cv. Somnath was sown 45 cm apart with a seed rate of 100 kg ha^{-1} . The crop was fertilized with 25-50-0 NPK kg ha^{-1} and was irrigated as and when required. The crop was sown on 31-1-95 and harvested on 4-6-95.

Significantly the highest seed germination was recorded with gibberellin

seed treatment. Addition of FYM and gypsum slightly increased the germination however significant reduction in germination was recorded with castor cake, paddy straw mulch and rhizobium inoculation. Earlier germination of summer groundnut was noted with lime, paddy straw mulch. Gibberellin FYM and Gypsum application. Sangupta *et al.*, (1977) and Soliya *et al.* (1991) also reported similar results.

Pressmud and lime application registered almost same plant height which was significantly higher than other treatments. Paddy straw mulch significantly reduced the lowest plant height. Plant spread was maximum with FYM application and found to be at par with all other treatments except T_4 and T_8 . Control recorded the lowest plant spread.

Maximum pod yield was recorded due to FYM application but remained at par with T_9 , T_{10} , T_6 and T_5 due to increased number of pods plant⁻¹. Maximum haulm yield was recorded with gibberellin treatment but was at par with T_{10} and T_2 due to better plant spread. These findings are in agreement with the findings of Reddy (1991). The lowest pod and haulm yield was recorded with control but it did not differ from T_3 and T_7 .

TABLE 7
Effect of different treatments on growth, yield attributes, pod and haulm yield of summer groundnut.

Treatment	Germi- nation percentage	Days to germi- nation	Plant height (cm) at harvest	Plant spread (cm) at harvest	No. of branches/ plant	No. of pods/ plant	Pod yield (q/ha)	Haulm yield (q/ha)
T ₁ — Control	73.67	12.0	34.9	77.6	5.07	11.3	9.39	58.91
T ₂ — FYM @ 10 t/ha	78.00	10.0	36.7	96.6	6.20	19.3	14.72	74.61
T ₃ — Castor cake @ 500 kg/ha	60.67	12.0	32.4	93.7	6.07	12.9	10.93	67.26
T ₄ — Pressmud @ 500 kg/ha	75.00	12.0	42.6	88.5	5.80	14.5	11.64	70.88
T ₅ — Lime @ 500 kg/ha	63.67	9.0	42.5	90.5	6.07	16.9	12.79	70.03
T ₆ — Rhizobium culture inoculation	61.67	12.0	36.2	94.0	5.53	15.9	12.85	72.87
T ₇ — Pre-sowing water soaking	65.33	13.3	34.5	90.3	5.60	13.2	11.11	63.82
T ₈ — Paddy straw mulch @ 5 t/ha	61.00	9.0	27.4	85.5	5.80	13.3	12.44	70.07
T ₉ — Gibberellin 0.1 mg/l	88.67	10.0	38.3	95.6	5.83	19.1	14.52	82.66
T ₁₀ — Gypsum @ 500 kg/ha	78.00	10.0	37.7	94.8	5.23	15.4	13.10	75.55
S. Em. ±	3.42	0.11	1.05	2.30	0.35	1.27	0.71	2.84
C. D. at 5%	10.16	0.31	3.11	6.83	NS	3.77	2.00	8.47

Thus for getting higher production of summer groundnut, seed should be treated with either gibberellin (0.1 g/l) or rhizobium cul-

ture or the crop should be applied with 10 t FYM or 500 kg gypsum per hectare.

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Effect of Irrigation and Cycocel on Growth and Yield of Summer Okra (*Abelmoschus esculentus* (L.) Moench)

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Field experiment was conducted during summer season of 1993 at the College Farm, Gujarat Agricultural University, Navsari to study the effect of irrigation and cycocel on growth and yield of summer okra. The treatment consisted of four IW/CPE ratios viz., 0.5 (I_1), 0.7 (I_2), 0.9 (I_3) and 1.1 (I_4) each of 60 mm depth and three cycocel levels and water spray control (C_1), 250 ppm (C_2), 500 ppm (C_3) and 750 ppm cycocel (C_4). The experiment was laid out in Factorial Randomized Block Design with sixteen treatment combinations replicated three times. The experimental soil was clayey in texture with 7.9 pH. The field capacity, permanent wilting point and bulk density of the top 30 cm soil depth was 32.50, 18.0 per cent and 1.44 g/cm³, respectively. Total number of irrigations including two common irrigations (80 + 60 mm) applied as per treatment during crop season was 6, 8, 10 and 12 for IW/CPE ratio of 0.5, 0.7, 0.9 and 1.1 respectively. Okra variety 'Parbhani Kranti' was sown on 5th February, 1993 at the spacing of 45 x 15 cm. Single

spray of cycocel and water was given to the crop on 7-3-93. Total 14 pickings were taken up from 1-4-93 to 17-5-93.

Data presented in Table -1 indicated that irrigation treatments had a significant effect on growth and yield of okra. The highest plant height, number of branches per plant, number of leaves per plant, number of fruits per plant and fruit yield were recorded with IW/CPE ratio of 1.1, but statistically it was at par with treatment IW/CPE ratio of 0.9 except number of leaves per plant. The significant variation in plant height, number of branches per plant and number of leaves per plant could be attributed to cell division, their elongation and turgidity owing to variation in soil moisture supply under different IW/CPE ratios. The higher yield obtained under IW/CPE ratio of 1.1 and 0.9 was mainly due to significant improvement in growth and yield attributes, as the crop did not face any moisture stress during different growth and development stages under these treatments. These findings are in agreement with those of Pandey and Singh (1979).

The marked retarding effect of cycocel treatments was observed on plant height. The highest plant height was recorded with water spray (control), while significantly the lowest plant height was recorded with 750 ppm

TABLE 1

Growth and yield of summer okra as influenced by irrigation and cycocel.

		Plant height (cm)	Number of branches per plant	Number of leaves per plant	Number of fruits per plant	Green fruits yield (q/ha)
Irrigation						
IW/CPE ratio	0.5	63.55	1.92	16.65	8.10	60.75
IW/CPE ratio	0.7	75.40	2.13	20.63	9.89	79.44
IW/CPE ratio	0.9	102.00	2.53	26.30	11.46	100.32
IW/CPE ratio	1.1	104.50	2.62	27.90	11.75	106.65
S.Em.±		1.02	0.06	0.54	0.15	3.04
C. D. 5 %		2.96	0.17	1.56	0.43	8.76
Cycocel						
Water spray (control)		89.60	2.08	21.45	9.62	74.63
250 ppm		88.48	2.18	22.15	10.02	81.92
500 ppm		85.40	2.35	23.30	10.51	90.80
750 ppm		81.98	2.58	24.58	11.06	99.81
S. Em. ±		1.02	0.06	0.54	0.15	3.04
C. D. 5 %		2.96	0.17	1.56	0.43	8.76

cycocel treatment. Application of 750 ppm cycocel i.e. highest concentration recorded the highest number of branches, number of leaves and number of fruits per plant. Similarly, the highest green fruit yield was also obtained with

application of 750 ppm cycocel and the lowest green fruit yield was recorded with water spray (control). The reduction in plant height was mainly due to shorter internodes caused by reducing cell division, cell expansion and elongation.

tion of subapical meristems. Cycocel treatments were effective in suppressing the apical dominance, thereby promoting growth of axillary buds into new shoots. Cycocel has pronounced effects on formation of more number of nodes and branches which are main sites for formation of flowers and fruits and

thereby ultimately increased total green fruits yield. These results are supported by Tosh *et al.* (1978), Gowda and Gowda (1983) and Patel (1989). The interaction effect of irrigation and cycocel on fruit yield was found to be non-significant.

