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

M. V. Desai, G. J. Patel, H. M. Shah and S. N. Pillai

Dept. of Plant Pathology, B. A. College of Agriculture, GAU, Anand campus, Anand.

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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