EFFICACY AND ECONOMIC RETURNS OF FUNGICIDE SEED TREATMENTS USED TO REDUCE COTTON SEEDLING DISEASES IN WEST TEXAS

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Abstract

Field experiments were conducted in 2006 and 2007 to evaluate combinations of various fungicide seed treatments under low (natural) and/or high (artificially inoculated with *Rhizoctonia solani*) field conditions. The use of fungicides (standard or over treatments) improved stands under high disease pressure situations. Likewise, fungicides provided increased vigor of seedlings. This trend was also apparent with over-treatments compared to standard treatments. Lint yields were increased 300 to 700 lb/acre over base treatments when over-treatments were used. The use of over-treatments increased gross and net returns by $100 to $300/acre when compared to the base treatments. While devastating seedling disease losses are rare, these results indicate that the use of fungicide over-treatments lead to improved plant stands, vigor, and higher yields and economic returns under high pressure situations, thus producers with a history of high disease pressure should consider their use.

Introduction

Several pathogens, including *Rhizoctonia solani*, *Thielaviopsis basicola, Pythium* spp., and *Fusarium* spp. are capable of causing seedling diseases of cotton (Davis et al., 1981). In west Texas, losses associated with seedling diseases are incurred annually and are typically <5% (Blasingame and Patal, 2006); however, increased losses may be experienced under cool, wet environmental conditions (Davis et al., 1981). The majority of cotton varieties grown in this region are treated with some sort of fungicide. While the application of standard seed treatments typically provides acceptable control of seedling diseases, there are occasions when substantial reductions in stand may occur. Producers are encouraged to replant if final plant stands are below 1.5 plants/foot (Supak, 1991). Additional fungicides (or overtreatments) may be used to improve final plant stands in fields with a history of high seedling disease pressure. Evaluations of over-treatments are needed so that appropriate recommendations can be made to producers. In addition to improving stands, these products must also result in increased economic returns. The objectives of this work were to evaluate the efficacy of various seed treatments, and to determine their economic returns under varying field conditions.

Materials and Methods

A total of three experiments were conducted to address the aforementioned objectives. In 2007, two trials (referred to as the Trilex Advanced or Vortex trials) were established at the Texas Tech University Quaker Farm. A total of eight treatments were evaluated in the Vortex trial (Table 1), while the Trilex Advanced trial contained six treatments (Table 1). Treatments were arranged in a randomized complete block design with eight replications. Plots were two rows (planted on 40 inch centers) by 34.5 feet in length. Plots were inoculated by placing three grams of ground oat seed infested with *R. solani* in seed packets at planting. An additional experiment, initiated in 2006 and repeated in 2007, were conducted at the Texas A&M AgriLife Research and Extension Center, Halfway Station. In this experiment, five treatments (Table 1) were arranged in a split-plot design with four replications. Seed treatment served as whole plots and infestation rate served as sub-plots. Infestation rates consisted of non-inoculated (low pressure) artificially infested (high pressure) plots were inoculated as described previously. All trials had corresponding standard treatments and non-treated (black seed) as controls. The trials were planted

between 27- and 28-April. The variety DeltaPine 444 BG/RR was used in all trials. All other management decisions were based on local extension recommendations.
Stand counts were initiated 14 days after planting (DAP) and were conducted weekly for three weeks in 2006 and seven weeks in 2007. Vigor ratings were made 35 DAP and skip index values were taken 49 DAP. Plots were harvested by mid-November using a two row stripper equipped with digital scales. Samples (~1,000 g) were collected from four replications per test and ginned for percent turnout. Subsequent samples were submitted to the Texas Tech University International Textile Center for HVI analysis. Fiber properties were used to determine loan values and to calculate crop value. Net returns were calculated for each plot. An analysis of variance was performed using the GLM procedure of SAS (SAS Institute, Cary, NC, version 9.1). Means were separated using the Waller-Duncan multiple range test. Differences were deemed significant if $P \leq 0.05$.