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Effect of Temperature on Population Buildup of Mustard Sawfly (*Athalia lugens proxima*) and Mustard Aphid (*Lipaphis erysimi kalt*)

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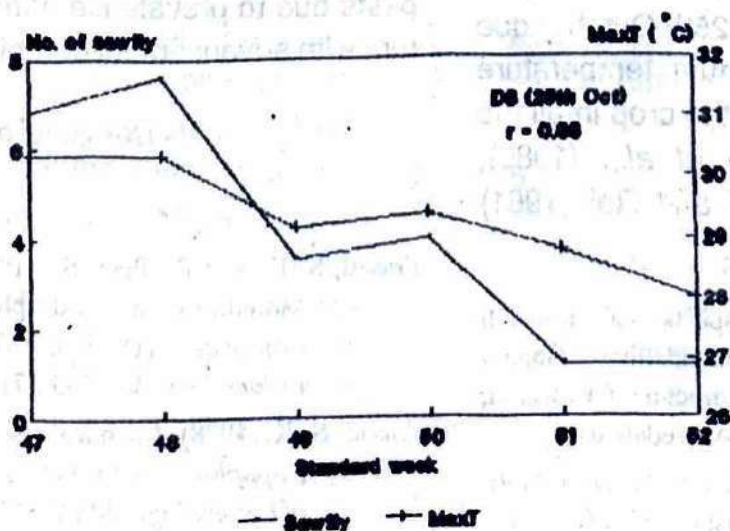
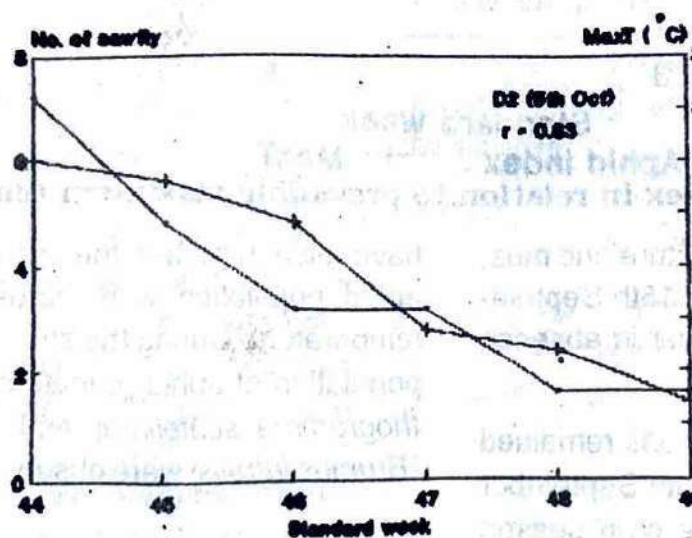
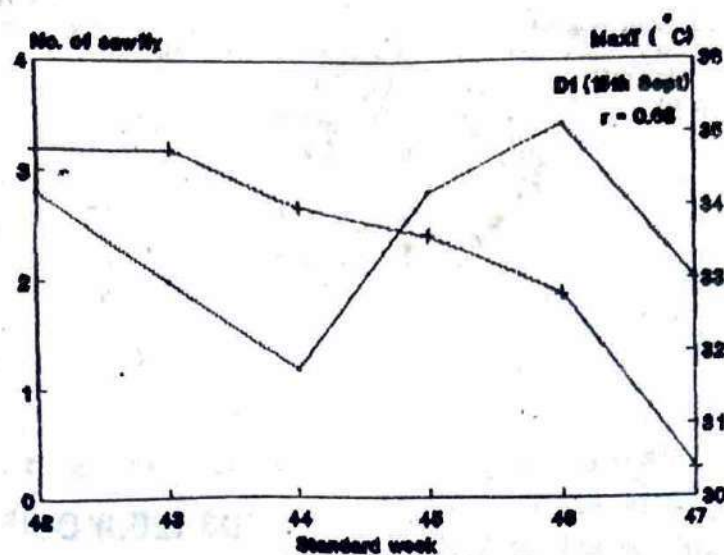
India occupies first position in the world with regard to production and acreage in respect of mustard (*Brassica juncea*) and rapeseed (*Brassica napus*). One of the most serious constraints for production of mustard is the non-availability of pest resistant varieties. Out of 24 types of insect pests that attack these crops, mustard aphid (*Lipaphis erysimi kalt*) and mustard sawfly (*Athalia lugens proxima*) are the major ones. Generally the mustard sawfly appears in the early stage of the crop during October-November, whereas the aphid is found during the flowering stage and causes major damage during December-February. The average loss in seed yield due to mustard aphid was estimated to be 74.3 per cent (Anonymous 1993). Under such a situation, timely plant protection measures the only way to save the crop from the pests in relation to prevailing weather conditions, as weather plays an important role in controlling and rapid multiplication of these pests.

Therefore studies were undertaken to know the effect of different weather parameters on the incidence and development of mustard sawfly and mustard aphid populations.

Field experiments on mustard cv. Varuna were conducted in randomized block design at the College Farm of the Gujarat Agricultural University, Anand Campus, Anand with three dates of sowing viz. 15th September (D1), 5th October (D2) and 25th October (D3) during *rabi* seasons of 1988-89, 1990-91 and 1992-93. The plot size was 5.0 x 3.6 meter. The row to row distance of 30 cm was maintained. Number of sawfly larvae were recorded at 0830 hours by observing randomly selected 5 spots each of 900 sq. cm area after three weeks of sowing at weekly interval. The mustard aphid index was also recorded at weekly interval using 0 to 5 indexing as described by Prasad (1978) on randomly selected 10 plants from each plot after 11th week of sowing at 0830 hours. The meteorological data were recorded from the meteorological observatory throughout the crop growing season.

The mustard sawfly population in the crop sown on 25th October decreased as the crop season advanced due to reduction in maximum temperature during the years 1988-89, 1990-91 and 1992-93 (Fig. 1). Slight variations in the individual cases for different dates of sowing were observed due to sudden changes in the prevailing relative humidity. There was a posi-

Fig. 1 : Mustard sawfly population in relation to prevailing maximum temperature.



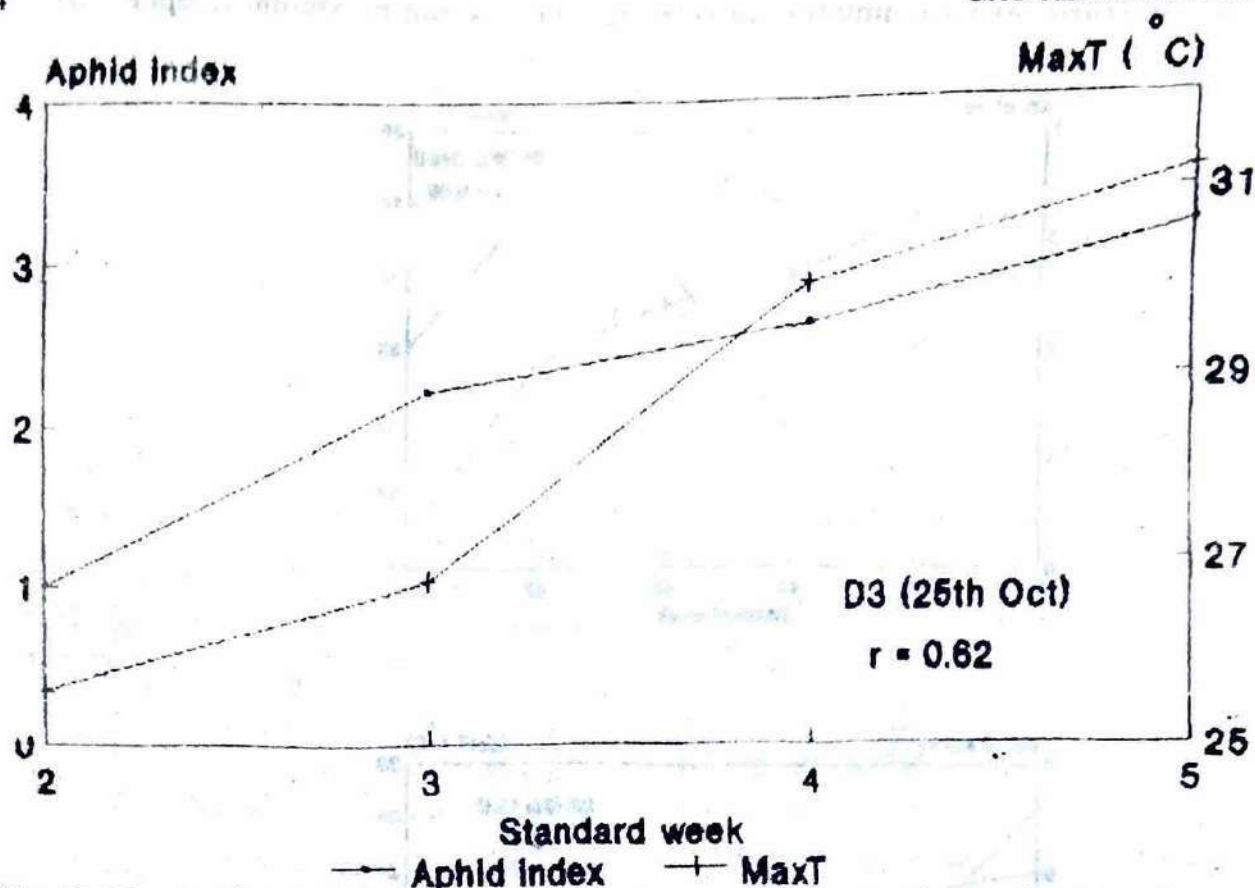


Fig. 2: Mustard aphid index in relation to prevailing maximum temperature

tive association between temperature and mustard sawfly for the crop sown on 15th September, 5th October and 25th October in absence of the *bioagent* of mustard sawfly.

