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Director of Extension Education

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Heterosis for Seed Cotten Yield, Yield Components and Some Fibre Quality Characters in Upland Cotton (*Gossypium hirsutum* L.)

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ABSTRACT

An experiment was conducted to study the extent of heterosis for seed cotton yield, yield components and fibre quality characters in upland cotton (*Gossypium hirsutum* L.). Twenty out of 21 hybrids expressed significant relative heterosis ranging from 6.92 to 203.9 per cent for seed cotton yield. Out of these, 13 hybrids each for bolls per plant and dry weight, six hybrids each for fibre fineness and uniformity ratio and five hybrids for average boll weight recorded significant relative heterosis. The hybrid 'G-67 x G. Cot-10' recorded the highest *per se* performance and also possessed heterobeltosis to the extent of 151.2 per cent.

(Received on Jan. 7, 1980)

INTRODUCTION

Knowledge of magnitude of heterosis and type of gene action involved for different characters is helpful in breeding. Since in India production of hybrid cotton seed is feasible through hand emasculation because of the availability of cheap manual labour and simple technique for crossing (Patel, 1955), hybrids are being extensively cultivated in Gujarat, Karnataka, Maharashtra, Andhra Pradesh, etc. Many reports on heterosis in intervarietal crosses of upland cotton are available in the literature (Al-Rawi and Kohel, 1970; El-Adl and Miller, 1971; Singh and Murty, 1971; Meredith and Bridge, 1972; Baker and Verhalen, 1975). Such information on newly developed varieties of cotton is rather scanty. The present report describes the extent and nature of heterosis for various characters including fibre quality characters in inter-varietal crosses of upland cotton.

MATERIALS AND METHODS

The experimental material comprised of seven cultivars of *G. hirsutum* (Gujarat-67, G.Cot-10, DHY-286, MCU-5, Pramukh, C.P. 5/5 and P.S.10) exhibiting wide spectrum of variation in different plant characters, obtained from different cotton breeding stations of India. These cultivars were crossed in all possible combinations excluding reciprocals. Seven parents alongwith their 21 crosses were grown in a randomised block design with four replications during rainy season of 1975 at

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the Main Cotton Research Station, Surat. Each plot consisted of three rows 9 m long accommodating ten plants with inter and intra-row spacing of 120 cm and 90 cm respectively. Recommended agronomic practices were followed to raise the experimental crop. Observations were recorded on 14 agronomic and fibre quality characters on five randomly selected plants from each plot. The data were subjected to analysis of variance as per standard statistical procedure (Panse and Sukhatme, 1961). The degree of heterosis in F_1 over the mid parent and better parent (hetreobeltosis) was calculated by the method suggested by Turner (1953) and Hays, Immer and Smith (1955). The statistical significance of heterosis was tested by 't' test as per method given by Mani (1972).

RESULTS AND DISCUSSION

The analysis of variance (Table 1) revealed significant varietal differences for most of the characters under study except plant height, boll weight, seed index and fibre maturity coefficient. The parent *vs* F_1 comparison was significant for majority of characters under study indicating the presence of considerable mean heterosis. This comparison for ginning percentage, seed index,

TABLE 1

Analysis of variance for design of the experiment.

Source	*Mean Squares*							
	d.f.	*Plant height*	*Petiole length*	*Bolls/ plant*	*Boll weight*	*Ginning percentage*		
Block	3	102.7	5.3**	201.7*	1.3	24.7**		
Treatment	27	202.3	4.7**	368.2**	2.2**	33.6**		
Parents	6	234.0	17.1**	801.6**	1.1	43.6**		
Hybrids	20	121.4	1.2*	77.0	2.1**	31.3**		
Parent *vs* Hybrids	1	1630.0*	0.1**	3594.0**	9.5**	20.8		
Error	81	247.1	0.6	70.2	0.8	5.4		
	Mean Squares							
Dry weight	*Seed index*	*Lint index*	*Mean fibre length*	*2.5% span length*	*Fibre fineness*	*Fibre uniformity ratio*	*Fibre maturity coeff.*	*Seed cotton yield*
900.8	19.3	4.5**	3.5	5.3	0.57*	9.2*	0.447**	25.4
12389.9**	5.0	3.1**	15.6**	23.1**	0.75**	12.0**	0.004	9087.7*
7168.3**	5.5	1.5*	28.7**	43.5**	0.70**	18.8**	0.008	7738.0**
11055.4**	5.1	3.6**	12.1**	15.9**	0.68**	10.8**	0.002	5482.3**
10412.1**	0.5	2.4	7.2	45.8**	2.3**	23.1**	0.015	98294.7**
343.8	6.9	0.6	1.8	2.8	0.14	3.2	0.091	78.3

*Significant at P=0.05

**Significant at P=0.01

TABLE 2

Heterosis over mid-parent for different characters in *G. hirsutum.*

Crosses/Characters	*Plant height*	*Petiole length*	*Bolls/ plant*	*Boll weight*	*Dry weight/ plant*	*2.5% span length*	*Fibre fineness*	*Uniformity ratio*	*Yield plant*
G67 x G.Cot.10	11.2	5.0	91.9**	54.8**	44.6**	3.5	0.3	5.3	193.4**
G67 x DHY 286	12.5	2.0	50.5	2.0	25.3**	-1.4	6.7	2.7	55.8**
G67 x MCU 5	7.0	-15.1**	69.7**	63.5**	38.2**	1.1	13.9	3.8	143.2**
G67 x Pramukh	13.1	2.3	117.8**	0.6	51.0**	3.5	15.6*	1.1	110.0**
G67 x CP 5/5	5.2	1.1	36.5	14.4	-9.3*	0.7	2.2	-0.5	38.8**
G67 x PS 10	7.3	4.4	185.7**	11.1	10.6**	-8.7*	16.8**	-1.3	203.9**
G.Cot.10 x DHY 286	5.6	6.7	15.0	6.4	44.3**	-8.1*	36.0**	8.8**	6.9**
G.Cot.10 x MCU 5	10.7	-6.4	10.2	10.6	12.1**	-13.0**	31.8**	10.6**	28.1**
G.Cot.10 x Pramukh	5.9	6.3	41.8*	-7.2	34.6**	1.9	1.1	1.5	33.5**
G.Cot.10 x CP 5/5	-0.3	9.0	-13.2	27.9	-13.8**	-4.3	12.2*	6.1*	14.5**
G.Cot.10 x PS 10	15.0	4.9	57.9**	62.6**	2.9	0.6	1.0	-1.7	152.7**
DHY 286 x MCU 5	7.5	-8.5	36.4*	-1.3	14.1**	-9.9*	9.5	7.0**	37.4**
DHY 286 x Pramukh	12.2	2.4	41.8**	2.4	40.8**	0.6	-0.3	-3.1	49.8**
DHY 286 x CP 5/5	12.2	-10.0*	35.3*	2.4	13.1**	-1.1	7.4	1.0	69.1**
DHY 286 x PS 10	21.3	-0.3	74.4**	13.9	16.5**	-2.9	0.5	-3.8	101.5**
MCU 5 x Pramukh	15.1	1.1	36.3*	40.5**	58.2**	-14.9**	27.4**	8.0**	82.8**
MCU 5 x CP 5/5	-4.5	-6.9	0.1	-3.4	8.1*	-5.0	4.6	3.7	1.8
MCU 5 x PS 10	19.4	1.6	21.1	9.8	-5.1	-8.4*	-4.8	1.3	35.4**
Pramukh x CP 5/5	5.8	-10.1	45.2**	5.7	35.3**	8.7*	4.4	-3.0	55.6**
Pramukh x PS 10	9.7	-2.4	56.3*	46.4**	8.3	2.4	10.8	-1.2	119.5**
CP 5/5 x PS 10	10.7	-9.0	3.3	30.2	4.6	4.6	5.5	0.7	24.1**

*Significant at P=0.05

**Significant at P=0.01

TABLE 3

Heterosis over better parent for different characters in *G. hirsutum.*

Crosses/Characters	*Plant height*	*Petiole length*	*Bolls/ plant*	*Boll weight*
G67 x G.Cot.10	10.6	–20.0**	28.4	52.0**
G67 x DHY 286	11.1	–6.4	–2.1	–2.2
G67 x MCU 5	1.6	–28.1**	13.3	40.4*
G67 x Pramukh	9.1	–21.4**	51.9*	0.0
G67 x CP 5/5	2.4	–14.4**	–10.9	6.5
G67 x PS 10	–2.0	–14.0**	168.9**	–2.2
G.Cot.10 x DHY 286	5.2	–13.0	8.7	3.9
G.Cot.10 x MCU 5	8.4	–17.7**	9.7	9.5
G.Cot.10 x Pramukh	2.8	–1.2	31.6	–9.4
G.Cot.10 x CP 5/5	–3.4	–4.1	–17.4	17.1
G.Cot.10 x PS 10	4.6	–5.0	9.2	45.5*
DHY 286 x MCU 5	4.8	–16.3**	29.6	–4.5
DHY 286 x Pramukh	9.2	–11.3*	25.1	–2.3
DHY 286 x CP 5/5	9.7	–17.7**	34.3*	8.7
DHY 286 x PS 10	8.6	–11.4*	17.0	4.2
MCU 5 x Pramukh	9.3	–4.7	26.0	38.6*
MCU 5 x CP 5/5	–8.9	–6.9	1.4	–10.7
MCU 5 x PS 10	10.7	–1.6	–16.5	–2.6
Pramukh x CP 5/5	5.4	–15.2*	28.9	–1.1
Pramukh x PS 10	–3.0	–5.2	13.1	28.3
CP 5/5 x PS 10	–1.8	–12.0*	–30.4	–7.8

Dry weight plant	*2.5% span length*	*Fibre fineness*	*Uniformity ratio*	*yield/ plant*
37.2**	–7.5*	8.4	2.6	151.2**
21.2**	–5.7	9.9	1.0	11.3
28.9**	1.0	20.0*	2.7	100.0**
33.1**	–9.0*	17.8*	–1.5	70.8**
–15.4**	–8.6*	–13.0	–4.5	–14.5*
9.6*	–19.1**	29.5**	–6.3*	187.9**
36.7**	–14.3**	42.6**	7.7**	24.0**
–0.8	–22.3**	50.7**	6.7*	26.9**
13.1**	0.0	11.6	1.5	30.1*
–15.1**	–6.0	14.2*	4.5	0.1
–3.7	–0.4	3.4	–4.4	98.3**
3.1	–13.9**	19.0*	4.2	35.7**
20.7**	–7.9	4.7	–4.1	43.5**
8.8*	–6.3	15.1*	–1.5	57.6**
11.6**	–10.4*	8.0	–7.3**	45.2**
49.1**	–25.3**	31.7**	4.1	78.2**
–5.6	–13.8**	22.2*	–1.5	–11.4*
–10.7*	–19.0**	11.7*	–4.9	–19.7*
8.4*	4.9	17.8*	–4.5	37.8**
–3.7	1.5	25.0**	–3.9	67.6**
–3.5	1.8	5.7	–0.5	–39.6**

* Significant at P=0.05

**Significant at P=0.01

lint index, mean fibre length and fibre maturity coefficient was not significant. Though parents did not differ significantly for boll weight, the significant variance due to hybrids for average boll weight suggested that inspite of phenotypic similarity they possessed genetic differences for this trait.

The estimates of percentage of heterosis over the mid-parent and better parent for different characters under study are presented in Table 2 and Table 3 respectively.

Plant height:

The magnitude of variability in parents was more than their hybrids. In general, the crosses with 'Pramukh' possessed higher plant height. However, the increase in plant height of hybrids over mid-parental value or better parent was not significant indicating thereby the predominance of additive gene action. These results are in partial agreement with those of Young and Murray (1966) and Singh and Murty (1971) in intra-*hirsutum* crosses.

Petiole length:

Petiole length is an important indication of the leaf placement and canopy of the plant. The varieties with longer petiole tend to possess somewhat open plant habit. The parent 'G-67' possessed the longest petiole whereas 'G-Cot-10' had the shortest one. Out of 21 crosses, only two crosses, viz. 'G-67 x MCU-5' and 'DHY-286 x CP 5/5' showed significant negative heterosis while significant heterobetosis was observed in 13 crosses which indicated the presence of partial dominance. However, the effect was towards reduced petiole length.

Bolls/plant:

This is one of the most important yield contributing characters in cotton. In majority of the crosses, heterosis expressed over mid-parent was significant and in the positive direction which indicated the predominance of non-additive type of gene effects in these crosses. Out of 14 crosses which significantly departed from mid-parental value, three crosses viz. 'G-67 x Pramukh', 'G-67 x P.S.10' and 'DHY-286 x CP 5/5' were significantly better than their respective better parent indicating thereby overdominance in these crosses. These results are in close agreement with the findings of Singh *et al.* (1964), and Singh and Murty (1971). This indicated that heterosis breeding would be useful for obtaining more bolls/plant which may ultimately result in higher seed cotton yield.

Average boll weight:

This is an important direct component of yield and heterosis for boll size contributed to favourable yield increases in hybrids (Miller and Marani, 1963; Miller and Lee, 1964). Only six crosses showed significant and positive heterosis for this character. Out of these, four crosses viz. 'G-67 x G.Cot-10', 'G-67 x MCU-5', 'G.Cot-10 x P.S. 10', and 'MCU-5 x Pramukh' exhibited significant positive heterobeltosis indicating thereby the overdominance for this character in these crosses. Almost identical results have been reported by Miller and Lee (1964), Bhatol (1971) and Meredith and Bridge (1972) in *G. hirsutum*.

Dry weight per plant:

The dry weight of the plant is an indication of the efficiency of the plant

for total uptake of the nutrients for its growth. Among parental group, 'CP 5/5' had the highest dry weight per plant while 'Pramukh' possessed the lowest. Majority of the crosses (15) showed significant and positive heterosis over mid-parental value indicating the presence of dominant gene action. Out of these 15 crosses, 12 crosses exhibited significant positive heterobeltosis indicating the presence of overdominance. Patil (1973) in *G. herbaceum* also reported dominance and overdominance to be operative for this character. Two crosses over mid-parental values and three over better parent exhibited significant negative heterosis. In general, crosses with negative trend in heterosis involved either 'CP 5/5' or 'P.S.10'.

2.5% span length:

This is a new concept of measurement of fibre length parameter to be recorded by Digital Fibrograph and corresponds well with the American Classer's staple length. Majority of the crosses showed negative heterosis over mid-parent and better parent. Only one cross ('Pramukh x CP 5/5') resulted in high order positive heterosis over mid parent. It is interesting to note that this cross claimed high significant positive heterosis for yield as well as a high *per se* performance for yield. This showed a possibility of getting high yielding hybrids with long span length. These results are in partial agreement with the results obtained by Marani (1968) and Chinnadurai and Sree Rangasamy (1975) in *G. hirsutum* crosses. However, Meredith and Bridge (1972) and Baker and Verhalen (1975) recorded considerable magnitude of positive heterosis for this character.

Fibre fineness (Micronaire value):

This is an important criterion in judging lint quality of long staple cottons. Six crosses recorded significant increase in fibre weight (coarse) over mid-parental value indicating dominance in these crosses. Out of these six crosses, three crosses viz. 'G.Cot-10 x DHY-286', 'G-Cot-10 x MCU-5' and 'MCU-5 x Pramukh' possessed higher fibre weight than their respective better parent indicating overdominance. These results are in accordance with the findings of Patel (1974) and Baker and Verhalen (1975). The increase in micronaire value is indicative of coarseness and is not desirable beyond certain limit since the fibres above 3.9 MV are considered coarse. Heterobeltosis considering lower micronaire value as better parent indicated that 12 crosses were significantly superior over their respective better parent. Out of these, five crosses, viz. 'G-67 x MCU-5', 'G-67 x Pramukh', 'DHY-286 x MCU-5', 'MCU-5 x CP 5/5' and 'Pramukh x CP 5/5' possessed fine fibre (MV < 3.9).

Uniformity ratio:

Fibre uniformity ratio indicates the magnitude of length irregularities in cotton sample. In most of the cases under study, F_1s had higher uniformity ratio than mid-parental values or either of the parents. Significant positive heterosis was observed for six crosses while two crosses showed significant positive heterobeltosis. Other crosses had intermediate values for this trait between better parent and mid-parent. This indicated that the character is determined by additive and non-additive genes with more influence of additive genes. Baker and Verhalen (1975) also observed signifi-

cant positive and negative deviations from mid-parental values in different crosses for this character.

Seed cotton yield per plant:

Twenty out of 21 crosses exhibited significant positive heterosis over mid-parental values. The heterosis ranged from 1.8 to 203.9 per cent with the highest relative heterosis observed in 'G-67 x P.S.10'. The heterobeltosis for yield ranged from -39.6 to 187.9 per cent. Fifteen crosses showed significant superiority over their respective better parental values with 'G-67 x P.S.10' possessing the highest heterobeltosis to the extent of 187.9 per cent. These results indicated pre-dominance of non-additive gene action for seed cotton yield, which is in confirmity with the findings of Singh and Murty (1971), Meredith and Bridge (1972), Kumar, Pathak and Singh (1974) and Patel (1974).

Though the cross 'G-67 x P.S. 10' recorded the highest heterosis as well as heterobeltosis, its *per se* performance was not very high. Under such circumstances, crosses with higher *per se* performance alongwith considerable magnitude of superiority over better parent should be considered for commercial exploitation of heterosis for yield. In this context cross 'G-67 x G.Cot-10' deserves merit since its *per se* performance was the highest and it possessed heretobeltosis to the extent of 151.2 per cent.

