GUJARAT AGRICULTURAL UNIVERSITY

RESEARCH JOURNAL

VOLUME : 13 NUMBER : 1

JULY, 1987

GAU RES. J. 13 (1)

Gujarat Agricultural University Research Journal

July, 1987
Vol. 13, No. 1

Editorial Office:
Publication Unit,
Gujarat Agricultural University,
Shahibag, Dafnala,
Ahmedabad
380 004. INDIA

CONTENTS

Short Communications

GAU Res. J. 1987. 13 (1) : 1-6

Effect of Various Levels of Nitrogen, Phosphorus and Cycocel on Yield and Yield Contributing Attributes of Cluster Bean Green Pod under Rainfed Conditions [*Cyamopsis tetragonoloba* (L.) Taub.] cv. Pusa Naubahar

S. J. P. Singh, C. B. S. Rajput and K. P. Singh

Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221 005

ABSTRACT

Yield of green pods and yield contributing attributes of cluster bean cultivar Pusa Naubahar increased significantly and positively correlated by various levels of nitrogen, phosphorus and foliar application of cycocel during the years 1981 and 1982. The dry weight of green pods per plant by the application of cycocel did not differ significantly during both years. Finally, 40 kg of nitrogen, 60 kg of phosphorus and 500 ppm of cycocel significantly improved yield of green pod and yield contributing attributes over control in the years 1981 and 1982.

(*Received on 23rd May, 1986*)

INTRODUCTION

Among the several approaches made to improve cluster bean productivity, regulation of plant metabolism by using exogenous growth substances or soil feeding of nitrogen, phosphorus and foliar feeding of cycocel has been reported to improve the yield and yield contributing attributes by influencing the plant physiological processes favourably (Tomar *et al.*, 1972 and Rao *et al.*, 1983). The present investigation was undertaken to study the influence of nitrogen, phosphorus and cycocel on cluster bean vegetable under rainfed condition.

MATERIALS AND METHODS

A field experiment was conducted at the Vegetable Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221 005, during *kharif* season of years 1981 and 1982. The experiment was laid out in split plot design with three replications. The treatments comprised three levels of nitrogen (0, 20 and 40 kg/ha), three levels of phosphorus (0, 30 and 60 kg/ha) and three concentrations of cycocel (2-chloroethyl trimethyl ammonium chloride) (0, 500 and 1000 ppm). The half dose of nitrogen and full dose of

phosphorus was applied as basal dressing. Remaining half dose of nitrogen was applied as top dressing 20 days after sowing. One foliar spray of cycocel solution was done at 25 days after sowing.

The soil was sandy loam, low in available nitrogen (0.095%), phosphorus (0.081%) and potassium (0.542%) having pH value of 7. The physical conditions of soil were coarse sand (5.44%), fine sand (44.80%), silt (29.59%) and clay (18.19%).

RESULTS AND DISCUSSION

Guar being a legume responds to the small amount of nitrogen and improves the yield and yield contributing attributes (Sanderson, 1974 and Denins, 1977). The data presented in Tables 1 and 2 indicate that increasing levels of nitrogen produced highly significant yield and yield attributes like number of green pods per plant, number of clusters per plant, fresh and dry weight of green pod, mean weight of cluster, mean weight of green pod, length, thickness and number of seeds per green pod and total crude protein percentage during both the years (1981 and 1982).

The various levels of phosphorus significantly increased all the yield and yield contributing atrributes during both the years (1981 and 1982). The maximum and minimum values were obtained in 60 kg/ha P_2O_5 and control. Similar findings were reported by Gill and Singh (1981) and Tomar *et al.*, (1973).

In both the years (1981 and 1982) the various concentrations of cycocel increased all the yield and yield attributes significantly except dry weight of fresh green pod per plant. The maximum and minimum values were obtained in 500 ppm cycocel and control respectively. These findings are obtained from depressing nature of vegetative growth, but increased the leaves longevity which is the main source of photosynthesis and other metabolism thereby augmenting yield by prolonging the period of metabolization of metabolites from leaves and fruits (Tolber, 1960).

Correlation coefficient between yield and yield contributing attributes

The correlation coefficient of yield and yield contributing attributes has been worked out on average data of two years and presented in Table 3. This indicated that the various levels of nitrogen and phosphorus along with growth retardant cycocel are more effective in favour of yield and yield contributing attributes like number of green pod per plant, number of cluster per plant, green pod per cluster, fresh and dry weight of green pod, mean weight of cluster, mean weight of green pod, length, thickness and number of seeds per green pod and total crude protein percentage. Similar findings were reported by Gill and Singh, (1981) and Rao *et al.* (1983).

TABLE 1

Effect of nitrogen, phosphorus and cycocel on yield contributing attributes of cluster bean and green pod during year 1981.

Treatments	*Yield of green pod/ha (qtls.)*	*No. of green pod/ plant*	*No. of cluster/ plant*	*No. of green pod/ cluster*	*Fresh weight of green pod/ plant (g)*	*Dry wt. of green pod/ plant (g)*	*Mean wt. of cluster (g)*	*Mean wt. of green pod (g)*	*Length of green pod (cm)*	*Thickness of pod (cm)*	*No. of seeds/ green pod*	*Total crude protein %*
Levels of nitrogen (kg/ha)												
0	75.48	32.21	10.75	4.35	77.89	12.96	8.72	2.37	8.67	0.386	8.94	20.69
20	100.15	49.74	12.80	4.98	107.83	20.84	10.15	2.67	10.85	0.433	9.96	22.24
40	122.77	74.59	17.78	6.57	165.10	31.68	16.68	3.28	12.75	0.527	11.19	23.47
S.Em.	±0.845	1.374	0.487	0.193	0.959	0.213	0.412	0.048	0.172	0.023	0.088	02.26
C.D. at 1%	3.890	6.325	2.242	0.888	4.415	0.980	1.896	0.220	0.791	0.133	0.405	10.40
Levels of phosphorus (kg/ha)												
0	70.81	42.67	11.58	4.69	72.85	11.48	8.25	2.59	9.91	0.378	9.21	20.59
20	102.44	55.99	14.07	5.25	123.99	23.58	11.80	2.84	10.79	0.461	10.08	22.49
60	125.16	64.88	15.68	5.95	152.98	30.39	15.23	3.20	11.47	0.507	10.80	23.34
S.Em.	±1.984	1.268	0.153	0.206	0.788	0.136	0.315	0.067	0.183	0.015	0.181	0.157
C.D. at 1%	6.061	3.873	0.467	0.629	2.258	0.415	0.962	0.204	0.256	0.045	0.552	0.464
Concentrations of Cycocel (ppm)												
0	91.78	47.92	13.11	4.87	81.42	20.88	10.74	2.59	11.56	0.401	9.57	21.88
500	108.10	59.85	14.46	5.59	122.55	22.87	12.98	2.95	10.74	0.490	10.48	22.46
1000	98.53	55.77	14.16	5.44	117.61	21.69	11.80	2.78	9.87	0.455	10.03	22.07
S.Em.	±0.921	1.374	0.030	0.123	0.543	—	0.497	0.111	0.078	0.004	0.118	0.101
C.D. at 1%	2.490	2.617	0.081	0.332	1.464	N.S.	1.342	0.300	0.210	0.010	0.319	0.233

N.S. = Not Significant.

TABLE 2

Effect of nitrogen, phosphorus and cycocel on yield and yield contributing attributes of cluster bean green pod during the year 1982.

Treatments	*Yield of green pod/ha (qtls.)*	*No. of green pod/ plant*	*No. of cluster/ plant*	*No. of green pod/ cluster*	*Fresh weight of green pod/ plant (g)*	*Dry wt. of green podper plant (g)*	*Mean wt. of cluster (g)*	*Mean wt. of green pod (g)*	*Length of green pod (cm)*	*Thick-ness of green pod (cm)*	*No .of seed/ green pod*	*Total crude. protein (%)*
Levels of nitrogen (kg/ha)												
0	74.23	39.61	10.75	4.51	77.89	11.92	8.07	2.22	8.96	0.386	8.94	20.78
20	96.67	50.39	13.02	4.96	105.83	20.02	9.99	2.56	10.89	0.933	9.96	22.02
40	117.33	71.00	16.71	5.77	152.61	30.24	3.29	12.49	12.49	0.527	11.16	23.69
S.Em.	±2.857	0.544	0.390	0.092	0.721	1.272	0.105	0.255	0.255	0.029	0.088	0.095
C.D. at 1%	13.153	2.504	1.795	0.423	3.319	5.856	0.483	1.174	1.174	0.133	0.405	0.437
Levels of P_2O_5 (kg/ha)												
0	63.35	43.985	11.34	4.22	70.46	10.11	8.31	2.22	9.90	0.378	9.21	20.16
30	98.19	53.890	13.89	5.18	118.99	22.78	11.80	2.78	10.89	0.461	10.08	92.30
60	120.70	64.750	15.34	5.83	134.87	29.29	16.00	3.07	11.69	0.507	10.80	23.50
S.Em.	±1.164	0.539	0.14	0.046	0.819	0.097	0.284	0.111	0.131	0.015	0.181	0.108
C.D. at 1%	3.556	1.646	0.42	0.140	2.502	0.296	0.867	0.339	0.400	0.045	0.552	0.329
Concentrations of cycocel (ppm)												
0	91.01	48.79	12.86	4.71	104.16	20.59	9.98	2.50	11.60	0.401	9.57	21.83
500	100.03	58.48	14.13	5.39	117.71	21.59	12.76	2.88	10.65	0.490	10.48	22.48
1000	95.80	53.14	13.74	5.14	111.20	20.54	11.78	2.86	10.00	0.455	10.03	22.15
S.Em.	±0.384	2.548	0.010	0.043	1.291		0.405	0.101	0.141	0.004	0.118	0.022
C.D. at 1%	0.928	6.886	0.027	0.116	3.490	N.S.	1.095	0.273	0.381	0.010	0.319	0.059

N.S. = Not Significant.

TABLE 3

Correlation coefficient between yield and yield contributing attributes (average data of two years, i.e. 1981 and 1982).

Yield of green pod/ha (qtls.)	*No. of green pod/ plant* (X_1)	*No. of cluster/ plant* (X_2)	*No. of green pod/ cluster* (X_3)	*Fresh wt. of green pod/plant* (X_4)	*Dry wt. of green pod/ plant (g)* (X_5)	*Mean wt. of cluster (g)* (X_6)	*Mean of green pod (g)* (X_7)	*Length of green pod(cm)* (X_8)	*Thick-ness of green pod(cm)* (X_9)	*No. of seeds/ green pod* (X_{10})	*Total protein (%)* (X_{11})
Y	0.896**	0.913**	0.912**	0.950**	0.941**	0.902**	0.952**	0.758**	0.936**	0.945**	0.982**
X_1		0.980**	0.973**	0.854**	0.944**	0.959**	0.963**	0.743**	0.974**	0.961**	0.913**
X_2			0.968**	0.968**	0.939**	0.963**	0.971**	0.782**	0.967**	0.969**	0.927**
X_3				0.951**	0.923**	0.979**	0.973**	0.683**	0.974**	0.963**	0.904**
X_4					0.989**	0.958**	0.981**	0.759**	0.955**	0.937**	0.944**
X_5						0.935**	0.961**	0.769**	0.939**	0.907**	0.941**
X_6							0.967**	0.319**	0.950**	0.934**	0.895**
X_7								0.729**	0.976**	0.962**	0.944**
X_8									0.702**	0.778**	0.813**
X_9										0.973**	0.941**
X_{10}											0.951**
X_{11}											

**Significant at 1% level.

REFERENCES

Dennis, R. E. (1977). Growing guar in arid zone, Ariz. Univ. Dept. Plant Sci. Agri. File Fc. Z88-0.

Gill, P. S. and Singh, K. (1981). Effect of fertilization and yield contributing characters on grain yield of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] *Haryana Agri. Univ. Jour. Res.* **11**(3): 333-338.

Rama Rao, R. C.; Venkateswarlu, M. S. and Sankara Reddy, G. H. (1983). Effect of growth regulators on yield attributes and yield of TMVZ groundnut at various plant densities. *Indian J. Agron.* **28**(3): 243-247.

Sanderson, K. M. (1974). •Guar (*Cyamopsis tetragonoloba*) in the Rodesian lowkeld. *Rodesia Agri. Jour.* **71**: 17-91.

Tolbert, N. E. (1960). 2-chloroethyl trimethyl ammonium chloride and related compound as plant growth substances. *J. Biol. Chem.* **235**: 475-479.

Tomar, P. S.; Kundu, R. S.; Gill, P. S. and Bishnoi, K. C. (1972). Effect of seed rates and levels of phosphorus and nitrogen on growth, yield and quality of guar forage. *Ind. J. Agron.* **16**: 143-146.

Tomar, P. S.; Dalal, S. K.; Gill, P. S. and Bishnoi, K. C. (1973). Comparative efficiency of guar [*Cyamposis tetragonoloba* (L.) Taub.] varieties with varying level of phosphorus and seed rate. Ann. Arid. Zone (12): 163-66.

GAU Res. J. 1987. 13 (1) : 7-12

A Correlation Study of Maize Yield with its Components

P. G. Patel,* R. P. Singh and K. R. V. Raja

Department of Agronomy, IARI, New Delhi-12

ABSTRACT

An experiment was conducted on maize for two years at IARI, New Delhi to study the correlation of yield with its associated biometrical characters. The grain yield was found to be highly correlated with stover yield and 1000-grain weight in both the years. The selection indices developed through multiple regression showed that during 1977-78, stover yield, girth of cob and 1000-grain weight covered 98% variation, while during 1978-79, stover yield grain yield per cob and 1000-grain weight covered 95% of the total variation.

Yield is the fore-most consideration in the breeding of any crop. Since the formation of yield depends upon many characters associated with the yield, it is an essential feature of any breeding work to study the contribution of each character in the production of yield.

In the case of maize also, many such attempts were made earlier. Murthy and Roy (1957) obtained a high correlation between yield and length of cob, yield and 100-grain weight, girth of cob and 100-grain weight, but low association between yield and girth of cob, yield and plant height and plant height and 100-grain weight.

(*Received on 25th March, 1985*)

MATERIALS AND METHODS

Field experiments were conducted during 1977-78 and 1978-79 on Ganga hybrid maize at the Indian Agricultural Research Institute, New Delhi to ascertain the responses of graded doses of nitrogen directly applied to maize on the plots of previously sown different leguminous crops, wheat and fallow. The split-plot design was used in which the main plot treatments comprised of lathyrus, gram, lentil, pea, wheat and fallow in which the crops were sown during the previous *rabi* season and 3 doses of nitrogen viz., 0, 60 and 120 kg N/ha applied to *kharif* maize as subplot treatments. There were 3 replications.

Since the objective of this particular study was confined to assess the correlation between the yield and its components alongwith some qualitative characters, only the mean values of each treatments were considered here. The different components that were under study are stover yield (X_1), N-uptake (X_2), P-uptake (X_3), length of cob (X_4), girth of cob (X_5), grain yield per cob (X_6), number of grains

*Present address : Associate Research Scientist (Agro), Main Cotton Research Station, GAU, Surat.

per cob (X_7), 1000-grain weight (X_8), protein content (X_9), moisture per cent at harvest (X_{10}) and plant height (X_{11}). The correlations worked out and selection indices were prepared through multiple regression equations.

RESULTS AND DISCUSSION

The correlation matrices of yield and the 11 independent characters for the year 1977-78 and 1978-79 are presented in Tables 1 and 2. In both the years, all the characters were found to possess highly significant correlation with the yield. Not only that, all these characters were themselves found to be highly correlated with each other. Even though multicollinearity has been observed, this has not much affected the predictive values of the regression coefficients. However, looking to those characters which are directly concerned with the formation of yield, it is observed that stover yield and 1000-grain weight showed a correlation exceeding 0.9 in both the years. Girth of cob during 1977-78 and grain yield per cob and moisture per cent at harvest during 1978-79 also showed more than 0.9 correlation with yield. The fact that 1000-grain weight possessed maximum amount of correlation with yield (0.98 and 0.96) in both the years and substantially contributed towards yield is supported by Prabhakaran Nair *et al.* (1974) who observed that this character exerted a substantial influence on the grain yield of maize. Shukla and Wassay (1970) found that an increase in the number of cobs, number of grains per cob and weight of grain per cob was reflected in the increased yield of hybrid maize. Mason and Zuber (1976) found that grain weight per ear and number of ears per 100 plants were highly correlated with yield.

When all the characters were regressed with the yield, it was observed that the total variation contributed by these characters (R^2 value) were 99.6% during 1977-78 and 98.8% during 1978-79. The regression coefficients and their standard errors are presented in Table 3.

However, it is obvious that the contribution of all the characters are not of the same magnitude and some of them do substantially contribute than others. In order to examine this aspect, selection indices were prepared through multiple regression equation (Table 4). During 1977-78, out of the 99.6% variation contributed by the 11 characters, three of them, namely, stover yield (X_1), girth of cob (X_5) and 1000-grain weight (X_8) covered 98.2% variation. In the year 1978-79, stover yield, grain yield per cob and 1000-grain weight contributed 94.74% out of a total of 98.8%. With the addition of X_{10}, (moisture per cent at harvest), the coverage had gone upto 96.41 per cent as shown in equation 3. There was a marginal increase of 0.14 per cent when X_7 (No. of grains per cob) was also included as the fifth variable in the equation.

It is therefore obvious that the stover yield and 1000-grain weight are the most important characters in the formation of the yield of maize. Rajput *et al.* (1970) observed that any increase in the 1000-grain weight reflected in the increase in yield of maize.

TABLE 1

Correlation among different characters (1977-78).

		Grain yield	*Stover yield*	*N uptakr*	*P uptake*	*Length of cob*	*Girth of cob*	*Yield per/cob*	*No. of grains per cob*	*1000-grain wt.*	*Protein per cent ic grain*	*Moisn % in groin at harvest*
		Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
Stover yield	X_1	0.9752										
N-uptake	X_2	0.9159	0.8682									
P-uptake	X_3	0.7315	0.6260	0.8682								
Length of cob	X_4	0.9424	0.9342	0.9006	0.6650							
Girth of cob	X_5	0.9662	0.9485	0.8908	0.6694	0.9716						
Grain yield per cob	X_6	0.9010	0.8800	0.9584	0.7563	0.9485	0.9221					
No. of grains per cob	X_7	0.8563	0.8258	0.9443	0.7742	0.9299	0.8890	0.9783				
1000-grain wt.	X_8	0.9771	0.9458	0.8816	0.7089	0.9383	0.9487	0.8725	0.8287			
Protein % in grain	X_9	0.7190	0.6574	0.9034	0.8126	0.7000	0.6874	0.8486	0.8258	0.6461		
Moisture % in grain at harvest	X_{10}	0.5042	0.4611	0.7531	0.6914	0.5445	0.5233	0.7469	0.7802	0.4249	0.8735	
Plant ht. at maturity	X_{11}	0.7161	0.6439	0.8849	0.8055	0.6847	0.7115	0.8309	0.8187	0.6200	0.9460	0.8618

TABLE 2

Correlations among different characters (1977-78).

		Grain Yield Y	*Stover yield*	*N uptake*	*P uptake*	*Length of cob*	*Girth of cob*	*Grain yield per cob*	*No. of grains per cob*	*1000-grain wt.*	*Protein per cent in grain*	*Moisture % in grain at harvest*
			1	2	3	4	5	6	7	8	9	10
Stover yield	X_1	0.9367	—									
N-uptake	X_2	0.8763	0.7490	—								
P-uptake	X_3	0.7136	0.6912	0.7904	—							
Length of cob	X_4	0.8908	0.8116	0.7799	0.7342	—						
Girth of cob	X_5	0.8253	0.8040	0.6873	0.6693	0.7755	—					
Grain yield per cob	X_6	0.9245	0.9280	0.7823	0.7190	0.8735	0.8137	—				
No. of grains per cob	X_7	0.8991	0.8030	0.8874	0.6735	0.8737	0.7980	0.8226	—			
1000-grain weight	X_8	0.9631	0.9132	0.9035	0.7676	0.8421	0.8355	0.9270	0.8826	—		
Protein % in grain	X_9	0.8811	0.8152	0.8525	0.8549	0.9088	0.6761	0.8437	0.8029	0.8576	—	
Moisture % in grain at harvest	X_{10}	0.9096	0.8246	0.8469	0.7867	0.8393	0.6852	0.7961	0.8088	0.8702	0.8994	—
Plant ht. at maturity	X_{11}	0.8835	0.8301	0.8812	0.6672	0.7421	0.6519	0.8102	0.8286	0.8386	0.7521	0.831

TABLE 3

Regression coeffects and standard errors.

