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Differential Response of Whiteflies (*Bemisia tabaci* Gen;) to Nicotiana Species

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ABSTRACT

Responses of 18 *Nicotiana* species to whiteflies (*Bemisia tabaci*) were studied under glass-house conditions. Fourteen species showed varying degrees of susceptibility, while four were toxic. *N. repanda* and *N. wigandioides* had a minimum number of whiteflies among the susceptible and toxic groups, respectively. *N. glauca* and *N. gossei* were highly attractive to whiteflies within the susceptible and toxic groups, respectively. The paper suggests the utilization of toxic species for extraction of biochemical substance for control of whiteflies and using the species as donors for breeding leaf curl resistant cultivars. Use of *N. gossei* as a plant community benefactor is also suggested. *(Received on Spet. 25, 1975).*

INTRODUCTION

WHITEFLIES, the vectors of leaf curl disease, are important pests of tobacco. This disease adversely affects the product both qualitatively and quantitatively. This pest could be controlled, of course with difficulty, by insecticidal sprays, but the tobacco trade is very averse to chemical residues present in the final product. Hence, biological control either by finding suitable parasites of whiteflies or by developing varieties resistant to whiteflies would be the most desirable way to control the vectors of leaf curl. Many *Nicotiana* species have been found resistant to various insect pests but no information is available about the response of *Nicotiana* species to whitefly infestation. Moreover, the insects prevalent in different regions may vary genetically in regard to insect plant relationships. Hence, the present study was undertaken to find out the response of whiteflies to various *Nicotiana* species under green house conditions.

METHODS

Eighteen *Nicotiana* species (Table 1) were tested in 1974-75. Seedlings, 6 cm tall, of the different species were transplanted in earthen pots of 15 cm dia-

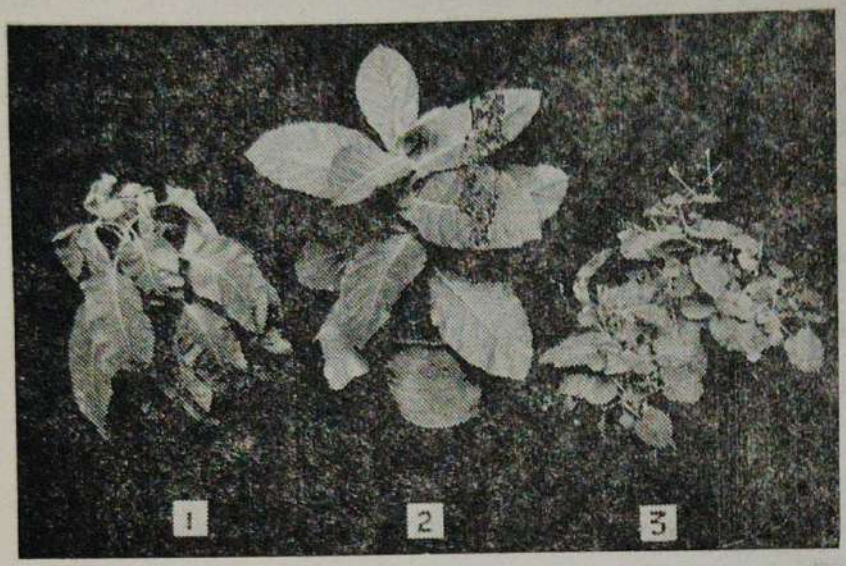

Fig. 1. Susceptible and toxic species of *Nicotiana*

1. *N. glauca* **(Susceptible)**

2. *N. gossei* **(Toxic)**

3. *N. umbratica* **(Toxic)**

meter. One month after transplanting, four pots of each species were randomised on green house benches. Migrant whiteflies from an unknown host provided the source of infestation in the green house. The whiteflies were allowed to breed for 30 days on the different species, and the population was estimated by counting all whiteflies present on the plant, by lifting the leaves gently one by one commencing at the top of the plant and working downwards. It was possible to count the insects while they continued to feed undisturbed. Early morning hours were found to be very congenial for taking counts. Only adults actually sitting and feeding on the leaves were included in the counts. Except in cases of severe infestation a very few adults flew away from the plant during counting.

The different species of *Nicotiana* are divided into two groups viz., susceptible and toxic, the former group had alive whiteflies whereas the latter group had all dead whiteflies. This suggested the desirability to divide the species into two broad categories. The average number of whiteflies on various species are presented in Table 1.

RESULTS AND DISCUSSION

All 18 species (Table 1) gradually accumulated varying degrees of whitefly population. Among the species in the susceptible group, *N. repanda* had the lowest whereas *N. glauca* had the highest number of whiteflies (Fig.1), indicating that the whiteflies preferred to breed profusely on *N. glauca*. Within the toxic group, *N. gossei* and *N. umbratica* were third and fourth in order for the large number of dead flies which indicates the high toxicity levels of these species and rapidity of mortality of the insect. Thurston and Webster (1962) reported the toxicity of *N. gossei* to aphids (*Myzus persicae* Sulz.) due to the toxic principle secreted by the glandular trichomes. It is likely that the same principle may also work against whiteflies when they

TABLE—1

Population of whiteflies on different species of *Nicotiana*.

Nicotiana species	*Average* number of whiteflies*	*Rank*
Susceptible group:		
N. repanda Willd	2	1
N. rustica Lin	9	2
N. langsdorffii Wein	13	3
N. glutinosa Linn	14	4
N. palmeri Gray	25	5
N. hesperis Bur	36	6
N. benthamiana Dom	36	6
N. longiflora Cava	41	7
N. tabacum Lin A. 119	205	8
N. amplexicaulis Bur	277	9
N. debneyi Dom	328	10
N. undulata Rin & Pav	498	11
N. sylvestris Speg & Com	580	12
N. glauca Gr	1500	13
Toxic group:		
N. wigandioides Koch & Fin	4 D	1
N. trigonophylla Don	8 D	2
N. umbratica Bur	210 D	3
N. gossei Dom	344 D	4

*Average of four plants
D–Dead whiteflies

feed on *N. gossei* and *N. umbratica*; the latter species also has trichomes. The cultivated bidi tobacco variety, Anand 119 ranked eighth among the species studied. *N. repanda* and *N. wigandioides* were the least preferred hosts but had different mechanisms to protect themselves from whiteflies; the former had living flies, while the latter had dead flies. These findings indicate the desirability of isolating and identifying the compound responsible for killing the attracted whiteflies. This compound could be utilized in controlling whiteflies. *N. gossei* could also be used for peripheral planting to attract and kill the whiteflies, thus perhaps providing effective protection to the main crop without any insecticidal spray.

Nicotiana glauca would be a desirable host for the mass multiplication of whiteflies for biological studies. During the current study it was observed that though *N. repanda* was a least preferred host, the two whiteflies (on an average) observed on the plant were enough to transmit leaf curl virus as some of the plants had succumbed, whereas none of the species from the toxic group viz., *N. gossei*, *N. umbratica*, *N. trigonophylla*, *N. wigandioides* had leaf curl symptoms. This suggests that presumably the whiteflies feeding on these plants were either killed instantaneously prior to their transmitting the inoculum to the host or that the host cell constituents were not congenial for the multiplication/survival of the virus. Hence the group

of species that inhibit the virus could be utilized for incorporating resistance/tolerance factors to leaf curl in *N. tabacum*. Among the four toxic species, *N. gossei* would be the most desirable donor considering its high toxicity and the rapidity of mortality of whiteflies.

REFERENCES

Thurston, R. and J. A. Webster. 1962. Toxicity of *Nicotiana gossei* Domin to *Myzus persicae* Sulzer. *Entomol. Exp. Appl.* 5: 233-238.

Effect of Nitrogen and Phosphate Levels on Forage Yield and Quality of Maize Varieties and Teosinte

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ABSTRACT

The present investigation was carried out during *kharif* (1971-73) at Anand to find out a variety of maize or teosinte suitable for this region and its manurial requirements for optimum forage yield. Nitrogen was applied at 0, 40, 80 and 120 kg/ha and phosphate at 0, 30 and 60 kg/ha. Among the four varieties of maize and one of teosinte, the maximum green forage, dry matter and crude protein yields were 465, 101 and 7.9 q/ha, respectively for teosinte variety T-1. Next was Ganga Safed-2. The varieties Ganga-5, Farm Sameri and Ganga-5 (F-2) showed poor performance as compared to the above two varieties. The application of nitrogen from 0 to 120 kg/ha, progressively increased the yield of green forage, dry matter and crude protein from 341 to 463 q/ha, 60.9 to 83.5 q/ha and 5.2 to 7.4 q/ha, respectively. Phosphorus application did not show such marked effect. *(Received on Octo. 9, 1974).*

INTRODUCTION

AMONG the high yielding cereal forage crops, maize (*Zea mays* L.) occupies an important position. Tripathi, Tomer and Moolani (1972) and Budoi and Budoi (1973) have studied the effect of nitrogen manuring on maize forage. The increase in yield of maize forage by the application of fertilizers has been reported by Raj, Rao, Lingegouda and Krishnamurthy (1971), Ovsyannikova (1974) and Tkachenko (1974). No effect on yield and quality of maize forage was observed by Gill, Pandey, Maurya, Singh and Abhichandani (1972) and Robinson and Murphy (1972) due to the application of phosphate. Gupta and Das (1961) and Kulshrestha, Upadhyaya and Saxena (1972) have studied the nutritive value of maize forage. Walli and Relwani (1962) have reported increase in the yield of teosinte (*Euchlaena mexicana*) by increasing the doses of nitrogen application.

The present experiment was therefore, undertaken to study the comparative performance of four maize varieties and one of teosinte under the influence of different levels of nitrogen and phosphate manuring.

METHODS

This experiment was conducted in *kharif* seasons of 1971, 1972 and 1973 at the Forage Research Project, Gujarat Agricultural University, Anand. Four varieties of maize viz., 'Ganga Safed–2', 'Ganga-5', 'Farm Sameri' and 'Ganga-5 (F-2)' and one of

teosinte 'T-1' were sown by drilling in rows 25 cm apart at 50 kg/ha seed rate. Split-plot design with three replications was followed. A common basal dose of 25 kg K_2O/ha was applied at the time of preparation of land. Nitrogen was applied at four levels of 0, 40, 80 and 120 kg/ha and phosphate at three levels of 0, 30 and 60 kg/ha. The main plot treatments were of varieties × phosphate levels and sub-plot treatments were of nitrogen levels.

Each variety was harvested at silking stage and plot–wise green forage yield was recorded, from which dry matter yield was determined. Crude protein content of forage samples of each treatment was determined as per the AOAC (1960) method. At the harvesting stage plot–wise plant height was measured and from the weights of leaf and stem, leaf-stem ratio was calculated.

RESULTS AND DISCUSSION

The data on green forage and dry matter yields are given in Table 1 and the results of crude protein and plant characters are presented in Tables 2 and 3, respectively.

TABLE—1

Green forage and dry matter yields of maize varieties and teosinte.

Treatments	Green forage, q/ha				Dry matter, q/ha			
	1971	1972	1973	Mean	1971	1972	1973	Mean
Varieties:								
Ganga Safed-2	409	372	561	447	64.2	71.3	74.6	70.0
Ganga-5	441	355	478	425	71.0	81.1	59.3	70.5
Farm Sameri	351	294	493	379	51.6	58.5	63.0	57.7
Ganga-5 (F-2)	244	340	364	316	36.4	75.4	70.2	60.7
Teosinte	584	415	395	465	126.3	97.7	79.0	101.0
C.D. at 5%	40.8	33.6	49.2	—	6.5	7.6	7.0	—
N levels:								
0 kg/ha	334	286	404	341	57.1	64.3	61.4	60.9
40 ,,	385	354	434	391	64.7	77.2	65.7	69.2
80 ,,	435	375	479	430	72.4	78.0	72.6	74.3
120 ,,	469	406	515	463	85.4	87.8	77.2	83.5
C.D. at 5%	15.6	14.6	30.2	—	3.1	3.5	4.5	—
P_2O_5 levels:								
0 kg/ha	414	373	444	410	71.0	77.5	66.9	71.8
30 ,,	408	350	469	409	71.4	79.1	71.6	74.0
60 ,,	395	342	461	399	67.4	73.9	69.2	70.2
C.D. at 5%	—	—	—	—	—	—	—	—
C.D. at 5% for interactions:								
V x N	—	—	—		2.2	7.8	—	
V x P	—	—	—		—	13.2	—	
N x P	—	—	—		5.4	—	—	
V x P x N	—	—	—		10.4	13.5	—	

N.B.: C.D. values are given only for significant effects.

TABLE—2

Crude protein content and yield of maize varieties and teosinte.

Treatments	*Crude protein per cent*				*Crude protein yield q/ha*			
	1971	*1972*	*1973*	*Mean*	*1971*	*1972*	*1973*	*Mean*
Varieties:								
Ganga Safed-2	8.9	9.3	10.0	9.4	5.70	6.63	7.43	6.59
Ganga-5	8.5	7.7	9.4	8.5	5.99	6.27	5.60	5.95
Farm Sameri	9.6	9.3	10.3	9.7	4.98	5.46	6.52	5.65
Ganga-5 (F-2)	10.8	7.8	8.8	9.1	3.91	5.90	6.25	5.35
Teosinte	7.3	8.0	8.4	7.9	9.24	7.83	6.67	7.91
N levels:								
0 kg/ha	9.1	8.2	9.1	8.8	4.84	5.17	5.54	5.18
40 „	9.2	8.1	9.3	8.9	5.56	6.15	6.12	5.94
80 „	8.9	8.7	9.8	9.1	6.11	6.71	7.04	6.62
120 „	9.0	8.8	9.4	9.1	7.34	7.65	7.27	7.42
P_2O_5 levels:								
0 kg/ha	9.4	8.7	9.3	9.1	6.34	6.64	6.23	6.40
30 „	8.8	8.2	9.3	8.8	5.87	6.46	6.61	6.31
60 „	8.9	8.4	9.6	9.0	5.69	6.16	6.63	6.16

TABLE—3

Plant height and leaf-stem ratio of maize varieties and teosinte.

