

タバコにおけるTMV感染によるジャワネコブセンチュウ (*Meloidogine javanica*)の寄生の増加

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**Host-Parasite Relationship of Tobacco and Root-knot Nematode,
Meloidogyne javanica (Treub) Chitwood,
Influenced by Tobacco Mosaic Virus Infection**

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Abstract

Studies on the influence of TMV in tobacco having *M. javanica* infection revealed that TMV influences the host-parasite relationship of *M. javanica*. The virus-nematode infection complex had marked effect on the host. Higher nematode population was observed in roots and soils of TMV infected tobacco plants. The maximum synergistic interaction between TMV and *M. javanica* to the tobacco plants occurred when both pathogens infect the host simultaneously. (Received August 4, 1972)

Introduction

In recent years it has been reported that other than transmission of plant viruses by the nematode, there exists an interaction between root-knot nematode and plant viruses parasitizing the same host. Various synergistic effects have been observed between nematode, *Meloidogyne* spp. and different plant viruses viz. nematode population was significantly increased in soybeans and tomato plants having tobacco ringspot virus (TRSV), Ryder and Crittenden⁶) and leaf curl virus infection, Swarup and Goswami⁷) respectively. Bird²) showed that TRSV influences host by increasing nematode penetration in the roots of beans but tobacco mosaic virus (TMV) influenced the rate of nematode growth only and virus infection of host did not influence its resistance towards nematode. However, maize mosaic virus infection resulted in the greater nematode population as well as nematode influenced the host susceptibility towards virus infection⁴).

It is clear from the above review that simultaneous infection by virus and nematode influences host-parasite relationship in different ways. Therefore, a study was undertaken to determine the possible relationship existing between TMV and *Meloidogyne javanica* in tobacco plants infected with TMV and *M. javanica*. The experiments described below were conducted to elicit information on influence of the virus on nematode population, its penetration in the roots and changes in host morphology etc.

Materials and methods

Plants of tobacco (*Nicotiana tabacum* var. Harrison special), raised from surface sterilized seeds were transplanted singly in 10 cm plastic pots containing steam sterilized soil, at 40 days age. They were maintained in an insect proof glass house.

The virus, TMV strain "PP" used throughout the experiment was cultured⁵) on tobacco variety White Burley and inoculations were made by the usual leaf rubbing method.

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For nematode inoculations, roots of tobacco infected with *M. javanica* were taken and the larvae were hatched by incubating egg masses at 27°C for 2-4 days. These larvae were introduced to all plants wherever nematodes were to be involved in equal numbers as far as possible by pouring known amount of nematode suspension into pit made around the plants. The experiment was repeated once having five replicates per treatment. For studying the nematode population, plants were uprooted after 50 days of the last corresponding (nematode or virus) inoculation. Soil population of nematode was determined per 500 g of rhizosphere soil. Average length and weight of roots, shoots and number of leaves per plant were also recorded. The root system was washed, blotted to remove excess of water and observation regarding nematode penetration in roots was recorded as number of root galls per 0.5 g of root weight randomly selected from each of the samples.

Experimental results

The influence of TMV on nematode population

Thirty tobacco plants each in two groups, the first group inoculated with TMV and the second having nematode inoculations were divided in six sub-groups of five each. One sub-group in each was left as such to serve as control (V and N alone) and also a group of five healthy tobacco plants was maintained as check (C). In another treatment a group of five plants was inoculated with nematode four hours after virus inoculations and regarded as simultaneous infection treatment (V+N). The remaining five sub-groups were inoculated with nematode on succeeding intervals of five days one after the other. The other sub-group, inoculated with nematode, were inoculated with virus after similar time lags. The treatments were named for convenience as V+n₁, V+n₂, V+n₃, V+n₄, V+n₅, and N+v₁, N+v₂, N+v₃, N+v₄, and N+v₅.

(1) Synergistic TMV-*M. javanica* interaction in tobacco plants

The observations presented in Table 1 clearly demonstrate that there exists a synergism between TMV and *M. javanica* as also reported by previous worker (Loc. cit.). Flowering in plants infected with TMV-*M. javanica* complex was greatly delayed.

(2) Effect of age of virus infection in tobacco plants on nematode population

It is evident from the data obtained that the nematode population increases to the maximum level when nematodes were introduced in tobacco plants simultaneously with virus inoculation (V+N). However, a lower number of nematodes were revealed in plants inoculated with nematodes on the 20th and 25th day of virus inoculation but it is noteworthy that the number of nematodes per 250 g soil though reduced was not less than the nematode population in control (N) treatment.

An influence of virus infection on the host towards its increased susceptibility for nematode root penetration was also observed and number of root galls (per 0.5 g root weight) was maximum when nematodes were introduced in tobacco simultaneously with the virus inoculation. Reduction in number of root galls was significant on plants inoculated with nematodes on 20th and 25th days after virus inoculation (Table 1).

