Suppression of Infection of Cotton Seedlings by Rhizoctonia Solani In the Presence of Thielaviopsis Basicola, the Causal Agent Of Black Root Rot

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Abstract

High population levels of Rhizoctonia solani in a field in Coolidge, AZ, which also contained Thielaviopsis basicola failed to cause the expected infection by R. solani in untreated seeds of Gossypium hirsutum. Growth chamber experiments with autoclaved soil amended with inoculum of both R. solani and T. basicola had a significantly lower infection rate by R. solani than did the control soil with R. solani alone.

INTRODUCTION

Average annual losses in yield of cotton due to seedling diseases in the U.S. total approximately 2.8%, despite the use of seed treatments. The major pathogen contributing to this loss is the fungus Rhizoctonia solani, the causal agent of sore shin disease. Another pathogen affecting cotton at the seedling stage is Thielaviopsis basicola which is responsible for Black Root Rot of cotton. However, the actual effect on yield of cotton due to T. basicola has not yet been determined.

T. basicola and R. solani are common inhabitants in many Arizona soils where Upland cotton is grown. At inoculum levels above approximately 100 c.f.u./gram of soil, T. basicola infects the cortical tissue of young cotton seedlings causing a brown cortical rot and decreased lateral root growth. As temperatures warm up and the cotton plant matures the diseased tissue is sloughed off and all visible signs of the disease disappear. Personal observations (Hine) made in Arizona as well as field data (1) suggest that infection by Thielaviopsis basicola may not normally affect cotton yields.

Personal observations (Hine) of untreated cotton seeds planted into soil containing levels of R. solani sufficient to cause soreshin disease and death did not appear to show the expected disease when the soil also contained T. basicola. This was investigated further to see if there were an interaction between R. solani and T. basicola as pathogens of seedling cotton which would act to decrease infection by Rhizoctonia solani.

MATERIAL AND METHODS

Untreated cotton seeds of Gossypium hirsutum (DP 90) were planted in April 1988 into a cotton field in Coolidge, Arizona which had been in cotton for the last four years. There were 10 completely random plots, each 4 m^2. A month after planting 10 plants were removed from each plot and evaluated for the incidence of Black Root Rot caused by T. basicola. Isolations for the R. solani were performed by washing the roots and surface sterilizing the hypocotyls before pressing them into water agar in petri plates. The soil population of T. basicola was determined by a previously described selective medium technique (2). The populations of R. solani were determined by a modification of the wet-screening technique (3).

Experiments were performed in growth chambers by planting seeds of G. hirsutum into 6 cm. pots with the same soil as in the field test and placing them under 5,200 lux fluorescent light on a 12-hour diurnal light cycle. One growth chamber was set at 18 C (the same average soil temperature as in the field test) and another at 22 C, a more favorable temperature for the cotton plants. After 10 days, the plants were evaluated for the presence of disease caused by R. solani or T. basicola as in the field test.