Treatments	*Plant height cm*				*Leaf–stem ratio*			
	1971	*1972*	*1973*	*Mean*	*1971*	*1972*	*1973*	*Mean*
Varieties:								
Ganga Safed-2	210	215	212	212	1.00	1.15	1.15	1.10
Ganga-5	209	211	211	210	0.90	1.00	1.12	1.01
Farm Sameri	190	185	213	196	0.95	0.95	1.05	0.98
Ganga-5 (F-2)	208	211	215	211	0.88	0.90	0.85	0.88
Teosinte	202	174	184	187	0.89	0.90	0.79	0.86
N levels:								
0 kg/ha	197	190	196	194	0.95	0.94	1.02	0.97
40 „	207	199	205	204	0.96	0.94	1.00	0.97
80 „	213	201	213	209	0.86	1.03	0.97	0.95
120 „	214	206	214	211	0.94	1.00	0.97	0.97
P_2O_5 levels:								
0 kg/ha	211	199	204	205	0.92	1.01	1.02	0.98
30 „	206	198	208	204	0.92	0.95	0.98	0.95
60 „	206	195	208	203	0.94	0.98	0.98	0.97

From the results presented in Table 1, it is seen that the green forage and dry matter yields of maize varieties differed significantly in all the three years. The yield of green forage ranged from 244 to 584 q/ha, 294 to 415 q/ha and 364 to 561 q/ha in the year 1971, 1972 and 1973, respectively. The yields of green forage obtained by Budoi and Budoi (1973), Kulshrestha *et al* (1972) and Tkachenko (1974) ranged from 274 to 419 q/ha, 312 to 419 q/ha and 266 to 427 q/ha, respectively. These values are in the range reported here. Gill *et al* (1972) have reported only 97 to 187 q/ha green forage yield. The trend of green forage yield with respect to varieties was not consistent in all the three years. On an average, teosinte and Ganga Safed – 2 were found superior, Farm Sameri and Ganga-5 (F-2) inferior and Ganga-5 intermediate in green forage yield.

In dry matter production teosinte was found consistently superior in all the years and on an average it yielded 101 q/ha dry matter. In rest of the varieties, the dry matter production ranged from 57.7 to 70.5 q/ha. Budoi and Budoi (1973), Kulshrestha *et al* (1972) and Tripathi *et al* (1972) reported dry matter yield ranging from 63 to 91, 90 to 123 and 82 to 94 q/ha, respectively. These results are comparable to those reported in the present study. Ganga Safed-2 and Ganga-5 were found intermediate and Ganga-5 (F-2) and Farm Sameri inferior in this respect. The yields of dry matter per day were 1.37, 1.23, 1.16, 1.02 and 1.00 q/ha for teosinte, Ganga Safed-2, Ganga-5, Farm Sameri and Ganga-5 (F-2), respectively.

A linear increasing trend was observed for green forage and dry matter yields in all the three years for nitrogen doses varying from 0 to 120 kg/ha. Similar trend has also been reported by Budoi and Budoi (1973), Gill *et al* (1972), Robinson and Murphy (1972) and Tripathi *et al* (1972) in the case of maize and by Walli and Relwani (1962) in the case of teosinte. The average green forage and dry matter yields increased significantly from 341 to 463 q/ha and 60.9 to 83.5 q/ha, respectively by the application of nitrogen from 0 to 120 kg/ha. Phosphate application had no significant effect on yield. Robinson and Murphy (1972) also observed no effect on yield due to application of phosphate, while Gill *et al* (1972) reported slight increase in the yield due to application of 100 kg P_2O_5/ha over no application.

No significant differences in green forage yield were observed due to interactions in all the three years. The differences in dry matter yield were significant due to interactions V×N, N×P and V×P×N in the year 1971 and V×N, V×P and V×P×N in the year 1972. The fertilizer dose consisting of 120 kg N and 30 kg P_2O_5 per hectare was found optimum for maximum dry matter production.

In respect to crude protein content, Farm Sameri was top ranking having an average of 9.7 per cent. Crude protein yield of teosinte (7.91 q/ha), though the lowest in crude protein content (7.9%), was maximum. The second best variety found was Ganga Safed-2 which yielded 6.59 q/ha crude protein.

Somewhat increasing trend in crude protein content of forage was observed with the increasing doses of nitrogen. Similar trend was also observed by Gill *et al* (1972) and Tkachenko (1974). The crude protein yield increased considerably in all the years with the application of increased doses of nitrogen. On an average, with the application of 0, 40, 80 and 120 kg N/ha, crude protein yield increased from 5.18 to 5.94, 6.62 and 7.42 q/ha, respectively. Phosphate application has not shown much effect either on crude protein content or its yield.

The results of plant height indicated that the high yielding variety teosinte was the lowest and Farm Sameri was intermediate in height, while other varieties were tall in this respect. The application of nitrogen showed consistent increase in plant height in all the years with an average height varying from 194 to 211 cm. Phosphorus application had no such effect. In leaf-stem ratio, Ganga Safed-2 was found more leafy, while Farm Sameri and Ganga-5 (F-2) less leafy. Various doses of nitrogen or phosphate were without any effect on leafiness of maize varieties.

REFERENCES

AOAC 1960. Official and Tentative Methods of Analysis. Association of Official Agricultural Chemists, Inc., Washington, 4, D. C. 9th. Ed. p. 94-117.

Budoi, G. and I. Budoi, 1973. Contribution concerning the culture of different maize double hybrids in stubble fields. *Herbage Abst.* **43:** 6.

Gill, A. S., R. K. Pandey, R. K. Maurya, M. Singh and C. T. Abhichandani, 1972. Response of NPK on the fodder yield of hybrid maize. *Indian J. Agri. Sci.* **6:** 159-162.

Gupta, Y. P. and N. B. Das, 1961. Nutritive value of maize as influenced by manures and fertilizers. *Indian J. Agri. Sci.* **31:** 47-52.

Kulshreshtha, S. K., R. B. Upadhyaya and J. S. Saxena, 1972. Studies on the potentialities of hybrid maize fodder for livestock. *Indian Vet. J.* **49 :** 619-622.

Ovsyannikova, S. M. 1974. Effect of nitrogen and phosphorus fertilizers and their combination with compost on maize yield. *Herbage Abst.* **44 :** 6.

Raj, P., D.S.H. Rao, B. K. Lingegouda and K. Krishnamurthy 1971. Suitability of closer spacing with high fertilizers for composite and hybrid maize. *Indian J. Agri. Sci.* **41:** 944-947.

Robinson, D. L. and L. S. Murphy, 1972. Influence of nitrogen, phosphorus and plant population on yield and quality of forage corn. *Agronomy J.* **64:**349-351.

Tkachenko, M. M. 1974. Fertilization of maize on peat-bog soils. *Herbage Abst.* **44**:133.

Tripathi, H. P., P.S. Tomer and M. K. Moolani, 1972. Quality of maize fodder in relation to nitrogen levels and weed control. *Indian J. Agri. Sci.* **42**:1047-1051.

Walli, T. K. and L. L. Relwani, 1962. A note on effect of seed rates and N levels on fodder yields of teosinte. *Indian J. Agri Sci.* **32**:79-86.

Line × Tester Studies in Flue-Cured Virginia Tobacco*

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ABSTRACT

The combining ability and gene effects of developmental and agronomic traits of the FCV tobacco were studied using 12 fertile cultivars, two male-sterile lines and their 24 hybrids. The general combining ability variance component of males was significant for leaf length, breadth and thickness; bright leaf yield, TBLE and leaf curl disease incidence. The general combining ability variance of females was significant for number of suckers, leaf breadth and tobacco mosaic virus disease incidence. The specific combining ability variance was significant for weight of suckers only. Nonadditive effects were primarily involved for internode length, weight of suckers, leaf area and chloride content, while both additive and nonadditive effects governed the expression of number of suckers, leaf length, breadth and thickness; bright leaf yield and TBLE. The tobacco mosaic virus and leaf curl disease characters were governed by additive effects. *(Received on July 16, 1975).*

INTRODUCTION

THE availability of cytoplasmic-genetic male-sterile lines (Chaplin, 1969) has hastened the feasibility of commercial cultivation of hybrid tobacco. Burley tobacco hybrids are currently being grown in the USA, but the Flue-Cured Virginia (FCV) tobacco hybrids are still under observations in order to put them on commercial footing. Isolation of varieties that will contribute favourable gene(s) for yield and quality is an essential step in the scientific development of FCV tobacco hybrids. The combining ability and gene action of developmental and agronomic traits of the FCV tobacco have been studied by many workers like Matzinger (1959), Matzinger, Mann and Robinson (1960), Matzinger *et al.* (1962), Legg, Matzinger and Mann (1965) Murty (1965), Chang (1966), Chaplin (1966), Gwynn (1966), Matzinger (1968) and Vandenberg and Matzinger (1970) using fertile × fertile FCV crosses. The object of this study is to determine the combining ability of 12 fertile and two male-sterile FCV tobacco varieties for various characters.

METHODS

The experimental material consisted of two male-sterile lines (PDMS 1 and PDMS 2) used as female parents, a set of 12 male parents (Bonanza, Delcrest, Golden wilt, Yellow Special, NC

*Part of the M.Sc. (Agri) thesis submitted to the Gujarat Agricultural University by the senior author.

73, NC 75, NC 95, SC 66, HR 62-7, CTRI Special, Special FCV and line 1-99-83-14 and their 24 hybrids. The F_1 seeds were produced by hand pollination. The experimental material was grown during 1973-74 in a randomised block design using two replications. Each plot had two rows of 12 plants each, the inter and intra row spacing being one m and 0.5 m, respectively. The border plots were provided with guard rows.

The characters studied were as under:

(1) Days to flower were recorded by counting the days from transplanting to the opening of first flower. (2) Plant height was measured in cm from ground level to the crow-foot. (3) Internode length was derived by dividing plant height by total number of nodes. (4) Number of suckers was derived by counting all suckers of individual plant. (5) Weight of suckers was computed by weighing (in g) all fresh suckers. (6) Number of leaves harvested per plant were counted. (7) Leaf length was measured (in cm) from leaf base to leaf tip. (8) Leaf breadth was measured (in cm) in the maximum expanded region of the leaf. (9) Leaf area was measured with the help of a frame calibrated in sq cm. (10) Leaf thickness was calculated (mg/cm^2) by dividing the dry weight of leaves by total leaf area. (11) Green leaf yield was determined by weighing (in g) all leaves, harvested per priming and summing up the weights. (12) Cured leaf yield was determined by weighing (in g) the entire produce of each plot after curing. (13) Bright leaf yield represented the top grades of cured leaf with bright yellow, orange colour or little blemish having high commercial value. (14) Total Bright Leaf Equivalent (TBLE) an indication of quality was calculated by using the formula, TBLE= (bright leaf yield)+0.465 (medium grades), where medium grades comprised light bright yellow and light green grades. (15) Chloride content of the samples was determined by electrotitrimetric procedure (Murty *et al.* 1962). Entrywise entire population was scored at flowering stage for natural incidence of (16) Tobacco Mosaic Virus (TMV) and (17) Leaf curl diseases.

For the study of characters 1 to 10, five plants were selected at random from each plot. The observations were recorded on individual plant basis and the mean value per plot was computed. From the middle portion of each of the five plants selected at rondom three, leaves were selected for the study of characters 7 through 10 and the mean value per plot was computed. The produce of the entire plot was taken into consideration for traits 11 to 14. For chloride estimation, samples of cured leaves were taken from alternate primings beginning with second priming from the entire produce on plot basis.

The statistical analysis of all traits was done as suggested by Steel and Torrie (1960) and the mean squares for males, females and males × females were used for estimating the general combining ability of males (g_i) and females (g_j) as well as the specific combining ability (s_{ij}) using the method suggested by Beil and Atkins (1967) with necessary modifications. The males used in this

study were considered as random effects representing the FCV population, whereas the two females were considered as the fixed effects. Hence, the expectation of mean squares for mixed model have been used.

RESULTS AND DISCUSSION

Among males the g_i variance component was significant for leaf length, leaf breadth, leaf thickness, bright leaf yield, the TBLE and leaf curl disease incidence traits (Table 1). NC 73 was found to

TABLE—1

Variance components for general and specific combining ability obtained from the F_1 hybrids and for parents *vs* hybrids.

Characters	$\hat{\sigma}^2_{g_i}$	$\hat{\sigma}^2_{g_j}$	$\hat{\sigma}^2_{s_{ij}}$	σ^2 *Parents vs Hybrids*
Days to flower	–5.00	–2.29	11.66	349.63
Plant height	25.45	30.55	73.31	380.67
Internode length	0.03	0.10	0.04	5.80**
Number of suckers	0.05	0.25*	0.14	21.33**
Weight of suckers	594.38	–352.88	2536.99*	62619.05**
Number of leaves	0.27	0.85	0.90	0.10
Leaf length	3.42*	–0.18	–1.98	79.22**
Leaf breadth	1.01*	0.83*	0.59	25.52**
Leaf area	33.19	11.75	54.02	2830.72**
Leaf thickness	9.80**	–0.07	–1.96	114.27*
Green leaf yield	23227.07	28844.93	907399.98	4214827.02
Cured leaf yield	7044.91	16803.13	45001.09	205723.31
Bright leaf yield	42937.63**	8707.94	9106.87	247939.57*
TBLE	21924.88*	3839.99	23045.18	445302.18*
Chloride content				
Second priming	0.02	0.01	0.01	0.82*
Fourth priming	0.01	–0.03	–0.05	0.15
Sixth priming	–0.35	0.07	0.09	0.02
Eighth priming	0.12	0.05	–0.02	0.13
Tobacco mosaic virus	0.05	0.77**	–0.05	0.32
Leaf curl	0.07*	–0.004	–0.02	0.01

be a good donor for leaf length, leaf breadth and the TBLE, whereas NC 95 was found to have good general combining ability to impart thinness to the leaf, a desired feature for the FCV tobacco (Table 2). From bright leaf yield view point, delcrest was found to be a good donor. Though none of the parents or hybrids were free from leaf curl incidence under field conditions, HR 62-7 was found to be a better parent to be selected from the male parents used in the study for hybridization work to partly keep the leaf curl incidence at low level.