(3) Changes in nematode population in tobacco plants when inoculated with both virus and nematode in different combinations

As observed earlier the nematode population was increased in N+v treatment compared with the control (N), the maximum increase being noted when both the pathogens were inoculated simultaneously (V+N). The nematode population in soil was more where plants were subjected to virus inoculation following the nematode infection (N+v₁ to N+v₅) as compared to the treatments where the sequence of inoculations was reversed (V+n₁ to V+n₅). It is interesting that a marked reduction

Table 1. Effect of TMV and *M. javanica* on the plant characters and nematode population in tobacco plants

Treatments	First inoc.	Second inoc.	Interval between inoc. of two pathogens (in days)	Weight of shoot(g) ^{a,e}	Length of root(cm) ^{a,e}	Weight of root(g) ^{a,e}	Nematode population	
							No. of galls in 5g root ^a	No. of nema in 250g of soil ^a
C ^b	—	—	—	19.0	15.2	4.0	—	—
V	Virus	—	—	15.4	11.8	2.6	—	—
N	Nema	—	—	11.4	9.6	3.9	40	1960
V+N	Virus	Nema	0	10.5	8.5	3.0	76	4450
V+n ₁	Virus	Nema	5	10.0	6.0	3.6	64	3875
V+n ₂	do	do	10	11.5	8.0	1.8	42	2833
V+n ₃	do	do	15	11.0	9.8	2.4	48	2875
V+n ₄	do	do	20	12.5	10.5	1.5	45	2470
V+n ₅	do	do	25	13.7	8.5	2.8	36	2105
N+v ₁	Nema	Virus	5	10.5	6.5	1.8	52	2885
N+v ₂	do	do	10	11.5	9.5	2.0	48	3240
N+v ₃	do	do	15	12.2	8.1	2.4	60	2085
N+v ₄	do	do	20	10.5	6.0	2.3	48	2890
N+v ₅	do	do	25	7.4	5.2	3.2	62	3630

a) Average of data of 5 replicates.

b) C: control, V: virus inoculated, N: nematode inoculated, V+N: virus and nematode inoculated simultaneously, V+n₁ to V+n₅: virus preceding nematode inoculation by different time intervals, N+v₁ to N+v₅: nematode preceding virus inoculation by different time intervals.

c) Average lengths of shoots and number of leaves per plants were also recorded, but these were left out from this table.

in nematode population was present in plants having been inoculated with the nematode on 20th and 25th days of virus inoculation. Root penetration of the nematode as observed as per number of root galls, there was an increase, it being maximum in V+N treatment.

It is noteworthy to point out that the influence of virus infection on host is favourable for nematodes when inoculated simultaneously resulting in very high population both in the roots and in soil as observed, which is also supported by the fact that plants having nematode infection succeeded by virus infection (N+v) have higher nematode population as compared to the plants with nematode infection followed by virus infection (V+n).

Discussion

The present investigation clearly demonstrates and emphasizes that there exists a synergistic interaction between TMV and *M. javanica* in tobacco. The host-parasite relationship of tobacco and *M. javanica* is influenced by TMV in many viz. significant reduction in length and weight of shoot and root, number of leaves per plants; nematode penetration in the roots and increased nematode population in soil as well as the plants expressed severe symptoms of the virus and flowering was adversely affected.

The data presented above are in general agreement with those obtained by Ryder and Crittenden⁶), Swarup and Goswami⁷) and Khurana *et al.*⁴). The investigations reported in this paper although

do not emphasize precisely on the mechanism of influence of virus on host-parasite relationship, but the observations clearly suggest that these effects of the virus on the host indirectly favour nematode multiplication.

Changes in nitrogen metabolism brought about during TMV biosynthesis³⁾ are known and Bird¹⁾ demonstrated that increased rate of nematode multiplication in plants is associated with nitrogen deficiency. Bird²⁾ found that the presence of TMV in the susceptible tomatoes, increased nematode population and suggested that physiological changes due to TMV infection may be responsible for such association which may be true for the results obtained during present investigation also.

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和文摘要

タバコにおける TMV 感染によるジャワネコブセンチュウ (*Meloidogyne javanica*) の寄生の増加

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タバコに TMV, ジャワネコブセンチュウの両者を接種し, タバコの生育阻害, その根部の根こぶ数, 根部周辺のセンチュウ数の変動を中心に試験した。TMV のみを接種した区, センチュウのみを接種した区, TMV, センチュウの両者を接種しない 3 つの区をそれぞれ対照区とした。TMV と センチュウを同時に接種した区—1 区, TMV 接種後, センチュウを接種した区—5 区, センチュウ接種後, TMV を接種した区—5 区の計 11 区とした。第 1 次接種と第 2 次接種との間隔は 5 日とし, 5~25 日のそれぞれ 5 区を設けた。TMV とセンチュウの両者を接種した区は, 全般に茎葉部, 根部ともに 3 つの対照区に比べ, 長さ, 重量とも明らかに生育阻害を示した。また TMV を接種したタバコでは, その根部の根こぶ数, 根部周辺土壌のセンチュウ数, とともにセンチュウのみを接種した対照区に比べ増加した。TMV とセンチュウの両者を接種したもの (上記 11 区) の中で, もっとも顕著にタバコの生育阻害, 根こぶ数の増加, 根部周辺土壌のセンチュウ数の増加のみられたのは, TMV とセンチュウを同時に接種した区であった。