Out of 20 hybrids which showed relative heterosis for seed cotton yield, 13 crosses each for bolls per plant and dry weight per plant, six crosses each for fibre fineness and uniformity ratio and five crosses for average boll weight recorded significant relative heterosis. This indicated that heterosis in these components contributed towards heterosis for seed cotton yield.

REFERENCES

Al-Rawi, K. M. and R. J. Kohel (1970). Gene action in the inheritance of fibre properties in intervarietal diallel crosses of upland cotton, *G. hirsutum* L. *Crop. Sci.*, **10:** 82-85.

Baker, J. L. and L. M. Verhalen (1975). Heterosis and combining ability for several agronomic and fibre properties among selected lines of upland cotton. *Cott. Gr. Rev.*, **52:** 209-23.

Bhatol, L. H. (1971). Study of heterosis, correlation and inheritance of certain characters in cotton Hybrid-4 (Gujarat-67 x Nectariless). *Unpublished M.Sc. Thesis*, South Gujarat University, Surat.

Chinnadurai, K. and S. R. Sree Rangasamy (1975). Heterosis for yield of seed cotton and mean halo length in a diallel cross of *G. hirsutum* L. *Andhra Agric. J.*, **20:** 30-33.

El-Adl, A. M. and P. A. Miller (1971). Transgressive segregation and the nature of gene action for yield in an intervarietal cross of upland cotton. *Crop. Sci.*, **11:** 381-84.

Hays, H. M., F F. Immer and D. C. Smith (1955). *Methods of Plant Breeding*, pp. 172-78. Mc Graw-Hill Book Co., Inc., New York.

Kumar, P., R. S. Pathak and R. K. Singh (1974). Heterosis and combining ability in upland cotton *G. hirsutum* L. *Indian J. Agric. Sci.*, **44:** 145-50.

Mani, S. C. (1972). A genetic study of parameters governing yield in crosses involving winter and spring wheats in *Triticum aestivum* L. *Unpublished Ph.D. Thesis.*, I.A.R.I., New Delhi.

Marani, A. (1968). Inheritance of lint quality characteristics in interspecific crosses of cotton· *Crop Sc.*, **8**: 653-57.

Meredith, W. R. Jr. and R. R. Bridge (1972). Heterosis and gene action in cotton, *G. hirsutum* L. *Crop Sci.*, **12**: 304-10.

Miller, P. A. and J. A. Lee (1964). Heterosis and combining ability in varietal top crosses of upland cotton, *G. hirsutum* L. *Crop Sci.*, **4**: 646-49.

Miller, P. A. and A. Marani (1963). Heterosis and combining ability in diallel crosses of upland cotton, *G. hirsutum* L. *Crop Sci.*, **3**: 441-44.

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

Patel, C. T. (1955). Technique for production of hybrid seed of cotton on commercial scale. *The Farmer.*, **7**: 61-63.

Patel, C. T. (1974). Exploitation of hybrid vigour in cotton improvement. *Indian J. Genet.*, **34A**: 205-10.

Patil, M. S. (1973). Heterosis for some agronomic characters in diploid cotton, *G. herbaceum* L. *Indian J. Agric. Sci.*, **43**: 595-601.

Singh, G. A. Singh and A. A. Singh (1964). Studies on heterosis and combining ability in intra-*hirsutum* and *hirsutum* x *barbadense* crosses. *Indian Cotton Gr. Rev.*, **18**: 121-37.

Singh, B. B. and B. R. Murty (1971). Hybrid vigour in intervarietal crosses of upland cotton. *Indian J. Genet.*, **31**: 1-7.

Turner, J. H. (1953). A study of hererosis in upland cotton. I yield of hybrids compared with varieties. *Agron. J.*, **45**: 484-86.

Young, B. F. Jr. and J. C. Murray (1966). Heterosis and inbreeding depression in diploid and tetraploid cotton. *Crop Sci.* **6**: 436-38.

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Effect of Short Duration EMS Treatments on the Frequency and Spectrum of Induced Mutations in Greengram*

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ABSTRACT

Two greengram (*Vigna radiata.* (Wilezek) varieties, viz. DT. 9-E and TT. 9-E were treated with 0.25 % EMS for a period of one hour under reduced atmospheric pressure, after pre-soaking the seeds from 11.00 to 13.00 hours at halff an hour intervals. The M_1, M_2 and M_3 generations were grown in the field and macro-mutants picked out in the latter two generations. The M_2 generation gave higher frequency and spectrum of mutations than M_3. Wider spectrum of chlorophyll, foliar and agronomic mutations occurred in treatments after different periods of pre-soaking showing time dependance of different loci for replication. EMS induced more of agronomic mutations than chlorophyll and foliar mutations. Maturity in greengram seems to be controlled by two groups of genes, one group tending towards earliness and the other towards lateness.

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INTRODUCTION

Possibility of increasing mutation frequency in greengram by EMS treatment was reported by Santos (1969). Pre-soaking seeds before mutagenic treatment was found to be very effective in increasing mutation frequency (Blixt, 1967; Sevin *et al.* 1968; Delgado de la Flor, 1972; Sahoo and Samolo, 1973 and Brunner, 1977). Swaminathan and Sharma (1968) and Singh and Singh (1977) gave short duration chemical mutagen treatments on barley and reported an increase in the spectrum of mutations. They also observed time dependance of certain loci for expression of mutant characters. Samolo (1971) gave short duration chemical mutagen treatment on wheat and observed time dependence of certain mutant characters for their expression and widening of spectrum of mutations. The present investigation in greengram was taken up to find out the effect of short duration treatments with EMS on the frequency and spectrum of mutations in M_2 and M_3 generations.

MATERIAL AND METHODS

Seeds of greengram varieties DT. 9-E and TT. 9-E were pre-soaked in distilled water for different durations from 11.00–13.00 hours at half an hour

*A Part of the M.Sc. Ag. thesis submitted by the first author to O.U.A.T. (1976).

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intervals before EMS treatment. Excess moisture from the seeds was blotted out before treating the seeds with 0.25% EMS at 27° C for one hour under reduced atmospheric pressure. The control was pre-soaked for 12.00 hours and was also kept under the same reduced pressure. After treatment, the seeds were thoroughly washed under running tap water for one hour and then sown in the field. Seeds from this generation (M_1) was harvested plantwise and were grown on plant to row basis in the M_2 generation. The cholorophyll, foliar and agronomic mutations were picked out from this generation. The seeds from M_2 plants (excluding macro-mutants) were bulked line-wise to grow the M_3 generation. The M_3 lines were also scored for mutations to know the trend of spectra in later generations. The frequency and spectrum of both the varieties have been considered together for the comparison of M_2 with M_3 generation.

RESULTS AND DISCUSSION

There was a gradual rise in mutation frequency from 11.00 to 12.30 hours of pre-soaking in M_2 generation and upto 13.00 hours in M_3 generation (Table 1). The peak in mutation frequency observed in the treatment after 12.30–13.00 hours of pre-soaking indicates that majority of loci in majority of cells replicate at that time. This provides more scope for the mutagen to act upon more number of loci. Savin *et al.* (1968) observed high mutation frequency in barley after 16 hours of pre-soaking and interpreted that this is due to synchronization of treatment time with S-phase of DNA synthesis. Sahoo and Samolo (1973) from long duration treatment studies suspected the mid S-phase in greengram perhaps correspond to a period around 12 hours of pre-soaking. On similar analogy this study pin points to the period of 12.30–13.00 hours after pre-soaking to correspond to the mid-synthetic phase.

The frequency of mutations observed in M_3 generation was less than that in M_2 generation in all pre-soaking hours. The occurrence of mutations in the M_3 generation indicates delayed effects of EMS. This might also be due to more number of genes controlling a character which gets expression in later generation. Lusina (1970) observed 12.5% decrease in chlorophyll mutations in M_3 generation of peas.

The occurrence of more agronomic mutations than chlorophyll and foliar mutations in the M_2 generation clearly indicates that EMS was an effective mutagen for increasing frequency of beneficial mutations (Table 1). Chlorophyll mutations had wider spectrum after 11.30 hours of pre-soaking, whereas, the foliar mutations had wider spectrum after 12.30 hours of pre-soaking in this generation. On the other hand the agronomic mutations had wider spectrum after 12.00 hours of pre-soaking. The effect of the mutagen is perhaps time dependent for different loci. This is due to differences in the replication time of different groups of loci. Similar results were reported by Swaminathan and Sharma (1968) in barley and Samolo (1971) in wheat.

In the M_3 generation also such difference existed. The widest spectrum of chlorophyll mutations occurred after 12.30 hours, foliar mutations after 13.00 hours and agronomic mutations after 12.00 hours of pre-soaking. This change

TABLE 1

Spectrum and frequency of mutations in M_2 and M_3 generations (in percentage).

Type of Mutations	*M_2 Generation*					*M_3 Generation*				
	Hours of pre-soaking before EMS treatment					*Hours of pre-soaking before EMS treatment*				
	11.00	*11.30*	*12.00*	*12.30*	*13.00*	*11.00*	*11.30*	*12.00*	*12.30*	*13.00*
Chlorophyll										
Xantha	0.05	0.16	0.06	0.17	—	—	0.14	0.14	0.09	—
Chlorina	0.29	0.59	0.25	0.17	0.49	0.27	0.32	0.35	0.62	0.65
Pale green	2.10	2.26	2.23	2.45	1.70	1.21	1.44	1.43	2.24	1.84
Viridis	0.49	0.43	0.70	0.61	0.49	0.34	0.25	0.38	0.26	0.65
Sectorial chimaera	0.93	0.81	0.64	0.79	0.97	0.30	0.22	0.35	0.31	0.28
Total (Chlorophyll)	3.86	4.25	3.88	4.19	3.65	2.12	2.37	2.65	3.52	3.42
Foliar										
Mono-cotyledonary	0.34	0.38	0.51	0.09	—	0.23	0.29	0.07	0.04	—
Tri-cotyledonary	—	—	0.32	0.35	0.49	—	—	0.35	0.44	0.46
Uni-foliata	—	0.22	0.06	0.26	—	—	0.32	0.14	0.22	—
Bi-foliata	0.59	0.75	0.32	0.44	0.97	0.57	0.68	0.66	0.53	0.18
Quadri-foliata	0.93	0.22	0.70	1.57	1.70	1.21	1.04	1.29	1.23	1.94
Penta-foliata	0.20	0.11	—	0.35	—	0.38	0.39	0.52	0.26	0.09
Lobed-loaf	0.20	0.48	0.38	0.35	0.24	0.23	0.18	0.28	0.18	0.37
Obtuse apex	0.39	0.38	0.51	0.52	0.24	0.19	0.04	0.10	0.22	0.28
Waxy leaves	0.98	1.02	1.02	1.40	0.49	0.38	0.25	0.38	0.48	0.65
Total (Foliar)	3.63	3.56	3.82	5.33	4.13	3.19	3.19	3.79	3.60	3.97
Agronomic										
Late	1.56	2.20	1.65	1.48	0.97	0.95	1.40	1.60	1.23	0.92
Early	1.42	1.72	1.91	1.48	2.18	0.61	0.75	0.73	0.66	0.92
Tall	0.68	0.86	1.15	1.14	0.73	0.19	0.22	0.28	0.22	0.37
Dwarf	0.34	0.59	0.83	0.87	0.49	0.30	0.32	0.28	0.40	0.09
Terminal inflorescence	0.29	0.48	0.70	0.52	0.77	0.15	0.32	0.31	0.18	0.28
More branched	0.20	0.48	0.57	0.17	—	0.23	0.11	0.17	0.26	0.18
Long podded	0.15	0.22	0.32	0.17	0.24	0.11	0.07	0.03	0.04	—
Short podded	0.15	0.16	0.06	0.35	—	0.11	—	0.07	0.09	0.09
More podded	0.05	0.11	—	—	—	0.04	0.04	0.03	0.09	0.09
Bold podded	0.10	—	0.19	0.26	—	0.11	0.11	0.03	0.04	—
Fodder type	—	0.11	0.06	—	0.24	0.04	0.04	0.03	—	—
Male sterile	—	0.05	0.13	0.52	0.73	—	0.07	0.14	0.18	0.46
Total (Agronomic)	4.94	6.98	7.57	6.96	6.55	2.84	3.45	3.70	3.39	3.40
Mutation frequency	12.43	14.79	15.27	16.48	14.33	8.15	9.01	10.14	10.51	10.79
Total plants scored	2048	1860	1571	1145	412	2639	2786	2874	2276	1085

in the timing of chlorophyll and foliar mutations may be due to delayed effects of EMS.

The palegreen, quadrifoliata, late, early, tall and dwarf mutants had wider spectrum of mutations in both the generations. These are semi-quantitative characters and are perhaps affected to different degrees and get expressed in different generations. It is also interesting to note that tri-cotyledonary mutations appeared only in treatments after 12.00 to 13.00 hours pre-soakings, whereas, uni-foliata mutatns appeared only in 11.30 to 12.30 hours of pre-soaking. The genes controlling these characters were perhaps affected in the said particular pre-soakings. Singh and Singh (1977) reported occurrence of particular chlorophyll mutations in particular pre-soaking periods in barley.

Widest spectrum of early mutants occurred after 13.00 hours of pre-soaking, whereas, the same for late maturing mutants was observed in the treatment after 11.30 and 12.00 hours of pre-soaking in both the generations. A time gap between these two mutation peaks indicate that genes controlling maturity character were affected by the mutagen at two different times. Thus it can be suspected that maturity in greengram is controlled by two groups of genes, one group tending towards earliness and the other towards lateness.

REFERENCES

Blixt, S. 1967. Studies on induced mutations in peas. 22. Effect of pre-soaking time and treatment temperature in EMS treatment. Agri. Hort. Genet. **25**: 121-130.

Brunner, H. 1977. Mutagenicity of EMS and Sodium azide in grain legumes. *Mutation Breeding News Letter*. **9**: 8-9.

Delgado de la Flor, B. F. 1972. The frequency of mutations induced by gamma-rays and EMS in different stages of germination of bean seeds. IAEA Symposium (Vienna): 447-481.

Lushina, L. I. 1970. Obtaining mutants of peas by treating the seeds with chemical mutagens. Uch. Zap. Kuibyshev. gos. Ped. in-ta. **84**: 35-42.

Sahoo, S. and B. N. Samolo. 1973. Effect of pre-soaking on EMS induced M_1 pollen sterility and M_2 mutation frequency in disploid and tetraploid greengram. *OUAT. J. of Research* **3**: 28-31.

Samolo, B. N. 1971. Induction of mutations in breed wheat and study of genetics of some induced mutants. Ph.D. Thesis, Divn. of Genet. IARI. (Unpublished).

Santos, I. S. 1969. Induction of mutations in Mung bean (*Phaseolus aureus* Roxb.) and genetic studies of some induced mutattions in plants. IAEA Symposium (Vienna): 169-179.

Savin, V. N., M. S. Swaminathan and B. Sharma. 1968. Enhancement of chemically induced mutation frequency in barley through alteration in duration of pre-soaking of seeds. *Mutation Research* **6**: 101-107.

Singh, R. M. and J. Singh. 1977. Mutagenic effects of H. A. in barley through treatments of different periods in the S-phase. *Barley Genetics News Letter*. **7**: 58-59.

Swaminathan, M. S. and N. P. Sharma, 1968. Alteration of mutation spectrum in barley through treatment at different periods in the S-phase of DNA synthesis. *Curr. Sci.* **24**: 685-686.

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Effect of Nitrogen and Spacing on Yield and Quality of 'Hybrid-4' Cotton under Rainfed Condition

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ABSTRACT

A field experiment to evaluate the effect of three levels of nitrogen and nine spacing on 'Hybrid-4-' cotton was conducted for three years from 1975-76 to 1977-78 on loamy sand (*Goradu*) soil of middle Gujarat under rainfed condition. The results indicated that the 50 kg N/ha with spacing 120 x 50 cm² was conducive for higher yield. The moisture use efficiency (kg/mm/ha) was higher under 120 x 50 cm² spacing.

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INTRODUCTION

According to Sawhney and Sikka (1960), the rainfed crop of cotton in India on an average removes 25.8 kg N, 20.2 kg P_2O_5 and 87.4 kg K_2O/ha. Beneficial effect of nitrogen application to cotton has been reported by almost all workers. But there have been variable responses of the crop to different doses of nitrogen varying from 33.6 to 67.2 kg/ha under different sets of conditions (Sharma, 1961 and Garg, 1964).

Optimum spacing between and within rows is an essential pre-requisite for obtaining good yield of cotton crop. Swaminathan (1971) reported that the low plant population is one of the major reasons of low yields of cotton in India. Bederker *et al.* (1956) did not observe any beneficial effect of close spacing on final yield.

Under present day fertilizer constraint and increased price of nitrogenous fertilizers, it was thought worth while to find out the optimum levels of nitrogen and spacing for increased yield of rainfed cotton 'Hybrid-4' under Anand condition.

MATERIALS AND METHODS

This investigation was undertaken at the Gujarat Agricultural University, Anand Campus, Anand during *Kharif* of 1975-76, 1976-77 and 1977-78. Soil of the experimental plot was loamy sand (*goradu* soil). The experiment was conducted on different fields during different years. The fertility status of the experimental site during each year in respect of available nitrogen was 325.2, 340.5 and 380.0 kg/ha during 1975-76, 1976-77 and 1977-78 years, respectively while available phosphorous was 52.8, 58.4 and 107.5 kg/ha and available potassium was 369.6, 336.0 and 322.6 kg/ha, respectively. No phosphorous and potassium was applied as soils are under high group for both the nutrients. The experiment was laid out in a randomized block design with 27 treatments formed by combining three levels of nitrogen (50, 100 and 150 kg/ha) and nine levels of spacing viz. 90 x 45,

90 x 60, 90 x 75, 120 x 35, 120 x 50, 120 x 65, 150 x 75, 150 x 65 and 150 x 35 cm^2 representing a plant population ranging from 9000 to 25000, replicated thrice. The sowing was done in June by dibbling. Gap filling was done by transplanting the seedlings raised in polyethylene bags. Half the quantity of nitrogen was applied as a basal dressing in furrows and the remaining half was top-dressed when the plants were 45 days old.

