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INTERACTION BETWEEN *Rhizoctonia Solani* AND *Meloidogyne incognita* ON DAMPING-OFF OF FOUR COTTON CULTIVARS

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ABSTRACT

The interaction of *Rhizoctonia solani* and *Meloidogyne incognita* Race 3 and Race 4, was tested on four cultivars of American cotton namely RNR-120, RNR-315, DP-50 and Auburn-634.

The obtained data revealed that the artificial infection to the susceptible cultivar DP-50 with the fungus in combination with either nematode races increased the root galling from 25-30% in case of nematode alone to 30-40% respectively. Combined infection also increased the pre-emergence damping-off from 60% in case of fungal infection alone to 80%. At the same time the root necrosis of the same cultivar was increased by 25-30% in the combined infection. The second susceptible cultivar to nematode (RNR-315) gave almost similar results in which the pre emergence damping-off was increased from 40% in fungal infection alone to 80% in the combined infection with either races 3 or 4 of the nematode. However, galling and root necrosis were not affected by combined infection.

Both cotton cultivars RNR-120 and Auburn-634 were resistant to nematode infection. On the other hand, the pre-emergence damping-off of the cultivar RNR-120 was increased from 80% to 100%, when the race 3 was combined with the fungus. Galling and root necrosis were increased from 10% to 30% under the combination between the fungus and either nematode races 3 and 4. Also, the results showed that cv Auburn-634 was resistant to both nematode races but susceptible to the fungus. Such data revealed that the synergistic effect is limited to susceptible cotton cultivars to nematodes, whereas the nematode resistant cultivars did not affected much by the combined infection of the fungus plus nematode.

INTRODUCTION

Rhizoctonia solani Kuhn is a common pathogenic fungus in many agricullural fields and may survive on several hosts and remain in soil for extended periods. It is the most common cause of damping-off disease of cotton plants throughout the world (Hillocks 1992). When the nematode *Meloidogyne incognita* (Kofoid & Whitch) Chitwood, was found in the soil, substantiall increase in susceptibility of cotton plants to the damping-off incited by *R.solani* was noticed by several investigators. Carter (1975) mentioned that when cotton plants were inoculated with both *R.solani* and *M.incognita* in several different soil types; resulted in the increase of hypocotyl lesions and root galling of nematode. Also Carter (1981) proved that mechanical wounding of cotton seedling roots was not as effective as the damage caused by *M. incognita* infection on the severity of *R.solani* damping-off. Carter (1982) found also that diseased seedlings of cotton were increased from 43.1% to 93% when *R.solani* was combined with

Rotylenchulus reniformis compared to *R.solani* alone. Kumar (1999) *et al.,* reported that the greatest loss of fresh and dry weight's of the shoots and roots of "brinjal" plants was achieved when infected with the two nematodes *M.incognita, R.reniformis* and the fungus *R.solani* in combination; more than the infection with both combined nematodes.

In Egypt Oteifa and Ragab (1957) recorded the positive association of *R.solani* with root-knot nematode *Meloidogyne spp.* on cotton plants.

Abou-El-Amayem *et al.,* (1978) showed that numbers of galls per tomato root system and larvae of *M.incognita* were increased in soil infested with the nematode in combination with *R.solani* as compared to those in soil infested with nematode alone. Abou-El-Seoud *et al.,* (1987) found that there was synergistic effect of the combination of nematode *M.incognita* with *Cephalosporium maydis* on corn. Mahgoub (1996) showed that infection of cowpea (Cv. Fetryat) with *R.solani* plus *M.incognita* resulted in significant increase in the numbers of root galls and nematode egg masses as compared with the namatode infection alone.

The present work was designed to study the susceptibility of four American cotton cultivars to the infection of *Rhizoctonia solani* alone or in combination with *Meloidogyne incognita* races 3 and 4 .