The mustard aphid populations remained negligible in the crop sown on 15th September and 5th October throughout the crop season during all the years due to fall in maximum temperature. The mustard aphid population increased rapidly with the advancement of the crop season in crop sown on 25th October due to continuous rise in maximum temperature during the flowering stage of the crop in all the three years (Fig. 2). Sinha *et al.*, (1989), Prasad and Pradhan (1971) and Rai (1961)

have also reported the increase in mustard aphid population with increase in maximum temperature. During the study period negligible population of aphid predators, syrphidfly (*Xanthogramma scutellare*) and Lady bird beetle (*Brumus lustralis*) were observed.

The results of the present study indicate that the crop sown on 15th September and 5th October escaped from the severity of mustard pests due to prevalence of moderate temperature with advancement of winter season.

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Nitrogen Management for Rainfed Sorghum

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Sorghum is an important crop in dryland agriculture. Nitrogenous fertilizers play most important role in crop production per unit area and economical remuneration in cereals. The application of 90 kg N ha^{-1} in two splits was recommended for sorghum to get optimum yield and maximum net profit in North Saurashtra Agroclimatic Zone (Anon, 1981). The rainfall in this area is erratic in nature and uneven in distribution and hence, sometimes, moisture is inadequate for utilization of fertilizer. Under such situation, the recommended dose need to be split more as per moisture availability in the soil. A split application of nitrogen, if feasible, would also reduce the risk by way of investment for the fertilizer under dryland condition. Therefore, the field experiment was conducted in randomized block design with three replications for six successive years from 1989-90 to 1994-95 at Main Dry Farming Research Station, Targhadia to find out optimum proportion, time and method of application of nitrogenous fertilizer to *kharif* sorghum. The soils of the experimental field was deep, well drained, clayey in texture, non saline

(EC 0.23 to 0.49) and alkaline in nature (pH 7.80 to 8.20), low to medium in organic carbon (0.32 to 0.50%), low in available phosphorus (15.0 to $23.3 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$) and medium to high in available potash (225 to $450 \text{ kg K}_2\text{O ha}^{-1}$).

The recommended dose of nitrogen (90 kg ha^{-1}) through urea was arranged in following treatments :

Viz.,

- T₁ — 100% at sowing.
- T₂ — 75% at sowing time + 25% at tillering (25 – 30 days after sowing).
- T₃ — 50% at sowing time + 50% at tillering (25-30 days after sowing).
- T₄ — 50% at sowing time + 25% at tillering (25-30 days after sowing + 25% at leaf/penical emergence stage.
- T₅ — 25% at sowing time + 75% at tillering (25-30 days after sowing).
- T₆ — 25% at sowing time + 50% at tillering (25-30 days after sowing) + 25% at flag leaf/penical emergence stage.
- T₇ — 50% at sowing time + 25% at tillering (25-30 days after sowing) + 25% at flag leaf/penical emergence (through spray).
- T₈ — 25% at sowing time + 50% at tillering (25-30 days after sowing) + 25% at flag leaf/penical emergence (through spray).

A basal dose of phosphorus @ 30 kg ha^{-1} was applied through single superphosphate. The data (Table 1) indicated that the application of nitrogen at different stages of crop growth in

TABLE 1

Effect of split application of nitrogen on yield (q/ha^{-1}) and economics of rainfed sorghum.

Sr. Treat- No. ment	1989-90		1990-91		1991-92		1992-93		1993-94		1994-95		Pooled		Gross return Rs/ha ⁻¹
	Grain	Fodder	Grain	Fodder	Grain	Fodder	Grain	Fodder	Grain	Fodder	Grain	Fodder	Grain	Fodder	
1 T ₁	10.05	127.09	07.05	60.84	3.74	097.88	—	15.83	1.05	35.27	0.95	40.56	4.57	62.91	14867
2 T ₂	11.96	141.75	07.71	61.74	3.49	097.60	—	21.16	0.90	39.68	0.92	45.85	5.00	67.86	16072
3 T ₃	09.94	125.66	06.43	67.88	3.10	093.47	—	22.93	0.90	33.16	1.34	45.85	4.34	64.82	15134
4 T ₄	09.26	136.77	09.17	58.20	2.26	093.47	—	31.75	0.92	39.93	0.88	48.50	4.50	68.10	15870
5 T ₅	07.35	143.33	07.67	68.36	2.40	094.75	—	22.05	1.41	39.51	1.60	52.91	4.09	70.15	16075
6 T ₆	08.15	128.81	11.20	80.79	2.54	099.65	—	22.05	1.50	40.92	0.81	49.38	4.84	70.27	16475
7 T ₇	07.40	110.00	03.17	49.37	2.73	103.17	—	15.87	1.06	35.09	1.00	45.85	3.07	59.89	13513
8 T ₈	11.43	113.49	04.99	64.49	2.62	091.71	—	19.84	0.81	33.86	1.59	02.91	4.28	62.72	14684
S. Em. +	1.37	17.23	2.51	6.86	0.42	4.08	—	4.70	0.15	3.58	0.34	6.02	0.59	3.92	—
C. D. 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	—	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	—
C. V. %	22.30	23.30	60.70	18.60	25.55	7.34	—	37.96	25.28	16.72	55.40	21.87	52.00	21.00	—

Note : Selling price of sorghum grain and fodder are computed @ Rs. 500 and 200 per quintal, respectively.

various quantity showed non-significant differences in grain and fodder yields of sorghum during all the years of experimentation and also in pooled. Similar finding was also reported by Jadhav *et al.*, (1991). However, maximum gross return of Rs. 16475 ha⁻¹ was obtained when recommended dose of N (90 kg ha⁻¹) was splitted as 25% at sowing time + 50% at tillering

to utilize applied quantity of nitrogen during these period. While low quantity as basal application is sufficient as starter dose, which also check the need of more water if dry spell may be occur on later stage growth of the crop. So that, it is advisable that application of nitrogen to *kharif* sorghum can be adjusted either as 25% at sowing + 50% at tillering stage + 25% at

TABLE 2
Rainfall (mm) and its distribution during the crop season.

Month	1989	1990	1991	1992	1993	1994
May	—	62.0 (2)	—	—	—	—
June	82.3 (4)	48.6 (1)	25.2 (1)	28.4 (2)	46.6 (3)	97.5 (8)
July	—	59.4 (3)	240.2 (9)	361.8 (13)	160.0 (7)	456.1 (17)
August	344.1 (3)	28.8 (8)	71.2 (9)	63.2 (7)	—	99.7 (9)
September	48.1 (5)	103.0 (9)	11.9 (1)	88.7 (4)	134.9 (5)	228.7 (9)
October	140.8 (8)	28.5 (2)	—	22.4 (1)	19.3 (3)	—
Total	615.3 (30)	528.3 (25)	348.5 (20)	564.5 (27)	400.8 (18)	882.0 (43)

Figures in parentheses indicate number of rainy days.

stage + 25% at flag leaf/penical emergence. On these basis, present recommended dose of N @ 90 kg ha⁻¹ in 3 splits is confirmed for the zone. However, the rain fall during last week of July and first week of August is much higher as compared to earlier or later period of monsoon (Table 2) and hence, profile moisture would be available

flag leaf/penical emergence stage or 25% at sowing + 75% at tillering stage on availability of fertilizer, financial position of farmers and soil moisture condition which reduce risk by way of investment on the nitrogenous fertilizer under dryland condition.

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Effect of N, P and Biofertilizers on Yield Quality and Nutrients Uptake in Wheat

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A field experiment was carried out at Agronomy Farm, Gujarat Agricultural University, Junagadh during the *rabi* season of 1991-92. The soil was clayey in texture, low in available N (229 kg/ha), low in available P (20 kg/ha) and medium in available K (208 kg/ha) and slightly alkaline in reaction (7.8 pH) with normal E.C. (0.39 dS/m). The treatments comprising three levels each of nitrogen (60, 90 and 120 kg/ha), phosphorus (30, 45 and 60 kg P_2O_5 /ha) and biofertilizer (uninoculated, *Azotobacter chroococcum* and *Pseudomonas striata* inoculation). The experiment was laid out in randomised block design with four replications. Half dose of N and full dose of P as per treatments were applied in form of urea and single super phosphate, respectively at the time of sowing and remaining half dose of N was top-dressed in form of urea at 25 days after sowing. The crop was sown on November 26, 1991 with inter-row spacing of 22.5 cm apart using wheat cv. GW-496 and harvested on March 11, 1992.

The uptake of N and P by wheat crop was significantly increased with successive increase in the levels of nitrogen from 60 to 120 kg/ha, whereas the uptake of K increased significantly only upto 90 kg N/ha. The results are in accordance with that of Maurya and Verma (1991). Appreciable increase in protein content in grain was noticed with increase in subsequent levels of nitrogen. Nitrogen is an important constituent of protein, which markedly influence protein synthesis. The results are in conformity with the study conducted by Singh *et al.*, (1992). Crop fertilized with 90 and 120 kg N/ha did not differ materially in respect of grain and straw yields of wheat but found significantly superior to 60 kg N/ha. The findings are in agreement with those of Singh *et al.*, (1992). Maximum net realization of Rs 10540/ha was recorded under 120 kg N/ha closely followed by 90 kg N/ha.

