



## Chemical Seed Treatments for the Control of Cotton Seedling Pathogens

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### ABSTRACT

Seedling diseases of cotton are a very serious problem in Greece because planting starts early in the spring when cold soil and weather conditions favour the development of the disease. The major soil borne pathogens involved are *Pythium ultimum*, *Rhizoctonia solani* and *Thielaviopsis basicola*. Cotton seed treatments are designed to protect seed and seedlings from the pathogen complex that cause the seeds, roots and hypocotyl to rot. Following many years of testing, Vitavax was found to be the most effective against *R. solani* while two different commercial formulations of metalaxyl (Apron and Ridomil) were found to be effective against *P. ultimum*. Black root rot of cotton was significantly reduced when cotton seed was treated with any one of the fungicides Benlate, Bayfidan or Bayleton. Combinations of metalaxyl, benlate and carboxin were found to be effective against damping off caused by all three pathogens. Evaluation of cotton seed treatments in 1994 showed that metalaxyl plus carboxin was the combination that gave the highest final cotton seedling survival. However, the specific pathogen controlled in this trial was *R. solani*.

### Introduction

Cotton is a crop of economic importance for Greece, which one of the two major cotton producing countries of the European Union, the other being Spain.

Damping-off of seed and seedlings occurs all over the world where cotton is grown. In Greece, cotton seedling diseases could be even more devastating, since the country is located near the geographis limit of cotton cultivation and planting starts early in the spring when cold soil and adverse weather conditions favour the development of disease. The major soil-borne fungal pathogens involved are *Pythium ultimum* Trow, *Rhizoctonia solani* Kuhn and *Chalara elegans* Nag Raj and Kendr. [*Thielaviopsis basicola* (Berk. and Broome) Ferraris]. Cotton seed treatments are designed to protect seed and seedlings from the pathogen complex that cause rot to seed, roots and hypocotyl tissues (DeVay *et al.*, 1988). Chemical seed treatments have been the most effective measures for the protection of the seed and the emerging seedling in order to ensure a good stand. Evaluating the effectiveness of cotton seed protectant fungicides in the field is a long and laborious process that does not always guarantee reproducible results, since the pathogen structure in the soil is practically unknown and varies with time (Kouyeas and Davatzi-Helena, 1980). Evaluate chemical treatments against soil-borne plant pathogens initially was based on the comparison of their effectiveness against a certain inoculum concentration of the pathogen in artificially infected soil or a series of increasing inoculum densities.

Recently, inoculum has been produced as follows (Paplomatas and Katsimiha, 1996). *R. solani* and *P. ultimum* were grown at 25°C for one week in plastic

Recently, fungicide performance under greenhouse conditions was evaluated against a high inoculum pressure of each of the three pathogens alone or together (disease complex).

### Material and Methods

The fungicides tested in the experiments over the whole period of chemical seed treatment evaluation, are presented in Table 1.

When this work was initiated (about twenty five years ago) chemical treatments of the cotton seed were carried out by the slurry method (with 1% water) about three months before planting and the treated seed was kept in burlap sacks. The seed used in the tests belonged to the Greek variety 4S and was machine delinted. The treated seed was planted in plastic cups (5 seeds per cup) containing soil with a series of inoculum concentrations. Inoculum levels were 0.08, 0.16, 0.75, 6.25 and 12.5% w/w of the soil. The soil had a pH of 7.8. It was steam sterilized 4-5 months before sowing and kept outdoors in open plastic bags where it was wetted from time to time to re-establish a saprophytic microflora. The inoculum of the pathogen (*Thielaviopsis basicola*) was grown for 28 days in a mixture of sand (250 g), carrot (7.5 g), yeast extract (2.5 g) and 39 ml of water (60% of the holding capacity). For production of inoculum of *Pythium ultimum* and *Rhizoctonia solani*, corn meal (7.5 g) was used instead of carrot and yeast extract (Koyeas and Davatzi-Helena, 1980).

Petri dishes containing P.D.A. medium, while *T. basicola* was incubated under the above conditions for two weeks. Subsequently, the content of each Petri

dish (fungus plus culture medium) was homogenized in a blender and the inoculum was incorporated by hand mixing into a sandy loam soil that was placed in plastic greenhouse flats (45 x 30 x 15 cm). In each flat, six rows of 20 seeds were planted. For every pathogen-fungicide combination, two flats (blocks) were used.