MATERIALS AND METHODS

The present research work was done in the Department of Plant Pathology, North Carolina State University, Raleigh, North Carolina, U S A. The isolate of *Rhizoctonia solani,* originally isolated from infected Cotton plants grown in North Carolina, was maintained on potato dextrose agar medium (PDA). *Meloidogyne incognita* race 3 (MI3) and race 4 (MI4) were isolated from infected cotton roots and maintained on Rutgers tomato *(Lycopersicum esculentum L*.) in the greenhouse to obtain the needed nematode inocula. Nematode galls of tomato roots were washed with water, cut to small pieces, placed in 200 ml of 1.25% NaOCl solution (Clorox), and stirred for 4 minutes in an electric mixer. The nematode- clorox water mixture was then quickly poured through a 200 mesh sieve and nested on 500 mesh sieve. The nematode eggs trapped on the 500 mesh sieve were washed under a slow stream of tap water to remove the residual NaOCl. Extracted eggs were then counted under a light microscope (Hussey and Barker, 1973). Four American cotton (*Gossypium hirsutum L*.) cultivars namely : RNR-120, RNR-315, Auburn-634, were obtained from Mississippi Agriculture and Forestry Experimental Station, in addition to the cultivar DP-50 from North Carolina State University, were used in the present study. Hyphal suspensions of *R.solani* grown in 250 ml conical flasks containing 50 ml of PD liquid medium were added to clay pots of 15 cm diameter, partially filled with 1:1 (v:v) mixture of steam sterilized sandy and clay loam soil.

Two weeks after soil infestation with *R.solani,* five surface sterilized cotton seeds per pot were sown, then each pot was reinfested with 5000 nematode eggs. Uninoculated pots served as control. Treatments were

replicated five times and pots were arranged in a randomized complete block design.

Numbers of pre and post-emergence damped-off seedlings survived plants were recorded 7, 14, 28 and 35 days after nematode infestation. Also percentages of root necrosis as well as galling were determined, 35 days after nematode infestation.

RESULTS

Data presented in Tables (1-5) show the effect's of infection of *R.solani* and /or *M.incognita* races 3 and 4 (MI3 and MI4) on damping-off, plant surviving root galling and root necrosis of the tested cotton cultivars.

Data of Table (1) revealed that severe (80%) pre-emergence damping-off was observed in cotton cv. DP-50 with treatments of *R.solani* plus either MI3 or MI4 and followed by treatment of *R.solani* alone with 60% pre-emergence damping-off . Nematode treatment with either MI4 and MI3 showed 20-40% pre-emergence damping-off respectively. On the other hand mild (10-20%) post-emergence damping-off was found in cotton seedlings raised in soil infested with either *R.solani,* MI3 or MI4 alone. Cotton plants treated with *R.solani* plus MI3 or *R.solani* plus MI4 showed more root necrosis than the other treatments. On the other hand, plants inoculated with MI4 alone or in combination with *R.solani* exhibited higher root galling than plants treated with MI3 alone or MI3 plus *R.solani* (Table 1). It is evident that the cotton cv. DP-50 was the most susceptible cultivar to *R.solani* alone or in the presence of MI3 or MI4. Also, this cultivar was a good susceptible host to both MI3 and MI4, as more nematode galls were observed on the infected roots. However, the other tested cultivars showed a moderately resistant reactions to both MI3 and MI4.

Data in Table (2) showed that high pre-emergence (80%) damping-off was observed in cotton cv. RNR-120 with treatments of *R.solani,* and *R.solani* plus MI4. Treatment of *R.solani* plus MI4 showed more galling and necrosis (30%) than the other treatments. Table (2) also indicate that cv. RNR-120 was resistant to the artificial infection by MI3 or MI4 alone, but when the nematode was combined with *R.solani,* the cultivar became more susceptible (100%) with MI3 pre-emergence damping-off.

Data in Table (3) revealed that pre-emergence damping-off of cotton cv. Auburn-634 occurred in 80% of seedlings with infected *R.solani* alone or in combination with MI3 or MI4. Percentage of survived seedlings reached 20% with the fungal treatments (*R.solani* alone, *R.solani* plus MI3 and *R.solani* plus MI4) as compared with 100% survived seedlings which were infected with nematode. Auburn-634 cv. was resistant to infection by either MI3 or MI4 alone, low percentage (10%) of root-galling and root necrosis were exhibited in treatments with MI3 or MI4 alone or in combination with *R.solani* .

Data in Table (4) indicated that treatment of *R.solani* plus MI3 or MI4 of cv. RNR-315 resulted in severe 80% pre-emergence damping-off and low percentage 20% of survived seedlings. The same treatments caused low

percentage 10% of root galling and root necrosis. No post-emergence damping-off was observed.

