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Nitrogen Management in Summer Paddy

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ABSTRACT

A field experiment conducted at college farm, Gujarat Agricultural University, Navsari campus, Navsari to study the effect of nitrogen levels and its split application on summer rice Var IR-22 revealed that though the maximum yield was obtained with application of 140 kg N/ha, application of 100 kg N/ha was found most economical. Split application of nitrogen did not prove advantageous for increasing yield in summer rice under agro-climatic condition of South Gujarat.

(Received on 24th July, 1985)

INTRODUCTION

Fertilizer is an effective but costly input in increasing the crop production. About 1/3rd of total nitrogenous fertilizer consumed in the country goes exclusively to rice crop. However, the efficiency of applied nitrogen to this crop is only 30 to 50 per cent and in many cases still lower (Prasad *et al.*, 1970 and Prasad and De Datta, 1978). Top priority is, therefore, required to be given to agronomical practices which enhance the efficiency of nitrogen fertilization in rice crop.

The studies made in India have clearly suggested the supremacy of two to four splits of nitrogen application for higher yield and recovery. (Pande and Singh, 1970; Prasad *et al.*, 1970 and Patel, 1982). Keeping this in view, the present experiment was laid out to ascertain suitable level of nitrogen and its time of application for summer rice (Var. IR-22) under clayey soil of south Gujarat.

MATERIALS AND METHODS

A field experiment was conducted during summer seasons of 1980, 1981 and 1982 at College Farm, Gujarat Agricultural University, Navsari in split plot design with four levels of nitrogen (80, 100, 120 and 140 kg/ha) as main plot treatments and four split applications (one, two, three and four splits) as sub-plot treatments. The trial was replicated four times. A common basal dose of 50 kg P_2O_5/ha was applied in form of single super phosphate to each plot before transplanting. Nitrogen was applied in form of ammonium sulphate. Forty-five days old seedlings of popular rice variety IR-22 were transplanted keeping two plants/hill with 20×15 cm spacing on 3rd, 1st and 4th February and the crop was harvested on 25th, 27th, 26th and May during respective years. The soil of the experimental field was clayey in texture (56.80 per cent clay) with a pH of 7.4 and the organic carbon content

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0.59 per cent. The available P_2O_5 and K_2O were 17.40 and 260.0 kg/ha, respectively.

RESULTS AND DISCUSSION

Effect of levels of nitrogen :

A linear response of nitrogen application was noticed during all the three years as well as in pooled data and significantly the highest grain yield was obtained with an application of the highest level of nitrogen (140 kg N/ha) in the pooled data (Table 1). This finding was in line with those reported by Kalola (1978) and Patel *et al.* (1980). The yield equation is $Y = 552.5 + 53.42 X - 0.1687 X^2$.

Effect of time of application :

The data presented in Table 1 revealed that the grain yield was significantly influenced by split application of nitrogen during 1980 crop season only. While during 1981, 1982 as well as in pooled data the yield differences remained non-significant. This might be

TABLE 1

Grain yield (kg/ha) of summer rice as affected by levels of nitrogen and its split application.

Treatment		*Grain yield (kg/ha)*			
		1980	*1981*	*1982*	*Mean*
Nitrogen levels (kg/ha)					
80		4178	3717	3326	3740
100		4495	4487	3701	4227
120		4943	4882	3717	4514
140		5121	5067	4031	4740
S.Em. ±		112	164	88	72
C.D. (5%)		358	524	280	210
Time of N application (No. of splits)					
Full dose at 10 DAT	One	4126	4749	3815	4230
1/2 + 1/2 at 10 and 20 DAT	Two	4660	4304	3607	4190
1/3 + 1/3 + 1/3 at 10, 20 and 30 DAT	Three	4893	4512	3714	4373
1/4 + 1/4 + 1/4 + 1/4 at 10, 20, 30 and 40 DAT	Four	5058	4588	3611	4419
S.Em. ±		169	181	85	87
C.D. (5%)		485	N.S.	N.S.	N.S.
Interaction effect					
S.Em. ±		338	363	169	174
C.D. (5%)		N.S.	N.S.	N.S.	N.S.

N.S. = Not significant.

DAT : Days after transplanting.

Note : The crop growth stages at 10, 20, 30 and 40 days after transplanting corresponded to establishment of seedlings, tillering, maximum tillering and panicle initiation stage, respectively.

TABLE 2

Economics of nitrogen application.

Nitrogen levels (kg/ha)	*Av. grain yield (kg/ha)*	*Additional yield (kg/ha)*	*Incremental cost (Rs./ha)*	*Incremental benefit (Rs./ha)*	*Gross ICBR*	*Net ICBR*
80	3740	—	—	—	—	—
100	4227(24.35)*	487	180	730.50	1:4.06	1:3.06
120	4514(14.35)	287	180	430.50	1:2.39	1:1.39
140	4740(11.30)	226	180	339.50	1:1.88	1:0.88

(*) Figure in parenthesis indicated the nitrogen use efficiency. (kg of additional grain/kg of additional 'N' applied).

(1) Price of nitrogen in form of Ammonium sulphate Rs. 9/ /kg with application cost.

(2) Price of rough rice Rs. 1.50/kg.

due to the fact that the profile contained a fine texture layer which coupled with puddling impeded water percolation. Run off losses were not a factor in summer season. The result was in contrast to that of Patel (1982), who obtained increased yield with nitrogen application in four splits in sandy-clay soil at Nawagam (Middle Gujarat).

Effect of nitrogen levels x split application :

The interaction effect of nitrogen levels and its split application was also found to be non-significant.

Nitrogen use efficiency and its economics :

The response per kg of 'N' was 24.35, 14.35 and 11.30 kg of rough rice at 100, 120 and 140 kg N/ha, respectively (Table 2). The linear response of nitrogen levels with respect to net incremental cost benefit ratio (net ICBR) were 3.06, 1.39, and 0.88 at 100, 120 and 140 kg N/ha, respectively. This indicated that application of more than 100 kg N/ha was not economical to the farmers at the prevailing price of nitrogen and rough rice as the corresponding values were not attractive. Mahapatra *et al.* (1974) also suggested that net ICBR value should not be less than 1 : 2.5.

REFERENCES

Kalola, G. L. (1978). Effect of different levels and sources of nitrogen on transplanted summer rice (Var. Ratna). M.Sc. (Agri.) Thesis submitted to GAU Sardar Krushinagar.

Mahapatra, I. C.; Bapat, S. R. and Singh, M. (1974). Economics of fertilizer use. *Fertil. Marketing News* **5:** 1-12.

Pande, H. K. and Singh, H. P. (1970). Response of lowland rice to split application of nitrogen fertilizer. *Indian J. Agron.* **15:** 285-287.

Patel, M. S. (1982). Effect of time of nitrogen application on yield and utilization by mid-late rice variety. *Indian J. Agron.* **27:** 445-447.

Patel, R. B.; Patel, P. G.; Naik, A. G. and Patel, I. G. (1980). Response of rice varieties to nitrogen in summer season. *Indian J. Agron.* **25:** 528-529.

Prasad, R.; Bain, S. S.; Rajale, G. B. and Lakhdive, B. A. (1970). Nitrogen fertilizer practices for rice for maximum efficiency. *Indian Fmg.* **8:** 11-14.

Parasad, R. and De Datta (1978). Increasing fertilizer nitrogen efficiency. Symp: on nitrogen for rice. IRRI, Los. Banos, Philippines, 4-8.

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Effect of Certain Ethylene Absorbents on Storage Behaviour of Basrai Banana

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ABSTRACT

The effectiveness of nine ethylene absorbents was tested on ripening and shelf life of Basrai Banana hands stored at ambient temperature. The treatments consisted of Vermiculite and silicagel soaked in potassium permanganate and tested in the form of crystals as well as in the form of blocks. Crystals of potassium permanganate packed in muslin cloth also comprised one treatment and naked banana hand served as control. The results revealed that shelf life of bananas was singificantly influenced by the ethylene abosrbents and when vermiculite blocks were inserted into the banana packages (T4) shelf life was significantly extended by 3.270 days and was found beneficial. Fruits subjected to this treatment also maintained better fruit firmness and marketability during storage and exhibited delayed accumulation of T.S.S. and retarded catalase activity. Compared to vermiculite, silica gel (T1 and T2) was found less effective as medium to carry potassium permanganate. When crystals of silica gel or vermiculite were packed in muslin cloth (T5 to T8), or when potassium permanganate crystals were directly used (T9), ripening was not significantly retarded and fruits were stained. In untreated fruit, shelf life was low and fruits exhibited a rapid rate of ripening as evidenced by rapid increase in T.S.S. content, catalase activity, lowered fruit firmness and marketability.

(Received on 27th Dec. 1983)

INTRODUCTION

Gujarat is one of the major states of Banana production (Anon, 1980) and in particular South Gujarat has an excellent export potential for Basrai Bananas. However, exports have declined since 1977 (Anon, 1978) due to fungal spoilage, early ripening in transit and due to lack of a cheaper technique of storage. In our country bananas are transported over a long distance at ambient temperatures and production and accumulation of volatile gases like ethylene is important as such gases accelerate fruit ripening. Of late, the technique of ethylene absorption was suggested as an inexpensive means of retarding ripening and involves absorption of ethylene evolved by ripening fruits by potassium permanganate absorbed into certain media. For extension of shelf life of bananas, Scott

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et al. (1968) recommended packing of potassium permanganate crystals in polythene packages and shelf life was extended by 15 days. Scott and Gandenagara (1974) and Tongdee (1972) succeeded by inserting 50-75 g of potassium permanganate using vermculite as carrier and shelf life was reported to be extended by a week at ambient temperature. Avan and Ndubizu (1978) utilised silica gel for carrying potassium permanganate and extended the shelf life of banana by a week. It is apparent that the type of media for carrying potassium permanganate varied considerably and therefore, it was proposed to test the efficacy of certain ethylene absorbents made of silica gel and vermiculite on storage behaviour of Basrai banana when packed in polythene packages and stored at ambient temperature.

MATERIALS AND METHODS

The trial was laid out in a randomized block design with three replications and there were ten treatments as under:

1. Silica gel block soaked in potassium permanganate at 50 g/l
2. Silica gel block soaked in potassium permanganate at 100 g/l
3. Vermiculite block soaked in potassium permanganate at 50 g/l
4. Vermiculite block soaked in potassium permanganate at 100 g/l
5. Potassium permanganate treated silica gel (20 g) packed in muslin cloth
6. Potassium permanganate treated silica gel (20 g) packed in muslin cloth and with a moisture absorbent (20 g calcium hydroxide)
7. Potassium permanganate treated vermiculite (20 g) packed in muslin cloth
8. Potassium permanganate treated vermiculite (20 g) packed in muslin cloth and with a moisture absorbent
9. Potassium permanganate crystals (20 g) packed in muslin cloth
10. Control (Naked hand)

One hand of twelve fruits packed in polythene package (40 x 30 cm) along with a block of ethylene absorbent represented one experimental unit. Third hand from the mature and freshly harvested bunches formed the experimental material.

Preparation of ethylene absorbents: The method of Tongdee (1972) was slightly modified and vermiculite or silica gel. cement and sand in 4 : 2 : 1 ratio were mixed and moulded into blocks of 3 x 2 x 1". The blocks so prepared were shade dried over-night. Subsequently, blocks were saturated by dipping in solutions of potassium permanganate and shade dried for 60 minutes. Such blocks were inserted into polythene packages and sealed. In case of other treatments, vermiculite or silica gel granules were saturated in corresponding solutions of potassium permanganate. The saturated granules were quickly dried and packed in muslin cloth. Fifty grams of calcium hydroxide were packed in muslin cloth and this served as moisture absorbent. Data on ripe fruit percentage, days to ripening (expressed as weighted average), marketable fruit percentage, fruit texture, T.S.S. and catalase activity were collected at regular intervals. One fruit was sampled from the middle portion of the hand and was utilised for chemical analysis. The packages were sealed air-tight immediately after each withdrawal of sample. Fruit firmness was tested by penetrating a pocket pressure tester and expressed as pressure required in Kg/Cm^2. Pulp from the middle

portion of the finger was utilised for biochemical analysis (Desai and Deshpande, 1978). Enzyme extract (1 : 4) prepared according to the method of Desai and Deshpande (1978) employing phosphate buffer (pH 6.7). The activity of catalase was determined employing the method of Colowick and Kaplan (1968) at room temperature and expressed in μ l of H_2O_2 oxidized per minute per ml of enzyme solution.

RESULTS AND DISCUSSION

1. Rate of ripening

The data on ripe fruit percentage under the influence of different treatments were presented in Table 1.

It is apparent from the table that till 6th day of storage, the differences in ripe fruit percentage were not significant. On 8th day, all the treatments except treatment 9 recorded significantly lower ripe fruit percentage over control which recorded highest percentage of ripe fruits. Similarly, on 10th day, except treatment 5, all the treatments continued to record lower percentage of ripe fruits. However, in the subsequent storage period, the differences in the treatments remained non-significant. Thus, it is clear from the data that ripe fruit percentage was reduced when blocks of vermiculite (T3 and T4) were employed and followed by Silica gel (T1 and T2).

Significantly higher number of days were taken by the treatment 4 (13.770 days) for total ripening while all other treatments were at par with control which took only 9.907 days. Thus, treatment 4 (vermiculite block soaked in 100 g of potassium permanganate/L) was found to be very efficient followed by T3 and delayed the ripening by 3.270 and 2.802 days, respectively.

2. Marketable fruit percentage

Data regarding marketable fruit percentage as affected by the treatments are furnished in Table 2. A perusal of

TABLE 1

Effect of ethylene absorbents on ripe fruit percentage and days to ripening in banana cv. Basrai.

Treatment	*Storage Period (Days)*						*Days to ripening (Wgtd. avg.)*
	6	*8*	*10*	*12*	*14*	*16*	
1.	2.78(5.60)	5.55(11.17)	52.77(46.59)	72.72(59.50)	100.00(90.00)	100.00	10.994
2.	2.78(5.60)	8.33(13.63)	38.88(38.38)	78.78(63.00)	100.00(90.00)	100.00	12.046
3.	2.78(5.60)	5.55(8.06)	36.11(36.27)	57.57(49.81)	90.00(78.93)	100.00	12.809
4.	5.55(8.06)	8.33(13.63)	33.33(30.01)	57.57(49.83)	90.00(78.93)	100.00	13.177
5.	8.33(16.74)	13.88(21.66)	44.44(41.77)	72.72(63.95)	90.00(78.93)	96.29	12.176
6.	8.33(13.63)	16.66(20.01)	41.66(38.81)	57.57(49.71)	83.33(66.63)	100.00	12.038
7.	5.55(8.06)	11.10(16.09)	30.55(33.49)	57.57(49.35)	90.00(75.00)	100.00	11.458
8.	5.55(11.17)	16.66(23.62)	36.11(36.77)	75.75(61.61)	96.66(83.85)	100.00	11.467
9.	11.11(16.09)	19.44(25.36)	36.11(36.38)	75.75(65.26)	93.93(77.70)	100.00	11.752
10.	27.78(31.75)	41.66(40.13)	72.72(58.23)	100.00(90.00)	100.00(90.00)	100.00	9.90
C.D. at 5%	N.S.	16.39	N.S.	17.26	N.S.		2.980

*Figures in parenthesis represent transformed values.
N.S. = Not significant.

TABLE 2

Effect of ethylene absorbents on marketable fruit percentage in banana cv. Basrai.

Treatment	*Storage Period (Days)*			
	10	*12*	*14*	*16*
1.	94.44 (78.84)	72.72 (59.03)	53.33 (46.92)	25.92 (30.49)
2.	94.44 (78.84)	84.84 (71.42)	53.33 (46.92)	37.03 (37.42)
3.	83.33 (70.21)	90.90 (79.83)	66.67 (55.08)	59.25 (50.85)
4.	97.22 (84.42)	84.85 (71.78)	70.00 (57.00)	40.74 (39.60)
5.	86.11 (68.34)	72.72 (59.50)	56.67 (48.85)	48.14 (43.90)
6.	88.88 (74.42)	75.75 (61.25)	60.00 (50.77)	51.85 (46.03)
7.	91.66 (73.26)	72.72 (59.50)	70.00 (56.79)	55.55 (48.16)
8.	77.77 (62.67)	69.69 (57.30)	40.00 (38.85)	29.63 (27.61)
9.	88.88 (70.80)	63.63 (53.81)	36.67 (36.64)	29.63 (31.21)
10.	66.66 (54.85)	54.54 (47.63)	40.00 (38.85)	22.22 (23.50)
C.D. (5%)	N.S.	17.31	N.S.	N.S.

Figures in the parenthesis represent transformed values.
N.S. = Not significant.

the data revealed that till 10th day, the marketability was not affected by various treatments. But on 12th day of storage, the differences were significant and higher percentage of marketable fruits was recorded by the treatment 3, followed by treatment 2 and 4 against a minimum percentage registered in control. It is apparent that at least upto 12th day, the marketability of fruits was maintained by the ethylene absorbents.

3. Fruit texture

Data in respect of the firmness of the fruit during storage as influenced by the treatments are presented in Table 3. It was observed that till 10th day, the fruit texture remained unaltered by various treatments. However, on 12th day of storage, fruits in treatment 4 significantly recorded higher pressure values followed by treatment 3, as against a minimum pressure value recorded in the control. Thus, till 12th day, the hard texture of the fruits was maintained by the fruits subjected to the ethylene absorption treatments.