Characters		*77-78*			*78-79*		
		b	*SE*	*t*	*b*	*SE*	*t*
Stover yield	X_1	0.2761	0.0561	4.93**	0.06696	0.09855	0.68
N-uptake	X_2	0.1255	0.0692	1.81	0.00052	0.07672	0.0067
P-uptake	X_3	0.0531	0.0579	0.92	0.2720	0.1136	2.39
Length of cob	X_4	0.7033	0.7266	0.98	0.5147	0.9859	0.52
Girth of cob	X_5	0.5164	1.5949	0.32	1.0144	0.7997	1.27
Grain yield per cob	X_6	0.1427	0.0885	1.61	0.0303	0.1054	0.29
No. of grains per cob	X_7	0.5848	0.0332	1.76	0.00284	0.0209	0.14
1000-grain wt.	X_8	0.2482	0.0664	3.74**	0.2410	0.2165	1.11
Protein content	X_9	1.7539	1.0733	1.63	1.8574	2.2877	0.81
Moisture % at harvest	X_{10}	0.5051	0.3299	1.53	0.4377	0.3998	1.09
Plant ht. at maturity	X_{11}	0.1025	0.0479	2.14	0.0723	0.08659	0.83

TABLE 4

Selection indices.

	Year	*Multiple regression equation*	*Mult. correln. coefficient*	*Variation explained (%)*
1.	77-78	$-39.6518+0.1867\times1+1.7136\times5+0.1550\times8$	0.9910**	98.2
2.	78-79	$-55.234+0.1330\times1+0.0180\times6+0.3651\times8$	0.9733**	94.74
3.	78-79	$-44.5649+0.1000\times1+0.0515\times6+0.2367\times8+0.6728\times10$	0.9819**	96.41
4.	78-79	$-42.1075+0.0701\times1+0.0707\times6+0.2073\times8+0.6583\times10+0.0115\times7$	0.9826**	96.55

REFERENCES

Mason Lu, and Marcus Zuler (1976): Diallel analysis of maize angle, leaf area, yield and yield components. *Crop Sci.* **16**(5); 693-96.

Murthy, G. S. and Roy, N. N. (1957): Study of the Indian collection of maize varieties with special reference to the relationship between yield and other characters. *Ind. J. Genet. & Pl. Breeding* **17**(1): 73-89.

Prabhakaran Nair P. K., and R. P. Singh (1974): Correlative analysis of yield and its components in maize. *Expt. Agric.* **10**(2) 81-86.

Rajput V. S., Singh D. K., Pande R. C. and Verma K. P. (1970): Response of maize to levels of nitrogen and spacing. *JNKV Res. J.* **4** (1/2): 62-66.

Satishkumar (1974): Correlation between yield and yield components and their combining abilities in maize. *Madras Agric. J.* **61**(5): 111-117.

Shukla S. C. and Wassey H. (1970): Studies in the correlation between yield and yield components in relation to time and method of N application in hybrid maize. Accolated Farmer Vol. x LIV No. 5: 291-294.

GAU Res. J. 1987. 13 (1) : 13-16

Natural Enemies of Groundnut Leafminer, *Aproaerema modicella* Deventer (Lepidoptera : Gelechiidae) and their Impact on its Infestation at Anand (Gujarat)

D. N. Yadav, R. R. Patel and R. C. Patel

A. I. C. R. P. on Biological Control, GAU, Anand Campus, Anand

ABSTRACT

Natural enemies of groundnut leafminer *Aproaerema modicella* **Deventer were recorded at Anand (Gujarat). The larvae of** *A. modicella* **were found parasitised by** *Bracon gelechiae* **Ashm.,** *Apanteles sp. laevigatus* **group.,** *Chelonus* **sp.** *Goniozus* **sp.** *Stenomesius japonicus* **Ashm., and an unidentified hymenopteran and the pupae were parasitised by a chalcid,** *Brachymeria* **sp. Of these,** *Apanteles* **sp.** *Goniozus* **sp. and** *S. japonicus* **were the important ones. They accounted for a maximum of 38.21, 50.00 and 79.16% parasitisation. These parasites were very effective and did not allow the pest to build up pestiferous population to call for any chemical treatment. Conservation of these natural enemies is suggested.**

(*Received on 17th Dec. 1985*)

INTRODUCTION

The groundnut leafminer *Aproaerema modicella* Deventer is a serious pest of groundnut and soybeans in many Asian and South-East Asian countries (Reddy, 1978). In India, it has been reported as serious pest from Andhra Pradesh (Channabasavanna 1957; Krishnamurthy Rao *et al.*, 1962) Karnataka (Channabasavanna, 1951, Krishnamurthy and Appanna 1951, Usman and Puttarudraiah 1955), Maharashtra (Khan and Raodeo 1979) and Tamil Nadu (Cherian and Basheer 1942). Apart from infesting groundnut, it has been reported infesting soybean and lucerne from Madhya Pradesh and Punjab (Gujarati *et al.*, 1973, Gangrade, 1974 and Sandhu, 1978). Recently it has attained a status of serious pest of groundnut in Gujarat also. Since no information is available on its natural enemies in Gujarat, studies were undertaken in Anand during 1983 and 1984 and the results obtained are presented in this paper.

MATERIAL AND METHODS

Surveys were conducted in leafminer infested groundnut fields in and around Anand. Infested leaves were collected and held in the laboratory to study the emergence of parasites. The parasites reared, their period of activity and percentage parasitism are given in Table-1.

In order to study the impact of the naturally occurring parasites on *A. modicella* infestation, observations on the leaflet damage were recorded at fortnightly intervals in rainfed as well as irrigated crops.

TABLE 1

Parasites of groundnut leafminer, their intensity and period of activity at Anand (Gujarat).

Parasite	*Perod of activity*	*% Parasitism*	*Remarks*
Apanteles sp. *laevigatus* group	July-Oct.	1.02–27.27	Solitary, endoparasite
Bracon gelechiae	July-Oct.	0.01–50.00	Gregarious, ectoparasite
Chelonus sp.	July-Oct.	0.83– 2.22	Egg-larval, solitary parasite
Goniozus sp.	March-May July-Oct.	0.54–50.00	Gregarious, ectoparasite
Stenomesius japonicus	March-May July-Oct.	0.20–79.16	Solitary
Brachymeria sp.	July-Oct.	2.03– 6.38	Solitary
Elasmus sp.	April-May	9.90–13.64	Solitary
Idris sp.	April-May	Negligible	—
Unidentified hymenopteran	April-June	4.17–25.00	Internal solitary

RESULTS AND DISCUSSION

The survey revealed that larvae of *A. modicella* are parasitised by three braconids, *Bracon gelechiae* Ashm., *Apanteles* sp. *laevigatus* group and *Chelonus* sp., one bethylid, *Goniozus* sp. one eulophid, *Stenomesius japonicus* Ashm. and an unidentified hymenopteran. The pupae were parasitised by a chalcid, *Brachymeria* sp. The important species were *Apanteles* sp. *Goniozus* sp. and *Stenomesius japonicus*. The percentage parasitism by parasites varied from 1.02 to 27.27, 0.54 to 50.00 and 0.2 to 79.16 respectively. The percentage parasitism by *B. gelechiae*, *Chelonus* sp., *Brachymeria*, *Elasmus* and an unidentified hymenopteran varied from 0.01 to 50.00, 0.83 to 2.22, 2.03 to 6.38, 9.90 to 13.64 and 4.17 to 25.00 respectively. It was observed that all these parasites were active more or less simultaneously in the field.

The results presented in Table-2 show that the parasites were quite abundant in irrigated crop during 1983 season parasitising as many as 75% of the larvae. The impact of this high percentage parasitism permitted only 5.56% leaflet damage. Similarly, in the presence of parasites, the leafminer infestation was generally low in rainfed crop during 1983 (Table-3) where the maximum leaflet damage was 11.38% in the fourth week of August. In 1984 season, the irrigated crop was totally free from leafminer infestation. The pest, however, appeared in rainfed crop in the second week of August and could inflict only 4.20% leaflet damage. This was largely due to heavy mortality of *A. modicella* larvae by hymenopterous parasites which accounted for 47.66 to 89.70% parasitism. Other workers reported parasitism of *A. modicella* by no less than 25 hymenopterous parasites (Charian and Kalayasam, 1941; Cherian and Basheer, 1942; Krishnamurthy and Usman 1954; Subba Rao *et al.* 1965; Subba Rao and Sharma 1966; Atma Ram and Subba Rao 1967; Nayar *et al.* 1976; Khan and Raodeo 1978; Bhatnagar and Davies 1979). The information on the ecology of the parasites and quantitative data on their effectiveness was lacking. Only Khan and Raodeo (1978) from Maharashtra reported similar impact of 6 larval parasites on *A. modicella* infestation in ground-

TABLE 2

Extent of leaflet damage by *A. modicella* in irrigated groundnut in presence of its larval parasites during 1983.

Period of observation	*No. of larvae collected*	*% Parasitised by*				*Total*	*%*
		Goniozus	*Apanteles*	*S. japonicus*	*Others**	*Parasitism*	*Leaflet damage*
March IV Week	44	15.91	25.00	11.36	13.64	65.91	5.56
April II Week	48	50.00	0.00	25.00	0.00	75.00	0.00
April IV Week	16	31.25	18.75	0.00	25.00	75.00	0.00
May II Week	No infestation						

*1. *Bracon gelechiae*
2. *Elasmus* sp.
3. Unidentified hymenopteran

TABLE 3

Extent of leaflet damage by *A. modicella* in rainfed groundnut in presence of its larval parasites during 1983 and 1984.

Period of observation	*No. of larvae collected*	*% parasitised by*				*Total parasitism*	*% Leaflet* damage*
		Apanteles	*Goniozus*	*S. japonicus*	*Others*		
July IV WK	112	14.17	0.00	4.17	4.13	22.47	11.15
Aug. II WK	85	38.21	1.41	7.06	0.00	46.68	7.09
	(12)**	(16.66)	(16.66)	(50.00)	(0.00)	(83.32)	(0.30)
Aug. IV WK	110	27.27	0.00	10.90	2.72	40.89	11.38
	(120)	(2.22)	(0.83)	(79.16)	(7.49)	(89.70)	(2.26)
Sept. II WK	176	20.49	9.09	0.00	0.00	29.58	7.16
	(44)	(4.54)	(4.54)	(34.09)	(4.49)	(47.66)	(4.20)
Sept. IV WK	33	12.12	0.00	12.12	0.09	33.33	6.74

**Elasmus*, unidentified hymenopteran and *Bracon*.

**Figures in parenthesis indicate data collected during 1984.

nut. Ayyar (1963) reported that parasites are rarely effective as natural check against groundnut leafminer, however, our studies clearly show that parasites exerted appreciable check and did not allow the pest to build up pestiferous population to call for any chemical treatment. It is suggested that, when natural enemies are active, care should be taken to conserve them by all means. *Apanteles* sp. and *Stenomesius japonicus* merit trial introduction against groundnut leafminer in other areas where they are not available.

ACKNOWLEDGEMENT

The authors are thankful to the Indian Council of Agricultural Research for financing the project and the Director of Campus, Anand Zone for providing facilities.

REFERENCES

Atma Ram and Subba Rao, B. R. (1967). Descriptions of *Goniozus stomopterycis* n. sp. (Bethylidae : Hymenoptera) a primary larval parasite of *Stomopteryx nerteria* (Meyrick) in South India and a revised key to oriental species. *Bulletin of Entomology, Delhi* **8** (2): 73-78.

Ayyar, T. V. R. (1963). Handbook of Economic Entomology for south India Government Press Madras 516 pp.

Bhatnagar, V. S. & Davies, J. G. (1979). Arthropod endoparasitoids of insect pests (excluding *Heliothis* spp.) recorded at ICRISAT Centre, Andhra Pradesh, India, 1974-79. Cropping Entomology Progress Report-3 (1979) Pages 7-8. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru-India.

Channabasavanna, G. P. (1951). 'The surulpuchi' (leafminer) of groundnut. *Mysore Agricultural Journal* **26** : 67-68.

Channabasavanna, G. P. (1957). The groundnut leafminer and its control. Mysore Agricultural College Year Book (1956-57). pp. 123-124.

Cherian, M. G. & Kalayasam, M. S. (1941). Preliminary notes on the parasites of the spotted and the pink bollworms of cotton in Coimbatore. *Proceedings of the Indian Academy of Sciences Section B* **14**(6): 517-528.

Cherian, M. G. & Basheer, M. (1942). Studies on *Stomopteryx nerteria* Meyr. A pest of groundnut in the Madras Presidency. *The Madras Agricultural Journal* **30**: 379-381.

Gangrade, G. A. (1974). Insects of Soybean. Technical Bulletin Jawaharlal Nehru Krishi Vishwa Vidyalaya No. 24. 88 pp.

Gujarati, J. P., Kapoor, K. N. & Gangrade, G. A. (1973). Biology of Soybean leafminer *stomopteryx subsecivella* (Lepidoptera: Gelechiidae). *Entomologist* **106** (1323): 187-191.

Khan, M. I. & Raodeo, A. K. (1978). Importance of larval parasites in the control of *Stomopteryx subsecivella* Zeller. *Journal of Maharashtra Agricultural Universities* **3** (3): 261-263.

Khan, M. I. & Raodeo, A. K. (1979). Chemical control of groundnut laefminer (*Stomopteryx subsecivella* Zeller), a serious pest of groundnut and soybean. *Journal of Maharashtra Agricultural Universities* **4** (1): 116-117.

Krishnamurthy Rao, S., Rangacharulu, P. & Yesudar, T. (1962). Aerial spraying against surulpuchi (*Stomopteryx nerteria*) on summer irrigated groundnut. *The Andhra Agricultural Journal* (9): 202-206.

Krishnamurti, B. & Appanna, M. (1951). Occurrence, distribution and control of major insect pests of some important crops in Mysore. *Mysore Agricultural Journal* **27**: 1-23.

Krishnamurti, B. & Usman, S. (1954). Some insect parasites of economic importance noted in Mysore State. *Indian Journal of Entomology* **16**: 327-344.

Nayyar, K. K. Ananthakrishnan, T. N. & David, B. V. (1976). General and Applied Entomology–Tata McGraw Hill Publishing Co., 589 pp.

Reddy, D. B. (1978). Insect Pests, Diseases and Nematodes of Groundnut (*Arachis hypogaea*) recorded in the South-East Asia and Pacific Region. Technical Document No. 115. F.A.O. Plant Protection Committee for the South East Asia and Pacific Region. 9 pp.

Sandhu, G. S. (1978). Note on the incidence of *Stomopteryx subsecivella* (Zell). (Lepidoptera: Gelechiidae) on lucerne at Ludhiana. *The Indian Journal of Agricultural Sciences* **48** (1): 53-54.

Subba Rao, B. R., Kundu, G. G., Sharma, Y. K., Anand, R. K. & Rai, S. 1965. New records of parasites of groundnut leafminer, *Stompteryx nerteria* (Meyrick) (Gelechiidae : Lepidoptera). *Indian Journal of Entomology* **27**: 355-357.

Subba Rao, B. R. & Sharma, A. K. (1966). Two new species of parasites, reared from *Stomopteryx nerteria* (Meyrick) (Lepidoptera: Gelechiidae). *Indian Journal of Entomology* **28**: 299-304.

Usman, S. & Puttarudraiah, M. (1955). A list of insects of Mysore including mites. Department of Agriculture Mysore State Entomology Series Bulletin 16. 194 pp.

GAU Res. J. 1987, 13 (1) : 17-20

Agroclimatic Classification of Arid and Semi-arid Regions of Gujarat State on the Basis of Humid and Moist Periods

Vyas Pandey and R. R. Patel

Dryland Research Project, GAU, Sardar Krushinagar-385 506

ABSTRACT

The different agroclimatic parameters viz., moisture index, humid and moist periods were worked out for twenty stations of Gujarat State which fall under arid and semi-arid climate. Since humid period promotes vegetative growth and development of crops and moist period supports them, these two parameters were selected for subdividing the arid and semi-arid regions of Gujarat into four zones viz., A, B, C and D.

The zone 'A' has been found to be a very low crop potential area and farmers may find it difficult to raise crops under rainfed conditions. Short to medium duration crops may be grown in area 'B'. The zone 'C' is favourable for medium and drought resistant long duration crops under dry farming. The cropping season exceeds 100 days in the zone 'D' and, therefore, it may be favourable for long duration crops. However, two short duration crops may be successfully harvested by adjusting dates of sowing suitably.

(Received on 29th May, 1985)

INTRODUCTION

Heat and moisture are the vital determining factors for the natural plant growth while the energy and water budget largely set the pattern of vegetation. In tropical regions, the radiant energy assumed to be abundant for plant growth and precipitation becomes a dominant factor for successive change in vegetation.

More than 80 per cent of the area of Gujarat comes under arid and semi-arid regions where rainfall is generally less than 1000 mm. Only 15 per cent of the cultivated land is irrigated. It is, therefore, necessary to have the study of the climatic resources of the state so that the information evolved may be used for crop planning. A number of climatic classification methodologies based on rainfall, temperature and potential evapotranspiration have been developed by many scientists, (Koppen 1936, Thornthwaite and Mather 1955, Troll 1965, and Cocheme and Franquin 1967). Some of these methodologies have been applied to Indian Regions (Subramanyam *et. al.*, 1965; Krishnan, 1968 and Rao *et. al.* 1972). Biswas (1982) has classified dry farming tract of Gujarat state into four zones on the basis of optimum moisture availability index. The present study, aimed to classify the arid and semi-arid regions of Gujarat on the basis of humid

and moist periods, which promote and support, respectively, the vegetative growth and development in the plants, would be very much useful to agricultural scientists and farmers in crop planning.

MATERIAL AND METHODS

Weekly normals of rainfall were taken from daily accumulated normals of rainfall published by Indian Meteorological Department (IMD, 1965), whereas the weekly potential evapotranspiration (PET) values have been obtained by interpolating both in space and time from monthly values calculated by Rao *et al.* 1971. The moisture index has been determined by Thornthwaite and Mather's methodology. Humid period was defined as the period in which precipitation (P) exceeded the PET and moist period during which P lies in between PET and PET/2.

The following criteria were used for classifying the area.

Zone 'A' — Humid plus moist period for less than 60 days.

Zone 'B' — Humid period less than 60 days but humid plus moist period more than 60 days.

Zone 'C' — Humid period more than 60 days but less than 90 days.

Zone 'D' — Humid period more than 90 days.

RESULTS AND DISCUSSION

The different agro-meteorological parameters of twenty stations covering almost all areas of arid and semi-arid regions of Gujarat state have been presented in Table 1. On the basis of humid and moist periods, these stations were grouped into four zones. Within the same zone rainfall, PET and soil vary considerably; therefore, these zones have been discussed considering all these points together.

Zone 'A'

The zone 'A' comprises Bhuj, Rapar and Dwarka stations which cover most of Kutch district and a small part of Jamnagar district. The soil is mainly sandy except for some areas of medium black soils in and around Bhuj. The annual rainfall within this zone is less than 400 mm, whereas potential evapotranspiration is between 1700 mm to 1900 mm. This caused moisture index more than –80 per cent which characterized this area as extremely arid. The humid and moist period together does not exceed 60 days in this area and, therefore, it may be difficult to raise crops under rainfed conditions. However, pearl millet, sorghum and pulses like kidney bean and greengram may be grown in some parts of the zone.

Zone 'B'

This zone consists of Kandla, Radhanpur, Amreli, Veraval, Dhrangadhra and Dhoraji stations. These stations cover some south eastern part of Kutch, western part of Banaskantha and Mehsana districts and most of Surendranagar, Rajkot, Jamnagar, Junagadh and Amreli districts. The soil in the zone varies from sandy to coastal alluvial and medium black. Annual normal rainfall in the zone 'B' ranged between 400 mm to 600 mm. However, within this zone some patches of moderate rainfall of the order of 850 mm are found (IMD, 1962) in and around Junagadh and Girnar forest areas. The highest PET values have been found only in this zone (Rao *et al.*, 1971). Most of this zone falls under arid type climate and the moisture index ranged between -67 to -79 per cent.

TABLE 1

Different agroclimatic parameters at 20 stations of arid and semi-arid zones of Gujarat.

Climatic zones	*Stations*	*Rainfall mm*	*Potential evapotranspiration mm*	*Moisture Index %*	*Humid periods days*	*Moist periods days*	*Soil types*	*Climate type*
Zone 'A'	Bhuj	340.4	1896	–82.0	7	49	Medium black	Arid
	Dwaraka	358.3	1714	–79.1	21	35	Sandy	Arid
	Rapar	351.3	1862	–81.1	7	49	Sandy	Arid
B_1	Kandla	400.9	1896	–78.9	21	49	Sandy	Arid
	Radhanpur	433.0	1752	–75.3	42	35	Sandy	Arid
Zone 'B' B_2	Amreli	515.0	1901	–72.9	14	98	Medium black	Arid
	Dhrangdhra	507.8	1898	–73.2	35	49	Sandy to medium black	Arid
	Dhoraji	607.9	1854	–67.2	35	70	Medium black	Arid
	Veraval	526.2	1683	–68.7	42	56	Coastal alluvial	Arid
Zone 'C'	Deesa	622.5	1714	–63.7	70	14	Sandy	Semi-arid
	Patan	618.2	1725	–64.2	63	28	Sandy	Semi-arid
	Viramgam	586.6	1787	–67.2	63	28	Sandy loam	Arid
	Ahmedabad	782.8	1678	–53.3	84	14	Sandy loam	Semi-arid
	Lunawada	778.2	1591	–51.1	84	21	Medium black	Semi-arid
	Bhavnagar	663.6	1814	–63.4	77	21	Coastal alluvial	Semi-arid
Zone 'D'	Idar	974.0	1636	–40.5	98	14	Sandy to medium black	Semi-arid
	Dahod	810.4	1577	–48.6	98	14	Medium black	Semi-arid
	Baroda	916.6	1575	–41.8	98	7	Loamy	Semi-arid
	Broach	1000.2	1725	–41.9	98	21	Deep black	Semi-arid
	Surat	1071.1	1603	–33.2	105	14	Deep black	Semi-arid to dry subhumid

Although the humid periods are less than 60 days in the zone, the total periods (humid + moist) ranged from 70 days to 112 days indicating that there may be wide variations in the cropping pattern within this zone. Therefore, this zone can be further sub-divided into two sub zones. In the first zone 'B'_1, the soil is sandy and the crop growing season is found to be 60 to 80 days which may be favourable for short duration crops like pearl millet, sorghum and pulses only. The zone 'B'_2 in which soil is medium black and the total crop growing season is of about 100 days may be found suitable for medium duration crops like groundnut and cotton under rainfed conditions.