Crop fertilized with higher doses of P_2O_5 (45 and 60 kg/ha) significantly increased N, P and K uptake by wheat crop. This might be due to higher amount of phosphorus application resulted in mobilization of native phosphorus to the extent that plant utilized more phosphorus from the native source. Application of phosphorus @ 60 kg/ha increased protein content of grain as compared to that of 30 and 45 kg P_2O_5 /ha. More protein synthesis in presence of P and

Effect of different treatments on yield, quality, nutrient uptake and net realization of wheat.

Treatments	Yield (q/ha)		Nutrient uptake (kg/ha)			Protein content (%)	Net realization (Rs/ha)
	Grain	Straw	N	P ₂ O ₅	K ₂ O		
Nitrogen (kg/ha)							
60	33.43	40.41	89.73	9.44	71.63	13.44	8847
90	37.12	44.59	103.02	10.61	80.96	13.87	10207
120	<u>38.38</u>	<u>46.59</u>	<u>116.49</u>	<u>11.41</u>	<u>85.39</u>	<u>14.63</u>	<u>10540</u>
C. D. at 5%	2.47	3.23	7.16	0.78	6.05	0.20	—
Phosphorus (kg/ha)							
30	33.99	39.96	91.27	9.34	72.30	13.55	9203
45	36.90	44.81	104.61	10.95	80.57	14.00	10338
60	<u>38.03</u>	<u>46.75</u>	<u>113.35</u>	<u>11.17</u>	<u>85.12</u>	<u>14.39</u>	<u>10690</u>
C. D. at 5%	2.47	3.23	7.16	0.78	6.05	0.20	—
Biofertilizers							
Uninoculated	34.34	41.16	92.75	9.24	73.54	13.69	9671
<i>A. chroococcum</i>	37.59	45.59	111.69	10.78	82.14	14.33	10950
<i>P. striata</i>	36.99	44.78	104.78	11.44	82.32	13.92	10690
C. D. at 5%	2.47	3.23	7.16	0.78	6.05	0.20	—

formation of some stable phospho-protein compounds is responsible for higher protein content with P application. Grain and straw yields recorded with application of 45 and 60 kg P_2O_5 /ha were found statistically at par but significantly superior over 30 kg P_2O_5 /ha. The findings corroborate the reports of Shrinivas and Singh (1991). Application of 60 kg P_2O_5 /ha recorded maximum net realization of Rs. 10690/ha closely followed by 45 kg P_2O_5 /ha (Rs 10338/ha).

Seeds inoculated with *A. chroococcum* exhibited their superiority in the uptake of N

and protein content in seeds over *P. striata* and uninoculated treatment but in case of P and K uptake, inoculation with *P. striata* was proved superior over *A. chroococcum* and uninoculation. Inoculation of wheat seed with bio-fertilizers substantially increased grain and straw yields of wheat. This lends support to the findings of Gaur (1990). Seed inoculated with *A. chroococcum* recorded the maximum net realization of Rs 10950/ha closely followed by *P. striata* (Rs 10690/ha).

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Effect of Irrigation, N and P on Safflower Yield Quality, Uptake of Nutrients and Economics

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A field experiment was conducted at Agronomy Farm, Gujarat Agricultural University, Junagadh during *rabi* season of 1992-93 on clayey soil having low total N (0.07%, medium available P 34 kg/ha) and high available K (303 kg/ha) and slightly alkaline in reaction (7.9 pH) with normal E.C. (0.30 dS/m). The treatments comprising three levels each of irrigation (0.4, 0.6 and 0.8 IW/CPE ratio), nitrogen (0, 25 and 50 kg N/ha) and phosphorus (0, 10 and 20 kg P_2O_5 /ha) were tried in split plot design having irrigation levels in main plots and combinations of N and P levels in sub-plots and replicated thrice. Half dose of N and full dose of P were applied in form of urea and SSP, respectively at the time of sowing and remaining half dose of N was top-dressed in form of urea at 40 days after sowing. The safflower variety "Tara" was sown on October 17, 1992 with inter row spacing of 45 cm and harvested on February 9, 1993.

Irrigation at IW/CPE ratio of 0.8 recorded significantly higher seed and stover yields than 0.4 IW/CPE. However, irrigation at IW/CPE of 0.6 was on par with IW/CPE of 0.8. Each increase in frequency of irrigation significantly improved the contents of oil and protein. Uptake of N and P by seed and stover were statistically similar under irrigation at 0.8 and 0.6 IW/CPE ratios but significantly higher over that at 0.4 IW/CPE ratio. The results confirm the findings of Singh and Singh (1980). The maximum net realization of Rs 4679/ha was secured with the application of irrigation at 0.8 IW/CPE.

Fertilizing the crop with 50 kg N/ha recorded the highest seed yield mainly on account of higher N and P uptake. Stover yield followed the similar trend except that 25 and 50 kg N/ha were on par. Similar results were also reported by Bhanvadia (1993). The oil content decreased with each increase in N level. The finding is in accordance with that of Singh *et al.*, (1992). Protein content recorded at 50 and 25 kg N/ha were materially the same but higher over control. Application of 50 kg N/ha recorded the highest net return of Rs 4626/ha.

Application of 20 kg P_2O_5 /ha recorded the highest seed and stover yields on account

TABLE 1

Effect of different treatments on yield, quality, nutrient uptake and net realization of safflower.

Treatments	Yield (q/ha)		Oil content (%)	Protein content (%)	N uptake (kg/ha)		P uptake (kg/ha)		Net realization (Rs/ha)
	Seed	Stover			Seed	Stover	Seed	Stover	
Irrigation (IW/CPE)									
0.4	12.61	37.82	31.42	12.85	25.97	23.29	3.91	2.60	3793
0.6	14.05	44.50	31.95	13.17	29.39	27.88	4.46	3.06	3393
0.8	14.80	48.12	32.69	13.48	31.98	31.37	4.90	3.29	4679
C. D. at 5%	1.35	5.53	0.55	0.22	3.24	3.55	0.53	0.43	—
Nitrogen (kg/ha)									
0	12.99	39.38	32.47	12.93	26.92	23.90	4.04	2.64	4016
25	13.81	44.07	32.11	13.26	29.26	27.93	4.42	2.99	4318
50	14.66	46.99	31.48	13.31	31.16	30.71	4.81	3.32	4626
C. D. at 5%	0.65	3.39	0.30	0.13	1.38	2.27	0.24	0.23	—
Phosphorus (kg/ha)									
0	12.96	39.66	31.88	12.94	26.88	24.54	4.11	2.59	4014
10	13.83	43.54	32.02	13.25	29.18	27.00	4.38	3.00	4325
20	14.67	47.24	32.16	13.31	31.28	31.00	4.78	3.36	4621
C. D. at 5%	0.65	3.39	N.S.	0.13	1.38	2.27	0.24	0.23	—

of highest N and P uptake. However, application of P did not exert any significant effect on oil content of seed. Similar findings were earlier reported by Bhanvadia (1993). Protein content recorded at 20 and 10 kg P_2O_5 /ha were statistically similar but

significantly higher over control. Similar observations were also made by Ahmed *et al.*, (1985). Application of 20 kg P_2O_5 /ha also gave maximum net profit of Rs 4621/ha.

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Yield, Quality and Economics of Safflower (*Carthamus tinctorias*) as Influenced by Different Sowing Dates

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A field experiment was conducted at Agronomy Farm, Gujarat Agricultural University, Junagadh during *rabi* season of 1992-93. The soil was clayey in texture, medium in total nitrogen (0.07%), medium in available phosphorus (34 kg/ha) and high in available potassium (302 kg/ha) and slightly alkaline in reaction (7.9 pH) with normal E.C. (0.30 dS/m). The treatment comprising four dates of sowing (10, 20 and 30 October and 9 November) in main plots and five varieties (Bhima, Tara, Manjira, A-1 and NRS-209) in sub-plots were replicated four times in split plot design. Half dose of N and full dose of P were applied in form of urea and single super phosphate, respectively at the time of sowing and remaining half dose of N was top-dressed in form of urea at 40 days after sowing. The crop was sown at 45 cm row spacing.