TABLE—2

Estimates of relative general combining ability effects of tobacco traits having significant $\hat{g}_i$ and $\hat{g}_j$ variances.

Parents	*Characters*							
	Number of suckers	*Leaf length*	*Leaf breadth*	*Leaf thickness*	*Bright leaf yield*	*TBLE*	*Tobacco mosaic virus incidence*	*Leaf curl incidence*
Males				$\hat{g}_i$				
Bonanza		–1.14	–0.84	–0.48	–163	–85		–0.44
Delcrest		0.17	–0.50	0.40	168	123		–0.05
Golden Wilt		0.29	0.53	–2.33	71	41		0.06
Yellow Special		–6.18	–2.07	10.61	–695	–556		–0.31
NC 73		4.07	2.96	–0.61	26	174		–0.02
NC 75		0.29	0.78	–1.65	82	40		0.06
NC 95		0.96	1.38	–4.56	80	106		0.33
SC 66		1.34	0.08	–3.29	151	165		–0.15
HR 62–7		–0.86	0.15	–0.30	113	38		–0.53
CTRI Special		–0.56	–1.24	1.36	–19	–108		0.41
Special FCV		–0.46	0.13	1.61	146	38		0.68
1–9–83–14		2.07	–1.27	–0.35	45	21		0.01
Females				$\hat{g}_j$				
PDMS 1	–0.4		–0.71				0.20	
PDMS 2	0.4		0.72				–0.21	

The g_j variance component of females was significant for number of suckers, leaf breadth and tobacco mosaic virus disease incidence trait (Table 1). Between the PDMS 1 and the PDMS 2 the former male–sterile line having tendency to produce minimum suckers was found to be a good donor for number of suckers, whereas the latter line was found to have good general combining ability for leaf breadth and to keep tobacco mosaic virus incidence at low level under field conditions (Table 2). The s_{ij} variance component was significant for weight of suckers (Table 1) and the hybrid PDMS 1 × Yellow Special had minimum sucker weight (Table 3). The femlae parent of this hybrid was also a good donor for poor sucker production. The PDMS 2 × Yellow Special hybrid had maximum value for specific combining ability for weight of suckers.

The presence of significant general and specific combining ability variances for number of suckers have been reported by Matzinger *et al.* (1962), whereas Chaplin (1966) could find only the general combining ability variance for this trait in the FCV tobacco. Matzinger *et al.* (1962), and Vandenberg and

TABLE—3

Estimates of relative specific combining ability $\hat{S}_{ij}$ effect for weight of suckers.

Females	*Males*											
	Bonanza	*Delcrest*	*Golden Wilt*	*Yellow Special*	*NC 73*	*NC 75*	*NC 95*	*SC 66*	*HR 62-7*	*CTRI Special*	*Special FCV*	*1-99-83-14*
PDMS 1	-28	-10	50	-100	5	40	36	14	-20	-35	-22	70
PDMS 2	28	9	-51	100	-6	-41	-36	-14	20	35	21	-71

Matzinger (1970) have reported significant general combining ability variance for leaf length and breadth of the FCV tobacco. Significant general combining ability variance for the FCV leaf quality has been observed by Matzinger *et al* (1962), Chang (1966), Chaplin (1966) and Gwynn (1966), whereas Vandenberg and Matzinger (1970) reported the presence of both general and specific combining ability variances for this trait.

The g_i, g_j and s_{ij} variance components for days to flower, plant height, internode length, number of leaves, leaf area, green leaf yield, cured leaf yield, chloride content in the produce of the second, fourth, sixth and eighth primings; the g_i variance compoent for number of suckers, weight of suckers and tobacco mosaic virus incidence; the g_j variance component for weight of suckers, leaf length, leaf thickness, bright leaf yield, the TBLE and leaf curl incidence and the s_{ij} variance component for number of suckers, leaf length, leaf breadth, leaf thickness, bright leaf yield, the TBLE, and tobacco mosaic virus and leaf curl incidences were nonsignificant.

The ratio of the sum of the variance components for general combining ability of males and females of those of the specific effects as well as the parents *vs* hybrids comparision (Table 1) revealed that nonadditive effects were primarily involved in the expression of internode length, weight of suckers, leaf area and chloride content in the produce of second priming, whereas both additive as well as nonadditive effects were involved in the expression of number of suckers, leaf length, leaf breadth, leaf thickness, bright leaf yield, and TBLE. For tobacco mosaic virus and leaf curl traits, additive effects were primarily involved.

Presence of additive variance for number of suckers (Matzinger, 1959; 1968), additive x additive (Matzinger *et al.* 1960) and additive genetic variances (Legg *et al.* 1965; Matzinger, 1968) for leaf length and additive variance for leaf breadth (Matzinger *et al.* 1960; Legg *et al.* 1965; Matzinger, 1968); and leaf quality (Matzinger, 1968) have been reported.

In summary, among the male lines studied, NC 73 showed good general combining ability for leaf length and breadth, and TBLE, whereas NC 95 was a good donor for leaf thinness. For bright leaf yield, delcrest was found to be a good donor. Between two male-sterile lines PDMS 1 and PDMS 2 studied, former was relatively shy for sucker production in hybrid combinations, while

the latter was a good donor for leaf breath. The PDMS 1 × Yellow Special hybrid had minimum sucker weight.

REFERENCES

Beil, G. M. and R. E. Atkins, 1967. Estimates of general and specific combining ability in F_1 hybrids for grain yield and its components in grain sorghum, *Sorghum vulgare* Pers. *Crop. Sci.* **7**:225-28.

Change, E. Y. 1966. Studies on combining ability in flue cured tobacco. *Chung—hua Nung—hsueh Hui Pao.* 53: 25-30 (*Fide Plant Breed. Abstr.* **43**:529).

Chaplin, J. F. 1966. Comparative performance of F_1 flue cured tobacco hybrids and their parents. 1. Agronomic and quality characteristics. *Tob. Sci.* **10:** 126-30.

————,1969. Registration of PDMS 1 and PDMS 2 tobacco germplasm. *Crop Sci.* **9**:681-82.

Gwynn, G. R. 1966. Combining ability in flue cured tobacco. *Tob. Sci.* **10**:149-53.

Legg, P. D., D. F. Matzinger, and T. J. Mann 1965. Genetic variation and covariation in a *Nicotiana tabacum* L. Synthetic two generations after synthesis. *Crop Sci.* **5**:30-33.

Matzinger, D. F. 1959. Genetic variability in flue cured varieties of *N. tabacum.* II Dixie Bright 244 x Cocker 139. *Abstr.* Annual Meeting Amer. Soc. Agron. Cincinnati, Ohio: p. 98 (*Fide Plant Breed. Abstr.* **30**:1241).

————, 1968. Genetic variability of flue cured varieties of *Nicotiana tabacum* L. III SC 58 x Dixie Bright 244. *Crop Sci.* **8**:732-35.

————, T. J. Mann, and H. F. Robinson. 1960. Genetic variability in flue cured varieties of *N. tabacum.* I. Hicks Broadleaf x Cocker 139. *Agron. J.* **52:** 8-11.

————,————, and C. C. Cokerham. 1962. Diallel crosses in *Nicotiana tabacum. Crop Sci.* **2:** 383-86.

Murty, B. R. 1965. Heterosis and combining ability in relation to genetic divergence in flue cured tobacco. *Indian J. Genet.* **25:** 46-56.

Murty, G.S.R., C.K.R. Kurup and A. S. Sastry 1962. Determination of chloride content of tobacco–A rapid electrotitrimetric method. *Indian tobacco.* **12:** 151-54.

Steel, R.G.D., and J. H. Torrie 1960. Principles and procedures of Statistics. *Mc. Graw—Hill Book Co., Inc., New York.*

Vandenberg, P., and D. F. Matzinger 1970. Genetic diversity and heterosis in Nicotiana. III Crosses among tobacco introductions and flue cured varieties. *Crop Sci.* **10** : 437-40.

Occurrence of Banana Mosaic in South Gujarat Area and its Host—Range*

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ABSTRACT

Banana mosaic is widely distributed in the South Gujarat area. Heart-rot was found to be associated with mosaic, which appears to be a different syndrome of the same infection. Infected plants do not bear bunches and hence loss due to disease can be about 10 per cent. *Zinnia elegans* **jacq.,** *Chrysanthemum sp.* **vis.,** *Centaurea cyanus* **Druce. and** *Dianthus barbatus* **L. are found to be new hosts for the virus. As** *Datura stramonium* **L. is an efficient host, the same is proposed to be used as test plant. The virus is considered to be Cucumis virus-1.** *(Received on April 19, 1975).*

INTRODUCTION

Virus diseases in banana are known to cause severe effect on their leaves (Wardlaw, 1961). Mosaic, heart-rot and bunchy top of banana do not allow bearing of the bunch on the affected plants. This is probably because the later 15 leaves, which contribute towards the yield of the crop, if damaged, normal yield is not expected (Brouhns, 1957).

Capoor and Verma (1968, 1970) reported that mosaic of banana in India is not associated with heart-rot and is not transmitted to solanaceous plants; while Magee (1940) reported association of heart-rot stage in Australia; and Silbertschmidt and Nobrega (1941) reported transmission of the disease to solanaceous hosts in Brazil. Hence, Capoor and Verma (1970) suggested the Indian strain to be different. In Gujarat, definite heart-rot was observed to be associated with mosaic of banana and hence investigations were undertaken to establish its identity.

METHODS

Survey:

Five places in South Gujarat area, where banana is extensively grown, were selected for a systematic survey of virus diseases of the banana. In each of these centres, two villages in the immediate vicinity were chosen (i) Bardoli—Tan and Barasadi (ii) Gandevi—Sonvadi and Gadat (iii) Kadodra—Haripura and Umbhel (iv) Motavarachha—Mamadev and Utran (v) Puna—Kumbharia and Magob.

In each of these ten villages total forty plots of (four plots in one village)

*Part of M.Sc. thesis of Shri D. M. Joshi.

½ acre of 4-5 months old basarai banana plantations were selected at random. These forty plots together with two such plots on the college farm were examined for the intensity of banana mosaic. These were again visited after two months and observations were recorded.

Host Range Study:

Thoroughly cleaned infected leaves were cut into small pieces, weighed and triturated to a fine pulp after adding equal quantity of 0.12 M sodium sulphite solution, in mortar with pestle. The juice was extracted by passing it through double layers of fine muslin cloth and diluted by adding 1 c c of 0.12 M phosphate buffer. Four young plants in each case were inoculated and the same number of plants were maintained as control.

RESULTS

Survey:

In the initial observation the intensity of infection observed in the area was 0.3, 1, 1, 1.5, 1.5 per cent at Bardoli, Gandevi, Kadodra, Motavarachha and Puna, respectively. However, in the second visit it was observed that at most of the centres cultivators had eradicated the infected plants. At places where farmers did not remove infected plants from the fields, the disease incidence was observed to be increasing five times within a period of a month. In such cases at the later stage the intensity of infection reached up to about 10%.

Though systematic survey could not be pursued at all the places, however, both mosaic and heart-rot were observed at all the places visited. Thus, the suvey confirmed that mosaic of banana together with heart-rot is prevalent throughout the South Gujarat area. No other virus disease could be traced during survey from the area.

The symptoms of the mosaic disease observed in the fields during the survey were more or less similar as described by Capoor and Verma (1970) (fig. 1).

The infected plants can be traced easily in the fields, as the leaves are of eractile habit with an uneven size and they are comparatively dwarf. In severely infected plants the leaves were

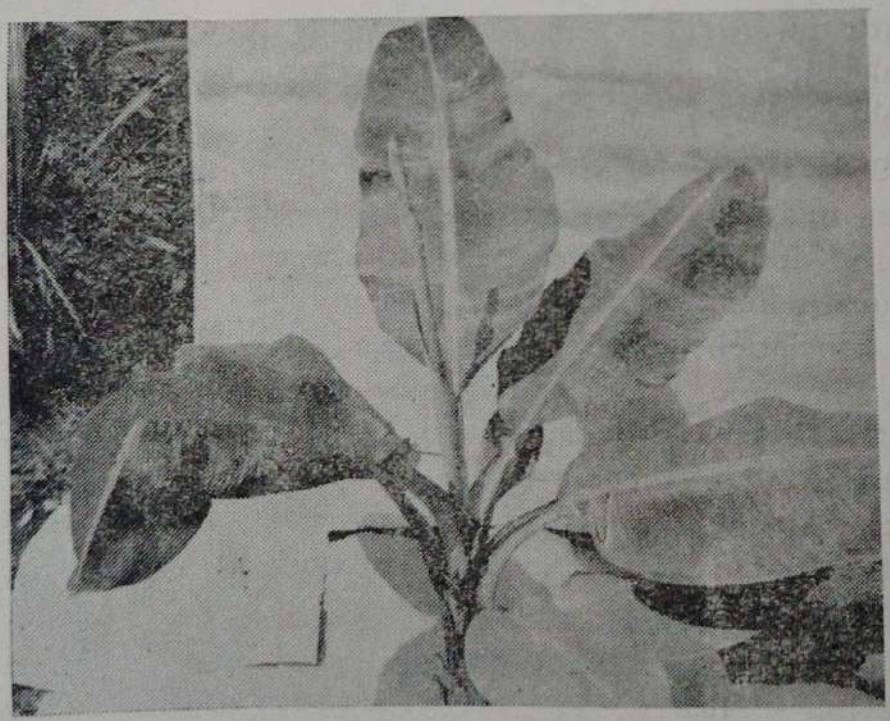

Fig. 1: Mosaic symptoms observed in field.

narrow with mosaic symptoms and the entire plant remained more or less stunted. The plant did not bear a bunch.