Zone 'C'

The most of the semi-arid areas are covered under this zone. This zone includes Deesa, Patan, Viramgam, Ahmeddabad, Lunawada and Bhavnagar stations. The districts covered under the zone are Banaskantha, Mehsana, Ahmedabad, Gandhinagar, Kaira, Bhavnagar and some eastern parts of Surendra-

nagar. Some western parts of Sabarkantha and Panchmahal districts are also covered under this zone. The annual rainfall ranged between 580 to 800 mm and potential evapotranspiration has been found ranging between 1600 to 1800 mm. The moisture indices were between -50 to -67 per cent. The soils are sandy, sandy loam, and black. The humid periods have been found between 60 to 90 days which indicate that the area has good potential for dry farming. Medium to short duration crops like pearl millet, sorghum, pluses, clusterbean, cotton, groundnut and drought resistant long duration crops like castor may be found suitable to this zone under rainfed conditions.

Zone 'D'

The fourth zone denoted as 'D' can also be called as "Transition zone" between semi-arid and dry sub-humid climate. The stations covered under this zone are Idar, Dahod, Baroda, Broach and Surat. The areas included are eastern half part of Sabarkantha and Panchmahal districts, western half part of Baroda and Broach districts, whereas only a small north-west part of Surat falls under this zone. The annual rainfalls in the zone ranged between 800 mm to about 1070 mm. Surat has been found at the boundary line of semi-arid and dry sub-humid climatic zone with moisture index value of -33.2 per cent. The soils are medium to deep black with high field capacity. The humid periods have been found more than 99 days indicating that the crop gowing prospect is very high in this region. During most of monsoon periods rainfall exceeded PET and thus generally caused soil moisture saturation and surplus water. Under these conditions maize crop in medium black soils and cotton, and paddy in the deep black soils may be found suitable. With suitable sowing adjustments, two short duration crops viz., pearl millet and pulses in *kharif* gram in *rabi* season can also be harvested under rainfed conditions. These areas may also be suitable for a long duration crop like pigeon pea.

REFERENCES

Anonymous, 1962. Annual normals of rainfall and rainy days. *Memoirs of India Meteorological Department, Pune*. **31**: (3).

Anonymous, 1965. Normals of daily accumulated rainfalls. Vol. 2, India Meteorological Department, Pune.

Biswas, B. C. 1982. Agroclimatic classification on the basis of moisture availability index and its application to dry farming tract of Gujarat. *Mausam* **33** (4): 665-76.

Gocheme, J. and P. Franquin, 1967. An agroclimatic survey of semi-arid area in Africa South of Sahara. W.M.O. tech. note no. 86. Geneva, Switzerland.

Koppen, W. 1936. Das geographische system der klimate. *In* Handbuche der klimatologil, eds. W. Koppen and R. Geiger. Vol. 1, Part C. Berlin, Germany.

Krishnan, A. 1968. Distribution of arid area. Proc. symp. of Arid zone, 21st Int. Geogr. Congress.

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

Rao, K. N. 1972. Agroclimatic classification of India. I.M.D. Monograph Agrimet no. 4.

Subramanyam, V. P., Subba Rao, S., and Subramaniam, A. R. 1965. Koppen and Thornthwaite climatic classification as applied to India. *Annals of Arid Zone* **4** (1): 46-55.

Thornthwaite, C. W. and Mather, J. R. 1955. The water budget. Water—the year book of Agriculture 1955. Washington, D.C. U.S. Department of Agriculture, pages 346-358.

Troll, C. 1965. Seasonal climates of the earth world maps of climatology, p. 28. Eds. E. Rodenwaldt and H. Jusatz, Berlin: Springer-verlag.

GAU Res. J. 1987. 13 (1) : 21-27

Agroclimatic Appraisal of Khedbrahma

Vyas Pandey and A. T. Patel

Dryland Research Project, GAU, Sardar Krushinagar

ABSTRACT

The different climatic and agroclimatic parameters of Khedbrahma have been studied for 18 years (1966-1983). The study revealed that the area falls under semi-arid climate with moisture index value of -52%. The coefficient of variability of annual rainfall has been found to be 43.2 per cent. Twenty-sixth standard week (June 25 to July 1) has been found to be the safe period for carrying out the *kharif*/Rainy-season sowing. It is found that it is possible to harvest sufficient amount of surplus water (201 mm) which can be recycled to crops at the time of water need. The study has also revealed that the agroclimatic parameters of the area are more suitable for growing 125 days duration crops. Further that this period can be extended reasonably upto 150 days by adjusting sowing dates suitably and recycling the available surplus water.

(Received on 28th Jan. 1986)

INTRODUCTION

Khedbrahma is a northern most taluka of Sabarkantha district of Gujarat State and lies at the latitude 24° N and longitude 73° 5° E, height above MSL 203.91 m. The taluka covers an area of about 846.2 sq. km. More than 67 per cent of total area of the district is under cultivation and out of that only 11.5 per cent is irrigated and the rest depends upon the rainfall. The average annual rainfall is 810 mm and varies from place to place between 740 to 975 mm. Sandy, alluvial and medium black soils are found in the district. The main crops grown in the district during *kharif* season are cotton, maize, groundnut, redgram and rice. The adoptability of these crops is mainly on the basis of soil, topography, rainfall and to some extent on the availability of irrigation facilities. Although the district receives quite a good amount of rainfall, due to the vagaries of monsoon, the heavy rains, the agricultural droughts and water scarcity often occur side by side. As per statistical atlas of Gujarat (1982) Khedbrahma has been declared scarcity area in five years during the decade 1965-1974, and thus it is prone to water scarcity. Therefore, there is need to study the climatic and agroclimatic parameters to facilitate agriculturists and planners for increasing crop production. The studies of Biswas (1982) and Virmani *et al.* (1982) give some information on rainfall probability and agroclimatic classification of Gujarat State. In these studies soil factor has not been taken into account. The present study aimed to study the agroclimatic parameters in detail considering the soil characteristics of the area.

MATERIAL AND METHODS

The daily rainfall data in respect of cotton research sub-centre Khedbrahma, Gujarat Agricultural University for 18 years (1966-1983) have been considered in the present study. The potential evapotranspiration values used in the analysis were determined using Penman's equation (Penman, 1948).

The available water capacity of the soil column representing the root zone of crops (upto 1 meter depth) was considered for the area based on the soil characteristics. The monthly and weekly water balance parameters were computed using Thornthwaite and Mather (1955) methodology in which the soil moisture storage (SMS) has been determined by using the formula.

$$SMS = AWC \times Exp. \left[\frac{Acc-(RF-PE)}{AWC}\right]$$

Where AWC is available water capacity of the soil, Acc—(RF-PE) is accumulated value of negative RF—PE, RF is rainfall, PE is potential evapotranspiration, Exp. is exponential term.

The mositure adequacy index (MAI) which has been defined as the ratio of actual evapotranspiration (AE) to PE has been used to define excellent $\left[\frac{AE}{} > 0.75\right]$ good $(0.75 > \frac{AE}{PE} > 0.50)$ poor $(0.50 > \frac{AE}{PE} > 0.25)$ and very poor $\left[0.25 < \frac{AE}{PE}\right]$ periods. Virmani (1975) has suggested a value of .25 as $\frac{AE}{PE}$ requirement during seeding. In the case of Khedbrahma this value seems to be inadequate and hence a moderate value of 0.4 has been selected for determining the starting of sowing periods.

RESULTS AND DISCUSSION

Climatic features :

The climatic water balance chart is shown in fig. 1 and the different parameters are given in Table-1. Khedbrahma recieves the annual rainfall of 774.5 mm out of which 94% is received during four months (June to September). The area falls under semi-arid climate with Thornthwaite moisture index of -52 % and varied between -23 to -74 per cent during the period under study. The coefficient of variation of annual rainfall is 31.6%. The C.V. per cent of monthly rainfall has been more than 100 during the off seasons and it is minimum in August (43.2%). Mean monthly rainfall is maximum in August (281 mm) however, the highest monthly rainfall of 525.3 mm was recorded during July 1977.

The potential evapotranspiration (PE) at Khedbrahma has been maximum during May (244 mm) followed by June (198 mm). A secondary maximum has been found in September. Atmospheric water need has been minimum (69 mm) during the month of December. The actual evapotranspiration (AE) which is the combined effect of RF and PE has been maximum and equal to PE during July. Soil moisture storage increase from July and reaches to field capacity in August. Thereafter, it decreased continuously. Water deficit is mainly during summer with peak value during May. During July and August there is no water deficit. The moisture adequacy index (AE/PE) more than 0.5 has been from June to November suggesting the water availability periods of six months. These values on monthly and annual basis give valuable information about march of different parameters with season and are useful as a

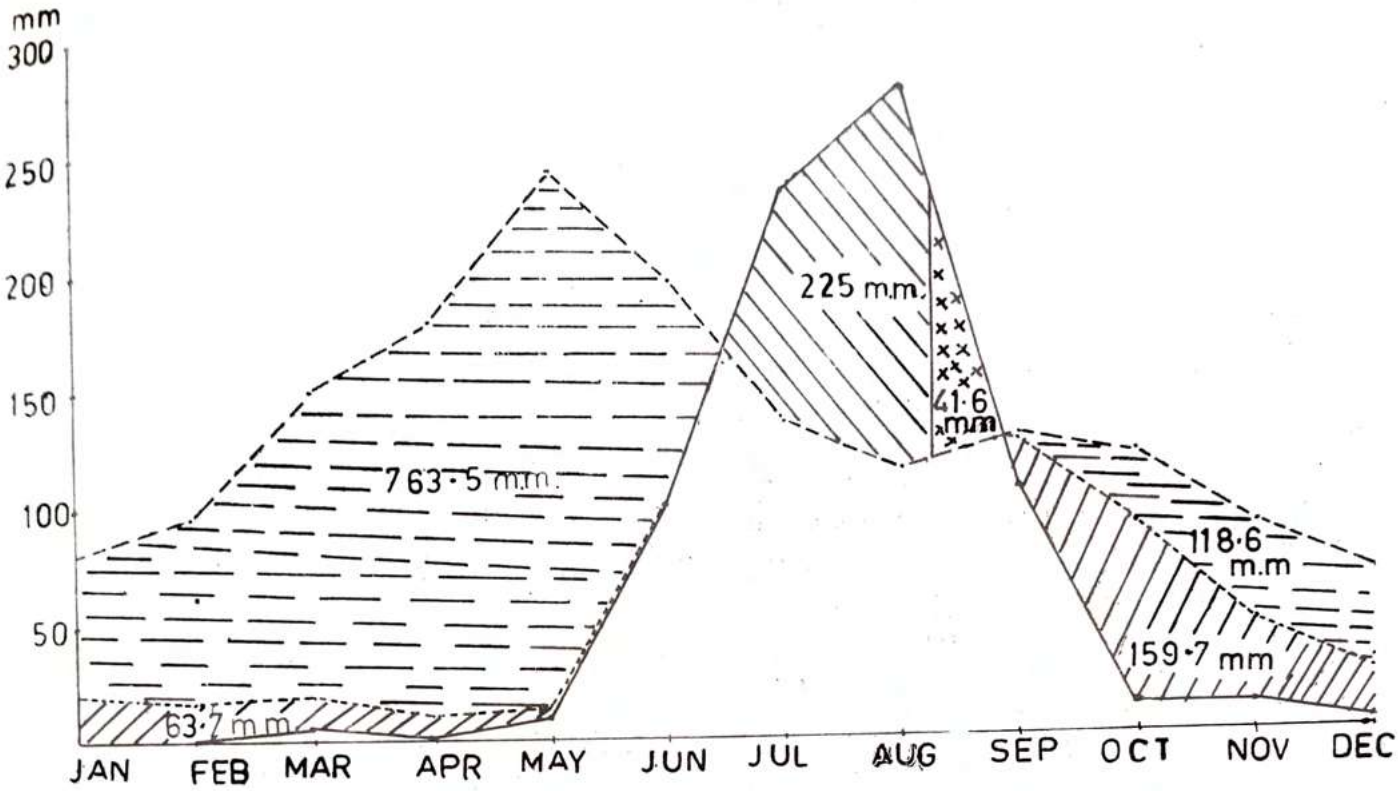


Fig 1 Climatic water balance of Khedbrahma.

Soil moisture recharge — Soil morsture utilization

Water surpius — Water deficit.

TABLE 1

Water budget parameters of Khedbrahma.

Months	*RF*	*PE*	*AE*	*SMS*	*WD*	*MAI*
January	1.0	81	20.5	45.8	60.5	0.25
February	1.5	96	17.2	30.1	78.8	0.18
March	5.4	150	19.7	15.8	130.3	0.13
April	1.7	180	10.3	7.2	169.7	0.06
May	9.1	244	13.8	2.5	230.2	0.06
June	103.1	198	104.0	1.6	94.0	0.53
July	237.4	137	137.0	102.0	0.0	1.00
August	280.6	116	116.0	225.0	0.0	1.00
September	107.6	131	129.8	202.8	1.2	0.99
October	11.8	123	90.9	123.7	32.1	0.74
November	11.7	90	48.1	87.3	41.9	0.53
December	3.6	69	25.6	65.3	43.4	0.32
Annual	774.5	1615	732.9	—	882.1	0.45

Where RF=Rainfall, PE=Potential Evapotranspiration, AE=Actual Evapotranspiration, SMS = Soil Moisture Storage at the end of the month, WD=Water Deficit, Values are in mm. MAI=Moisture adequacy index.

first hand information in hydrological and Agricultural planning (Subramanyam, 1982).

Agroclimatic features :

Sowing periods :

The successful sowings of different crops mainly depend upon sufficient rainfall and SMS.

Moisture availability index which takes into account both the parameters can therefore be used for deciding sowing periods.

The per cent chance of availability of MAI more than 0.4 is given in Table-2. It is found that the chances of availability of moisture for sowing are less than 17 per cent before 24th standard week. It is 33 per cent during 25th week (June-18-24). Twenty sixth and 27th standard weeks have 55 per cent chances of having MAI more than 0.4. Ninety five per cent chances have been found during 28th standard weeks. The results indicated that the sowing before 26th standard week (June 25) is very risky. It can be safely done during and after 26th std. week.

TABLE 2

Per cent chances of occurrence of MAI > 0.4 for sowing at Khedbrahma.

Std. Week	*Chance of occurrence of MAI > 0.4 in per cent*
23	11.1
24	16.7
25	33.3
26	55.5
27	55.5
28	94.5

Water balance parameters during cropping season :

Table-3 shows the different water balance parameters during cropping

TABLE 3

Agroclimatic parameters during 24th to 45th std. weeks.

Year	*RF*	*AE*	*SMS*	*WS*
1966	477.7	407.1	70.6	-
1967	672.4	441.1	86.0	142.3
1968	509.4	370.4	65.5	73.5
1969	543.0	415.0	79.3	48.7
1970	987.4	544.7	96.6	381.7
1971	540.0	454.2	85.8	-
1972	552.5	434.1	63.7	54.7
1973	1118.5	531.1	113.0	474.8
1974	358.0	282.1	75.9	-
1975	993.9	517.7	110.3	366.0
1976	931.5	434.2	76.7	420.6
1977	1199.3	541.2	77.5	580.6
1978	783.8	460.5	81.3	242.0
1979	526.5	415.5	55.1	55.9
1980	756.2	492.2	53.2	210.8
1981	799.0	527.5	151.0	172.3
1982	626.0	349.1	51.6	225.3
1983	713.8	473.4	71.9	168.5
Mean	727.2	449.5	81.4	201.0

Where RF, AE and SMS have their usual meanings and WS is water surplus in mm.

season of 22 weeks starting from 11th June to 11th November (24th to 45th std. weeks). The mean seasonal rainfall at the station was 727.2 mm with wide variation from year to year. Maximum (1199.3 mm) and minimum (358.0 mm) were recorded during 1977 and 1974 respectively. The mean AE during the cropping season was 449.5 mm and ranged between 282 to 545 mm.

The soil moisture storage (SMS) which is the important parameter of water balance studies indicated that about 13 per cent of rainfall remained in the soil at the end of 45th standard week. The third important parameter of water balance study is surplus water. The surplus water was found in as many as in 15 years with an average value of 201 mm. It was 28 per cent of its seasonal rainfall. This indicated that the area has good potential for water harvesting which can be recycled to crops at the time of water need.

Water availability periods:

The water availability periods of different types are given in Table 4. The water availability periods without stress conditions were mostly between 7 to 14 weeks with an average value of 11.3 weeks. Higher water availability periods were found between 2 to 5 weeks. No. of weeks with moderate stress conditions were more than that of slight stress and on average basis it was 4.3 weeks. The water availability with severe stress condition also ranged between 1 to 3 weeks

TABLE 4

No. of weeks of water availability periods with different MAI during 24th to 45th standard weeks.

Years	*No. of weeks of water availability periods*			
	Excellent	*Good*	*Poor*	*Very poor*
1966	7	5	9	1
1967	11	3	5	3
1968	9	3	7	3
1969	12	3	3	4
1970	14	5	2	1
1971	11	5	4	2
1972	10	5	5	2
1973	15	4	2	1
1974	5	2	9	6
1975	14	5	1	2
1976	11	4	4	3
1977	14	4	4	–
1978	13	3	4	2
1979	8	8	4	2
1980	12	4	5	1
1981	17	3	–	2
1982	7	4	6	5
1983	13	3	4	2
Mean	11.3	4.1	4.3	2.3

with one year (1974) experiencing the severe stress condition of 6 weeks during the cropping season.

Tables 3 and 4 altogether revealed that although rainfall during 1971 was only 549 mm, the crop growing season was of 16 weeks, whereas during 1967, 1969, 1972, 1976 and 1982 the rainfall was upto about 73 per cent more than that of 1971, the crop growing season was not more than 15 weeks. This revealed that it is the rainfall distribution which decides the length of crop growing seasons rather than total amount of rainfall.

The weekly distribution of MAI showed that 33 per cent of years experienced severe water stress conditions for at least one week before or one week after sowing. It is interesting to note that in such cases sowing rains had occurred before 25th std. week. The mean values of MAI in per cent for 24 weeks from 22nd to 45th standard weeks (May 28 to Nov. 11) are plotted in Fig. 2. The 50% MAI is considered to be good period for crop growth and development. The curve crosses the 50% level only after 26th std. week and continues to be above the level upto 43rd std. week and thus the total crop growing period at Khedbrahma is of 18 weeks. The moderate and severe moisture stress conditions are found before 25th and after 43rd std. weeks. This suggests that medium duration *kharif* crops of 125 days viz. maize, groundnut and cotton etc., may be grown under rainfed condition in the area.

It has already been stated that the area receives good amount of surplus water (about 200 mm), the same amount can be utilized for recycling it during the periods of crop water requirements. Since the atmospheric water demand during November and December is about 160 mm, the surplus water if stored suitably, will be sufficient to meet the water requirement of the crops for a period of atleast 30 days and therefore, crop growing periods can be increased upto 150 days.