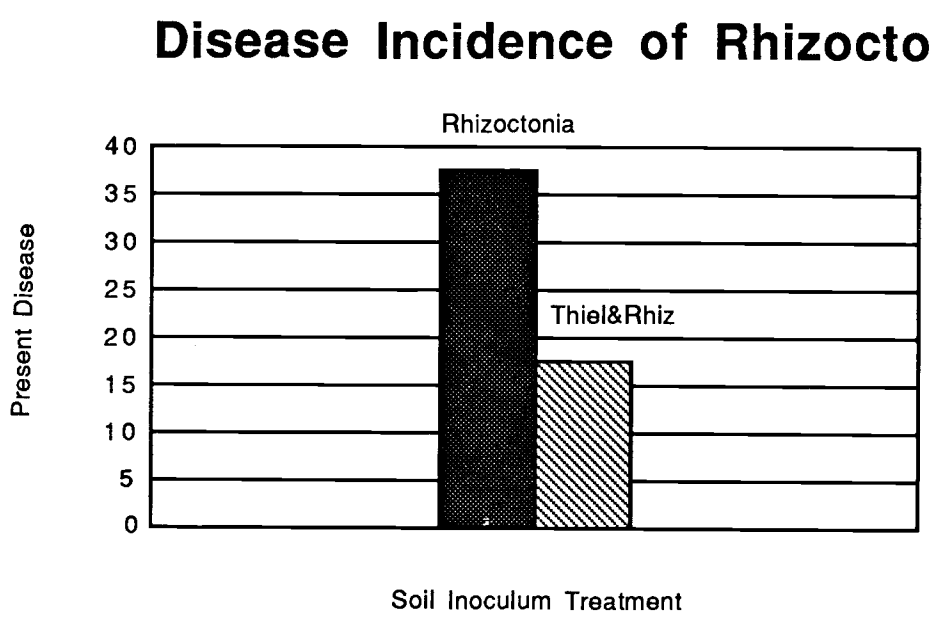
The same field soil was autoclaved for two hours on two successive days and then amended or not with artificial inoculum of T. basicola and R. solani to make the following four treatments: 1) no inoculum, 2) inoculum of T. basicola only, 3) inoculum of R. solani only, 4) inoculum of T. basicola and R. solani both. The soil populations of both pathogens were adjusted to that found in the fresh field soil. Seeds of G. hirsutum were planted into 6 cm. pots containing one of the four amended soils. Five seeds per pot and 20 pots per treatment were grown in growth chambers as described above. The experiment was repeated twice. The purpose of these treatments was to see if the apparent suppression of cotton seedling disease caused by R. solani was due to an interaction between R. solani and T. basicola rather than with another microorganism.

RESULTS AND DISCUSSION

Soil dilutions prepared from the field plots in Coolidge, AZ, after being plated out on the selective media and incubated for 10 days showed that the inoculum potential of T. basicola was 125 cfu/gram of soil. There was a 97% incidence of T. basicola infected plants one month after planting.

The results from the field tests revealed that the inoculum potential of R. solani in the soil was 8-10 propagules per 100 grams of soil. This population level is sufficient to cause 50% infection of cotton seedlings according to a study done by Weinhold in California (3). Yet in this Arizona field there was only a 2% incidence of R. solani infected plants. The isolates of R. solani from this field were tested for their virulence in pasteurized soil and were found to be highly virulent to the host.

The studies in the growth chamber with the non-pasteurized field soil revealed the same levels of infection of both T. basicola and R. solani at both 18 C and at 22 C as in the field study. The plants grown at 22 C were taller and had more root development than did those grown at 18 C, although they had the same levels of disease. These experiments just confirmed that the same results in the field were obtainable in the growth chamber. The results of the experiments with the pasteurized field soil and artificial inoculum of the two pathogens are shown in Fig. 1. At 18 C, the soil inoculated with only R. solani caused an average of 38% disease incidence. In contrast, the autoclaved soil amended with both T. basicola and R. solani resulted in an average of 17% incidence of infection by R. solani and a 97% incidence of Black Root Rot caused by T. basicola. It appears that the presence of T. basicola in the soil or infection of a cotton seedling with T. basicola may suppress infection by R. solani.



The soil populations of the two pathogens in the field studied were fairly representative of cotton fields in Arizona. Thielaviopsis basicola at 125 cfu/gram of soil has a population level 20,000 times greater than that of R. solani (10 propagules/100 grams of soil). It is conceivable that in many cases T. basicola will infect first and thereby outcompete R. solani for infection sites or induce the production of a resistance mechanism in the cotton root to the second pathogen.

REFERENCES

(1) Chapman, M.A., and Hine, R.B. 1988. Lack of correlation incidence and severity of Black Root Rot of cotton caused by Thielaviopsis basicola and yield. Phytopathology 78:1529 (Abstr.).

(2) Specht, L.P., and Griffin, G.J. 1985. A selective medium for enumerating low populations of Thielaviopsis basicola in tobacco field soils. Can. J. Plant Pathol. 7:438-441.

(3) Weinhold, A.R. 1977. Population of Rhizoctonia solani in agricultural soils determined by a screening procedure. Phytopathology 67:566-569.