BIOFUMIGATION AND SOIL AMENDMENT EFFECTS ON COTTON ROOT ROT SUPPRESSION

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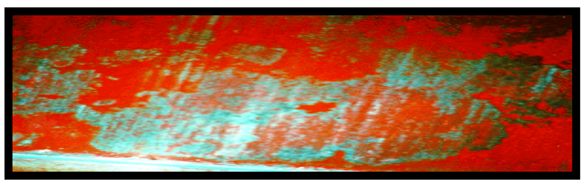
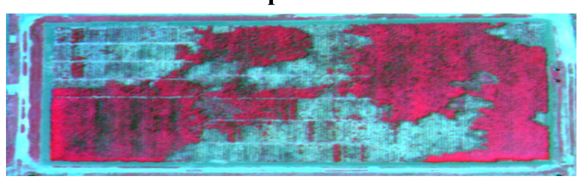
Introduction

One of the major diseases of cotton grown on high pH, calcareous soils of the Southwest is cotton root rot. The unique nature of the pathogen, *Phymatotrichopsis omnivora*, enables it to survive over extremely long periods of time. Previous research (Matocha, et al. 1985) has suggested cotton response to improved plant nutrition and some tolerance to root rot disease. Use of chelated and inorganic trace elements in soil and foliar applications could influence the degree of Phymatotrichopsis root rot (PRR) suppression. The purpose of these studies was to develop economically feasible and field applicable methods to suppress PRR on cotton using plant nutrition, including trace elements, soil pH reduction and possibly biofumigation.



Phymatotrichopsis root rot (PRR) 60% mortality on 100 ac. cotton field in Corpus Christi area.



PRR in experimental field plot where these studies were conducted (USDA-ARS Research Farm, Weslaco).

Materials and Methods

Field experiments were conducted using South Texas soils typical of those used in grain sorghum and cotton production. Hidalgo sandy loam (hyperthermic calciustolls) with several years histories of producing sorghum with symptoms of slight to moderately severe Fe deficiency chlorosis was selected for these studies. The Hidalgo soil site was located on the USDA-ARS Research farm at Weslaco, Texas. Cotton grown previously on this soil suffered moderately severe infestation from PRR. Earlier field observations showed a possible relationship between trace elements deficiencies and severity of PRR on cotton

Chelated Fe was supplied as ethylenediamine dihyroxphenylacetic acid-Fe (Fe-EDDHA). Zinc sulfate and ferrous sulfate were also used as sources of inorganic Zn and Fe. The synthetic Fe-EDDHA chelate is the most stable Fe chelate under the high soil pH and Ca status of these soils. Elemental S was soil applied as powered sulfur to reduce soil pH.

Methods used in the field experiments were as follows. Preplant placements – 10 cm to side and 5 cm below seed: all N and P fertilizers. In-seedrow placement – directly with the seed in band, but from different sprouts: granular controlled release CGA-64250 (Propiconazole, PCU),$(NH_4)_2SO_4$ Fe-EDDHA, and FeSO4, Zn SO4. Stem drench approximately 15 ml sprayed on each stem at 30 cm plant height: chelate iron (Fe-EDDHA), and Bayleton and Propiconazole fungicides. All treatments were arranged in an RCB with three replications.

As part of the biofumigation project a Brassica cover crop known to be effective in suppressing certain soil borne fungi was grown as a winter crop on a portion of the experimental site on the Hidalgo soil. The Brassica was incorporated as a green manure soil crop and cotton was seeded some 4 weeks later. Other treatments included preplant band applications of Brassica seed and processed (oil removed) meal directly below the seed row and some 4 weeks prior to cotton planting. Plant mortality counts were recorded at early mid and late season.

Results and Discussion

Results of these field experiments located in the Lower Rio Grande Valley are presented in Figures 1, 2, 3,4 and 5. Phymatotrichopsis root rot (PRR) increased rapidly from June 16 until July 3 (Fig.1) Suppression of PRR appeared substantial for both $(NH_4)_2SO_4$ (AS) and granular elemental S + Fe at all mortality counting dates (MCD).