4. Total soluble solids

The details of changes in total soluble solids content of fruits as affected by the treatments are presented in Table 4. It is evident from the results that till 6th day, the differences in

TABLE 3

Effect of ethylene absorbents on fruit texture (in kg/cm^2 pressure) in banana cv. Basrai.

Treatment No.	*Storage Period (Days)*				
	3	*6*	*9*	*12*	*16*
1	2.42	1.58	1.25	0.67	0.23
2	2.25	1.65	1.25	0.57	0.25
3	2.45	1.58	1.25	0.75	0.32
4	2.42	1.83	1.33	0.83	0.32
5	2.42	1.17	0.92	0.50	0.20
6	2.17	1.33	1.00	0.62	0.33
7	2.25	1.33	1.00	0.70	0.25
8	2.33	1.58	1.15	0.62	0.37
9	2.39	1.18	0.82	0.62	0.20
10	2.08	1.17	0.70	0.40	0.10
CD at 5%	N.S.	N.S.	N.S.	0.17	0.25

N.S. = Not significant.

TABLE 4

Effect of ethylene absorbents on total soluble solids (%) in banana cv. Basrai.

Treatment No.	*Storage Period (Days)*				
	6	*8*	*10*	*12*	*16*
1	2.50 (9.01)	10.00 (18.44)	16.33 (23.84)	17.67 (24.85)	14.67 (22.52)
2	3.50 (10.77)	12.00 (20.26)	16.33 (23.85)	18.00 (25.10)	16.00 (23.57)
3	4.16 (11.78)	12.67 (20.82)	16.00 (23.57)	17.67 (24.85)	17.00 (24.34)
4	3.83 (11.29)	12.67 (20.79)	15.33 (23.05)	18.33 (25.35)	19.67 (26.32)
5	3.50 (10.78)	14.33 (22.24)	17.17 (24.47)	20.33 (26.89)	17.00 (24.34)
6	3.50 (10.78)	13.67 (21.68)	16.83 (24.47)	19.00 (25.83)	18.67 (25.58)
7	3.33 (10.51)	15.00 (22.78)	18.50 (25.47)	20.00 (26.56)	16.00 (23.57)
8	3.50 (10.78)	13.00 (21.12)	17.33 (24.59)	19.67 (26.30)	17.00 (24.34)
9	3.50 (10.78)	14.00 (21.90)	18.83 (25.71)	18.00 (25.10)	18.67 (25.58)
10	3.50 (11.26)	15.66 (23.32)	21.00 (27.27)	17.50 (24.73)	15.33 (23.05)
C.D. (5%)	N.S.	1.62	1.06	1.28	N.S.

*Figures in parenthesis represent transformed values.

N.S. = Not significant.

T.S.S. were non-significant, but in subsequent storage, the same attained the statistical significance. The rise in T.S.S. content was rapid in untreated fruits while the same was found to be slower in treated fruits, indicating that ripening was retarded in the treated fruits.

5. Catalase activity

The data regarding the relative activities of catalase under the influence of different treatments are furnished in Table 5.

TABLE 5

Effect of ethylene absorbent on catalase activity (as / U_1 of H_2 O_2 oxidized per minute per ml) in banana cv. Basrai.

Treatment	*2nd Day*	*10th Day*
1	4114.1	5656.9
2	4045.9	6685.8
3	4330.7	7253.9
4	3708.1	6441.9
5	4249.5	7335.1
6	4141.2	7497.5
7	3951.7	6441.9
8	3735.2	7199.7
9	3951.7	8146.1
10	4655.5	8580.1

(Values represent average of duplicate samples)

From the data, it is evident that in general, enzyme activity showed an increase in all the treatments during ripening. At both the stages, the rate of catalase activity in the pulp tissue was low in treated fruit whereas the same was greater in untreated fruit indicating retarded metabolic rate of tissues in treated fruit.

From these results, it is evident that the rate of ripening was significantly retarded at least till 10th day by the ethylene absorbents as evidenced by the lower percentage of ripe fruits. Vermiculite was found to be efficient carrier of potassium permanganate when employed in the form of blocks (treatment 4 and 3) and delayed the ripening by 3.270 and 2.902 days, respectively. Fruits subjected to these treatments maintained better fruit firmness and marketability during storage. Accumulation of T.S.S. was also considerably delayed reflecting the delayed starch hydrolysis. Catalase is a respiratory enzyme and retarded catalase activity in these treatments point out the fact that tissue respiration was retarded reducing the metabolic rate of the fruit tissues. Exogenous application of ethylene to fruits is known to induce catalase activity (Mattoo and Modi, 1969) and the retarded enzyme activity supports these observations indirectly. These findings are in agreement with the reports of Tongdee (1972) and Scott and Gandenagara (1974) who employed vermiculite and observed retarded ripening of bananas. Scott *et al.* (1970) reported reduced ethylene concentrations in banana packages and increased fruit firmness when vermiculite was used. Awan and Ndubizu (1978) reported extended shelf life of bananas by seven days when silica gel was employed as a carrier of potassium permanganate, associating with delayed accumulation of sugars. In untreated fr t, ripening was rapid in terms of ra id increase in T.S.S. content, losses in fruit firmness and rapid increase in catalase activity.

Present studies also revealed that insertion of moisture absorbent had no extra advantage and so the different strengths of potassium permanganate. When silica gel and vermiculite were packed in muslin cloth (Treatments 5 to 8) and when potassium permanganate was directly packed in muslin cloth (T-9), ripening was slowed down

but results were not promising. In addition, the fruits were also stained by the potassium permanganate.

Therefore, considering the days taken to total ripening, retention of marketability, and firmness of the fruits during storage, it can be concluded that, for extension of shelf life of banana hands, ethylene absorbent made of vermiculite block (T-4) would be beneficial for insertion into the banana packages. The results also gave an indicaion that in the later stages of storage, the ethylene absorbents lost their efficacy and probably the quantity of ethylene absorbent material required need to be standardized per unit weight of bananas for enhancing the efficincy of ethylene absorbent and on these lines, further work is worth attempting.

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REFERENCES

Anonymous. (1978). Fifteenth annual report of Gujarat State Cooperative Fruit and Vegetable Marketing Federation Ltd., Bardoli, Gujarat.

Anonymous. (1980). Agricultural Situation in India. Published by Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation, New Delhi. **33:** 180-182.

Awan, J. A., and T. O. C. Ndubizu (1978). Some aspects of nutrient changes in stored plaintain fruits. *Paradisiaca*. **3:** 18-24.

Colowick, S. P. and N. O. Kaplan (1968). Methods in Enzymology. Academic Press, New York, p. 159.

Desai, B. B. and P. B. Deshpande (1978). Effects of Stages of maturity on some physical and biochemical constituents and enzyme activities of banana fruits. *Mysore J. Agric. Sci.* **12:** 193-201.

Scott, K. J., W. B. Mc. Glasson and S. A. Roberts (1968). Ethylene absorbent increases storage life of bananas packed in polythene bags. *Agric. Gaz. New South Whales*. **79:** 52.

Scott, K. J. and S. Gandenagara (1974). Effect of Temperature on the storage life of bananas held in polythene bags with ethylene absorbent. *Trop. Agric. (Trinidad)*. **51:** 23-26.

Tongdeo, S. C. (1972). Polythene bags and Ethylene absorbent for delaying banana ripening. *Thai. J. Agr. Sci.* **5:** 265-71.

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Life-Tables and Population Dynamics of *Heliothis armigera* Hubn. on Groundnut

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ABSTRACT

Life-tables were prepared for *Heliothis armigera* Hbn. infesting groundnut crop (*Arachis hypogaea* Linn.) to understand the population dynamics and role of various mortality factors during two consecutive summer seasons of the year 1981-82 and 1982-83 at Gujarat Agricultural University, Junagadh. Mortality in younger larvae (first and second instar) was high (25.59 and 26.07 per cent) due to unknown causes. Population of older larvae (third to six instars) declined by 22.75 and 23.08 per cent due to nuclear polyhedrosis virus disease during the seasons under study. The positive values of trend index (1.054 and 1.03) indicated that the mortality factors operating during summer were not effective in suppressing the *Heliothis* population on groundnut crop. Pupal mortality resulting from failure to complete develoment or inability of the imago to eclose was 7.63 and 6.68 per cent during respective seasons. However, few pupae died due to a larval-pupal parasite *Eucarcelia illota* Curr.

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INTRODUCTION

Life-tables are the most useful tools in the study of population dynamics of insects. The use of life-tables has recently been made for studying natural populations. By this technique, relationship of various environmental factors with the fluctuations in a pest population and the key factor(s) that bring about change in the population size can be determined (Harcourt, 1969; Atwal and Bains, 1974). Deevey (1947) was the first to apply the technique to a growing population in nature. Morris and Miller (1954) used this approach in describing the population dynamics of *Choristoneura fumiferana* (Clemens) and since then life-tables have been constructed for the insect pests of forest, orchard and few agricultural crops (Allen and Pienkowski, 1975; Witter *et al.*, 1972; Singh *et al.*, 1979). *Heliothis armigera* Hubn. is typically a polyphagous pest damaging many cultivated crops including cotton, pulses and cereals. Recently, it was observed feeding on groundnut (*Arachis hypogaea* Linn.) which is one of the important cash crops in the Gujarat State.

Studies on this pest have been mainly restricted to biology and chemical control measures. The pest shows violent population fluctuations with intermittent outbreaks. Therefore, the present studies were undertaken to construct life-tables and determine the

causes for the population fluctuations of this pest under the natural conditions.

MATERIALS AND METHODS

Absolute population of *H. armigera* was recorded in groundnut field during two consecutive summer seasons of the year 1981-82 and 1982-83 at the Main Oilseeds Research Station Farm, Gujarat Agricultural University, Junagadh Campus, Junagadh. The generations were not distinct and there was much overlapping. The pest infested more than one crop during the same season. Hence, the life-tables were prepared for the season instead of generation of the pest. In order to record the absolute population of this pest, sample quadrates of 2m x 2m were used. For this purpose, the groundnut field was divided into 20 quadrates and they were observed at weekly interval. All the plants in each quadrate were examined thoroughly for recording the population which was continued till the harvest of the crop. The population was then computed on hectare basis.

The egg stage could not be collected in the field but the stages sampled included the younger larvae (first and second instars) and older larvae (third to sixth instar). The larvae thus collected were reared in the laboratory until the adults emerged. The extent of larval and pupal parasitism and mortality due to nuclear polyhedrosis virus (NPV) were recorded in different instars. The number of eggs were derived indirectly from the average fecundity of the pest. The present life-tables were constructed according to the format of Morris and Millar (1954) and Harcourt (1969) as under:

x = The age interval (egg, larva, pupa or adult).

lx = The number surviving at the beginning of the stage noted in column 'x'

dx = The number dying within the age interval stated in column 'x'.

dxf = The mortality factor responsible for 'dx'.

100 qx = Per cent mortality.

sx = Survival rate within the age mentioned in column 'x'.

The 'lx' for eggs was derived indirectly on the basis of field collected eggs and the 'dx' value worked out.

Separate budgets were prepared to find out the key factor that affect the population trend in different crop seasons. The method suggested by Varley and Gradwell (1963 and 1965) was followed for key factor analysis. Similarly, the values of killing power (k) of each mortality factor in different age groups were computed by taking the difference between the logarithms of population density before and after its action. The total killing power (K) was worked out by taking the sum of killing power k's.

RESULTS AND DISCUSSION

Present studies were carried out in two consecutive summer seasons of the years 1981-82 and 1982-83. Results in the form of life-tables are presented in Tables 1 and 2.

Data on life-tables revealed that there was 14.0 to 15.0 per cent mortality in the egg stage. This mortaliy was primarily due to sterility. Mortality in different larval instars ranged from 3.70 to 25.59 (summer, 1981-82) and 1.28 to 23.23 (summer, 1982-83)

TABLE 1

Life-table of *H. armigera* during the summer (February to May, 1982) on groundnut (population/ha).

x	*lx*	*dxf*	*dx*	*100 qx*	*sx*
Expected eggs	36513	Mortality/sterility	4763	15.00	0.87
Viable eggs	31750				
Younger larvae (N_1)		Parasitoid	0000	0.00	
(first and second instar)	31750	Disease unknown	0000	0.00	0.74
			8125	25.59	
			8125	25.59	
Older larvae		Parasitoid	875	3.70	
(third to sixth instar)	23625	Disease	5375	22.75	0.69
		Unknown	1000	4.23	
			7250	30.68	
		Parasitoid	625	3.82	
Pupae	16375	Disease	500	3.05	0.87
		Unknown	1250	7.63	
			2375	14.50	
Moths	14000	(Sex 50% females)			1.00
Females x 2 (N_3)	14250				1.00
Normal females x 2	14250				1.00
General total	22513			60.97	

Expected eggs	4624125
No. of dead sterile eggs	693619
Viable eggs	3939506
Expected number of younger larvae	3930506
Actual number of younger larvae (N_2)	33163
Trend index = N_2/N_1	1.4
Generation survival (SG) = N_3/N_1	0.45

per cent. The mortality was caused by three factors viz., parasites, viral disease and unknown factors. High mortality in younger larvae (first and second instars) during the years was due to unknown causes. The population of older larvae (third to sixth instars) was reduced by 30.68 and 34.64 per cent during the summer season of the years 1981-82 and 1982-83 respectively. During pupal stage the mortality was 14.50 and 14.70 per cent in the two respective years. The trend index was to the tune of 1.04 (summer, 1981-82) and 1.03 (summer, 1982-83). The positive values of trend index indicated that the mortality factors were not operating efficiently during the season under study.

TABLE 2

Life-table of *H. armigera* during the summer (February to May, 1983) on groundnut (population/ha).

x	*lx*	*dxf*	*dx*	*100 qx*	*sx*
Expected eggs	30659	Mortality/ sterility	4292	14.00	0.86
Viable eggs	26367				
Younger larvae (N_1)		Parasitoid	750	2.84	
(First and second instar)	26367	Disease	000	0.00	0.74
		Unknown	6125	23.23	
			6875	26.07	
		Parasitoid	250	1.28	
Older larvae		Disease	4500	23.08	0.65
(third to sixth instar)	19500	Unknown	2000	10.28	
			6750	34.64	
		Parasitoid	250	1.96	
Pupae	12750	Disease	750	5.88	0.85
		Unknown	875	6.68	
			1875	14.52	
Moths	10875	(Sex 50% females)			1.00
Females X_2 (N_3)	10875				1.00
Normal females X_2	10875				1.00
General total	19792			64.53	

Expected eggs	3726155.63
Number of dead/sterile eggs	521661.79
Viable eggs	3204493.84
Expected number of younger larvae	3204493.84
Actual number of younger larvae (N_2)	27136
Trend index = N_2/N_1	1.03
Generation survival (SG) = N_3/N_1	0.41

Data in Tables 3 and 4 show that the maximum population declined during the younger larval stage as the values of 'k' for the older group larvae was the highest (0.1283 and 0.1187) during both the seasons. Considering the values of 'k' in both younger as well as older groups of larvae, the mortality in youner larvae was mainly due to unknown factors, but the decline in older larval population was primarily due to the action of nuclear polyhedrosis viral disease. Similar observations were also reported by Reed (1965) in Tanganyika, Patel *et al.* (1968) in Gujarat and Bilapate *et al.* (1979) in Maharashtra.

Mortality in pupal stage due to unknown factors can be ascribed due to failure of larvae to moult and unsuccess-

TABLE 3

Budget for *H. armigera* **for summer (February to May, 1982) on groundnut.**

Age interval	*Nos./ha*	*Log Nos./ha*	*k's*
Expected eggs	36513	4.5824	
Viable eggs	31750	4.5018	0.0806
Actual number of younger larvae (First to second instar)	31750	4.5018	
After mortality due to unknown causes third to six instar larvae	23625	4.3750	0.1283
After mortality due to parasitoid (*C. chloridae*)	22750	4.3570	0.0165
Disease (NPV)	17375	4.2400	0.1170
Unknown	16375	4.2143	0.0257
			0.1591
Pupae	16375	4.2143	
After mortality due to			
Parasitoid (*E. illota*)	15750	4.1473	0.0170
Disease (NPV)	15250	4.1832	0.0141
Unknown	14000	4.1461	0.0371
Adult	14000	4.1461	
Reproducing females	7000	3.8451	0.3010
			K=0.7373

TABLE 4

Budget for *H. armigera* **for the summer season (February to May, 1983) on groundnut.**

Age interval	*Nos./ha*	*Log. Nos./ha*	*k's*
Expected eggs	30659	4.4866	
Viable eggs	26367	4.4211	0.0655
Actual number of younger larvae (First and second instar)	26367	4.4211	
After mortality due to			
Parasitoid	25617	4.4085	0.0126
Unknown	19492	4.2898	0.1187
Third to sixth instar larvae	19492	4.2898	
After mortality to			
Parasitoid	19242	4.2842	0.0056
Diseases	14742	4.1685	0.1157
Unknown	12742	4.1042	0.0643
			0.1856
Pupae	12742	4.1042	
After mortality due to			
Parasite	12492	4.1042	0.0077
Disease	11742	4.0697	0.0268
Unknown	10867	4.0363	0.0334
Adult	10867	4.0363	
Reproducing female	5434	3.7351	0.3012
			K=0.7515

ful adult eclosion. Many of the larvae formed puparia failed to complete development (7.63 and 6.68 per cent). Such observations were also made by Bilapate *et al.* (1979), while studying the key mortality factors responsible for reduction of the population of *Heliothis* on sorghum, pigeonpea and chickpea. However, few larvae died because of the larval-pupal parasite *Eucarcelia illota* Curr.