Sowing of safflower on 10 October out yielded the rest of the dates of sowing by recording significantly the highest seed and stover yields. This appeared to be probably due to convenient temperature for longer time favourable for germination as well as vegetative and reproductive growth of plants as sowing of crop on 10th October significantly improved yield attributes viz., heads/plant, seeds/head and test weight. The results are in close confirmity with those of Ghule *et al.*, (1987). Dates of sowing failed to exert any significant influence on harvest index. Protein content of seed was not affected significantly due to varying dates of sowing, whereas maximum oil content (30.39%) and oil yield (5.65 q/ha) were recorded under 10 October sowing. Early sowing might have improved root development and ultimately better nutritional environment within plant resulted in increase oil content. These findings are in concurrence with those of Alessi *et al.*, (1981). Crop sown on 10th October recorded the maximum net realization of Rs 6939/ha.

Significantly the highest seed and stover yields were recorded by variety Bhima. Yield attributes viz., heads/plant, seeds/head and test weight were significantly the highest in variety Bhima. The higher genetic yield

TABLE 7
Effect of different treatments on yield, yield attributes, quality and economics of safflower.

Treatments	Yield (q/ha)		Heads/ plant	Seeds/ head	100- seed weight (g)	Harvest index (%)	Protein content (%)	Oil content (%)	Oil yield (q/ha)	Net realization (Rs/ha)
	Seed	Stover								
Date of sowing										
10th October	18.40	52.82	18.94	20.90	3.93	25.80	20.01	30.39	5.65	6939
20th October	16.32	47.19	18.64	19.17	3.80	25.67	19.76	30.29	5.02	5767
30th October	13.38	38.59	15.38	16.73	3.66	25.72	19.99	29.82	4.02	4107
9th November	7.99	23.03	13.68	15.55	3.48	25.73	20.32	29.49	2.35	1064
C. D. at 5%	1.24	3.30	1.79	0.96	0.13	N.S.	N.S.	0.34	0.42	—
Variety										
Bhima	17.71	51.29	18.32	21.40	4.62	25.63	18.84	31.42	5.56	6552
Tara	13.21	38.04	16.62	17.26	3.34	25.74	10.72	30.51	4.06	4011
Manjira	12.07	34.76	16.61	17.17	3.11	25.75	20.21	29.66	3.60	3367
A-1	12.50	35.95	16.04	16.33	3.54	25.76	20.36	29.57	3.84	3610
NRS-209	14.61	41.99	15.99	18.25	3.98	25.79	20.98	28.84	4.25	4800
C. D. at 5%	0.68	2.00	1.63	0.73	0.09	N.S.	0.38	0.27	0.23	—

potentiality and greater adaptability of variety Bhima may be responsible for higher yields. However, none of variety exert any significant influence on harvest index. Remarkably higher protein content was recorded in variety NRS-209, whereas variety

Bhima recorded considerably higher oil content and oil yield. Maximum net realization of Rs 6552/ha was secured by variety Bhima.

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Natural Enemies of Cotton Bollworms in Saurashtra Region of Gujarat

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The bollworms, *Earias vittella* F. and *Helicoverpa armigera* Hub. cause losses of cotton production and quality too in cotton growing areas of Gujarat State. Bioagents and their potentiality of bollworms have been studied in middle Gujarat (Yadav *et al.*, 1982), but preliminary information on natural enemies of cotton bollworms from Saurashtra region of the State being scanty has prompted to conduct the present investigation.

Periodical collections of bolls infested with larvae and pupae of *E. vittella* and *H. armigera* were made from cotton fields grown at University Centres, Junagadh during 1993-94 and Targhadia during 1991-94. They were reared in laboratory till their complete development. *E. vittella* larvae were reared individually in glass tube (3 x 20 cm) containing okra fruits as their food and *H. armigera* larvae on cotton bolls or tomato. Number of parasitoid adults emerged out from each collection was recorded according to bioagent type and preserved. Subsequently they were identified from International

Institute of Entomology, London. Percentage parasitism was calculated on the basis of total healthy and parasitized host larvae.

Result showed that both the bollworms were found to be parasitized by the hymenopterous and dipterous larval parasitoids. A chalcidid, *Brachycoriphos nersi* Gahan was only recorded as a pupal parasitoid of *E. vittella*.

A. Parasitism of *E. vittella*

Three braconids, *Rogas aligarhensis* Quadri, *Apanteles* sp. and *Agathis fabise* (Nixon) and a tachnid, *Peribaeda* sp. were found parasitizing *E. vittella* larvae. Amongst, *R. aligarhensis* and *Peribaeda* sp. were important, causing 6.7 to 36.2 per cent with an average of 24.9 per cent parasitism in the season (Table 1). Parasitism by *Peribaeda* sp. was 15.1 per cent with the maximum (20.0-23.3%) during October-November while *R. aligarhensis* was active during November to February (11.1 to 13.5%). Thus *Peribaeda* sp. preponderated to *R. aligarhensis* throughout the season. Under North Saurashtra condition, both were active, causing 12.6 to 40.1 per cent parasitism during September to November.

b. Parasitism of *H. armigera*

H. armigera was found to be regulated by a parasitoid complex and predators, *Chrysoperla carnea* (Stephens) and *Mallada*

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TABLE 2
Parasitism of cotton bollworms by different larval parasitoids.

Month	Parasitism (%) / host					
	<i>E. vittella</i>			<i>H. armigera</i>		
	No. of larvae observed	<i>R.aligar-hensis</i>	Peribaea	Total	No. of larvae observed	C. chlorideae E. illota Total
August 1993	40	00.00	14.3	14.3	50	4.4 10.0 14.4
September 1993	48	00.5	18.0	18.5	130	8.80 9.9 18.7
October 1993	45	2.8	20.0	22.8	140	10.1 16.2 26.3
November 1993	84	12.9	23.3	36.2	146	12.3 18.2 30.5
December 1993	96	11.1	18.8	29.9	138	14.3 22.9 37.2
January 1994	128	13.5	13.3	26.8	170	16.4 20.0 36.4
February 1994	48	11.5	8.5	20.0	80	8.5 14.2 22.7
March 1994	30	2.4	4.3	6.7	38	4.2 3.4 7.6
Mean	—	6.8	15.1	24.9	—	9.9 14.3 24.2

boninensis (Okamoto) (both chrysopids), an insectivorous bird, Babbler and a microbioagent, nuclear polyhedrosis virus (NPV). A parasitoid complex consisted of six tachnids, *Carcella* (*Senometapia*) *illota* curron, *Eucarcellia illota* Curron, *Drino imberbis* Weidemen, *Exorista xanthospis* Muesebeck, *Strobilimia angateli* Villenneue and *Eriborus* sp., three braconids, *Microchelonus heliope* Gupta, *Apanteles angaleti* Muesebeck and *Bracon greeni* Ashm, and an ichneumonid, *Compoletis chlorideae* Uchida.

Of them, *E. illota* and *C. chlorideae* were important and percentage parasitism ranged from 3.4 to 22.9 and 4.2 to 16.4 averaging 14.3

and 9.9, respectively (Table 1). Thus *E. illota* proved dominant to *C. chlorideae*. The cold months, December and January favoured high activity of both the parasitoid (36.4 — 37.2%), while humid months i.e. August and September (14.4 — 18.7%) and hot months i.e. February and March (7.6 — 22.7%) suppressed their development.

The study concluded that the larval parasitoids of *E. vittella* and *H. armigera* in cotton field should be protected and encouraged by providing congenial environment during October-February.

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Infestation of *Liriomyza trifolii* (Burgess) in Relation to Varying Agronomic Practices on/in Summer Castor

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The serpentine leaf-miner, *Liriomyza trifolii* (Burgess) (Agromyzidae : Diptera) introduced recently in India causes damage to more than 250 host plants (Viraktamath *et al.*, 1993). Monsoon-castor induces heavy population and speedy development of this pest (Kapadia and Parmar 1993). It remains active throughout the year (Kapadia,

1994), and seems to be damaging also to the winter and summer sown castors under Junagadh conditions of Gujarat.

For search the feasibility of summer castor, a split plot designed experiment consisting three dates of sowing (15th and 30th January, and 15th February), two spacings (60 x 90 cm, 60 x 60 cm) and three varieties, was laid out in the University Campus, Junagadh during summer 1995. The experiment was observed to be heavily infested with leaf-miner and observations were, therefore, taken during May to know pest density in relation to sowing date, spacing and variety. Five randomly selected plants in each plot were observed to record larval mines density (=number of larvae) as

TABLE 1
Effect of different interactions (Sowing date, Spacing and variety) on population of *L. trifolii*

Sowing date X Spacing X Variety Interactions.