One prominant character, invariably associated in all the plants infected with mosaic disease was the partial rotting of the rhizomes. Horizontal cuts of the rhizomes of infected plants showed typical necrosis, gradually reducing from the bottom of the rhizomes towards the growing region, while the rest of the portion would be healthy.

Basarai banana plants showing severe mosaic symptoms later develop heart-rot symptoms, normally during late monsoon and in early winter. In this case, initially, water soaked black coloured, necrotic area was observed at the bottom of the newly emerging leaf (fig. 2). As the disease progresses the entire heart leaf may rot. The rotting proceeds upto rhizome. In a verticle section of such pseudostem, central portation would show severe necrosis (fig. 3). The disease brings about the death of the pseudostem but not that of the rhizome. Next season such rhizomes give out new suckers, which normally would be expressing typical mosaic symptoms.

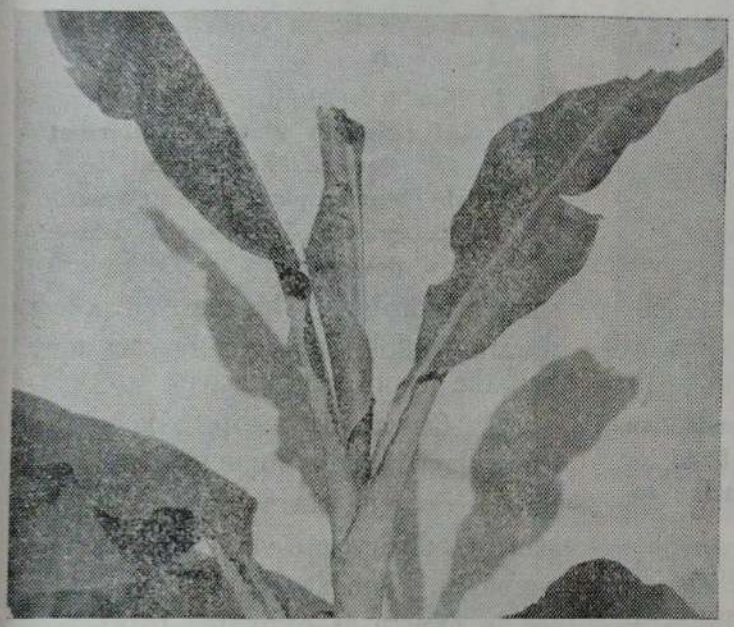

Fig. 2: Rotting observed at the bottom of the newly emerging leaf shows initiation of heart-rot.

Host Range Study:

Host range study was undertaken particularly to test solanaceous crops and also to know any other crop plants, might be acting as hosts for this virus.

The crops which proved to be the hosts are given in Table 1.

TABLE—1

Sap-transmission test, by the juice extracted from mosaic infected banana plant to various other host crops.

Hosts	*Total Nos. of plants*	
	Inoculated	*Infected*
Caryophyllaces:		
Dianthus barbatus L.	4	1
Compositae:		
Centaurea cyanus Druce.	4	4
Chrysanthemum sp. vis.	4	2
Zinnia elegans jacq.	4	4
Cucurbitaceae:		
Cucumis sativa L.	4	4
Pepilionaceae:		
Phaseolus vulgaris L.	4	2
Vigna sinensis Saviex Hassk	4	4
Solanaceae:		
Datura stramonium L.	4	4

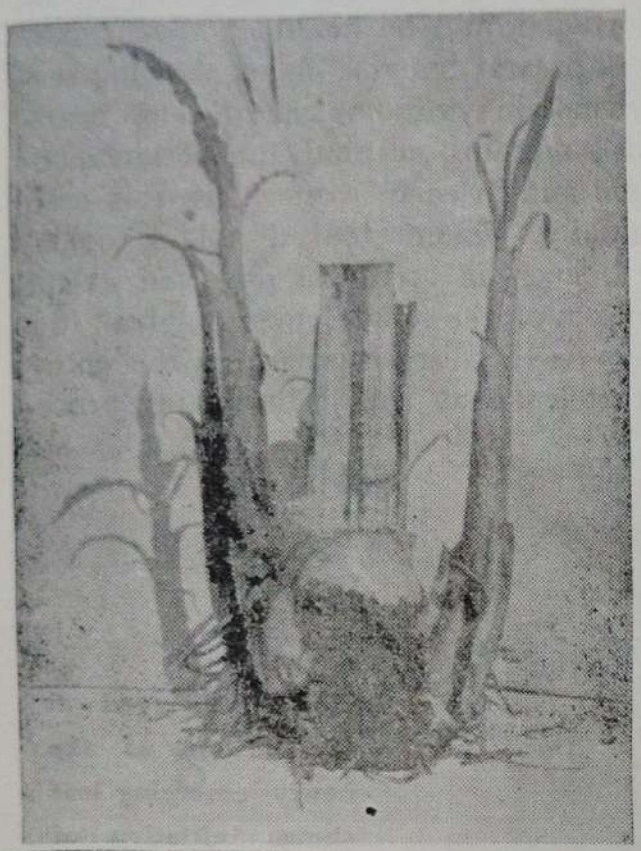

Fig. 3: Central portion of the pseudostem severely necroted, with band of black discoloration advancing towards rhizome end.

Thus under the investigation eight hosts were found to be susceptible to banana mosaic virus.

The symptoms expressed by *Cucumis sativa* L.; *Phaseolus vulgaris* L. and *Vigna sinensis* Saviex Hassk; are more or less similar as described by Capoor and Verma (1968, 1970). The symptoms expressed on new host plants are described as under:

1. *Dianthus barbatus* L.: The plants remain quite stunted and green for little longer time. The leaves are bunched together and show eractile habit of growth as compared to controls (fig. 4).

2. *Centaurea cyanus* Druce: In this host, the symptom development is exactly similar to that on *Zinnia elegans* Jacq,. The tips of the infected leaves

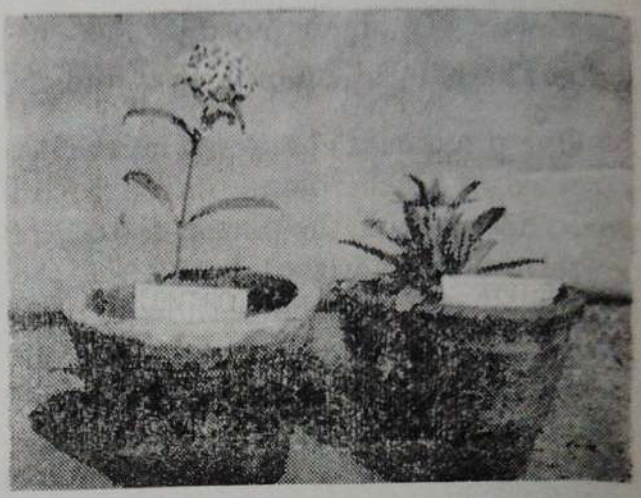

Fig. 4 : *Dianthus barbatus* L.
Left : Healthy plant with normal flower inflorescence.
Right : Stunted plant showing eractile growth of the leaves delayed flowering.

showed bronzing. This slowly proceeds towards petiole but never reaches upto half the length of the leaves.

3. *Chrysanthemum* Sp.: Inoculated leaves show initial symptoms after about three weeks. The leaves are slightly thickened and develop very mild mosaic symptoms. The plants are slightly reduced in growth as compared to healthy uninoculated controls.

4. *Zinnia elegans* Jacq.: The infected plants remain dwarf as compared to controls. After 20 days, the first sign of symptoms are visiable. Initially, leaves are found to be slightly chlorotic with very mild mosaic mottling. Later, the leaves reduced in size, slightly curved and deformed. It takes much longer time to produce floral heads, which are also reduced in the size and shape as compared to control. The colour of the flowers appear to be faded in infected plants (fig. 2).

5. *Datura stramonium* L. : Initially, the leaves start showing mild mosaic mottling within ten days. Gradually the margin of the infected leaves beco-

mes totally curved upward and inward. It also develops severe mosaic mottling together with reduction in leaf size (fig. 5).

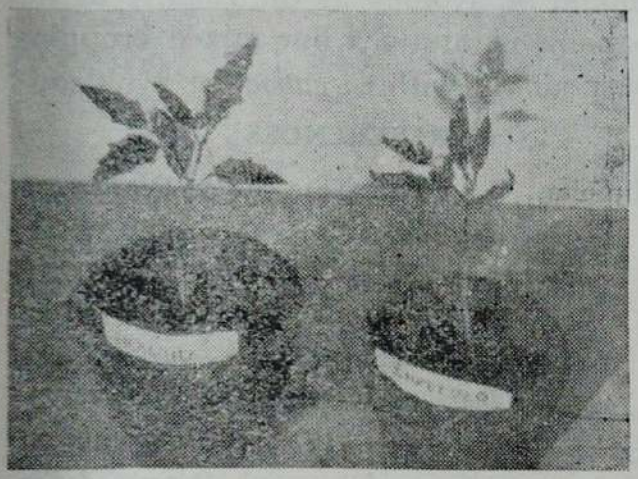

Fig. 5 : *Datura stramonium*
Left: Healthy control.
Right: Infected. Severe mosaic mottling leaf margin curved upward and inward.

The virus could not be transmitted mechanically to *Callistephus flavescens* Nees; *Tagetes sp.* L.; (Compositae), *Beta vulgaris* L. (Chenopodiaceae), *Lagenaria siceraria* Standl.; *Luffa egyptica* Roxb.; *Cucumis melo* E.C. 50385 L. (Cucurbitaceae); *Althea rosea* Cav. (Malvaceae); *Azadirachta indica* A.; (Meliaceae); *Musa cavendishi* Lamb. (Musaceae); *Medicago sativa*, L. E.C. 87657 and 87658; (Pepilionaceae), *Capasicum frutescence* L.; *Datura metel* L.; *Solanum melongena* L.; *Lycopersicon esculentum* Mill; *Nicotiana glutinosa* L.; *N. rustica* var Mohorka; *N. sylvastris; N. tabacum* L. Var Harrisons, Vartticks, Var white Burley, Var xanthi; (Solanceae), and *Daucus carota* L.; (Umbellifereae).

DISCUSSION

The survey on prevalence of virus diseases indicated that mosaic of banana associated with heart-rot was distributed throughout South Gujarat area. No other virus disease was found present. Thus, as reported by Kamat and Patel (1951) the bunchy top was not found prevalent in the survey, in South Gujarat area. Capoor and Verma (1968, 1970) reported occurrence of mosaic in South Gujarat area but did not find the occurrence of heart-rot symptoms with mosaic. In the investigation, mosaic and heart-rot were observed to be the two syndromes of the same type of infection. Unlike the report by Capoor and Verma (1970), the investigations revealed that mosaic of banana present in India is transmissible to solanaceous host *Datura stramonium.*

The disease reported from Brazil by Silbertschmidt and Nobrega (1941) is transmissible to species of *Nicotiana* together with *Datura stramonium* and *Petunia* sp.; one reported by Magee (1940) from Australia is transmissible to cucumber, tomato, tobacco, together with canna and abaca. The virus under this investigation is transmissible to hosts like *Datura stramonium* and *Cucumis sativa;* which are reported to be the hosts for banana mosaic virus in Brazil and Australia, respectively. The symptoms described are exactly similar. Therefore, virus reported in this study is probably the same as reported from these two countries. As reported by Capoor and Verma (1970) the virus could not be mechanically transmitted from banana to banana. The virus under present investigation is also transmitted to all the three hosts, *C. sativa*, *V. sinensis* and *P. vulgaris* as reported by Capoor and Verma (1970).

The symptoms produced on all the hosts are more or less similar, moreover, mosaic symptoms reported on banana are also exactly similar. Hence, it indicates that all these four viruses are identical.

Dianthus barbatus, *Centaurea cyanus*, *Chrysanthemum sp.* and *Zinnia elegans* are recorded to be the new hosts for the virus. So far, *Datura stramonium* was not recorded as the host for the Indian strain of banana mosaic virus. Previous workers have used *C. sativa* as test plant, to workout the different characteristics and nature of the virus. We propose here that instead of *C. sativa*, *Datura stramonium* would be a better test plant. This is because *D. stramonium* not only gives very pronounced symptoms but it also produces symptoms quite quickly. It takes less than 10 days to show infection while *C. sativa* takes more than three weeks.

Many workers have reported this to be the Cucumis virus-1 (Magee, 1940; Silbertschmidt and Nobrega, 1941; Vanhoof, 1962; Waite 1961;, Yot-Dauthy *et al*, 1966; Out of the hosts reported for the Cucumber virus; *C. sativa D. stramonium*, *Vigna sinensis*, *Phaseolus vulgaris*, *Lycopersicon esculentum*, *Zinnia elegans*, *Nicotiana glutinosa*, *N. rustica*, *Petunia* sp. and *Musa textilis* are now reported to be the hosts for the banana mosaic virus. The symptoms on these hosts produced by Cucumis virus are also in confirmity with what had been described by Magee (1940) and Slibertschmidt and Nobrega (1941). Therefore, banana mosaic virus is considered to be caused by Cucumis virus–1.

Khandesh area of Maharastra is known to be the source of fresh suckers for planting in South Gujarat area. The disease must, have been introduced from Khandesh. Importing the planting material from Khandesh, must therefore, be avoided. Fresh and healthy suckers should be obtained from disease-free area.

Mixed cropping is quite a common practice in the potential area of banana in South Gujarat, hence it is suggested that not only above narrated host crops should be avoided in the vicinity of the banana plantations but mixed cropping particularly with *C. sativa* be avoided.

REFERENCES

Brouhns, G., 1957. Note Surlo Crosissance due bananier "Gross Michel". *Fruits d'outere mer* **12:** 261-268.

Capoor, S. P. and P. M. Verma, 1968. Banana mosaic in Deccan. *Indian phytopath. Bull.* **4:** 11-14.