REFERENCES

Allen, W. A. and R. L. Pienkowski, 1975. Life-tables for the fruit-fly *Ocinella frit* in reed canary grass in virginia. *Ann. ent. Soc. Am.*, **68** : 1001-7.

Atwal, A. S. and S. S. Bains. 1974. Construction of life-tables for study of field population in *Applied Animal Ecology*, Kalyani Publishers, Ludhiana, pp. 180-185.

Bilapate, G. G.; A. K. Raodeo and V. M. Pawar. 1979. Population dynamics of *Heliothis armigera* Hubner on sorghum, pigeonpea and chickpea in Marathwada. *Indian J. Agric. Sci.* **49** (7): 560-566.

Deevey, E. S. 1947. Life-tables for natural population of animals. *Rev. Bio.*, **22** : 283-284.

Harcourt, D. G. 1969. The development and use of life-tables in the study of natural insect populations. *Ann. Rev. Ent.*, **14** : 175-196.

Morris, R. F. and C. A. Miller. 1954. The development of life-tables for the spruce budworm. *Can. J. Zool.*, **32** : 283-301.

Patel, R. C.; R. Singh and P. N. Patel. 1968. Nuclear polyhedrosis of the gram pod borer, *Heliothis armigera* Hubner. *J. Econ. Ent.*, **61** (1): 191-193.

Reed, W. 1965. *Heliothis armigera* (Hb) (Noctuidae) in Western Tanganyika-II. Ecology and natural and chemical control. *Bull. ent. Res.*, **56** : 127-140.

Singh, B.; J. S. Dhaliwal and A. S. Atwal. 1977. Population studies on the maize borer, *Chilo partellus* (Swinhoe), in the Punjab. IV. Life-tables for determining key mortality factors. *Indian J. Ecol.*, **4** : 107-117.

Varley, G. C. and G. R. Gradwell. 1963. The interpolation of insect population changes. *Proc. Ceylon Ass. Sci.*, **18** : 142-156.

Varley, G. C. and G. R. Gradwell. 1965. Interpreting winter moth population changes. *Proc. Int. Cong. Ent.*, **12** : 377-378.

Witter, J. A.; R. M. Kulman and A. C. Hodson. 1972. Life-tables for the tent caterpillar. *A. Ent. Soc. Am.*, 65 : 25-31.

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Occurrence and Distribution of Different Parasites of *Opisina arenosella* Walker Under Mahuva Conditions of Gujarat

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ABSTRACT

Studies on the natural enemies of *Opisina arenosella* Walker under Mahuva conditions of Gujarat State for three years (1980-83) revealed that maximum parasitism 5.73% and 5.98% by larval parasites viz. *Bracon brevicornis* (Wesm.) and *Parasierola nephantidis* Mues. was recorded in December, 1982 and November, 1981, respectively. Both the parasites remained more active during cold months of the year and less active in warm and humid months. The larval mortality of *O. arenosella* due to diseases was observed to be highest (24.00%) in June, 1981. The highest parasitism by pupal parasites viz. *Brachymeria* spp. and *Xanthopimpla punctata* F. was 26.43% in February and 10.22% in August, respectively. *Brachymeria* spp. were active throughout the year while *X. punctata* was not active in February, March, May and July.

Parasitism of *O. arenosella* by all the parasites was found to be maximum (24.90%) in February followed by June (20.83%) and minimum (1.04%) in May.

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INTRODUCTION

Leaf eating caterpillar, *Opisina arenosella* Walker is one of the most serious pests of coconut palms in India. It is parasitised by more than 20 species of parasites (Dharmaraju, 1962; Joseph *et al.*, 1973). According to Joy and Joseph (1977 and 1978), the most important pupal parasites of *O. arenosella* are the Chalcids, *Brachymeria notsaoi* Habu. and *B. nephantidis* Gahan. Pillai and Nair (1981) reported more than 50% of natural suppression due to pupal parasites in Kerala. Maximum parasitism (48%) by a larval parasite was reported by Rao *et al.* (1948). During survey on natural enemies of this pest at the Plantation Crops Research Station, Mahuva, two larval parasites, nine pupal parasites, eight egg/larval/pupal predators, twenty unidentified species of spiders and fungal/bacterial diseases were recorded. Studies were carried out with view to find out the relative intensity of parasitisation of *O. arenosella* by various parasites during different seasons of the year under Mahuva conditions.

MATERIALS AND METHODS

Collections of the leaflets infested with larvae of *O. arenosella* were made fortnightly from the coconut orchards in and around the Plantation Crops Research Station, Mahuva. The leaflets samples were collected randomly from 25 infested coconut palms. The

parasitized larvae were reared in laboratory till parasite adults emerged. The pupae collected were kept in glass vials/ conical flasks for observations. The parasitized pupae from which the parasite did not emerge were also taken into account. Emergence of parasites was recorded daily. The percentage parasitism by individual parasites was counted on the basis of total number of larvae or pupae and the number of parasitized larvae or pupae. The *Opisina* larvae killed by fungal/bacterial diseases were also recorded. The results on parasitism by different larval and pupal parasites during the different months of three years, 1980-81, 1981-82 and 1982-83 are presented in Table 1 and 2.

RESULTS AND DISCUSSION

Among the natural enemies of *O. arenosella*, a braconid, *Bracon brevicornis* Wesm.; a bethylid, *Parasierola nephantidis* Mues.; Chalcids, *Brachymeria* spp.; an ichneumonid, *Xanthopimpla punctata* Fab. and unidentified diseases were found to be the important ones.

Larval parasitism

Data presented in Table 1 revealed that maximum parasitism by *B. brevicornis* and *P. nephantidis* was 5.73% in December and 5.98% in November followed by 4.81 and 5.75% in February, respectively. The average parasitism by *B. brevicornis* was maximum in February (2.24%) followed by December (1.94%). In case of *P. nephantidis* it was maximum in February (3.66%) followed by November (3.20%). The activity of both the parasites was low in May and June and during periods of high humidity from July to September. The parasitism increased from November onwards. Both the parasites remained active during the cold months of the year. Among the parasites, *P. nephantidis* was observed to be more important than *B. brevicornis* in regulating the pest population. Rao *et al.* (1948) reported that *P. nephantidis* was not active during monsoon period. Nandarajan and ChnnaBasavanna (1980) observed this prarasite to be active throughout the year with a slight reduction in April. They also reported that there was a rise in parasite population during December and from February onwards it showed a downward trend.

Opisina larvae were killed by two unidentified pathogens under field conditions. The incidence of larval disease was highest in June (24.00%) followed by October (11.43%). Average larval disease incidence was maximum in June (12.55%) followed by July (6.15%). Onset of monsoon from 3rd week of June may be responsible for the increase of pathogens which are activated under humid condition.

Average larval mortality due to parasites and pathogens was observed maximum in June (13.61%) followed by February (10.19%) and April (7.92%).

Pupal parasitism

Data presented in Table 2 revealed that the highest parasitism by *Brachymeria* spp. and *Xanthopimpla* was 26.43% in February and 10.22% in August, 1981 followed by 25.88% in December and 8.54% in October, 1980, respectively. The average parasitism by the pupal parasites indicate that *Brachymeria* spp. were more active during the months of October to April and less active in the remaining months of the year. The average parasitism by *Brachymeria* was maximum in November

TABLE 1

Parasitism of *O. arenosella* **by larval parasites.**

Month	*Parasitism (%)*												*Average larval parasitism %*
	Bracon brevicornis				*Parasierola nephantidis*				*Unidentified larval disease*				
	1980-81	*1981-82*	*1982-83*	*Ave.*	*1980-81*	*1981-82*	*1982-83*	*Ave.*	*1980-81*	*1981-82*	*1982-83*	*Ave.*	
April	—	1.35	2.43	1.26	—	3.25	2.70	3.02	—	1.50	3.78	2.64	7.92
May	—	0.00	0.00	0.00	—	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00
June	—	0.00	0.00	0.00	—	0.00	2.32	1.16	—	24.00	1.55	12.55	13.61
July	—	0.00	0.00	0.00	—	0.00	1.53	0.77	—	—	6.15	6.15	3.72
August	—	0.00	0.00	0.00	—	0.02	0.00	0.03	—	—	0.00	0.00	0.01
September	—	0.00	1.50	0.75	—	0.00	2.10	1.05	—	—	3.20	3.20	4.25
October	0.00	1.70	0.00	0.57	0.00	0.73	1.23	0.65	0.00	11.43	1.45	4.39	5.61
November	1.43	0.24	0.00	0.56	5.98	3.62	0.00	3.20	1.43	0.43	0.00	0.93	2.89
December	0.10	5.73	0.00	1.94	1.64	3.93	0.00	1.86	0.54	0.00	0.00	0.18	2.66
January	0.00	0.00	0.22	0.70	0.00	3.55	0.91	1.49	0.00	0.00	1.68	0.56	1.26
February	4.81	0.00	0.91	2.24	0.75	5.75	4.48	3.66	8.86	5.04	0.53	4.81	10.91
March	0.00	0.00	1.53	0.51	0.08	5.34	2.94	2.45	0.00	0.24	1.53	0.59	3.55

(–) Observations were not taken.

TABLE 2

Parasitism of *O. arenosella* by pupal parasites.

Month	Parasitism (%)								Total pupal parasitism %	Overall total parasitism by all parasites %
	Brachymeria spp.				*Xanthopimpla punctata Fab.*					
	1980-81	*1981-82*	*1982-83*	*Average*	*1980-81*	*1981-82*	*1982-83*	*Average*		
April	—	8.02	0.00	4.01	—	2.50	0.00	1.25	5.26	13.18
May	—	2.08	0.00	1.04	—	0.00	0.00	0.00	1.04	1.04
June	—	8.88	3.70	6.29	—	0.00	1.85	0.93	7.22	20.83
July	—	0.00	12.00	6.00	—	0.00	0.00	0.00	6.00	12.92
August	—	15.90	0.00	7.95	—	10.22	0.00	5.11	13.06	13.07
September	—	0.00	1.50	0.75	—	0.00	4.70	2.35	3.10	7.35
October	18.11	0.35	5.62	8.03	8.54	0.35	1.25	3.38	11.41	17.02
November	7.41	20.00	3.51	10.31	0.39	0.00	0.00	0.13	10.44	13.33
December	25.88	0.00	0.00	8.39	1.29	0.99	0.00	0.76	9.15	11.81
January	21.88	0.00	0.00	7.29	0.95	0.00	0.00	0.32	7.61	8.87
February	26.43	0.00	0.54	8.99	0.00	0.00	0.00	0.00	8.99	24.90
March	24.39	0.00	0.00	8.13	0.00	0.00	0.00	0.00	8.13	11.68

(–) Observations were not taken.

(10.31%) followed by February (8.99%) and December (8.39%). *Xanthopimpla* was more active in August, September and October. It was absent in May, February and March. Nandarajan and ChannaBasavanna (1980) reported *Xanthopimpla* parasitising only during November and again in April, 1975. Thus *Brachymeria* was more important than *Xanthopimpla*. Total parasitism by the pupal parasites was found almost uniform (8-10%) in all the months of the year except April, May, July and September and the maximum parasitism (13.06%) was noted in August followed by October (11.44%). Joy and Joseph (1973) recorded average parasitism by *B. nosatoi* to be 14.5 per cent with a maximum of 29 per cent in Kerala and parasitism by *B. nephantidis* was found to be 6.5%. Pillai and Nair (1981) reported that more than 50% of natural pest suppression was due to the pupal parasites.

The overall parasitism of *O. arenosella* by all parasites was found to be highest (24.90%) in February followed by June (20.83%) and lowest (1.04%) in the month of May. It ranged from 8.87 to 17.02% in winter season with a maximum (17.02%) in October, 1.04 to 24.90% in the summer season with a maximum (24.90%) in February and 7.35 to 20.83% in the rainy season with a maximum (20.83%) in June (Table 2).

REFERENCES

Dharmaraju, E. 1962. A check list of parasites, hyperparasites, predators and pathogens of the coconut leaf caterpillar, *Nephanthis serinopa* Meyrick, recorded in Ceylon and in India and their distribution in these countries. *Ceylon cocon. Quart.* **13** (3 & 4).

Joseph, K. J.; Narendran, T. C. and Joy, P. J. 1973 *Oriental Brachymeria* (Hymenoptera: Chalcididae). Zoological Monograph No. 1, pp. 215, Departemnt of

Zoology, University of Calicut, Kerala, India.

Joy, P. J. and Joseph, K. J. 1973. Notes on the biology of *Brachymeria* (*Neobrachymeria*) *nosatoi* and its importance in the control of *Nephantis serinopa*. *Ehntomophaga*. **18** (3): 317-319.

——— 1977. Role of pupal parasites in the biological control of the black headed caterpillar. *Indian cocon. J.* **8** (1): 1-2 & 7.

——— 1978. Relative incidence of the pupal parasites infesting *Nephantis serinopa* Meyrick, the black headed caterpillar pest of coconut in Kerala. *Bull Ent.* **19** : 185-187.

Nandarajan, L. and G. P. Channa Basavanna. 1980. Population dynamics of coconut black headed caterpillar, *Nephantis serinopa* Meyrick (Lepidoptera: Cryptophasidae) and its parasites. *Mysore J. Agric. Sci.* **14** : 533-541.

Nirula, K. K. 1965. Investigations on the coconut palm. Part-III. *Nephantis serinopa* Meyr. *Indian cocon. J.* **9** (2): 102-131.

Pillai, G. B. and K. Ramachandran, Nair. 1981. Role of pupal parasitoides in the natural suppression of the coconut caterpillar, *Nephantis serinopa* Meyrick. *J. Plant. Crops.* **9** (2): 84-87.

Rao, Y. Ramachandran; M. C. Cherian and K. P. Ananthanarayanan. 1948. Infestation of *Nephantis serinopa* Meyr. in S. India and their control by the biological control method. *Indian J. Ent.* **10** : 205-247.

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Influence of Varying Fe : Zn Ratios on Yields of Rice Varieties

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ABSTRACT

Five rice varieties behaved differently under sand-culture with varying Fe: Zn concentration in the nutrient medium. Dry matter production was least in case of variety GAUR-10. Jaya and Mashuri were at par and also yielded significantly more than Padma and IET (1039). Response towards Fe and Zn nutrition indicated that GAUR-10 was Zn-responsive, while Padma and IET (1039) were susceptible to Fe-deficiency. Jaya and Mashuri being intermediate required both Fe and Zn in balanced proportion.

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INTRODUCTION

Nutritional problems of paddy especially regarding micronutrients are mainly those concerned with either Fe, Mn and Zn deficiencies or their excesses. Mere presence of nutrients is not of greater significance but their proportions in relation to one another are equally important. As different varieties of common plant species perform differently under varying conditions of growth, there is a need to test some of the existing rice cultivars for their tolerances or susceptibilities to a specific environment.

MATERIAL AND METHODS

Five varieties of rice (*Oryza sativa* L.) viz. Jaya, IET-1039, Padma, Mashuri, and GAUR-10 were tested for their susceptibility or toxicity towards varying Fe:Zn concentration in the nutrient medium under sand-culture technique. Six possible combinations of three levels of Fe-5.6 (Fe_0), 56 (Fe_1) and 280 ppm (Fe_2), and two levels of Zn-0.065 (Zn_0) and 0.65 (Zn_1) ppm were tried. Treatments were replicated thrice. The required quantity of complete nutrient solution as suggested by Hewitt (1952) excluding Fe and Zn nutrients was given once in a day initially, for raising the seedlings under sand-culture. Eight paddy seedlings uniform in size and growth were transplanted carefully in the polythelene-lined porcelain pots containing 2 kg washed purified sand. Treatments were imposed immediately after transplanting seedlings. Requisite quantity of nutrient solution was supplied to each of the pots daily. The pots were flushed off with deionized water sufficient to remove accumulated salts. Plants were allowed to grow till panicle initiation stage and harvested after 60 days, as abosrption

of the nutrients generally reaches the peak by that period. Dry matter (70° C) yields were recorded.

RESULTS AND DISCUSSION

Dry matter production of rice was greatly influenced by the kind of variety raised. Average produce of different varieties ranged between 19.39 and 25.69 g/pot (Table 1). The highest was noted in case of variety Jaya, while the least was found under GAUR-10. The performance of Mashuri was statistically not different from that of Jaya, and proved significantly superior to Padma and IET (1039) in yielding more dry matter. The latter twos were at par. Different Fe : Zn ratios in the nutrient medium did not alter the yield component significantly. However, the joint effect of variety cum Fe : Zn ratio was significant, which emphasizes the fact that different genetic build-ups make them behave differently under specific set of environment. Rice in general, is considered to be a Fe-loving crop. Moreover, Zn is supposed to be linked with the metabolism and cell-division activities in the plants, which in turn influences the tillering habit and ultimately the dry matter production. Hence, varying levels of both Fe and Zn affected the performance of rice varieties.