The pests like aphids, jassids and boll worm were observed during all the three years while the incidence of leaf roller was observed during 1976-77 only. Dimethoate 0.03%, phosphamidon 0.03% were sprayed to control aphids and jassids while endosulfan 0.075%, parathion 0.03% and carbaryl 0.2% were sprayed to check bollworm. The different chemicals were used in different sprayings. In all, six sprayings were carried out.

The cotton seed (after delinting) as well as dry stalks were collected during the year 1977-78 only and composite samples were made for each treatment after mixing all replications. These were analysed for nitrogen, phsophorous and potassium content by standard methods as described by Jackson (1958). The oil content in seed was analysed by Soxhlet's method.

The seed cotton samples were taken from each treatment and replication at the time of final harvest after thorough mixing of seed cotton from each picking and also after cleaning the seed cotton. These were analysed for fibre length, ginning percentage, staple length, uniformity ratio, fineness, maturity coefficient and tenacity for the year 1976-77 and 1977-78.

Total rainfall amounted to 909.9, 1687.1 and 1282.0 mm in 54, 52 and 62 rainy days for the years 1975-76, 1976-77 and 1977-78, respectively against an average annual rainfall of 815 mm of the tract. The rain received during 1975-76, was well distributed up to October without severe drought and incidence of disease or pest. However, during 1976-77, the rain received was double than the average annual rainfall. The higher intensity of rainfall during July and August (28th to 38th standard week) as per fig. 1 favoured the attack of pests as well as adversely affected the vegetative growth. The rain received during November favoured the crop growth. During 1977-78, the rain received was higher than the average annual rainfall but the distribution was erratic. The continuous rain from June to middle of August (24th to 33rd standard week) favoured the occurrence of diseases and pests posing difficulties in their control. The monsoon ceased early.

RESULTS AND DISCUSSION

Yield and yield attributes:

Data on the average yield of seed cotton, dry stalk, number of bolls per plant are presented in Table 1.

The differences in yield of seed cotton in different years are attributed to seasonal variations which modified the growth development and ultimately the yield of the crop. The season during 1976-77 and 1977-78 were favourable up to the month of July with normal growth of the crop. But excessive rains, received

TABLE 1

Effect of nitrogen and spacing levels on yield and yield attributes of cotton.

Treatments	Seed Cotton (q/ha)				Dry Stalk (q/ha)				No. of bolls/plant			
	1975-76	1976-77	1977-78	Mean	1975-76	1976-77	1977-78	Mean	1975-76	1976-77	1977-78	Mean
N-Levels, kg/ha												
50	14.21	12.96	8.74	11.97	30.9	24.6	15.8	23.79	15.9	49.2	21.1	28.75
100	15.91	10.34	10.47	12.24	31.2	20.4	19.2	23.60	18.6	50.5	21.8	30.32
150	15.93	9.00	11.48	12.16	32.9	16.7	22.5	24.03	21.3	47.7	24.7	31.26
SEm ±	0.61	0.86	0.52	0.55	2.2	1.13	0.83	2.16	1.93	3.35	1.09	1.2
CD at 5%	NS	2.44	1.49	NS	NS	3.19	2.36	NS	2.64	NS	3.10	NS
Spacings, cm²												
90 x 45	17.50	13.45	10.87	13.49	39.9	22.5	19.4	27.27	12.8	45.5	16.7	24.99
90 x 60	16.11	11.95	11.00	13.02	34.7	20.9	19.7	25.11	17.1	61.0	21.7	33.27
90 x 75	16.16	10.58	10.19	12.32	30.9	20.7	18.1	23.21	21.1	53.8	24.0	32.99
120 x 35	16.67	10.24	9.78	12.23	34.1	21.6	17.3	24.33	14.1	38.2	16.3	22.87
120 x 50	17.53	13.61	12.10	14.41	40.6	23.9	22.1	28.85	17.8	43.9	24.4	28.10
120 x 65	17.29	10.87	9.97	12.78	37.1	22.1	18.7	25.93	20.3	57.7	24.4	34.17
150 x 75	13.06	8.81	9.03	10.30	22.4	17.5	17.6	19.16	25.8	50.9	29.6	35.43
150 x 65	11.64	6.80	8.54	8.99	20.2	14.6	15.7	16.83	21.9	49.0	26.1	32.31
150 x 35	12.19	10.63	10.63	11.15	25.6	21.3	23.9	23.58	16.8	42.1	19.9	26.27
SEm±	1.07	0.50	0.90	0.95	3.7	1.9	1.4	2.14	1.61	5.81	1.89	2.12
C.D. at 5%	3.04	1.41	NS	2.63	10.6	NS	4.1	6.42	4.57	NS	NS	5.91
N x Spacing												
SEm ±	1.87	1.49	2.46	0.96	6.44	3.38	2.49	2.50	2.79	10.06	3.28	3.74
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

during August in 1976-77 and early cessation of rain during 1976-77 and 1977-78 when the crop was in flowering and fruiting stage, caused severe set back to the crop.

The differences due to application of nitrogen were significant for seed cotton and dry stalk yields for 1976-77 and and 1977-78 only. During the 1976-77 the application of 50 kg N/ha gave higher seed cotton yield over 100 and 150 kg N/ha. But in 1977-78, the application of 150 kg N/ha gave higher yield over 50 kg N/ha while it was at par with 100 kg N/ha. The dry stalk yield was increased with the increase in nitrogen levels in 1977-78 while reverse trend was observed in 1976-77. The pooled analysis showed that the application of nitrogen has no significant effect on seed cotton and stalk yields. This shows that the application of 50 kg N/ha is sufficient for cotton 'Hybrid-4' under rainfed condition. The result is in agreement with Garg (1964) and Sanap et al. (1978). The number of bolls per plant differed significantly during 1975-76 and 1977-78. The pooled analysis showed that the nitrogen application had no significant effect on the boll number per plant.

The data on the effect of spacing revealed that the differences in seed cotton yield were significant during first and second year only. The pooled analysis indicated that the spacing of 120 x 50 cm² was at par with 90 x 45, 90 x 60, 90 x 75, 120 x 35 and 120 x65 cm² spacings, but it was significantly superier to rest of the spacings. The spacings of 90 x 45, 90 x 60, 90 x 75, 120 x 35 and 120 x 65 cm² were superior to 150 x 65 cm², while 90 x 45 and 90 x 60 cm² were superior over 150 x 75 cm². The spacing 120 x 50 cm² was better as compared to other spacings although they were at par statistically. It is also relatively more convenient for cultural operations requiring less seed rate of 'Hybrid-4' which is quite costly. The dry stalk yield showed significant differences during the first and third years and remained unaffected during the second year. The pooled analysis indicated that the spacing of 120 x 50 cm² gave higher dry stalk yield and was superior over 150 x 75 and 150 x 65 cm². The number of bolls per plant was significant in the first year but non-significant during 1976-77 and 1977-78.

The interaction of nitrogen x spacing and other interaction viz., year x spacing, year x nitrogen and year x nitrogen x spacing were not significant for seed cotton and stalk yields as well as number of bolls per plant.

Quality:

It was observed that the ginning percentage, fineness and maturity coefficient decreased with the increase in level of nitrogen while other characters did not show any definite trend (Table 2). Practically the qualitative characters remained unaffected due to different spacings. The reduction in ginning percentage with the increase in nitrogen application may be due to increase in the seed weight and addi-

TABLE 2

Effect of nitrogen and spacing levels on the quality characters of cotton (Mean of (1976-77 and 1977-78).

Treatments	*Mean fibre length, mm*	*Ginning, %*	*Staple length, mm*	*Uniformity ratio, %*	*Fineness, micronaire*	*Maturity Coefficient*	*Tenacity, g/tex.*
N-Levels, kg/ha							
50	27.9	32.7	31.1	47	3.7	0.80	46.6
100	27.8	31.8	31.0	48	3.5	0.78	46.1
150	28.0	31.7	31.1	47	3.5	0.78	46.4
Spacing, cm²							
90 x 45	27.0	32.1	31.1	48	3.6	0.79	46.1
90 x 60	27.8	32.2	31.0	48	3.6	0.79	46.3
90 x 75	28.0	32.4	31.2	47	3.6	0.79	46.5
120 x 35	27.8	31.3	30.9	48	3.4	0.77	46.5
120 x 50	27.8	32.3	31.0	48	3.7	0.80	45.7
120 x 65	27.7	31.8	30.8	48	3.6	0.79	46.0
150 x 75	27.8	32.3	31.0	48	3.6	0.79	46.5
150 x 65	28.0	32.5	31.1	47	3.4	0.77	46.9
150 x 35	28.2	31.8	30.9	48	3.6	0.79	46.8

TABLE 3

Effect of nitrogen and spacing levels on the nutrient content of seed and dry stalk and oil percentage in cotton seed.

Treatments	Cotton seed			Oil Content, %	Dry Stalk		
	N%	P%	K%		N%	P%	K%
N-Levels, kg/ha							
50	3.31	1.24	3.10	22.89	0.72	0.262	2.51
100	3.40	1.20	3.10	22.20	0.92	0.247	1.33
150	3.49	1.17	3.04	21.20	1.03	0.219	1.13
Spacings, cm^2							
90 x 45	3.51	1.24	3.13	22.13	0.92	0.215	0.25
90 x 60	3.48	1.20	3.13	23.05	0.82	0.223	1.25
90 x 75	3.22	1.23	2.98	22.18	0.90	0.234	1.28
120 x 35	3.49	1.18	3.03	22.33	0.98	0.266	1.32
120 x 50	3.52	1.28	3.15	22.01	0.99	0.269	1.32
120 x 65	3.27	1.23	3.06	23.36	0.91	0.255	1.28
150 x 75	3.16	1.14	3.10	22.26	0.91	0.247	1.20
150 x 65	3.24	1.25	3.05	22.50	0.88	0.225	1.23
150 x 35	3.25	1.19	2.93	22.96	0.86	0.253	1.13

tional nitrogen might have been utilized in the synthesis of seed material as observed by Verma *et al.* (1965). Iyengar (1941) also observed lack of definite relation between fibre length and nitrogen application.

Nutrients content:

The application of nitrogen increased the nitrogen content in cotton seed as well as in dry stalk, while phosphorus and potassium content decreased (Table 3). No definite trend was observed with the different spacings. The increase in nitrogen application decreased the oil percentage. However, no definite trend was observed with the different spacing. Similar results in other oil-seed crops were also reported by Bhan and Singh (1973) and Mitchell *et al.* (1974).

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REFERENCES

Bederker, V. K., G. C. Shaligram and J. N. Kapadnis. 1956. Studies on agronomy of Gaorani Cotton V. spacing. Proceeding of the 7th Conf. on Cotton Growing Problems in India, pp. 126-134.

Bhan, S. and A. Singh, 1973. Studies on the fertilizer requirements of sesame in central tract of U.P. *Indian J. Agric. Res.* **7:** 39-42.

Garg, K. P. 1964. Effect of levels, forms and methods of application of nitrogenous

fertilizers on cotton. *India Cotton Grow. Rev.* **18:** 286-293.

Iyenger, R.L.N. 1941. Indian J. Agric. Sci. 2: 876-878.

Jackson, M. L. 1958. Soil chemical Analysis. Prentic-Hall Inc. Engalewood Cliffs., N.J.

Mitchell, M. A., F. T. Bingham and D. M. Yermanous. 1974. Growth, mineral composition and seed characteristics of sesame as affected by nitrogen, phosphorous and potassium nutrition. *Field Crop Abstr.* **28:** 570.

Sanap, M. G., U. G. Kurlekar and K. R. Pawar. 1978. Boll development and yield of cotton (*Gossypium hirsutum*) variety N D 9 as influenced by varying plant density and nitrogen levels. *Madras Agric. J.* **65:** 760-762.

Sawhney, K. and S. M. Sikka. 1960. "Cotton in India" Monograph volu. II Indian Central Cotton Committee, Bombay.

Sharma, H. P. 1961. A preliminary study on the effect of sowing time, spacing and manuring on the yield of cotton in U.P. *Indian Cotton Grow. Rev.* **15:** 297-302.

Swaminathan, M. S. 1971. Forward, Seminar on cotton production problems and prospects, held at Regional Res. Station (I.A.R.I.) Sirsa (Haryana) on 11-12th Oct. 1971.

Verma, S. S., P. S. Lamba and H. P. Dwivedi. 1965. Response to doses of N, P and K on development and yield of indigenous and American Cotton. *Indian J. Agron.* **10:** 170-177.

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Estimation of Useful Rain for Groundnut Crop (*Arachis hypogaea* L.) in Saurashtra Region

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ABSTRACT

Effect of rainfall distribution on groundnut crop was studied by employing the concept of "Useful Rain" which was determined on daily basis. Reported yield for groundnut in Rajkot, Keshod, Mahuwa, Bhavnagar and Jamnagar in Saurashtra Region was found linearly related with useful rain. The correlation coefficient (R) between reported and estimated yield for above places was found to be 0.696, 0.557, 0.715, 0.666 and 0.849, respectively. The relationship was highly significant for all places except Keshod where it was only significant. The use of useful rain as a parameter in rainfall crop yield relationship is observed to be better than total rain.

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INTRODUCTION

In India, the area under groundnut cultivation is reported to be about 69.0 lakh hectares with an average yield of 840 kg/ha and thus accounts for about 37% of world average area and 33% of world production (Anonymous, 1975). In Gujarat alone this crop is sown in 15.82 lakh hectares of which approximately 85% is covered in Saurashtra region mainly in Junagadh, Jamnagar, Rajkot, Bhavnagar and Amreli districts and produces on an average 785 kg/ha (Anonymous, 1974). The success of any *Kharif* crop depends on amount of rainfall and frequency of rain days with effective rainfall in respect of the availability of water to the plant during the crop growing season. It becomes even more important for groundnut cultivation in areas with untimely and scarce rainfall. Singagi (1964) carried out a study to know the effect of rainfall distribution on the yield of groundnut in Raichur tract of Mysore State and summerised that well distributed rainfall ranging from 575 mm to 625 mm appeared to be quite sufficient to get good yield of wheat crop at crop weather observatories located at Parbhani, Niphad, Powerkhera, Dharwar and Jalgaon where the crop is entirely rainfed. They concluded that, about 75% of the total variation in yield could be accounted for by the rainfall distribution constant. Joshi and Kabaria (1973) carried out the study and observed that only once in three years, the distribution of rainfall was favourable for the bunch variety of groundnut in Saurashtra region.

In view of varying rainfall with respect of amount. time and space, an attempt was made to assertain useful rainfall for groundnut cultivation in Saurashtra region.

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MATERIALS AND METHODS

Location : The geographical situation of various stations under study are give in (Table 1).

TABLE 1

Location of various stations under study of groundnut growing area (Saurashtra Region).

Sr. No.	*Station*	*District*	*Latitude*	*Longitude*
1.	Rajkot	Rajkot	22°.18'N	70°.47'E
2.	Keshod	Junagadh	21°.18'N	70°.15'E
3.	Mahuwa	Bhavnagar	21°.05'N	71°.47'E
4.	Bhavnagar	Bhavnagar	21°.45'N	72°.12'E
5.	Jamnagar	Jamnagar	22°.29'N	70°.04'E

Source and Period of data:

Daily temperature data for the period 1960-61 to 1974-75 were collected from the India Meterological Department, Poona and Meterological Station (Air Port), Ahmedabad. The daily rainfall and crop yield data were obtained from the office of the Director of Agricultuer, Gujarat State, Ahmedabad. The data on soil physical characteristics (Table 2) utilized in this study were taken from the record of different trial -cum-demonstration farms situated in respective districts.

TABLE 2

Soil physical characteristics data of various stations under study.

Depth of effective root zone, mm	*Depth of water at field capacity (FC) and permanent wilting percentage (PWP), mm*									
	RAJKOT		*KESHOD*		*MAHUWA*		*BHAVNAGAR*		*JAMNAGAR*	
	FC	*PWP*	*FC*	*PWP*	*FC*	*PWP*	*FC*	*PWP*	*FC*	*PWP*
150	54.6	30.9	58.0	32.5	57.6	25.4	49.7	25.3	54.2	23.2
300	128.3	72.9	116.9	65.1	113.4	46.8	101.8	54.6	106.5	47.7
450	202.6	114.9	188.3	97.6	172.4	70.3	153.3	83.8	161.9	77.5
600	274.9	156.9	251.1	130.2	234.0	96.5	205.4	112.3	211.0	93.8

Useful rain:

Useful rain for the purpose of this study was defined as the amount of rainfall, which charged the soil moisture storage in plant root-zone after deducting the potential evapotranspiration loss. The rainfall in excess of field calacity of root-zone received during the day after deducting potential evapotranspiration, was considered as combined loss due to runoff, percolation and deep drainage (Lewin, 1972). The remaining amount of rainfall after deduction of these combined losses was considered as useful rain. This moisture is stored in the root-zone of soil for subsequent use in the dry period. In other words useful rain has been formuleted as

$$RU = TP - [(TP - FC) - PE]$$

Where:

RU = Useful rain in mm

TP = Total preciption received in mm

PE = Potential evapotranspiration in mm

FC = Field capacity in mm

Potential Evapotranspiration:

The daily potential evapotranspiration was calculated by using formula of Thernthwaite (1948), and was adjusted by multiplying with the day length factor 'l' for different months of the monsoon season, corresponding the latitudes of different stations to obtain the adjusted potential evapotranspiration.