DISCUSSION

The effect of *R.solani* alone or in combination with *M.incognita* MI3 and MI4 on cotton cvs resulted in 20-100% pre-emergence damping-off of all tested cotton cultivars DP-50, RNR-121, RNR-315 and Auburn-634. Post-emergence damping-off was observed in cotton cv DP-50 seedlings inoculated with *R.solani plus* MI3 or *R.solani plus* MI4 (10-20%). Necrosis were higher in treatments of *R.solani plus* MI3 or *R.solani plus* MI4 than treatments of MI3 or MI4 alone on both cotton cvs DP-50, RNR-120. Such data is in agreement with obtained data by Brodie and Cooper (1964), Carter (1975) and Moustafa *et al.,* (1993). It is evident that the presence of *M. incognita* significantly increased the severity of *R.solani* damping-off incidence of cotton seedlings.

The obtained results revealed that the pre- emergence damping-off in case of DP-50 was severely affected by the addition of the fungus to the races of nematodes from 60% to 80%. However, in the cv. RNR-315 the disease incidence was increased form 20-40% to 80%.

In case of fungal necrosis even the nematode addition increased the disease incidence in both DP-50 and RNR-120 from 20-30% but the incidence in both RNR-315 and Aubern-634 was not affected. Also in case of galling of the nematode, data observed that the fungus inhance their formation in DP-50 and RNR-121 by about 5 to 20%. However, the other cultivars were not affected.

Similar finding was reported by White (1962)., Cauqil, and Shephered (1970) and Carter (1975 & 1981). In case of seedling damping-off, the present result show that effects of root-kont nematode and *R.solani* damping-off were additive. Such finding is confirming by Carter's (1981), who indicate that combined effects of *M.incognita* plus *R.solani* were additive and that depending on root wounds caused by *M.incognita* larva. Also Abou-El-Seoud *et al.,* (1987) and Mahgoub (1996) found that combination of *M.incognita* and *Cephalosporium maydis* or *M.incognita* and *R.solani* had synergistic effect.

Table (1): Mean Effect of the infection of *Rhizoctonia solani* (*R. solani*) and/or *Meloidogyne incognita* races 3 and 4 (M13 and M14) on pre-emergence damping-off, surviving plants, root galling and necrosis of cotton cv. DP-50.

Treatment	Pre-Emergence Damping-off %	Post-Emergence Damping-off %	Surviving plants %	Root Galling %	Root Necrosis %
R. solani	60 b*	20 a	20 c	0	15
MI3	40 c	10 a	50 b	25	10
MI4	20 c	20 a	60 b	30	15
***R. solani* +MI3**	80 a	0 b	20 c	30	25
***R. solani* +MI4**	80 a	0 b	20 c	40	30
control	20 c	0 b	80 a	0	0

Means are averaged of 5 replicates with 5 plants in each replicate.
*** Means in each column followed by the same letter are not significantly different at P ≥ 0.05.**

Table (2): Effect of the infection of *Rhizoctonia solani* (*R. solani*) and/or *Meloidogyne incognita* races 3 and 4 (M13 and M14) on pre-emergence damping-off, surviving plants and root galling and necrosis of cotton cv. RNR-120.

Treatment	Pre-Emergence Damping-off %	Post-Emergence Damping-off %	Surviving plants %	Root Galling %	Root Necrosis %
R. solani	80 b*	0	20 b	0	20
MI3	0c	0	100 a	10	10
MI4	0c	0	100 a	10	15
***R. solani* +MI3**	100 a	0	0 c	10	10
***R. solani* +MI4**	80 b	0	20 b	30	30
control	0	0	100 a	0	0

Means are averaged of 5 replicates with 5 plants in each replicate.
*** Means in each column followed by the same letter are not significantly different at P ≥ 0.05.**

Table (3): Effect of the infection of *Rhizoctonia solani* and/or *Meloidogyne incognita* races 3 and 4 (M13 and M14) on percentages of pre-and post-emergence damping-off, surviving plants and root galling and necrosis of cotton cv. Auburn-634.