The yield of variety Jaya decreased progressively with the increase in level of Fe application from 5.6 (Fe_0) to 280 ppm (Fe_2) along with the normal level (Zn_0) of 0.065 ppm Zn in nutrient medium to the extent of 17.7%. In contrast, the yield improved by 34.3% when corresponding levels of Fe were coupled with 0.65 ppm Zn (Zn_1) i.e. ten-folds higher Zn than the optimum. Overall improvement due to Zn being masked (Table 2), it indicates that variety Jaya is greatly influenced by the alteration in level of Zn nutrition. If Zn requirement is not fully satisfied for rice then its dry matter production will be considerably hampered. Such was the case under optimum level of Zn. When both Fe and Zn were at the normal level (Fe_0Zn_0), its performance could be considered as normal and yielded the maximum, which declined subsequently on account of poor utilization of Zn within the plant system due to excessive Fe. Jaya being rated as highly susceptible variety to Zn deficiency (Dangarwala and Patel, 1981) plants of this

TABLE 1

Dry-matter production (g/pot) of different rice varieties under varying Fe : Zn ratios.

Sr. No.	*Treatments (R)*	*Varieties (V)*					*Mean*
		Jaya	*IET (1039)*	*Padma*	*Mashuri*	*GAUR-10*	
1	Fe_0 Zn_0	28.94	18.24	19.93	20.38	21.27	21.75
2	Fe_1 Zn_0	25.93	22.39	20.06	23.58	19.93	22.38
3	Fe_2 Zn_0	23.82	24.25	28.90	26.41	12.13	23.10
4	Fe_0 Zn_1	21.73	20.09	20.11	22.80	24.39	21.82
5	Fe_1 Zn_1	24.55	20.02	20.56	24.54	24.35	22.80
6	Fe_2 Zn_1	29.18	25.78	21.52	28.44	14.30	23.84
	Mean	25.69	21.79	21.85	24.36	19.39	

C.D. @ 5% Variety (V) = 1.82, Ratio (R) = N.S., V × R = 4.34

variety must have suffered for the want of adequate quantity of Zn under higher levels of Fe. Randhawa and Takkar (1975) have also reported that Jaya is susceptible towards poor Zn nourishment. This is clearly evidenced by the increase in dry matter production due to simultaneous increase in level of Zn application along with that of Fe. It appears that the yield could be maintained at optimum if the levels of both Fe and Zn are elevated in balanced proportion.

In case of variety IET (1039), increasing levels of Fe in association with both the levels of Zn showed an overall improvement of 30.5% in dry matter production (Table 2). Almost identical performances under treatments Fe_0Zn_1 and Fe_1Zn_1 are inexplicable. At the highest level of Fe application (Fe_2) in association with two levels of Zn viz. the normal rate (Zn_0) and ten times higher than the normal (Zn_1) the percentage increases in yield over Fe_0 were 33 and 28.3 respectively. At the constant level of Fe the effect of the rate of Zn application was not consistent and ultimately resulted in 1.6% higher dry matter produce under higher level of Zn viz. Zn_1. This variety seems to be benefitted to greater extent by excessive levels of Fe rather than Zn.

Dry matter produce of Padma showed an enhancement of 45% when the normal rate of 5.6 ppm Fe was raised by fifty folds in association with 0.065 ppm Zn (Zn_0) in the nutrient solution. Surprisingly, such beneficial effect of excessive Fe was absent and only increasing tendency was observed under the series of 0.65 ppm Zn (Zn_1). An overall improvement was lowered down to 25.9% due to Fe application at the rate of 280 ppm (Fe_2). Mean produce under higher level of Zn (Zn_1) showed reduction of 9.7% from the yield obtained under optimum level of Zn (Zn_0). According to Mehta (1974) and Anonymous (1977), on the basis of work carried out under All India Co-ordinated Research Project on Micronutrients in Soils and Plants, the variety Padma has

TABLE 2

Overall yield (g/pot) and percentage response by different rice varieties to Zn and Fe application.

Sr. No.	*Treatments*	*Varieties*					
		Jaya	*IET (1039)*	*Padma*	*Mashuri*	*GAUR-10*	*Mean*
1	Zn_0	26.23	21.63	22.96	23.46	17.78	22.41
2	Zn_1	25.15	21.96	20.73	25.26	21.01	22.82
	% Response at Zn_1	–4.1	1.6	–9.7	7.7	18.2	
3	Fe_0	25.34	19.17	20.02	21.59	22.83	21.79
4	Fe_1	25.24	21.21	20.31	24.06	22.14	22.59
5	Fe_2	26.50	25.02	25.21	27.43	13.22	23.48
	% Response at Fe_1	–0.4	10.6	1.5	11.4	–3.0	
	% Response at Fe_2	4.6	30.5	25.9	27.0	–42.1	

mediocre tolerance to Zn deficiency. Hence, it is indicated here too, that the performance of Padma was tremendously boosted up by the increasing Fe level with optimum of Zn i.e. it has an affinity for higher levels of Fe.

The performance of Mashuri under varying Fe and Zn levels was quite typical. In both the series of Zn viz. Zn_0 and Zn_1 increasing Fe levels from Fe_0 to Fe_2 the yield component showed percentage increases of 29.6 and 24.7 under respective Zn series, with an overall improvement of 27%. The beneficial effect of Fe was relatively more when Zn was at the optimum. Likewise, at the constant Fe level, ten times higher Zn application had a little edge (7.7%) over the lower rate of application. This indicates that as in case of Jaya, Mashuri also responded to both Fe and Zn nutrients but to a greater extent to the former. This gains support as variety Mashuri is considered to be tolerant towards Zn deficiency (Dangarwala and Patel, 1981) i.e. it could survive undert he conditions of the bare minimum Zn i.e. at the optimum level. Hence, balanced fertilization with respect to Fe and Zn is always desirable so that its production is not impaired.

At both the levels of Zn application the yield of GAUR-10 diminished with the progressive increases in level of Fe application from Fe_0 to Fe_2. The percentage decreases in dry matter production were 43 and 41.4% under 0.065 and 0.65 ppm Zn series respectively. This suggests that variety GAUR-10 could not tolerate excessive Fe nutrition because that affected adversely its ability to utilize Zn on account of antagonistic relationships between them within the plant system. Warnock (1970) found that mobilities of Fe and Mn were inversely related to that of Zn. At constant levels of Fe, the performances with higher level of Zn (Zn_1) were relatively better than those in association with the lower level of Zn (Zn_0). Overall the percentage enhancement in dry matter production was 18.2, which indicates that GAUR-10 variety has an affinity for Zn but showed its vulnerability towards excessive Fe. Therefore, with normal level of Fe and increased Zn concentration in the nutrient medium will prove beneficial in case of variety GAUR-10.

Thus, GAUR-10 is Zn responsive, while Padma and IET (1039) are susceptible to Fe-deficiency. Jaya and Mashuri being intermediates require both Fe and Zn in balanced proportion.

REFERENCES

Anonymous (1977). 'Rice' — A publication of the fertilizer association of India, New Delhi-110 057.

Dangarwala, R. T. and Patel, B. K. (1981). Screening of rice varieties for susceptibility to zinc deficiency. *Guj. Agric. Uni. Res. J.* **7** (1): 49-52.

Hewitt, E. J. (1952). Sand and water-culture methods used in study of plant nutrition. *Commonwealth Agr. Bur. Tech. Comm.* No. **22** : 113.

Mehta, B. V. (1974). Micronutrients in Indian Agriculture. *Fert. News* **19** (12): 27-31.

Randhawa, N. S. and Takkar, P. N. (1975). Micronutrient research in India — present status and future projection. *Fert. News* **20** (5): 11-19.

Warnock, R. E. (1970). Micronutrient uptake and mobility within corn plants (*Zea maya* L.) in relation to phosphorus-induced zinc deficiency. *Soil Sci. Soc. Amer. Proc.* **34** : 765-769.

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Climatic Study of North Eastern Region of Rajasthan

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ABSTRACT

The rainfall pattern of 10 stations of North Eastern Rajasthan Region comprising of Alwar, Dholpur and Bharatpur districts were analysed. The half period average of five yearly moving average of rainfall showed decreasing trend only at three places out of ten. The per cent occurrence of drought years varied from 17.4% at Dholpur to 36.4% at Govindgarh. The maximum numbers of surplus water years were found at Nadbai (56.5% year). According to moisture index values all the stations fall under semi-arid climate with 46 to 91 per cent chances of occuurrence.

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INTRODUCTION

The north-east Rajasthan region comprises of Alwar, Bharatpur and Dholpur districts and lies under geographical location between longitude 76° 17' E to 78° 10' E and latitude 26° 25' N to 28° 15' N covering a total area of about 16500 sq.km. The annual rainfall over this area is more than 600 mm. Gupta and Singh (1980) have calculated the variability of rainfall, percentage contribution of monsoon rainfall to its annual and climatic water balance parameters for Alwar and Bharatpur stations. These two stations may not represent the whole N-E region and therefore this study was conducted considering the ten representative stations covering the region.

MATERIAL AND METHODS

The daily rainfall data of Alwar, Govindgarh, Laxmangarh, Kishangarh and Ramgarh were collected from collectorate office, Alwar; whereas the rainfall data of Bharatpur, Baseri, Dholpur, Nadbai and Rajakhera were collected from Bharatpur collectorate office. The rainfall data of district level stations were available from 1901 whereas that of tehsil levels were from 1957 or 1958. Since the collection and analysis work was started during 1980, the rainfall data were considered only upto 1979. With the help of these data five year progressive averages of rainfall and half period moving averages were calculated. The drought years were defined as the years which received rainfall less

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than 80% of the normal value. The potential evapotranspiration value computed by Rao *et al.* (1971) were used in carrying out the water balance studies by Thornthwaite and Mather (1955) technologies and accordingly surplus water, moisture index and climate type were defined.

RESULTS AND DISCUSSION

Rainfall characteristics :

The average rainfalls of Alwar and Bharatpur area are 639.4 mm and 696.6 mm respectively. The maximum rainfall (1383.3 mm) was recorded at Bharatpur in 1926 and minimum (212.0 mm) at the same station in 1941. The contribution of SW monsoon rainfall to its annual value is 90 to 95% in this region. Out of 10 stations only three viz., Laxmangarh, Dholpur and Nadbai had the decreasing trend in rainfall and rest 7 had increasing trend (Table 1).

Occurrence of drought, water surplus and climate type :

The percentage occurrence of drought and surplus water years ranged from 17.4 to 36.4 and 18.2 to 56.5, respectively (Table 2) which indicated that drought may occur once in three to six years whereas the surplus water year may be found once in two to five years.

All the stations have more chances of surplus water than drought year except Govindgarh where occurrence of drought year per cent (36.4) is more than that of water surplus (31.8) year. The moisture index ranged from–49.5 to–65.5 per cent and these stations fall under semi-arid climate. However, a climate type of a station may vary with variation in the total rainfall of the year. The percentage occurrence of diffent climate types are presented in Table 3. Baseri had 91 per cent semi-arid climate and 9 per cent dry sub-humid. At this station there were no chances of having arid climate whereas Laxmangarh had 50% chances of arid climate. On the other hand Rajakhera was the only station which had 4.6% chances of being in moist humid climate. The study revealed that the total N-E region of Rajasthan fall under

TABLE 1

Half period moving average (mm).

Sr. No.	*Name of station*	*Period*	*First half*	*Second half*	*Differences*	*Trend*
1.	Alwar	1901-79	638.40	707.20	68.8	Increasing
2.	Govindgarh	1958-79	516.18	592.42	76.24	Increasing
3.	Kishangarh	1958-79	596.76	720.48	123.72	Increasing
4.	Laxmangarh	1958-79	509.17	476.26	–32.91	Decreasing
5.	Ramgarh	1958-79	551.56	570.25	18.69	Increasing
6.	Baseri	1958-79	679.20	690.76	11.56	Increasing
7.	Bharatpur	1901-79	714.75	726.88	12.18	Increasing
8.	Dholpur	1957-79	762.06	677.33	–84.73	Decreasing
9.	Nadbai	1957-79	760.63	687.33	–73.30	Decreasing
	Rajakhera	1958-79	657.62	667.46	9.84	Increasing

TABLE 2

Percentage occurrence of drought and surplus water years, moisture index and climate type.

Sr. No.	*Station*	*No. of years studied*	*% Occurrence of*		*Moisture index*	*Climate type*
			drought year	*surplus year*		
1.	Alwar	79	32.9	40.1	–54.5	Semi-arid
2.	Govindgarh	22	36.4	31.8	–60.3	,,
3.	Kishangarh	22	31.8	54.6	–54.4	,,
4.	Laxmangarh	22	22.7	18.2	–65.5	,,
5.	Ramagarh	22	18.2	31.8	–61.0	,,
6.	Baseri	22	22.7	54.6	–51.8	,,
7.	Bharatpur	79	30.4	40.1	–56.0	,,
8.	Dholpur	23	17.4	39.1	–52.5	,,
9.	Nadbai	23	26.1	56.5	–50.1	,,
10.	Rajakhera	22	27.2	45.5	–49.5	,,

TABLE 3

Percentage occurrence of different climatic conditions.

Sr. No.	*Station*	*Arid climate*	*Semi arid*	*Dry sub-humid*	*Moist sub-humid*
1.	Alwar	26.6	63.3	10.1	–
2.	Govindgarh	36.4	59.1	4.6	–
3.	Kishangarh	22.7	72.7	4.6	–
4.	Laxmangarh	50.0	45.5	4.5	–
5.	Ramgarh	18.2	81.8	–	–
6.	Baseri	–	90.9	9.1	–
7.	Bharatpur	26.6	67.1	6.3	–
8.	Dholpur	13.0	78.3	8.7	–
9.	Nadbai	4.3	82.6	13.1	–
10.	Rajakhera	9.1	81.8	4.5	4.6

semi-arid climate with 46-91% chances of occurrence.

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REFERENCES

Gupta, B. L. and N. N. Singh (1980). Preliminary studies in Hydrometeorology of Rajasthan. Technical report Nos. 2 & 3. Ground Water Department, Jodhpur.

Rao, K. N., C. J. George and K. S. Ramasastri 1971. Potential evapotranspiration over India. Prepublished scientific report No. 136, I.M.D., Poona.

Thornthwaite, C. W. and Mather, 1955. The water balance. Publication in climatology. Vol. 8, No. 1.

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Comparison of the Systematic Arrangements with the Random Arrangement for Spacing Experiments

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ABSTRACT

The estimate of experimental error in FAN design (Nelder's design I.a.) was compared with that of Randomized Block design. Experiments on cotton IAN 579-188 were conducted for this purpose in the same field. FAN design-systematic arrangement gave overestimation of the estimate of error. Therefore FAN design is not useful for spacing experiments.

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INTRODUCTION

The systematic arrangements, though simple to execute, violates the basic assumptions of the least square analysis resulting in biased estimate of error (Tedin, 1931; Barbacki and Fisher, 1936; Greenberg, 1951 and Salmon, 1955). However, Nelder (1962) advocated the use of systematic design for spacing trials. Such trials need large area under such replication for testing a number of spacing treatments in the conventional designs based on random arrangement. Nelder's design I.a. looks like a Japanese fan and hence termed as FAN design. It permits single row plot per spacing treatment in sequence (needing much smaller area as compared to the conventional design), hence the estimate of error is likely to be influenced by the adjacent plots (Fisher, 1935).

The results reported herein relate to the field experiments conducted to study the effect of systematic arrangement—FAN design—on the estimate of error in relation to random arrangement–randomized block design. For this purpose the field experiments on cotton IAN 579-188 were conducted during the year 1973-74 at the College Agronomy Farm, Gujarat Agricultural University, Anand Campus, Anand.

Keeping in view the growth habit of the cotton IAN 579-188, the different spacings were considered, which varied from 0.045 m^2 to 0.270 m^2 per plant in both the layouts. The parameters of the FAN design were worked out as suggested by Nelder (1962). There were 10 spacing treatments in both the layouts, the replications being 12 in systematic arrangement and 4 in random arrangement. The data on plant

height and plot-wise cotton yield were collected and used in the statistical analysis. The measurement of height of five randomly selected plants per row was recorded in centimeters from collor to the tip of the plant after three months of sowing. The observations were taken at every 10 days interval. Such eight observations (P_1 through P_8) were available.

RESULTS AND DISCUSSION

The data collected in systematic arrangement (FAN) were analysed as random arrangement (RBD) by analysis of variance (though theoretically not valid) to assess the effect of systematic arrangement (FAN) on the estimate of error. The results are presented in Table 1.

TABLE 1

The error mean squares for plant height and cotton yield in FAN and RBD.

Variable	*Period of observation*	*Error mean square*	
		FAN	*RBD*
Plant height	P_1	54.32	22.30
	P_2	67.67	44.98
	P_3	94.50	50.25
	P_4	91.89	48.50
	P_5	86.94	45.26
	P_6	87.17	72.17
	P_7	90.85	36.36
	P_8	91.36	37.04
Cotton yield	–	71.91	32.49

The results presented in Table 1 reveal the presence of bias in the estimate of experimental error. The plant height and cotton yield had consistently overestimates of error mean squares in FAN compared to similar estimates in RBD. The per cent overestimate ranged from 20.78 in P_6 (87.17/72.17) to 149.65 in P_7 (91.36/37.04) for plant height, whereas it was 121.33 per cent for cotton yield. It is evident, therefore, that the FAN design — systematic arrangement gives biased estimate of error compared to RBD — random arrangement. These results are similar to those reported by Tedin (1931), Barbacki and Fisher (1936), Greenberg (1951) and Salmon (1955).