Book-keeping procedure:

In a simple book-keeping procedure, the depth of effective root-zone (0-60 cm) for groundnut crop was considered periodically (Table 3). The depth-wise maximum water holding capacity was considered at field capacity as mentioned in (Table 2). Excess of precipitation over maximum water holding capacity (amount of water held at field capacity in root-zone) was discarded as the combined loss in runoff, percolation and deep drainage.

TABLE 3

Root depth at different phases of bunch groundnut crop.

Stage of plant growth	*period, days*	*Root depth, cm*
Germination and vegetative development	0–22	15
Flowering and pegging	23–50	30
Full pegging to pod development	51–80	45
Maturity	81–100	60

Relating yield with estimated useful rain:

The expected yields were estimated for each station by fitting the trend equation of the form $y = a + bx$. The agreement between the estimated yield and reported yield was tested by the correlation coefficient 'R'.

RESULTS AND DISCUSSION

The useful rain varied from 106 to 582.8 mm, 103.3 to 606 mm, 220.6 to 582.8 mm, 103.3 to 538.9 mm and 97.6 to 593.1 mm at Rajkot, Keshod, Mahuwa, Bhavnagar and Jamnagar, respectively. The data of Mahuwa station showed that not only the amount of average useful rain was higher than other stations but the lower limit of useful rain was also high. This meant that more amount of precipitation is contributed in accumulation of soil moisture at this station. From the results of availability of useful rain, it can be fairly assumed that, for the purpose of growing the groundnut, the rainfall distribution pattern would rank the stations in the descending order as –Mahuwa, Bhavnagar, Keshod, Rajkot and Jamnagar.

Relationship of useful rain with yield:

The relationship between computed useful rain and the reported average yield (District average) was found fairly linear ($R > 0.557$) fitting a linear equation of the form $Y = a + b x$ (Table 4).

TABLE 4

Linear equation and the values of correlation coefficient (R) for different stations under study.

Station	*Linear equation*	*'R'*	*'R'²*
Rajkot	Ye = 49.95 +1.530 RU	0.696**	0.484
Keshod	Ye = 322.42+1.558 RU	0.557*	0.310
Mahuwa	Ye = (–70.35)+1.497 RU	0.715**	0.511
Bhavnagar	Ye = 94.14+1.286 RU	0.666**	0.444
Jamnagar	Ye = (–71.62)+2.270 RU	0.849**	0.721

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

Ye=Expected yield, kg/ha.

RU=Depth of useful rain per unit area, mm.

The value of 'R' indicating the closeness of fit was highly significant for all the stations except Keshod, where it was observed only significant. Similar findings have also been reported by the other research workers. Gangopadhyaya and Sarkar (1970) concluded that about 75 per cent of the total variation in yield could be accounted for the rainfall distribution constant. Lewin (1972) estimated soil moisture from the total rainfall by considering the water losses in the same way as considered in this study and observed that the decrease in the soil moisture below the critically chosen level (10.6%) on a day during the growth period reduced the yield by one-half of a per cent of the potential yield. Lahane and Staple (1965) have shown that rainfall distribution during the season gave better estimation of yield than equation using total seasonal rainfall only. Joshi and Radder (1975) in a field experiment observed very low yield of groundnut mainly due to reduction in the total amount of precipitation as well as long dry spell in the month of September coinciding with the peak period of pod development.

TABLE 5

Total and estimated useful rainfall of the season for the various stations under study during 1960-61 to 1974-75, mm.

Year	*Rajkot*		*Keshod*		*Mahuwa*		*Bhavnagar*		*Jamnagar*	
	Total rain	*Useful rain*	*Total rain*	*Useful rain*	*Total rain*	*Useful rain*	*Total rain*	*Useful rain*	*Total rain*	*Useful rain*
1960-61	523.0	312.6	525.0	347.7	413.3	393.5	422.0	281.1	296.1	207.8
1961-62	742.6	480.8	1233.0	606.0	672.9	582.8	455.7	399.8	952.4	593.1
1962-63	339.7	299.9	742.4	456.0	532.1	366.1	349.2	276.6	275.4	257.3
1963-64	470.5	381.0	624.6	384.4	584.1	410.4	601.4	409.7	221.3	206.9
1964-65	751.8	401.2	—	—	682.4	550.6	494.0	313.7	563.9	321.4
1965-66	450.8	273.4	515.4	351.3	441.6	372.3	394.1	377.6	304.3	263.9
1966-67	435.5	373.0	518.5	339.5	274.3	220.6	516.2	394.7	260.6	244.6
1967-68	426.8	307.0	816.4	490.9	521.5	398.9	558.9	428.5	727.3	322.7
1968-69	589.4	308.3	574.8	246.1	446.3	300.0	719.5	254.7	374.5	208.2
1969-70	306.1	256.3	649.5	308.7	618.9	409.1	455.6	342.4	280.6	193.9
1970-71	1149.8	503.5	784.5	478.6	871.5	564.9	1371.0	538.9	713.2	441.2
1971-72	533.0	366.6	889.9	402.9	802.2	551.5	527.7	395.7	694.9	319.4
1972-73	342.3	167.0	483.1	130.3	307.2	262.4	191.9	141.3	229.6	112.2
1973-74	319.5	291.7	800.3	276.5	637.6	438.6	808.0	431.5	494.6	453.3
1974-75	106.0	106.0	330.0	338.0	266.8	257.7	106.0	106.0	110.5	97.6
Average	499.12	321.86	678.24	368.41	538.18	405.29	339.48	339.48	433.28	282.90

The results obtained in this study are in contrast to those obtained by Joshi and Kabaria (1973), who found that neither the total rainfall nor the number of rainy days had any relationship with the yield of groundnut. However, they mentioned that only once in three years, the distribution of rainfall was favourable for the bunch groundnut in Saurashtra region. It is inconceivable for the rainfed crop like groundnut to accept that the rainfall has no relation with yield. What is more important is consideration of rainfall in terms of the apporpriate parameter contributing the effective rainfall for the purpose of the crop performance.

Though correlation coefficient is statistically significant under the Null hypothesis R = O, the regression equation fitted explained the total variation of only 48.4, 31.0, 51.1, 44.4 and 72.1 per cent for Rajkot, Keshod, Mahuwa, Bhavnagar and Jamnagar, respectively. Eventhough in comparision with the conventional parameters like total rainfall and the number of rainy days, the useful rain parameter was observed to be better in rainfall-crop-yield relationship than the total rain. The reason for the better behaviour of the parameter 'useful rain' lies in the fact that it is based on consideration of Soil Physical Parameters concerned with the soil moisture available for plant growth. Hence careful analysis of temporal distribution of rainfall, preferably on a daily basis, was essential for realistic assessment of soil moisture accumulation.

REFERENCES

Anonymous, 1974. Area production and yield per hectare of important food and non-food crops in Gujarat State (1949-50 to 1973-74) Department of Agriculture, Gujarat State, Ahmedabad: 1-6.

Anonymous, 1975. Summary of the All India Final estimates of principal crops, Agricultural situation in India, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India (Nov. 1975): 621-23.

Gangopadhyaya, N. and R. P. Sarkar, 1965. Influence of rainfall distribution on the yield of wheat crop. *Agri. Meteorol.* **2:** 331-50.

Joshi, S. N., and M. M. Kabaria, 1973. Effect of rainfall distribution on yield of groundnut (*Arachis hypogaea*, L.) in Saurashtra. *J. Agric. Sci.* **42**(8); 681-84.

Joshi, M. S., and G. D. Radder, 1975. The performance of groundnut under paired row culture and two level of fertility *Indian J. of Agron.*, **20**(2): 164-65.

Lehane, J. J. and W. J. Staple, 1965. Influence of soil texture, depth of soil moisture storage and rainfall distribution on wheat yield in South-Western Saskatchewan. *Can. J. Soil Sci.* **45:** 207-19.

Lewin, J., 1972. A simple soil water stimulation model for assessing the irrigation requirement of wheat. *Israel J. of Agric. Res.* **22**(4): 201-14.

Singagi, S. S., 1964, Effect of rainfall distribution on the yield of groundnut in Richar tract of Mysore state. *Indian Oil Seed J.* **8**(1): 41-43.

Thornthwaite, C. W., 1948. An approach towards a rational classification of climates. *Geog. Rev.* **38:** 55-94.

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Field Evaluation of Some Insecticides Against Stem Fly, *Melanagromyza phascoli* Coquillete Infesting Green gram, *Vigna radiata* (L) Wilczeck*

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ABSTRACT

Stem fly, *Melanagromyza phaseoli* Coq. is an important pest of green gram during early stages of the crop growth and it considerably reduces the grain yield. Field evaluation studies revealed that 4% seed treatment with carbofuran, phorate and disulfoton were effective in controlling the stem fly in green gram. Among the two granular formulations, phorate, 10G proved better than disulfoton 5G at both the dosages of 1.0 and 1.5 kg. a.i./ha during *kharif* as well as summer seasons.

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INTRODUCTION

Stem fly, *Melanagromyza phaseoli* Coq. is one of the important pests of green gram during the early stages of crop growth. In case of severe infestation, more than 10% of plants are dried up and thus the grain yield is considerably affected. It has been found that summer as well as *kharif* cultivation of this crop badly suffer if adequate plant protection measures are not taken in advance. Saxena *et al.* (1972) reported that basal application of disulfoton granules @ 1.5 kg a.i./ha at the time of sowing the crop is an effective treatment against this pest on summer *moong*. According to Verma and Pant (1975) soil application of phorate @ 1.5 kg a.i./ha at the time of sowing gave significant protection against stem fly, both in *kharif* as well as summer seasons. Ghar and Maksond (1960) reported that seed dressing with 50% phorate or disyston @ 2 and 8 lb/100 lb of seeds gave effective protection against snap been fly, *Agromyza phaseoli Coq.*for 2-3 weeks after germination. Attempts have been made in this paper to present and discuss the results obtained with some insecticides against this pest in a field testing trial carried out at Indian Agricultural Research Institute, Delhi during 1976-78.

MATERIALS AND METHODS

Replicated experiments were carried out using disulfoton 5G and phorate 10G @ 1.0 and 1.5 kg a.i./ha, 1%, 2% and 4% seed treatments with disulfoton and phorate and 4% seed treatment with carobfuran. PS-7 variety of green gram was sown @ 15 kg/ha with row to row distance of 0.30 m. There were 6 rows of 3.5 m length and the plot size was 3.5 m x 1.8 m.

*Part of thesis of the senior author approved for Ph.D. Degree of P. G. School, IARI, New Delhi.

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Both disulfoton 5G and phorate 10G supplied by M/s. Bayer India Ltd. and M/s. Cynamid India Ltd., respectively were applied in furrows before sowing the seeds. Seed treatments with these chemicals were given by preparing 50% powder in laboratory from technical material received from the manufacturers and the seeds were treated by using white acasia gum as sticking agent. Carbofuran 50 SP supplied by M/s. Rallis India Ltd., was used for treating the seeds.

Total number of plants and the number of plants infested by stem fly were counted in three rows in each plot when the crop was about 4 weeks old and the percentages of plants damaged by the stem fly in various treatments were calculated. The data thus obtained were subjected to arc $\sqrt{\sin}$ = angular transformation values and analysed statistically.

RESULTS AND DISCUSSION

Mean values of average percentages of infested plants by stem fly in various insecticidal treatments are presented in Table 1.

Perusal of the data reveals that the average percentage of infested plants by the stem fly during *kharif* 1976 ranged from 1.70 in 4% seed treatment with carbofuran to 13.49 in control. All the insecticidal treatments showed significant effect in controlling the stem fly, however, 4% seed treatment with carbofuran was the best followed by phorate 10G @ 1.5 kg a.i./ha. Soil application with phorate 10G and disulfoton 5G granules were also at par in their effect.

TABLE 1

Percentage infested plants by the stem fly, *Melanagromyza phaseoli* **Coq., after 30 days of sowing. (Mean of four replications).**

Treatments	*Percentage infested plants by stem fly*			
	Kharif		*Summer*	
	1976	*1977*	*1977*	*1978*
Disulfoton 5 G @ 1.0 kg a.i./ha	—	—	—	8.13 (17.34)
Disulfoton 5 G @ 1.5 kg a.i./ha	5.68 (14.43)	10.15 (19.59)	6.85 (13.63)	—
1% seed treatment with disulfoton	8.71 (18.46)	—	—	—
2% seed treatment with disulfoton	—	11.58 (21.09)	9.23 (18.30)	—
4% seed treatment with disulfoton	—	—	—	2.23 (8.20)
Phorate 10 G @ 1.0 kg a.i./ha	—	—	—	2.98 (10.97)
Phorate 10 G @ 1.5 kg a.i./ha	2.89 (10.70)	4.92 (13.77)	2.19 (7.89)	—
1% seed treatment with phorate	6.74 (15.48)	—	—	—
2% seed treatment with phorate	—	10.83 (10.85)	9.69 (18.59)	2.10 (9.05)
4% seed treatment with phorate	—	—	—	1.17 (5.55)
4% seed treatment with carbofuran	1.70 (7.02)	2.38 (8.89)	1.78 (7.18)	12.08 (21.53)
Control (untreated)	13.49 (22.67)	14.61 (23.19)	11.55 (20.51)	2.18
S. Em.	1.92	0.87	3.34	4.64
C. D. @ 5%	4.08	1.85	7.11	

Note: Figures in parentheses are means of angular transformed values.

Almost similar trend in the results was also observed during *kharif* 1977 but phorate 10G differed significantly with disulfoton 5G and 4% seed treatment with carbofuran.

In the experiment carried out during Summer 1977, 4% seed treatment with carbofuran was significantly superior but the treatment of soil application with phorate 10G and disulfoton 5G @ 1.5 kg a.i./ha also proved equally effective against stem fly infestation. During summer 1978, 4% seed treatment with carbofuran again showed least damage by the stem fly but it did not differ significantly with 4% seed treatment with disulfoton and phorate. There were also non-significant differences among 4% seed treatment with phorate, 4% seed treatment with disulfoton and phorate 10G @ 1.0 kg a.i./ha. Disulfoton 5G @ 1.0 kg a.i./ha and control (untreated) were at par. This indicates that the reduced dose of disulfoton was not effective against the stem fly as compared to the same dosage of phorate 10G.

The results, thus show that the treatments with 4% seed treatment of carbofuran, phorate and disulfoton were more effective in controlling stem fly as compared to the rest of the treatments. Among the two granular formulation, phorate 10G, proved better than disulfoton 5G. The efficacy of phorate and disulfoton granules and seed treatments with these insecticides are in close agreement with such results reported earlier by various workers (Saxena *et al.*, 1972; Verma & Pant, 1975; Ghar and Maksond, 1960). However, the information regarding the bioefficacy of 4% seed treatment with carbofuran, phorate and disulfoton in green gram is a new contribution in this particular field.

REFERENCES

Ghar, M. R. A. and M. A. Maksond, (1960). Preliminary experiments on the control of snap bean fly. *Agromyza phaseoli* Coq. (Diptera: Agromyzides). *Bull. Soc. Ent. Egypt.* **44:** 97-103.

Saxena, H. P., A Phokela and Y. Singh (1972) Entomological research work carried out during *Rabi* 1971-72 in the Division of Entomology, I.A.R.I., New Delhi *Proc. 8th Workshop* (Rabi pulses): 236-243.

Verma, S. and N. C. Pant (1975). Effect of Phorate and Endosulfan on 'Moong' and 'Arhar' crops. Entomologists' *News Letter* **5**(5): 25.

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Studies on Causes of Disposal in Kankrej Cattle Herd

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ABSTRACT

Causes of disposal of cows and heirfers of Kankrej herd at Anand were investigated and production level of culled cows was studied.

Average annual disposal of cows and heirfers was 29.54± 6.26 and 12.21± 0.62 per cent of their respective average strength in the herd. Low yield (40.49%)' breeding troubles (20.07%) tuberculosis (6.69%) and old age (5.63%) were the major reasons for disposal of cows due to sale. Similarly' accidents (10.98%), old age (6.85%) and diseases (72.19%) were the major reasons for disposal due to death. Tuberculosis (30.10%) and tympany (9.59%) were observed to be the main causes responsible for causing death.

Of the total heirfers sold, 43.47% were sold with dam, 10.70% due to breeding troubles, 18.90% for breeding purpose. Disposal due to death constituted of 10.85% at birth, 19.53% due to accidents and 63.11% due to diseases.

The average daily milk production of those sold due to low production, breeding troubles and for breeding purpose was 2.45± 0.28 kg, 3.48± 0.46 kg and 3.72 kg against the average daily milk production of 4.75± 0.39 kg for whole herd.

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INTRODUCTION

Knowledge regarding causes of disposal of cows or heifers from the dairy cattle herd is of great significance to intensify the managemental practices on certain rectifiable causes so as to minimize the losses of highly productive animals. Further, it also helps in maintaining the herd strength and production level at an optimal target level. Moreover, it also aids in making rapid improvement through slection.

Large quantum of information is available on this aspect for herds of temperate countries (Seath, 1940, Asdell, 1951, Leech *et al.* 1960; White and Nichols, 1965 and Fosgate, 1965). However, for herds of tropical countries like us, such information seems very limited except that reported by Dutt and Desai (1968) and Chhikara and Balaine (1977). Therefore, in the present paper an attempt has been made to present some information on disposal pattern of Kankrej cattle herd.