Treatment	Pre-Emergence Damping-off %	Post-Emergence Damping-off %	Surviving plants %	Root Galling %	Root Necrosis %
R. solani	80* a	0	20 b	0	10
MI3	0 b	0	100 a	10	10
MI4	0 b	0	100 a	10	10
***R. solani* +MI3**	80 a	0	20 b	10	10
***R. solani* +MI4**	80 a	0	20 b	10	10
control	0 b	0	100 a	0	0

Means are averaged of 5 replicates with 5 plants in each replicate.
*** Means in each column followed by the same letter are not significantly different at P ≥ 0.05.**

Table (4): Effect of the infection of *Rhizoctonia solani* and/or *Meloidogyne incognita* races 3 and 4 (M13 and M14) on percentages of pre-and post-emergence damping-off, surviving plants and root galling and necrosis of cotton cv. RNR-315.

Treatment	Pre-Emergence Damping-off %	Post-Emergence Damping-off %	Surviving plants %	Root Galling %	Root Necrosis %
R. solani	40* b	0	60 b	0	10
MI3	20 b	0	80 ab	10	15
MI4	40 b	0	60 b	10	10
***R. solani* +MI3**	80 a	0	20 c	10	10
***R. solani* +MI4**	80 a	0	20 c	10	10
control	0 c	0	100 a	0	0

Means are averaged of 5 replicates with 5 plants in each replicate.
*** Means in each column followed by the same letter are not significantly different at P ≥ 0.05.**

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تأثير التداخل بين فطر ريزوكتونيا سولانى *Rhizoctonia solani* ونيماتودا تعقد الجذور *Meloidogyne incognita* على إصابة بعض أصناف القطن الأمريكى

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تم دراسة تأثير الإصابة بفطر ريزوكتونيا سولانى *Rhizoctonia solani* منفردا أو بإضافته مع السلالتين 3 , 4 لنيماتودا تعقد الجذور *Meloidogyne incognita* على أربعة أصناف قطن أمريكية هى RNR-120 و RNR-315 و DP-50 وAuburn-634 .

وقد بينت نتائج العدوى الصناعية بكل من الفطر والسلالتين 3و4 من النيماتودا للصنف DP-50 زيادة ملحوظة فى عدد العقد الجذرية النيماتودية root galling حيث كانت 25-30% مع النيماتودا فقط وأصبحت 30-40% مع كل من النيماتودا والفطر كما وجد أن أضافة الفطر مع النيماتودا قد زاد من نسبة الذبول الطرى للبادرات قبل الظهور pre-emergence damping-off من 60% مع عدوى الفطر منفردا إلى 80% عند إضافة أى من السلالتين النيماتودتين لنفس الصنف DP-50 فى حين كانت النسبة عند العدوى المنفردة لأى من سلالتى النيماتودا 40% مع العزلة 3 و 20% مع العزلة 4 . كما زادت نسبة تقرح الجذور إلى 25-30% فى العدوى المشتركة. أما الصنف الآخرRNR-315 القابل للإصابة النيماتودية أيضا، فقد أعطى نتائج مشابهة للصنف السابق حيث زادت نسبة الذبول الطرى للبادرات قبل الظهور من 40% فى حالة الإصابة الفطرية المنفردة إلى 80% فى حالة الإصابة بكل من الفطر وأى من السلالتين النيماتودتين بينما لم تؤثر إضافة النيماتودا للفطر على النسبة المئوية لكل من العقد الجذرية أو تقرح الجذور.

أما فى حالة الأصناف المقاومة للإصابة بالنيماتودا قد بينت نتائج الصنف RNR-120 أن العدوى بكل من الفطر والسلالة رقم 3 النيماتودية قد زادت من نسبة الذبول الطرى قبل الظهور من 80% مع الفطر مستقلا إلى 100% فى الاصابة المختلطة مع السلالة 3 ولم تتأثر النسبة المئوية لتكوين العقد النيماتودية أو تقرح الجذور.

فى حين إن إضافة الفطر مع السلالة 4 لم تؤثر على النسبة المئوية للذبول الطرى للبادرات ولكن زادت النسبة المئوية لأعداد العقد الجذرية وكذلك تقرح الجذور من 10% إلى 30% فى كل منهما.

الصنف المقاوم للنيماتودا Auburn-634 لم يتأثر مطلقا عند إضافة النيماتودا للفطر حيث كان التأثير الكلى راجع للفطر فقط فى جميع القياسات المقدرة خلال التجربة.

وبالتالى تظهر النتائج أن أصناف القطن القابلة للإصابة بالنيماتودا قد زادت نسبة إصابتها النيماتودية فى وجود الإصابة الفطرية.