Sowing date, Spacing	No. of larvae/leaf and variety					
	GAUC-1		GC-2		GCH-4	
D ₁ X S ₁	168.85	(12.76)*	88.00	(9.37)	108.20	(10.32)
D ₁ X S ₂	129.60	(11.26)	98.90	(9.89)	156.10	(12.39)
D ₂ X S ₁	172.00	(12.89)	166.90	(12.90)	185.35	(13.45)
D ₂ X S ₂	166.35	(12.84)	87.20	(9.23)	186.80	(13.45)
D ₃ X S ₁	186.75	(13.50)	124.85	(10.70)	156.95	(12.22)
D ₃ X S ₂	167.55	(12.82)	150.25	(12.18)	162.80	(12.03)

S. Em. $\pm$ = 0.62 Non-Significant.

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1.	2.	3.	4.
Sowing date X Variety interaction			
	149.22 (12.01)	93.45 (9.63)	132.15 (11.36)
D ₁	169.18 (12.87)	127.05 (11.07)	186.08 (13.45)
D ₂	177.15 (13.16)	137.55 (11.44)	159.88 (12.12)
D ₃			
S. Em. $\pm$ = 0.50 Non-significant			
Spacing X Variety interaction			
	175.87 (13.05)	126.58 (10.99)	150.17 (12.00)
S ₁	154.50 (12.31)	112.12 (10.43)	168.57 (12.62)
S ₂			
S. Em. $\pm$ = 0.50 Non-Significant			
$\sqrt{X + 0.5}$ transformed value.			
		D ₁ = 15th January	D ₃ = 15th February
		D ₂ = 30th January	S ₁ = 90 x 60 cm
			S ₂ = 60 x 60 cm

per method for assessing density of *L. trifolii* of Kapadia and Parmar (1995) in which number of larval mines on third leaf from the top of plant was counted. Data collected were computerised for analysis.

The data analysis (Table 1) revealed that the different interactions, sowing date X spacing X Variety, Sowing date X variety, Spacing X variety and agronomical practices excluding varieties i.e. sowing dates and spacings did not influence significantly the pest population. However, variety GC-2 sown in January at 60 x 60 cm distant has comparatively low mines i.e. 87.20 - 98.90 than other combinations having 124.85-166.90 mines/leaf. Pest density was varied significantly according to varieties. Variety GC-2 recorded low mines (119.35/leaf) than GCH-4 (159.37) and GAUCH-1 (165.18) (Table 2). This finding proved GCH-4 and GAUCH-1 as most preferable varieties of the leaf-miner in

support of similar finding of Kapadia (1993) who found monsoon sown both the varieties as susceptible. Lakshimnarayanan et al., (1992) observed this leaf-miner infesting castor fields sown in monsoon, winter and summer.

TABLE 2

Larval population of *L. trifolii* on three varieties of castor.

Variety	No. of larvae/leaf	
GAUG-1	165.18	(12.68)*
GCH-4	159.37	(12.31)
GC-2	119.35	(10.71)
S. Em. $\pm$		(0.36)
C. D. at 5%		(1.01)

* $\sqrt{X + 0.5}$ transformed value.

These observations indicate that *L. trifolii* can multiply on as monsoon castor as summer

castor, without seasonal effect on its ability to survive and multiply.

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Monitoring of Spotted Bollworm Moths with Sex Pheromone Traps and its Relationship with Field Incidence*

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Spotted bollworms, *Earias* spp. (Noctuidae : Lepidoptera) are important potential pests of cotton. Two species of the pest i.e. *Earias vittella* (Fab.) and *Earias insulana* (Boisd.) are found attacking cotton crop. Kehat and Bar (1975) made first attempt to monitor the population of *E. insulana* in cotton fields, with the use of traps baited with virgin females. (E, E) — 10, 12-Hexadecadienal was identified as a component of the sex pheromone of female *E. insulana* (Hall et al., 1980). Synthetic pheromone traps have been reported to be a good tool in monitoring of *Earias* population (El-Mosa, 1986). Information on the seasonal activity of spotted bollworm moths using sex pheromone is very meagre. No successful attempt has been made to monitor the pest in Dharwad region of Karnataka State except the work of Naik (1988). Hence, the present study was undertaken to fill up the lacunae and to promote the research in this direction.

Seasonal activity of spotted bollworm moths was studied by using sex pheromone traps at two different locations i.e. at the Main Research Station (MRS), Dharwad and Agricultural Research Station (ARS), Dharwad, Karnataka. Monitoring of moths was done during entire cotton growing seasons in 1989-90 and 1990-91. Polythene sleeve traps baited with 1.2 mg sex pheromone/lure (Plastic vial) were used to monitor the pest.

Such pheromone traps were installed in general cotton field (Variety DS-28) at MRS, Dharwad and in the experimental area of different discipline at ARS, Dharwad. Five pheromone traps were operated during both the seasons of study, except during 1989-90, where only 4 pheromone traps were operated at the ARS, Dharwad. The traps were placed at 15 cm above the crop canopy as suggested by Dhawan and Sidhu (1987), and this height was maintained by raising the trap frequently as the crop grew. The minimum distance between two traps was 30 to 40 metres. Lures were replaced at 20 days interval. A small cotton plug with few drops of dichlorvos (DDVP) was placed at the bottom of polythene sleeve traps to kill the trapped moths. The number of moths trapped was recorded daily in the morning and the trap was emptied.

The observations were made at weekly interval by picking 50 green bolls randomly

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TABLE 1

Correlation coefficient (r) between pheromone trap catches of *Earias* spp. and larval population and field incidence on cotton bolls.

Correlated weeks	Larval population			Field incidence	
	1989-90	1990-91		1989-90	1990-91
	ARS	MRS	ARS	ARS	MRS
Three weeks before trap catch	-0.920**	-0.460	-0.247	-0.997**	-0.711**
Two weeks before trap catch	-0.710*	-0.157	+0.085	-0.654*	-0.144
One week before trap catch	-0.423	-0.157	+0.400	-0.479	+0.263
During the same week of trap catch	+0.348	+0.536	+0.635*	+0.231	+0.463
One week after trap catch	+0.669*	+0.776**	+0.858**	+0.687*	+0.655*
Two weeks after trap catch	+0.564	-0.037	+0.697**	+0.614	+0.383
Three weeks after trap catch	+0.231	-0.269	+0.409	+0.293	-0.335
Four weeks after trap catch	+0.248	-0.085	+0.002	+0.310	-0.303

** 1% level of significance.
* 5% level of significance.

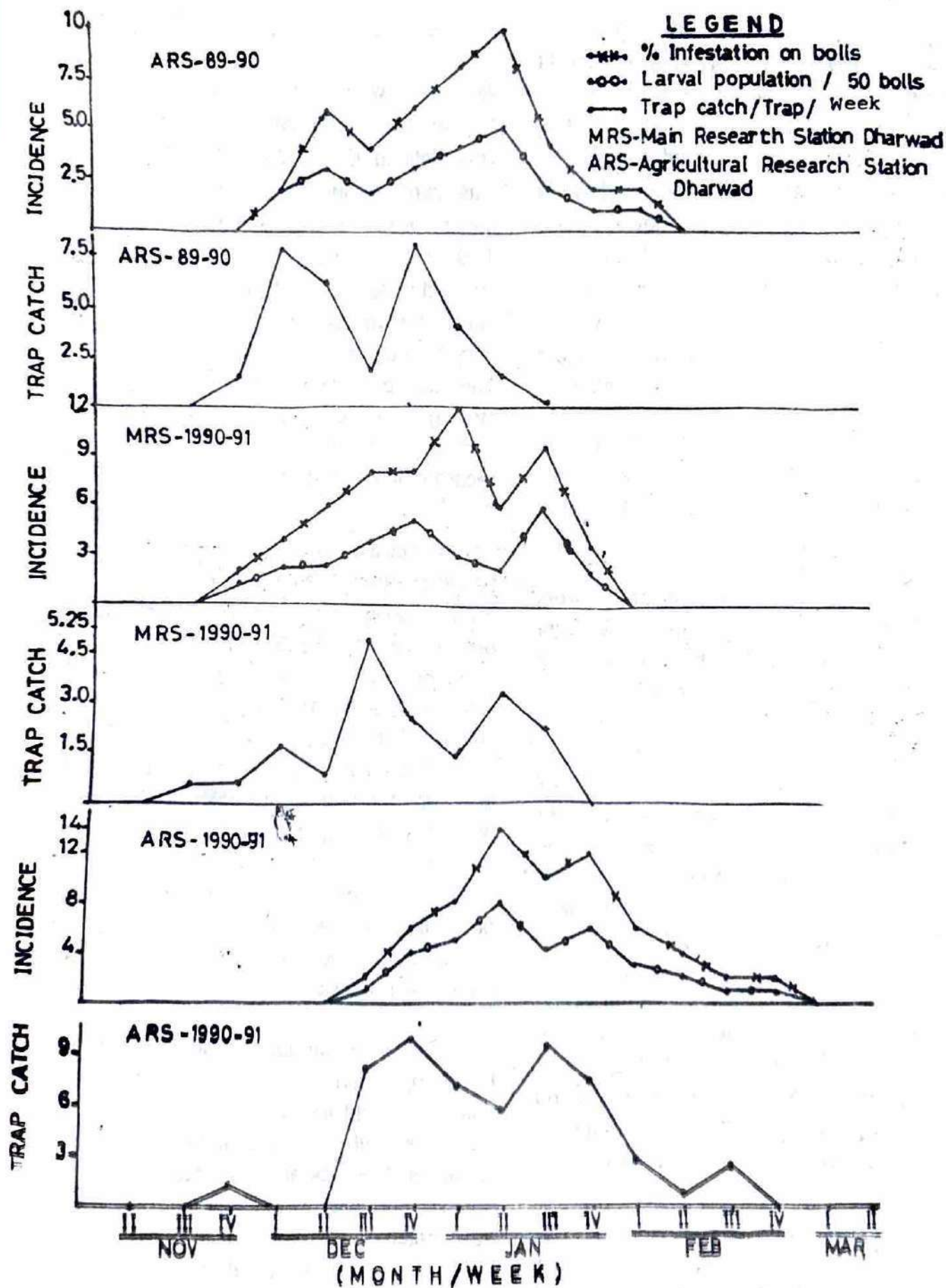


Fig. 1 : Relationship between trap catches of *Barbus* spp. and larval population and field incidence during 1989-90 and 1990-91.