MATERIALS AND METHODS

The data of 20 years (1951-52 to 1970-71) were compiled from records of Kankrej cattle breeding farm at Institute of Agriculture, Anand. Since the main objective of the study was to analyse the causes of disposal of cows and

heifers, the herd register, birth and death register and sale register were studied critically. In order to compare the level of production the overall average daily milk production of the whole herd in a given year and the average daily milk production of the culled animals for the previous year were considered.

The average total herd strength for the period of study was 178.09 units. The average strength of cows and heifers was 60.43 ± 2.60 and 83.54 ± 3.49 units.

RESULTS AND DISCUSSION

Disposal of cows:

Analysis of the data showed that average annual disposal of cows was 29.54 ± 6.26 per cent of the average strength of cows. The proportion observed in this study is in agreement with the findings of Seath (1940), Asdell (1951), Leech *et al.* (1960) and O'connor and Hodges (1963) for herds of temperate climate.

Analysis of the data further revealed that 79.55 per cent of the total disposal of cows was by sale and 20.45 per cent due to deaths. Various causes of disposal with their respective percentage are presented in Table 1.

TABLE 1

Causes and percentage of disposal of cows.

Disposal by sale				*Disposal due to death*			
Causes	*Number culled*	*% of sold*	*% of total disposal*	*Causes*	*Number culled*	*% of died*	*% of total disposed*
Low yield	115	40.49	32.22	Tuberculosis	22	30.14	6.16
Breeding trouble	57	20.07	15.97	Weak	12	16.44	3.36
Weak	23	8.10	6.44	Accident	8	10.96	2.24
Tuberculosis	19	6.69	5.32	Old age	5	6.85	1.40
Old age	16	5.63	4.48	Tympany	7	9.59	1.96
Breeding purpose	12	4.23	3.36	Other diseases	18	24.66	5.05
Mastitis	9	3.17	2.52	Unknown	1	1.37	0.28
Blind teats	8	2.82	2.24				
Other reasons	25	8.80	7.00				
Total	284	100.00	79.55	Total	73	100.00	20.45

From Table it can be seen that of the cows sold, 40.49% were due to low yield, 20.07% due to breeding troubles, 6.69% due to tuberculosis, 5.63% due to old age and 19.31% due to other reasons.

Of the total deaths 6.85% died due to old age, 10.96% due to accidents, 30.14% due to tuberculosis and 52.05% due other diseases and unknown reasons.

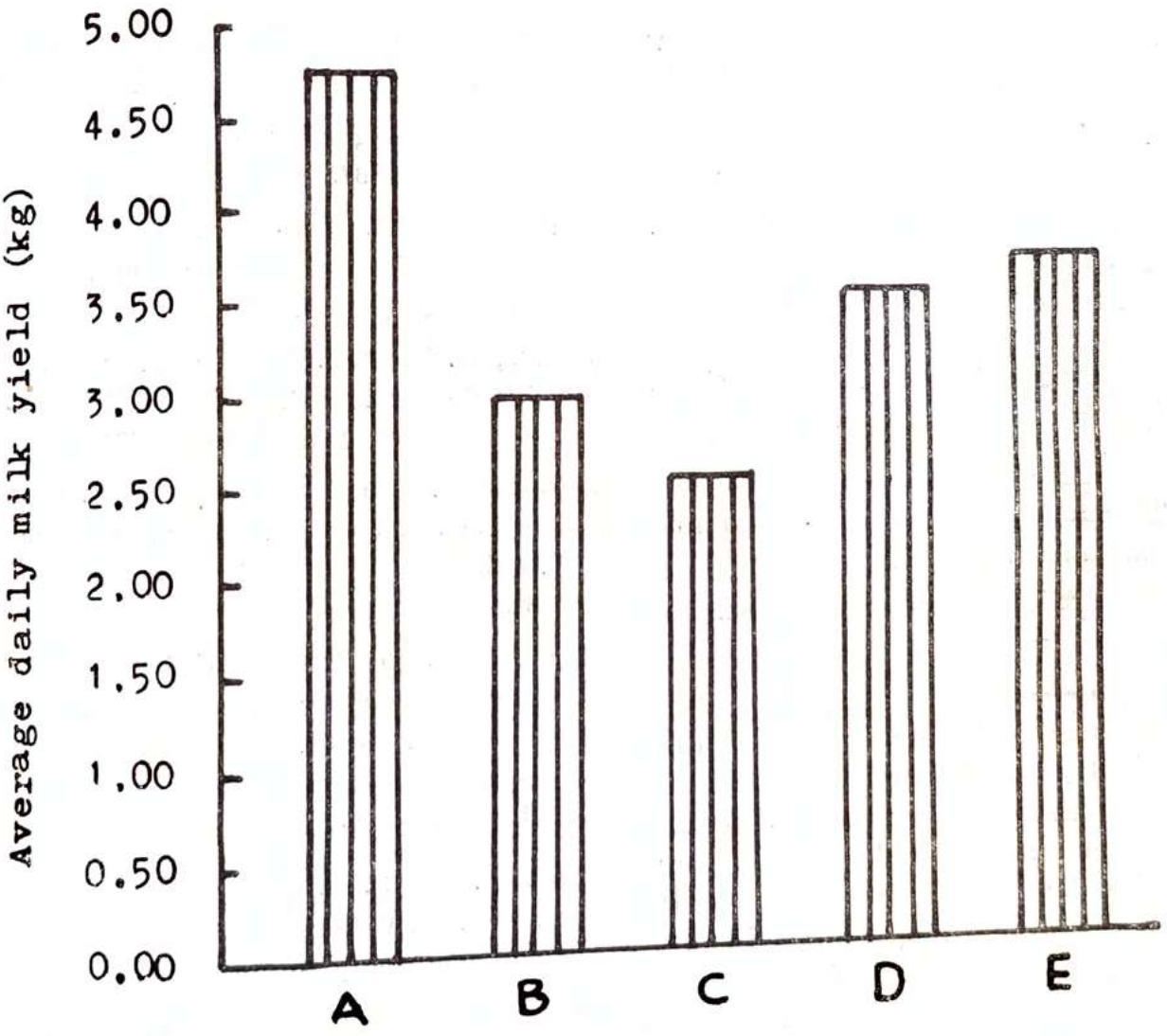
The results are broadly in agreement with those reported by Seath (1940), Becker *et al.* (1954), White and Nichols (1965) Dutt and Desai (1968) and Chhikara and Balaine (1977).

Thus, analysis of the data very clearly indicated that low milk yield, breeding trouble, old age and extremely high incidence of tuberculosis were the major reasons for disposal of cows. Chikkara and Balaine (1977) observed considerably low incidence of reproductive disorders and tuberculosis as compare to this study.

Production level and disposal of cows:

The production levels of the cows sold due to different reasons are presented in Figure 1.

Figure-1 : Performance level of the herd and the cull cows.



A = Whole herd.
B = All cows sold.
C = Sold due to low production.
D = Sold due to breeding trouble.
E = Sold for breeding purpose.

From Figure 1 it can be seen that the average daily milk production of the whole herd was 4.75 ± 0.39 kg, whereas the average for all cows sold was 3.03 ± 0.09 kg. Thus there was a difference of 1.72 kg (36.21%) in the average daily milk production of whole herd and that of cull cows. This is in agreement with Seath (1940).

The average daily milk production for those sold due to low production, breeding trouble and for breeding purpose was 2.45 ± 0.28 kg, 3.48 ± 0.46 kg and 3.72 ± 0.25 kg respectively.

Age and disposal of cows:

Age of the cows disposed off due to old age varied from 10 to 16 years. About 63% of the total 16 animals were disposed off between 10-13 years of age. Similar results have been reported by Seath (1940), Nikolic *et al.* (1964) and Kecsker (1965).

Disposal of heifers:

The average number of annual disposal of heifers from the herd was 10.20 ± 1.30 which is 12.21 ± 0.52 per cent of the average strength of the heifers.

Analysis of the data indicated that 77.45% of the total disposal was due to sale, whereas 22.55% was due to deaths. Of the total heifers sold, 43.47% were sold with dam (being unweaned herd), 10.71% due to breeding trouble, 18.90% for breeding purpose and 26.92% due to other reasons. Of the total deaths, 10.85% died at birth, 19.53% due to accidents, 63.11% due to diseases and 6.5% due to unknown reasons. Horwood and Weaver (1949) and Dhanda and Khera (1957) found lower proportion of sales and deaths than recorded in the present study.

REFERENCES

Asdell, S. A. (1951). Variation in amount of culling from DHIA herds. *J. Dairy Sc.*, **34:** 529-534.

Becker, R. B., P. T. D. Arnold and A. H. Spurlock. 1954. Productive life span of dairy cattle. *Bull Fla. Agric. Exp. Sta.* **540:** 18 p.

Chhikara, B. S. and D. S. Balaine. 1977. A note on disposal patterns in some Indian Dairy cattle herd. *Indian J. Anim. Sc.*, **47** (7): 420-421.

Dhanda, M. R. and S. S. Khera. 1957. Mortality in young calves in India. *Indian Vet. J.*, **34:** 384-387.

Dutt, M. and R. N. Desai. 1968. Causes of disposal of Hariana cattle from a herd. *Indian Vet. J.*, **45:** 512-518.

Fosgate, O. T. 1965. Rate, age and criteria for disposal in a herd of registered Jersey cattle. *J. Dairy Sc.*, **48:** 1481.

Horwood, R. E. and E. Weaver. 1949. What becomes of the calves in purebred dairy herd. *Quart. Bull. Mich. Agric. Exp. Sta.*, **32:** 149.

Kecsker, S. 1965. Results of breeding and production obtained between 1950 and 1960 from the Experimental dairy farm established to study problems on longevity. *Anim. Breed. Abstr.*, **35:** 52.

Leech, F. B., M. E. Davis, W. D. Macrae and F. W. Withers. 1960. Disease wastage and husbandry in British dairy herd. Report of a national survey in 1957-58. *Anim. Breed. Abstr.*, **29:** 23.

Nikolic, D., B. Simovic and S. Pecar. 1964. Reproduction of Red Danish Centre in Yugoslavia. *Anim. Breed. Abstr.*, **33** : 367.

O'Connor, L. K. and J. Hodges. 1963. Wastage and culling in dairy herds. *Anim. Breed. Abstr.*, **31:** 466.

Seath, D. M. 1940. The intensity and kind of selection actually practiced in dairy herds. *J. Dairy Sc.*, **23:** 931-36.

White, J. M. and J. R. Nichols. 1965. Reasons for disposal of Pennsylvania Holstein cattle. *J. Dairy Sc.*, **48:** 512-18.

Studies on Natural Outbreaks of Infectious Bursal Disease (Gumboro) in Chickens

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ABSTRACT

A study on natural outbreaks of infectious bursal disease complicated with or without New Castle disease in 11 broiler farms around Bombay was undertaken in respect of clinical signs, morbidity, mortality and gross lesions. Serological diagnosis of infectious bursal disease has been discussed. *(Received on Oct. 24, 1980)*

INTRODUCTION

Infectious bursal disease (Gumboro) was first reported by Cosgrove (1962) from Gumboro town of U.S.A. In the initial stage the disease was described as "avian nephrosis" or "nephritis nephrosis syndrome". It was Hitchner (1970) who had noted pathognomic changes in the bursa of Fabricius (BF) of the affected birds and named the disease as "infectious bursal disease (IBD)". Since the initial report by Cosgrove, IBD has been diagnosed in many areas of the world. In India it was first reported by Mohanty *et al.* in 1971. Infection at an early age with infectious bursal disease virus (IBDV) has been found to render the bird more susceptible to other common poultry diseases like Marek's disease (Cho, 1970), Salmonella and E. coli. infections (Wyeth, 1975), Mycoplasmosis, New Castle disease (ND) and infectious bronchitis (Giambrone *et al.* 1977). Recently from the state of Maharashtra, there were increasing reports on failure of ND vaccination particularly in broiler chickens due to immunosuppressive effect of IBD (Ajinkya *et al.* 1980).

MATERIALS AND METHODS

Eleven commercial broiler farms varied in sizes from 5,000 to 50,000 birds, situated far from each other around Bombay were studied for outbreaks of the disease. All the birds were vaccinated with Lasota or F_1 or CDF_{66} vaccine upto 5th day of age.

Frequent visits were made to the farms and clinical symptoms, morbidity and mortality were recorded. Detailed postmortem examinations of 91 birds were carried out and gross lesions were recorded. Pieces of BF and spleen were collected aseptically for detection of IBDV by agar gel precipitation test (AGPT) and New Castle disease virus by haemagglutination inhibition (HI) test respectively .Serum samples from 163 recovered birds from all the farms were collected at the time of slaughter, for

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detecting precipitating antibodies by AGPT.

Monospecific IBD antigen for AGPT and for production of antisera in rabbits was obtained from the Intervet International B.V. Holland. Antiserum against IBD antigen in rabbits was raised as per the standard methods using complete Freund's adjuvant. Serum samples and 10% bursal suspension in broth from each bird were subjected to AGPT (Jayaramaiah and Mallick 1975) for detection of serum antibodies and viral antigen respectively.

RESULTS AND DISCUSSION

Three to six weeks age broiler chicks were commonly found affected in all the farms. No outbreaks were recorded in the layer flocks during the study. The problem of IBD was found more important to the broiler industry, than to any other segments of the poultry industry (Winterfield 1977). The onset of the disease was rapid. Common symptoms observed in all the affected farms comprised ruffled feathers, dullness, whitish diarrhoea, anorexia, trembling, severe prostration and death. However, greenish diarrhoea and torticollis were also observed in five farms in which IBD was complicated with New Castle disease. Ajinkya *et al.* (1980) observed similar symptoms of IBD in ND uncomplicated and complicated birds. The course of the disease was on an average 3-7 days terminating in death or recovery.

Morbidity rate varied from 30%–80% with an average of 62%. The average mortality observed in uncomplicated flocks was 13.3% while it increased to 27.5% in those flocks superinfected with ND. Mortality pattern in both the cases characterized by reaching peak halfway through the disease period. Mortality pattern in IBD was considered to be of diagnostic importance by Parkhurst (1964), Bygrave and Faragher (1970). The overall mortality in outbreaks of IBD as noticed by Cosgrove (1962), Fraser (1964) and Parkhurst (1964) was within the range of 1-15%, the average mortality being 5-6%. However, Bygrave and Faragher (1970) recorded 36% mortality during 29th to 34th days of age.

The necropsy observations were characteristic of IBD. The pathognomic lesions were seen in BF. The gross lesions in BF observed during present study were in agreement to the observations made by Hirai *et al.* (1973) and Ojo *et al.* (1973). Birds died with short illness of 3-4 days showed great enlargement of BF with edema, while birds with longer duration of illness on the contrary showed atrophy of BF with thinning of wall. In severe cases petechial and ecchymotic haemorrhages on mucosa were also noticed. The presence of cheesy necrotic mass in the bursal lumen has been described by many workers (Mohanty *et. al.* 1971, Hirai *et al.* 1973). However, in the present study this was found in only few cases. Muscular haemorrhages observed in natural outbreaks of IBD were not a constant feature as observed by Mohanty *et al.* (1971). In ND complicated birds lesions like haemorrhages in proventriculus, caecal tonsils and small intestine with ulcerations were also observed. Similar observations were also made by the Ajinkya *et al.* (1980). However, haemorrhages in proventricular and intestinal mucosa were also observed in uncomplicated IBD outbreaks (Fraser 1964, Ojo *et al.* 1973 and Onunkwo 1975).

Serum samples were collected at about 8th week of age, i.e. 2-5 weeks after the onset of the disease. These were put for AGPT for detection of IBD precipitating antibodies. All the sera samples failed to produce the precipitating line within 24 hours with known antigen. Ajinkya *et al.* (1980) during similar study got only 3 weakly positive reactions out of 60 sera samples tested by AGPT. Presence of serum precipitin was reported to be inversely proportional to the severity of the disease by Faragher (1972). Out of 91 bursal suspensions put for AGPT to detect IBD antigen, 87 showed positive reactions. As reported by Ajinkya *et al.* (1980), the bursal suspensions were found more reliable as the precipitating antigen is organ specific and detectable only in the BF.

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REFERENCES

Ajinkya, S. M., B. D. Survashe and P. D. Sardeshpande. 1980. Breakdown in immunity to Ranikhet disease (New Castle disease) with infectious bursal disease (Gumboro disease) in broiler chicks. *Ind. Vet. J.* **57:** 265-269.

Bygrave, A. C. and J. T. Faragher. 1970. Mortality associated with Gumboro disease. *Vet. Rec.* **86:** 758-759.

Cho, B. R. 1970. Preliminary observations on the effect of infectious bursal agent on Marek's disease. *Avian Dis.* **14:** 665-675.

Cosgrove, A. S. 1962. An apparently new disease of chickens—Avian nephrosis. *Avian Dis.* **6 :** 385-389.

Faragher, J. T. 1972. Infectious bursal disease of chickens. *Vet. Bull.* **42 :** 361-369.

Fraser, D. M. 1964. Gumboro Disease; a review. *Vet. Rec.* **76:** 430-431.

Giambrone, J. J., C. S. Eidson and S. H. Kleven. 1977. Effect of infectious bursal disease on response of chickens to Mycoplasma synoviae, New Castle disease virus and infectious bronchitis virus. *Am. J. Vet. Res.* **38 :** 251-253.

Hirai, K., S. Shimakura, C. N. Chang, Y. Adachi and M. Hirose. 1973. Isolation of infectious bursal disease virus and distribution of precipitating antibodies in chicken sera. *Jap. J. Vet. Sci.* **35:** 105-113.