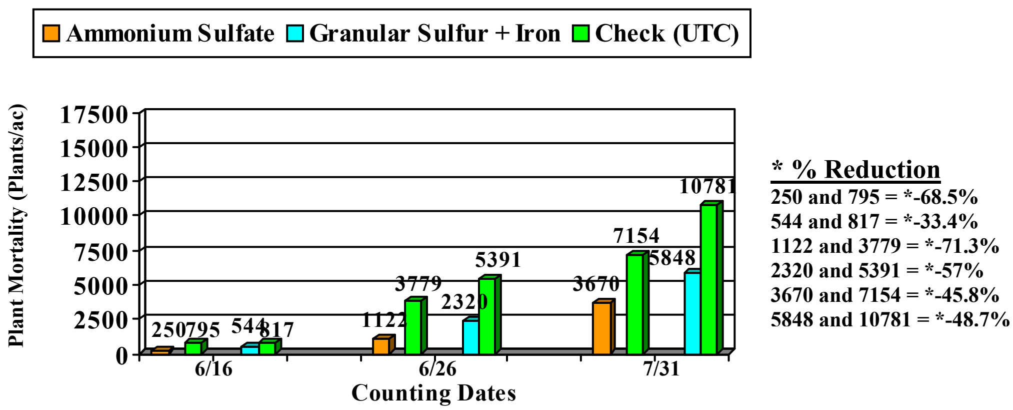


Fig. 1. Effect of ammonium sulfate and granular iron on plant mortalitites from Phymatotrichopsis root rot on cotton (Hidalgo Co. TX-06).

The greatest suppression appeared at the middle MCD (6/26) with 71 and 57 % disease reduction for AS and GS Fe, respectively. At the last MCD (7/31) these disease suppression values decreased to 46 and 49%. The larger decrease in effective disease reduction with time in the case of AS as compared to granular S + Fe may be due to the plant response to the Fe in the GS Fe material.

In the same experiment powdered elemental S at 750 lb/ac applied preplant suppressed PRR 88% early, 58% at midseason and 62% at late season below values recorded for corresponding UTC's. With the exception of the early date these appear to be relatively close to reduction readings for the granular S + Fe reported in Figure 2.

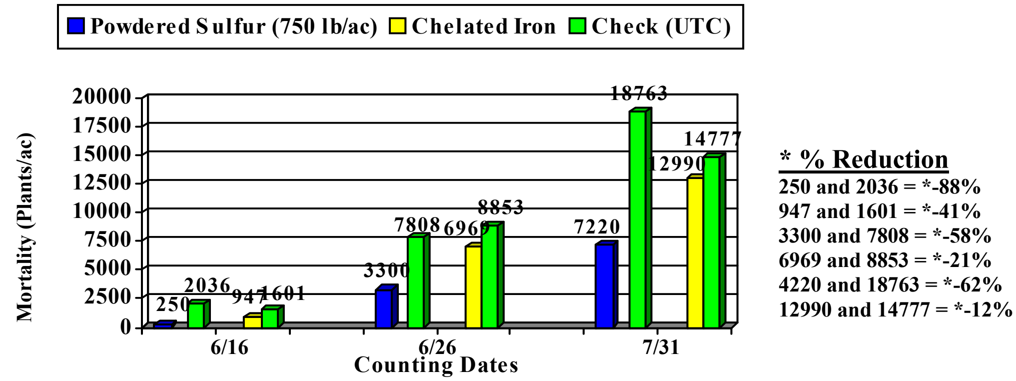
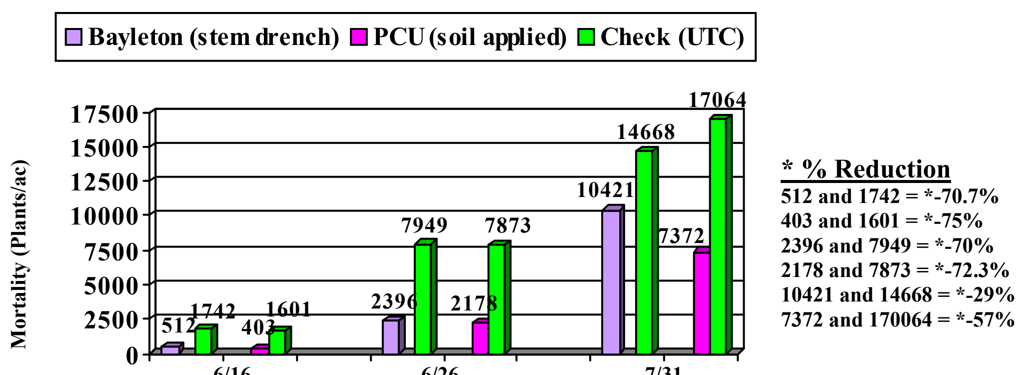


Fig. 2. Effect of powdered sulfur and chelate iron on plant mortalities from Phymatotrichopsis root rot on cotton (Hidalgo Co. TX-06).

In split-plot comparisons with the powdered S, chelated Fe (2 lb/ac) applied as stem drench was less effective in reducing incidence of PRR with percentages of 41, 21 and 12% for the early, mid and late season, respectively. Powdered S maintained relatively good PRR suppression over the 6 week critical period when disease pressure was increasing. A possible explanation could involve decreasing soil pH with time resulting from the oxidation of the elemental S. Previous greenhouse research reported substantial reductions in PRR incidence associated with soil pH depression.