Results and Discussion

Environmental conditions were drastically different for the two growing seasons. A severe drought was experienced during most of the 2006 growing season; however, supplemental irrigation provided environmental conditions conducive for seedling disease development. For 2007, rainfall was well above and temperatures well below the long term average for the region (data not shown) resulting in severe seedling disease conditions.

Vortex trial:
Significant differences in stand counts, vigor ratings, skip index values, and lint yield were observed between treatments (Table 2). All treatments provided stands greater than the untreated control. Stand reduction were observed up to six weeks after planting. This trend is atypical and was a result of unseasonably cool and wet conditions. Increasing rates of Vortex resulted in greater plant stands when applied in addition to Baytan and Allegiance by 49 DAP. Overall, the use of Vortex lead to increased stands, compared to treatments where Vortex was absent. Over-treatments of Vortex applied in conjunction with Trilex and Allegiance resulted in similar stands (1.4 plants/foot); however, this level of stand establishment is near recommended replant populations (CITE). Stands for the Apron/Maxim/Systhane treatment did not differ from the standard base treatment, reflecting the limited systemic activity of the fungicides comprising the treatment. Vigor ratings were highest for the Baytan/Allegiance/Vortex (0.342 oz/cwt) treatment. No differences in vigor were observed between any of the other treatments containing Vortex. Skip index values were greatest for the untreated control, standard treatment, and Apron/Maxim/Systhane treatment with values of 53.9, 32.6, and 37.6, respectively. In general, yields were highest for treatments containing Vortex, except when the lowest rate (0.0086 oz/cwt) which resulted in intermediate yields. Overall, yields were increased over the untreated control by an average of 975 lb/acre when fungicides were used, thus indicating the benefits of fungicide seed treatments. Gross returns were calculated using a loan value of $0.5858/lb. Gross returns $753/acre for the standard treatment and $987/acre for the high Vortex rate plus Baytan plus Allegiance.

Trilex Advanced trial:
As was the case for the Vortex trial, significant differences in the parameters evaluated were observed (Table 3). All treatments improved plant stands over the untreated control. The standard 'base' treatment provided final plant stands <1.0 plant/foot, which would probably lead to a replant decision for producers. Increased stands were obtained for all over-treatments compared to the base treatment with over-treatments of Vortex plus Trilex and Dynasty providing exceptional stands. Vigor ratings ranged from 1.3 for the untreated control to 9.6 for the Vortex plus Trilex and Dynasty treatments. Similar trends were observed with skip index values. The Vortex plus Trilex and Dynasty treatments increased yields by 480 and 384 lb/acre, respectively over the base treatment. A mean loan value of $0.582/lb was used to calculate gross returns. Gross returns ranged from $307 to $1062/acre for the untreated control and base plus Trilex plus Vortex treatment, respectively.

National Cotton Council trial:
In 2006, final plant stands were not different in non-inoculated (natural) plots; however, significant treatment effects were observed in artificially infested plots (Table 4). All treatments improved stands over the untreated control. Plant stands for seed treatments ranged from 1.3 plants/foot for the base treatment to 2.0 plants/foot for the base plus Trilex plus Vortex treatment. Significant differences in stands were observed under both infestation rates in 2007 (Table 6). All treatments provided improved stands compared to the untreated control; however stands for the base plus Dynasty treatment were intermediate. Greater differences were observed when plots were artificially infested with *R. solani*. Over-treatments containing Trilex and Dynasty resulted in stands of 1.5 and 1.6 plants/foot,

respectively. No differences in yield were observed for treatments under either infestation level during in 2006, or in the natural conditions in 2007 (Table 6). Yield was increased by 508 and 708 lb/acre over the base treatment for over-treatments containing Trilex and Dynasty, respectively in 2007. Net returns were not different in 2006 under each infestation level. Net returns ranged from $541 to $688/acre and $317 to $549/acre for natural and artificially infested plots, respectively. For 2007, net returns were similar for all treatments under non-infested plots. Under high disease pressure, returns were highest for the overtreatment consisting of Dynasty ($1,040/acre), and the base plus Trilex treatment ($924/acre). Overall, the use of over-treatments increased net returns by $300 and $600 over the base and untreated control, respectively.