Hitchner, S. B. 1970. The differentiation of infectious bursal disease (Gumboro) and avian Nephrosis. 14th World's poultry Congr. Madrid. Abstr. Sci. commun. Sect. II. p. 447. Cited by Faragher, J. T. 1972.

Jayaramaiah, B. and B. B. Mallick. 1975. Serological survey of infectious bursal disease. *Ind. Vet. J.* **52:** 673-676.

Mohanty, G. C., A. P. Pandey and B. S. Rajya. 1971. Infectious bursal disease in chickens. *Curr. Sci.* **40:** 181-184.

Ojo, M. O., O. C. Oduye, L. M. Noibi and A. L. Indowu. 1973. Gumboro like disease in Nigeria. *Tro. Ani. Hlth. & Prod.* **5:** 52.

Onunkwo, O. 1975. An outbreak of IBD of chickens in Nigeria. *Vet. Rec.* **97:** 433.

Parkhurst, R. T. 1964. Pattern of mortality in avian nephrosis. *Poul. Sci.* **43:** 788-790.

Winterfield, R. W. 1977. Some clinical and subclinical effects of infectious bursal disease on other viral infections of chickens. Proceedings of the symposia on infectious bursal disease. Atlanta, Georgia. pp. 23-28.

Wyeth, P. J. 1975. Effect of infectious bursal disease on the response of Chickens to *S. typhimurium* and *E. coli* infection. *Vet. Rec.* **96:** 238-243.

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Short Communications

Genetic Variability in Ragi[1]

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Ragi (*Eleusine coracana* Gaertn.) constitutes an important crop for the southern India. It is also grown in the tribal areas of Gujarat State. Despite of being one of the hardiest crops grown under dryland agriculture and having high nutritive value, very scanty work has been done for improvement of this crop. To study the extent of variability present in the genetic stock maintained at Hill millet Research Station, Waghai, forty entries were raised in a randomized block design with three replications. Each strain was provided three-metre long plot consisting of three rows with 30 cm inter row and 15 cm intra row spacings. Ten plants were selected at random from each plot for recording the observations. The mean values were used for analysis of variance and covariance. Coefficients of variability (Burton, 1952; Miller *et al.* 1958), heritability (Burton and de Vane, 1953) and genetic advance (Johnson *et al.* 1955) were computed.

Highly significant varietal differences were observed for all the characters (Table 1) suggesting the presence of sufficient genetic variability. Varieties Dibyansinha and T-20-1 and dwarf. Bolder deed size was possessed by HR-374, TNAU-9, PR-1044 and BR-407. Varieties PR-722, JNR-981-2, PR-202 and JNR-1008 were high-yielders. Among the twelve characters studied, maximum variability was observed for plant height (73.53 to 127.07 cm), followed by days to flowering (68 to 113), straw weight per plant (7.66 to 43.33 gm), and weight of total earheads (9.49 to 33.06 gm). Moderate range was conspicuous for grain yield per plant, weight of main earhead and days to maturity. Rest of the characters showed relatively narrow range of phenotypic variability.

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TABLE 1

Mean values and genetic parameters in ragi.

Name of variety	*Source*	*Days to 50 per cent flowering (cm)*	*Plant height*	*Number of tillers*	*Length of main earhead (cm)*	*Breadth of main earhead(cm)*
KM-1	Unknown	84	108	6.4	8.1	5.5
KM-13	,,	75	113	4.0	9.2	6.2
PES-9	UP	91	116	4.1	9.5	6.4
PES-18	UP	90	118	4.0	7.9	6.3
JNK-380-1	MP	88	112	5.9	8.3	6.1
TNAU-46	TN	77	94	5.0	7.9	6.3
PR-1044	AP	96	119	4.3	7.5	5.9
PR-1091	AP	81	105	7.0	8.2	5.5
B-4-10-56	Ori	94	115	5.5	7.4	5.6
VR-415	AP	89	106	3.6	11.4	7.3
HR-231	KT	99	93	3.3	9.9	6.1
HR-344	KT	100	114	4.5	10.2	6.4
HR-374	KT	97	111	4.3	8.2	6.1
PR-202	AP	96	120	4.7	8.3	6.4
OO-10	OO	98	96	4.2	8.8	5.6
T-25-1	Ori	72	88	6.4	7.0	5.2
T-20-1	,,	68	73	5.7	6.7	4.5
Dibyasinha	,,	68	76	5.4	7.1	4.0
T-36-B	,,	74	82	5.9	7.0	4.9
PES-144	UP	72	87	6.3	7.4	4.8
CO-8	OO	71	83	5.2	7.1	4.8
PES-172	UP	83	100	3.7	9.6	6.0
BC-4847	TN	80	98	3.8	8.9	5.5
VL-201	UP	70	92	5.8	7.6	5.1
VL-7	UP	85	120	4.1	8.3	6.7
PPR-1791	AP	95	114	3.9	9.8	6.2
PR-717	AP	93	119	4.8	7.5	5.6
PR-722	AP	94	126	7.5	8.3	6.2
INDAF-5	KT	105	96	2.9	10.1	7.5
HR-23 A	KT	113	81	3.1	10.2	5.7
TAH-85-3	KT	99	107	3.9	9.8	6.4
Sodangi-6	Ori	90	127	5.7	7.8	5.8
JNR-1008	MP	92	121	5.2	8.4	5.8
PES-8	UP	92	122	4.6	8.0	6.0
JNR-852	MP	93	121	6.0	7.8	5.9
JNR-981-1	MP	94	116	5.9	7.6	5.9
TNAU-9	TN	93	118	5.9	7.6	5.6
HPR-7-6	Unknown	95	110	3.8	10.2	6.4
BR-407	Bihar	86	115	6.8	9.5	6.4
GN-1	Guj	101	98	3.5	10.4	8.2
Mean		87	105	4.9	8.5	5.9
S.Em.		0	3	0.4	0.2	0.2
C.D.5%		1	10	1.2	0.3	0.6
C.B.%		1	5	15.7	5.4	6.5
6^2p		118.1	238.7	1.9	1.4	0.7
6^2g		117.1	200.0	1.3	1.2	0.5
6^2e		1.0	38.6	0.6	0.2	0.1
GCV		12.3	13.3	23.4	13.1	12.5
h2(b)		99.1	83.8	68.8	85.5	78.9
GA		22.1	26.6	1.9	2.1	1.3
GA % of mean		25.2	25.1	40.0	25.0	23.0

Number of fingers per main earhead	*Days to 50 per cent maturity*	*Weight of main earheads (gm)*	*Weight of total earheads (gm)*	*Grain yield per plant (gm)*	*Straw weight per plant (gm)*	*Thousand grain weight (gm)*
6.6	112	4.6	14.7	12.6	24.5	2.68
7.2	114	6.2	15.2	12.3	21.6	2.89
8.0	123	8.5	18.0	12.6	26.0	3.03
7.9	119	7.7	18.3	11.8	26.3	3.04
7.1	120	6.8	21.0	18.4	21.6	2.93
6.5	105	5.7	25.2	13.4	23.3	2.98
7.0	125	6.7	17.3	15.0	25.0	3.22
6.6	104	5.2	20.2	17.3	23.6	2.67
6.7	125	6.6	22.5	18.5	37.3	3.14
8.0	124	6.4	13.3	11.1	18.3	3.10
6.7	123	7.7	15.4	11.5	21.3	2.85
7.2	129	8.3	19.0	14.2	34.0	1.42
6.7	115	6.4	18.4	14.3	22.5	3.33
7.0	123	8.0	23.4	19.3	34.1	3.09
6.7	107	6.3	17.2	14.6	18.6	2.80
6.4	97	4.1	15.1	12.7	13.3	2.67
5.5	91	2.9	10.7	8.5	8.6	2.29
5.7	91	3.0	9.9	7.5	7.6	2.42
6.7	98	3.8	11.2	9.2	10.0	2.98
6.3	97	4.6	14.5	12.5	15.8	2.69
6.5	96	2.9	9.4	8.3	11.0	2.81
7.6	120	6.4	15.7	13.4	17.3	2.85
7.0	106	5.4	15.1	12.5	17.8	2.80
6.1	99	4.5	14.2	11.9	18.0	2.52
10.0	120	8.7	20.2	13.1	21.6	2.55
7.6	124	7.3	19.6	12.6	25.8	2.89
6.6	124	7.2	20.7	17.1	30.0	3.12
7.1	133	8.8	26.5	22.1	43.3	3.08
7.5	131	8.3	12.6	9.5	25.5	2.70
5.1	238	6.3	10.0	7.7	20.6	2.39
7.2	127	8.9	18.5	13.7	23.0	2.91
6.8	122	7.4	20.7	15.2	31.3	2.13
6.7	125	7.7	22.4	18.8	23.5	3.14
6.7	124	8.1	20.8	17.7	22.6	3.05
6.9	125	7.2	33.0	17.1	38.3	3.11
7.2	124	7.6	23.4	19.4	33.3	3.10
6.5	123	6.7	22.3	18.4	30.6	3.26
8.7	120	6.4	17.0	12.7	20.6	2.98
8.3	114	6.0	20.8	17.6	23.1	3.18
7.0	130	10.2	24.7	18.8	23.6	2.50
7.0	116	6.5	17.7	14.1	23.3	2.85
0.2	0	0.3	1.1	0.9	2.0	0.05
0.6	1	0.9	3.1	2.6	5.7	0.01
5.8	1	8.9	10.7	11.4	15.1	3.48
0.8	148.5	3.3	21.2	15.3	68.4	0.07
0.6	147.0	2.9	17.6	12.6	62.2	0.06
0.1	1.4	0.3	3.6	2.6	6.2	0.01
11.8	10.4	26.1	23.6	25.0	33.7	9.0
80.4	99.0	89.4	82.8	82.6	90.8	87.2
1.5	24.8	3.3	7.8	6.6	15.4	0.5
21.8	21.3	50.8	44.3	46.9	66.2	17.4

The variance components for different characters (Table 1) revealed that the genotypic variation was comparatively higher in magnitude for all the characters and the environmental component contributed smaller share to total variation indicating that phenotypic variability was a reliable measure of genotypic variability.

High GCV was observed for thousand-grain weight, straw yield per plant, weight of main earhead, grain yield per plant. weight of total earheads and tillers per plant. Patnaik (1968), Dhagat *et al.* (1972), Mahudeswaran and Murugesan (1973), Setty *et al.* (1974), Appadurai *et al.* (1977) and Goud and Lakshmi (1977) have also reported similar results for a few or many of these characters. Lowest genetic variability observed in the present study for thousand-grain weight is in agreement with the findings of Dhagat *et al.* (1972).

Among various metric characters studied, higher estimate of heritability was observed for days to flower, day to maturity, straw yield per plant, weight of main earhead, thousand-grain weight, length of main earhead, plant height, weight of total earheads and grain yield per plant. Appadurai *et al.* (1977) also reported high heritability values for days to flowering and days to maturity. Similarly our results are akin to the findings of Mahudeswaran and Murugesan (1973) with respect to high heritability estimates for grain yield, straw yield, plant height, earhead length and thousand-grain weight suggesting that straight selection based on the phenotypic performance would be rewarding.

Heritability estimated in conjunction with genetic advance would prove more helpful in predicting the advance made through selection (Johnson *et al.* 1955). Moreover, since heritability estimated in the broad sense includes both additive as well as non-additive gene effects, it would be reliable only if it is accompanied by high genetic advance (Ramanujam and Tirumalachar, 1967). The straw yield per plant, weight of main earhead, grain yield per plant, weight of total earheads and number of tillers per plant exhibited high genetic advance expressed as percentage of mean values. Kempanna and Tirumalachar (1968), Narsimha Rao and Pardhasarathi (1968), and Setty *et al.* (1974) have also reported high genetic advance for grain yield. Interesting feature of the present investigation was found in having high genetic co-efficient of variation together with high heritability value and large magnitude of genetic advance for grain yield and earhead weight. Advantage of this nature deserves careful and sustained exploitation of genetic variability present in the ragi collection. Improvement in these economic characters could be brought about through coventional breeding methods.

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REFERENCES

Appadurai, R., M. S. Thangam, T. S. Ravindran and U. S. Natarajan (1977). Genotypic association, Heritability and Path analysis in Ragi (*Eleusine coracana Gaertn*) *Madras Agric J.* **64:** 18-21.

Burton, G. W. (1952). Quantitative inheritance in grasses. *Proc. 6th Int. Grassld. Cong.*, *I*: 227-283 (*Fide, Pl. Breed Abstr.* **24:** 229).

Burton, G. W. and E. H. de Vane (1953). Estimating heritability in tall fescue. (*Festuca arundinacea*) from replicated clonal material. *Agron. J.* **45 :** 478-481.

Dhagat, N. K., C. L. Patidar, P. S. Shrivastava and R. C. Joshi (1972). Correlation and genetic variability in ragi. *JNKVV Res. J.* **6 :** 121-124.

Goud, J.V. and P. V. Lakshmi (1977). Morphological and genetic variabilities for quantitative characters in ragi. *Mysore J. Agric. Sci.* **11 :** 438-443.

Johnson, H. W., H. F. Robinson and R. E. Comstock (1955). Estimates of genetic and environmental variability in soyabean. *Agron. J.* **47:** 314-318.

Kempanna, C. and D. K. Tirumalachar (1968). Study on genotypic and phenotypic variation in ragi. *Mysore J. Agric. Sci.* **2**(1): 29-34.

Mahudeswaran, K. and M. Murugesan (1973). Correlation and path analysis in *Eleusine Coracana* Gaertn. *Madras Agric. J.* **60:** 1287-1291.

Miller, P. A., J. C. Williams, H. F.Roibnson and R. E. Comstock (1958). Estimates of genotypic and environmental variances and covariances in upland cotton and their implication in selection. *Agron. J.* **50:** 126-31.

Narsimha Rao, D. V. and A. V. Pardhasarathi (1968). Study on genetic variability in ragi. Genetic advance and heritability. *Madras Agric. J.* **55:** 392-397.

Patnaik, M. C. (1968). Variance and correlation in finger millet. *Indian J. Genet.* **28:** 225-229.

Ramanujam, S. and D. K. Tirumalachar (1967). Genetic variability of certain characters in red pepper (*Capsicum annum* L.) *Mysore J. Agric. Sci.* **1 :** 30-36.

Setty, M. V. N., D. R. Govindarajan, S. Vijayakumar and B. I. Shettar (1974). Variability pattern of yield and its components in finger millet. *Mysore J. Agric. Sci.* **8 :** 519-524.

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Effect of Application of Urea and Ammonium Sulphate Blended with Neem Cake and Soil on the Growth and Yield of Rice (*Oryza sativa* L)

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Generally about 40 per cent of the nitrogen applied to rice is lost in different ways. The losses should be minimised to the possible extent in order to make best use of the applied nitrogen profitably. The alternate submerged and drained conditions in rice soils favour nitrification of ammonia and urea-nitrogen applied to the soil (Prasad and Bains, 1968). Nitrate nitrogen thus formed is easily lost either through leaching or denitrification. One of the ways to overcome this situation is to use nitrification retardants. Prasad *et al.* (1970) emphasized that studies should be carried out with indigenous products like *neem* cake which possess nitrification retarding properties of nitrogen from fertilizers applied to rice.

In view of the paucity of adequate experimental data on different techniques of N fertilizer application and nitrification inhibitors for *Kyari* land in Gujarat State, the present study was planned in the *kharif* season of 1977-78 at the main Rice Research Station, Gujarat Agricultural University, Nawagam under low land condition.

There were 15 treatments which consisted of combinations of seven methods of N application and two levels of nitrogen along with a control (Table 1). The experiment was conducted in a Randomised Block Design with four replications. It was sown and transplanted on June 22, 1977 and July 25, 1977, respectively.

The soil of the experimental plot was sandy clay loam locally known as *Kyari* land. It was deep having good moisture holding capacity and slightly alkaline in reaction. The status of total nitrogen, available phosphate and available potash was 840, 64 and 220 kg/ha, respectively. The total rainfall during the crop season was 881 mm distributed over 45 rainy days. Sufficient rain was received in the months of June, July and August. Supplement canal irrigation was given as and when required.

