ASSESSMENT OF BENEFITS OF COTTON SEED DRESSINGS FOR THE CONTROL OF SEEDLING DISEASES IN RELATION TO INOCULUM DENSITIES OF PYTHIUM AND RHIZOCTONIA

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Abstract

Twenty-five field trials (each with 6 or 8 replications) conducted over a three year period in five San Joaquin Valley counties included the following treatments: nontreated seed (cultivar Maxxa); seed treated with myclobutinol (NuFlow M) for the control of Rhizoctonia-induced damping-off; seed treated with metalaxyl (Apron) for the control of Pythium-induced damping-off; and seed treated with a combination of the fungicides. The following parameters were measured: healthy stands from each treatment, soil populations of Pythium spp. and Rhizoctonia solani at planting, soil temperature at planting, air temperatures for five days after planting, soil particle analysis, EC, calcium, pH, and organic matter. In 1993 and 1994, myclobutinol and the combination of the fungicides resulted in improved stands in 14 of 18 fields. Metalaxyl did not increase stands with the exception of one field, where it significantly increased stands but not to the degree of the myclobutinol treatment alone or in combination with metalaxyl. In three fields in 1993-4, no treatment significantly increased stands. In 1995, the combination of fungicides increased stands relative to the nontreated seeds and was more effective in increasing stands than either myclobutinol or metalaxyl alone. Pythium populations were much greater in 1995 than in 1993-4 and may explain the beneficial, synergistic effect of the fungicides. Covariate analysis of all the data indicated no relationship between stand increases due to the fungicide seed treatment and any soil parameters. Heat units following planting were not limiting and had no effect on stands. Benefits of fungicides were not influenced by pathogen populations with the exception of a negative correlation between stand increases due to seed treatment with myclobutinol and Pythium populations. Apparently, seed treated with myclobutinol are more susceptible to infection by Pythium spp. Overall, the myclobutinol seed treatment increased cotton stands regardless of soil type and pathogen population. There were small benefits from the metalaxyl seed treatment.

Introduction

Fungicide seed dressings are generally used indiscriminately in the San Joaquin Valley of California for the control of cotton seedling diseases. However, in fields where inoculum densities of soilborne pathogens are relatively low or where soil factors promote rapid plant development, seed treatments may not be necessary. It was the goal of this project to predict benefits of seed dressings based on inoculum density, soil temperature, and various soil parameters that might allow the selective use of specific fungicides on an individual field basis. The relationship between inoculum densities of Pythium spp. and cotton stands was previously reported for SJ2 (1), a cotton cultivar currently used on a small percentage of the acreage in the San Joaquin Valley, but this relationship has not been explored with the cultivar Maxxa, the dominant cultivar in use in California today. Also, the relationship between inoculum density of Rhizoctonia solani and cotton stands has not been reported in California.

Materials and Methods

Cotton seed (cultivar Maxxa) was treated in a Hege Seed Treater as follows a) none, b) myclobutinol (NuFlow M) at 2.25 oz/cwt. for the selective control of Rhizoctonia, c) metalaxyl (Apron) at 2 oz/cwt. for the selective control of Pythium spp., and d) myclobutinol + metalaxyl. The fungicides were added to water for a final volume of 8.13 ml per 1 lb. of seed, which included an additional 10% to account for loss on the container during treatment. Seeds were planted in 25 foot plots replicated 6 or 8 times in a randomized complete block design in 25 locations in five San Joaquin Valley counties in 1993-5. Each treatment was planted through each planter unit [John Deere 71 FlexPlanters fitted with Kincaid cones (Kincaid Equip. Manufac., POB 400, Haven, KS 675443)] an equal number of times to eliminate variation attributable to differences in planting depth. At planting, soil temperature was measured and soil samples were collected from 10 sites within each block. Inoculum densities of Pythium spp. were determined by soil dilution and plating on a selective medium containing pimaricin, pentachloronitrobenzene, ampicillin, penicillin, and rifampicin; inoculum densities of R. solani were determined by plating the organic matter fraction from each soil sample onto water agar (2). Data were subjected to covariate analysis to determine if a relationship existed between benefits of fungicides and the parameters measured. Stand values were transformed prior to analysis by logit transformation, i.e. the log of the ratio between the maximum number of healthy plants by any treatment and the measured stands.