Stem drenching with Bayleton at 2 lb a.I/ac reduced PRR by 70% below the corresponding UTC at the 6/16 and 6/26 counting dates but decreased to 29% at the 7/31 date (Fig. 3). The reduced efficacy of Beyleton as the PRR progressed indicates a need for controlled release formulation of this material.

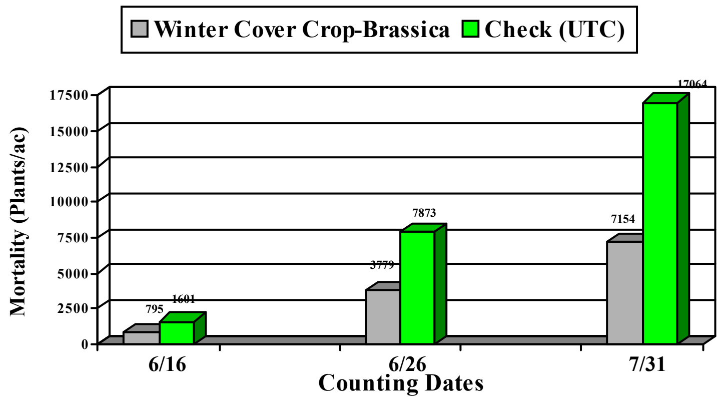
Seedrow applications of controlled release as funigicide (PCU) was equally effective as Bayleton stem drench at the first two counting dates but considerably better later in the season (57% vs 29%) disease suppression for Bayleton stem drench.



Biofumigation using Brassi[...] crop (Pac[...]l) as green [...] resulted in variable PRR suppression (Fig.4-5). In the initial year (Fig. 4) mortalities were decreased by 50% or more and staying relatively constant during June ar[...]

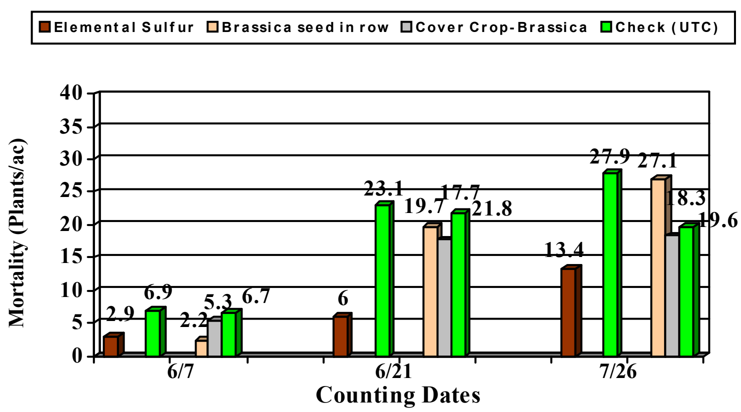
Fig. 3. Effect of controlled release fungicides and application method on disease progression from Phymatotrichopsis root rot on cotton (Hidalgo Co. TX-06).

In the second [...] sing the disease ranging from 11% early, 18.9 mi[...] cotton seedrow for fumigation was only effective [...] l S preplant banded in the seedbed suppressed PRR from 58% early to 52% late in the season.



*** % Reduction**
795 and 1601 = *-50%
3779 and 7873 = *-52%
7154 and 17064 = *-58%

Fig. 4. Effect of biofumigation with Brassica cover crop on Phymatotrichopsis root rot on cotton (Hidalgo Co. TX-07).



*** % Reduction**
2.9 and 6.9 = *-58%
2.2 and 5.3 and 6.7 = *-40%
6 and 23.1 = *-74%
19.7 and 17.7 and 21.8 = *-19%
13.4 and 27.9 = *-52%
27.1 and 18.3 and 19.6 = *-7%

Fig. 5. Effect of biofumigation with mustard plants and seed and elemental sulfur on Phymatotrichopsis root rot on cotton (Hidalgo Co. TX-07)

Summary

This serious disease of cotton grown in southwest USA can be suppressed to varying degrees. Our results indicates the following: Improved plant nutrition with certain chelated trace elements; Soil applications of slow release fungicides; Preplant banding of high rates of powdered elemental S; Use of Brassica as winter cover crop for biofumigation produced variable and less consistent results. Further research should focus on combining soil amendments with biofumigation.

Reference

Matocha, J.E., S. Mostaghimi and F.L. Hopper. 1985. Effect of Soil and Plant Treatments on Phymatotrichum Root Rot. Proc. Beltwide Cotton Prod. Res. Conf., Cotton Disease Council p 24-26.