The experiment conducted on the same field with the same set of treatments in random as well as systematic arrangements may show variation in performance of different treatments. Such variation is largely due to fertility variation. Since adjacent plots are positively correlated in field experiments, fertility variation introduces bias in the estimates of the systematic arrangement. The present investigation was conducted side by side on the same field, hence the overestimation observed in error mean square of FAN design could be attributed to systematic arrangements of spacing treatments. Therefore, it is not advisable to use FAN design for spacing experiments.

REFERENCES

Barbacki, S., and R. A. Fisher. 1936. A test of the supposed precision of systematic arrangements. *Eugenics.* **7:** 189-193.

Fisher, R. A. 1935. *The Design of Experiments.* Oliver and Boyd, London.

Greenberg, B. G. 1951. Why randomize. *Biometrics* **7:** 309-322.

Nelder, J. A. 1962. New kinds of systematic designs of spacing experiments. *Biometrics.* **18:** 283-307.

Salom, S. C. 1955. Random versus systematic arrangements in non-latin square field experiment. *Agron. J.* **47:** 289-294.

Tedin, O. 1931. The influence of systematic plot arrangement upon the estimate of error in field experiments. *J. Agric. Sci.* **21:** 191-208.

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Utilization of *babul* (*Acacia nilotica* L.) Seeds *chuni* by Growing Crossbred Calves

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ABSTRACT

An experiment was conducted on 18 male cross-bred calves (9 of F_1-Jersey x Kankrej and 9 of F_1-Holstein x Kankrej) having 6 to 9 months of age and 109 to 130 kg body weights. The 3 treatments were T_1, T_2 and T_3 having 0, 30 and 45% level of *babul* seed *chuni* in concentrate mixture. The experiment was of 210 days duration. Two kg green 'NB 21' was provided to meet Vitamin A requirements. Crude protein and TDN were provided through green 'NB 21', mature pasture grass and concentrate mixture. Two metabolism trials were conducted during the feeding period (one at mid and second at the end of the experiment).

No significant difference was observed for the digestibility of nutrients in three treatment groups. Crude Protein digestibility was found to be significantly ($P < 0.05$) lower at 45% level of *babul* seed *chuni* in concentrate mixture while inclusion of 30% *babul* seed *chuni* had comparable digestibility as control ration.

The balances of nitrogen, calcium and phosphorus were found positive in all the treatments. However, the difference between treatments were found to be non-significant. Thus, looking to the large scale availability of *babul* seed *chuni* and its comparable utilization at 30% level in concentrate mixture it can be used upto 30% level.

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INTRODUCTION

The present shortage of feeds and fodders has led the nutritionists to evaluate new feeds from the agricultural, industrial, forest and other resources. Among these *babul* (*Acacia nilotica*) seeds are one of the most nutritious forest byproducts for cattle. *Babul* seed *chuni* (extracted) prosesses a high nutritive value. To find out the possibility of utilising *babul* seeds *chuni* in the ration of growing calves an experiment was conducted on crossbred F_1 — Jersey x Kankrej and F_1 — Holstein x Kankrej calves.

MATERIALS AND METHODS

Eighteen crossbred male F_1 calves were divided in 3 different groups. The calves were assigned at random in different groups as and when they were available. The experiment was of 200 days duration. The 3 treatments were T_1, T_2 and T_3 having 0, 30 and 45% level of *babul* seed *chuni* in concentrate mixtures.

TABLE 1

Proportion (%) of different ingredients used in the concentrate mixtures.

Ingredients	*Treatments*		
	T_1*	T_2	T_3
G. N. Cake (Decoiled)	15	15	18
Wheat bran	16	16	10
Cotton seed cake	16	6	—
Rice polish	26	6	—
Babul seeds *chuni*	0	30	45
Maize gluten	14	14	14
Molasses	10	10	10
Mineral mixture	2	2	2
Salt	1	1	1

*Chalk is added in concentrate mixture–T_1.

Feeding of animals was carried out as per feeding standards for growing cattle. Two kg green 'NB 21' was fed to meet Vit. A requirements while crude protein and TDN were provided through green 'NB 21', mature pasture grass and concentrate mixture. Individual feeding was carried out for all animals. The animals were let loose in paddock and had free access to drinking water.

Metabolism trials were conducted once in the mid of period and next at the end of experiment by conventional methods and samples of feeds, feces and urine were collected and analysed. (A.O.A.C., 1975). Data on digestibilities and balances were analysed statistically (Snedecor and Cochran, 1968).

RESULTS AND DISCUSSION

Effect on chemical composition

The average chemical composition of feeds and fodders used in the experiment are given in Table-2.

It is revealed that the chemical composition of the feeds and fodders was more or less the same. Tannin content was found to be increasing as the level of *babul* seeds *chuni* increased.

Effect on digestibility of proximate nutrients

The digestibility coefficients of different rations are presented in Table-3.

The average results of digestibility coefficients for proximate nutrients revealed that the crude protein digestibility was lower at 45% level of *ba-*

TABLE 2

Average* chemical composition of feeds and fodders used during *babul* seeds *chuni* feeding experiment (% on D.M. basis).

	Concentrate mixture			*Babul seeds chuni*	*'NB-21' Green*	*Mature Pasture grass*
	T_1	T_2	T_3			
Crude protein	25.54	24.31	23.98	16.63	11.16	2.45
Ether extract	7.02	5.03	4.73	5.97	4.71	3.43
Crude fibre	6.92	7.91	8.41	12.28	31.93	39.47
N.F.E.	50.44	53.20	53.93	60.68	39.89	45.85
Ash	10.08	9.55	8.95	4.44	12.31	8.80
Silica	1.98	1.46	1.16	0.06	5.30	6.88
P	1.42	1.04	0.87	0.34	0.48	0.04
Ca	0.94	1.02	1.10	0.94	0.43	0.39
Tannin	0.70	1.35	1.82	2.70	—	—

*Average of six samples (except *babul* seeds *chuni*).

TABLE 3

Digestibility coefficients of whole ration under *babul* seeds *chuni* feeding experiment.

		T_1	T_2	T_3	'F' Value		C.D. Value	
					Treat.	*Breed.*	*Treat.*	*Breed.*
Crude Protein	J x K	71.16	69.65	67.39				
	H x K	70.38	65.75	59.51				
	Average	70.77	67.70	63.45	4.17*	4.06	5.55	N.S.
Ether Extract	J x K	70.33	69.31	70.66				
	H x K	69.03	62.79	62.19				
	Average	69.68	66.05	66.42	1.16	6.44*	N.S.	4.66
Crude Fibre	J x K	66.22	64.03	67.48				
	H x K	64.84	61.98	61.73				
	Average	65.53	63.00	64.60	0.59	2.52	N.S.	N.S.
N.F.E.	J x K	58.60	54.21	55.96				
	H x K	58.98	54.40	54.07				
	Average	58.79	54.30	55.01	1.61	0.04	N.S.	N.S.
Organic Matter	J x K	63.83	60.36	61.50				
	H x K	62.95	58.82	57.56				
	Average	63.39	59.59	59.53	1.24	1.72	N.S.	N.S.

*Significant at 5% level; N.S. = Non-significant.

bul seed *chuni* in concentrate mixture. However, inclusion of 30% *babul* seed *chuni* had comparable digestibility to that of control ration. The digestibility coefficients for ether extract, crude fibre, N.F.E. and organic matter were found to be higher in control ration than experimental ration. However, the differences among treatments were found to be non-significant. Anon. (1979) also reported that feeding of processed *babul* seeds upto the level of 45% in concentrate mixture to bullocks did not adversely affect the digestibility of proximate nutrients.

Effect on balance of nitrogen and minerals

The data on balance of nitrogen, phosphorus and calcium are presented in Table-4.

The results on average balances revealed that under all the treatments the nitrogen, phosphorus and calcium balances were positive. The retentions were lower in *babul* seeds *chuni* incorporated groups. However, the differences among treatments were found to be statistically non-significant. Similar results were also reported on adult Kankrej bullocks (Anon. 1979).

Plane of nutrition

The relevant results on Crude Protein, T.D.N. and ME (Metabolisable energy Calculated) intake are presented in Table-5.

The average results on intake of Crude Protein, T.D.N. and ME (Calculated) revealed that under all the groups the requirements for these nutrients were met as per N.R.C. (1978) feeding standards.

TABLE 4

Balances of N, P and Ca under *babul* seeds *churi* feeding experiment (g/day/animal).

Particulars	T_1	T_2	T_3
		Nitrogen	
Total intake	143.13	140.06	125.72
Voided in feces	41.28	45.26	45.82
Voided in urine	42.59	42.33	34.81
Total voided	83.87	87.59	80.63
Balance	+ 59.26	+ 52.47	+ 45.09
N retained (% of intake)	41.40	37.46	35.86
N retained (% of absorbed)	58.18	55.35	56.43
		Phosphorus	
Total intake	48.79	38.07	31.78
Voided in feces	25.18	19.40	15.75
Voided in urine	3.77	2.17	1.19
Total voided	28.95	21.57	16.94
Balance	+ 19.84	+ 16.50	+ 14.84
		Calcium	
Total intake	44.63	45.40	41.74
Voided in feces	29.83	33.03	31.29
Voided in urine	1.78	1.14	1.04
Total voided	31.61	34.17	32.33
Balance	+ 13.02	+ 11.23	+ 9.41

TABLE 5

Plane of nutrition of calves under *babul* seeds *churi* feeding experiment.

Phase	*Av. Body Wt. (kg)*	*Actual intake/day*			*Recommended by NRC (1978)*		
		C. Protein Intake (g)	*TDN Intake (kg)*	*ME Intake (Mcal)*	*C. Protein (g)*	*TDN (kg)*	*ME (Mcal)*
			T-1				
I	200.9	858	3.76	13.60	702	3.68	12.52
II	264.3	932	4.55	15.96	781	4.40	15.61
Av.	232.6	895	4.16	14.78	733	4.06	14.31
			T-2				
I	194.6	872	3.44	12.43	688	3.60	12.75
II	254.6	908	4.30	15.53	770	4.33	15.29
Av.	224.6	890	3.87	13.98	733	3.98	14.03
			T-3				
I	170.5	737	3.28	11.86	622	3.24	11.54
II	223.5	786	3.59	12.97	732	3.97	14.18
Av.	197.0	761	3.43	12.41	695	3.68	12.86

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Effect of Irrigation and Nitrogen on Quality Characters of Sugarcane

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Nitrogen application under assured water supply helps in more tillering and stalk elongation in sugarcane resulting into increase in yield, but with delayed maturity depresses juice quality, purity of sugar and its recovery and increases contents of ash, reducing sugar and other non-sugar compounds. In Gujarat, average sugar recovery was 9.74 per cent during the last three years (1980-81 to 1982-83). It was below the national average of 9.87 per cent (Indian sugar, 1984). The cane growers of Gujarat are applying more nitrogen than the recommended dose of 250 kg/ha. In the light of this, it was thought necessary to study effect of nitrogen levels on quality characters of sugarcane and sugar yields and so the present investigation was undertaken at the Regional Sugarcane Research Station, Navsari for two years (1980-81 and 1981-82) on heavy black soils having high water table conditions. The treatments kept in the experiment were three levels of irrigation based on IW/CPE ratio of 0.5, 0.7 and 0.9 and four levels of nitrogen viz., 100, 200, 300 and 400 kg N/ha.

Sugarcane crop variety Co. 6304 was planted in the first week of January 90 cm apart in rows in both the years. Two common irrigations to all the treatment plots were given to avoid adverse effect of crust formation and establishment of crop. The rest of the irrigations at the rate of 80 mm each as measured by water meter, were given as per treatment. A common dose of phosphorus and potash, each of 125 kg/ha was given at the time of planting. Nitrogen was given as per treatment in four splits, the first 15 per cent at the time of planting, the second 30 per cent at the time of the second irrigation, the third 20 per cent nearly one month after application of the second dose and the remaining 35 per cent at the time of earthing-up at crop age of 5 1/2 months. The sugarcane crop was harvested at the age of 12 months in both the years. The cane yield and the data on quality characters viz., sucrose percentage in juice, cane and commercial cane sugar percentage (CCS) were taken at the time of harvest.

The data on sucrose percentage in juice as influenced by levels of irrigations (Table 1) indicated that the effect of various IW/CPE ratio R_1, R_2 and R_3 on sucrose content of juice was not found to be significant indicating no effect of irrigation levels on sucrose content of juice. The results are in accor-

dance with the results reported by Narasimha Rao and Krishanan Raju (1961) and Shinde *et al.* (1981). Similar not significant effect was also observed on sucrose content in cane. However, sucrose content in cane was found to be improved with increasing levels of irrigation (Table-1). Similar results were reported by Misra *et al.* (1966).

The data on commercial cane sugar percentage (CCS) and CCS yields (t/ha) given in Table-2 indicated that the effect of IW/CPE ratios on CCS

TABLE 1

Number of irrigation, quantity of irrigation water applied, sucrose percentage in cane and juice as influenced by levels of irrigation and nitrogen (Pooled for 1980-81 and 1981-82).

IW/CPE ratios	*Sucrose percentainge cane*				*Sucrose percentage in juice*			
Nitrogen level (kg/ha)	$R_1=0.5$	$R_2=0.7$	$R_3=0.9$	*Average*	$R_1=0.5$	$R_2=0.5$	$R_3=0.9$	*Average*
100 (N_1)	13.83	14.01	14.75	14.10	17.47	17.74	18.09	17.77
200 (N_2)	13.98	13.84	14.01	13.94	17.65	17.78	17.44	17.62
300 (N_3)	13.47	13.64	14.00	13.70	17.11	17.31	17.63	17.35
400 (N_4)	13.64	13.75	13.37	13.59	17.66	17.38	16.84	17.29
Mean	13.72	13.81	13.96	13.83	17.47	17.55	17.50	17.51
Av. No. of irrigation	10-11	13-14	16-17					
Quantity of water applied (mm)	840	1080	1320					
			S.Em.±	C.D. @ 1%			S.Em±	C.D. @ 1%
Ratio (R) IW/CPE			0.28	N.S.			0.19	N.S.
Nitrogen (N)			0.10	0.29			0.12	0.33
Interaction (R × N)			0.18	N.S.			0.20	0.57

TABLE 2

Commercial Cane Sugar (CCS) percentage and CCS yield (t/ha) as influenced by levels of irrigation and nitrogen (Pooled for 1980-81 and 1981-82).

IW/CPE ratios	*Commercial cane sugar (CCS) %*				*Commercial cane sugar (CCS) yields (t/ha)*			
Nitrogen level (kg/ha)	$R_1=0.5$	$R_2=0.7$	$R_3=0.9$	*Average*	$R_1=0.5$	$R_2=0.7$	$R_3=0.9$	*Average*
100	12.36	12.46	12.22	12.35	11.31	11.29	10.64	11.08
200	12.03	12.26	12.43	12.24	12.58	13.71	12.96	13.08
300	12.24	12.61	12.70	12.52	13.98	14.45	14.36	14.26
400	12.26	12.38	12.34	12.33	13.96	14.35	14.46	14.25
Mean	12.22	12.43	12.42	12.36	12.96	13.45	13.10	13.17
	S.Em±		C.D. at 5%		S.Em. ±		C.D. at 1%	
Ratio (R) IW/CPE	0.14		N.S.		0.27		N.S.	
Nitrogen (N)	0.11		N.S.		0.22		0.63	
Interaction (R x N)	0.19		N.S.		0.39		N.S.	

and CCS yields was not found to be significant. The results are not in agreement with those reported by Lakshmikanthan *et al.* (1962), Zende (1970), Raul and Allison (1976), Reddy *et al.* (1978) and Hapase *et al.* (1981) who observed that CCS yields were increased with increasing levels of irrigations. This may be attributed to the sufficient quantity of available moisture present in 0.90 cm soil layer before each irrigation in present investigation (Table-3) indicating that the crop was not under moisture stress at any stage during the crop growth period almost in all the treatments.

TABLE 3

Average available soil moisture percentage before each irrigation (1980-81 and 1981-82) at different depths.

Depth (cm)	*Available soil moisture storage capacity(mm)*	*Available soil moisture (%) before each irrigation*		
		R_1=0.5	R_2=0.7	R_3=0.9
0-30	53.28	13.36	19.37	22.97
30-60	55.12	64.33	69.23	72.86
60-90	55.37	91.55	92.25	92.45

The data reported in Table-1 on sucrose percentage in juice and cane showed that the effect of nitrogen on sucrose percentage in juice and cane was found to be significant in pooled analysis. In both the cases, treatment N_1, was significantly superior to the treatment N_3 and N_4 but was at par with the treatment N_2. Thus the result revealed that higher level of nitrogen beyond 200 kg N/ha had no favourable effect on increasing sucrose percentage in juice as well as in cane. The results are in agreement with those reported by Gupta and Prasad (1971), Singh *et al.* (1975), Agarwal *et al.* (1976), Patil *et al.* (1977), Panwar *et al.* (1980) and Patil and Shingte (1981). The decrease in sucrose content at a high level of nitrogen might be due to utilization of component of sucrose in formation of amino acids and other non-sugar compounds, all leading to poor recovery.