————and————, 1970. Investigation on mosaic disease of banana in Deccan. *Indian phytopath.* **23:** 62-68.

Kamat M. N. and M. K. Patel, 1951. Notes on two important plant diseases in Bombay State. *Plt. Prot. Bull.*, **3:** (1): 16.

Magee, C.J.P., 1940. Transmission of infections chlorosis or heart-rot of banana and its relationship to cucumber mosaic, *J. Austr. Jns. Agric. Sci.* **6:** 44-47.

Silbertschmidt, K and N. R. Nobrega, (1941). Sobre uma doenca de virus de bananeira (on a banana virus disease) *Biologico*, **7:** 216-219.

Vanhoof, H. A. 1962. A virus diseases of banana and plantain-surinaum-Landb; **10**(2): 47-52.

Wardlaw C. W., 1961. Banana diseases including plantains and abaca, Longmans Green and Co. Ltd., London. 68-145.

Waite, B. H. 1961. Virus disease of banana in Central America-*Proc. Carib. Reg., Amer. Soc. Hot. Sci.* **4:** 26-30.

Yot-Dauthy, Danielle and J. M. Bove, 1966. Banana mosaic identification and purification of various strains of the virus. *Fruits d'outevember* **21** (9): 449-446, (45-ref. INRA, Versailles).

Off Season Cultural Practices in Control of Root-knot of Tomato*

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ABSTRACT

An experiment to control root-knot nematodes on tomato in split plot design with four replications was conducted for three years. The results indicated that the plots unirrigated during summer had higher plant stand, fruit yield and shoot weight with comparatively less incidence of root-knot than irrigated ones. Similarly, deep ploughing during summer resulted in increased plant stand, fruit yield and shoot weight with reduction in disease index. Spot application of farm yard manure also resulted in increased plant stand, fruit yield and shoot weight, the disease index being least in these plots. Thus, deep ploughing without irrigation during summer coupled with spot application of farm yard manure in *kharif* resulted in increased plant stand, fruit yield and shoot weight, providing reasonable control of root-knot. From returns point of view, it gave higher gross realization even better than fumigation of soil with DD. (*Received on March 17, 1975*).

INTRODUCTION

ROOT—KNOT nematodes cause serious damage to tomato crop. Use of nematicides though effective, owing to their exorbitant cost and temporary effects, do not provide panacea for the melody to the common farmers. It was, therefore, felt imperative to explore the possibilities of other cheap, effective and practical methods to check the phytonematodes in the soil and have reasonable yields. Watson (1921) and Godfrey (1947) recommended summer fallow with periodic cultivation of soil for the control of root-knot disease. Several workers found addition of organic manure to the soil to be useful in reducing nematode infestation (O' Brien and Prentice, 1932; Goffart, 1949; Oostenbrink, 1950; and Schmidt, 1954). Oostenbrink (1954) obtained reduction in population of *Pratylenchus* sp. with f.y.m. Hams and Wilkin (1961) found that addition of f.y.m. in nematode infested soil promoted better growth of potato plants. Similarly, with addition of f.y.m., Desai, Patel, Shah and Naphade (1969) and Menon, Logiswaran, Seshadri and Thangaraju (1969)

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obtained increased yield of tomato and potato, respectively.

In the light of the above information and experience gained in feeler study, an experiment was conducted during 1968-69 to 1970-71 to find out efficacy of irrigation and cultivation in summer and application of f.y.m. in *kharif* in the control of root-knot nematodes on tomato.

METHODS

The experiment was laid out in a split-split-plot design with four replications. Tomato variety Marglobe was planted at 90 cm x 90 cm spacing. Treatments under trial were as follows:

Main plots: (1) Irrigation during April after the harvest of the preceding crop and (2) no irrigation.

Sub plots: (1) Deep ploughing once during April with mold board plough. (2) Harrowing four times during summer months.

Sub-sub-plots: (1) Spot application of f.y.m. @ 6 tonnes/ha,(2) Broadcast application of f.y.m. @ 6 tonnes/ha, (3) Fumigation with DD@ 562 l/ha applied 15 cm deep at 30 cm x 30 cm spacing and (3) Control (no application of f.y.m. or DD).

Observation on plant stand recorded at the close of the crop season was considered as final plant stand. Initial plant stand in the ultimate plot was 40.

Green tomato fruits plucked as and when ready for harvest provided the fruit yield and the weight of the plants cut at the collar joint at the end of the season provided fresh shoot weight.

Root-knot disease index was worked out by categorising the roots as healthy, slight, moderate, moderately high, heavy and very heavy infestation based on the intensity of galling on individual plant roots and grading them as 0 to 5, respectively. The average index was then worked out as under:

$$R_i = \frac{\Sigma n_{ij}\, G_j}{n_i}$$

Where R_i = Root-knot index for *ith* plot.

n_{ij} = Number of plants under *jth* category in *ith* plot.

G_j = *jth* grade value.

n_i = Number of plants examined in *ith* plot.

Data for 1968-69 season were excluded from the pooled analysis as the disease index was based on only four categories as against six in the remaining year.

RESULTS AND DISCUSSION

Pooled analysis of plant stand data for the year 1969-70 to 1971-72 (Table 1)

TABLE—1

Influence of some of the agronomical practices and organic amendments on plant stand of tomato (average number of plants per plot).

Irrigation	*Tillage*	*Organic amendments*				*Mean*	
		F.Y.M. spot application	*F·Y.M. as broadcast*	*Fumigation*	*Control*	*Tillage*	*Irrigation*
Summer irrigation	Deep ploughing	29	27	29	26	28.88	27.38
	Harrowing	31	25	27	25	27.75	
No irrigation	Deep ploughing	34	31	29	26		29.25
	Harrowing	31	30	28	25		
Mean organic amendments		31.25	28.25	28.25	25.50		

	S.Em.	*C.D. @ 5%*	*C.V. %*
Irrigation	0.46	1.44	16.0
Tillage	0.93	NS	18.3
Organic amendments	0.61	1.70	14.6

Interaction effects were not significant.

revealed that irrigation before commencement of summer cultivation had significantly adverse effect on plant stand as compared to no irrigation although it being relegated as main plot treatment, was unfavourably placed with regard to detection of differences. The effect of tillage, deep ploughing and harrowing in summer, was not significant, while the effect of organic amendments was significant and the spot application of f.y.m. at 6 tonnes/ha had maintained significantly more stand than the rest. There was no difference between 6 tonnes f.y.m. applied as broadcast and fumigation with DD, but both were better than the control which had the lowest plant stand (25.50 per plot). None of the interaction effect was significant. The results were more or less the same for individual years.

The green fruit yield data (Table 2) on pooled analysis revealed that though the effect was not significant, irrigation before commencement of summer cultivation had adverse effect on fruit yield as on plant stand and it gave lower yield (20802 kg/ha) than no irrigation (21852 kg/ha). The effect of tillage operations was significant and deep ploughing in summer gave significantly higher yield (24753 kg/ha) than normal harrowing (17870 kg/ha). The effect of organic amendments was significant and all treatments differed significantly among themselves. Spot application of f.y.m. had given the highest yield (27191 kg/ha), the next in order being fumigation with DD (23827 kg/ha). None of the interaction effect was significant, but the yield of 32284 kg/ha for the spot application of f.y.m. under deep ploughing and no irrigation in summer was quite high and noteworthy. The results for individual years had more or less the same trends.

TABLE—2

Influence of some of the agronomical practices and organic amendments on fruit yield of tomato (kg/ha).

Irrigation	Tillage	Organic amendments				Mean	
		F.Y.M. spot application	F.Y.M. as broadcast	Fumigation	Control	Tillage	Irrigation
Summer irrigation	Deep ploughing	28271	23302	28179	20123	24753	20902
	Harrowing	22562	13055	18457	12438	17870	
No irrigation	Deep ploughing	32284	22654	25432	17870		21852
	Harrowing	25710	15802	23179	11821		
Mean organic amendments		27191	18704	23827	15586		

	S.Em.	C.D. @ 5%	C.V.%
Irrigation	1423	NS	41.4
Tillage	731	2148	33.8
Organic amendments	843	2463	26.1

Interaction effects were not significant.

The fresh shoot weight data (Table 3) had similar trends as for fruit yield except that the irrigation effect was significant and all the treatment differences for organic amendments were not significant as in the case of fruit yield.

The pooled data on root-knot index (Table 4) revealed that none of the effect of summer irrigation, tillage and organic amendments was significant,

TABLE—3

Influence of some of the agronomical practices and organic amendments on green shoot weight of tomato (kg/ha).

Irrigation	Tillage	Organic amendments				Mean	
		F.Y.M. spot application	F.Y.M. as broadcast	Fumigation	Control	Tillage	Irrigation
Summer irrigation	Deep ploughing	5556	4660	6018	4414	5772	4537
	Harrowing	4630	3086	4105	3889	4414	
No irrigation	Deep ploughing	7376	6234	6790	5154		5648
	Harrowing	5617	4876	4969	4228		
Mean organic amendments		5802	4722	5463	4414		

	S.Em.	C.D.@5%	C.V.%
Irrigation	281	873	53.7
Tillage	151	444	29.2
Organic amendments	191	534	26.1

Interaction effects were not significant.

but the interactions irrigation x organic amendments and tillage x organic amendments were significant. In general disease index was high which indicated high level of disease build up. The average disease indices of 3.56 and 3.62 for broadcast and spot application of f.y.m. under no irrigation treatment, respectively, were at par. The former one was significantly lower than the rest and the latter one also was significantly lower than the rest except the control under irrigation. Slightly lower disease index value (3.88) for control under irrigation treatment than no irrigation treatment (3.99) is a deviation from the general trend of higher disease index under irrigation treatment than no irrigation treatment.

Similarly slightly lower value (3.56) for broadcast application than that for spot application (3.62) is difficult to explain and has to be considered as no difference. It can, therefore, be generalised that application of f.y.m. either as broadcast or spot application helped in reducing the root-knot disease incidence in tomato crop. Higher value of disease index for DD fumigation than even control may be due to the plants getting higher index values on account of large root system with more galls resulting from fast multiplication of parasitic nematodes after degradation of the DD fumigant.

The interaction tillage x organic amendments was significant. The combination of harrowing and DD fumigation

TABLE—4

Influence of some of the agronomical practices and organic amendments on root—knot incidence (average index value per plot).

Irrigation	*Tillage*	*Organic amendments*				*Mean*	
		F.Y.M. spot application	*F.Y.M. as broadcast*	*Fumigation*	*Control*	*Tillage*	*Irrigation*
Summer irrigation	Deep ploughing	4.05	3.98	4.11	3.93	3.86	4.03
	Harrowing	3.89	4.21	4.28	3.83	3.94	
No irrigation	Deep ploughing	3.63	3.43	3.65	4.15		3.77
	Harrowing	3.61	3.68	4.21	3.82		
Mean organic amendments		3.79	3.83	4.06	3.93		

	S.Em.	*C.D. @5%*	*C.V.%*
Irrigation	0.15	NS	22.2
Tillage	0.13	NS	19.2
Organic amendments	0.11	NS	11.6
Irrigations x organic amendments	0.11	0.32	11.6
Tillage x organic amendments	0.11	0.32	11.6

Other interaction effects were not significant.

had the highest disease index of 4.25 which was significantly more than the rest of the combinations except harrowing with f.y.m. broadcast and deep ploughing control.

While f.y.m. broadcast and spot application did not show significantly differential effect under deep ploughing and harrowing, fumigation with DD had significantly lower disease index under deep ploughing than under harrowing. This indicates that fumigation with DD is more effective under deep ploughing than no deep ploughing, probably because the loose and open soil conditions provide larger coverage of soil by DD fumes resulting into more efficient fumigation. These results are in accordance with the observation of Call (1957).

When disease index and fruit yield are considered together, it is found that spot application of f.y.m. has high yield and low disease index (27,191 kg/ha; 3.79) which is the normal expected trend. Fumigation with DD had fruit yield next to spot application of f.y.m., while the disease index was the highest (23, 827 kg/ha; 4.06). This happened probably because DD fumigation provided protection to the crop in the early growth period which resulted in better root and shoot development of the plant leading to higher yield even though the root-knot nematodes attack the plant in the later stage. As for f.y.m. broadcast, there was relatively low yield despite of relatively low disease index (18, 704 kg/ha; 3.83). This resulted largely because of relatively less plant development under this treatment as compared to spot application of f.y.m. and DD fumigation.

The plant stand and fruit yield data showed that between the two methods of f.y.m. application, spot application was more efficient than the broadcast method, the former being even superior to fumigation with DD. These results corroborate with the finidings of Oostenbrink (1954), Van der Lann (1956), Desai *et al.*, (1969) and Menon *et al.*, (1969). Van der Lann (1956) attributed low incidence of root-knot disease in f.y.m. treated plots to physiological changes in the host plant developing slight resistance to the parasitic nematodes, besides suppressing their rate of reproduction. According to Singh and Sitaramiah (1970), addition of organic matter, besides making the physical and chemical conditions of soil favourable for better root development, stimulates the growth of predacious fungi and other nematophagus organisms which results in nematode injury on the palnts. In the present study also, better plant stand, higher fruit yield and green shoot weight and lower disease index for spot application of f.y.m. resulted from better root and shoot development and also probably reduction in the nematode effect.

TABLE—5

Influence of some of the agronomical practices and organic amendments on gross realisation in tomato (Rs/ha).

Irrigation	*Tillage*	*Organic amendments*				*Mean*	
		F.Y.M. spot application	*F.Y.M. as broadcast*	*Fumigation*	*Control*	*Tillage*	*Irrigation*
Summer irrigation	Deep ploughing	4704	3358	5491	3537	4015	3546
	Harrowing	3818	2123	3500	1849	2895	
No irrigation	Deep ploughing	5312	3117	4343	2253		3361
	Harrowing	4040	2105	4127	1590		
Mean organic amendments		4469	2676	4361	2309		

The gross realization data (Table 5) worked out on the basis of sale prices and yield of each picking revealed that maximum return (Rs. 4469) was obtained for spot application of f.y.m., it being slightly more than that for DD fumigation (Rs. 4361). When input cost of amendments (cost prevailing at the time of application) inclusive of cost of application was considered, the cost for spot application of f.y.m. came to Rs. 60 per ha as against Rs. 2850 per ha for DD fumigation. Thus, it was more advantageous to adopt spot application of f.y.m. at 6 tonnes/ha than to go in for DD fumigation.