Flats were kept under a 12 h light regime with an 18°C soil temperature. This inoculation method resulted in about 5 propagules per g soil of *R. solani*, 60 propagules per g soil for *P. ultimum* and 100 propagules per g soil for *T. basicola*. High inoculum concentrations were preferred for all three pathogens in order that the chemical treatments be evaluated under high disease pressure.

Final seedling survival was recorded 15 days after planting. In addition, for *T. basicola*, the root damage (disease index) was also rated based on an arbitrary 1 to 5 scale with 1 having completely white, healthy roots with numerous lateral rootlets and 5 showing completely blackened roots with few or no lateral rootlets.

A field trial in an area with a known disease history (near Thibes, about 80 km north of Athens), was set up in 1994. Seed treatments were based on the greenhouse performance of the fungicides tested, using a Latin square experimental design (eight treatments including the untreated control with eight replications for each treatment). One hundred cotton seeds were sown in each replication.

## Results and discussion

From the early experiments where several levels of inoculum densities of the pathogens were tested, the following conclusions were drawn (Kouyeas and Davatzi-Helena, 1980). Dexon alone or in combination with one of the fungicides Brassicol, Demosan, Vitavax or Daconil and the combined treatment Ridomil+Captan were found the most effective against seedling damping-off caused by *P. ultimum*. The fungicides Demosan-C, Vitavax-C, Benlate and Terracoat L-21 controlled *R. solani* most efficiently, while the most effective seed treatments for the mixed inoculum (both pathogens incorporated in the soil together) proved to be those of Terracoat L-21, Demosan + Dexon, Brassicol + Dexon and Vitavax-C. For *T. basicola*, the combinations Benlate + Dexon and

the fungicide Neoptan alone were very effective even at the highest inoculum density tested (12.5%).

In the greenhouse trials in 1994 Vitavax 98% W.P. was found to be the most effective against *Rhizoctonia* damping-off with cotton seedling survival that did not differ significantly from the uninoculated control (untreated seeds planted in sterile soil). Celest 25% F.S. and Vitavax-C gave good protection as well, with survival that did not differ significantly from the untreated control (untreated seed planted in inoculated soil) but not as high as that of Vitavax 98% W.P. For *P. ultimum*, Apron 20% L.S. and Ridomil 25% W.P. were the most effective seed treatments, while Celest 25% F.S. and Benlate 50% W.P. protected the seedlings from black root rot caused by *T. basicola*. The most effective combined seed treatments against the disease complex (all three pathogens together) under these experimental conditions, were Apron 20% L.S.+Benlate 50% W.P.+Vitavax 98% W.P. and Apron 20% L.S.+Celest 25% F.S (Paplomatas and Katsimiha, 1996).

In the 1994 field trial, seed coating with Apron 20% L.S.+Vitavax 98% W.P. resulted in the highest seedling survival that was significantly different from the untreated control. However, sampling of diseased plants from the untreated control and the area surrounding the experimental plot area showed that *R. solani* was the causal agent of seedling damping-off in that location.

## References

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**Table 1. Seed protectants used alone or in combination against cotton seedling diseases.**

Fungicide	Active ingredient
Apron 20% L.S.	metalaxyl
Bayfidan 25% E.C.	triadimenol
Bayleton 5%	triadimefon
Benlate 50%	benomyl
Brassicol	PCNB
Busan 30A	TUMBT
Celest 25% F.S.	fludioxonil
Daconil 75% W.P.	chlorothalonil
Demosan 65% W.P.	chloroneb
Demosan-C W.P.	chloroneb 40%-captan 22.5%
Dexon 50% W.P.	fenaminosulf
Dithane M-45	mancozeb
Dithane S 60 60% W.P.	mancozeb
Kathon S.P. 70 70% E.C.	RH 893
Neoptan	neotopsin 17.5% - captan 62%
Orthocide 50% W.P.	captan
Ridomil 25% W.P.	metalaxyl
Terraclor 75% W.P.	quintozene
Terracoat L-21 L	PCNB 22.8% - ETCMTD 11.4%
Terracoat L-205	PCNB 23.2% - ETCMTD 5.8%
Vitaflo	carboxin 15% - DTMTD 13%
Vitavax 75% W.P.	carboxin
Vitavax 98% W.P.	carboxin
Vitavax-C W.P.	carboxin 37.5% - captan 37.5%