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INTERACTION BETWEEN TOMATO MOSAIC VIRUS AND *MELOIDOGYNE INCOGNITA* IN TOMATO

by
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Summary. Root-knot nematode *Meloidogyne incognita* and tomato mosaic virus together caused more damage to tomato plants than alone, thereby showing a synergistic effect. Both pathogens were antagonistic to each other. However, the dominance of one pathogen over the other was dependent on the time of establishment of the pathogen.

There are several reports of interactions of viruses and *Meloidogyne incognita* (Kofoid *et* White) Chitw. on tomato (Swarup and Goswami, 1969; Goswami and Chenulu, 1974; Naqvi *et al.*, 1979). However, nothing is known about the possible interrelationship between tomato mosaic virus (ToMV) and *M. incognita*.

Materials and methods

Seedlings of tomato cv. Pusa Ruby, susceptible to both tomato mosaic virus and root-knot nematode, were raised in autoclaved sandy loam soil. Two week old seedlings were transplanted to 15 cm diameter clay pots containing 1 kg sterilized sandy loam soil mixed with manure. The plants were mechanically inoculated with sap from virus-infected leaves of tomato in phosphate buffer pH 7.5, using carborundum (500 mesh) as an abrasive. The identity of the virus was confirmed by Ouchterlony double diffusion test which gave a positive reaction with an antiserum of ToMV, obtained from Dr. D.Z. Maat of The Netherlands. Suspensions of second stage juveniles (J2) of *M. incognita* were added to the root zone of the plants at the inocula levels indicated in Tables I and II. Uninoculated plants served as control. The treatments were replicated five times.

The experiment was terminated two months after inoculation, and plant growth (weight of shoot and root) determined. Root-knot index was determined on 0-5 scale of Taylor and Sasser (Sasser *et al.*, 1984), while the soil population of root-knot nematode (J2) was extracted by using Cobb's sieving and decanting method along with modified Baermann funnel technique (Southey, 1986). Virus concentration of the inoculated plants was determined by local lesion bioassay (Holmes, 1929). Dilution of 1:2000 (whole plant sap) was used for assaying on the local lesion host, *Chenopodium amaranticolor* Costa *et* Reyn.

Results

Both tomato mosaic virus and root-knot nematode caused a significant reduction in the growth of tomato (Table I). However, nematodes caused a greater reduction in plant growth than virus and this increased with increasing inoculum level. Concomitant inoculation produced a greater reduction in plant growth than either of the pathogens alone.

Root-knot index at highest initial inoculum level (1000 J2/plant) and final population of nematode (J2) at all initial inocula significantly decreased in the presence of the virus. The virus concentration in the host was also adversely affected by the nematode (Table I) and decreased with increasing nematode inoculum.

A second experiment examined the effect of concomitant and sequential inoculation of the test pathogens. Reduction in plant weight was greater with simultaneous inoculation than with sequential inoculations (Table II). There was a greater reduction in plant growth where nematodes were inoculated before the virus compared with virus inoculation before the nematodes. As in the first experiment, *M. incognita* caused more damage than the virus.

Root-knot development was greatly inhibited by the virus, and this inhibitory effect gradually decreased with decrease in the length of viral infection (Table II). Conversely virus multiplication was also adversely affected by the nematode. Here also decrease in the duration of nematode infection gradually decreased inhibition of virus concentration.

TABLE I - *Individual and concomitant effect of tomato mosaic virus (V) and different inocula of* Meloidogyne incognita (N_{100} to N_{1000}) *on nematode multiplication, root-knot development, virus concentration and plant growth of tomato cv. Pusa Ruby.*

Treatment	Plant weight (g)			Root-knot index	Final population of J_2 per pot	Virus concentration (No. of local lesions)
	Shoot	Root	Total			
Control	18.6	3.5	22.1			
V	15.7	2.8	18.5	–	–	74
N_{100}	13.8	2.5	16.3	1.3	3576	
N_{500}	12.3	2.2	14.5	2.5	7815	
N_{1000}	10.1	2.0	12.1	4.5	8965	
$V + N_{100}$	11.8	2.3	14.1	1.0	3095	56
$V + N_{500}$	10.6	2.1	12.7	2.0	6896	50
$V + N_{1000}$	5.7	1.9	7.6	3.5	8004	36
C.D. ($P = 0.05$)			3.5	0.6	323.3	7.6
C.D. ($P = 0.01$)			4.8	0.8	441.0	11.0

TABLE II - *Effect of individual, concomitant and sequential inoculation of tomato mosaic virus* (V) *and* Meloidogyne incognita *on root-knot development, virus concentration and plant growth of tomato cv. Pusa Ruby.*

Treatment	Plant weight (g)			Root-knot index	Virus (No. of local lesions)
	Shoot	Root	Total		
Control	18.6	5.4	24.0		
Virus only (V)	15.7	4.0	19.7	–	77
Nematode only (N)	12.5	3.3	15.8	3.5	
Both simultaneously	8.3	2.7	11.0	1.5	60
V 5 days after N	8.7	2.4	11.1	1.5	59
V 10 days after N	9.0	2.6	11.6	1.8	53
V 15 days after N	10.2	3.0	13.2	2.0	51
V 20 days after N	11.0	3.1	14.1	2.0	50
V 25 days after N	11.5	3.4	14.9	2.5	49
V 30 days after N	11.9	3.8	15.7	2.8	45
N 5 days after V	12.6	2.7	15.3	1.5	64
N 10 days after V	13.3	3.0	16.3	1.5	69
N 15 days after V	13.9	3.1	17.0	1.3	72
N 20 days after V	14.2	3.2	17.4	1.0	79
N 25 days after V	14.3	3.5	17.8	1.0	73
N 30 days after V	15.8	3.9	19.7	0.5	76
C.D. ($P = 0.05$)			2.1	0.4	6.8
C.D. ($P = 0.01$)			2.9	0.6	9.2

Initial inoculum of *M. incognita* = 1000 J_2 per pot.

Discussion

The results show that competition existed between *M. incognita* and tomato mosaic virus when both were present in the host plant. Similar antagonistic behaviour between *M. incognita* and tobacco mosaic virus in tomato has been reported by Goswami and Chenulu (1974). Both these viruses are closely related and have been classified in a common group of Tobamovirus (Harrison *et al.*, 1971). Naqvi *et al.* (1979) have also observed an inhibitory effect of launaea mosaic virus on root galling in tomato caused by *M. incognita*.

The results also indicate that the dominance of one pathogen over the other was dependent on the time of establishment of the pathogen. When the virus was established first, the host became 'unfavourable' to the other pathogen (*M. incognita*), and this resulted in suppression of galls produced in the roots. On the contrary, root galling increased in treatments where nematodes were inoculated before the virus. This was also accompanied with suppression in virus multiplication. The establishment time-dependent behaviour of the test pathogens may be due to altered physiology of the host as has been suggested by Weischer (1969, 1975).

The combined effect of the test pathogens on plant growth was more than that caused by them alone, thus showing a synergistic or additive effect. Similar synergistic effects on tomato have been caused by *M. incognita* with tomato leaf curl virus (Swarup and Goswami, 1969), tobacco mosaic virus (Goswami and Chenulu, 1974) and launaea mosaic virus (Naqvi *et al.*, 1979).

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