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REFERENCES

Call, F. 1957. Soil fumigation V. Diffusion of ethylene dibromide through soils. *J. Sci. Fd. Agric.*, **8** : 630-639.

Desai, M. V., G. J. Patel, H. M. Shah, and S. D. Naphade, 1969. Effect of some agronomical practices in the control of root-knot nematodes on tomatoes. First All-India Nematology Symposium held at New Delhi.

Godfrey, G. N. 1947. A practical control for nematodes. Proc. Second Ann. Lower Rio Grade Valley, Citrus and Vegetable Institute, 1942, 142-149.*

Goffart, H. 1949. Nematodes, Fadenwiirmer. In: SORAUER, P. Handbuch der Pflanzenkrankheiten, **4** : 4-95.*

Hams, A. F. and G. D. Wilkin, 1961. Observations on the use of predacious fungi for the control of *Heterodera sp.* Ann. Appl. Biol. **49** : 515-523.*

Menon Vasudeva, P. P., G. Logiswaran, A. R. Seshadri and Thangaraju, 1969. Observations on the control of the golden nematodes (*Heterodera rostochiensis*, Woll.) of potatoes in the Nilgiris. First All-India Nematology Symposium held at New Delhi.

O'Brien, D. G. and E. C. Prentice, 1932. A nematode disease of potatoes caused by *Heterodera schachtii* (Schmidt). *Res. Bull. W. Scot. Coll. Agric.*, **2** : 63 pp.*

Oostenbrink, M. 1950. Het aardappelaaltje (*Heterodera rostochiensis*, Woll.) Een Gevaarlijke parasiet voor dee enzijdige aardappetcultuur. Versl. Pl Ziekt. Dienst Wageningen, **115** : 230 pp.

———, 1954. Over de betekenis van vrijlevende wortelaaltjes in land—en tuinbouw. Versl. Pl Ziekt. Dinest Wageningen, **124:** 196-223. pp.*

Schmidt, J. 1954. Der gegenwartige Stand der Kartoffel-nematodenforschung. Wiss. Z. Univ. Rostock, math.—nat., **3** : 371-377.*

Singh, R. S. and K. Sitaramiah, 1970. Control of plant parasitic nematodes with organic soil amendments. PANS, **16:** 287-297.

Van der Laan, P. A. 1956. The influence of organic manuring on the development of potato eelworm, *Heterodera rostochiensis*, Nematologica. **1:**112-115.

Watson, J. R. 1921. Control of Root—knot. Fla. Agri. Expt. Sta. Bull. **159:**31-44 pp. Original not seen, reference taken from Christie J. R. Plant Nematodes, their bionomics and control.

*Original not seen, reference taken from Plant Nematology by J. F. Southey H.M.S.O. Tech. Bull. **7:**1965.

Chloroquine Phosphate in Treatment of Theileriasis in Exotic and Crossbred Cattle; A Clinico-pharmacological Approach

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ABSTRACT

One hundred and nine clinical cases of Theileriasis were treated and observed. 178 treatments were given. The clinical diagnostic picture has been discussed. Six different treatments have been tried. It is observed that chloroquine phosphate in the doses of 1200, 2400 or 2800 mg. b. e. I/m with 3 g quinine dihydrochloride I/v or I/m once daily where needed, for four days gave encouraging results. The coupled immunopharmacological therapy was also tried which needed further observations. With these treatments the mortality observed was 2 per cent. (*Received on Oct. 22, 1975*).

INTRODUCTION

GUJARAT has imported the exotic breed for the cross breeding programme; and perhaps with this, it has also imported the problem of theileriasis. The stray cases were recovered in past but under the present situation the disease is rampant in Gujarat.

A plethora of literature is available on the treatment of theileriasis. Barnet (1968) has reported that theileriasis is infectious in man and animals and concluded that there is no satisfactory treatment. Gautam (1975) has put up good amount of findings before us. Rao (1973) has reported a variety of treatments like (A) Acaprin, Acriflavin and Terramycin in eight cases; (B) Acromycin and Nivaquin in four cases and (C) Berenil and Acromycin in 55 cases with inconsistant results. Mathur (1972) treated a few cases with Camoquin oral as well as intramuscular. Dhar and Gautam (1972) has reported regarding the use of Berenil and Terramycin with inconsistant results. In some clinical experiments Nivaquin was also used and did not give encouraging results. In later trials Pamaquin (oil suspension) was also used and similar results were obtained. Several immunological approaches have been tried by various workers.

The present work aims at the clinical and diagnostic approach to the theileriasis, with a view to be, of immediate help to the cattle owners to save the exotic animal in the field. Whatever the laboratory findings may be what is needed, is to spot out the subclinical cases and start the treatment without involving in any laboratory dispute. This may perhaps serve as a better solution to cater to immediate need for saving the costly animal.

METHODS

Diagnosis: The life history of theileriasis and its infectivity are wellknown. Four to five pathogenic species are generally recognised in cattle. The clinical symptomatic picture is very conspicuous to a trained eye.

The incubation period is 10 to 15 days. Presence of ticks may or may not be seen on the body of the animal. The body temp. increases and ranges from 105° F to 107° F. There is no noticeable symptom during the first few febrile days except there is drop in production. Apetite is lost, muzzle is dry, lacrimation and nasal discharge are commonly seen—superficial lymph nodes are enlarged and can be felt on palpation. Breathing is accelerated, difficult and accompanied with coughing, diarrhoea is usually present often tinged with blood and mucus. Signs of anaemia become evident and the animal starts wasting. As the disease progresses there is marked emaciation, lymph nodes often regress in size, breathing is laboured, asphyxiation sets in with froth in the nostrils. The course of the disease is fatal from 4th to 14th febrile days. The mortality rate is 94% in adult exotic breeds and in non endamic areas (British Vet. Asso. 1962).

Drugs: The use of Nivaquin has opened up the possibility of usefulness of antimalarial drugs. Chemically these drugs have a different chemical structure. The present work aims at the use of such drugs keeping in view such a structural relationship.

Some of the available antimalarials are:

1. Quinoline derivatives:
   (a) Quinine (alkaloid from Cinchona; does not contain amino group but has Quinulidine group).
   (b) 8—aminoquinoline group e.g. Pamaquine, Primaquine, Pentaquin etc. =8 (4 dimethyl-amino 1 methyl butyl amino) 6-methoxy-quinoline.
   (c) 4-aminoquinoline group:—
      i. Chloroquine phosphate (Resochin, Avloclor)=7 chloro-4(4 dimethyl amino 1 butyl amino) quinoline diphosphate.
      ii. Nivaquine=7 chloro-4 (4-dimethyl 1 methyl butyl amino) quinoline sulphate.
      iii. Camoquine (Amodiaquine hydrochloride)=4 (3 diethyl amino methyl 4 hydroxy anilino) 7 chloroquinoline.
      iv. Hydroxy quinoline sulphate (Plaquenil)=7 chloro (4-N ethyl N P hydroxyethyl amino–1 methyl butyl amino) quinoline.
2. Acridine derivatives e.g. Mepacrine. Quinacrine (Atabrine) etc.
3. Biguanide derivatives. e.g. Chlorguanide hydrochloride (Palludrine) etc.
4. Diamino pyrimidine derivatives. e.g. Pyrimethamine (Daraprim).
5. Sulphones and some sulphonamides like sulphadiazine. These are out dated.

Out of these antimalarials they are therapeutically divided as;

i. Drugs acting on exoerythrocytic forms, used as causal prophylactics are; Primaquine, Pamaquine etc.

ii. Drugs acting on the asexual forms; Scizonticidal are; Chloroquine, Amodiaquine, Mepacrine, Quinine, Pyrimethanine etc.

iii. Drugs destroying gametocytes are; Primaquine, Pamaquine, Pentaquine, etc.

From the above explanation it was thought that as Nivaquine (4-amino quinoline-sulphate salt) has shown some inconsistant results, it would be worthwhile to screen the diphosphate salt, keeping in view the ionisation and protein binding of the drugs. Moreover, the available literature does not show any reference on the use of chloroquine phosphate. To a field worker all such drugs may seem alike but they are different chemically to a good extent and hence the trials on the chloroquine phosphate and immunopharmacological attempts were undertaken.

Observations: In the present study, 109 cases with 178 treatments of theileriasis were studied. The observations on the occurrence in different breeds and groups are presented in Table 1.

TABLE—1

Incidence of Theileriasis according to the breed and the location in Gujarat during June to September 1975.

Region	*Breed*					
	H.F. Cross	*Pure Jersey*	*Jersey cross*	*Red Danish cross*	*Kankrej*	*Total number of animals*
Baroda—1	11×2=22	—	1×3=3	—	2×2=4	18
Baroda—2	1×1=1	3×2=6	—	—	—	—
Anand area / Mogri—Dakor	5×1=5	—	1×1=1	—	—	6
Ahmedabad—1	19×3=57	2×1=2	—	1×3=3	1×1=1	—
Ahmedabad—2	3×1=3	—	—	—	—	26
Mehsana—1	9×2=18	1×2=2	—	1×2=2	—	—
Mehsana—2	24×1=24	1×1=1	8×1=8	3×1=3	12×1=12	59
Total animals treated	72	7	10	5	15	109
Total treatments	130	11	12	8	17	178
Mortality after treatment	—	1	1	—	—	2=1.8% i.e. 2%

Note:—× Multiplications show number of repeat treatments due to repeat attacks.

RESULTS AND DISCUSSION

Treatment-1 : 27 animals were treated in this group. Chloroquine phosphate (CLQ) I/m was used varying from 40 mg base equivalent to 200 mg base equivalent (mg b.e.) dose. The blood smears of all the animlas were positive. The dose range of 40 to 100 mg b.e. did not give consistant results eventhough the repeat doses were tried at 24 hourly interval. The clinical picture did not alter.

It was observed that 200 mg b.e. dose given to 9 animals brought down the clinical picture to normal in 5-7 days. 10 animals had responded in 3 days treatment also. Total treatment required about 1000 to 1200 mg b. e. of the drug.

Out of this group because of the unhygienic conditions and non control of ticks, about 10 animals got the reattack after one month. They were treated with 2000 mg b.e./ 24 hrs for 3 days, and were cured.

The supportive treatments used in this group was as follows:–

Inj. B–Complex 5 ml, Inj. Liver Ext. 5 ml for 6 days. Carminative mixtures were necessary. Some animals were given 0.17 g Iron tablets; 50 to 100, tab/orally/b.d., daily for 10 days.

Treatment-2: 20 animals were treated in this group. CLQ 800 mg b.e./ 24hrs/for 3 days was used with supportive treatment as in group-1. After 3 days no improvement was seen. As such the dose of CLQ was altered after a gap of 2 days and CLQ 2400 mg b.e./24hrs/ after 3rd day was given. 15 animals recovered on the 4th day and the blood picture and the clinical picture was clear. 5 animals did not respond to treatment and showed dullness. For the remaining 5 problematic animals following treatment was given.

CLQ 2800 mg b.e. I/m+4 g of quinine dihydrochloride I/v diluted in 30 ml distilled water. This was given for one day. I/v quinine gave a severe reaction which subsided within 30 minutes. These animals were again given the similar treatment after 5 days. In this treatment quinine was used at very slow speed of injection and the reaction was not seen. One problematic animal was also given quinine hydrochloride powder 15 g orally/once/daily for 4 days. All the five animals recovered.

Treatment-3: After the experience of treatment 1 and 2, 13 animals with clinical symptoms and blood smear positive with, temp. ranging between 105° f to 106° f were treated directly with the higher dose.

CLQ 2800 mg b.e./day 3 g quinine dihydrochloride (diluted) I/v once daily for four days was given. The infection was cleared out on 3rd day and all the animals were normal.

Treatment-4: 10 animals with temp. ranging between 105° f to 107° f were taken up. 9 animals were treated and one was kept as control (untreated, for want of drug). In this group Nivaquine 40 ml+Terramycin 40 ml was given for 4 days. The animals did not respond. After a gap of two days, these animals were divided into 2 groups. *Group 4* A: Having 9 animals, was given CLQ 1200 mg b.e.+Acromycin 2000 mg+15 ml Belamyl for 4 days. Animals did not respond. Then all the animals were given

the following treatment as in 4 B. None of the treated animlas then died. *Group 4 B:* 24 cows in milk were given, CLQ 2800 mg b.e.+3 g quinine dihydrochloride I/m for 4 days. All the animals were negative blood smear picture and normal by 5th day.

Treatment-5 : 10 milking cows in the light infection detected earlier were treated with CLQ 1200 mg b.e.+3g quinine-dihydrochloride I/m/once/daily for 5 days, and responded nicely to the treatment and all animals became normal.

Treatment-6: With CLQ 1200 mg b.e.+3 g quinine dihydrochloride I/m daily for 4 days and immunotherapy was tried. 50 ml blood was collected from a blood smear positive case and was mixed with 50 ml saline and thoroughly shaken, till haemolysed and erythrocytic forms were thrown in saline. 20 ml of this suspension was injected subcutaneously in animals with clinical signs and in febrile condition. 5 cases were treated and encouraging results were seen. This seems to be an easy field work immunopharmacological approach, which need further trails and observations.

Out of 109 animlas treated only two animals have died. The mortality was upto 2% after this treatment.

Observation on Milch Cows: In milch cows the production drops for two days when CLQ 2800 mg b.e. is given. With CLQ 1200 mg b.e. drop in production is not noticed. Another peculiar symptom noted was a transient oedematous mastitis after a week or 10 days of the treatment for 1 or 2 days which yielded to local therapy. This was partly an oedematous swelling of the mammary gland and glycerine magsulph paste and iodex relieved the symptoms. No other big damage was noticed.

