

### Effect of the Herbicide, Trifluralin, on Rhizoctonia Disease in Cotton

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#### ABSTRACT

Application of the herbicide, Trifluralin ( $\alpha,\alpha,\alpha$ -trifluoro-2,6-dinitro-N, N-dipropyl-*p*-toluidine), to either sterilized or nonsterilized soil was associated with increased incidence of seedling disease caused by *Rhizoctonia solani* in cotton. Trifluralin suppressed *in vitro* development of *Rhizoctonia* but did not influence its virulence against cotton. Trifluralin in soil increased both the susceptibility of the host plants and the activity of the fungus. *Phytopathology* 63:651-652

*Additional key words:* *Gossypium hirsutum*.

Results of herbicide treatments in field plots of cotton (*Gossypium hirsutum* L.) in the Yizre'el Plain, Israel, indicated that Trifluralin ( $\alpha,\alpha,\alpha$ -trifluoro-2,6-dinitro-N, N-dipropyl-*p*-toluidine) increased the incidence of disease caused by *Rhizoctonia solani* Kuehn. An increased incidence of *R. solani* on cotton in soil treated with Trifluralin has been reported (1, 4) and explained by a decrease of host resistance, but no proof of this hypothesis was given. We report herein the results of tests that demonstrated the effects of Trifluralin on the disease through changes in resistance of the host and in the behavior of the pathogen in soil.

**MATERIALS AND METHODS.**—Cotton cultivar Acala 1517 was sown in a temperature-controlled (25-27 C day, 20-22 C night) greenhouse, in 300-ml containers filled with sterilized or nonsterilized soil infested with *R. solani*. Disease incidence was determined by assessment of the percentage of plants affected by pre-emergence and postemergence damping-off up to 21 days after planting.

To test the hypothesis that Trifluralin increases the susceptibility of cotton to *R. solani*, seedlings were grown in sterilized sand either treated with Trifluralin or left untreated. After 7 days, the seedlings were removed, washed, and replanted in sterilized sand free of the herbicide but infested with *R. solani*.

The effect of the herbicide on the growth of *R. solani* was tested on potato-dextrose agar (PDA) to

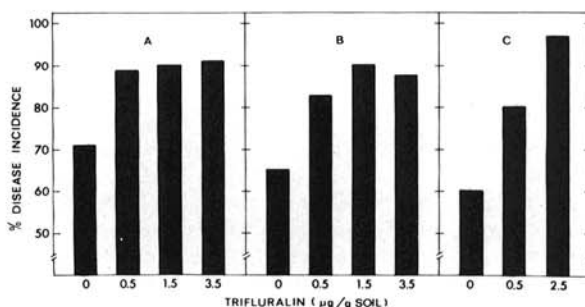


Fig. 1A-C. Effect of Trifluralin on *Rhizoctonia* disease of cotton: A) in sandy loam soil; B) in autoclaved sandy loam soil; C) in dry sterilized sand. Disease incidence = percentage of plants affected by pre-emergence and postemergence damping-off determined as the average of 14 replicates, each planted with five seeds. The differences between the control and Trifluralin treatments are significant at  $P = .05$  in A and in B, and at  $P = .01$  in C. Significant differences between the different concentrations of Trifluralin are found only in C, at the  $P = .01$  level.

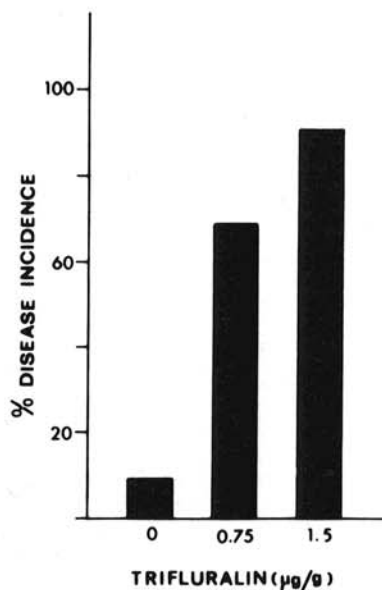


Fig. 2. Effect on susceptibility to *Rhizoctonia solani* of cotton seedlings pretreated with Trifluralin and then inoculated with the pathogen. Values are averages for 12 replicates, each containing three seedlings.

which Trifluralin was added after an autoclaving of the medium.

The effect of Trifluralin (0.5 to 5 µg/ml) on the virulence of *R. solani* was determined by a procedure similar to that used by Fields (2); the inoculum used for inoculation of the cotton was grown in media containing Trifluralin.