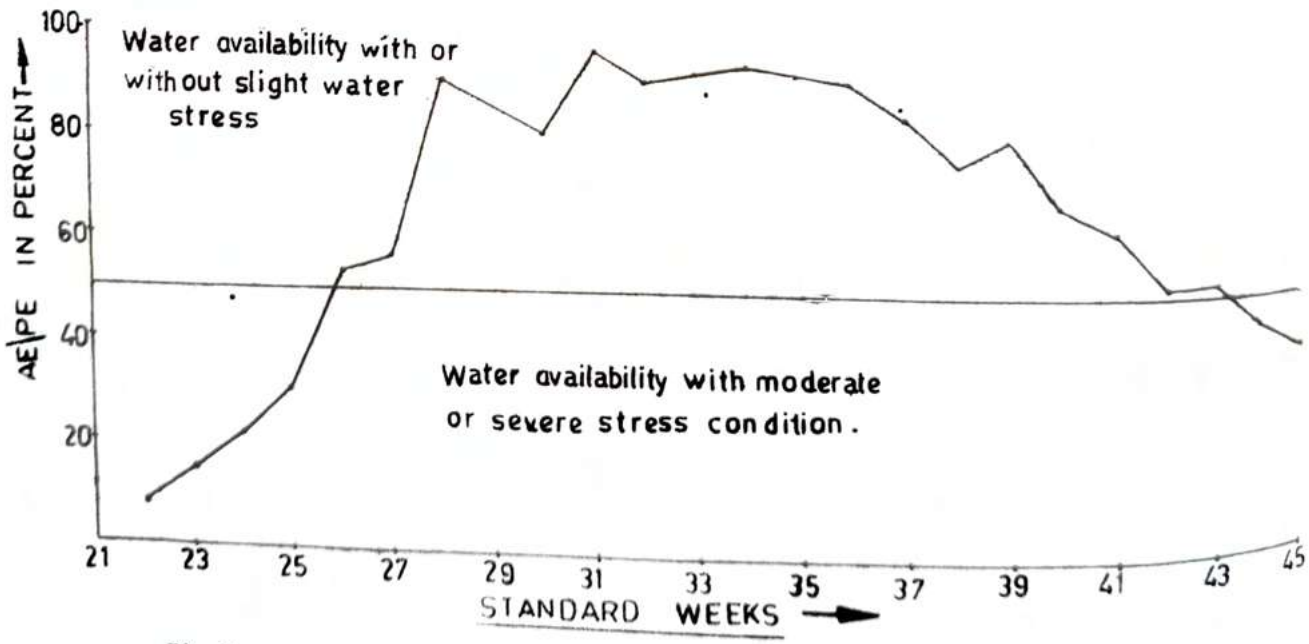


Fig 2 Mean water adequacy index at Khedbrahma during cropping season.

REFERENCES

Biswas, B. G. (1982). Agroclimatic classification on the basis of moisture availability index and its application to the dry farming tract of Gujarat. *Mausam* **33** (4), 465-476.

Penman, H. L. (1948). Natural evaporation from open water, bare soil and grass. Proc. Roy. Soc. London Sr. A 120-146.

Subrahmanyam, V. P. (1982). Water balance and its application Andhra University Press. Waltair, A.P.

Thornthwaite, C. W. and Mather, J. R. (1955). The water balance publication in climatology, N.J., U.S.A. Vol. 8, No. 1, 104.

Virmani, S. M. (1975). The Agriculture Climate of Hyderabad region in relation to agricultural planning. Tech. Bulletin ICRISAT, Hyderabad 54 pp.

Virmani, S. M., Sivakumar, MVK and Reddy S. J. (1982). Rainfall probability estimates for selected locations of Semi-arid India. 2nd enlarged edition. Research Report No. 1, ICRISAT, Patancheru, A.P.

GAU Res. J. 1987. 13 (1) : 28-30

Farm Mechanisation and Productivity in Farming

R. L. Sagar and G. L. Ray

Indian Veterinary Research Institute, Izatnagar-243 122

ABSTRACT

A study was conducted with 100 marginal, 75 small and 50 medium randomly selected farmers of 18 randomly selected villages in Haringhata block, Nadia district West Bengal. The level of farm mechanisation of the small and medium farmers were of the same order and were significantly higher than that of the marginal farmers. Correlation coefficients between farm mechanisation index and productivity in farming were found to be positive and significant in respect of small, medium and pooled sample of farmers.

Use of farm machinery not only saves human and animal labour but also ensures performance of various farm operations more efficiently and in time. Use of farm machinery may, therefore, lead to higher production of crops.

(*Received on 15th June, 1985*)

MATERIALS AND METHODS

Farm mechanisation : It was measured by farm mechanisation index developed by Samanta (1977). In this index 13 items such as tractor, power tiller, discharrow, cultivator, trailor, mould board plough (bullock drawn), seed drill, pumping set, wheelhoe, paddy weeder, duster, sprayer and thresher which were given weights varying from 3 to 1 according to their degree of contribution toward farm mechanisation. It was calculated for each individual farmer by the following formula.

$$\text{Farm Mechanisation Index} = \sum_{j=1}^{N} W_j \times t_j$$

Where,

W_j = weightage of the jth item,

t_j = total period in year of the jth item has been used, and

N = total number of item selected by a farmer.

Productivity in farming: It was measured by crop yield index formula developed by Yang (1980). For this purpose six principal crops of the area, i.e. Jute, Paddy (*aus*, *aman* and *bor*), Wheat, Potato, Pulses (gram, lentil, *mung*, *urid* and pea) and Oilseeds (*tori*, *rai* and *til*) were taken into consideration.

Area of study and selection of respondents: The study was conducted in Haringhata block of Nadia district, West Bengal. There are 9 Gram Panchayats in Haringhata block. From each gram panchayat 2 villages were selected at random on the basis of probability proportion to the number of households in villages. The farmers in each of the 18 selected villages were stratified into three categories-marginal (below 1 hac.), small (1-2 hac.) and medium (more than 2 hacs.).

A proportionate random sample was drawn from each of the three categories of farmers in such a way that there were at least two respondents from each category from each village and the size of sample was not less than 4 per cent of the population. In this way, 100 marginal, 75 small and 50 medium (total 225) respondents were selected which formed the sample of the study.

The data were collected from January to March, 1981.

RESULTS AND DISCUSSION

Level of farm mechanisation of the marginal, small and medium farmers:

The mean values of farm mechanisation indices of the marginal, small and medium farmers were found out. The significance of difference between the mean values of farm mechanisation indices were tested by analysis of variance and are presented in Table 1.

Table 1 indicated that the mean farm mechanisation scores of the marginal, small and medium farmers were 55.39, 88.92 and 91.20 respectively. The computed 'F' value was found to be significant at 1 per cent level. The critical differences indicated that the level of farm mechanisation of the small and medium farmers were of the same order and were significantly higher than that of the marginal farmers.

Relationship of farm mechanisation index with productivity in farming:

Zero-order correlation between farm mechanisation index and productivity in farming as measured by crop yield index were computed separately for the marginal, small, medium and pooled samples of farmers and are presented in Table 2.

It was revealed from Table 2 that no significant relationship between farm mechanisation index and productivity in farming was observed in case of marginal farmers. This may be because of their low level of use of farm machinery.

TABLE 1

Significance of difference in the mean values of farm mechanisation index of the marginal, small and medium farmers.

Variable	*Unit*	*Mean values*			*F Value*
		Marginal farmers (N=100)	*Small farmers (N=75)*	*Medium farmers (N=50)*	
Farm mechanisation index	Score	55.39	88.92	91.20	20.68**

**Significant at 1 per cent level.

Critical difference at 5%

Marginal Vs. Small	*Marginal Vs. Medium*	*Small Vs. Medium*
11.96	13.56	14.29

Note: Mean values of the same order (i.e. having no significance difference) have been underlined.

TABLE 2

Relationship of farm mechanisation index and productivity in farming of the marginal, small, medium & pooled sample of farmers.

Farmers categories	*Correlation Coefficient*
Marginal farmers (N = 100)	0.167 NS
Small farmers (N = 75)	0.891**
Medium farmers (N = 50)	0.958**
Poolld sample of farmers (N = 225)	0.423**

**Significant at 1 per cent level.
NS = Not significant.

The correlation coefficients between productivity in farming and farm mechanisation index of the small, medium and pooled sampic of farmers were, however, positive and significant at 1 per cent level.

REFERENCES

Samanta, R. K. (1977). A study of some Agro-Economic, Socio-Psychological and Communication Variables Associated with Repayment Behaviour of Agricultural Credit users of Nationalised Bank. Unpublished Ph.D. Thesis, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, West Bengal.

Yang, W. Y. (1980). Methods of Farm Management Investigation, F.A.O. Agricultural Development Paper No. 80, FAO, Rome.

GAU Res. J. 1987. 13 (1) : 31-40

Sheep Nutrition Survey in Banaskantha District

P. C. Shukla, H. B. Desai, M. C. Desai, L. P. Purohit, J. S. Patel and R. T. Dangarwala

Department of Animal Nutrition, GAU, Anand Campus, Anand-388 110

ABSTRACT

Sheep nutrition survey was carried out in randomly selected talukas and villages of Banaskantha district during different seasons (July-August, 1980; January-February, 1981 and May-June, 1981). During survey samples of feeds, fodders, vegetations, soils together with information on sheep husbandry practices followed in the region were collected. Most of the grasses, shrubs and vegetations were relatively low in Crude protein and phosphorus content in summer season than in those collected in monsoon and winter seasons. Majority of samples were found deficient in zinc. Therefore, there is a need for supplementations of zinc. The soil samples were also found to be deficient in zinc. Summer period was found to be the most critical period for grazing sheep.

(*Received on 14th June, 1985*)

INTRODUCTION

Banaskantha district is having arid and semi arid conditions and lies between 71° to 73° eastern longitude and 23° – 30′ to 24° – 30′ northern latitude. It is among one of the districts of Gujarat state with a larger population of sheep. The breed of sheep is predominantly Marwari. The sheep are mainly raised by shepherds or *Maldhari* community whose major source of income is from sheep. Sheep in this tract are mainly raised on grazing and no supplemental feeding is done even under period of greater demand of nutrients e.g. pregnancy and lactation. Therefore, it was thought to carry out survey work in this district to find out the nutritive value as well as trace mineral content of the vegetations grazed by sheep.

MATERIAL AND METHODS

Sheep nutrition survey in Banaskantha district of Gujarat state was carried out in six randomly selected talukas in three different seasons during 1980-81. From each taluka two to four villages were selected for survey work. The details of villages selected for survey work are given in Table 1.

During survey work information about common sheep husbandry practices were collected together with feeds, fodders (grasses & vegetations) and soil samples. The feeds and fodder samples were analysed for proximate composition following AOAC (1975) methods. Trace minerals (zinc, copper, manganese and iron) in feeds and fodders were determined by wet digestion technique using atomic absorption spectro-

TABLE 1

Villages visited in different seasons during sheep nutrition survey in Banaskantha district.

Taluka	*Season/Village*		
	Monsoon	**Winter**	**Summer**
Dhanera	S. K. Nagar	S. K. Nagar	S. K. Nagar
	Dharnodhar	Dharnodhar	Dharnodhar
	Pathawada	Pathawada	Pathawada
	Jorapura	—	—
Tharad	Naroli	Naroli	Naroli
	Duva	Duva	Duva
	Tharad	—	—
	Rah	—	—
Wav	Dhima	Dhima	Dhima
	Tithgam	Tithgam	Tithgam
	Wav	Suigam	Suigam
	Balutri	—	—
Danta	Kuwarsi	Kuwarsi	Kuwarsi
	Mandali	Mandali	Mandali
	Danta	Danta	Danta
Kankrej	Thara	—	—
	Nanata	—	—
Santalpur	Garamdi	—	—
	Gadha	—	—
	Varahi	—	—

photometer. Soil samples were analysed for above minerals with the help of atomic absorption spectrophotometer.

RESULTS AND DISCUSSION

Proximate composition of grasses and vegetation usually grazed by the sheep in waste and other lands is given in Table 2.

The grasses and shrubs (pasture grasses) had enough of Crude protein (11.75%) in monsoon season. It was intermediate (9.16%) in winter season which was marginal and during summer season the value of Crude protein was very low (5.97%). Therefore, summer period was a critical period as far as protein nutrition is concerned when sheep are maintained on grazing alone. During summer, grasses and shrubs were more fibrous and deficient in phosphorus. The ash and silica content were also higher in pasture grasses in all the seasons. However, they are adequate in calcium content. The other vegetations typical to semiarid region like *budo* (*Aerva javanica* (Burm. f) W & A), *dharo* (*Cynodon dactylon*), *Kharhania* plant (*Tephrosia pumila* (Lam) Pers), *Sangatro* (*Fagonia hetice*), *Ankada* leaves (*Calotropis gigantea*) showed similar seasonal trend in chemical composition especially for protein content. The leaves of *Arajia* (*Acacia leucopholea*), bamboo (*Bambusa arundinacea*), *bore* (*Zizypus nummularia* (Burm. f) W & A), *gundi* (*Cordia*

TABLE 2

Chemical composition (% on D.M. basis) of pasture grasses, shrubs, tree leaves and other fodders samples.

Name of sample	*Season*	*Crude Protein*	*Ether Ext.*	*Crude fibre*	*N.F.E.*	*Ash*	*Silica*	*P*	*Ca*
				Pasture Grasses and Shrubs					
Pasture grasses	M(24)	11.76	2.30	25.67	41.71	18.56	9.55	0.26	0.96
		±0.50	±0.14	±0.87	±1.12	±1.50	±1.19	±1.01	±0.06
	W(5)	9.16	2.90	21.58	52.73	13.63	9.03	0.20	0.66
		±2.06	±0.37	±2.66	±2.98	±1.92	±1.75	±0.03	±0.12
	S(4)	5.97	2.29	28.11	50.07	13.56	8.25	0.22	0.67
		±1.50	±0.16	±4.37	±2.63	±1.69	±1.09	±0.01	±0.17
	G.AV. (33)	10.66	2.39	25.34	44.39	17.22	9.31	0.25	0.87
		±0.60	±0.12	±0.92	±1.23	±1.20	±0.91	±0.01	±0.05
Budo(Aerva javanica (Burmf Juss.) (Flower & Stem)	W(4)	10.16	3.43	27.57	48.13	10.71	2.15	0.16	1.72
		±1.73	±0.23	±3.00	±1.27	±0.89	±0.50	±0.03	±0.11
Budo(Aerva javanica (Burmf Juss.) (Stems & Leaves)	S(3)	8.03	3.06	28.87	48.44	11.60	3.04	0.11	1.34
		±1.11	±0.15	±1.15	±5.03	±2.06	±1.10	±0.01	±0.71
Dabhado (Demostachya bipinnata, (Linn)Stapt.)	S(4)	3.84	2.22	38.45	47.02	8.47	3.74	0.07	0.66
		±0.11	±0.16	±3.59	±3.19	±1.17	±1.65	±0.01	±0.21
Dharo (Cynodon dactylon, (L) Pers.)	M(1)	11.50	1.47	29.33	47.29	10.41	4.91	0.21	0.41
	S(1)	5.39	2.33	27.05	53.95	11.28	5.90	0.22	0.48
G.Av. (2)		8.45	1.90	28.19	50.62	10.84	5.41	0.22	0.45
Kharhania plant (*Taphrosia pumila,* (Lam.)Pers.)	M(3)	22.66	3.74	22.72	41.13	10.15	0.90	0.34	2.22
		±0.26	±0.25	±0.32	±0.59	±0.46	±0.03	±0.01	±0.14
	W(1)	12.88	3.97	26.26	49.50	7.39	0.96	0.15	1.60
(Leaves and Tender Stem)	S(1)	14.50	4.20	21.02	45.75	14.53	1.65	0.21	4.46
G.Av. (5)		18.83	3.88	23.09	43.72	10.48	1.06	0.28	2.54
		±2.12	±0.16	±0.88	±1.73	±1.61	±0.15	±0.04	±0.50
Kanjaro (Digera muricata (L) Mert.)	M(1)	20.45	2.20	15.26	37.54	24.55	1.84	0.27	2.69
Kanti (Achyranthes aspera L.)	M(1)	14.67	2.42	27.27	39.45	16.19	1.10	0.23	3.91
Manso (Dactyloctenium aegyptium)	M(3)	12.22	2.01	29.61	43.07	13.09	2.67	0.23	1.07
		±2.14	±0.37	±2.51	±2.69	±0.79	±0.63	±0.02	±0.20

TABLE 2 (contd.)

Name of sample	Season	Crude Protein	Ether Ext.	Crude fibre	N.F.E.	Ash	Silica	P	Ca
Moras (*Suaeda nudiflora*, Mcg.)	W(1)	13.58	1.95	11.93	38.22	34.32	0.43	0.07	0.58
Sangatro (*Fagonia hetica*)	M(2)	9.41	2.20	41.22	40.46	6.71	0.66	0.12	1.31
	(W(6)	7.50	2.73	47.53	36.62	5.62	0.56	0.11	1.13
		±0.25	±0.11	±1.60	±1.47	±0.16	±0.09	±0.01	±0.07
	S(3)	6.73	4.54	44.60	37.96	6.17	0.33	0.15	1.30
		±0.18	±0.06	±2.49	±2.29	±0.44	±0.58	±0.03	±0.19
G.Av. (11)		6.63	3.13	45.59	37.68	5.97	0.51	0.12	1.21
		±0.32	±0.300	±1.27	±1.04	±0.19	±0.05	±0.01	±0.06
Shrubs and Tree Leaves									
Ankda leaves (*Calotropis gigantea*)	W(2)	8.60	7.84	10.44	55.07	18.05	2.84	0.18	3.31
	S(6)	7.29	9.45	12.75	46.47	24.04	2.49	0.20	4.25
		±0.52	±0.74	±1.18	±2.17	±1.37	±0.83	±0.06	±0.38
G.Av. (8)		7.61	9.05	12.17	48.62	22.55	2.49	0.20	4.01
		±0.75	±0.62	±1.06	±2.21	±1.54	±0.46	±0.05	±0.34
Aval leaves (*Cassia auraculata*)	S(1)	10.93	6.06	13.38	57.92	11.71	3.91	0.15	1.99
Arajia leaves (*Acacia leucopholea*)	S(1)	15.77	5.90	25.88	41.08	11.37	1.00	0.13	3.15
Bamboo leaves (*Bambusa arundinacea*)	S(1)	4.02	3.04	25.16	48.63	19.15	15.35	0.05	1.06
Bore leaves (*Zizyphus nummularia*, Burmf) W & A.	W(3)	12.68	6.21	15.97	55.24	9.90	1.37	0.16	2.82
		±0.14	±0.82	±3.00	±2.60	±0.17	±0.98	±0.00	±0.27
	S(1)	6.74	2.16	34.72	46.18	10.20	2.51	0.18	0.31
G.Av. (4)		11.19	5.20	20.66	52.97	9.98	1.65	0.17	2.70
		±1.49	±1.17	±5.14	±2.91	±0.14	±0.75	±0.005	±0.23
Gundi leaves (*Cordia perrottetii*)	W(1)	13.94	5.29	7.66	52.89	20.32	0.76	0.41	4.58
Kamboi leaves leaves (*Breynia retusa*)	W(2)	14.58	8.08	5.80	63.36	8.18	0.21	0.36	2.28
Kerdo (Stem and Leaves) (*Capparis decidua*)	S(4)	16.47	3.26	34.22	34.30	11.75	0.17	0.16	1.72
		±0.70	±0.17	±3.31	±2.22	±1.36	±0.05	±0.03	±0.028
Khijada leaves (*Prosopis cineraria*)	W(2)	15.00	5.25	15.84	53.55	10.36	1.15	0.28	3.09
Kothi leaves (*Limonia acidissima*)	W(1)	14.05	4.89	7.89	59.86	13.31	0.70	0.32	3.79

TABLE 2 (contd.)

Name of sample	*Season*	*Crude Protein*	*Ether Ext.*	*Crude fibre*	*N.F.E.*	*Ash*	*Silica*	*P*	*Ca*
	S(1)	20.48	2.19	12.77	54.58	9.98	0.18	0.18	2.62
G.Av: (2)		17.26	3.54	10.33	57.22	11.65	0.44	0.25	3.21
Neem leaves (*Azadirachta indica*, A Juss.)	S(1)	17.81	7.53	15.44	47.90	11.32	0.68	0.16	1.18
Pilludi leaves (*Perotri indica*, O.Koze)	S(5)	14.62 ± 8.84	2.80 ± 0.27	8.57 ± 0.41	35.14 ± 1.36	38.87 ± 0.57	0.53 ± 0.14	0.10 ± 0.02	10.45 ± 0.64
			Flowers & Pods						
Ankada flower (*Calotropis gigantea*)	W(2)	15.62	6.02	13.80	53.26	11.30	1.01	0.45	0.83
	S(1)	15.68	4.08	16.38	49.07	14.79	1.66	0.36	1.48
G.Av. (3)		15.64 ± 1.24	5.37 ± 0.69	14.66 ± 1.21	51.86 ± 1.42	12.47 ± 1.17	1.22 ± 0.25	0.42 ± 0.03	1.04 ± 0.25
Babul pods (*Deshi*) (*Acacia nilotica*)	M(1)	13.84	7.62	10.89	60.23	7.42	0.21	0.19	1.41
	S(1)	10.99	3.23	14.72	64.83	6.23	0.52	0.15	1.08
G.Av. (2)		12.41	5.43	12.80	62.53	6.83	0.37	0.17	1.25
Prosopis julifora pods	M(3)	15.77 ± 0.98	3.43 ± 0.50	23.19 ± 2.82	50.59 ± 2.99	7.12 ± 0.54	0.36 ± 0.13	0.24 ± 0.02	0.65 0.12
	W(5)	13.99 ± 0.28	4.18 ± 0.38	19.22 ± 0.78	57.27 ± 1.19	5.34 ± 0.22	0.24 ± 0.04	0.21 ± 0.02	0.47 0.05
	S(5)	13.29 ± 0.95	3.25 ± 0.19	23.63 ± 1.38	53.76 ± 1.67	6.07 ± 0.23	0.29 ± 0.05	0.16 ± 0.02	0.46 0.06
G.Av. (13)		14.04 ± 0.49	3.65 ± 0.22	21.83 ± 0.99	54.45 ± 1.22	6.03 ± 0.25	0.29 ± 0.04	0.20 ± 0.01	0.51 ± 0.04

M = Monsoon W = Winter S = Summer

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

perrottetii), *khijada* (*Prosopis cineraria*), *neem* (*Azadirachta indica*) etc. are lopped and fed to sheep during summer season. These leaves had usual range of composition. They are enough in protein and calcium except bamboo leaves which are deficient in protein.