Observation on Pregnant Cows: CLQ 2800 mg b.e. with 3 g quinine was given in some pregnant cows. Two pregnant animals aborted out of which in one cow a still born calf was recovered. In pregnant animals therefore a low does long term therapy may be beneficial or change to high dose as the stretagy demands.

Observation on Calf Treatment: CLQ 600 mg b.e. and 1200 mg b.e. along with two doses with 1.5 g quinine dihydrochloride gave satisfactory results. Plain CLQ treatment in earlier cases was also responsive.

Supportive Therapy: In all cases of theileriasis the supportive therapy equally plays an important role. Inj. whole liver extract: Glucose saline, oral iron therapy, inj. Imferon, oral dosing of phosphomin with iron and carminatives whenever necessary have helped the treatment. Haematinics and Vitamin B Complex play a considerable role in each treatment.

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REFERENCES

Barnet, S. F. 1968. Theileriasis. Infectious disease of man and animals by Weinmann and M. Ristic **2** : 269. Through Gautam, O. P. 1975 No. 3.

Dhar, S. and O. P. Gautam, 1972. Paper read at 14th conference of research workers in animal diseases at Mathura Nov., 25-26, 1972.

Gautam, O. P. 1975. Souvenir papers at summer institute on the emerging diseases of exotic and crossbred amimals. HAU, Hissar. July, 1975.

Mathur, S. C. 1972. Theileriasis in Jersey, bulls. *Indian Vet. J.* **48** : 962.

Rao, S. G. 1973. Treatment of Theileriaisins exotic breed and crossbred bovines *Indian Vet. J.* **50** : 1-104.

British Vet. Assos. 1962. Hand book on tropical diseases. Mansfield Street, London, p. 156.

Study on Effect of Feeding Deoiled Sal Seed Meal (DSSM) at Different Levels to Kankrej Cows on Milk Yield and Composition

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ABSTRACT

To study the effect of feeding Deoiled Sal Seed Meal (DSSM) at 0, 10 and 20 per cent levels in the concentrate mixtures, on milk and the FCM yields and on milk composition of the Kankrej cows, an experiment was conducted for a period of 300 days lactation.

The results on milk and the FCM production revealed significant reduction for both milk and the FCM yields in T_3. This suggested that incorporation of 20 per cent DSSM in concentrate mixture of lactating cows hampered both milk and the FCM yield when compared with T_2. Treatment T_2 wherein 10 per cent DSSM was added, showed the best performance amongst the three treatments. Thus, the DSSM should not be fed more than 10 per cent to the milch animals.

Moreover, it is further observed that the composition of milk was slightly lower for the second group (10 per cent level) for some of the constituents analysed. However, the differences for all the constituents of the milk analysed from all the three groups are found to be nonsignificant.

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INTRODUCTION

THE most urgent and challanging problem in the feeding of cattle is of the acute shortage of cattle feeds, (Kehar, 1968). Efforts have been made to study the usefulness of various by-products, unconventional feeds and industrial waste. Deoiled Sal Seed Meal (DSSM) is one of the by-products of fat industry available in large amount. After the extraction of oil from Sal fruit (*Shorea robusta* Gaerth F.) deoiled Sal seed meal is obtained. Verma and Panda (1973) have reviewed the availability, economics and use of this product for using it in a poultry feed.

An attempt has been made to study the effect of feeding the DSSM at different levels on the milk yield, the FCM yield and the composition of milk for 300 days lactation period.

METHODS

A completely randomized design was followed for the study with 18 lactating cows. An equal number of similar cows were allotted to the three groups as and

when they calved. Details of the experimental animals are given in Table 1.

TABLE—1

Details of experimental animals.

Treatment	*Sr. No.*	*Age in months*	*Lactation No.*	*Initial body weight in kg.*
T_1	1	89	3	446
	2	92	3	431
	3	81	3	392
	4	73	2	334
	5	78	4	344
	6	81	3	303
	Av.	82.3	3	374.8
T_2	7	70	2	342
	8	106	3	373
	9	51	2	408
	10	111	3	420
	11	50	1	415
	12	53	2	272
	Av.	73.5	2	371.7
T_3	13	70	2	363
	14	109	4	415
	15	74	3	365
	16	79	2	342
	17	106	4	342
	18	89	4	402
	Av.	87.8	3	371.5

Alongwith the control, 10 and 20 per cent DSSM was fed to replace maize in the conventional concentrate mixture. All the cows were fed as per NRC recommendations (1971) to meet the DCP requirements. The fodder requirement was met by feeding daily 5 kg of hybrid napier and mature pasture hay *ad lib.* The composition of concentrate mixtures used during the feeding trial is given in Table 2.

Weekly morning and evening milk samples were collected separately for each of the experimental cows and composite samples were prepared and analysed every week for fat test and similar samples were analysed at biweekly intervals for the other proximate constituents. The daily milk yield data recorded, were utilised for the FCM calculations.

Total nitrogen (C. Protein) was determined by the standard Kjeldahl procedure (AOAC, 1970) and the other constituents except the SNF were analysed as per the ISI (1962) and the SNF was calculated by subtracting fat from total solids. Statistical analysis was carried out as per Snedecor and Cochran (1967).

TABLE—2

Composition of concentrate mixtures (minimum-maximum) on per cent dry matter basis.

	Treatments		
Constituents	*T—1*	*T—2*	*T—3*
C. Protein	19.83-24.79	21.29-25.54	23.79-26.29
E. Ext.	2.19-4.52	2.27-3.60	1.58-3.97
C. Fibre	6.71-12.61	5.59-10.02	6.02-9.35
N.F.E.	57.49-61.88	58.07-60.17	56.36-59.12
Ash	6.10-7.54	5.95-6.97	5.58-8.80
Silica	0.67-0.84	0.75-1.08	0.64-1.39
P	0.62-0.91	0.70-0.88	0.65-0.97
Ca	0.54-0.98	0.58-0.96	0.68-0.93

RESULTS AND DISCUSSION

Effect on milk and FCM production:

Daily milk yields were recorded including the milk suckled by the calf throughout the experiment. Milk suckled by the calf was accounted by weighing the calf every week before and after suckling. The difference in weight was taken as milk suckeld. The total milk yields for 300 days lactation period are given in Table 3 alongwith the results of the analysis of covariance.

TABLE—3

Effect of feeding DSSM on milk production (kg) of Kankrej cows during 300 days lactation period.

	Treatments		
Cow. No.	*T1*	*T2*	*T3*
1	2027	2245	558
2	2257	2807	443
3	2222	2028	1497
4	1680	2691	1802
5	1648	2404	1846
6	1357	1113	1299
Av.	1865	2215	1241

Relevant results of the analysis of covariance for the characteristic milk yield for 300 days lactation period.

Source of variation	*d.f.*	*M.S.S.*	*'F'*
Treatment	2	1450930	5.54*
Error	14	261514	

Treatment	Milk yield for 300 days lactation mean adjusted.
T1	1855.02
T2	2219.34
T3	1246.21
S.E.	±208.59
C.D.	633.26

*Significant at 5% level.

From the results it is observed that the cows receiving 10 per cent DSSM (T_2) replacing 50 per cent maize, yielded highest milk yield and the cows receiving 20 per cent DSSM yielded the lowest. The reduction in milk yield of the cows under 20 per cent DSSM was significantly low compared to T_2 but was not significantly different when compared with control. The total FCM yields in each group for the 300 days lactation period are given in Table 4.

TABLE—4

Effect of feeding DSSM on FCM production (kg) of Kankrej cows during 300 days lactation period.

	Treatments		
Cow. No.	*T1*	*T2*	*T3*
1	2431	2613	650
2	2602	2919	481
3	2493	2448	1501
4	1692	2793	2191
5	1666	2585	1985
6	1652	1324	1553
Average	2089	2447	1393

Relevant results of the analysis of covariance for the characteristic FCM yield for 300 days lactation.

Source of variation	*d.f.*	*M.S.*	*'F'*
Treatment	2	1630350	5.17*
Error	14	315172	

Treatment	FCM yield for 300 days lactation mean adjusted.
T1	2077.99
T2	2451.79
T3	1398.75
S.E.	±229.26
C.D.	830.84

*Significant at 5% level.

It is observed that with respect to treatments the FCM yield also followed a trend similar to milk yield. The FCM yield of the cows receiving DSSM at 10 per cent level (T_2) increased to the extent of 20 per cent, whereas at the 20 per cent level of the DSSM (T_3) it affected the FCM yield adversely to the extent of 33 per cent as compared to the control group. However, differences in the FCM yields were found to be statistically significant between T_2 and T_3, but not between T_1 and T_3. Das and Mohanty (1970) also found the lower level of Sal seed meal in the ration of Hariana cows resulted in higher FCM production while Prasad (1971) has reported that even at 15 per cent level of DSSM in the ration of Murrah buffaloes, there is no effect on FCM production.

Effect on composition of milk:

Overall results of analysis of milk samples together with statistical analysis are summarized in Table 5.

TABLE—5

Overall effect of different treatments on milk constituents (%).

Constituents	*Treatments*			*'F' Value*	
	T—1	*T—2*	*T—3*		
Milk fat	5.11	5.06	5.14	0.004	N.S.
Total solids	14.51	14.19	14.45	0.013	N.S.
Solids-not-fat	9.40	9.13	9.31	0.26	N.S.
Crude protein	3.48	3.30	3.34	0.94	N.S.
Lactose	4.66	4.59	4.61	0.049	N.S.
Ash	0.75	0.75	0.73	0.0054	N.S.
Calcium	0.155	0.160	0.159	1.82	N.S.
Phosphorus	0.092	0.087	0.084	2.43	N.S.

N.S.—Non significant.

The data of overall average values in Table 5 for all the constituents under the three treatments reveal that values were slightly lower for some of the constituents of milk samples of second group. However, the differences for all the constituents of milk analysed were found to be non-significant. Das and Mohanty (1970) and Prasad (1971) have reported that Sal seed and DSSM feeding to Hariana cows and Murrah buffaloes did not affect fat, total solids and SNF as is also observed in the present study.

From the results obtained it can be concluded that DSSM feeding at 10 and 20 per cent levels in concentrate mixture did not affect the composition of milk. However, considering the milk and FCM yields DSSM can be used to the extent of 10 per cent when no other unconventional feed is used in the mixture.

REFERENCES

AOAC, 1970. Official methods of analysis of the Association of Official Agricultural Chemists. 11th Ed., Washington, DC, 20044.

Das, B. K. and G. P. Mohanty, 1970. Annual progress report of Co-ordinated Research Project for investigation on agricultural by-products and industrial waste material for evolving economic rations for livestock. Uni. of Agri. Tech. Bhubaneswar.

ISI, 1962. Methods of test for Dairy Industry Part II. *Chemical Analysis of milk.* Indian Standards Institution, Manak Bhavan, New Delhi. P. 4-32.

Kehar, N. D. 1968. Use of agricultural and factory by-products waste for evolving economic rations for the livestock. Proceedings of 1st workshop on agri. by-products and industrial waste material for evolving economic ration for livestock, Trichur.

NRC, 1971. National Research Council. Nutrients requirement of dairy cattle. National Academy of Science, Washington, D. C. 20044.

Prasad, M. R. 1971. Studies on the effect of deoiled Sal meal on quality and quantity of milk in lactating Murrah buffaloes. Thesis submitted to Andhra Pradesh Agricultural University, Rajendranagar, Hydrabad.

Snedecor, G. W. and W. G. Cochran, 1967. Statistical Methods Oxford and IBH Publishing Co., Bombay, 6th Ed. P. 229-338.

Verma, S.V.S. and B. Panda, 1973. Utilization of Sal seed and products in poultry feed-A review. *Indian Poult. Gazette* **57** (4): 109-119.

Short Communications

Evaluation of Cowpea lines for Resistance to Aphid *Aphis craccivora* koch+

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Aphid (*A. craccivora* Koch) is an important pest of cowpea (*Vigna sinesis* L) and other grain legumes in most regions in India. It feeds on all the aerial parts of the plant. At seedling stage, the growing point is severely affected resulting in stunting or death of the plant. Infested leaves curl and do not develop fully. Heavy losses occur when inflorescence and pods are affected. Besides being pest, this aphid is an important vector of plant attacking cowpea (Nene, 1972).

In the *kharif* season (July-October) of 1974, an International Cowpea Disease Nursery comprising 104 multiple disease resistant germ plasm lines supplied by the International Institute of Tropical Agriculture, Nigeria, was raised in two replications at the IARI, New Delhi. Widespread aphid attack was observed in this nursery three weeks after planting. The aphid was identified as *A. craccivora*. Since the germplasm lines differed greatly in the extent of infestation, observations were recorded on the number of plants infested, total plants in a germ plasm line and extent of colonization by the aphid in the infested plants 28 days after planting. Only one observation could be taken as insecticide had to be sprayed to save the plants for studying their reactions against diseases.

The observations revealed that six lines viz., TVU-57; —408 P_2 —410; —1037; —3273 and-4538 were uniformly free of aphid infestation in both the replications.

In some germ plasm lines, very few or several plants were affected but aphid population on such plants was not much. Growing shoot was also not deformed compared to twisting and stunting in heavily infested plants in very susceptible lines. The lines in this category were TVU -131; -191; -381; -461; -476 P_2; -1190; -1283; 1404; -1423 P_1; -1446; -2000; -2276; -2545; -3349; -4539 and -4543.

In the remaining 82 germplasm lines large number of plants showed heavy infestation with stunting. Among the released varieties FS-68, C-20, PS-42, NP_1, Barsati Mutant, Pusa Dofasali P_3-1, Pusa Phalguni and Pusa Barsati were moderately to heavily infested. C-152 though showed less infestation in the seedling stage, has been observed in

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the past to be highly susceptible at flowering stage.

