*Nematol. medit.* (1978), 6: 125-128.

*Division of Mycology and Plant Pathology,*
*Indian Agricultural Research Institute,*
*New Delhi - 110012 India*

# INTERRELATIONSHIPS BETWEEN SPECIES OF FUSARIUM AND ROOT-KNOT NEMATODE, *MELOIDOGYNE INCOGNITA* IN SOYBEAN

by

B. K. GOSWAMI [1] and D. K. AGARWAL

During a survey of soybean crops [(*Glycine max* L.) Merr.] a large number of *Fusarium* wilt fungus affected plants were found also to be infected with root-knot nematodes. An investigation, therefore, was initiated on the interrelationships of four *Fusarium* spp. viz., *F. oxysporum, F. solani, F. graminearum* and *F. equiseti* and *Meloidogyne incognita* (Kofoid *et* White) Chitwood which are capable of existing independently on soybean.

## MATERIALS AND METHODS

The four species of *Fusarium* were isolated on potato dextrose agar (PDA) from the diseased root parts of soybean plants by sterilizing them for two minutes in 0.01% mercuric chloride. Pure cultures of each fungus were maintained on PDA by transferring a single hyphal tip. Healthy seeds of soybean cv. Clark-63 were raised in 15 cm. earthenware pots containing sterilized soil. Ten days after their establishment the seedlings were given following six treatments in different combinations together with an uninoculated control viz. 1) Nematode alone —N; 2) Fungus alone —F; 3) Nematode and fungus simultaneously — N + F; 4) Fungus preceding nematode inocu-

[1] Present address: Istitut für Nematologie; D-4400 Münster (Westf.) Federal Republic of Germany.

lation by three weeks −F+n; 5) Nematode preceding fungus inoculation by three weeks − N + f and 6) Uninoculated control − C. Five replicates were kept for each treatment and the same treatments were maintained for each of the four *Fusarium* spp. Inoculations of the fungus were made by growing the pathogens on sand-maizemeal medium (1:9) for 15 days. A measured amount of 50 g sand containing the fungal mycelial crop was transferred to the rhizosphere of each plant, except the control. Nematode inoculations were done by collecting the egg masses of the soybean root galls and allowing the eggs to hatch at 27 °C about 1000 freshly hatched larvae were inoculated near the roots of each seedling. About 45 days after inoculation the length and weight of shoots and roots were recorded for each plant and the numbers of root-knot galls were counted.

## RESULTS AND DISCUSSION

The data presented in Table I show that when *F. oxysporum* and *F. solani* interact separately with *M. incognita* on the common host there is a significant reduction in length and weight of shoots and roots of those plants that were inoculated with nematodes prior to the fungus (N+f) of the reverse (F+n) compared with the controls (F, N or C). When inoculated simultaneously with both pathogens (N+F), the plants appeared to be unaffected but nematode populations were suppressed as observed also by Khurana and Singh (1971) on sugarcane and in contrast with an increase in nematode numbers on tomato (Swarup and Goswami, 1969) and brinjal (Goswami *et al.*, 1970). *F. graminearum* and *F. equiseti* interact with the root-knot nematode with maximum reduction of plants in the N+f treatment (Table II) which was significantly different from all other treatments, including the uninoculated control. However, the plants in the N+F and F+n treatments appeared normal. No significant differences in nematode populations were recorded between N + f and N treatments. The above results show that there is an interaction between *F. oxysporum*, *F. solani* and *M. incognita* on soybean. The dominance and establishment of the fungus prior to nematode infection of the host (F+n) causes a characteristic « wilting » symptom and suppresses the development of nematode populations. On the contrary when the nematodes are established first in the host (N+f), they dominate and cause « stunting » and wilting due to the fungus is

Table I - *Effect of plant growth characters and multiplication of* M. incognita *in association with* F. oxysporum *and* F. solani *on soybean.*