The effect of nitrogen on commercial cane sugar (CCS) percentage was not significant (Table-2). Similar results were reported by Kale (1976). The effect of nitrogen levels on sugar yield (CCS t/ha) was highly significant (Table-2). The results indicated that the treatment N_3 and N_4 were at par and were significantly superior to the treatments N_1 and N_2. Thus the results showed that sugar recovery (CCS t/ha) was found to have increased only upto 300 kg N/ha, and higher dose of nitrogen than this had an adverse effect of sugar recovery. The results are in agreement with those reported by Tembhekar and Cristian (1978) and Reddy *et al.* (1978). The interaction effect of irrigation and nitrogen was not found to be significant in almost all the quality characters except, significant effect was found on sucrose percentage in juice (Table-1 and 2). Treatment combination R_3N_1 (0.9 IW/CPE ratio x 100 kg N/ha) gave the maximum sucrose percentage (18.09%) in juice and was significantly superior to the rest of the treatment combinations R_2N_2, R_2N_1, R_1N_4, R_1N_2 and R_3N_3. The lowest sucrose percentage was 16.84 in the treatment combination R_3N_4 (0.9 IW/CPE ratio x 400 kg N/ha). These results indicate that the combination of the highest level of both the

factors (R_3N_3) have an adverse effect on the sucrose percentage in juice. Further, the significant interaction effect indicated that the sucrose percentage in juice can be increased by either combining higher level of one factor with the lowest level of other factor i.e. R_3N_1 (irrigation at an IW/CPE ratio of 0.9 with 100 kg N/ha) or R_1N_4 (irrigation at an IW/CPE ratio of 0.5 with 400 kg N/ha).

From the above results it was observed that irrigation levels under high water table conditions had no significant effect on quality characters viz., sucrose percentage in juice and cane, CCS percentage and CCS yields (t/ha), while higher dose of nitrogen than 200 kg N/ha had an adverse effect on sucrose percentage in juice and cane. The sugar recovery (CCS t/ha) increased upto 300 kg N/ha. Further, the results indicated that the interaction effect was not significant except on sucrose percentage juice, where the results indicated that the combination of the highest level of both the factors (R_3N_3) have an adverse effect on sucrose percentage in juice.

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REFERENCES

Agarwal, M. L., S. P. Dua and M. Dayal (1976). Effect of nitrogen, phosphorus and potassium on yield and juice quality and economics of application in sugarcane in Uttar Pradesh, Proc. forty first Ann. Conv. STAI. Kanpur, Part-I Ag: 25-29.

Gupta, A. P. and B. Prasad (1971). Composition of cane Juice-II. Effect of nitrogen manuring on various organic non-sugars in cane juice of plant and ratoon crop. Fourth joint Conv. STA, DSTA and SISTA held at Poona A: 81-90.

Hapase, D. G., J. G. Thakare, S. P. Mulik and V. S. Mane (1981). Effect of prolonged irrigation under mulching conditions on the yield and quality of Adsali Sugarcane (Co. 740) Thirty-first Ann. conv. DSTA Part-I. A: 163-168.

Indian Sugar (1984). Statewise figure of average sugar recovery percentage. *Indian Sugar* **34** (1): 63.

Kale, R. A. (1976). Nitrogen fertilization for quality cane production. *Maharashtra Sugar* **1**(3): 29-31.

Lakshmikantham, M. G., Narasimha Rao, R. L. Narasimham, P. Hanumentha Rao, B. Subbarao and T. Sivaramakrishna (1962). Studies on the influence of irrigation and nitrogen fertilization on tissue composition as related to cane and sugar yields. Proc. Eleventh Cong. Int. Soc. Sug. Tech: 238-247.

Misra, G. N., J. D. Singh and Singh, V. N. (1966). Response of sugarcane to different levels of manuring and irrigation under the two methods of planting cane. Proc. Thirty-fourth Ann. Conv. STAI, Part-I: 33-39.

Narasimha Rao, G. and S. S. R. Krishnan Raju (1961) Studies in yield and juice quality of sugarcane irrigated with reference to soil moisture, Co-419 (Plant crop). Proc. nineth conv. of STAI: 13-21.

Panwar, B. S., D. N. Rathore and R. F. John (1980). Effect of graded dose of nitrogen on growth, yield and quali y of sugarcane varieties, *Indian sugar* **30** (9): 487-490.

Patil, J. P., Bavaskaer and S. J. Ranadive (1977). Response of sugarcane varieties to rate of nitrogen fertilization. *Indian sugar* **27** (9): 581-584.

Patil, V. D. and A. K. Shingte (1981). Studies on effect of different levels of pressumed cake in combination with various levels of nitrogen on quality of sugarcane (CO-740) *Maharashtra sugar* **6** (12): 45-49.

Raul Pera Escolar and William D. Allison (1976). Effect of water table depth on the yield of seven sugarcane varieties in Pureto Rico. *The J. Agric. Uni. Pureto Rice LX* (*2*): 1-13.

Reddy, M. Ramachandra, S., Chandrasekhar Reddy, A. Venkatachari and M. L. Kulkarny (1978). Studies on the effect of nitrogen and moisture regimes on yield and quality of sugarcane. Forty-second Ann. Conv. STAI, New Delhi, Ag. 99-105.

Shinde, A. G., S. L. Gaur, C. D. Salunkhe and J. P. Patil (1981). Response of promising early and mid-late varieties of Kolhapur region to rate of nitrogen fertilization. *Maharashtra sugar* **6** (12) : 39-43.

Singh, R., H. P. Singh and S. K. Ojha (1975). Effect of nitrogen, phosphate and potash fertilization on quality of gur. *Co-operative sugar* **7(3)**: 109-114.

Tembhekar, V. V. and M. S. Christian (1978). Studies of different time of planting and various levels of nitrogenous doses on sugarcane crop. *Co-operative sugar* **9** (7): 345-352.

Zende, G. K. (1970). An inter-relationship between irrigation manuring and kind of planting. DSTA Symp. On concept of manuring. Pune: 1-24.

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Cultivation Problems of Major *Kharif* Crops in Dry Farming Area of Rajkot District (Gujarat)

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The information is not available regarding the location specific problems faced by the farmers in raising the crops under dry farming conditions. Very few studies have reported the cultivation problems. Chavda (1980) reported few problems for non-adoption of agricultural technology. These problems were educational and economical viz., high cost of pesticides, lack of technical guidance, complicated plant protection practices, coverage of large areas for spraying and dusting was not possible, and lack of knowledge about diseases and pests. Mathukia (1981), Joshi (1980) and Khan *et al.* (1980) reported more or less similar type of problems in their studies. It was, therefore, considered necessary to conduct a study to obtain information related to the problems faced by the farmers in raising crops under dry farming.

A survey study was conducted before framing technical research programmes under NARP-sub-project Targhadia. The main objective of the study was to identify specific cultivation problems of dry farming *kharif* crops (groundnut, cotton, pearl millet and sorghum). Five talukas viz., Rajkot, Gondal, Jasdan, Wankaner and Paddhari surrounding the district headquarter of Rajkot were selected for this purpose. Two villages of each taluka were selected randomly. Five farmers were selected at random from each of the village, making a total of 50.

Set-row system: It is evident from the data (Table 1) that majority (64%) of the farmers were maintaining set-rows. Most of them had not changed the rows since last ten years. Remaining 36 per cent of the farmers were changing their crop rows every year.

The reasons for maintaining set-rows were due to the following beliefs of farmers.

1. The residual and cumulative effects of previous manuring and fertilization increase the yields.
2. The set-rows collect the run-off water. The sowing can be done with the receipt of minimum rainfall.
3. If the furrows are changed the crops will give lesss yield for two-three years.

Spacing: It is appeared from the data given in Table-1 that 88 per cent, 70 per cent and 68 per cent farmers in groundnut, cotton and pearl millet crops respectively kept spacing of 90 cm and above, though the recommended spacing was 60 cm or less. Very few farmers adopted 60 and 45 cm inter-row spacing.

TABLE 1

No. of farmers who adopted different agricultural practices.

	Practices	*No. of farmers*			
1.	**Mode of rows**				
	Set-rows	32(64)			
	Changing-rows	18(36)			
	Total	50(100)			
2.	**Sowing distance**				
		Ground-nut	Cotton	Pearl millet	Sor-ghum
	45 cm	—	04(10)	06(13)	06(16)
	60 cm	—	02(05)	01(02)	03(08)
	75 cm	04(12)	06(15)	08(17)	10(27)
	90 and above	30(88)	28(70)	31(68)	18(49)
	Total	34(100)	40(100)	46(100)	37(100)
3.	**Adoption of variety**				
	Improved	18(53)	29(72)	42(91)	07(19)
	Local	16(47)	11(28)	04(09)	30(81)
	Total	34(100)	40(100)	46(100)	37(100)
4.	**Soil analysis**				
	Get analysed	09(18)			
	Not get analysed	41(82)			
	Total	50(100)			
5.	**Use of chemical fertilizers**				
	As per recommendation	7(14)			
	Not as per recommendation	34(68)	(82)		
	A. Over dose	14(28)			
	B. Under dose	20(40)			
	Not using at all	09(18)			
	Total	50(100)			
6.	**Mixed cropping**				
	Adopted	10(29)	10(25)	07(15)	
	Not sdopted	24(71)	30(75)	39(85)	
	Total	34(100)	40(100)	46(100)	

Figures in parantheses show percentage.

In case of sorghum, 49 per cent and 27 per cent farmers kept spacing of 90 and 75 cm. respectively though they grew the sorghum for fodder purpose. Only 16 per cent and 8 per cent farmers adopted spacing of 45 and 60 cm. respectively.

The farmers were knowing that the narrow spacing gave higher yield, however, they were not ready to reduce the sowing distance. They opined that the advantage in terms of increase in yield due to narrow spacing would be off-set by increase in labour cost of

weeding. At the same time weed infestation would also increase. Another reason for not reducing the sowing distance was the set-row system followed by the farmers. The farmers in general were not willing to disturb the set-rows.

Choice of variety: The majority (53%) of groundnut growers used old improved variety Punjab-1 while forty-seven per cent of the farmers had used local variety of groundnut. In case of pearl millet, 91 per cent farmers used the improved (Hybrid) varieties and only nine per cent of the farmers were not using improved varieties. They were using F-2 or local varieties of pearl millet. Seventy-two per cent of the sample farmers used improved varieties of cotton, while 28 per cent farmers had sown local varieties of cotton.

Reverse trends of the farmers were observed in case of sorghum. Mostly (81%) the farmers used the local variety, though, the hybrid sorghum was found to be economical in dry farming area. However, only 19 per cent of the farmers had used the improved varieties (Hybrids).

Reasons stated by the farmers for not adopting hybrid sorghum were:

1. They grow the sorghum crop only for fodder purpose.
2. Sorghum is not the traditional food in Saurashtra and is considered "Poor man's food". There is, however, a need to find out the causes for non-adoption of hybrid grain sorghum by the farmers.
3. Non-availability of hybrid seeds and being more costly.

In Saurashtra area, the farmers grow sorghum mostly for fodder purpose. So they need a better fodder variety.

Soil analysis: The results presented in Item-4 indicated that most of the farmers (82%) did not get their soil samples analysed for the nutrient status due to the lack of knowledge, guidance, facility available nearly at least at taluka head quarters, and its usefulness. However, 18 per cent farmers got their soil analysed.

Use of fertilizers: Data presented in Item-5 showed that most of the farmers (82%) used chemical fertilizes; of which 78 per cent farmers used the phosphatic fertilizers. Thus, the phosphatic fertilizers were popular. This may be due to the groundnut crop which is grown in large area. Only 4 per cent farmers had used nitrogenous fertilizers (urea). The remaining farmers (18%) had not used any chemical fertilizers.

Mixed cropping: A look at item-6 revealed that most of the farmers (85% in pearlmillet, 75% in cotton and 71% in groundnut) did not adopt mixed cropping. Twenty-nine per cent farmers adopted mixed cropping in groundnut but it was not as per recommendation. They used maize, *urd* or *mung* as mixed crops. In case of cotton, 25 per cent farmers used mixed cropping of *urd*, *mung* and maize in the same rows. Only 15 per cent farmers adopted mixed cropping in pearl millet. Eighty-five per cent farmers did not follow mixed cropping. None of the farmers adopted inter-cropping as per recommendation in all the three crops.

The research results showed that the mixed cropping or inter-cropping was one of the low cost technologies in dry farming area to sustain crop yields and insure against crop failure. However, most of the farmers had not adopted these technologies.

The reasons stated by the farmers for non-adoption were:

1. Difficulty of sowing the base and inter-crops in the rows ratio such as 2 : 1, 3 : 1 and 4 : 1. They need suitable seed drill for sowing the base crop and inter-crop simultaneously.
2. In these cases, where mixed crop matures late, it was damaged by the stray cattle of the professional cattle breeder after harvesting of the base crop.
3. It creates difficulty in interculturing.
4. They have fear that pest and diseases may be increased.

Suggestions which emerged from the studies for research are as follows:

1. Evaluation of existing system of set-row cultivation.
2. Inter-relationship of adequate spacing, weed population, its economics and grain yield.
3. Evolving good varieties of sorghum for fodder purpose.
4. Fabrication of suitable seed drill for sowing in the inter-cropping system.
5. Evaluation of existing strain for their suitability to draught.

Following suggestions can be made for extension workers.

1. To popularise hybrid sorghum and inter-cropping system under dry farming area.
2. To induce farmers to get their soil samples analysed and use fertilizers on the basis of soil test.

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REFERENCES

Chavda, P. R. (1980). Problem of the groundnut growers in Adoption of Plant Protection measures for groundnut cultivation in Maliya Taluka of Gujarat State, *an M.Sc. Thesis (unpublished)*, G.A.U. Sardarkrushinagar.

Joshi, V. D. (1980). Difficulties experienced by the small farmers in adoption of improved practices of sugarcane cultivation in Kodinar taluka of Gujarat State, *an M.Sc. Thesis (unpublished)G.A.U. Sardarkrushinagar.*

Khan, M. M., Rajagopal, D. and Hanumappa, P. (1978). Plant protection practices and problems of chilly growers of Kolar district. *Mysore J. Agril. Sciences, 12* p. 163-169.

Mathukia, B. K. (1981). Problems faced by the farmers in adoption of plant protection measures for groundnut cultivation, *an M.Sc. Thesis (unpublished) G.A.U. Sardarkrushinagar.*

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Studies on Split Application of Nitrogen to Hybrid Maize in Summer Season Under South Gujarat Conditions

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Maize has been introduced recently as a summer crop in South Gujarat due to availability of canal water from the Ukai-Kakrapar project. The favourable response of high yielding varieties and hybrids of maize to high dose of fertilizer particularly nitrogen is well established, but the influence of variation in the time of application of nitrogen in various proportions at various growth stages of maize has not been fully ascertained under South Gujarat conditions. An investigation was, therefore, undertaken at the farm of Gujarat Agricultural University, Navsari, during 1982 in the summer season. The soil was clayey in texture, deficient in nitrogen, medium in phosphorus and fairly rich in available potash and slightly alkaline in reaction. Sixteen treatments were tested in this investigation where nitrogen was applied in the form of urea in different proportions at various stages as shown in Table-1. A common dose of phosphorus and potash was applied @ 60 and 40 kg/ha respectively. The experiment was laid out in randomised block design with four replications. Maize "Ganga safed-2" was sown on 16th February, 1982 at a distance of 60 cm x 20 cm and harvesting was done on 1st June 1982. In all nine irrigations were given as and when required.

Grain yield

Split application of nitrogen showed conspicuous effect in increasing grain yield of maize. Application of nitrogen in three equal splits viz., 1/3 at sowing + 1/3 at knee-high stage + 1/3 at tasseling stage (T_{12}) gave significantly higher grain yield than those given by treatments T_8, T_4, T_2, T_9 and T_1 but the same did not differ significantly from T_{16}, T_{14}, T_{15}, T_{11}, T_5, T_3, T_6, T_7, T_{13} and T_{10}. Treatment T_{12} produced significantly higher grain yield by 36.3% over the treatment receiving all the N at sowing time (T_1). The reason for higher yield may be due to application of nitrogen in three splits viz., at sowing time, knee-high stage and at tasselling stage when it met the nitrogen requirement throughout the critical growth stages adequately. These results are in agreement with those of Tiwari (1981) and Jones (1973).

Stover yield

As in the case of grain yield, stover yield had also been appreciably

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TABLE 1

Grain and stover yields (kg/ha) of hybrid maize 'Ganga safed-2' as affected by different times of nitrogen application.

Treatment No.	Rate of N application at various growth stages (kg/ha)				Grain yield (kg/ha)	Stover yield (kg/ha)
	At sowing	At knee-high	At tasseling	At silking		
T_1	120	—	—	—	3871	8229
T_2	80	40	—	—	4357	9597
T_3	80	—	40	—	4906	9349
T_4	80	—	—	40	4367	10130
T_5	—	80	40	—	5015	9323
T_6	—	80	—	40	4794	9375
T_7	40	80	—	—	4679	10156
T_8	40	—	80	—	4421	10104
T_9	40	—	—	80	4123	9115
T_{10}	—	40	80	—	4504	8672
T_{11}	—	—	40	80	5018	9271
T_{12}	40	40	40	—	5276	10339
T_{13}	40	—	40	40	4541	8151
T_{14}	40	40	—	40	5209	9505
T_{15}	—	40	40	40	5206	8255
T_{16}	30	30	30	30	5267	9271
	S.Em. ±				292	430
	C.D. @ 5%				831	1225
	C.V. %				12	9

influenced by split application of nitrogen. Nitrogen applied in three splits viz., 1/3 at sowing time + 1/3 at knee high stage + 1/3 at tasselling stage (T_{12}) produced significantly higher stover yield than those by T_1, T_{10}, T_{13} and T_{15}. Traetment T_{12} produced significantly more stover yield by 2110 kg/ha than that due to treatment T_1 i.e., all N applied as basal. This might be due to application of N in three splits (T_{12}) which met the requirement throughout the critical growth stages adequately and thus resulted in more vegetative growth which reflected in higher stover yield. These observations are in close agreement with those reported by Sharma (1980) and Tiwari *et al.* (1973).