The pods of *Prosopis juliflora* and *Acacia nilotica* are also eaten by sheep and have usual composition. The flowers of *Ankada* (*Calotropis gigantea*) shrubs which are also eaten during critical period of summer are having enough of protein, phosphorus and calcium.

Trace element contents in feeds and fodders:

The average values of zinc, manganese, copper and iron in feeds and fodders are given in Table 3.

The grasses and vegetations of waste land (pasture grasses) are adequate in manganese, copper and iron content. However, they are deficient in zinc considering the requirement value of 40 ppm given by N.R.C. (1975). The other vegetations and shrubs are also deficient in zinc but they have enough of other trace minerals.

TABLE 3

Trace element content in feed and fodder samples.

Name of sample	*Seasons*	*Zn ppm*	*Mn ppm*	*Cu ppm*	*Fe mg/100 g*
		Pasture Grasses and Shrubs			
Pasture grasses	M(25)	28.89 ± 1.41	109.89 ± 8.66	14.53 ± 1.04	140.29 ± 14.90
	W(7)	29.98 ± 4.69	93.48 ± 11.22	14.02 ± 1.64	117.74 ± 13.49
	S(4)	26.40 ± 4.50	81.11 ± 19.29	16.91 ± 1.69	78.76 ± 13.69
G.Av.	(36)	26.74 ± 1.40	103.25 ± 6.76	14.70 ± 0.80	129.01 ± 11.52
Bant grass (*Cenchrus catharticus*)	M(2)	16.96	79.54	11.27	88.07
Budo (flower and stem) (*Aerva javanica* (Burm.) f) Juss..	W(4)	10.20 ± 0.73	65.05 ± 6.99	10.86 ± 0.34	80.34 ± 14.32
Budo (Stem and leaves) (*Aerva javanica* (Burm.) f) Juss.	S(3)	9.80 ± 1.40	165.40 ± 13.03	15.17 ± 1.47	129.65 ± 14.51
Dabhado (*Demostachva bipinnata*, (Linn)Stapf.)	S(4)	6.60 ± 0.65	55.09 ± 13.71	11.17 ± 2.96	33.02 ± 3.19
Dharo (*Cynodon dactylon*, (L)Pers.)	M(1)	14.08	71.76	12.94	62.56
	S(1)	20.40	121.45	11.69	28.08
G.Av.	(2)	17.24	96.61	12.32	45.32
Kharhania plant (*Taphrosia pumila*, (Lam.) Pers.)	M(3)	11.95 ±0.77	82.06 ±3.34	11.97 ±0.85	39.14 ±5.45
	W(1)	11.40	128.29	13.78	27.04
	S(1)	12.72	117.98	5.85	72.15
G.Av.	(5)	11.99 ±0.47	98.51 ±10.37	11.11 ±1.44	43.32 ±8.15
Kanjaro (*Digera muricata* (L) Mert.)	M(3)	13.97 ±0.85	122.46 ±15.51	13.64 ±0.28	86.62 ±6.83
Kanti (*Achyranthes aspera* L.)	M(1)	11.52	30.30	11.69	57.75
Manso (*Dactyloctenium aegyptium*)	M(3)	13.01 ±3.49	117.42 ±20.86	10.29 ±0.91	60.32 ±21.73
Moras (*Suaeda mudiflora*, Meg.)	W(1)	8.40	78.08	12.11	39.52
Sangataro (*Fagonia hetice*)	M(2)	7.68	30.30	7.10	28.40

TABLE 3 (contd.)

Name of sample	*Season*	*Zn* ppm	*Mn* ppm	*Cu* ppm	*Fe* mg/100 g
	W(5)	8.40	18.74	9.27	23.30
		±0.50	±3.78	±0.40	±1.28
	S(3)	7.60	27.18	9.19	31.89
		±0.20	±6.04	±0.58	±7.62
G.Av.	(10)	8.02	23.58	8.81	26.90
		±0.27	±2.89	±0.40	±2.54
Shrubs and Tree Leaves					
***Ankada* leaves** (*Calotropis gigantea*)	W(2)	20.70	242.90	9.61	67.60
	S(7)	11.92	370.30	10.20	90.96
		±2.01	±47.02	±0.71	±70.01
G.Av.	(9)	13.87	341.98	10.07	85.77
		±2.11	±40.65	±0.56	±9.14
Arajia leaves (*Acacia leucopholea*)	S(1)	11.66	93.69	6.68	86.95
Bamboo leaves (*Bambusa arundinacea*)	S(1)	19.08	48.58	10.02	66.60
Bore leaves (*Zizyphus nummularia* (Burm.f) W & A)	W(4)	12.75	117.11	9.81	52.78
		±1.08	±17.71	±0.36	±4.27
	S(1)	9.01	62.42	10.42	52.73
G.Av.	(5)	11.94	106.17	9.85	52.77
		±1.09	±16.02	±0.28	±3.31
Gundi leaves (*Cordia perrottetii*)	W(1)	22.20	22.56	20.88	31.20
Kamboi leaves (*Breynia retusa*)	W(2)	26.10	293.22	15.45	40.56
Kerdo (stem and leaves) (*Capparis decidua*)	S(4)	14.23	46.84	11.38	21.84
		±3.73	±0.24	±0.69	±1.85
Khijda leaves (*Prosopis cineraria*)	W(3)	14.40	72.29	13.06	59.97
		±0.35	±30.72	±0.97	±14.88
Kothi leaves (*Limonia acidissima*)	W(1)	10.60	86.75	10.02	47.84
	S(1)	14.84	34.70	5.43	48.10
G. Av.	(2)	12.82	60.73	7.73	47.97
Neem leaves (*Azadirachta indica*, A. Juss.)	S(1)	10.60	34.70	8.35	71.23
Pilludi leaves (*Perotri indica*, O. Keze)	S(5)	9.31	60.72	9.19	39.14
		± 1.11	± 9.02	± 1.45	± 3.68

TABLE 3 (contd.)

Name of sample		Season	Zn ppm	Mn ppm	Cu ppm	Fe mg/100 g.
		Flowers and Pods				
Ankada flower		W(2)	27.00	81.55	9.81	63.52
(*Calotropis gigantea*)		S(1)	20.14	116.56	6.26	101.75
	G. Av.	(3)	24.71	93.22	8.63	77.60
			± 2.31	± 12.70	± 1.45	± 12.79
Babul pods (*Desi*)		M(1)	20.40	20.82	14.61	20.80
		S(1)	10.34	13.88	8.35	13.88
	G.Av.	(2)	15.37	17.35	11.48	17.34
Prosopis juliflora pods		M(4)	14.85	24.29	14.93	31.20
			± 0.51	± 1.23	± 0.62	± 4.55
		W(5)	11.52	13.88	7.93	16.64
			± 1.16	± 0.00	± 0.23	± 2.16
		S(5)	14.89	21.17	10.19	16.65
			± 0.90	± 2.35	±0.41	± 1.94
	G. Av.	(14)	13.68	19.46	10.74	20.80
			± 0.67	± 1.47	± 0.81	± 2.37

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

The range and the percentage of samples deficient or adequate in particular mineral in different class of grasses and vegetations are summarized in Table 4.

Most of the samples were found deficient in zinc. Recently zinc deficiency has been reported in many parts of our country by different workers (Sawhney and Bedi, 1972; Sawhney *et al.* 1973, 1977; Shukla *et al.* 1980, 1982; Desai *et al.* 1983). The results are quite comparable with their findings. Deficiency of copper was noted only in shrubs and tree leaves and of manganese in case of shrubs, flowers and pods. Iron content was adequate in all the samples.

Trace elements in soils:

Average and range of zinc, manganese, copper and iron content in soil samples are given in Table 5.

As with feeds and fodders, deficiency of zinc in soils in all the three seasons was encountered. Rest of the elements were found to be adequate in soil samples collected in all the seasons except 54% of samples were deficient in iron during monsoon. Even average zinc content was found below the threshold level in winter and summer. Zinc deficiency in soils of different parts of country have been reported by other authors, (Anonymous, 1976-77, Dangarwala *et al.*, 1983). It is suggested that zinc supplementations through feeds rich in zinc like rice polish, groundnut cake or through mineral mixture should be done to ration of sheep of this region.

TABLE 4

Range of trace elements and percentage of samples adequate or deficient during different seasons.

	Pasture grasses		*Other grasses*		*Shrubs*		*Tree leaves*		*Flower & pods*	
	Min.	*Max.*	*Min.*	*Max.*	*Min.*	*Max.*	*Min.*	*Max.*	*Min.*	*Max.*
					Zn (ppm)					
	9.6	49.2	4.80	22.48	6.60	24.60	6.60	22.20	8.40	27.60
Adequate (%)	14		—		—		—		—	
Deficient (%)	86		100		100		100		100	
					Mn (ppm)					
	41.66	227.27	29.49	115.29	10.41	537.85	20.82	131.86	5.50	116.56
Adequate (%)	100		100		91		100		61	
Deficient (%)	—		—		9		—		39	
					Cu (ppm)					
	7.10	28.39	7.93	20.04	6.68	17.95	5.43	20.88	6.26	16.28
Adequate (%)	100		100		93		82		96	
Deficient (%)	—		—		7		18		4	
					Fe mg/100 g					
	29.76	265.55	19.25	115.50	16.64	152.88	20.08	98.44	10.40	101.75
Adequate (%)	100		100		100		100		100	
Deficient (%)	—		—		—		—		—	

TABLE 5

Range of trace elements in soils in Banaskantha district.

Season	*No. of sample analysed*	*Contents (ppm)*			
		Zn	*Mn*	*Cu*	*Fe*
		Min Max	*Min Max*	*Min Max*	*Min Max*
Monsoon	(37)	0.23—4.23	4.4 —18.0	0.2— 1.9	3.0 —18.8
		(0.75±0.13)	(8.87 ± 0.54)	(0.53±0.05)	(6.50 ± 0.79)
Winter	(17)	0.05—0.85	4.6 — 19.4	0.31—0.78	7.3 —25.5
		(0.23±0.04)	(9.76 ± 0.99)	(0.55± 0.05)	(11.19 ± 1.05)
Summer	(15)	0.10—2.15	6.2 —19.2	0.29—2.47	6.9 —25.2
		(0.55±0.15)	(10.68 ± 1.07)	(0.80 ± 0.16)	(11.15 ± 1.26)

REFERENCES

Anonymous (1976-77). Annual Report of All India Coordinated Research Project on Micronutrients in soils and plants, GAU, Anand.

A.O.A.C. (1975) Official methods of Analysis of the Association of Analytical Chemist. 11th Edn. Benzamin Franklin Station. Washington, DC 20044.

Dangarwala, R. T., Trivedi, B. S., Patel, M. S. and Mehta, P. M. (1983). Micronutrients Research in Gujarat. Research Bulletin, Gujarat Agricultural University, Anand Campus, Anand.

Desai, H. B., Purohit, L. P., Desai, M. C., Patel, B. H. and Shukla, P. C. (1983). Animal Nutrition Survey in tribal area of Dang district. *GAU Res. J.* **8** (2): 102-110.

N.R.C. (1975). Nutrients requirements of Domestic Animals No. 5 Nutrient Requirements of sheep. Fifth Revised Edn. National Academy of Sciences. Washington D.C.

Sawhney, P. C., and Bedi, S. P. S. (1972). Trace element content of hill feeds and fodders 1. Fodder of Kumaon range (District Nainital (U.P.). *Indian J. Anim. Sci* **42**: 72-75.

Sawhney, P. C., Bedi, S. P. S. and Khan, S. A. (1973). A note on the content of feeds and fodders of Kumaon range (District Almora, U.P.). *Indian J. Anim. Sci.* **42**: 72-75.

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

Shukla, P. C., Desai, H. B., Pande, M. B. and Patel, B. H. (1980). Proximate and trace element content of roughages of Surat district. *Gujvet.* **10** (12).

Shukla, P. C., Desai, H. B., Pande, M. B., Purohit, L. P. and Patel, B. M. (1982). Note on proximate and trace element content of some samples of cattle feeds of Mehsana district. *GAU Res. J.* **7** (2): 127-129.

GAU Res. J. 1987. 13 (1) : 41-44

Border Effect in Jassids Count of an Insecticidal Trial of Hybrid-4 Cotton*

N. K. Patel and T. J. Khatri

Gujarat Agricultural University, Navsari Campus, Navsari-396 450

ABSTRACT

An experiment with ten treatment combination of (i) number of border row(s) (no border, one, two, three and four border rows) on either side of the net plot and (ii) spraying levels (no spraying and recommended spraying) was conducted in a randomized block design with three replications on hybrid-4 cotton at college farm of N. M. College of Agriculture, Gujarat Agricultural University, Navsari, to assess the border effect in Jassids count in an insecticidal trial. The results lead to the conclusion that three border rows on either side of the net plot are necessary to eliminate border influence for unbiased estimate of Jassids count in an insecticidal trial.

(*Received on 1st Sept., 1986*)

INTRODUCTION

The large variation in the treatments of the adjacent plots (e.g. spraying of insecticides and no spraying of insecticides) is likely to cause inter-plot competition affecting treatment means (Federer, 1974). The treatment effects obtained from such experiments are not free from border effect. It inflates the error estimate by increasing heterogeneity among plots. (Hutchinson and Panse, 1935). Multiple row plots with the centre rows for the estimation of yield are generally adopted in field trials to eliminate inter-plot competition component of variance from the experimental error variance.

Muller (1953) studied the invading flight of aphids and concluded that in crops threatened by aphid attack, paths between rows should be largely avoided in order to eliminate the peripheral infestation also on the inside edges. Jassids with similar migratory behaviour is expected to cause inter-plot competition affecting treatment means in insecticidal trial.

The elimination of inter-plot competition is accomplished by leaving non-experimental margin (border area) around net plot. The size (width) of margin usually varies with the kind of crop and nature of treatment. The present investigation on hybrid-4 cotton was, therefore, undertaken to determine the width of the border area (rows) to be provided around net plot, in an insecticidal trial.

MATERIAL AND METHODS

Ten treatment combinations of number of border rows viz., b_0-No bor-

der, b_1-One border, b_2-Two border, b_3-Three border and b_4-Four border rows on either side of the net plot and insecticidal treatments viz., s_0-No spraying of insecticides and s_1-Spraying of insecticides recommended by the department of Entomology, N. M. College of Agriculture, Navsari were studied in a randomized block design with three replications.

From each row randomly two plants were selected and tagged. Three leaves viz., top, middle and lower from each tagged plant were selected and tagged. The influence of border effect was measured by recording jassids population on each tagged leaf before spraying and 24 hours after spraying.

Statistical : The border rows on either side of a plot might be affected by the adjacent plots. The difference in performance of the border row as compared to corresponding net row or row adjacent to border row is an indication of the border effect. If there were no border effect for a given treatment(s) the estimates available should not differ significantly.

Let $\bar{d}_{ij}$ be the difference between the mean performance of border and net rows (or first row adjacent to border row) on ith side of the jth treatment, i.e. $\bar{d}_{ij}' = \bar{S}_{ij}' - \bar{S}_{ij}$

Where

$\bar{S}_{ij}'$ = average performance due to jth treatment in border row on ith side of the plot

$\bar{S}_{ij}$ = average performance due to jth treatment in net row (or first row adjacent to border row) on ith side of the plot.

The border effect for ith side was tested by paired t-test.

RESULTS AND DISCUSSION

The difference in jassids population of the border row as compared to the corresponding row adjacent to border row was tested by paired 't' test. Such two t-values, one for side-1 and second for side-2 were obtained except b_0s_0 and b_0s_1 treatments. The average performance of two border rows of each treatment was also compared with the average performance of the net rows. Thus three t-values (side-1, side-2 and overall) were worked out for each treatment to assess border effect in an insecticidal trial.

The population of jassids per plant for border and net rows of eight treatments (except b_0s_0 and b_0s_1 treatments) alongwith t-values are presented in Table 1.

The examination of results (Table 1) revealed that the treatment involving S_1 level of insecticidal spray had all positive t-values for side-1, side-2 and overall and vice-versa for S_0 level of insecticidal spray barring side-1 of b_2s_0 and b_3s_0. This is because jassids population in border rows of sprayed plots (S_1) was increased while decreased in non-sprayed plots (S_0) for same rows due to the migration of jassids from non-sprayed plots to the sprayed plots. Schheider (1962) also noticed that the aphids moved towards most favoured feeding sites or dispersed from over crowded position to new ones.

The results further reveal that the overall 't' values for b_1s_1, b_2s_1, b_3s_1 are positive and significant which indicate that the jassids population of the border rows of sprayed plot has increased and this effect of increase can be seen upto b_3s_1 i.e. upto three border. Individually side-1 and side-2 could show border effect, but has not reached to significant level except side-1 of b_2s_1.

TABLE 1

The treatmentwise population of jassids for border and net rows alongwith t-values.

Treatment		*JASSIDS*		
		Border row	*Net row*	*t-value*
b_1s_0	Side-1	91.17	121.83	–2.587
	Side-2	112.83	129.50	–0.863
	Overall	102.00	125.66	–5.856*
b_1s_1	Side-1	15.00	5.50	2.106
	Side-2	11.83	5.83	0.770
	Overall	13.42	5.66	4.556*
b_2s_0	Side-1	128.75	124.00	0.895
	Side-2	118.42	125.17	–0.481
	Overall	123.58	124.58	–0.192
b_2s_1	Side-1	16.58	4.83	41.080*
	Side-2	4.42	4.00	0.472
	Overall	10.50	4.42	19.785*
b_3s_0	Side-1	127.78	121.50	1.953
	Side-2	114.11	125.00	–1.391
	Overall	120.94	123.25	–0.544
b_3s_1	Side-1	6.66	3.50	1.330
	Side-2	6.99	4.83	1.428
	Overall	6.83	4.17	5.393*
b_4s_0	Side-1	116.46	127.17	–2.026
	Side-2	120.30	129.33	–1.163
	Overall	118.42	128.25	–7.457*
b_4s_1	Side-1	6.21	5.17	0.881
	Side-2	6.00	5.00	7.142*
	Overall	6.10	5.08	1.913

*P=0.05

The jassids population data were further examine in details for the following combination of the adjacent plots to study migratory movement of the jassids and presented in Table 2.

(1) Sprayed plot adjacent to non-sprayed plot

(2) Non-sprayed plot adjacent to sprayed plot

(3) Sprayed plot adjacent to sprayed plot

(4) Non-sprayed plot adjacent to non-sprayed plot

The results revealed that differences between border row and first row for jassids population was significant in two combinations viz., sprayed plot adjacent to non-sprayed and non-sprayed plot adjacent to sprayed plot. Whereas such differences were not significant for next two combinations viz., sprayed plot adjacent to sprayed plot and non-sprayed plot adjacent to non-sprayed plot.

This implies that jassids from non-sprayed plots moved towards sprayed plots. The sprayed plots have most favoured feeding site and less crowding of

TABLE 2

The populations of jassids per plant for border and first row adjacent to border row (first row) of four combinations of sprayed and non-sprayed plots alongwith t-values.

Sr. No.	*Combinations*	*Row*	*Jassids*
1.	Sprayed plot adjacent to non-sprayed plot	Border row	13.88
		First row	5.21
		t	4.565*
2.	Non-sprayed plot adjacent to sprayed plot	Border row	104.66
		First row	126.42
		t	−3.986*
3.	Sprayed plot adjacent to sprayed plot	Border row	4.64
		First row	4.45
		t	0.425
4.	Non-sprayed plot adjacent to non-sprayed plot	Border row	126.75
		First row	121.94
		t	2.019

*P=0.05

jassids due to insecticidal spraying. Muller (1953) indicated the need for a border area around the experimental plots to check the aphid migration. The jassids with similar migratory behaviour also cause corresponding similar inter-plot competition. Thus results lead to the conclusion that three border rows on either side of the net plot are required to eliminate the border influence for unbiased estimate of jassids count in an insecticidal trial on cotton.

REFERENCES

Federer, W. T. (1974). Expt. Design Theory and Application 2nd Ed. Oxford and IBM Publishing Co., Calcutta.

Hatchinson, J. B. and Panse, V. G. (1935). Studies in the technique of field experiments (in a study of Margin effect in variety trials with cotton and wheat) *Ind. J. Agric. Sci.* 5 (6): 671-692.

Muller, H. J. (1953). Der Blattlausbetallsflug in Bereicheines, Acker bohnen und kartoffelbestandes. Beitrage, Entomologie Ed. Nc. 3.