The main effects of different treatments on growth and yield attributes of rice are presented in Table 1. Nitrogen applied in the form of urea blended with neem cake (M_2) remarkably increased productive tillers/m^2, number of filled spikelets/panicle, test weight and straw yield. This method ultimately registered the highest grain yield of 5762 kg/ha which was significantly higher than rest of the treatments. The lowest rice grain (4863 kg/ha) was produced under urea applied as such (M_1). The magnitude of increase was 15.6 per cent under M_2 over M_1. Maximum net realization of

TABLE 1 **Effect of different treatments on yield, yield attributing characters and uptake of nutrients in rice.**

Treatments	*Productive tillers/m²*	*Filled spikelets/panicle*	*Test weight, g*	*Grain yield kg/ha*	*Straw yield, kg/ha*	*Total uptake, kg/ha*			*Net realization, Rs/ha*	*Net incremental cost Benefit Ratio*
						N	P_2O_5	K_2O		
Method of N application:										
M_1–N from Urea applied to soil in four equal splits	237.37	189.50	14.853	4863	4598	81.81	25.17	126.59	2692	7.72
M_2–N from Urea blended with Neem cake	285.62	232.62	15.449	5762	5412	100.89	26.24	158.11	3811	12.40
M_3–N from Urea blended with deoiled Neem cake	261.25	194.37	15.204	5266	5005	92.48	24.29	144.14	3179	9.90
M_4–9 from Urea (1 part) blended with soil (5 parts)	244.62	191.00	15.069	4869	4720	84.93	22.70	127.09	2681	7.89
M_5–N from Urea, 80% throughsoil + 20% through foliarspray	245.25	198.62	14.895	5012	4679	85.26	23.24	130.21	2873	8.31
M_6–N from Ammonium sulphate applied to soil in four equal splits	248.50	201.62	15.156	5135	5045	86.84	22.85	138.96	2976	7.16
M_7–N N from Urea mixed with sulphur	250.75	196.25	15.047	5110	4964	85.72	23.80	138.15	2470	2.38
SEm±	6.25	7.72	0.13	141.41	156.25	2.21	0.72	1.95	—	—
C.D. at 5%	17.90	22.04	0.37	403.71	449.22	6.32	2.02	5.60	—	—
Levels of Nitrogen:										
N_1–50 kg N/ha	232.67	191.82	14.933	4714	4488	77.74	22.52	126.21	2532	9.40
N_2–100 kg N/ha	274.03	209.32	14.258	5576	5348	98.80	25.76	149.30	3377	6.52
S.Em±	3.35	4.13	0.07	75.33	91.25	1.17	0.39	1.04	—	—
C.D. at 5%	9.56	11.79	0.20	215.04	269.42	3.32	1.11	3.00	—	—
Fertilizer v/s control:										
Fertilizer	253.54	200.57	15.097	5154	4917	88.27	24.31	137.76	2955	—
Control	148.75	168.25	14.682	2856	2686	45.70	13.54	72.53	424	—
S.Em±	6.49	7.99	0.13	146.48	158.85	2.30	0.78	2.02	—	—
C.D. at 5%	18.54	22.80	0.38	406.25	455.73	6.51	2.21	5.79	—	—
C.V.%	—	—	—	7.95	—	—	—	—	—	—

Rs. 3811/ha with a Net Incremental Cost Benefit Ratio of 12.40 was also secured from M_2. There was no significant deference between two sources of nitrogen viz., urea (M_1) and ammonium sulphate (M_6) which yielded 4863 and 5135 kg/ha of rice grain, respectively. Addition of sulphur to urea (M_7) and urea blended with soil (M_4) did not differ significantly from the treatment of urea applied as such (M_1). Similarly, nitrogen from urea blended with deoiled neem cake (M_3) also did not differ significantly over rest of the methods except M_2.

Nitrogen applied at 100 kg N/ha (N_2) recorded remarkably increased total number of productive tillers number of filled spikelets/panicle and test weight. The favourable effects of higher level of N were finally reflected in increased grain and straw yield of rice over lower level of 50 kg N/ha (N_1). The increase in the grain yield was 862 kg/ha. The application of 100 kg N/ha also resulted in increased mean net profit of Rs. 845/ha over 50 kg N/ha with a Net Incremental Cost Benefit Ratio of 9.40.

The interaction between methods of N application and levels of nitrogen was significant. Application of urea blended with neem cake at 100 kg N/ha gave the highest grain production of 5809 kg/ha. However, it was at par with urea applied at 50 kg N/ha blended with neem cake which yielded 5714 kg/ha of rice grain with the maximum net profit of Rs. 3866/ha and the highest Net Incremental Cost Benefit Ratio of 16.64.

Total uptake study indicated higher values of N. P_2O_2 and K_2O_5 by grain and straw under the application of urea blended with neem cake over rest of the treatments. The values were higher at 100 kg N/ha than at 50 kg N/ha.

On the whole, maximum yield was secured by application of N at 100 kg/ha as urea blended with neem cake. However, from economic point of view, application of 50 kg N/ha as urea blended with neem cake was superior. Hence, for maintaining the soil fertility, application of 100 kg N/ha as urea blended with neem cake is recommended for rice.

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REFERENCES

Prasad, R. and S. S. Bains, (1968). Nitrification inhibitors for increasing efficiency of fertilizers nitrogen in paddy soils. *Fert. News* **13** (5): 37-38.

Prasad, R. E., G. B. Rajale and B. A. Lakhdive, (1970). Effect of time and method of application of urea and its treatment with nitrification inhibitors on the yield and N uptake by irrigated upland rice. *Indian J. Agri. Sci.* **40**: 1118-1127.

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Bracon hebator Say Infesting Laboratory culture of *Corcyre cephalonica* St. and its Effectiveness in a Warehouse Stacked with Jowar

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Rice moth, *Corcyra cephalonica* St. is one of the important laboratory hosts for mass culturing parasites of insect pests of crops. *C. cephalopica* was mass cultured for three successive years in the Parasite Research Laboratory at the Anand Campus of the Gujarat Agricultural University for mass breeding egg parasite, *Trichogramma chilonis* Ishii, and a larval parasite, *Bracon qelechiae* Ash. During November 1973, the authors came across an ecto-larval parasite infesting the laboratory culture of *Corcyra* and was found to be well established in almost all the host rearing cages. The parasite was later identifided as *Bracon hebator* (Hymenoptera: Braconidae). The following observations were recorded during the course of the study.

The parasite was found penetreating into loose grain in the cages in search of host larvae. It was also noticed to parasities the host larvae through the top cover of the host rearing cages. Full grown *Corcyra* larvae were parasitised by the Braconid. Althought the young host larvae were stung, the parasite did not lay eggs on them. At the peak period of parasitisation, 60 per cent of *Corcyra* larvae were found parasitised in the rearing cages. This high rate of parasitisation of the larvae adversely affected *Corcyra* moth emergence which ultimately affected its egg production. The number of *corcyra* eggs produced during the period and the number of parasite adults collected from rearing cages are given in Table 1.

The data given in the table show that *Corcyra* culture should have been infested by *B. hebator* some time in October and built up the population so that 330 adults could be collected from the *Corcyra* rearing cages in the first week of November. Despite the efforts to collect the adults from the cages and baiting the escaping adults with cotton swabs soaked with poisoned sugar solution, the parasite continued to infest the culture till the last week of December. This parasitisation adversely affected *Corcyra* moth emergence which ultimately reduced the egg pro duction. The data show that egg production was over 1300 thousands during October when the parasite was beginning to build up in the culture. Be cause of the parasite infesting the culture, the egg production was reduced to as few as 64 thousand eggs per week in the last week of December. When the corrective steps were successful, thc culture esablished normally and *corcyra* egg production increased to as high as 618 thousand per week by fourth week of January. Subramaniam

TABLE 1

Weekly collection of *Corcyra* eggs (in thousands) and the number of *Bracon hebator* adults collected from the rearing cages (given in parenthesis

Month	*Number of eggs in thousands/week*				*Total*
	I	II	III	IV	
October	1438	2167	2070	1300	6775
	(0)	(0)	(0)	(0)	(0)
November	395	116	290	670	1471
	(330)	(461)	(294)	(317)	(1357)
December	435	420	200	64	1119
	(150)	(62)	(35)	(11)	(258)
January	252	418	540	618	1828
	(0)	(0)	(0)	(0)	(0)

and Seshagiri Rao (1940) have also reported *Microbracon brevicornis* Wsm. (Hymenoptera: Braconidae) as limitting factor in mass culturing of *C. cephalonica* at Mandya, Mysore. They set light traps continuously for about two months in summer to reduce the trouble to negligible proportion. *Effectiveness of B. hebator releases in godown in fested* with *C. cephalonica.*

Very little attention has been paid to biological control of pests of stored grain in India. Pingley (1954), however made some preliminary experiments with a Reduviid, *Amphibolus venator* Klug which was found preying on the larvae of *Tribolium castaneum* Herbst, *T. granarium* Everts and *corcyra cephalonica.* In this release trial with 100 adults of *A. venaator* against *Ephestia cautella* Wlk. and *Alphitopius diaperinus* (Panz.), he reported that grain damage was less in warehouses where predator was released. However, no attempt like this has been made against *corcyra cephalonica.* Therefore, after getting sufficient numbers of *B. hebator* adults from *Corcyra* rearing cages, they were released in a storage godown (12 x 9 x 3m) belonging to the Polutry Section and having about 200-250 gunny bags of jowar stacked in it. Before releasing the parasites in the godown, it was checked that no parasite was present on the *Corcyra* larvae. Observations on parasitism were recorded after 4 days from the release of the parasite. The details of parasite release and percentage of parasitism are given in Table 2.

The data presented in Table 2 show that the parasite was effectiv soon after the release giving 93.4% kill of *Corcyra* larvae. No parasitism was recorded in a similar godown located in Anand town grain market whict was maintained as control. The effect of release of parasites in the godown after these releases could not be estimated because the godown was emptied and fresh stocks, free from *Corcyra* infestation was brought in. However, a large number of *B. hebator* adults were observed hunting for the host larvae even after a month from the release.

TABLE 2

Effectiveness of *B. hebator against C. cephalonica* **infestation in godown.**

Date of release	*No. of parasites released*	*Experimental godown*		*Control godown*	
		No. of Corcyra larvae examined	*% parasitised*	*No. of Corcyra larvae examined*	*% parasitised*
1973					
Nov. I week	330	136	73.4	60	0.0
Nov. II week	416	86	83.7	120	0.0
Nov. III week	294	62	93.4	24	0.0
Nov. IV week	317	42	88.0	13	0.0

These observations suggest that mass release of *B. hebaator* in *Corcyra* infested grain godowns could be effectively utilized to achieve biological control of the pest. This can be substantiated by the fact that a similar Braconid, *Bracon gelechiae* was introduced from Canada for the control of potato tuber moth, *Gnorimoschema operculella* infesting potato tubers under storage in Bihar and has been reported to be established (Sen, 1964).

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REFERENCES

Pingley, S. V. 1954. Biological control of some stored grain pests by the use of a bug predator, *Amphibolus Venator* Klug. *Indian J. Ent.* **16** (3): 300-302.

Sen, A. C. 1964. Biological control of the potato tuber moth *Gnorimoscheme operculella* Zell. *Indian Agric.* **8**(1): 1.

Subramaniam, T. V. and D. Seshagiri Rao. 1940. Biological control of sugarcane borers in Mysore. *Bull. Dept. Agri. Mysore ent.* Series **12**: 1-12.

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Observations on Chlorosis in Groundnut

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Chlorosis is acute during prolonged drizzling rain in groundnut grown on medium black calcareous soils of the Saurashtra region. The typical yellowing of leaves is attributed to poor drainage, lime induced Fe chlorosis and other causes as well. An investigation was initiated to study the effect of soil moisture regimes on availability of iron, and its uptake and translocation in groundnut.

An incubation study was carried out on a calcareous medium black clayey soil which contained 2.01 per cent total iron and 1.02 ppm available iron (1 N NH_4 OAc—pH 4.8). A bulk surface soil to a depth of 20 cm was collected from the university farm, Junagadh. One kg air dried soil (2 mm sieved) was incubated using different treatmens. Only the data pertaining to moisture regimes viz; 50% of field capacity (M_1), field capacity (M_2) and saturation (M_3), are presented here. Periodical sampling of soil was done and available iron was determined using 1 N NH_4OAc (pH 4.8) extractant.

In a separate experiment pots were filled up with soil. Two healthy groundnut plants, variety GAUG-1, were maintained in each pot. The following soil moisture regimes were studied:

Soil moisture regimes	*Symbol*
0 bar soil moisture potential	0 bar
0 to—1/3 bar soil moisture potential	1/3 bar
0 to—5 bar soil moisture potential	5 bar
0 to –10 bar soil moisture potential	10 bar
0 to –14 bar soil moisture potential	14 bar
Moisture stress during flowering stage (30 to 50 days after sowing)	SF
Moisture stress during pegging Stage (40 to 65 days after sowing)	SP
Moisture stress during pod development stage (60 to 85 days after sowing)	SD
Surface soil moist with normal irrigation	M
Surface soil dry, irrigated through upward flow from bottom of the pot	D

Treatments were imposed after 20 days of sowing. To apply required quantity of water, an average water content of 30 cm soil profile was estimated from soil samples drawn from 5, 15, and 30 cm soil depths. The soil water potentials in bars were read out from soil moisture retention characteristics curve of this soil which was construct-

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ed by using pressure membrane apparatus. The soil moisture stress of about 10 bar was imposed at flowering, pegging and pod development stages. The crop was fertilized with recommended doses of nutrients. The crop was harvested after 111 days. Roots, shoots and pods were analysed separately for Fe content (Jakson 1967).

Incubation study revealed that the soil maintained at saturation recorded significantly higher available Fe content than that was kept at 50% of field capacity throughout except on the day of incubation (Table 1). Progressive increase

TABLE 1 **Influence of moisture regimes and incubation period on the available iron (ppm) (Oven dry basis).**

Incubation period (days)	*Moisture regimes*			*C.D. at 5%*
	M_1	M_2	M_3	
0	1.46	1.48	1.48	N.S.
3	1.48	1.58	1.76	0.11
5	1.54	1.74	2.27	0.17
7	1.67	2.02	2.96	0.26
14	1.75	2.64	3.49	0.31
21	1.92	3.31	6.36	0.89
28	2.48	4.28	9.11	1.01
42	2.76	5.92	14.46	1.67
56	2.01	5.10	12.00	2.13
Pooled over the period	1.90	3.12	6.06	0.32
Period x Moisture C.D. (5%)	0.98			

in incubation period increased the available Fe content under all the moisture regimes, however, the rate of increase was maximum with saturation. It was highest with $P_{42} \times M_3$ combination and least with $P_0 \times M_1$ combination. Pooled analysis showed that with increase in moisture content from M_1 to M_2, there was 64 per cent increase in available Fe content, further increase in moisture content to saturation (M_3) the availability of Fe increased by 94 per cent over the field capacity (M_2).

Results of pot experiment revealed that the Fe content of root, shoot and pod was maximum with saturation which decreased significantly with decrease in soil water potential (Tale 2).

TABLE 2 **Effect of different soil moisture regimes on concentration and uptake of iron by groundnut (oven-dry basis).**

Treatments	*Concentration of Fe (ppm)*			*Uptake of Fe (mg/pot)*		
	Root	*Shoot*	*Pod*	*Root*	*Shoot*	*Pod*
O bar	2320	573	883	5.89	19.58	7.97
1/3 bar	2080	427	566	8.02	22.34	16.14
5 bar	1933	340	387	4.67	13.28	6.25
10 bar	1427	300	320	2.54	10.40	3.04
14 bar	827	240	260	1.15	6.39	1.83
SF	1773	427	333	2.72	13.49	4.18
SP	1293	393	307	1.40	10.50	3.19
SD	1080	307	320	1.66	9.45	3.28
M	2013	400	527	6.56	19.79	11.20
D	1800	360	400	6.59	22.07	6.82
C. D. at 5%	124	48	122	0.79	00.88	0.90

Treatment M was at par with 1/3 bar for Fe content in various plant parts. Crop subjected to moisture stress during different stages of growth also recorded lower concentration of Fe in root, shoot and pod than 1/3 bar. Accumulation of Fe decreased progressively with increase in moisture stress from 1/3 bar. Generally, saturation treatment recorded higher uptake of Fe than the rest of the treatments except 1/3 bar, M and D.

Since Fe is largely assimilated by plants as ferrous ion, moist calcareous soils would not favour Fe availability owing to following reactions (Bear 1965.)

$$Fe^{2+} + CaCO_3 \rightleftharpoons FeCO_3 + Ca^{2+}$$

$$4FeCO_3 + O_2 + Ca(HCO_3) \rightleftharpoons 2Fe_2(CO_3)_3 + Ca(OH)_2$$

$$Fe_2(CO_3)_3 + 3H_2O \rightleftharpoons Fe_2O_3 + 3H_2CO_3$$

In the present investigation it appears that with the increase in moisture content of soil there was an increase in availability of Fe which in turn resulted into greater concentration of Fe in plant body. Thus lime induced Fe-chlorosis in calcareous soils does not seems to be tenable for groundnut chlorosis in Saurashtra region of Gujarat. It appears that poor aeration is the primary cause for chlorosis as could be seen from saturation treatment. Plants were quite green under other treatments indicating that soil has supplied sufficient Fe to meet the requirement of plant. While studying the chlorotic phenomenon in groundnut, Gopalakrishnan and Srinivasan (1976) reported that chlorosis occurred due to poor drainage. With regard to transplocation of Fe, roots retained more quantity of Fe than shoots and pods. Babaria and Patel (1980) also reported that the concentration of Fe was maximum in sorghum roots followed by shoots and grains. When the concentration of Fe is low in plant tissues, mobility of Fe injected into phloem is highest. This mobility decreases with increase in concentration of in tissues (Rediske and Biddulph 1953). It seems that roots did not translocate Fe proportionately with increase in concentration of Fe. These findings again confirmed that lime-induced chlorosis caused by Fe dificiency is not due to non-availability of Fe in soil but it may be due to restricted translocation of Fe from root to shoot or inactivation of Fe within plant body. Secondly the widespread groundnut chlorosis in fields under wet conditions can be attributed to migration of clay particles from surface soil to a depth of 1 or 2 cm owing to heavy downpour followed by prolonged drizzling might resulting in the formation of a layer which restricts the permeability of air to root zone. Subsequent drying of the soil with formation of cracks permits free movement of air to rhizosphere which reduces the chlorosis.

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REFERENCES

Babaria, C. J. and C. L. Patel. 1981. Response and uptake of iron by sorghum to application of iron, farmyard manure and sulphur in calcareous soil. *GAU Res. J.* **6**; 21-114:

Bear, F. E. 1965. Chemistry of the soil. Pub. Oxford and IBH Co. 17 Park Street, Calcutta-16. Acid, Alkaline, Saline, and Sodic Soils. 292-319.

