New Developments in Cottonseed Treatment from China, CIS Republics and United States

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ABSTRACT

Research results from the three largest cotton producing areas of the world have demonstrated significant increases in disease control and cotton yields by utilizing new combination chemical seed treatments. In China, 16 formulations were studied at eight field trial sites in four provinces for several years. Combinations of 2-(thiocyanomethylthio) benzothiazole, a-butyl-a-(4-chlorophenyl)-1 H-1,2,4-triazole-1-propanenitrile and N-(2,6-dimethylphenyl)-N-(methoxyacetyl) alanine methyl ester significantly increased plant stand and yield compared to single and composite treatments. This combination has also demonstrated significant increases in cotton stand and survival in field trials conducted across the cotton growing area of the United States, over 4 years. In Uzbekistan, the combination of 2-(thiocyanomethylthio) benzothiazole, 1,4-dichloro-2,5-dimethyoxybenzene and O,S-dimethyl acetylphosphoramidothioate significantly increased disease control and yield compared to the standard treatment, Bromotak and Thiram. The incidence of bacterial blight caused by Xanthomonas campestris, was also significantly reduced. It is concluded from these studies that cottonseed treatments containing a broad spectrum contact fungicide in combination with systemic products with activity against Pythium, Rhizoctonia and Thielaviopsis are highly effective in establishing acceptable field populations of cotton plants.

Introduction

Cotton seedling diseases continue to be a serious threat in the establishment of cotton stands in the three major cotton growing areas of the world: China, the CIS Republics and the United States. Certain diseases such as *Pythium ultimum*, *Rhizoctonia solani*, *Fusarium moniliformi* and *Thielaviopis basicola* are commonly found in all three of these regions. As a control measure, the use of fungicides applied as a seed treatment varies widely among the cotton growing regions due to factors such as government regulations, economics and equipment to apply seed treatments. As cotton seedling disease consists of a complex of pathogens, it is highly unlikely that a single fungicide would be capable of total control. For this reason, studies were conducted to determine the efficacy of new combination fungicide treatments in the regions. The products used in these studies were TCMTB: 2-(thiocyanomethlthio)benzothiazole, Chloroneb: 1,4-dichloro-2,5-dimethozybenzene, Thiram: Bis (dimethylthiocarbamoyl) disulfide, Bromotak: 2-bromo-2-nitropropane-1,3-dio, Myclobutanil: alpha-butyl-alpha-(4-chlorophenyl)-1H-1,2,4-triazole-1-propanenitrile, Metalaxyl: N-(2,6-dimethylphenyl)-N-(methoxyacetyl)-DL-alanine methyl ester, Baytan: ß-(4-chlorophenoxy)-∞-(1,1-dimethyl ethyl)-1H-1,2,4-trazole-1-ethanol, and the insecticides Acephate: O,S-dimethyl acetylphosphoramidothioate, and Furadan: 2,3 – dihydro - 2,2 – dimethyl - 7-benzofuranyl methyl carbamate.

Materials and Methods

China

In 1995 and 1996 field trials were established in China in collaboration with the Beijing Seed Treatment Technical Centre to determine the efficacy of several new cotton seed treatments. The trials were conducted at eight sites and were replicated three to eight times, depending on location. Emergence, seedling survival and yield data were collected. The various treatments and application rates studied were selected based on data generated from U.S. trials and are listed in Table 1.

CIS Republic Uzbekistan

In 1991, a cotton seed treatment study was conducted in co-operation with the Institute of Plant Protection, Tashkent, Uzbekistan. The Institute has a standard seed treatment testing programme where small scale replicated trials are conducted initially, followed by large scale field trials. All seed treatments were replicated 4 times in a randomized complete block design. Mechanically delinted seed were used as there is little acid delinted cottonseed presently available in the CIS republics. Application rates and treatments are presented in Table 3.

USA

In 1991 a field study was established with the University of Arizona to determine the efficacy of several cotton seed treatments at two locations in Arizona. All treatments were applied in slurry at a rate of 800 cc/cwt using DPL-Acala 90 cottonseed and planted in a complete randomized block design with four replications. Plant emergence evaluations were made 20 days after planting.

Results and Discussion

China

The results show that treatments T6 and T9 significantly increased the seedling emergence, survival and yield as compared to the untreated check and carbendazim (MBC) a standard fungicide treatment in Southern China (Table 2). The addition of myclobutanil (T9) in 1996 significantly increased seedling emergence, survival and yield as compared to all other treatments indicating that this four-way combination is one of the best treatments to control cotton seedling disease in Southern China.

In northern China T18 significantly increased seedling emergence, survival and yield as compared to the standard MBC treatment and the check in both 1995 and 1996. Treatment T17 with the addition of myclobutanil increased yield 213 kg/ha as compared to T18 in 1996. The overall yield in 1996 was better than in 1995 with the new combination seed treatments increasing yields, compared to the standard MBC treatment and the check in both years.