The effect of Trifluralin on the saprophytic stage of the pathogen was studied by a baiting method (3). Nonsterilized sandy loam soil treated with different concentrations of Trifluralin was adjusted to 50% moisture-holding capacity, and was kept in 200-ml

plastic-covered containers at 27 C. The soil was infested with *R. solani* simultaneously with the introduction of the baits, which consisted of bean stem segments (10 segments/50 g dry soil). This procedure was carried out on two separate sets of containers, one on the day of treatment with Trifluralin; and another, 7 days after treatment. Baits were removed after 24 hr, washed, and plated on water agar + 250 µg/ml chloramphenicol. The saprophytic activity was evaluated by a determination of the percentage of segments colonized by *R. solani*.

**RESULTS AND DISCUSSION.**—The application of Trifluralin to soil was associated with increased disease incidence both in sterilized and in nonsterilized soil (Fig. 1-A, B, C). Results obtained for sterilized soil lead us to two assumptions: (i) Trifluralin increased host susceptibility, or (ii) directly encouraged the pathogen. Data presented in Fig. 2 support the first assumption: seedlings that had been grown on Trifluralin were more susceptible to the disease. On the other hand, Trifluralin suppressed growth (Fig. 3) of *R. solani*. The herbicide did not affect the virulence of the pathogen toward cotton (disease incidence was 42-50% in all treatments).

The results presented in Fig. 4 show that the percentage of baits colonized by *R. solani* on the day of Trifluralin treatment was lower than in the

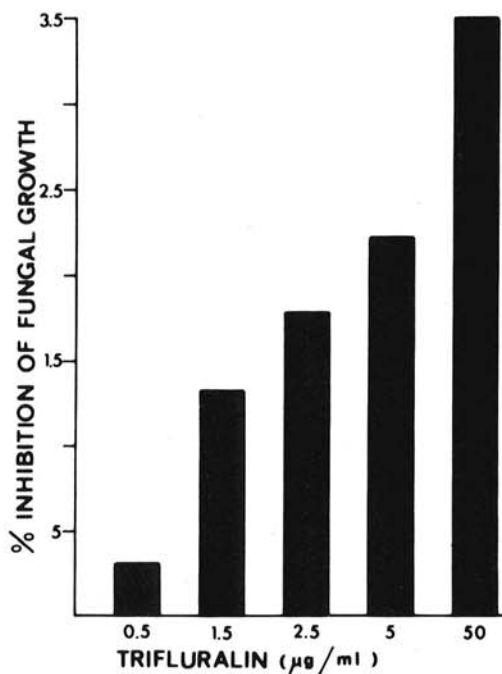


Fig. 3. Effects of Trifluralin on growth of *Rhizoctonia solani* on PDA after 2 days at 27 C. Values are averages for eight replicates. Control (growth on PDA without herbicide), average diam = 3.1 cm, significantly different from Trifluralin treatments at the  $P = .05$  level. % Inhibition of growth =  $\frac{\text{Colony diam of control} - \text{Colony diam of Trifluralin treatment}}{\text{Colony diam of control}} \times 100$

Colony diam of control

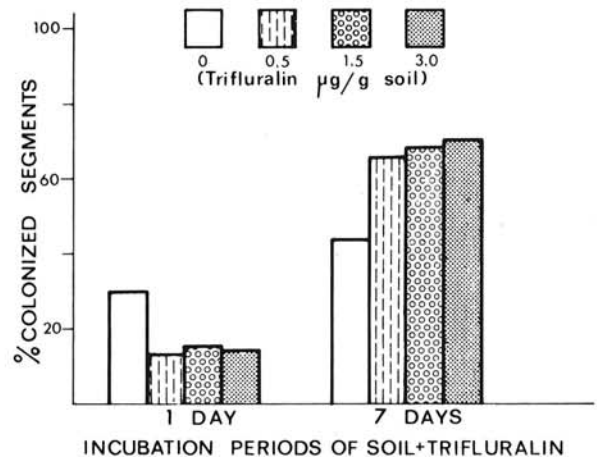


Fig. 4. Effect of duration of period that soil was treated with Trifluralin on the saprophytic activity of *Rhizoctonia solani* in soil, assessed as the percentage of colonized baits. Values are averages of 10 replicates, each containing 10 segments. Values for the control and Trifluralin treatments were significantly different at the  $P = .01$  level.

untreated soil. This corresponds with the results obtained in vitro (Fig. 3). However, when the soil was exposed to the herbicide for 7 days before infestation with *R. solani*, a higher percentage of baits was colonized in the Trifluralin-treated soil, indicating that an increase in saprophytic activity had occurred. The different concentrations of the herbicide did not differ significantly in their effects.

Since Trifluralin suppressed *R. solani* in culture and immediately after treatment of the soil, the delayed increase of *R. solani* in soil incubated with the herbicide was probably due to an effect of Trifluralin, or possibly its breakdown products, on the biotic equilibrium in soil which, by suppressing other microorganisms, indirectly increased the saprophytic activity of *R. solani*. In the field, the combined effects of Trifluralin on increasing the inoculum density and enhancing the susceptibility of the cotton probably outweighed the initial depressing effect on *R. solani* and thereby provided the conditions that resulted in an increased incidence of the disease.

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