Schheider F. (1962). "Dispersal and Migration" Annual Review of Entomol. 7: 223-242.

Short Communications

Note on a Rapid Method of Determining Leaf Area in Elephants' Foot Corm (*Amorphophallus campanulatus* Blume)

B. M. Patel and H. M. Mehta

Department of Agronomy, B. A. College of Agriculture, GAU, Anand Campus, Anand

Measuring whole leaf of elephant foot plant is obviously laborious as it is long petioled simple three lobed leaf. In order to eliminate this laborious and time-consuming method for leaf measurement, it was felt that any alternative method, if available, would be very useful in measuring leaf area. With this view in mind an alternative method for the purpose of leaf measurement is suggested. When elephant foot plant was found to reach near maturity stage, the leaf area was measured.

One plant was selected for the planimeter observations randomly from each plot. The selected leaf was traced on a graph paper and the reading of the whole leaf area and lobe-wise leaf area (cm^2) was recorded. Thus, the readings were, total leaf area of the plant (Y) and lobe-1, X_1, lobe-2, X_2 and lobe-3, X_3 which were recorded, following the method used by Tejwani (1957) for tobacco leaf area.

TABLE 1

Relation between measured leaf area (Y) and calculated leaf area (X) using lobe-wise leaf area of elephant foot plant.

Sr. No.	*Prediction through*	*Regression equation* $Y=a+b\ X$	*'r'*
1.	Leaf area of 1st lobe (X_1)	$Y=5516.06+0.4439\ X_1$	0.97**
2.	Leaf area of 2nd lobe (X_2)	$Y=2685.68+1.7931\ X_2$	0.94**
3.	Leaf area of 3rd lobe (X_3)	$Y=484.42+2.81\ X_3$	0.93**
4.	Mean leaf area of three lobes (X)	$Y=83.20+2.96\ X$	0.99**

**Indicates highly significant value at 1% level of probability.

The results presented in Table 1 revealed that the total leaf area could be predicted by measuring leaf area of any one of the three lobes to a fair degree of accuracy because the 'r' values obtained indicated significantly high correlation (0.93 to 0.97) between the total leaf area and leaf area of a lobe as the leaf is divided into three lobes but lamina is continuous and this method required less labour.

(Received on 20th Aug. 1985)

REFERENCE

Tejwani, K. G., K. Ramkrishna and K. V. Venkatram. 1957. Measurement of leaf area of tobacco. *Indian J. Agron.* **2** (1): 35-39.

GAU Res. J. 1987. 13 (1) : 46-47

Effect of Farm Yard Manure, Spacings and Nitrogen Application on Chemical Constituents of Elephant Foot Corm (*Amorphophallus campanulatus* Blume)

B. M. Patel and H. M. Mehta

Department of Agronomy, B. A. College of Agriculture, GAU. Anand Campus, Anand

A field experiment was conducted on the College Agronomy Farm of Gujarat Agricultural University, Anand during the *kharif* season of 1980-81 to study the effect of farm yard manure, spacing and nitrogen on nitrogen, phosphorus, potassium starch and silica content (%) and uptake (kg/ha) by elephant foot corm. The treatments consisting of all combinations of two levels of farm yard manure (0, 30 t/ha), three levels of spacing (60 cm x 90 cm, 90 cm x 90 cm and 120 cm x 90 cm) and four levels of nitrogen (0, 50, 100 and 150 kg N/ha) were tested in split plot design with four replications. Entire dose of farm yard manure and P_2O_5 (SSP) with half the dose of nitrogen was given manually in pits 30 cm x 30 cm x 30 cm before planting of corm. Remaining half dose of nitrogen was top-dressed in two equal splits (25% and 25%) around the plant after 95 and 123 days of planting the crop. The soil of the experimental plot was deep, alluvial and well drained loamy sand locally known as *goradu* soil.

Data presented in Table 1 indicated that nitrogen content did not show any effect of farm yard manure. Nitrogen content of corm showed higher value by 8.49% at wider spacing of 120 cm x 90 cm, however, uptake was increased by 32.80 per cent over narrow spacing of 60 cm x 90 cm. Significantly higher nitrogen content was noticed at 50 kg nitrogen application over no application. However, the highest uptake was observed at 150 kg nitrogen. The results indicated that as such the crop was very exhaustive using very high amount of nitrogen.

Application of 30 t F.Y.M. increased 17.27% higher phosphorus uptake over no application. Effect of spacing was absent on phosphorus content of corm but uptake increased by 19.10 and 38.59% in 60 cm x 90 cm sepacing over 90 cm x 90 cm and 120 cm x 90 cm spacing respectively. Application of nitrogen at the rate of 150 kg showed increased phosphorus content by 2.5 per cent compared to 50 kg application. As far as uptake was concerned there was a decreasing trend with decreasing nitrogen levels.

Application of 30 t F.Y.M./ha increased potassium content as well as uptake appreciably. The content was increased by 4.25%. As regard the effect of spacing on potassium content and its uptake, it was noticed that narrow spacing of 60 cm x 90 cm increased both its content and uptake. Data revealed that at 150 kg nitrogen application potassium content and uptake was increased by 2.10 and uptake by 10.76%. It was evident from the results that high amount

TABLE 1

Mean corm yield, nitrogen, phosphorus, potassium, starch and silica content (%) and uptake (kg/ha) by elephant foot corm.

Treatments	*Corm yield (kg/ha)*	*Nitrogen*	*Phosphorus*	*Potassium*	*Starch*	*Silica*
F.Y.M.(t/ha)						
0	31815	1.09	1.04	2.35	58.14	3.03
		(361.41)	(378.34)	(785.87)		
30	36731	1.31	1.34	2.45	58.79	3.31
		(411.29)	(443.69)	(893.01)		
C.D. at 5%	391.69	N.S.	0.58	0.05	N.S.	0.20
		(15.11)	(20.82)	(10.59)		
Spacing(cm)						
60 x 90	40138	1.06	1.19	2.44	58.20	3.29
		(433.55)	(481.43)	(1005.54)		
90 x 90	33694	1.11	1.19	2.39	58.12	3.26
		(399.17)	(404.23)	(809.77)		
120 x 90	28988	1.15	1.19	2.37	59.08	2.95
		(326.31)	(347.38)	(703.01)		
C.D. at 5%	616.34	0.06	N.S.	0.03	0.68	N.S.
		(28.45)	(18.52)	(29.66)		
Nitrogen(kg/ha)						
0	33243	1.05	1.20	2.38	57.96	3.18
		(353.17)	(383.71)	(781.34)		
50	34006	1.13	1.16	2.40	58.34	3.00
		(394.89)	(408.82)	(859.33)		
100	34446	1.11	1.23	2.40	58.75	3.26
		(389.20)	(425.44)	(851.67)		
150	35397	1.12	1.18	2.43	58.80	3.24
		(408.13)	(426.08)	(865.32)		
C.D. at 5%	711.69	0.06	0.05	0.03	0.79	N.S.
		(32.86)	(21.38)	(34.25)		

Figures in parenthesis are of uptake and expressed in kg/ha.

of potassium was utilized which indicates that critical assessment for the potash requirement may be ascertained.

The starch content at 120 cm x 90 cm spacing was found significantly higher as compared with 90 cm x 90 cm. Similarly it was significantly higher at 150 kg nitrogen dose as compared with no nitrogen application. Application of 30 t F.Y.M. increased silica content by 9.24% in corm over no F.Y.M. application. No remarkable differences due to silica content in corms were observed as a result of different levels of spacing and nitrogen.

(*Received on 4th Nov. 1985*)

GAU Res. J. 1987. 13 (1) : 48-49

Influence of Spacing, Sowing Time and Fertility Levels on Yield of Wheat under Irrigated Condition of South Gujarat

P. G. Patel*, B. P. Patel and B. D. Patel

Department of Agronomy, N. M. College of Agriculture, GAU, Navsari

A field experiment consisting of combination of three dates of sowing (15th Nov., 30th Nov. and 15th Dec.) and three row spacings (20, 25 and 30 cm) as main plot treatments and three fertility levels (50 + 25, 100 + 50 and 150 + 75 kg N + P_2O_5/ha) as sub-plot treatments was laid out in split plot design with three replications during *rabi* season of 1980-81 at Navsari. The soil of the experimental field was clayey with pH 7.8, total nitrogen 0.04%, available phosphorus 28.3 kg/ha and available potash 141 kg/ha. The full dose of phosphorus and potash and 50% of nitrogen was drilled in the rows as per treatments. The remaining 50% nitrogen was topdressed at 22nd day of sowing (CRI stage). The soures of nitrogen, phosphorus and potash were urea, single super phosphate and muriate of potash. The sowing was done manually in previously opened furrows using 100 kg seeds/ha for each spacing. First irrigation was given on 22nd day of sowing (CRI stage). In all six irrigations were given. The experiment was sown with wheat variety "LOK-1".

TABLE 1

Grain yield of wheat (kg/ha) as influenced by sowing time, spacing and fertility levels.

Treatment	*Grain yield (kg/ha)*
Sowing dates	
15th November	3663
30th November	3029
15th December	2934
S.Em. ±	74
C.D. @5%	218
C.V. %	11.0
Spacings	
20 cm	3191
25 cm	3226
30 cm	3211
S.Em. ±	74
C.D. @5%	N.S.
C.V. %	11.0
Fertility levels ($N + P_2O_5$ kg/ha)	
50 + 25	2819
100 + 50	3287
150 + 75	3521
S.Em. ±	46
C.D. @5%	131
C.V. %	7.0

N.S. = Not significant

Sowing dates had significant influence on grain yield of wheat. Wheat sown on 15th November registered the maximum grain yield of 3663 kg/ha which was significantly higher over rest of the sowing dates. Delaying sowing by

*Present Address: Associate Research Scientist (Agronomy), Gujarat Agricultural University, Surat 395 007.

15 to 30 days after 15th of November resulted in reduction in yield. Shekhawat *et al.* (1975) also obtained higher yield of wheat sown on 15th November. Higher grain yield in case of earlier sowing may be attributed to the availability of optimum temperature (14.5° to 18.8° c) for the germination of seeds at sowing and crop growth. These results are in line with those reported by Singh *et al.* (1971) and Mehta and Mathur (1972). The grain yield was reduced as sowing was delayed because the temperature conditions at the time of grain filling and development are very crucial for wheat yield. It has been reported that the temperature above 28° c during the period tended to decrease grain weight and yield (Anon., 1977). The extremely high temperature (29.7° to 34.6° c) which prevailed during the heading and flowering for the late sown crop hampered the grain yield. Purusothaman *et al.* (1979) also reported reduction in wheat yield when temperature at flowering and heading was higher.

Different row spacings had no significant influence on wheat yield, indicating that 20 cm row spacing was optimum for wheat. These results are in agreement with those reported by Dhillon *et al.* (1979).

Application of 150 N+75 P_2O_5 kg/ha recorded significantly higher grain yield of 3521 kg/ha than rest of the fertility levels. These results are in agreement with those reported by Shekhawat *et al.* (1975).

The increase in yield was to the tune of 702 (19.9%) and 234 (6.6%) kg/ha than 50 + 25 and 100 + 50, N + P_2O_5 kg/ha, respectively.

None of the interactions for grain yield was significant.

(Received on 24th Janu. 1986)

REFERENCES

Anonymous. (1977) Wheat. The Fertilizer Association of India. New Delhi.

Dhillon, G. S., Singh, Bhupinder and Kler, D. S. (1979). Effect of row direction on wheat yield with different sowing dates, plant populations and fertilizer levels. *Indian J. Agron.* **24** (3): 322-325.

Mehta, U. R. and Mathur, B. N. (1972). Effect of sowing time and seed rate on yield of wheat in Arid region of Rajasthan. *Indian J. Agron.* **17**: 35-36.

Purusothaman, S., Chandragiri, K. K., Morachan, Y. B. and Michaelraj, S. (1979). Note on the effect of sowing dates of different dwarf wheat in Coimbatore Region. *Madras Agric. J.* **66**(11): 753.

Shekhawat, G. S., Chaundawat, G. S., Gupta, M. B. and Bharaj, N. R. (1975). Effect of nitrogen, phosphorus, dates of sowing and seed rate on yield of dwarf wheat in Rajasthan. *Indian J. Agron.*. **20**(3): 236-239.

Singh, Amarjit, Bhardwaj, R. B. L., Gautam, R. C. and Singh Mahendra (1971). Optimum seed rate and nitrogen requirement of dwarf wheat varieties under different dates of sowing. *Indian J. Agron.* **16**(1): 23-27.

GAU Res. J. 1987. 13 (1) : 50-52

Response of Rainfed Cotton to Nitrogen and Phosphorus

K. N. Akabari, A. P. Gandhi and J. C. Patel

Main Dry Farming Research Station, GAU, Targhadia (Rajkot)

Cotton is an important cash crop of the dry farming region of North Saurashtra. Nitrogen by far, is the king pin for profitable cotton production and responses to phosphorus and potash applications have been only limited. But applications of both the nutrients, N and P, in the required proportion always enhanced seed cotton yields (Venkateswarlu and Sathe, 1971) considerably. Adequate information is not available on fertilizer requirements of Saurashtra region and hence the present investigation was undertaken.

A field experiment in randomised block design with three replications was conducted at Main Dry Farming Research Station, Targhadia (Rajkot) during three seasons of *kharif* 1980-81, 1981-82 and 1983-84. The soil was medium black and contained 56.33% clay. The soil was neutral in reaction and analysed for both organic carbon (0.5%) and available P_2O_5 (16.8 kg/ha). The treatments comprised of four levels each of nitrogen (0, 20, 40 and 60 kg/ha) and phosphorus (0, 10, 20 and 30 kg/ha). Half nitrogen and all phosphorus as per treatments was drilled at sowing. The remaining N was top dressed between 45-50 days of sowing. The crop during each season was sown after the onset of monsoon rains. The total rainfall received during 1980-81, 1981-82 and 1983-84 was 565, 706 and 750 mm, respectively. Cotton variety GAU-Cot-10 was used for testing. Cost Benefit Ratio (CBR) was worked out from the additional yield of seed cotton over control by multiplying the prevailing market rates for each level of nitrogen. The benefit was divided by cost of each level of nitrogen and the cost of nitrogen was then deducted to work out the net ICBR. The rainfall distribution during the cropping seasons is given in Table 1. The seed cotton yield during 1983-84 was low owing to dry spell which prevailed from 33rd to 37th standard week which coincided with flower initiation.

A perusal of data presented in Table 2 revealed that seed cotton yield was significantly increased with application of nitrogen in all the years (Table 2). The magnitude of increase over control due to 40 kg N/ha was to the tune of 48.6 per cent. The increase in yield with 40 kg N/ha was stemmed from favourable effect on growth and yield attributes viz. plant height, number of bolls/plant and seed cotton yield/plant (Table 2). These findings would show that an application of 40 kg N/ha secured seed cotton yield as high as that due to higher level of 60 kg N/ha. Failure to obtain significant increase in seed cotton yield beyond 40 kg N/ha can only imply that the optimum production has already been attained under lower level of 40 kg N/ha under rainfed conditions. This level has also recor-

TABLE 1

Standard week-wise rainfall (mm) distribution during the cropping seasons of 1980, 1981 and 1983.

Standard week number and date of start		*(Rainfall (mm)*		
		1980	*1981*	*1983*
22	28th May	0.0	0.0	0.0
23	4th June	5.2	0.0	0.0
24	11th June	8.4	0.0	14.2
25	16th June	76.4	0.0	87.0
26	25th June	220.2	48.0	19.7
27	2nd July	85.1	0.3	25.5
28	9th July	0.2	290.7	13.2
29	16th July	0.0	2.6	222.3
30	23rd July	77.7	34.4	53.4
31	30th July	19.2	0.4	29.0
32	6th August	26.9	124.4	164.6
33	13th August	0.0	68.2	12.9
34	20th August	22.9	6.2	7.5
35	27th August	7.2	0.0	0.0
36	3rd September	10.8	0.0	6.9
37	10th September	4.8	17.5	0.0
38	17th September	0.2	12.4	39.2
39	24th September	0.2	91.0	1.4
40	1st October	0.0	0.0	0.0
41	8th October	0.0	9.8	43.0
42	15th October	0.0	0.0	9.8

TABLE 2

Seed cotton yield, growth and yield attributes and economics as affected by levels of N and P.

Treatment	*Seed cotton yield (q/ha)*				*Plant height at maturity (cm)*	*No. of bolls/ plant*	*Seed cotton yield (g)/plant*	*Net ICBR*
	1980-81	*1981-82*	*1983-84*	*Average*				
Nitrogen (kg/ha)								
0	5.0	3.5	2.2	3.6	80.2	11.4	15.8	—
20	5.4	4.9	2.9	4.4	84.9	11.5	18.1	1:3.29
40	6.0	6.6	3.2	5.3	85.6	17.9	22.1	1:3.41
60	5.9	7.3	3.9	5.7	87.8	13.5	25.1	1:2.67
C.D. at 5%	0.6	1.1	0.7	0.5	–	–	–	
Phosphorus (kg/ha)								
0	5.5	5.1	2.9	4.5	83.4	11.9	19.6	–
10	5.4	5.6	3.2	4.7	86.4	12.1	18.2	–
20	5.6	5.2	3.0	4.6	83.3	12.6	20.8	–
30	5.8	6.4	3.2	5.1	85.6	12.8	22.7	–
C.D. at 5%	NS	NS	NS	NS	–	–	–	–

NS = Not significant
Interaction N × P was not significant

Cost of nitrogen Rs. 4.9/kg
Cost of P_2O_5 Rs. 5.7/kg
Cost of seed cotton Rs. 500/q

ded higher net ICBR of 1 : 3.41. The findings corroborate the results put forward by Khistaria *et al.* (1980); Patel *et al.* (1986) and Dhoble *et al.* (1986).

Different levels of phosphorus did not exert their significant influence on seed cotton yield in all the three years and in the pooled results. Lack of response to phosphorus in the soil rating low to medium in available phosphorus can probably be attributed to high phosphorus fixation capacity of these soils (60 to 70%) because of high calcareousness (30.0 m.e. exchangable ca/ 100 gm soil) and clay content (56.33), fluctuation in moisture due to scanty, erratic and unevenly distributed rains and contribution of native P from subsurface soil. The findings lend support to the results reported by Patel and Sutaria (1972), Khistaria *et al.* (1980) and Anon. (1984) who also found no response of P application to cotton under rainfed conditions.

Thus, from the results of the present study, it is recommended to apply 40 kg N/ha to cotton (GAU-Cot-10) for potential production and profit under rainfed conditions on medium black soil of North Saurashtra region.

(*Received on 18th March, 1986*)

REFERENCES

Anonymous (1984). Proceedings of the 20th meeting of Agronomy and Soil Science Sub-Committee of the Agricultural Research Council of Gujarat Agricultural University, Sardar Krushinagar held at Junagadh during 9-10 October, 1984.

Khistaria, M. K., Patel, R. B. and Patel, J. C. (1980). Effect of different levels of nitrogen and phosphorus on the yield of cotton. *Indian J. Agron.* **25** (1): 315-317.

Patel, A. S. and Sutaria, M. H. (1972). A summary of Agronomic studies in Gujarat State in cotton and paddy. *Agriculture in ten years.* **6** (1): 95-100.

Dhoble, M. V., Jadhav, J. K., Patil, V. D. and Giri, D. G. (1986). Studies on the effect of different levels of nitrogen, phosphorus and potassium on the yield of cotton (G. hirsutum). A paper presented at National Seminar on "Effect of application of phosphatic fertilizers to cotton held at Surat, May 21-22, 1986.

Patel, P. G., Mehta, N. P., Sanandia, C. J. and Patel, B. D. (1986). Response of rainfed cotton to graded levels of N, P and K in different soils. A paper presented at National Seminar on "Effect of application of phosphatic fertilizers to cotton, held at Surat, May 21-22, 1986.

Venkateswarlu, J. and Sathe, A. (1971). Use of Isotopes and Radiation in Agric and Animal Husbandry Res., New Delhi, Dec. P. 573.

GAU Res. J. 1987, 10 (1) : 53-55

Effects of Dates of Sowing and Fertilizers on Yield, Quality and Economics of Gram (*Cicer arietinum* L.)

M. K. Arvadia and Z. G. Patel*

Department of Agronomy, N. M. College of Agriculture, GAU, Navsari

A field experiment was carried out at College Farm of N. M. College of Agriculture, Gujarat Agricultural University, Navsari Campus, Navsari, during *rabi* season of 1981-82 in split-plot design with three dates of sowing (October, 22; November, 6 and November, 21) as main plots and six treatment combinations consisting of two levels of nitrogen (0 and 25 kg N/ha) and three levels of phosphorus (0.25 and 50 kg P_2O_5/ha) as sub-plot treatments. All the treatments were replicated four times. The Dahod yellow variety of gram was sown 30 cm apart with 75 kg seed rate/ha and was harvested on attainment of maturity. The soil was clayey in texture having pH 7.6, organic carbon 0.92%, total nitrogen 0.06%, available P_2O_5 24.78 kg/ha and K_2O 416.0 kg/ha.