Gopalakrishnan, S. and P. S. Srinivasan. 1976. Chlorotic phenomenon in groundnut. *Madras Agric. J.* 63: 219-223.

Jackson, M. L. 1967. Soil Chemical Analysis Prentice Hall of India Pvt. Ltd., New Delhi.

Rediske, J. H. and O. Biddulph. 1953. The absorption and translocation of iron. Plant Physiol. **28** : 576-580.

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Proximate and Trace Element Contents of Some Samples of Cattle Feeds of Mehsana District

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Mehsana is the home tract of famous Mehsana milch buffalo breed. Because of the importance of trace elements as well as proximate nutrients in the nutrition of animals, the present study was undertaken to screen the commonly available feeds and fodders of Mehsana district of Gujarat State.

Different types of feeds and fodder samples were collected for estimating their proximate and trace element composition. The proximate analysis was carried out following the methods described by A.O.A.C. (1970). Trace element viz. iron, copper, manganese and zinc were determined using wet digestion technique (atomic absorption spectrophotometer).

(i) Proximate composition:

The results of proximate composition of various feed samples are presented in Table 1.

From the table it is seen that cotton seed is a good source of ether extract though it has got higher amount of crude fibre. Great millet is a good source of carbohydrate and is fed to buffaloes.

Local green fodders, lucerne, pegion pea *gotar* (*gotar* is a byproduct of legume crops after taking out mature seeds and thick stems), castor leaves, *dodi* (*Leptadenia reticulata*) and mustard plants are good sources of protein and ether extract. Over and above cluster bean *gotar*, *rajagara* (*Polygnaceae polymorphum*) plant and mustard hulls, are sources of calcium. Castor leaves contain 3.77 per cent calcium. *Dodi* feeding even at 1.34 g/day in cows and buffaloes had increased 12 and 6 per cent milk production respectively (Anjaria and Gupta, 1967) during feeding period of 12 days. Somewhat similar composition of these types of feeds for cattle are also reported by Patel, Shah and Mistry (1958).

The cultivated fodders have usual range of composition. The present results of chemical composition of straws and *gotars* are in agreement with the findings of Patel and Shah (1957, 1959) and Patel, Shah and Mistry (1963).

Trace element contents:

The average results of iron, copper, manganese and zinc content of roughage samples collected during the survey in Mehsana district are presented in Table 2.

The results indicated that iron and manganese levels in fodders are adequate to meet the requirements of

TABLE 1

Proximate Composition of feeds and fodders of Mehsana district (% **on D.M. basis).**

Sample		*C. Protein*	*E. Extract*	*C. Fibre*	*N.F.E.*	*P*	*Ca*
Concentrate Mixture:							
Compounded cattle feeds	(6)	16.69 ±0.29	5.18 ±0.09	8.48 ±0.42	59.57 ±0.56	0.64 ±0.02	0.63 ±0.03
Grain and Seeds:							
Banti seeds (*Echinochola stagnina*)	(1)	7.99	5.91	7.39	74.43	0.41	0.35
Barley seeds	(2)	9.81	2.85	4.14	80.26	0.25	0.27
Cotton seeds	(3)	19.39 ±0.30	16.47 ±0.32	20.99 ±0.22	38.02 ±0.74	0.53 ±0.006	0.52 ±0.03
Isabgul seeds (*Plantago ovata* Forsk)	(4)	19.02 ±0.42	3.78 ±0.57	38.18 ±0.22	38.49 ±0.74	0.43 ±0.001	0.49 ±0.06
Jowar seeds (great millet)	(1)	16.17	5.48	1.02	75.20	0.48	0.27
Oil Cake and Chuni:							
Cotton seed cake	(5)	22.83 ±1.73	9.04 ±0.28	24.09 ±0.60	37.83 ±1.82	0.54 ±0.05	0.36 ±0.03
Pigeon pea *chuni*	(1)	14.86	1.63	22.67	55.10	0.22	0.81
Miscellaneous							
Scrap milk powder	(1)	27.60	21.82	0.00	42.55	0.96	1.85
Fodders							
Local green fodder	(4)	13.32	3.69	24.46	46.94	0.21	1.48
Shedha grasses mixed		±1.52	±0.34	±2.13	±2.74	±0.006	±0.22
Cultivated Fodders							
Lucerne	(5)	21.16 ±0.91	4.94 ±0.26	24.45 ±1.17	35.93 ±0.28	0.31 ±0.012	2.05 ±0.18
Wheat (green)	(1)	12.93	2.24	28.03	47.26	0.30	0.53
Gotars Cluster bean	(1)	12.99	1.85	16.43	55.47	0.17	2.61
Gram	(1)	4.82	2.05	37.15	49.03	0.05	0.96
Pigeon pea	(1)	14.98	7.71	16.54	48.93	0.19	2.18
Seed Hulls Watermelon (wild variety)	(2)	2.97	1.50	61.97	29.98	0.07	0.41
Castor	(2)	5.12	1.81	37.45	39.99	0.10	0.82
Mustard	(1)	11.61	3.12	20.34	42.96	0.10	1.66
Straws Pearl millet	(4)	4.29 ±1.88	1.83 ±0.35	39.96 ±4.10	46.04 ±1.88	0.12 ±0.034	0.65 ±0.10
Great millet	(10)	4.74 ±0.79	2.00 ±0.17	33.60 ±2.14	51.39 ±6.36	0.13 ±0.024	0.76 ±0.07
Wheat	(2)	4.52	1.81	3.79	46.19	0.10	0.48
Miscellaneous							
Castor leaves	(1)	15.65	5.31	13.41	54.32	0.25	3.77
Dodi (*Leptadenia reticulata*)	(1)	14.83	4.86	25.17	47.74	0.21	1.91
Cotton plant	(1)	7.59	1.23	32.25	49.56	0.09	1.32
Rajagara plant (*Polygnaceae polymerphum*)	(1)	7.66	2.91	26.05	51.36	0.29	1.97
Mustard plant	(1)	17.93	11.20	25.72	37.09	0.58	1.68

( ) Figure in the preanthesis indicates number of samples analysed.

TABLE 2

Trace element content (on D.M. basis) of fodders collected during survey (Average with standard error).

Samples		*Fe(mg%)*	*Cu(ppm)*	*Mn(ppm)*	*Zn(ppm)*
Gotars					
Cluster bean	(1)	90.08	10.87	106.64	32.56
Pigeon pea	(1)	122.78	22.79	140.91	40.46
Hulls and Husks					
Castor	(1)	23.32	13.47	31.09	4.57
Cheno	(1)	29.68	15.62	52.59	10.00
Rayda	(1)	50.03	12.77	38.56	22.15
Straws					
Jowar (great millet)	(3)	21.76	15.65	43.48	32.11
		±1.07	±1.91	±4.14	±6.13
Pearl millet	(4)	75.49	12.28	49.39	31.21
		±28.48	±2.93	±11.65	
Wheat	(2)	35.84	13.77	97.65	3.89
Miscellaneous					
Castor leaves	(1)	74.55	13.46	137.71	29.92
Rajagara plant	(1)	37.19	10.84	78.51	24.59

( ) Figure in the parenthesis indicates number of samples analysed.

cattle in Mehsana district. Underwood (1971) reported that minimum dietary iron requirement of the growing calves is not more than 40 ppm. He further stated that 25 ppm manganese in fodder is adequate to meet the requirements. Underwood (1971) reported 10 ppm level of copper in fodders to be sufficient to meet the requirement for cattle. In the present study almost all fodders have slightly higher copper content than 10 ppm.

Underwood (1971) reported deficiency symptoms in cattle fed pasture or fodder having zinc content in the range of 18-50 ppm. In the present study almost all fodders have less zinc content than the upper limit. Sawhney, Bedi and Khan (1977) reported 93 per cent samples of fodders of Jammu and Kashmir to be dificient in zinc. Thus zinc supplementation either through mineral supplement, salt or feeds higher in zinc is a must to safeguard health and production when compounded concentrates are not used.

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REFERENCES

Anjaria, J. V. and Gupta, I. 1967. Studies on lactogenic property of *Leptadenia reticulata* (*JIVANTI*;) and Leptaden tablets in goats, sheep, cows and buffaloes. *Indian Vet. J.* **44** (11): 967-974.

A.O.A.C. 1970. Official methods of analysis of the Association of Analytical Chemists,

11th Edn. Benzamin Franklin station, Washington, D.C. 20044.

Patel, B. M. and B. G. Shah. 1957. Studies on roughages in Kaira district (Bombay State). Chemical composition of wheat fodder (*Triticum sativum*), *Indian J. Agric. Sci.* **27** (4): 445-450.

Patel, B. M., and B. G. Shah 1959 Studies on the composition of straw in Kaira district. *Indian J. Agric Sci.* **29** (1): 19-25.

Patel B. M., B. G. Shah and V. V. Mistry. 1958. A study on fodder of Hissar district in the Punjab, *Indian J. Agric. Sci.* **28** (4): 597-606.

Patel, B. M., B. G. Shah and V. V. Mistry. 1963. Studies on the feeding value of some *gotars*. *Indian J. Dairy Sci.* **16**: 1-8.

Sawhney, P. C., S. P. S. Bedi and S. A. Khan. 1977. A note on trace element contents in fodders of Jammu and Kashmir state. *Indian J. Anim. Sci.* **47** (4): 223-229.

Sen, K. C. and S. N. Ray. 1971. Nutritive value of Indian cattle feeds and the feeding of animals, I.C.A.R. Bulletin No. 25, I.C.A.R., New Delhi.

Underwood, E. J. 1971. Trace element in Human and Animal Nutrition, 3rd Edn., Academic Press, New York.

GAU Res. J. 1982. 7 (2): 131-132

Composition of Camels' Milk

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Gujarat State ranked fourth in camel population in India. (Rao *et al.* 1970). Camels are beast of burden particularly in desert areas, but their meat and milk are important source of food for their professional breeders. Yasin and Wahid (1957) reported good milk yielding capacity in camel. However, no systematic data on the milk composition of camel are available in India or in Gujarat. Hence it was thought worthwhile to study the suitability of camel milk for manufacture of indigenous and western dairy products. Preliminary trials were undertaken to ascertain the physico-chemical make-up of camel milk.

Eighteen pooled milk samples were secured from Dormedary species of camel found in Charotar district of Gujarat in midst of their lactation period. The samples were analysed, in duplicate, within 3 hours of milking, for fat content; solids-not-fat content, total milk solids; lactose; protein; whey protein; ash; chloride content; specific gravity: acidity and pH. The analyses were carried out as recommended in Methods of Test for Dairy industry chemical analysis of milk, (IS:1479-II 1961). The milk samples were also subjected to visual examination and organoleptic evaluation. The average results of the study are depicted in the following table.

TABLE 1

Composition and physical properties of camel milk.

Constituent property	*Average value in percentage*	*Range in percentage*
Fat	3.20	2.9 to 3.9
Total solids	9.75	9.16 to 10.53
Solids Not Fat	6.55	6.03 to 6.89
Proteins	2.68	2.54 to 2.78
Casein	2.11	1.83 to 2.28
Whey proteins	0.57	0.43 to 0.77
Lactose	3.20	2.8 to 3.8
Ash	0.60	0.523 to 0.740
Chloride Expressed as % NaCl	0.25	0.204 to 0.283
Sp. gravity	1.026	1.024 to 1.027
Acidity expressed as % Lactic acid	0.17	0.162 to 0.180
p^H		6.45 to 6.53

The samples of camel milk on visual examination revealed white colour, opaqueness and higher appatrent visco sity. Organoleptically, the taste and smell of camel milk were unpleasant, the former being pronounced salty. This was due to a very high chloride content observed in the milk which ranged from 0.204 to 0.283%.

Average acidity of camel milk after 3 hours of milking was 0.17%. This was much higher than reported by Ohri and Joshi (1961). pH of camel milk ranged between 6.45 to 6.53.

The specific gravity of milk varied from 1.024 to 1.027. In contrast, Khan and Appanna (1964) reported specific gravity value of 1.0374 for camel milk.

Fat content of milk ranged from 2.9 to 3.9% with an average of 3.2%. These values are in close agreement with the results reported by Khan and Appanna (1964). However, the values for fat in present study are relatively lower when compared with one reported by Ohri and Joshi (1961). Protein cotnents averaged 2.68%, comprising of casein (2.11%) and whey proteins (0.57%). Khan and Appanna (1964) and Ohri and Joshi (1961) have reported 3.76% and 3.95% protein in camel milk, respectively.

Lactose content of the camel milk was found to be very low (3.2%) compared to the results reported by Ohri and Joshi (1961) and Khan and Appanna (1964). Similarly, ash content was also found to be low, averaging 0.6%, of which chlorides alone contributed to the extent of 0.25%. The average total milk solids were 9.75%.

The above results show that the camel milk is relatively, low in milk components, particularly lactose and proteins, and very high in chloride contents, the latter being undesirable from flavour and taste point of view of milk and milk products.

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REFERENCES

Indian standards: IS.1479, 1961. Methods of test for dairy Industry, Chemical analysis of milk. ISI, New Delhi-110001.

Khan, K. U. and Appanna, T. C. 1964. Studies in camel milk, General composition. *Indian J. of Physiol. Allied Sci.* **18**, 129-33.

Mittaine Jean, 1962. Milk other than cows milk, Milk Hygiene, WHO-FAO, Monograph series No. 48, p. 681-694.

Ohri, S. P. and Joshi, B. K. 1961. Composition of milk of camel. *Indian Vet. Journal.* **38** : 514.

Rao, M. B., Gupta R. C. and Dastur, N. N. 1970. Camel's milk and milk products. *Indian J. of Dairy Sci.* **23**: 171-78.

Yasin, S. A., and Wahid. A. 1957. Pakistan Camels—a preliminary survey. *Dairy Sci. Abstract*, **20** : 469.

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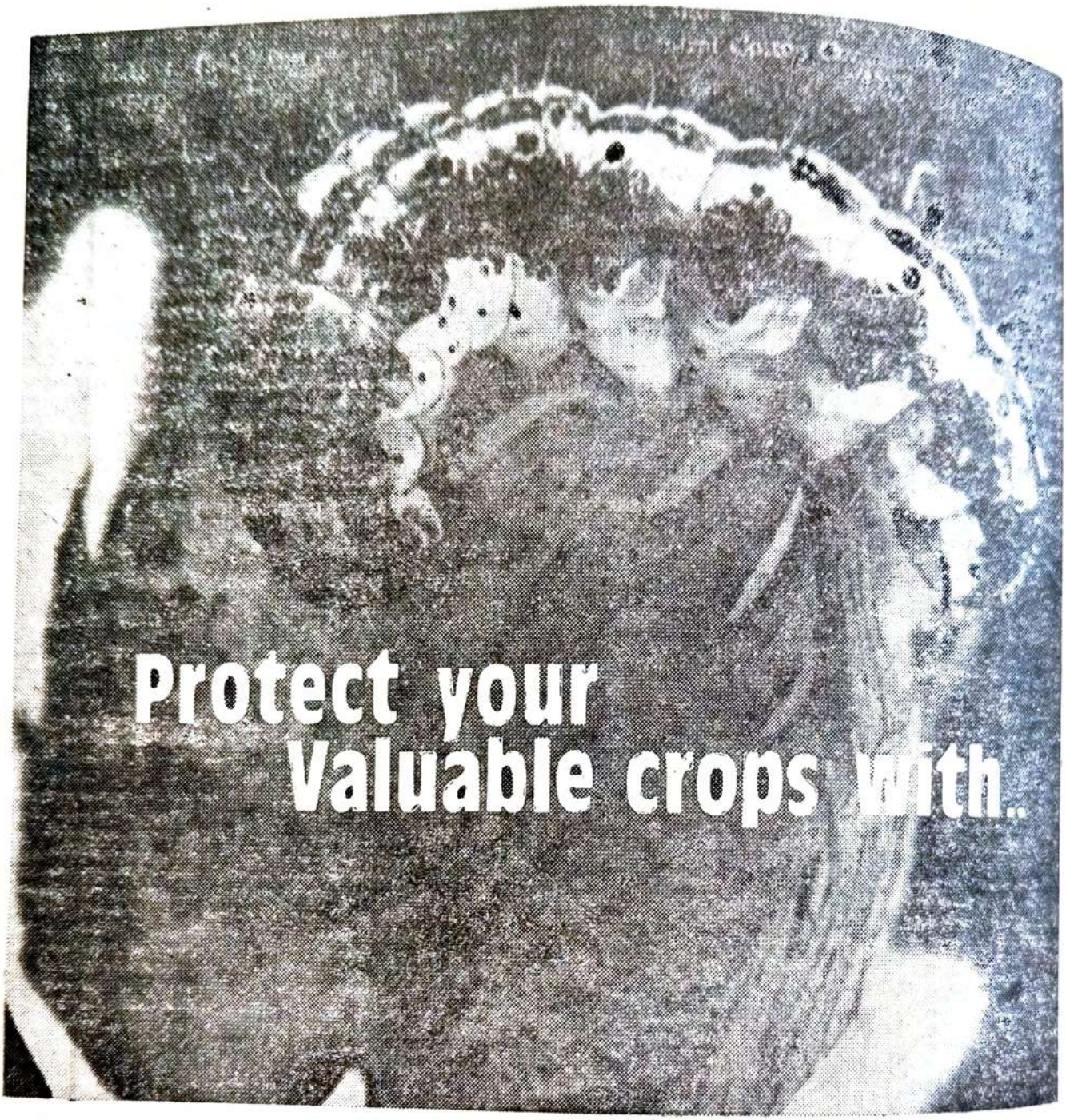

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