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Table 1. Description of seed treatments evaluated during the 2006 and 2007 growing seasons in west Texas

Trial treatment	Rate (oz/cwt)
Vortex	
1. Untreated control	- - - - - - -
2. Baytan 30 + Argent 30 + Allegiance FL	0.5 + 1.0 +0.75
3. Baytan 30 + Allegiance FL+ Vortex FL	0.5 + 1.0 + 0.086
4. Baytan 30 + Allegiance FL + Vortex FL	0.5 + 1.0 + 0.171
5. Baytan 30 + Allegiance FL + Vortex FL	0.5 + 1.0 + 0.342
6. Trilex FL + Vortex FL + Allegiance FL	0.32 + 0.171 + 0.75
7. Trilex FL + Vortex FL + Allegiance FL	0.32 + 0.342 + 0.75
8. Apron XL + Maxim + Systhane 400 WP	0.32 + 0.08 + 0.84
Trilex	
1. Untreated control	- - - - - - -
2. RTU Baytan Thiram + Allegiance FL	3.0 + 0.75
3. RTU Baytan Thiram + Allegiance FL + Trilex FL+ Allegiance FL + Baytan 30 + Vortex FL	3.0 +0.75 + 0.64 + 0.75 + 0.25 + 0.086
4. RTU Baytan Thiram + Allegiance FL + Trilex FL + Allegiance FL + Baytan 30	3.0 + 0.75 + 0.64 + 0.75 + 0.25
5. RTU Baytan Thiram + Allegiance FL + Trilex FL + Vortex FL + Allegiance FL	0.5 + 0.75 + 0.64 + 0.342 + 0.75
6. RTU Baytan Thiram + Allegiance FL + Dynasty CST	0.5 + 0.75 + 3.95
National Cotton Council	
1. Baytan 30 + Argent 30 + Allegiance FL	0.5 + 1.0 + 0.75
2. Baytan 30 + Argent 30 + Allegiance FL + Trilex FL + Vortex FL	0.5 + 1.0 + 0.75 + 0.64 + 0.342
3. Baytan 30 + Argent 30 + Allegiance FL + Trilex FL	0.5 + 1.0 + 0 .75 + 0.64
4. Baytan 30 + Argent 30 + Allegiance FL + Dynasty CST	0.5 + 1.0 + 0.75 + 3.95
5. Untreated control	- - - - - - -

Table 2. Effects of various combinations of seed treatments containing Vortex for control of seedling disease, caused by *Rhizoctonia solani*

Treatment[a]	Stand counts (plants/foot)						Vigor (1-10)	Skip index	Lint yield (lb/acre)	Gross value ($/acre)
	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP	49 DAP				
Untreated	0.7 d[b]	0.5 f	0.3 e	0.3 d	0.3 e	0.3 e	1.4 d	53.9 a	504 d	295 d
Baytan 30 +Allegiance FL +Argent TL	2.4 b	1.8 d	1.1 d	1.0 c	1.0 d	0.9 d	5.0 c	32.6 b	1,286 c	753 c
Baytan 30 +Allegiance FL +Vortex (0.0086 oz/cwt)	2.7 a	2.5 b	1.9 bc	1.6 b	1.6 bc	1.5 bc	8.0 b	20.4 cd	1,493 b	875 b
Baytan 30 +Allegiance FL +Vortex (0.171 oz/cwt)	2.7 a	2.6 ab	2.0 ab	1.7 ab	1.7 ab	1.7 ab	7.9 b	17.9 de	1,651 ab	967 ab
Baytan 30 +Allegiance FL +Vortex (0.342 oz/cwt)	2.8 a	2.8 a	2.2 ab	1.9 a	1.8 a	1.9 a	9.6 a	14.0 e	1,685 a	987 a
Trilex Flowable +Allegiance FL +Vortex (0.171 oz/cwt)	2.6 ab	2.1 c	1.7 c	1.5 b	1.5 c	1.4 c	7.4 b	25.8 c	1,550 ab	908 ab
Trilex Flowable +Allegiance FL +Vortex (0.342 oz/cwt)	2.6 ab	2.2 c	1.7 c	1.5 b	1.4 c	1.4 c	7.4 b	24.9 c	1,517 ab	889 ab
Apron XL +Maxim 4FS +Systhane 40WD	1.9 c	1.4 e	1.0 d	0.9 c	0.8 d	0.8 d	4.1 c	37.6 b	1,176 c	689 c