Nitrogen content from the grain was estimated by adopting modified Kjeldahl's method. Subsequently the protein content of grain was computed for each treatment by multiplying its nitrogen percentage with the conversion factor 6.25. Protein yield per hectare was worked out by employing the following formulae:

$$\text{Protein yield (kg/ha)} = \frac{\text{Grain protein content (Per cent)} \times \text{Grain yield (kg/ha)}}{100}$$

The gross realization in terms of rupees per hectare was estimated on the basis of the yield of grain and chaff for each of the treatments with the prices of the produce prevailing in market. The net realization was worked out by deducting the total cost of cultivation from the gross realization per hectare for each treatment.

The data presented in Table-1 indicated that protein content, protein yield and grain yield per hectare were significantly influenced by the sowing time. The highest protein content (19.77%) was recorded when the crop was sown on 21st November and this resulted into significantly higher protein yield (271.47 kg/ha). The highest protein yield obtained with late sowing might be due to the higher protein content and higher grain yield obtained under late sowing.

Data further indicated that protein content, protein yield and grain yield showed significant increase with the nitrogen application. Higher protein content (19.69%) was recorded with 25 kg N/ha. Similar results were also obtained by Mishra, and Ram (1971) and Singh and Yadav (1971). Application of nitrogen also increased the protein yield by 20.71

*Present address: Training Organiser, Krushi Vigyan Kendra, Gujarat Agricultural University, Waghai (Dangs) -394 730.

TABLE 1

Yield, quality and economics of gram as influenced by dates of sowing and fertilizer application.

Treatment	*Grain protein content (%)*	*Protein yield (kg/ha)*	*Grain yield (kg/ha)*	*Chaff yield (kg/ha)*	*Net realization (Rs/ha)*
Dates of sowing(D)					
D_1 22nd October	19.63	231.95	1182	2003	1430
D_2 6th November	18.77	217.48	1156	1853	1352
D_3 21st November	19.77	271.47	1372	2156	1922
S.Em. ±	0.13	6.00	31.94	65.28	—
C.D. (5%)	0.46	20.71	109.72	225.00	—
C.V. (%)	3.32	12.25	12.81	15.80	—
Nitrogen levels(N) (kg/ha)					
N_0 0	19.09	217.75	1138	1916	1380
N_1 25	19.69	262.85	1335	2092	1756
S.Em.±	0.14	4.28	23.61	48.61	—
C.D. (5%)	0.39	12.17	66.67	138.20	—
C.V. (%)	4.25	10.74	11.68	14.53	—
Phosphorus levels (p) (kg/ha)					
P_0 0	19.30	212.50	1105	1187	1406
P_1 25	19.33	251.45	1296	2049	1717
P_2 50	19.63	256.94	1308	2077	1581
S.Em. ±	0.17	5.25	29.17	59.72	—
C.D. (5%)	NS	14.92	82.92	NS	—
C.V. (%)	4.25	10.74	11.68	14.53	—
Interactions					
D×N	NS	Sig.	Sig.	NS	—
D×P	NS	Sig.	Sig.	NS	—
N×P	NS	NS	NS	Sig.	—
D×N×P	NS	NS	NS	Sig.	—

Sig.=Significant.

NS=Non-Significant.

per cent over that of no nitrogen. Though application of phosphorus did not show any response with respect to grain protein content, the application of 25 and 50 kg P_2O_5/ha increased the protein yield by 18.33 and 20.91 per cent over control.

From the economics point of view, the increased net returns of Rs. 1922, 1756 and 1717 per hectare were received from 21st November sowing, application of 25 kg N/ha and 25 kg P_2O_5 per-hectare, respectively (Table-1). However, maximum net realization of Rs. 2265 was obtained when the crop was sown on 21st November and was fertilized with 25 kg N and 25 kg P_2O_5 per hectare ($D_3N_1P_1$) (Table-2).

TABLE 2

Economics of gram as influenced by dates of sowing and fertilizers.

Sr. No.	Treatments	Yields kg/ha		Realization Rs./ha		Gross realization Rs/ha	Cost of production Rs./ha	Net realization Rs./ha
		Grain	Chaff	Grain	Chaff			
1	D_1 N_0 P_0	956	1697	2390	170	2560	1469	1091
2	D_1 N_0 P_1	1243	2135	3108	214	3322	1667	1655
3	D_1 N_0 P_2	1257	2013	3143	201	3344	1835	1509
4	D_1 N_1 P_0	1040	2026	2600	203	2803	1623	1180
5	D_1 N_1 P_1	1321	2106	3303	211	3514	1791	1723
6	D_1 N_1 P_2	1271	2040	3178	204	3382	1959	1423
7	D_2 N_0 P_0	1001	1648	2503	165	2668	1469	1199
8	D_2 N_0 P_1	961	1561	2403	156	2559	1667	892
9	D_2 N_0 P_2	1068	1778	2670	178	2848	1835	1013
10	D_2 N_1 P_0	1268	2046	3170	205	3375	1623	1752
11	D_2 N_1 P_1	1322	1985	3305	199	3504	1791	1713
12	D_2 N_1 P_2	1317	2106	3293	211	3504	1959	1545
13	D_3 N_0 P_0	985	1607	2463	161	2624	1469	1155
14	D_3 N_0 P_1	1393	2390	3483	239	3722	1667	2055
15	D_3 N_0 P_2	1376	2419	3440	242	3682	1835	1847
16	D_3 N_1 P_0	1381	2299	3453	230	3683	1623	2060
17	D_3 N_1 P_1	1538	2114	3845	211	4056	1791	2265
18	D_3 N_1 P_2	1558	2106	3895	211	4106	1959	2147

Notes: 1. Market price: Grain Rs. 250/Quintal.
Chaff Rs. 10/ Quintal.

2. Cost of Fertilizer nutrients.
Nitrogen (Urea)—Rs. 4.96/kg N
Phosphorus (SSP)—Rs. 4.71/kg P_2O_5

For getting higher production of grain and protein, sowing of gram variety Dahod yellow on 21st November with application of 25 kg N + 25 kg P_2O_5/ha was found profitable for South Gujarat region.

(Received on 22nd Dec., 1986)

REFERENCES

Mishra, S. S. and Ram, A. 1971. Tilth, nitrogen and method of phosphate application in relation to gram yield. *Fert. News.* **16** : 56-71.

Singh, R. S. and Yadav, S. V. 1971. Effect of number of cultivation and increasing levels of N and P on yield and quality of gram (*Cicer arietinum* L.) *Indian J. Agric. Res.* **5**: 51-54.

Oviposition Preference of *Spodoptera litura* Fabricius to Different Host Plants

I. S. Patel* and A. H. Shah

Regional Cotton Research Station, GAU, Bharuch

Cotton leaf eating caterpillar, ***Spodoptera litura*** F. which is popularly known as "Prodenia" among farmers in Gujarat. This pest is polyphagous and causes severe damage to many food plants. Moussa *et. al.* (1960) have reported this pest feeding on 112 crop species and some species of weeds. The feeding behaviour, larval development and egg laying preferences of ***Spodoptera litura*** Fb. is varying from crop to crop. The fecundity rate may be also dependant on the availability of host plants. Study was therefore carried out to see the oviposition preference of ***Spodoptera litura*** Fb. on different food plants under Bharuch conditions so as to find out the oviposition preference for ***Spodoptera litura*** Fb. on various food plants.

Laboratory trial was conducted at Regional Cotton Research Station, GAU, Bharuch during the year 1983-84 and was replicated five times with eight different host plants *viz.*, castor, cabbage, tobacco, lucerne, wal, cotton, cowpea and wild tondli. The egg masses of ***Spodoptera litura*** F. were collected from the cotton field and brought to the laboratory for rearing. After hatching, fresh leaves of different host plants were provided separately in wooden cages until pupation. After emergence of the adults, 1 pair was kept in individual glass jar and were fed with 10% honey solution soaked in cotton swab daily. Fresh leaves and branches of different host plants were provided daily to different glass jars and covered with muslin cloth. The number of eggs laid per female in different glass jars on different hosts were counted daily till the death of the female.

TABLE 1

Mean fecundity of *Spodoptera litura* F. on different host plants.

Sr. No.	*Host plants*	*Mean fecundity/ female*
(1)	Cotton, (*Gossypium hirsutum*)	2990
(2)	Cabbage (*Brassica oleracea*)	2379
(3)	Tobacco (*Nicotiana tabaccum*)	3365
(4)	Lucerne (*Medicago sativa*)	1928
(5)	Castor (*Ricinus communis*)	3412
(6)	Wild tondli (*Coccinia indica*)	1425
(7)	Wal (*Dolichos lablab*)	1669
(8)	Cowpea (*Vigna catiang*)	1531
	S.Em.±	111.38
	CD (P = 0.05%)	322.25
	C.V.%	10.65

The mean number of eggs laid by female on different host plants are given

*Present Address: Senior Research Assistant (Entomology), All India Co-ordinated Research Project on Dryland (ICAR), GAU, Sardar Krushinagar.

in Table-1. It is evident from the data, the maximum number of eggs laid/ female were on castor i.e., 3412 eggs/ female and it was followed by tobacco (3365 eggs/female) and cotton (2990 eggs/ female). The less preferred host plants were wild tondli, cowpea and wal on which less number of eggs laid were 1425, 1531 and 1669 eggs/female respetively.

The results are in confirmity with Honsy and Kotby (1960), Sureja (1978) and Parasuraman and Jayaraj (1983) who have reported castor as the most preferred host plants for oviposition and feeding for *Spodoptera litura* F. However the results of the investigation differing from Singh and Byas (1973) who observed that the ovipositional preference of *Spodoptera litura* F. was more on tobacco than castor.

(*Received on 20th Dec., 1985*)

REFERENCES

Honsy, M. M., and Kotby, F. A. 1960. Host plants favoured by the cotton leaf worm moth *Prodenia litura* F. for egg laying and their value as egg-mass trap-crops. *Bull. Soc. Ent. Egyt.* **44** : 223-34

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

Parasuraman, S. and Jayaraj, S. 1983. Ovipositional behaviour of Tobacco caterpillar *Spodopetra litura* F. *Cotton Development*, **13** (2): 15-20.

Singh, H. N. and Byas, V. 1973. Host selection in the tobacco caterpillar, *Spodoptera litura* F. (*Lepidoptera:* Noctuidae). *Ind. J. agric. Sci.* **43**: 357-60.

Sureja, B. V. (1978). Feeding response of tobacco leaf eating caterpillar *Spodoptera litura* (Fabricius) to different types of tobacco. A thesis submitted to Guj. Agril. Uni., Sardar Krushinagar, Pp. 34.

Managing Hopper Population in Mango Orchards

R. C. Patel, J. F. Dodia and G. D. Patel

Department of Entomology, B. A. College of Agriculture, GAU, Anand Campus, Anand-388 110 (Gujarat)

Mango (*Mangifera indica* Linnaeus), a seasonal fruit is popular throughout the country. The trees lose vigour and suffer heavily due to anthracnose and mango, hoppers. Out of the 175 insect pests (Butani 1979) recorded infesting mango, hoppers are most important affecting fruit production. The most damaging species are *Amritodus atkinsoni* (Lethierry) and *Idioscopus clypealis* (Lethierry). The hoppers breed only in the new young leaves or in the inflorescence and during the rest of the year, they rest in the crevices in the bark of trunk and large limbs particulary on the lower side in shady areas. Considering this behaviour of the hopper, an attempt has been made to check its population by destroying the resting adults so that these do not migrate to fresh growth and affect fruiting. Carbaryl has been reported to be effective against mango hopper (Sathianandan *et al.* 1972, Singh *et al.* 1974).

Consequently, carbaryl 0.1% was sprayed on the trunks and limbs of 248 mango trees in an area of 3.55 hectares at Anand campus of Gujarat Agricultural University, Anand. The hopper population on the tree trunks and limbs was recorded regularly by taking 5 sweeps with a hand net from each of 20 out of 248 trees. Similarly, pupulation of mango hoppers was recorded at regular intervals from 20 out of 82 trees in 1.5 hectare orchard located at about 500 meters away kept as control where no pesticide was applied. The population in both the orchards was recorded regularly and pesticide applications were made in the treatment block as and when necessary but before the trees put out fresh growth or inflorescence. The experiment was started in January 1981 and was continued until April 1983.

The results presented in Table-1 show that consistently high population of hoppers was recorded on the trunk than on the limbs. It is also seen that spraying the tree trunks was required to be done only twice, once in December or January preceding the development of the inflorescence and again in June-July preceding the development of fresh vegetative growth. With these two rounds of appropriately timed sprays of carbaryl, it is seen that the hopper population could be managed very effectively at subeconomic level.

An unseasonal cyclone with speed of 90 k.m./hour during second week of November 1982, alongwith heavy rains (254 mm) affected the hopper population in mango orchards as seen from the data in Table-1. The hoppers were not seen until February 1983. They, however, built up their population in the first week of April, 1983, (32.72/ sweep) after the flowering season of January-February 1983. One extra round of carbaryl applied on 10-4-83 reduced the hopper count from 16.07 to 7.69 on the

TABLE 1

Average number of mango hoppers per sweep in treated and untreated orchards.

Sr. No.	Date of observations	Treated orchards		Control orchards	
		Trunk	Limb	Trunk	Limb
1	2	3	4	5	6
1.	13-1-81	0.19	1.15	0.52	1.86
	27-1-81	Carbaryl spray			
2.	28-1-81	0.01	0.14	0.55	6.98
3.	3-2-81	0.0	0.02	0.64	8.06
4.	18-2-81	0.27	0.84	0.79	6.46
5.	5-3-81	0.49	1.42	1.28	7.09
6.	2-4-81	8.36	1.17	42.25	5.42
7.	16-4-81	12.26	0.99	55.43	4.21
8.	2-5-81	12.04	1.07	50.63	4.91
9.	1-6-81	11.51	1.44	47.70	5.34
10.	23-6-81	9.96	1.70	48.73	5.38
11.	3-7-81	7.87	2.60	42.44	6.73
	4-7-81	Carbaryl spray			
12.	4-7-81	0.15	0.32	41.20	7.22
13.	20-7-81	0.22	0.31	22.78	13.90
14.	4-8-81	0.35	0.38	25.36	11.91
15.	25-8-81	0.82	0.87	22.53	14.92
16.	16-9-81	1.38	1.58	23.03	14.07
17.	20-10-81	2.37	1.61	20.99	11.71
18.	6-11-81	1.89	1.04	15.10	9.54
19.	23-11-81	2.07	1.19	12.67	8.75
20.	23-12-81	1.54	1.04	9.67	6.70
	24-12-81	Carbaryl spray			
21.	26-12-81	0.32	0.25	7.19	6.99
22.	2-1-82	0.18	0.47	3.61	8.40
23.	17-1-82	0.21	0.66	2.05	9.21
24.	2-2-82	0.22	0.65	1.74	9.18
25.	26-2-82	0.43	0.96	0.99	10.18
26.	15-3-82	0.70	1.02	10.56	10.51
27.	3-4-82	5.77	0.87	16.85	6.88
28.	19-4-82	7.43	0.97	17.26	7.11
29.	26-4-82	7.80	1.46	17.95	7.62
30.	1-6-82	13.45	1.54	57.31	8.06
	3-6-82	Carbaryl spray			
31.	5-6-82	0.57	0.27	55.40	10.62
32.	10-6-82	0.66	0.28	46.86	9.37
33.	23-6-82	0.75	0.57	41.32	8.07
34.	22-7-82	1.50	0.58	31.58	8.56
35.	26-7-82	1.17	0.68	30.14	9.46

1	2	3	4	5	6
36.	10-8-82	1.23	0.84	27.26	10.91
37.	25-8-82	1.04	0.93	25.23	11.43
38.	10-9-82	0.95	1.02	22.54	13.70
39.	25-9-82	1.19	1.16	22.02	13.04
40.	13-10-82	14.69	5.06	25.44	13.44
41.	27-11-82	3.87	3.86	3.34	3.47
42.	6-1-83	2.81	3.87	3.58	5.87
		18-1-83	Carbaryl spray		
43.	20-1-83	1.28	1.04	2.47	3.38
44.	8-2-83	1.09	0.87	3.53	5.31
45.	4-3-83	1.28	0.97	8.30	7.10
46.	8-4-83	16.07	15.24	29.59	19.94
		10-4-83	Carbaryl spray		
47.	11-4-83	7.69	8.17	32.72	23.23

trunk and from 15.24 to 8.17 on the limbs. The population in the control plot remained very high during April 1983.

Thus, the experiment conducted for over two years in a large well established orchard with similar large orchard kept as control, we could keep the mango hopper population well below the economic injury level with only two rounds of a pesticide applied on the tree trunks and large limbs before the trees put out fresh growth or inflorescence.

(Received on 8th Janu. '86)

REFERENCES

Butani, D. K. 1979. "Insects and Fruit" published by periodical Expert Book Agency. Delhi. pp. 9

Sathianandan, V. K., Bettai Gowder, R. and Santhanraman, T. 1972. Control of mango hoppers, *Idiocerus* spp. proc. 3rd int. symp. subtrop. & Trop. Hort. (Abstracts): 83-84.

Singh, Gajendra, Ashok Kumar and Pathak, P. K. 1974. Studies on efficiency of some insecticides against mango hopper, *Amritodus atkinsoni* (Lethierry). *Indina J. Hort.* **31** (3): 283-285.

GAU Res. J. 1987. 13 (1) : 61-63

Life-table and Innate Capacity of Increase of *Heliothis armigera* Hubner (Lepidoptera : Noctuidae) on Tobacco

D. J. Koshiya and H. K. Patel

Department of Entomology, B. A. College of Agriculture, GAU, Anand

Heliothis armigera Hubner is typically a polyphagous pest infesting many cultivated crops. Bhatnagar and Davies (1978) recorded 50 species of crop plants and 48 species of wild and weed species of plants for this pest. Life-table can be used to make quantitative and qualitative evaluation of different host plants. A type of life-table developed by Birch (1948) can be used for both qualitative evaluation of the hosts and to estimate the potential increase of insects reared on different commodities. Many authors have described the importance of the ability of a population to increase. Because of the importance of reproductive ability or biotic potential, a statistic was developed to quantify and explain the population increase. This statistic is the innate capacity of increase which is also called as the true, inherent or intrinsic rate of natural increase. The innate capactiy for increase has not been determined for many of the Phytophagous insects (Wellik and Pedigo, 1978). An attempt was, therefore, made to construct the life-table under laboratory conditions, when the larvae of *H. armigera* were reared on tobacco capsules.

A laboratory culture of *H. armigera* was used for this study. Known number of adult pairs were released for egg laying in wooden cages (30 cmx30 cm x 45 cm). Freshly laid eggs were collected with the help of a wet camel hair brush and such 100 eggs were kept for hatching. Immediately after hatching, the tiny larvae were transferred on tobacco capsules (*Nicotiana tabacum*) kept in plastic container (5 x 5 cm). The tobacco capsules were changed daily in the morning till all larvae pupated. The adults emerged on a particular day were paired and released in separate cages for egg laying. The fecundity of females on subsequent days was noted daily till all the females died. The number of eggs laid per female was divided by 2 (sex-ratio 1:1) to get the number of female births (mx). Observations on mortality during different stages from hatching of eggs till the emergence of adults were recorded daily which provided the values for the life-table (lx). Life-tables were constructed according to the method of Birch (1948), Howe (1953) and Atwal and Bains (1974). The innate capacity of increase (rm), net reproductive rate (Ro) and mean generation time (T), were the basic parameters used to assess the population growth at a constant temperature of 26 ± 1°C. Stable age distribution (per cent distribution of various life stages) was also worked out by calculating the population schedule of birth-rate (mx) and death-rate, when reared in a limited space.

The life-table showing the survival (lx) and age-specific fecundity of *H. armigera* is presented in Table-1. The pre-oviposition period ranged from 33rd to

36th day of pivotal age. The first female mortality occurred on 43 rd day (lx=0.48) of pivotal age. The highest mx' was 130.60 females per female on 41st day of pivotal age. The net reproductive rate (Ro) representing the total fermale briths was 320.49 females.

The innate capacity for increase in numbers (rm) was 0.1416 female per female per day with a daily finite rate of increase (y) 1.1520 females per female per day. The length of developmental and reproductive stage was found to be 41.02 days for this cohort. The hypothetical F_2 females were 1,02,713,84 (Table 2). The stable-age distribution of *H. armigera* was computed, when reared under given set of conditions. It was found that the contribution made in adult stage was only 0.68 per cent of pupulation of stable-age. The contribution of other stages viz; egg, larva and pupa was 45.09, 52.46 and 1.18 percent respectively. Similar studies on different hosts were carried otn by Dhandapani and Balsubramanian (1979) on cotton, Bill apate and Pawar (1978) on pea, Bilapate *et al.* (1981) on chickpea and Bilapate *et al.* (1977) on green lima bean and lucerne. The results on innate capacity for increase in numbers (rm) reported by them are more or less similar to present investigation. Slight variations in different parameters were due to the variation in hosts.