Overall field observations indicated that some of the germ plasm lines may be heterogeneous for reaction to aphids. Seedlings in few others grew vigorously inspite of aphid infestation indicating tolerance.

Since single plant progenies in all the promising lines could not be harvested separately, only the six germ plasm lines found uniformly free in the field were taken in the initial artificial testing at Anand, Gujarat. Philippines Bush was used as a susceptible check. Plants were raised in earthen pots (17 cm x 17 cm) in glass house. Four seeds, two of a test line and two of susceptible were sown in each pot 9-10 cm apart. The aphid culture used was collected from wal (*Dolichos lablab*). Twenty apterous adults were placed on primary leaves of each seedling when they were six days old. One plant from each test line and one from Philippines Bush were covered with a glass chimney closed at the top with muslin cloth. Population counts were taken 3, 12 and 18 days after introduction of

TABLE—1

Aphid population on cowpea test lines and Philippines Bush 3, 12 and 18 days after introduction of 20 aphids/plant and effects on seedling height.

Test lines Vs. Philippines Bush	*Av. no. of aphids/plant at*			*Av. height (cm) of plant at*	
	3 days	*12 days*	*18 days*	*22 days*	*28 days*
TVU—57	5.8	2.0	1.2	14.1	19.4
Philippines Bush	35.5	26.8	12.0	9.7	10.0
TVU—408 P_2	13.9	8.6	3.3	13.6	18.4
Philippines Bush	57.0	32.2	+	10.0	+
TVU—410	7.6	2.8	2.6	14.4	19.3
Philippines Bush	32.0	28.6	11.5	9.1	12.5
TVU—1037	6.3	3.0	2.2	14.8	18.0
Philippines Bush	38.3	29.5	14.5	9.6	12.5
TVU—3273	8.7	3.6	2.7	16.1	18.1
Philippines Bush	38.3	37.0	11.4	8.8	10.0
TVU—4538	8.3	2.7	1.7	13.7	16.5
Philippines Bush	41.8	19.8	22.7	8.1	12.5
T—values (calcutated)	3.95*	4.75**	2.42	5.36**	3.12*
Overall mean test lines	8.43	3.78	2.08	14.45	18.26
Philippines Bush	40.48	28.83	14.42	9.22	8.96

+Plants dropped due to heavy infestation of aphids.

the aphids. Height of the seedlings was measured 22 and 28 days after germination. The data obtained were subjected to statistical analysis (paired t-test).

The data presented in Table 1 indicated that all the test lines were highly resistant to aphids. Within 3 days after 20 aphids were placed on each seedling, the aphid population decreased to an average of 8.43 in test lines compared to increase to 40.48 in the susceptible Philippines Bush. In all the test lines

the population continued to decrease as the plant growth advanced and the aphids failed to develop a colony even when they were confined to glass chimney. This suggests that antibiosis is the basis of this resistance.

Most of the aphids in Philippines Bush congregated on the hypocotyl of the seedlings in early stage. As a result of continuous feeding these seedlings lost the vigour and further multiplication of aphids was adversely affected as reflected in counts 28.43 and 14.42 recorded at 12 and 18 days. The drastic reduction in population at 18 days was due to complete drooping of the seedlings.

Observations on the height of plants showed that the test lines had good growth (18.26 cm) compared to Philippines Bush (8.96 cm). No crinckling of leaves was seen in test lines whereas, in Philippines Bush the seedlings remained at two leaves stage and showed the symptoms of crinkling, yellowing and drooping in all the pots (fig. 1).

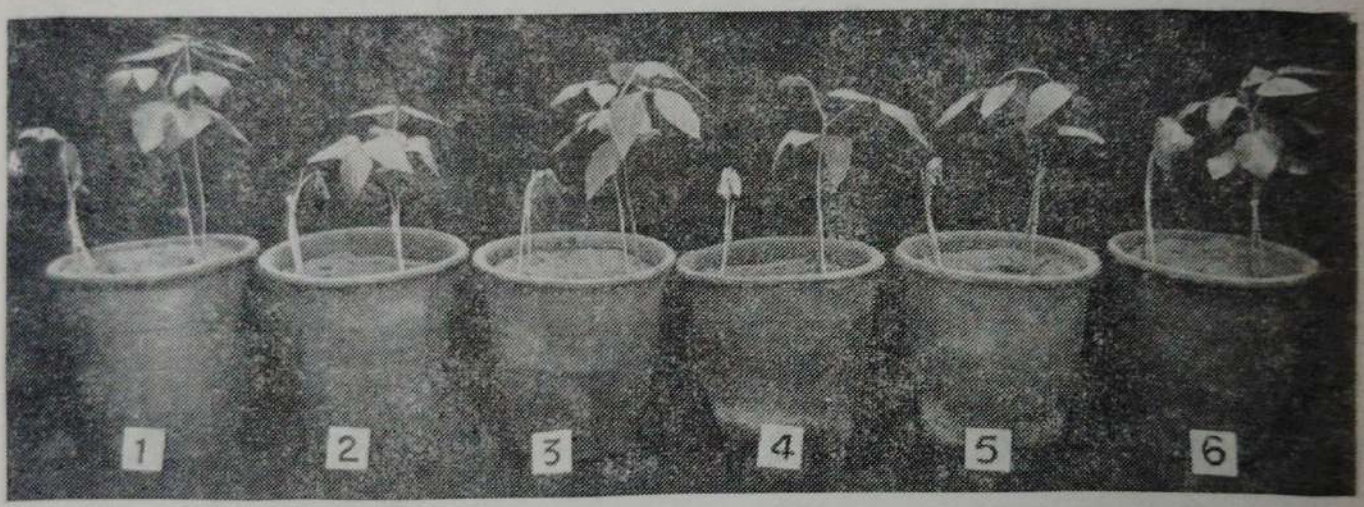

Fig. 1 : Susceptible (left) and resistant (right) lines of Cowpea.

Left : Philippines Bush in 1 to 6 pots.

Right : Pot 1; TVU 57; Pot 2; TVU 408 P_2, Pot 3; TVU 410, Pot 4; 1037; Pot 5; TVU 3273, Pot 6; TVU 4538.

The cowpea lines TVU-57,—408 P_2, —410, —1037, —3273 and—4538 identified as resistant to aphids in this study can be used as donors in developing aphid resistant varieties. In such varieties spread of the aphid transmitted virus diseases will also be very restricted.

REFERENCES

1. Nene, Y.L., 1972, A survey of viral diseases of pulse crops in Uttar Pradesh, G. B. Pant Uni. Agril. and Tech. Pantnagar Research Bulletin: **4**:191 pp.

A Note on Comparative Efficacy of New Herbicides for '*Kalyan Sona*' Wheat*

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Weed control is of great necessity in the cultivation of irrigated as well as rainfed crops. Especially in wheat which is a closely spaced crop, inter-row cultivation by mechanical means is generally difficult, while hand weeding is laborious and expensive. Hoeing, on the other hand, is ineffective against weeds in the crop rows which are the keenest competitors of wheat. It may also harm surface feeding roots. The weeds compete with the crops for water, light and nutrients if proper measures are not taken.

Recently, in addition to 2,4-D several new weedicides are available in the market. The farmers of Gujarat have practically no idea regarding their superiority over the conventional weedicide 2,4-D. It was, therefore, very necessary to test available herbicides for control of weeds in '*Kalyan Sona*' wheat which is a very important irrigated crop best suited to multiple cropping. This investigation was carried out on the mechanized commercial farm of the Gujarat Agricultural University at Junagadh Campus in winter season of 1971-72 on clay soil having a pH of 8.3. The test crop was '*Kalyan Sona*' wheat. There were 12 treatments consisting of nine different herbicides, two mechanical methods of weed control and an unweeded control laid out in a radomised block design with four replications. The cultivation practices for the crop were adopted as per recommendations of the Department of Agriculture, Gujarat State. The doses of different herbicides were based on the recommendations of concerned manufacturers. TOK E-25, Eptam, Machete and Lasso were applied as pre-emergence on Nov. 13, '71 (one day after sowing wheat). The rest of the weedicides were applied as post-emergence on Dec. 16, '71. An area of 90 cm x 90 cm was demaketed at two random spots in each plot for weed counts and other observations.

It was observed that two hand weedings at 4 and 6 weeks after sowing recorded the highest grain yield of 40.82 q/ha closely followed by TOK E-25 having grain yield of 40.59 q/ha. However, these treatments did not significantly differ from other herbicides such as Agroxone, 2,4-D, MCPA and Fernoxone. The lowest grain yield of 9.0 q/ha was recorded under Eptam followed by unweeded control which yielded 26.38 q/ha of grains. The herbicides viz., Eptam, Machete and Lasso were comparatively less effective due to their phytotoxic effects on germination as well as adverse effect on yield attributes such as productive shoots, grain number/spike and test weight.

The treatment of two hand weedings at 4 and 6 weeks was significant-

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ly superior to one hand hoeing at 4 weeks after sowing+one hand hoeing at 6 weeks in respect of grain yield. Thus hand hoeing was less effective against weeds because, it could not control weeds growing within the crop rows. This may also harm the surface feeding roots resulting in yield reduction.

The maximum protein percentage in grain was recorded under 2,4-D (14.44%), while it was the lowest under the unweeded control (11.55%).

It was also noticed that TOK E-25 and two hand weedings at 4 and 6 weeks gave equal maximum net profit of Rs. 1985 and Rs. 1984/ha, respectively. Unweeded control proved to be the poorest showing net realization of Rs. 704/ha, while Eptam recorded a loss of Rs. 1279/ha.

The above results clearly indicated the possibility of stepping up wheat production supressed by weeds by carrying out hand weeding at 4 and 6 weeks after sowing. The new herbicide TOK E-25 can also be used in place of conventional weedicides like 2, 4-D, MCPA, Agroxone and Fernoxone when there is a shortage of labour or the wages are high.

Studies on Control of Mite, *Tetranychus neocaledonicus* Andre Infesting Cotton (*Gossypium hirsutum* L.)*

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The wide spread mite epidemic on cotton in Gujarat during 1972-73 season was so extensive and severe that even recommended spray schedules did not offer complete relief. Laboratory investigations were, therefore, undertaken to find out the most effective insecticides from the conventional as well as new ones in market for the control of mites infesting cotton crop.

The adult stages of *Tetranychus neocaledonicus* Andre were used in these studies. These were collected from infested leaves from unsprayed cotton fields. Twelve different insecticides were tested at stipulated concentrations besides a ctonrol of only water spray. In each treatment 15 adults were treated with given insecticides by placing them on the cotton leaf in individual petri dishes (8 cm in diameter) having the moist sand at their bottom. Petioles of cotton leaves were wrapped with wetted cotton wool to keep the leaves fresh and turgid for a longer period. The insecticides were sprayed with help of Potter's tower with 1 ml of spray material at a pressure of 40 kg/cm.^{2} Each treatment was repeated four times. The mortality data obtained 72 hours after the treatment were corrected by using the Abbott's formula and then they were angularly transformed for statistical analysis. The results obtained are summarized in Table 1.

The data in Table 1 reveal that dimethoate 0.03%, phosphamidon 0.03%, dinocap 0.05%, dichlorvos 0.03%, thiometon 0.03%, methyl dematon 0.03%, monocrotophos 0.03% and carbophenothion 0.03% were more toxic than remaining insecticides giving 100% control, while the treatments endosulfan 0.05%, fenitrothion 0.05% and dicofol 0.05% were not so effective as mortality was only 71.02, 70.88 and 64.98 per cent respectively. DDT failed to control the mites as it gave only 3.57% mortality 72 hours after the treatment.

The findings above confirm the results obtained by Atwal, Chaudhary and Sohi, (1966) who also reported consistently high mortality of all the active stages of the phytophagous mite, *Tetranychus cucurbitae* Rahman and Sapra with sprays of dimethoate 0.05% and phosphamidon 0.025%. Mookerjee and Chatterjee (1971) have also reported 100% mortality of a very similar plant feeder mite, *Tetranychus telarius* Linn., within six hours when sprayed with 0.03% phosphamidon, carbophenothion or dimethoate on plants. There is thus very convincing evidence to recommend foliar application

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TABLE—I

Efficacy of different insecticides against the adults of *Tetranychus neocaledonicus* Andre infesting cotton.

Treatment	*Concentration used (%)*	*Mean % mortality 72 hours after treatment*	
Dimethoate EC	0.03	100.00	(90.00)*
Phosphamidon EC	0.03	100.00	(90.00)
Dinocap LC	0.05	100.00	(90.00)
Dichlorvos EC	0.03	100.00	(90.00)
Thiometon EC	0.03	100.00	(90.00)
Methyl dematon EC	0.03	100.00	(90.00)
Monocrotophos EC	0.03	100.00	(90.00)
Carbophenothion EC	0.03	100.00	(90.00)
Endosulfan EC	0.03	71.02	(57.79)
Fenitrothion EC	0.05	70.88	(57.33)
Dicofol EC	0.05	64.98	(54.75)
DDT W/P	0.25	3.57	(7.73)
Control (water spray)	—	0.0	(0.0)
	S.Em.		(3.84)
	C.D. (5%)		(7.79)

*Figures in parenthesis represent angular values.

(—) Means underscored by the same line are not significantly different.

of systemic pesticides like dimethoate 0.03%, phosphamidon 0.03% or carbophenothion 0.03% for mite control on cotton. Ineffectiveness of DDT even at a higher concentration of 0.25% has been conclusively established.

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REFERENCES

Atwal, A. S., J. P. Chaudhary and B. S. Sohi, 1966. Chemical control of red vegetable mite, *Tetranychus cucurbitae* Rahman and Sapra (Tetranychidae: Acarina). *J. Res. Punjab Agric. Uni.*, **6**(1): 214-219.

Mookerjee, A. L. and D. K. Chatterjee, 1971. Experiment with some insecticides against red spider mite (*Tetranychus telarius* Linn.) infesting lady's finger in West Bengal. *Pesticides*, **5** (7):16-17.