[a] Refer to Table 1 for a detailed description of treatments

[b] Values are the mean of 8 replications. Means within a column followed by the same letter are not significantly different according to the Waller-Duncan multiple range test (P=0.05).

Table 3. Effects of overtreatment fungicides for control of seedling disease, caused by *Rhizoctonia solani*

Treatment[a]	Stand counts (plants/foot)						Vigor	Skip index	Lint yield (lb/acre)	Gross value ($/acre)
	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP	49 DAP				
Untreated	0.7 d[b]	0.4 e	0.3 e	0.3 e	0.3 e	0.3 e	1.3 d	49.0 a	528 e	307 e
Base[a]	2.0 c	1.5 d	1.2 d	1.0 d	1.0 d	0.9 d	4.5 c	33.8 b	1,344 d	782 d
Base + Trilex +Vortex + Baytan	2.6 ab	2.5 b	2.3 b	2.1 b	2.1 b	2.1 b	8.6 a	14.6 d	1,584 bc	922 bc
Base + Trilex	2.4 b	2.1 c	1.8 c	1.6 c	1.6 c	1.6 c	6.8 b	22.6 c	1,536 c	894 c
Base + Trilex +Vortex	2.8 a	2.8 a	2.7 a	2.5 a	2.5 a	2.5 a	9.6 a	8.8 e	1,824 a	1062 a
Base + Dynasty CST	2.8 a	2.9 a	2.7 a	2.4 a	2.5 a	2.5 a	9.6 a	7.5 e	1,728 ab	1006 ab

[a] Refer to Table 1 for a detailed description of treatments

[b] Values are the mean of 8 replications. Means within a column followed by the same letter are not significantly different according to the Waller-Duncan multiple range test (P=0.05).

Table 4. Evaluation of seed treatment fungicides in natural soil and soil artificially infested with *Rhizoctonia solani*

Treatment[a]	Final stand counts (plants/foot)				Lint yield (lb/acre)				Net returns ($/acre)			
	2006		2007		2006		2007		2006		2007	
	Natural	Infested	Natural	Infested	Natural	Infested	Natural	Infested	Natural	Infested	Natural	Infested
Base	2.1 a[b]	1.3 b	2.4 a	0.6 bc	1,707 a	838 a	2,128 a	1,113 c	617	482	1,222 a	639 c
Base +Trilex +Vortex	2.2 a	2.0 a	1.9 ab	0.9 b	956 a	977 a	2,193 a	1,497 b	541	549	1,253 a	853 b
Base +Trilex	2.0 a	1.3 b	2.3 a	1.5 a	1,002 a	924 a	2,052 a	1,621 ab	563	519	1,172 a	924 ab
Base +Dynasty CST	1.9 a	1.6 b	1.6 bc	1.6 a	967 a	868 a	1,874 a	1,821 a	544	489	1,071 a	1,040 a
Untreated	1.9 a	0.5 c	1.0 c	0.2 c	1,200 a	553 a	1,903 a	590 d	688	317	1,092 a	339 d

[a] Refer to Table 1 for a detailed description of treatments

[b] Values are the mean of 8 replications. Means within a column followed by the same letter are not significantly different according to the Waller-Duncan multiple range test (P=0.05).