(Received on 13th Janu. 1986)

TABLE 1

Life-table (for females) and age specific fecundity for *H. armigera* **on tobacco.**

Pivolal age in days (*x*)	*Survival of female at different age interval* (*lx*)	*Age schedule for female birth* (*mx*)	*lxmx*	*xlxmx*
0-32	—	—	—	Immature
33	0.60	—	0.60	19.60
34	0.60	—	0.60	20.40
35	0.60	—	0.60	21.00
36	0.60	—	0.60	21.60
37	0.60	7.22	4.33	160.33
38	0.60	14.76	8.86	336.68
39	0.60	49.12	47.47	1851.19
40	0.60	93.43	46.86	2242.66
41	0.60	130.60	78.36	3243.08
42	0.60	100.86	60.52	2541.70
43	0.48	79.40	38.11	1638.78
44	0.38	47.71	18.13	787.50
45	0.32	19.83	6.25	281.25
46	0.30	—	—	—

Net reproductive rate (R0)

Σ lxm = 320.49

Σ xlxmx = 13145.94

TABLE 2

Mean length of generation, innate capacity for increase in numbers and finite rate of increase in numbers of *H. armigera* on tobacco.

Sr. No.	*Population growth statistics*	*Formula*	*Calculated values*
1.	Mean length of generation	$TC = \frac{\sum xlxm\ x}{R0}$	41.02 days
2.	Innate capacity for increase	$rm = \frac{\log e^{RO}}{TC}$	0.1406 females/ female/day
3.	Arbitrary 'rm' (rc)	0.14 and 0.15	
4.	Corrected 'rm'	$\sum e^{7}\text{-rmx} \cdot lxmx$	0.1416 females/ female/day
5.	Corrected generation time	$T = \frac{\log eRO}{rm}$	40.75 day
6.	Finite rate of increase in numbers	$\lambda = \text{antilog } e^{rm}$	1.1520 females/ female/day
7.	Weekly multiplication of population	$(\lambda)^7$	2.701 times
8.	Hypothetical F_2 females	$(R_0)^2$	102713.84

REFERENCES

Atwal, A. S. and S. S. Bains, 1974. Exercises in population studies *in* Applied Animal Ecology, Kalyani Publishers, Ludhiana, pp. 128-135.

Bhatnagar, V. S. and J. G. Davies, 1978. Factors affecting population of gram pod borer, *Heliothis armigera*(Hubner)(Lepidoptera: Noctuidae) in period of 1974-1977 at Patancheru (A.P.). Oriental Entomology Mini Workshop on Population Ecology in relation to insects of economic importance, Banglore (Karnataka).

Bilapate, G. G. and V. M. Pawar, 1978. Life-tables for the gram pod borer, *Heliothis armigera* Hubner (Lepidoptera: Noctuidae) on pea. *Proc. Indian Acad. Sci.* **87** (6): 119-121.

Bilapate, G. G.; V. P. Pawar and A. K. Raodeo, 1977. Growth of population of *Heliothis armigera* Hbn. on lucerne. *Indian J. Agric. Sci.*, **47** (11) 540-542.

Bilapate, G. G.; A. K. Raodeo and V. M. Pawar, 1981. Investigations of *Heliothis armigera* Hubner in Marathwada-III Life-tables and intrinsic rate of increase on chickpea. *J. Maharashtra Agric. Univ.* **6** (1): 51-54.

Birch, L. C. 1948. The intrinsic rate of natural increase of an insect population, *J. Anim. Ecol.*, **17**: 15-26.

Dhandapani, N and M. Balsubramanian, 1979. Life-tables for the gram pod borer, *Heliothis armigera* Hubner (Lepidoptera: Noctuidae) on Cotton *J. Entomol. Res.*, **3** (2): 186-190.

Howe, R. W. 1953. The rapid determination of intrinsic rate of increase of an insect population. *Ann. Appl. Biol.* **40**: 134-135.

Wellik, M. J. and L. P. Pedigo, 1978. The innate capacity for increase and ovipositional pattern of the green clover worm, *Environ. Entomol.*, **7**: 171-177.

Occurrence of *Altica cyanea* (Weber), a Possible Biocontrol Agent for Weeds in Rice Fields

R. C. Jhala, Z. P. Patel and A. H. Shah

Department of Entomology, N. M. College of Agriculture, GAU, Navsari Campus, Navsari-396 450

Altica (*Haltica*) *cyanea* (Weber), a chrysomelid commonly known as steel blue beetle was noticed feeding on weeds particularly *Spermacoce hispida* L. (Rubiaceae). *Ludwigia parviflora* Roxb. (Onagraceae) and *Ammania bacccifera* L. (Lythraceae) growing in rice fields of south Gujarat. The younger weed plants were preferred and the larvae were also observed feeding on weeds. A survey carried out in the paddy fields of Gujarat Agricultural University Farm at Navsari during October, 1984 indicated that on an average 54.40, 19.00 and 17.40 adults per plant were found feeding on *S.hispida*, L. *parvifiora* and *A. baccifera* respectively indicating its preference to these weeds in decreasing order. The weeds were found completely defoliated. Although the beetles were found resting on the rice plants, none of the rice plants was observed to be damaged indicating the specificity of the beetle to these weeds. Because of the considerable potential of this beetle feeding on the above mentioned weeds, it can be explored for the possible biological control of weeds in rice fields in south Gujarat and as such further studies on it are urged.

A. cyanea has also been reported feeding on *L. parviflora* at Cuttack in Orissa (Dubey, 1981), on *Ludwigia* spp. in Indonesia (Mangoendihardjo and Soerjani, 1979) and on *A. baccifera* in Delhi (Garg and Sethi, 1983). In south Gujarat too, *A. cyanea* can be taken advantage of for the biocontrol of weeds in paddy fields.

ACKNOWLEDGMENT

The authors are thankful to Dr. M. L. Cox, Commonwealth Institute of Entomology, London for the identification of beetle.

(*Received on 20th March, 1986*)

REFERENCES

Dubey, A. N. (1981). Biological control of weeds in rice. *Tropical Pest Management*, **27** (1): 143-144.

Garg, A. K. and G. R. Sethi (1983). Incidence of blue beetles on rice crop in Delhi. *Bull Ent.*, **24** (2): 95-98.

Mangoendihardjo, S. and M. Soerjani (1979). Weed management through biological control in Indonesia. 323-337. Gadjah Mada University, Yogyakarta, Indonesia.

Occurrence of White Tip Disease of Rice in Gujarat

N. A. Thakar, B. K. Patel, H. R. Patel and C. C. Patel

Department of Nematology, B. A. College of Agriculture, GAU, Anand Campus, Anand-388 110

During Kharif 1984, a sample of diseased rice plant was received from a cultivator of village Napad, taluka Anand district Kaira of Gujarat State. The microscopic examination of the diseased spikelets revealed the presence of plant-parasitic nematode *Aphelenchoides* sp. The number of nematodes in a diseased spikelet varied from 3 to 8.

A field visit was carried out to find out the incidence of the disease and the study of symptoms. The observations of the field indicated ten per cent of the panicles severely infected without having any effective kernels. While, some of the panicles were also partially affected by the disease. Thus, on a rough estimate the losses in yield were about 10-15 per cent. The rice variety as reported by the farmer was strain 81-3.

The affected plants were having shortened and twisted flag leaves, panicles shortened with reduced number of spikelets, spikelets unfilled and deformed in shape and yellowish brown in colour. The mottling of seed coat and crinkling of grains was also observed. The diseased plants were having characteristically white tips on leaves.

For species identification the diseased panicles were sent to Dr. Y. S. Rao, Senior Nematologist, Central Rice Research Institute, Cuttack (Orissa) who has identified the cause of the disease to be the white tip nematode, *Aphelenchoides besseyi* Christie, 1942.

As the nematodes directly affect the spikelets and panicles results in direct reduction of grain yield. Similar disease from Central Provinces of India was also reported by Dastur (1936). However, this record is a first record for the occurrence of *Aphelenchoides besseyi* Christie, 1942 on rice from the State of Gujarat.

(Received on 7th Aug. 1985)

REFERENCE

Dastur, J. P. (1936). A nematode disease of rice in the Central Provinces. *Proc. Indian Acad. Sci.* **4**: 108-121.

GAU Res. J. 1987. 13 (1) : 66-67

Nutritive Value of Green Lucerne (Anand-2) (*Medicago Sativa* Linn) for Camels

M. B. Pande, S. R. Bhagwat and N. S. Radadia

Livestock Research Station, GAU, Sardar Krushinagar-385 506

Camel is a domestic animal of great economic importance in some parts of this country. It is a pseudoruminant and has its habitat in areas where scarcity is predominant and lives in conditions where feed resources are meager. Digestibilities of the fodders varies according to species also.

Therefore, to assess the nutritive value of green lucerne (Anand-2) a conventional method of digestibility trial was conducted using five male camels. The animals were fed *adlib*. After a 25 days preliminary feeding a 7 days collection was made. The feed and faeces were analysed by A.O.A.C. (1970) methods.

The chemical composition of lucerne used for feeding to camels was 18.53, 2.59, 22.30, 45.17 and 10.31 per cent C. protein, E.Ext., C. fibre, NFE and ash respectively on dry matter basis.

Chemical composition of the lucerne was almost similar as reported by Anon (1970).

The average total dry matter intake was 8.85 ± 0.47 kg/day/animal.

The data on nutrients intake and their digestibility coefficients are given in Table-1.

The average digestibility coefficient of crude protein was 77.57. Anon (1970) reported somewhat higher digestibility of crude protein in cattle. The dry matter digestibility was as per the value reported by Anon (1970) in cattle. However, the crude fiber and ether extract digestibility was considerably lower in camels as compared to the values reported by Anon (1970). This may be due to the species difference.

The DCP and TDN values worked out to be 14.37 and 64.61 per cent on dry matter basis. The corresponding values were 19.34 and 69.71 per cent respectively for cattle (Anon, 1970).

TABLE 1

Nutrients intake and their digestibility coefficients.

Nutrients	*Average daily intake (g/day)*	*Digestibility coefficients*	*DCP %*	*TDN%*
Dry matter	8851 ± 0.47	70.10 ±1.80	14.37	64.61
Crude protein	1708 ±78.12	77.57 ±2.75		
Ether extract	231 ±12.38	48.52 ±4.63		
Crude fiber	1792 ±147.82	49.57 ±1.66		
N F E	4086 ±194.44	80.50 ±1.66		

On an average the camels consumed daily 1271 g DCP and 5718 g TDN on dry matter basis, which are more than their requirements as reported by Mathur (1984).

(*Received on 2nd Sept. 1985*)

REFERENCES

Anonymous (1970) A review of the research work from 1953 to 1970 on animal nutrition in western India.

A.O.A.C. (1970) Official methods of Analysis. The Association of Analytical chemist, 11th edn., Benzamin Franklin Station, Washington D.C. 20044.

Mathur, C. S. (1984). Camel production in Rajasthan desert in relation to feed and water requirements. Paper presented at Summer Institute at Division of Animal Studies, Central Arid Zone Research Institute, Jodhpur from 7th May to 26th May.

GAU Res. J. 1987. 13 (1) : 68-69

Abstract of Ph.D. Thesis

Critical Analysis of Sugarcane Growers' Knowledge and Adoption of Sugarcane Production Technology

Submitted to Gujarat Agricultural University, 1986

A. O. Kher

Department of Extension Education, College of Agriculture, Gujarat Agricultural University, Junagadh Campus, Junagadh

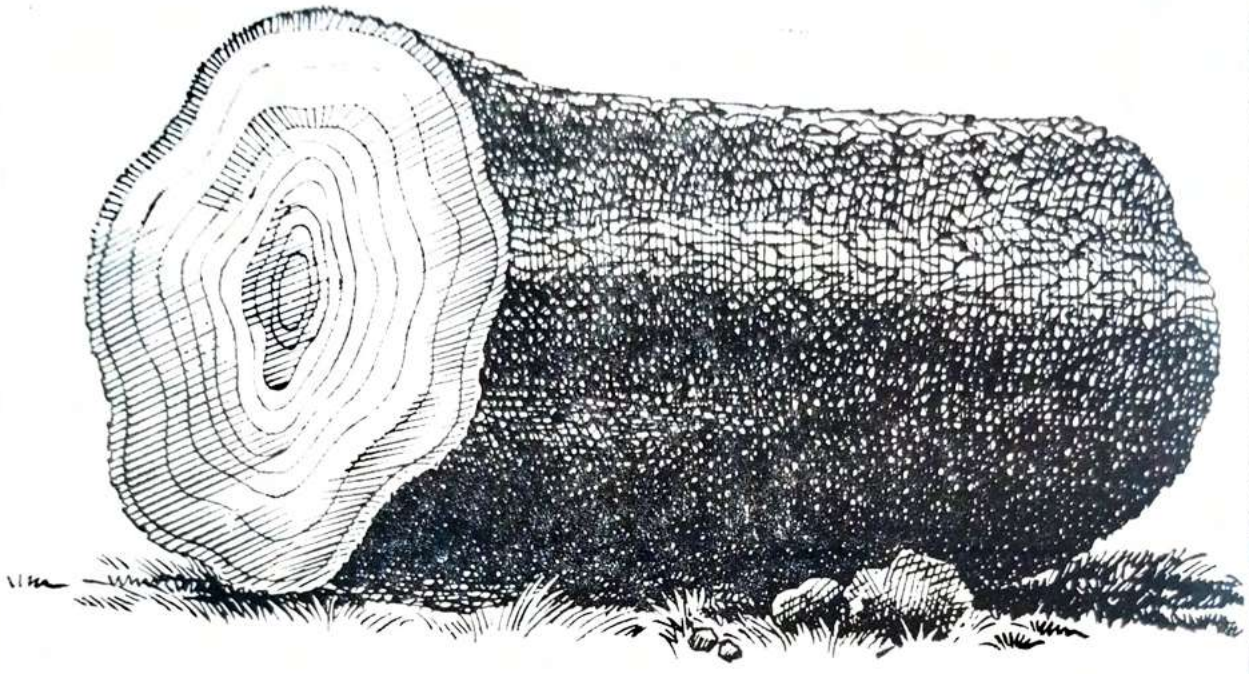
The study was undertaken to develop a standardized knowledge test on Sugarcane Production Technology, assess the level of knowledge and adoption, perdict the extent of variation in the level of knowledge of sugarcane growers caused by selected variables, to identify the constraints perceived and seek suggestions to overcome the same in adoption of Sugarcane Production Technology.

In order to realise the above objectives, a sample of 150 sugarcane growers, representing 12 villages of Kodinar taluka of Amreli district was drawn by using multistage random sampling technique.

Salient findings of the study were: (1) A standardised knowledge test consisted of 50 items was developed to measure the sugarcane growers' extent of knowledge about sugarcane production technology. (2) As many as 67.34 and 72.66 per cent of the sugarcane growers had medium level of knowledge and medium level of adoption about sugarcane production technology. (3) Sugarcane growers possessed more knowledge with respect to the practices of sugarcane production technology such as seed selection, earthing up, improved varieties, intercrops, irrigation and planting period while they possessed less knowledge with respect to the practices like plant protection, jaggery preparation, chemical fertilizers, seed treatment and weed control. The same trend was observed in case of the adoption of various practices of Sugarcane Production Technology. (4) There was a positive and significant association between sugarcane growers' level of knowledge about sugarcane production technology and their characteristics like education, social participation, farm mechanization index, adoption index, innovation proneness, extension participation index and localite cosmopolite value orientation. They were jointly contributing significantly to 36.36 per cent of the variation in extent of knowledge about sugarcane production technology of sugarcane growers. Among these seven variables, only three variables such as education, extension participation index and localite-cosmopolite value orientation were jointly contributing significantly to 32.17 per cent of the variation. The order of contribution of these seven variables from highest to lowest was extension participation index, localite-cosmopolite value orientation, education, social participation, farm mechanization, adoption index and innovation proneness. (5) Most important constraints in adoption of improved sugarcane production technology were irregular and insufficient electricity supply, small holding for green manuring, intercrops not convenient due to weeds, high cost of farm fuel, scarce irrigation facilities, absence of location specific recommendation for earthing

up, lack of drought resistant varieties and lack of technical know-how about plant protection chemical fertilizers, etc. (6) Most important suggestions to overcome the constraints were regular supply of electricity for irrigation purpose should be ensured, soil testing facilities should be available at least at taluka level, method demonstration on how to take soil sample, seed treatment, etc. should be conducted, drought resistant varieties should be evolved, technical guidance on improved varieties, fertilizers, etc. should be extended more number of check dams should be constructed at suitable places, varietywise water requirement should be recommended and effective biological weed control methods should be evolved.

From Strength to Strength



At Sudarshan Chemicals, growth has come from within. Converging upon itself to expand and diversify. From pigments and intermediates to insecticides and now herbicides. But above all to emerge as a company committed to indigenisation and quality.

In the process, Sudarshan has come closer to the farmer than ever before. Understood his needs and problems. Helped increase agricultural productivity, saved valuable foreign exchange for the country by indigenisation, thus holding the price line.

AND NOW BUTACHLOR

Now, for the first time in India, a Butachlor herbicide plant with technology developed entirely by our own R & D. Soon, Butachlor Technical and the herbicide formulation WIDKIL will both be available. A boon to the farmers, A boon to the country!

A Synonym for Self Reliance!

Sudarshan

Sudarshan Chemical Industries Ltd.
(Agro Chemical Division) 162 Wellesley Road, Pune - 411 001

PAUSHAMYCIN-a synonym of progressive farmers.

Paushak

PAUSHAMYCIN

preventive, curative and broad spectrum antibiotic to control

* Rice bacterial leaf blight and leaf streak
* Cotton angular leaf spot or black arm
* Cabbage, Cauliflower black rot
* Potato soft rot and ring rot
* Cucumber angular leaf spot
* Gram seedling rot and blight
* Sugarcane red stripe
* Sesamum bacterial blight and leaf spot.
* Betelvine bacterial leaf spot
* Citrus canker
* Chillies and Tomato black spot
* Tobacco wildfire and blue mold
* Cucurbit bacterial wilt
* Maize stalk rot
* Tea blister blight
* Soyabean blight/pustule
* Apple and pear fire blight

APPLICATION

1. seed treatment 2. seedling dip 3. crop spray

PAUSHAK LIMITED, Alembic Road, Baroda-390 003

ભરી-ભરી ખેતી
ફૂલી-ફાલી શેરડી
ઉજ્જવલા સંગ
લચી-લચી ફસલ!

ઉજ્જવલા

યુરિયા
૪૬.૪% નાઈટ્રોજન

સુફલા

રાષ્ટ્રીય કેમિકલ્સ ઍન્ડ ફર્ટિલાઈઝર્સ એશિયામાંના ફર્ટિલાઈઝરના સૌથી મોટા પ્લાન્ટ છે. આર.સી.એફ. નાં ટ્રૉમ્બે તથા થળ ખાતેનાં બંને એકમોમાં વાર્ષિક લગભગ ૨૦ લાખ ટન ઉજ્જવલા યુરિયાનું ઉત્પાદન કરાય છે.

સ્ફટિક જેવું શુભ્ર, દાણાદાર, વાસરહિત અને અદ્યતન પદ્ધતિથી બનાવવામાં આવતું ઉજ્જવલા યુરિયા ખેડૂતોમાં ખૂબજ લોકપ્રિય છે.

ઉજ્જવલામાં બાયયુરેટ્સનું પ્રમાણ ઓછું હોવાથી એ બધાયે પાકો માટે વધુ લાભદાયી નીવડે છે. ૪૬.૪ ટકા નાઈટ્રોજનનું તત્ત્વ ધરાવતું ઉજ્જવલા યુરિયા બીજાં ખાતરો-ફર્ટિલાઈઝરો અને જંતુનાશકોમાં ભેળવીને પણ વાપરી શકાય છે.

ઉજ્જવલા તથા સુફલા ફર્ટિલાઈઝરો વાપરતાં પહેલાં આર.સી.એફ.ની અમરાવતી, કોલ્હાપુર અને ટ્રૉમ્બે ખાતે આવેલી માટી-ચકાસણીની પ્રયોગશાળામાં માટીના નમૂનાની વિનામૂલ્ય ચકાસણી કરાવીને ભલામણ મુજબ સંતુલિત પ્રમાણમાં ફર્ટિલાઈઝરો વાપરવાં. સામાન્ય રીતે, બાજુમાં આપેલકોઠા અનુસાર ફર્ટિલાઈઝરો વાપરી શકાય

હેક્ટર દીઠ પ્રમાણ (કુવી)

પાક	ઉજ્જવલા યુરિયા ૪૬.૪%/નાઈટ્રોજન ૧૫:૧૫:૧૫	સુફલા
જુવાર	૩	૮
કપાસ	૨	૭
શેરડી (સુરુ)	૬	૧૫
(આડ વર્ષે)	૧૦	૨૩

રાષ્ટ્રીય કેમિકલ્સ ઍન્ડ ફર્ટિલાઈઝર્સ લિમિટેડ

(ભારત સરકારનું અંગીકૃત ઉદ્યોગમાલત્ત)