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REFERENCES

Jones, M. J. (1973). Time of application of nitrogen fertilizers to maize at Sameru, Nigeria. *Expt. agric.* **9** (2): 113-120.

Sharma, R. N. (1980). Effect of planting technique and time and method of fertilizer application on maize "Ganga-3". *Indian J. Agron.* **25** (3): 555-56.

Tiwari, K. P.; Yadav, S. C. and Mandol, K. V. (1973). Effect of time of nitrogen application on maize. *J. N. K. V. V. Research Journal* **7** (3): 131-133.

Tiwari, M. P. (1981). Response of maize to time of nitrogen application. *24th Annual Progress Report* C.M.I.P. pp. A. 17-26.

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Determination of Leaf Area in Cowpea (*Vigna unguiculata* L. Walp)

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The leaf area plays a vital role in growth and development of a plant which finally contributes towards yield. Green leaves are the main sources of a plant where light energy is entrapped and synthesis of carbohydrates occur. By and large, the leaf size or its area may be considered as best indicator to judge the photosynthetic efficiency of a plant. The determination of leaf area without detachment from a plant would be very useful in finding out its relation with yielding ability.

Montgomery (1911) was the first who successfully used length times breadth at maximum multiplied by the constant 0.75 for finding out leaf area in maize. Ashley *et al.* (1963), Bhan and Pande (1966) and Sharma *et al.* (1985) have also suggested similar techniques in respect of cotton, rice and clusterbean, respectively. The present study was initiated to find out suitable value of a constant "K" for calculating leaf area in cowpea crop. (*Vigna unguiculata* L. Walp) having varieties possessing different leaf sizes and shapes.

This study was carried out at Pulses Research Project, Gujarat Agricultural University, Sardar Krushinagar during *kharif* 1984. Twelve cowpea strains showing marked variation in leaf size and shape were selected. Ten leaflets were taken at random from five plants in each entry. The actual leaf area (A) of the leaflets was calculated using a planimeter. The apparent leaf area (B) of the same leaflets was calculated by multiplying length times breadth at maximum. The actual leaf area (A) was divided by the apparent leaf area (B) and the mean of all the entries was calculated provided the value of 0.6654. The apparent leaf area (B) was then multiplied with this constant to get estimated leaf area and its deviation from the actual leaf area (A) was calculated (Table 1). The significance of variance, following the "pair t test" method suggested by Fisher was then calculated.

The data revealed that 't' test was not significant at 5% level suggesting thereby that the constant would be useful for determining the leaf area of compound leaves in cowpea. Thus, for estimation of leaf area in cowpea the following formula might be used:

L X B X 0.6654
(at maximum)

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TABLE 1

Actual, apparent and estimated leaf area and deviation for actual leaf area cm² in different strains of cowpea (*Vigna unguiculata* **L. Walp.**).

Variety	*Actual leaf area (A) (cm^2)*	*Apparent leaf area (B) (cm^2)*	*Estimated leaf area (cm^2)*	*Deviation X*
1	*2*	*3*	*4*	*5*
G-151	50.0	75.5	50.23	+0.23
RG-48	51.1	74.8	49.77	−1.33
V-16	45.3	69.8	46.44	+1.14
W-488	48.2	72.9	48.50	+0.30
G. C-2	33.2	44.8	29.80	−3.40
V-27	40.1	58.0	38.59	−1.51
V-36	49.0	73.1	48.64	−0.36
TVX-944-2E	47.2	87.2	58.02	+10.82
V-70	53.9	77.8	51.76	−2.14
V-276	36.0	55.5	36.92	+0.92
RC-19	40.0	61.0	40.58	+0.58
H.G.-171	44.5	64.6	42.98	−1.52

Standard Error (SE) = 1.0341

't' value = 0.2997 (Non-significant) at 5%

This would help plant breeders in substituting the more cumbersome planimetric method.

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REFERENCES

Ashley, D. A., B. D. Doss, and O. L. Bennet (1963). A method for determining leaf area in cotton. *Agron. J.* **55**: 584.

Bhan, V. M. and H. K. Pande (1966). Measurement of leaf area in Rice. *Agron J.* **58**: 454.

Montgomery, E. C. (1911). Correlation studies of corn. 24th Ann. Rep. Nebraska Agr. Exp. Sta., 111-159.

Sharma, A. N., D. N. Chaudhari, and R. M. Shah (1985). Leaf area determination in Cluster beans (*Cyamopsis tetragonoloba* L. Taub.), *G.A.U. Res. J.* **10** (2): 85-86.

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Assessment of Losses in Groundnut Due to Rust and 'Tikka' Leaf Spots in Gujarat

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Groundnut rust caused by *Puccinia arachidis* speg. and early and late leaf spots normally referred to as 'tikka' disease caused by *Cercospora arachidicola* Hori and *Cercosporidum personatum* (Berk and Curt.) Deighton, respectively, are the major diseases of peanut in India. In Gujarat State, groundnut rust and 'tikka' have assumed serious proportions effecting all varieties under cultivation, resulting in severe losses in the yield of pods and fodder. However, proper estimates of losses are not available and hence the present investigations, were undertaken for assessment of cumulative losses due to rust and leaf spots as well as those caused by each of them separately.

This study was undertaken during *kharif* 1982 and 1983 using differential fungicides viz., tridemorph 0.04 per cent to control rust, (Mayee *et al.* 1978), carbendazim 0.025 per cent + tridemorph 0.04 per cent to control both the diseases and carbendazim 0.025 per cent alone to control 'tikka' (Vaishnav *et al.* 1983). In the same way mancozeb 0.2 per cent alone was used to control rust (Siddaramaiah, 1983), carbendazim 0.025 per cent + mancozeb 0.2 per cent was used to control both the diseases. A check treatment was kept in which no fungicidal spray was given. The experiment was conducted in a quadruplicate randomized block design. The plot size was kept as 5.0 x 3.6 m. The rows were spaced at 45 cm distance. Groundnut variety GAUG-1 was used. To create the uniform disease in all plots of the experiment, artificial built-up of disease was achieved by foliar application techniques normally adopted for rust and 'tikka' leaf spots after 25 days of germination. Fungicides were sprayed four times at 15 days interval commencing on 30 days after germination.

The results presented in Table 1 revealed that rust of groundnut was checked in the plots sprayed with tridemorph while 'tikka' leafspot was checked in the plots sprayed with carbendazim. The yield of pods and fodder was maximum where both rust and 'tikka' were controlled followed by the treatments where rust or 'tikka' was controlled separately. Due to combined infection of rust and 'tikka' the loss in yield of pods and fodder was 50.22 and 44.06 per cent, respectively. The loss in weight of 1000 kernels was 15.50 per cent and loss in oil percentage of kernels was 9.96. Lossses due to rust were 46.50 per cent in pod yield, 39.39 per cent in fodder, 12.50 per cent in 1000

TABLE 1

Estimated losses due to rust and 'Tikka' of groundnut (Pooled analysis).

Sr. No.	Treatment	Disease intensity		Yield of pods kg/ha	Per cent loss	Yield of fodder kg/ha	Per cent loss	Wt. of 1000 kernels gm.	Per cent loss	Oil per cent	Per cent loss
		Rust	Tikka								
1	Tridemorph	17.96	28.33	1281	45.60	1833	39.39	285.17	12.60	48.75	7.84
2	Carbendazim + Tridemorph	16.86	14.96	1400	50.22	1986	44.06	295.22	15.50	49.90	9.96
3	Carbendazim	35.53	16.14	1111	37.58	1569	29.20	273.55	8.80	47.23	4.87
4	Mancozeb	23.57	23.02	1187	41.30	1652	32.74	280.97	11.30	47.65	5.71
5	Carbendazim + Mancozeb	22.26	15.14	1352	48.46	1916	42.03	283.98	12.20	49.10	8.49
6	Check	47.47	44.13	697	—	1111	—	249.35	—	44.93	—
	S.Em. ±	0.875	0.556	88.89		36.81		2.03		0.304	
	C.D. at 5%	2.630	1.584	225.83		104.99		5.83		0.914	

kernels weight and 7.84 pre cent in oil content. Due to infection of 'tikka' the yield of pods, fodder, weight of 1000 kernels and oil percentage of kernel were decreased by 37.58, 29.20, 8.80 and 4.87 per cent, respectively .It seems that losses due to rust were higher than losses due to 'tikka' infection. These findings are in agreement with the results of Ghuge *et al.* (1911) and Kenjale *et al.* (1981). Looking to the severe losses caused by rust and 'tikka' diseases of groundnut in Gujarat the cultivators should strictly follow to the methods for the management and control of these diseases.

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REFERENCES

Ghuge, S. S., C. D. Mayee and G. M. Godbole, 1981. Assessment of losses in groundnut due to rust and tikka leaf spots. *Indian Phytopath.* **34:** 179-182.

Kenjale, L. D., P. A. Shinde and P. G. Utikar, 1981. Loss in groundnut yield due to rust. *Indian Phytopath.* **34:** 374-276.

Mayee, C. D., G. M. Godbole and F. S. Patil, 1978. Effectiveness of tridemorph in reducing intensity of rust of groundnut. *Pestology*, pp. 25-26.

Siddaramaiah, A. L., 1983. Groundnut research in Karnatak. *Plant Pathol. Newsletter* **1:** 1-123.

Vaishnav, M. U., V. A. Patel and B. K. Kikani, 1983. Economical schedule of different fungicides in controlling 'Tikka' disease of groundnut. *Indian J. Plant Prot.* **11:** 57-59.

Biology of *Heliothis armigera* Hb. As a Pest of Sunflower (*Helianthus annuus* L.)

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Sunflower, an ornamental plant is now cultivated as an oilseed crop. Sunflower headborer (*Heliothis armigera* Hb.) is the major pest of sunflower, causing direct damage to seeds. The eggs are sculptured and dome shaped with flat base. The eggs were laid singly on flower heads in the field. The eggs measured on an average 0.48 mm in diameter and 0.51 mm in height. The incubation period was on an average 4.00 days. The newly hatched larvae first feed on egg shell and then on the host leaves. There were five to six larval instars and duration of each instar averaged 4.71, 2.89, 2.86, 1.77, 2.23 and 3.00 days from first to sixth instar, respectively. Average larval period was 17.46 days. According to Lewin *et al.* (1973), larval period ranged from 15 to 20 days. Freshly formed pupae are greenish yellow in colour which turn to brownish black in a few hours. The pupae bear two cremasters at the tip of the abdomen. The pupae measured on average 16.66 mm in length and 4.53 mm in breadth. The pupal period averaged 9.17 days. The forewings of the male are pale brown to olive green and those of female are reddish brown. The number of eggs laid per female varied from 552 to 2052 with an average of 1031.68. The average longevity of male and female moths was 8.29 and 13.00 days, respectively. Nearly 60 per cent flower heads were found damaged by the *Heliothis* larvae. Two larval endoparasites were identified as; *Carcelia illota*, Curran. and *Exorista xanthaspis*, Wiedemann. The larval parasitism in field was 24.54 per cent.

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REFERENCE

Lewin, H. D., K. Thandavarayan, S. Kumar, and D. Sundararanju, 1973. Studies on the common and destructive pest of sunflower, *Pesticides*, **7** (4): 17-19.

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Biology of *Cardiastethus* sp. nr. *Nazarenus* Reuter (Hemiptera : Anthocoridae), A Predator of *Opisina arenosella* Walker

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Cardiastethus sp. has been recorded predating on the eggs and young larvae of *Ectomyelois ceratoniae* (Zell) (Daumal, 1969) and rice stem borer (Hidaku, 1965). *C. nazarenus* Reuter was found predating on the eggs and small larvae of the coconut leaf-eating caterpillar, *Opisina arenosella* during 1981 for the first time in Gujarat at Plantation Crops Research Station, Mahuva. Abdurahiman *et al.* (1982) recorded also *Cardiastethus* sp. as a predator of *O. arenosella* for the first time in Kerala State and they studied its preliminary biology. This predator was observed to be active during the months of August, October, November and December, 1981. Since this predator is recorded for the first time in Gujarat, its biology was studied under laboratory conditions between temperature range from 27.5 to 32.0° C. and relative humidity from 75 to 94 per cent.

Initial culture of *Cardiastethus* was raised by collecting the nymphal stages from coconut plantation and reared in laboratory. The first instar larvae of *Corcyra cephalonica* were provided daily as food for the predator. The newly emerged adults were paired and confined in the glass tubes (10 x 2.5 cm) closed with the cotton plug. In all twelve pairs were studied for biological investigations. Total number of eggs laid by a female bug were recorded. The newly hatched nymphs were reared individually on the *Corcyra* larvae. Observations on the hatching of eggs were taken to find out the incubation period. The nymphal instars were determined by presence of exuivae. Adult longevity, fecundity, nymphal period and sex ratio were recorded. The results obtained are presented in Table 1.

TABLE 1

Biology of *Cardiastethus nazarenus* **when reared on** *C. cephalonica*.

Stage	*No. of observations*	*Duration in days*	
		Range	*Average*
Egg	12	2-5	3.42 ± 0.96
Nymph	8	15-17	15.63 ± 0.79
First instar	8	4-5	4.25 ± 0.38
Second instar	8	2-3	2.50 ± 0.50
Third instar	8	1-3	2.00 ± 0.25
Fourth instar	8	2-3	2.38 ± 0.47
Fifth instar	8	4-5	4.38 ± 0.47
Adult:			
Female	7	26-52	39.43 ± 9.08
Male	7	4-26	15.57 ± 7.31

Biology:

Egg:

The egg was oblong, pinkish in colour and measured 0.45 - 0.54 mm

in length and 0.18 - 0.23 mm in breadth. The incubation period of eggs varied from 2 to 5 days with an average of 3.42 days (Table 1). Daumal (1969) reported that eggs hatched in 8 days. It was lasted for 4 to 5 days according to Abdurahiman *et al.* (1982).

Nymph:

The newly hatched nymph was reddish and enlongated. It measured 0.89 mm in length and 0.23 mm in breadth. The first instar nymph was very active. There were five distinct nymphal instars. The duration of first instar nymph varied from 4 to 5 days with an average of 4.25 days. The duration of second, third and fourth instar nymphs varied from 2-3, 1-3 and 2-3 days with an average of 2.50, 2.00 and 2.38 days, respectively. The final nymphal instar varied from 4 to 5 days with an average of 4.38 days. Thus the total nymphal period was 15.63 days on an average with a range of 15 to 17 days (Table 1). Abdurahiman *et al.* (1982) reported the nymphal period to be 18.22 days on an average.

Adult:

The adult was dark in colour and measured 1.75 mm in length and 0.65 mm in breadth. The males were more active than females. The females laid on an average 14.33 eggs with a range of 8 to 23 eggs. The longevity of females and males varied from 26 to 52 and 4 to 26 days with an average of 39.43 and 15.57 days, respectively (Table 1). The adults survived for 2 to 14 days without any food. Abdurahiman *et al.* (1982) reported that females lived one month on an average and laid 17 to 20 eggs when reared on *O. arenosella*. According to Daumal (1969), the females can live upto 50 days and lay upto 130 eggs when the predator was reared on eggs of *Ephestia kuchiella* Zell. The total life cycle was completed within 51 days when the predator was reared on *C. cephalonica*. The sex ratio of male and female from the field collected sample was found to be 1 : 1.36. According to Daumal (1982), the life cycle last for 35 days at 20° C. and 70% relative humidity.

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REFERENCES

Abdurahiman, U. C., U. V. K. Mohamad and O. K. Ramadevi. 1982. Studies on the biology of a predator, *Cardiastethus* sp. (Hemiptera: Anthocoridae) found in the galleries of *Nephantis serinopa* Meyr. (Lepidoptera: Xylorictidae). *Curr. Sci.* **51** (11): 574-576.

Daumal, J. 1969. Method for rearing of *Cardiastethus nazarenus* Reuter (Hemiptera: Anthocoridae) on the eggs of *Ephestia kuchiella* (Lepidoptera: Pyradidae). *Annls Epiphyt.* **19** (4): 721-726.

Hidaku, T. 1965. Studies on the natural enemies of insects injurious to rice plant, Tohoku District in Japan. 1. on the parasite and predators attacking the rice stem borer and their ecological peculiarities. *Bull. Tohoku natn. agric. exp. stn.* No. 32, pp. 145-160.

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Effect of Different Food Plants on Development of Leaf Eating Caterpillar, *Spodoptera litura* (F.)

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Leaf eating caterpillar, *Spodoptera litura* (F.) has been reported to feed on 112 species of crop and some species of weeds (Moussa *et al.* 1960). Biology of the insect is influenced to a great extent by different food plants and as such there are reports giving wide variation in larval development when reared on different host plants (Thobbi, 1962; Rattanlal and Nayak, 1963; Pandey and Srivastava, 1967). Thus the present study was undertaken at Bharuch to know the effect of food plants on larval development of *S. litura* (F.) under South Gujarat conditions.