from the field where the moth activity was monitored by pheromone traps. These bolls were observed for the presence of larvae and damage caused by them. An attempt was made to establish the relationship between trap catches, larval population and field incidence by correlating and regressing the larval numbers and damage level with trap catches during the same week, before trap catch upto three weeks and upto four weeks after trap catches. The correlation coefficient (r) values obtained are presented in Table 1.

The traps set in, both *E. insulana* and *E. vittella* were attracted. Hence, the results pertain to cumulative data of both the species.

The moth activity was observed from middle of November to third week of January during 1989-90 at MRS, Dharwad, while it continued till February third week at ARS, Dharwad during 1990-91. Thus, the major active period was found from November to February. These findings are corroborated by the observations of Thontadarya *et al.* (1980) and Thangavelu (1982), who reported the active period from November to February. However, light trap studies from Dharwad revealed the activity of moths from April to December assuming major status from September last week to December last week (Patil and Devaiah, 1978), while in pheromone traps from August last week to February first week at Dharwad (Naik 1988), from second fortnight of September 1987 to first fortnight of February, 1988 at Raichur (Nandihalli *et al.*, 1990).

During 1989-90, trapping was not successful at MRS, Dharwad because of unknown reasons. However two major peaks

at an interval of three weeks from the first in December first week were observed at ARS, Dharwad during 1989-90 and delayed appearance of these peaks by 2-3 weeks was noticed during 1990-91 (Fig.-1). There was variation in the number and timing of minor peaks between the two locations. This small variation in minor peaks is suspected to be due to less effectiveness of lures at moth density as no moths trapped despite the activity of moths in cotton fields. The above findings on number of peaks strikingly differed from the report of Patil and Devaiah (1978) and Naik (1988), who recorded four-five peaks in a year.

A positive significant correlation existed between trap catches and larval counts made during the same week ($r = 0.635^*$) one week ($r = 0.669^*$, 0.776^{**} and 0.858^{**}) and two weeks ($r = 0.697^{**}$) after trap catches (Table 1). These findings gain support from Kumar (1985) in the case of *E. vittella* on bhendi. Kehat and Bar (1975) also reported that adult peaks of *E. insulana* were followed by the appearance of larvae in the cotton field. Significant positive correlation established between larval population before trap catches and trapping of *E. vittella* by Naik (1988) contradicted the current results.

Since the damage in field is a function of larval population, the association between trap catch and field incidence followed the same trend as with larval population. The two variables have been correlated during the same week, one week and two weeks after trap catches. These observations are in conformity with the report of Planes Garcia (1955) who observed serious infestation of *E. insulana* after 20-25 days of peak catch.

Significant negative correlation between trap catch and larval population and field incidence recorded two and three weeks before trap catches at ARS during 1989-90, suggested that trap catch was not a reflection of larval activity in the study field much before trapping, instead was influenced by moths from nearby fields.

Results concluded that the spotted bollworm moths remained active from November to February. Positive and significant correlation existed between trap catch and larval numbers during the same week and up to two weeks after trap catches. Similar trend was noticed between trap catch and field incidence.

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Response of *Spodoptera litura* Fab. Larvae to A Phagostimulant*

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Feeding in insects on plants is elicited by carbohydrates, amino acids, sterols, vitamins as well as by specific phagostimulants (Schoonhoven, 1972). There are many reports on chemicals that control the feeding behaviour in phytophagous insects (Thorsteinson, 1960 and Jacobson, 1966).

In the present work an attempt has been made to study the response of *Spodoptera*

litura Fab. larvae to a commercial liquid feeding stimulant, 'Entice' (Specially prepared from cotton flour, diasaccharide, polysaccharide, vegetable lipid oil, alcohol and Alkoxyolate by 33.965%).

Two separate trials were made in the laboratory to know (i) the response of *S. litura* to phagostimulant alone and in combination with insecticide and (ii) the influence of the phagostimulant on the larvae feeding behaviour.

In the first experiment, four treatments viz., cypermethrin, cypermethrin + Entice, Entice alone and untreated (check) were evaluated in Completely Randomized Block Design with 5 replications. Cypermethrin

TABLE 1

Response of *Spodoptera litura* larvae to Entice treatments.

Sr. No.	Treatments	Dose (Per llt. water)	Mean + % larvae responded	
1.	Cypermethrin	0.5 ml.	20.20*	(20.00)a
2.	Cypermethrin + Entice	0.5 ml + 3 ml.	21.90	(27.00)a
3.	Entice only	3 ml.	28.20	(32.05)b
4.	Untreated (Check)	—	25.80	(30.51)b
	S. Em. ±		0.73	
	C. D. at 5%		2.18	
	C. V. (%)		5.56	

*Figures in parenthesis are Aresin transformed values.

± Mean of 5 replications.

Means followed by the same letter in each column are not statistically different.

*A part of Ph.D. thesis submitted to UAS Dharwad by first author under the guidance of second.

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TABLE 2

Influence of Entice (Phagostimulant) on larval and excretal weight of *Spodoptera litura*.

Sr. No.	Treatment	Mean + Larval weight (mg)				Mean + excretal weight (mg)		
		BT	3 DAT	7 DAT	10 DAT	3 DAT	7 DAT	10 DAT
1.	Treated	61.25	176.69	525.44	1120.81	109.25	328.75	1041.07
2.	Check	52.94	141.75	409.50	894.13	86.81	244.13	906.13
	Difference	8.31	34.94	115.94	226.68	22.44	84.62	134.94
	T test	N.S.	N.S.	N.S.	Sig.	N.S.	N.S.	N.S.

+ Mean of 16 observations.

BT = Before treatment.

DAT = Days after treatment.

NS = Not significant.

Sig. = Significant.

10 EC and Entice were tried at 0.5 MI. and 3 MI/lit. water, respectively. Fresh cotton leaves receiving various treatments were kept separately in each corner of iron tray (51 cm X 51 cm X 5 cm). Fifty laboratory reared third instar larvae were released in the centre of the tray and prevented from escape by a suitable cover. Observations on the number of larvae responded to each treatment were recorded after 3 hr. The experiment was repeated 4 times. The data obtained were analysed after Arcsin transformation.

The larval feeding behaviour as influenced by phagostimulant was assessed in terms of larval and excretal weight. Sixteen larvae (5 days old) after recording the weight were released individually on cotton leaf treated with 5% Entice solution in a petriplate (20 cm dia. X 4 cm ht). Fresh leaves treated with Entice were provided everyday. Larval and excretal weight of individual larva were recorded 3, 7 and 10 days after treatment. Similar observations were also made for another set of larvae by providing untreated cotton leaves. Data were subjected to 'T' test analysis.

Results (Table 1) revealed that minimum number of larvae responded to the leaves treated with insecticide alone (20.2%) followed by combination of insecticide and Entice (21.9%). Statistically both the treatments were equally effective in stimulating the larvae. In contrast significantly more number of larvae responded to leaves treated with entice alone (28.2%) followed by untreated check (25.8%).

Non-significant difference in the larvae response to insecticide alone and in combination with Entice suggests that positive

response evoked by the phagostimulant was perhaps nullified by the repellent or antifeedant action of insecticide. This explanation is supported by the findings of Aerts (1978), Tan (1981) and Nagia *et al.*, (1989).