Results and Discussion

The myclobutinol seed treatment resulted in stand increases in 22 of the 25 trials (Table 1). In three trials no treatment increased stands relative to the control. Metalaxyl was ineffective in 17 of the 18 trials in 1993 and 1994. In 1995, the combination of the fungicides was more effective than either one of the fungicides alone. The populations of Pythium spp. in 1995 was considerably greater than in

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1993-4 (295.3 cfu/g and 31.8 cfu/g, respectively), and may explain the small but significant increases due to metalaxyl in 1995. Stand losses could not be predicted based on any soil parameter or combination of parameters (means across all locations are presented in Table 2), nor were stands related to populations of either organism. Although R. solani was isolated from 60% of diseased cotton seedlings (whereas Pythium spp. were isolated from 15% of the diseased seedlings), stands were not related to Rhizoctonia populations, and fungicide benefits occurred at low or high populations. There was, however, a significant negative correlation between Pythium populations and stand increases due to the myclobutinol seed treatment (Table 3). Apparently, cotton seedlings treated with myclobutinol, a fungicide with activity against Rhizoctonia, are more susceptible to infection by Pythium. This may also explain the beneficial synergistic benefit of the two fungicides in 1995. Protecting seed and seedlings against infection by one pathogen may increase the incidence or severity of disease caused by the other.

Degree days (daily high + daily low/2 - 60) for five days following planting were generally adequate for cotton seed germination and seedling development (means of 16.7, 40.5, and 29.8 for five days after planting in 1993-4-5, respectively). Fifteen degree days is considered adequate for seed germination.

In general, the myclobutinol seed treatment was beneficial regardless of soil type or pathogen population. There was little benefit, however, from the metalaxyl seed treatment directed against infection by Pythium spp. Apparently, the cultivar Maxxa has relatively more field tolerance to Pythium infection than that reported in other cultivars, e.g. SJ2 . However, for optimum stands, both fungicides were required since at high Pythium population densities the benefits of myclobuinol decreased. Furthermore, there was a synergistic effect of the combination of the fungicides in all trials in 1995, when populations of Pythium were relatively high.

References

1. DeVay, J. E., Garber, R. H., and Matheron, D. 1982. Role of Pythium species in the seedling disease complex of cotton in California. Plant Disease 66:151-154.

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

Table 1. Effect of fungicide seed treatments on cotton stands (cv. Maxxa, 120 seeds planted).

Seed treatment	1993 (3)*	1994 (11)**	1995 (7)
None	68.9 a	74.1 a	66.2 c
Myclobutinol	90.2 b	91.3 b	70.9 b
Metalaxyl	69.2 a	75.9 a	69.9 b
Both	87.0 b	92.9 b	79.4 a

* Number of trials

** In three locations in 1994, there were no significant differences between treatments. In one location in 1994, stand results follow: none, 63.2 a; myclobutinol treated seeds, 87.0 c; metalaxyl treated seed, 72.0 b; and both fungicides, 88.5 c.

Table 2. Minimum and maximum values and means for soil parameters.

	Range	Mean
pH	6.7 - 7.7	7.3
EC millimhos/cm	0.48 - 3.36	1.28
P ppm	10 - 106	28.0
X-Ca meq/100g	3.6 - 26.4	15.9
OM %	0.45 - 3.07	1.29
% sand	17 - 76	47.6
% silt	17 - 49	36.1
% clay	1 - 35	16.3
Pythium pop (cfu/g)	0 - 725.6	105.6
Rhizoc. pop (cfu/100g)	0 - 7.6	1.44

Table 3. Correlations between stand increases and populations of Pythium spp. (cfu/g soil) and R. solani (cfu/100 g soil).

	r	Probability
Pythium pop. vs stand increase with myclobutinol treated seed	-0.323	0.0001
Rhizoctonia pop. vs stand increase with myclobutinol treated seed	-0.035	0.65
Pythium pop. vs stand increase with metalaxyl treated seed	0.047	0.54
Rhizoctonia pop. vs stand increase with metalaxyl treated seed	0.005	0.94
Pythium pop. vs stand increase with both fungicides on seed	-0.063	0.42
Rhizoctonia pop. vs stand increase with both fungicides on seed	0.003	0.96

Note: stand increases are the proportion of stand increases relative to the highest increase with any treatment and were subjected to logit transformation.