CIS Republic Uzbekistan

Bacterial blight is a major problem associated with cotton planting seed in the CIS republics as the casual organism, *Xanthomonas campestris* pv. *malvacearum*, which is usually controlled by the acid delinting process, is not affected by mechanical delinting. Bronotak is the standard treatment applied to control Gummosis. The product, TCMTB, was very effective in reducing the incidence of Gummosis

singly or in combination with chloroneb and acephate (Table 3). Root rot (*Rhizoctonia solani*) was effectively controlled by Chloroneb; however the combination treatment of TCMTB and Chloroneb was the best. The systemic fungicide, Chloroneb, has limited activity on bacterial blight but is very effective against *Rhizoctonia*. The combination of TCMTB, Chloroneb and Acephate resulted in the highest yield of seed cotton, indicating some yield increase due to insect control.

USA

The various treatments, application rates and mean emergence data are listed in Table 4. The combinations of TCMTB, Metalaxyl and Myclobutanil and TCMTB and Myclobutanil were the best treatments in both locations. The triazole fungicide Baytan in combination with Carboxin, Thiram and Metalaxyl did not perform any better than the untreated check in both locations. Baytan and Myclobutanil are both triazole fungicides with excellent activity against *Rhizoctonia solani* and *Thielaviopsis basicola*. However under cold, wet environmental conditions, Baytan may exhibit a stunting affect on the germinating cotton seed.

Since 1991, the combination of TCMTB, Metalaxyl and Myclobutanil has been included in several of the yearly U.S. Cotton Beltwide tests (Proceedings – Beltwide Cotton Conference 1995-1998). The TCMTB and Chloroneb combination which performed well in the CIS study has also significantly increased plant stands in the Beltwide cottonseed treatment trials by itself and as a component in other combinations (Proceedings – Beltwide Cotton Conference 1988-1997).

Conclusion

Newly developed cottonseed treatments have demonstrated increased disease control and significantly improved plant stands in the three major cotton-growing areas of the world. TCMTB, Metalaxyl and Myclobutanil were the most consistent performers in the US and China. In the CIS TCMTB and Chloroneb significantly increased yield and reduced the incidence of bacterial blight and root rot compared to the standard treatment and the untreated control. These data support the concept of utilising a broad-spectrum biocide such as TCMTB in combination with systemic fungicides such as Metalaxyl and Myclobutanil to control *Pythium*, *Fusarium*, *Rhizoctonia* and *Theilaviopsis*, the major components of the cotton seedling disease complex.

Table 1. Treatments and application rates tested in southern (S) and northern (N) China.

Treatment	Components	Application Rate ppm
T6 S	TCMTB/Myclobutanil/Metalaxyl	675/225/125
T9 S (1995)	TCMTB/Thiram/Metalaxyl	706/1706/125
T9 S (1996)	TCMTB/Thiram/Metalaxyl/ Myclobutanil	706/1706/125/225
T17 N	TCMTB/Metalaxyl/Myclobutanil/Furadan*	1312/125/225/4000
T18 N	TCMTB/Myclobutanil/Furadan*	1312/481/4000

*In northern China aphids (Aphis gossypii) are a serious problem so Furadan was added to the fungicides.

Table 2. The effects of cottonseed treatments on emergence, survival and yield in 1995-96 in China.

Treatment	Year	Emergence	Survival	Yield Kg/Mu**
T6 S*	1995	65.9	78.7	116.5
T9 S	1995	55.9	65.5	112.2
MBC S	1995	43.4	29.1	110.3
CK S	1995	34.1	n/a	102.1
T18 N	1995	68.1	78.9	109.5
MBC N	1995	54.5	63.8	96.4
CK N	1995	38.6	n/a	92.5
T6 S	1996	69.4	64.7	230.2
T9 S	1996	74.4	70.9	238.7
CK S	1996	37.5	18.6	192.7
T 17 N	1996	61.6	55.8	217.2
T18 N	1996	63.6	59.8	203.0
MBC N	1996	43.9	35.3	177.5
CK N	1996	36.3	n/a	169.5

*S - Southern China, N - Northern China
** - 1 Hectare = 15 Mu

Table 3. The effect of various cottonseed treatments on gummosis, root rot and seed cotton yield in greenhouse and field trials.

Treatment	Rate Kg/Ton	Bacterial blight		Root rot		Yield kg/ha
		Lab	Field	Lab	Field	Field
Control	-	36.9	17.2	20.5	15.1	2,370
Bronotak + Thiram	10 + 6	3.6	3.8	7.2	8.6	2,430
TCMTB	5	7.3	1.8	5.0	5.6	2,480
Chloroneb	5	21.3	10.7	3.5	4.4	2,410
Acephate	4	32.3	12.3	15.6	13.4	2,400
TCMTB + Chloroneb + Acephate	4 + 4 + 4	5.2	1.3	0.7	4.8	2,560

Table 4. The effect of various cottonseed treatments on plant emergence at two locations in Arizona.

Treatment	Rate ppm	Emergence	
		Site 1	Site 2
Untreated Check	-	33 D	58 BCD
TCMTB + Metalaxyl + Myclobutanil	450 + 125 + 300	46 AB	83 A
TCMTB + Myclobutanil	450 + 300	50 A	66 BC
Vitavax + Thiram + Metalaxyl + Baytan		33 D	60 BCD