Observations on larval and excreted weight (Table 2) indicate that larval growth was not impaired upto 7 days. However, the larvae gained significantly higher weight when fed on Entice treated leaves upto 10 days. These findings revealed that Entice induced phagostimulatory effect on treated surface. The report of Navon *et al.*, (1987) is in accordance with the present findings who reported that treatments differed significantly from control when neonate larvae of *Spodoptera littoralis* Boisd. were fed on FEST (Feeding Stimulant mixtures) treated leaves for 10 days. Further, they noted that experimental period of less than 10 days did not result in significantly higher feeding rates than control. Increased body weight is a reflection of enhanced feeding due to phagostimulatory action of the test product. Interestingly, though the weight of excreta was more in the treated, statistical differences in excretal weight were never noticed between treated and untreated at all intervals of study. It is possible that differential digestion efficiency after 7 days among the treatments might be an explanation for the observed phenomenon. In contrast, Meisner *et al.*, (1970) observed that the number of fecal pellets in case of *S. littoralis* larvae fed on thin styropor discs treated with host plants extracts was in fair agreement with rate of surface consumed.

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Cumulative Effect of Nuclear Polyhedrosis Virus (NPV) on Development of *Helicoverpa armigera* (Hubner) on Groundnut

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Helicoverpa armigera (Hubner) damages seriously cotton, pigeonpea, chickpea and also castor in Saurashtra (Gujarat). It also damages the vegetative phase of groundnut. Several attempts have been made in the past to control this pest with chemical insecticides and also microbials. In the present study, an attempt was made to assess the cumulative effect of nuclear polyhedrosis virus (NPV) on larval and post-larval development of *H. armigera*.

H. armigera culture was maintained in laboratory. Ha NPV was multiplied on the third instar larvae. HaNPV 250 LE was prepared from the NPV infected host larvae and sprayed on groundnut plants during August-1994, from which leaves were plucked up after one hr of drying. These were exposed to instarwise larvae for 24 h and individuals were reared on fresh unsprayed groundnut leaves until moth emergence. Forty host larvae under test were splitted into four replications. The larval mortality was recorded daily upto 8th day of

treatment. The larvae which pupated were kept under observation for adult emergence and number of pupae failed to emerge the moths were also recorded. The data thus obtained were analysed using Abot's formula.

a. Effect on larval survival

The mortality in first instar larvae was high at 3rd and 4th day i.e. 36.94 and 34.44 per cent and killing of host was recorded within 8 days (Table 1). Similar trend was found in case of 2nd instar, but mortality was low and total mortality was 84.72 per cent. High mortality in 3rd, 4th and one day late 4th instars was occurred on 5th and 6th days of exposure and total mortality among them was 48.26, 39.23 and 21.18 per cent, respectively. This test summed up that early instar larvae were more susceptible to NPV than late instar larvae. These findings are on conformity with the results of Teakle and Byrne (1989) and Tuan *et al.*, (1989).

b. Effect on pupal survival

The first instar larvae and second instar larvae succeeded for less pupation (Table 1). The pupae failed to emerge the moths were higher (61.30%) in one day late 4th instar, followed by the 4th instar (47.50%) and 3rd instar (41.25%), while it was low in case of 2nd instar (12.50%). This indicate that NPV infected late instars survived but mortality in

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TABLE 1

Larval mortality, pupation (%) and cumulative mortality in *Helicoverpa armigera* due to NPV infection.

Instar tested	Larval mortality (%) after days								Total larval mortality (%)	Pupation (%)	Pupae failed to emerge (%)	Cumulative (larval + pupal) mortality (%)
	3	4	5	6	7	8						
First (0 days)	37.12 (36.94)*	35.37 (34.44)	16.10 (7.50)	16.10 (7.50)	11.43 (2.50)	9.10 (0.00)		80.90 (100.00)	11.12	9.10 (0.00)		100.00
Second	33.73 (31.66)	26.58 (18.33)	21.57 (15.00)	16.10 (7.50)	9.10 (0.00)	9.10 (0.00)		67.28 (84.72)	15.28	18.10 (12.50)		97.20
Third	9.10 (0.00)	13.77 (5.00)	22.75 (15.27)	24.78 (17.77)	20.16 (12.50)	9.10 (0.00)		43.98 (48.26)	51.74	39.80 (41.25)		89.51
Fourth	9.10 (0.00)	11.43 (2.50)	23.60 (17.50)	18.13 (10.00)	18.44 (10.00)	13.77 (5.27)		38.77 (39.23)	60.77	43.55 (47.50)		86.73
One day late fourth	9.10 (0.00)	9.10 (0.00)	18.69 (10.27)	16.10 (7.50)	16.10 (7.50)	11.43 (2.50)		27.21 (21.18)	88.82	51.63 (61.30)		82.48
S. Em. ±	0.40	2.38	2.74	0.96	2.17	1.63		1.70	—	4.53		91.18
C. D. P = 0.05	1.24	7.35	N.S.	2.96	66.69	N.S.		5.24	—	13.65		(Mean)

*Figures in parentheses are actual values.

pupal stage was expressed. Dhandapani *et al.* (1993) also reported similar finding.

The cumulative mortality (larval + pupal) in tested instars was found to be 100.00, 97.20, 89.51, 86.73 and 82.48 per cent in 1st, 2nd, 3rd, 4th and late 4th instars, respectively. Overall cumulative effect was 91.18 per cent

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- mortality of the pest. The study concluded that the microbial control of *H. armigera* on groundnut can be achieved effectively through the HaNPV application. Jayaraj *et al.*, (1987) found 250 LE as the most effective in reducing *H. armigera* population.

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Phagostimulatory Response of *Helicoverpa armigera* Hubner Larvae to Entice*

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During the course of studies on evaluation of Entice, a liquid feeding stimulant against cotton bollworms, it was found that the plots treated with Entice alone, exhibited more damage of defoliators including *Helicoverpa* on cotton leaves. With this idea, an attempt has been made to study the phagostimulatory behaviour of cotton bollworm, *Helicoverpa armigera* Hubner larvae to cotton leaves treated with phagostimulant during kharif 1990.

Phagostimulatory response of *H. armigera* larvae on cotton leaves treated with

'Entice' manufactured by M/s. Fermone Chemicals Inc. Texas, USA, (Specially prepared cotton flour, disaccharide, vegetable lipid oil, alcohol, Alkoxylate and polysaccharide by 33.965% A.I.) was studied on potted cotton plants. For the purpose, 20 potted plants about four month old were selected and all the squares, flowers, bolls and damaged leaves were removed. Three leaves selected randomly were treated with 5% Entice solution and tagged. Water spray served as control. The treated plants were caged by cylindrical cages prepared out of mosquito nylon net (Plate-1) after the release of five laboratory reared 10 to 12 days old larvae of *H. armigera*.

Observations on leaf area consumed by the larvae were recorded after 24 hours. Leaf area consumed in per cent was assessed by visual gradation following 0 to 10 Scales as under :

Grade	Extent of consumption	Grade	Extent of consumption
0	No consumption	6	26 to 30% Consumption
1	1 to 5% Consumption	7	31 to 35% Consumption
2	6 to 10% Consumption	8	36 to 40% Consumption
3	11 to 15% Consumption	9	41 to 45% Consumption
4	16 to 20% Consumption	10	46 to 50% Consumption
5	21 to 25% Consumption		

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TABLE 1

Effect of Entice on leaf area consumption by *H. armigera* larvae in field.

Plant No.	Per cent leaf area consumed		Consumption Index	
	Treated	Check	Treated	Check
1.	35.00	8.33	7.00	1.67
2.	31.67	7.50	6.33	1.50
3.	23.33	15.00	4.67	3.00
4.	18.33	8.33	3.67	1.67
5.	15.00	10.00	3.00	2.00
6.	16.67	11.67	3.33	3.00
7.	30.00	0.00	6.00	0.00
8.	20.00	5.00	4.00	1.00
9.	21.67	16.25	4.33	3.25
10.	18.33	10.00	3.67	1.33
11.	23.33	8.33	4.67	1.67
12.	10.00	8.75	2.00	1.75
13.	31.67	0.00	6.33	0.00
14.	16.67	13.33	3.33	2.67
15.	25.00	0.00	5.00	0.00
16.	38.33	15.00	7.67	3.00
17.	16.67	13.33	3.33	2.67
18.	33.33	5.00	6.67	1.00
19.	25.67	16.67	5.33	3.33
20.	20.00	10.00	4.00	2.00
Mean	23.58	9.12	4.72	1.83
Calculated 't':		6.99**		8.24**
Table 't' at 5% 2.025 at 1% 2.713				

** Highly significant.

Another investigation was undertaken in the laboratory by confining individual larva on treated leaves in petriplate (20 cm. dia. x 4 cm. ht.). The turgidity of treated leaf was maintained by swabbing the petiole end with cotton

wad and wetting it frequently. Only half of leaf was smeared with 5% freshly prepared Entice solution on the abaxial surface, while the other half remained untreated (Plate-2). After air drying the treated surface, a single 10 to 12