A laboratory trial was conducted at Regional Cotton Research Station, Gujarat Agricultural University, Bharuch during the year 1983-84. Full grown larvae were collected from the field and nucleus culture was raised in the laboratory. Adult emerged from the pupae were released in breeding jars for copulation and the leaves of different hosts, viz. castor (*Ricinus communis* L.) Wal (*Dolichos lablab* L.), Cabbage (*Brassica oleracea* L.), Lucerne (*Medicago sativa* L.) and Wild tondli (*Coccinia indica* L.) were provided for oviposition and as food material. For studying the larval period, freshly hatched larvae were transferred and reared on leaves of different hosts separately. Totally 10 sets were arranged for this study. Rates of larval survival were also studied using complete randomised design having 25 larvae in each treatment with four replications. Growth indices were also worked out using formula suggested by Srivastava (1959).

$$\text{Growth index (G.I.)} = \frac{\text{Percentage of larval survival}}{\text{Larval duration (days)}}$$

The data on larval survival, larval duration and growth index are presented in Table 1.

Larval survival

Larval survival was 100 per cent on castor and cabbage and it was followed by Wal. and lucerne. The larval survival was significantly low on wild tondli (82.0%). Thobbi (1961) and Rattanlal and Nayak (1963) also reported the different food plants had significant effect on the mortality of *S. litura* (F.).

Larval duration

Larval duration was significantly low on castor i.e. 17.4 days. It was followed by lucerne (22.5 days) and cabbage

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TABLE 1

Effect of different host plants on larval development of *S. litura* **F.**

Host plants	*Larval survival*	*Larval duration (days)*		*Growth Index (G.I.)*
		Mean	*Range*	
Lucerne (*Medicago sativa* L.)	92.2(73.83)	22.5	21-23	4.08
Cabbage (*Brassica oleracea* L.)	100.0(90.00)	23.1	22-24	4.33
Castor (*Ricinus communis* L.)	100.0(90.00)	17.4	16-19	5.75
Wal (*Dolichos lablab* L.)	94.2(76.01)	25.0	24-26	3.76
Wild tondli (*Coccinia indica* L.)	82.0(64.93)	29.4	28-31	2.79
S.Em. ±	1.16	0.30	—	—
CD (P = 0.05%)	3.57	0.90	—	—
CV(%)	2.94	4.15	—	—

Note: The figures in parentheses are angular transformed values.

(23.1 days). The larval duration was significantly higher on wild tondli (*Coccinia indica* L.) i.e. 29.4 days. Rattanlal and Nayak (1963) also reported that the larval duration was 18 days on castor and 22 days on cabbage at 23° C.

Growth index (G.I.)

Growth index was highest on castor i.e. 5.75 and it was chlorologically followed by cabbage (4.33), lucerne (4.08), Wal (3.76) and wild tondli (2.79). Bhalani and Talati (1984) have reported G.I. for cabbage 7.71 and for castor 6.98 .While Pandey and Srivastava (1967) have also reported 2.50 G.I. for *Coccinia* Spp.

From the above results it could be concluded that the castor was found to be the most preferable host of *Spodoptera litura* with highest growth index, whereas wild tondli (*Coccinia indica* L.) was found the least unpreferred host.

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REFERENCES

Bhalani, P. A., and Talati, G. M. 1984. Growth and development of *Spodoptera litura* F. on certain food plants. *GAU Res. J.* **9** (2): 60-62.

Moussa, M. A., Zahar, M. A., and Kotby, F. 1960. Abundance of cotton leafworm *Prodenia litura* F. in relation to host plants I. Host plants and their effect on biology. *Bull Soc. Ent.* Egypt. **44** : 241-251.

Pandey, S. N. and Srivastava, R. P. 1967. Growth of larvae of *Prodenia litura* F. in relation to wild food plants. *Indian J. Ent.* **29** : (3) 229-233.

Rattanlal and Nayak, G. A. 1963. Effect of host plants on the development of caterpillar of *Prodenia*. *Indian J. Ent.* **25** (4) 299-306.

Srivastava, B. K., 1959. Growth potential of *Iaphygma exiqua* in relation to certain food plants. *Madras agric. J.* **46** (7): 255-259.

Thibbi, V. V. (1961). Growth potential of *Prodenia litura* in relation to certain food plants at Surat. *Indian J. Ent.* **23** : (4) 262-264.

Thobbi, B. V. 1962. Growth potential of *Prodenia litura* F. in relation to three species of cotton. *Indian Cott. Gr. Rev.* **16** : 148.

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Management of Gujarat Hairy Caterpillar, *Amsacta moorei* But. by Ultra Violet Light Trap

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Gujarat hairy caterpillar, *Amsacta moorei* is one of the most serious polyphagous pests of early sown kharif crops such as bajra, sunnhemp, cotton, groundnut, sesamum, tobacco nurseries etc. Jhaveri as early as 1921, showed the effectiveness of light traps for the control of this pest. Similarly, Milne (1927) also recommended the use of light traps for the control of the pest in the Punjab. Very recently Patel *et al.* (1981) reported effective control of this pest by ordinary 250 watt tungston electric bulb or kerosene pressure lamp (Petromax). They also advocated that, trapping of the moths should be done on co-operative basis in larger areas. Lim and Jusoh (1979) reported that ultra violet light source is 24 times more efficient in attracting insects than 60 watt tungston electric bulb and 20 times more effective than kerosene pressure lamp. In this paper the results of the effectiveness of ultra violet light trap (Pest-o-flash)* tested against *Amsacta moorei* in larger area during 1981, 1982 and 1983 seasons at Nirmali village of Kapadwanj Taluka are discussed.

The traps were installed at the rate of 11 per 10 ha, 7 per 8 ha and 8 per 10 ha in the groundnut area during 1981, 1982 and 1983 respectively at Nirmali village of Kapadwanj Taluka during 1981 and 1982 and at Pratappura village in Sabarkantha district during 1983. The traps were operated from 7 p.m. to 6 a.m. every day and number of moths attracted were collected, and recorded in the next morning starting with the onset of monsoon up to reasonable number of moths were trapped.

Apart from light trap collection the larval population of *A. moorei* was recorded in 34 places of 20' x 15' area each in different crops raised around the light trap study area and 21 places in an area where no light trap was installed.

An area of about 30 feet diameter around each trap was dusted with 5% BHC to kill the larvae hatching out from the eggs.

The results revealed that the first moth catch was five, three and seven days after the monsoon showers during 1981, 1982 and 1983 respectively, indi-

*The traps are manufactured and marketed by Pest Control (India) Pvt. Ltd., Bombay. Each trap has two ultra violet tubes of 20 watts with an electric grid. Electric supply is passed through the grid during the operation and the insects attracted to ultra violet light hit this grid and are killed.

cating the first set of moth emergence after the monsoon shower. It was found that 98.7% and 84.1% of the total catch in 12 days were during the first five days in 1981 and 1982 respectively, while 73.6% of the total catch was during the first six days in 1983 (Table 1). The above findings clearly indicated the period of high catch and the operation of light trap for six days after the first monsoon showers, will go a long way in the management of *A. moorei*.

The mean larval population ranged from 20.42 to 72.25 and 144.5 to 396.6/ 300 sq.ft. in area with and without light trap respectively in 1981. Similar difference in the larval population as a result of moth trapping using Petromax has been reported by Patel *et al.* (1981). The larval population during 1982 was drastically reduced both in the areas with and without light trap and it ranged from 8.49 to 11.9 and 18.99 to 24.66 respectively (Table 2). This indicated effect of large scale catch in 1981 which resulted in low larval population in subsequent year. Such reduction of *A. moorei* population in subsequent years after the use of light trap has also been reported by Jhaveri (1921).

The study over three years on the number of adults attracted to light trap

TABLE 1

Average number of *A. moorei* moths trapped in ultra violet light trap during 1981, 1982 and 1983.

1981		*1982*		*1983*	
Date	*Average catch/ day/trap*	*Date*	*Average catch/ day/trap*	*Date*	*Average catch/ day/trap*
26-6-81*	—	11-7-82*	—	25-6-83*	Electric
27-6-81	—	12-7-82	—	26-6-83	supply
28-6-81	—	13-7-82	—	27-6-83	was not
29-6-81	—	14-7-82	79.28	28-6-83	avail-
30-6-81	—	15-7-82	145.28	29-6-83	able
1-7-81	4334.00	16-7-82	101.43	30-6-83	
2-7-81	7000.00	17-7-82	123.14	1-7-83	
3-7-81	2429.00	18-7-82	54.20	2-7-83	80.62
4-7-81	0068.00	19-7-82	33.86	3-7-83	92.75
5-7-81	30.00	20-7-82	22.57	4-7-83	94.42
6-7-81	4.30	21-7-82	11.86	5-7-83	112.85
7-7-81	1.20	22-7-82	11.71	6-7-83	128.57
9-7-81	0.58	23-7-82	6.66	7-7-83	158.42
11-7-81	114.00	24-7-82	—	8-7-83	54.28
12-7-81	55.00	25-7-82	—	9-7-83	66.37
13-7-81	4.6	26-7-82	5.00	10-7-83	93.85
14-7-81	1.0	27-7-82	3.28	11-7-83	16.57
				12-7-83	8.28
Average	1171		49.85		82.65

*First monsoon showers received.

TABLE 2

Incidence of *A. moorei* larvae in light trapped and untrapped areas at Nirmali.

Particulars	*Average larval population/300 sq. ft. area in different crops and years*											
	*1981**				*1982**				*1983***			
	Cotton	*Ground-nut*	*Sesa-mum*	*Bajra*	*Cotton*	*Ground nut*	*Sesa-mum*	*Jowar*	*Cotton*	*Ground nut*	*Sesa-mum*	*Jowar*
Light trapped area	57.88	23.00	20.42	72.25	8.49	11.19	6.99	9.00	0.99	1.50	0.99	0.99
Untrapped area	396.60	144.50	295.00	185.16	22.50	24.66	18.99	18.99	15.00	16.65	10.98	6.00

*Observations recorded at Nirmali

**Observations recorded at Pratappura

and larval population on different crops indicated that subsequent to light trap operation for 12 days in the first year an adult catch and larval population were drastically reduced in the next year in a particular area.

Thus, if light traps are installed in large areas immediately after the first monsoon shower and are operated for about a week after the moths begin to be trapped, the pest population can be reduced appreciably.

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REFERENCES

Jhaveri, T. N. (1921). Note on "Katra" (Hairy caterpillar) and their controlling measures. *Rep. Procd. 4th ent. Mtgs.* Pusa: 98-104.

Lim, G. S. and M. Jusoh (1979). Relative attraction of rice hoppers and their common predators to different light source. *Int. Rice. Res. News letter*, **4** (6): 14-15.

Milne, D. (1927). Entomology Rep. Dept. Agric. Punjab. 1925-26 (1) 49-54.

Patel, B. S., R. C. Patel and M. S. Patel (1981). A note on effectiveness of light traps for the control of Gujarat hairy caterpillar *Amsacta* spp. *GAU Res. J.*, 7 (1) 47-48.

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Reactions of Root-Knot Nematode Resistant and Susceptible Cowpea Varieties to Reniform Nematode, *Rotylenchulus reniformis*

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Cowpea (*Vigna unguiculata* L. Walp) is an important pulse crop commonly grown in different parts of the country. Nutritionally, it has high protein and carotene contents. It is used as green vegetable as well as dry pulse recipe. Among several nemic diseases, root-knot is a serious problem for successful cultivation of cowpea crop in sandy loam soils of Gujarat. Variety C-152 (Patel *et al.*, 1977) has been found to be resistant to root-knot disease while Gujarat Cowpea 1 has been evolved as highly resistant variety by the Anand Centre of Gujarat Agricultural University. Besides root-knot, reniform nematode is also a limiting factor in the successful cultivation of cowpea crop. Linford and Yap (1940) for the first time observed *Rotylenchulus reniformis* on cowpea in Hawaii. Seshadri (1970) also found infestation of *R. reniformis* on cowpea. Decker *et al.* (1966) reported cowpea (*Vigna sinensis*) to be the best host for *R. reniformis*. Vallanueva and Castillo (1976) observed reduction in root-weight and dry seed yield of cowpea two months after inoculation with *R. reniformis*. The present investigation was undertaken to know the reactions of these two root-knot resistant varieties viz. C-152 and GC-1 alongwith two commonly grown root-knot susceptible varieties in the state viz. Pusa Phalguni and Philippines to *R. reniformis*.

Three seeds of each of the varieties viz. C-152, GC-1, Pusa Phalguni and Philippines were seeded in previously disinfested earthen pots (15 cm diameter) containing 1300 grams steamed soil. Each variety was replicated three times using completely randomized design. There were six pots for each variety. Fifteen days following seeding, three of the six (seeded) pots in each variety were inoculated with 500 immature vermiform females of *R. reniformis*. The remaining three pots served as uninoculated control. Pots were watered regularly. Forty-five days after inoculation, plants were removed carefully and roots were washed free of soil. The observations on fresh shoot and root weights as well as plant height were recorded. Nema population of soil was also determined. The number of females and eggs from one gram root in each variety was estimated following the technique suggested by Clark and Thomas (1979).

The significant differences were obtained among various cowpea varieties in all the growth attributes under

study (Table 1). The reduction in shoot and root weights as well as plant height was more under inoculated pots in varieties C-152, GC-1 and Philippines than that of uninoculated pots, while reduction for these attributes in variety Pusa Phalguni was considerably less.

Looking to the reproduction rate of *R. reniformis* on different cowpea varieties (Table 2), Variety Pusa Phal-

TABLE 1

Effect of *Rotylenchulus reniformis* on growth and development of different cowpea varieties.

Variety	*Shoot weight, g*	*Root weight, g*	*Plant height, cm*
C-152			
Inoculated	9.62 ab	1.30 ab	30.50 abc
Uninoculated	12.64 a	1.66 ab	36.17 a
GC-1			
Inoculated	6.81 b	1.01 ab	19.06 e
Uninoculated	7.26 b	1.78 a	22.94 cde
Pusa Phalguni			
Inoculated	8.10 b	0.70 b	22.65 de
Uninoculated	8.32 b	0.83 ab	28.61 abcd
Philippines			
Inoculated	7.82 b	0.80 ab	24.26 bcde
Uninoculated	9.71 ab	1.78 a	30.91 ab
S.Em.	1.04	0.30	2.38
C.V. %	20.5	41.9	15.3

Values followed by common letters do not differ significantly at 5% level of significance according to Duncan's New Multiple Range Test.

TABLE 2

The reproduction rate of *R. reniformis* on different cowpea varieties.

Variety	*Larvae/50 g soil**	*Females/g root**	*Eggs/g root**	*Total popula-tion build up**
C-152	2.1841 a (153)	1.5507 a (36)	2.5797 a (380)	2.7742 a (595)
GC-1	2.2475 a (177)	1.6106 a (41)	2.2123 ab (163)	2.5782 a (379)
Pusa Phalguni	0.6065 b (4)	0.1034 b (1)	0.3181 c (2)	0.6931 b (5)
Philippines	2.0882 a (123)	1.4313 a (27)	1.9057 b (80)	2.3660 a (232)
S.Em.	0.1779	0.1130	0.1881	0.2063
C.V.%	17.3	16.7	18.6	17.0

*Legend Log (X + 1) transformation.

Figures in parentheses indicate retransformed values.

Values followed by common letters do not differ significantly at 5% level of significance according to Duncan's New Muiltlpe Range Test.

guni had significantly less number of larvae/50 g soil, number of females and eggs/g root giving significantly less total population build up as compared to other varieties viz. C-152, GC-1 and Philippines which were at par with each other.

This suggests that variety Pusa Phalguni is highly resistant to reniform nematodes and can be successfully grown in the areas prone to *R. reniformis* infection.

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REFERENCES

Clark, G. A. and Thomas, R. J. 1979. Extraction of reniform nematodes eggs for inoculation or estimation of field population (Abstract). *Phytopathology* **69** : 1-43.

Decker, H.; Garcia, R. G. and Gandoy, P. 1966. Investigaciones sobre la apricion del nematodo sedentario de las raices *R. reniformis* on la provincia de las villas (Cuba). *Mems. a cent. Investnes Agrofec. Univ. Cent. Las villas, Year 1966,* 169-175. (*Fide. Helminth. Abst.* **38** (2); 2747, 1969.)

Linford, M. B., and Yap. F. 1940. Some host plants of the reniform nematode in Hawaii. *Proc. Helm. Soc. Wash* **7:** 41-44.

Patel, G. J.; Shah, H. M., and Patel, D. J. 1977. Screening of cowpea cultivars against root-knot nematodes. *Indian J. Nematol.* **7:** 169.

Seshadri, A. R. 1970. Chapter on Nematology, Agricultural Year Book, New Vistas in crop yields by IGAR, New Delhi P. 370-411.

Vallanueva, L. M. and Castillo, M. B. 1976. Pathogenic reaction of cowpea to the reniform nematode at varying levels of inoculation. *Philippines Phytopath.* **12:** 75-77.

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I, Prof. H. N. Patel, hereby declare that the particulars given above are true to the best of my knowledge and belief.

H. N. Patel
Director of Extension Education

Date: January 1st, 1987