| Treatments | Shoot | | | | Root | | | | Nematode count of galls/ g. of root | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Length cm) | | Weight (g) | | Length cm) | | Weight (g) | | | |
| | *F. oxysp.* | *F. sol.* | *F. oxysp.* | *F. sol.* | *F. oxysp.* | *F. sol.* | *F. oxysp.* | *F. sol.* | *F. oxysp.* | *F. sol.* |
| C | 49.1 | 50.2 | 2.8 | 2.9 | 12.9 | 12.8 | 0.9 | 0.6 | — | — |
| F | 46.9 | 48.6 | 2.2 | 2.1 | 10.0 | 9.9 | 0.8 | 0.9 | — | — |
| N | 42.9 | 44.6 | 2.3 | 2.1 | 7.5 | 7.5 | 1.2 | 1.4 | 250.0(2.40) | 299.0(2.48) |
| NF | 47.6 | 48.7 | 2.2 | 2.3 | 7.5 | 7.4 | 1.0 | 1.0 | 196.0(2.30) | 203.0(2.30) |
| Nf | 37.7 | 37.2 | 1.6 | 1.5 | 6.4 | 6.2 | 0.6 | 0.9 | 250.0(2.41) | 291.0(2.47) |
| Fn | 36.9 | 35 5 | 1.2 | 1.0 | 5.3 | 4.6 | 0.6 | 0.9 | 184.0(2.26) | 184.0(2.27) |
| S.E ± | 0.92 | 1.08 | 0.23 | 0.22 | 0.52 | 0.43 | 0.11 | 0.18 | 0.21 | 0.020 |
| C.D. at 1% | 3.8 | 4.01 | 4.8 | 0.9 | 1.02 | 2.0 | 2.3 | 0.5 | 0.5 | 0.099 |

Table II - *Effect of plant growth characters and multiplication of* M. incognita *in association with* F. graminearum *and* F. equiseti *on soybean.*

| Treatments | Shoot | | | | Root | | | | Nematode count of galls/ g of root | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Length (cm) | | Weight (g) | | Length cm) | | Weight (g) | | | |
| | *F. gra.* | *F. eq.* | *F. gra.* | *F. eq.* | *F. gra.* | *F. eq.* | *F. gra.* | *F. eq.* | *F. gra.* | *F. eq.* |
| C | 45.8 | 40.9 | 1.7 | 2.5 | 11.0 | 10.7 | 0.7 | 1.0 | — | — |
| F | 43.3 | 39.1 | 1.8 | 2.0 | 10.5 | 10.6 | 0.8 | 1.0 | — | — |
| N | 35.6 | 33.8 | 0.8 | 1.8 | 8.2 | 9.5 | 1.4 | 2.3 | 208.0(2.32) | 262.0(2.42) |
| NF | 41.2 | 32.3 | 1.2 | 2.0 | 9.5 | 10.2 | 0.8 | 1.6 | 214.0(2.37) | 229.0(2.37) |
| Nf | 33.6 | 25.4 | 0.8 | 1.2 | 7.1 | 8.5 | 1.4 | 2.0 | 208.0(2.32) | 272.0(2.44) |
| Fn | 42.2 | 36.1 | 1.8 | 2.2 | 11.2 | 11.5 | 0.7 | 1.5 | 166.0(2.23) | 196.0(2.30) |
| S.E ± | 2.23 | 1.38 | 0.15 | 0.22 | 0.75 | 0.60 | 0.19 | 0.28 | 0.038 | 0.023 |
| C.D. at 1% | 6.8 | 5.9 | 0.6 | 0.6 | 2.3 | 1.9 | 0.6 | 1.2 | 0.2 | 0.10 |

not evident. However, in the treatment, N+F neither of the pathogens could establish within the common host, and plant growth was largely unaffected.

When infection with *M. incognita* was followed by *F. graminearum* or *F. equiseti* the plants were severely damaged, indicating that the nematodes make the host more susceptible for the fungal infection and thus aggravating the disease syndrome. This agrees with the observations of Kawamura and Hirano (1968) and Agarwal and Goswami (1974).

Thus, in soybean *F. oxysporum* and *F. solani* interact antagonistically with *M. incognita* while *F. graminearum* and *F. equiseti* interact synergistically with *M. incognita.*

## LITERATURE CITED


AGARWAL D. K. and GOSWAMI B. K., 1974 - Interrelationships between *Macrophomina phaseoli* (Maubl.) Ashby and *M. incognita* in soybean. *Proc. Ind Nat. Sci. Acad., 39*: 701-704.

GOSWAMI B. K., SINGH D. V., SETH M. L. and GUPTA J. N., 1970 - Studies on association of root-knot nematode, *M. incognita* (Kofoid & White) Chitwood and *Sclerotium rolfsii* Sacc. in brinjal. *Indian Phytopath., 3*: 587-589.

KAWAMURA T. and HIRANO K., 1968 - Studies on the complex disease caused by root-knot nematode and *Fusarium* wilt fungus in tomato seedlings. *Fac. Hort. Chiba Univ., 16*: 23-35.

KHURANA S. M. P. and SINGH S., 1971 - Interrelationships of a fungus, *Curvularia lunata* with root-knot nematode, *M. incognita* in sugarcane seedling blight. *Ann. Phytopath. Soc. Japan, 37*: 313-315.

SWARUP G. and GOSWAMI B. K., 1969 - Interrelationship of root-knot nematode and leaf curl virus in tomato. *Indian J. Exptl. Biol., 7*: 64-65.



Accepted for publication on 23 December 1977.