

## EVALUATION OF DICROTOPHOS AND THIOPHANATE METHYL FOR MANAGEMENT OF HARDLOCK OF COTTON IN GEORGIA

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### Introduction

Hardlock of cotton is an important concern for growers in Georgia and significant yield loss is attributed to this condition. In this study, “hardlock” is defined as the presence of individual or multiple locules within an open boll where the lint appears to be relatively normal, yet does not “fluff”. The result for the grower is that a spindle picker does not effectively pick hardlocked bolls. Possible causes for hardlocked cotton include boll maturity and environmental conditions at the time of boll opening, damage from insect pests, for example stink bugs, and possibly from the fungus *Fusarium verticilloides*. In 2002, 2003, 2004, a condition that has become known as “Fusarium hardlock” received significant attention throughout the southeastern United States based upon research initiated by Dr. Jim Marois and Dr. David Wright at the University of Florida’s North Florida Research and Education Center in Quincy.

Beginning in 2002 researchers at the University of Florida reported a reduction in severity of hardlock after multiple treatments with the fungicide benomyl. As “Fusarium hardlock” often appears in fields where damage from stink bugs (*Nezara viridula* and *Euschistus servus*) has occurred, the objective of this study was to determine if multiple applications of the fungicide thiophanate methyl, with and without the insecticide dicotophos, would lead to a reduction of hardlocked cotton bolls. Thiophanate methyl is a benzimidazole fungicide closely related to benomyl (Benlate) which is no longer available in the United States. Benzimidazoles are known to be active against *Fusarium* sp. Thiophanate methyl is marketed as Topsin M and Topsin 4.5F and by Farm Saver as TM 85WDG.

### Materials and Methods

Field trials were established at multiple locations around the state, including replicated on-farm trials in Berrien and Colquitt Counties, and replicated small plot trials on the Coastal Plain Experiment Station, Tifton, the Sun Belt Expo, Moultrie, and the Southeast Georgia Research and Education Center, Midville. The experimental design in each trial was a randomized complete block with four, five, or six replications, depending on available space. Fungicide (thiophanate methyl) and insecticide

(dicrotophos) applications were initiated when 25-50% of the crop had reached first bloom. Fungicides were applied on a biweekly schedule for a total of six or eight weeks for a total of three or four applications. Stinkbug populations were monitored in the fields and plots were rated for severity of hardlock at the end of the season.

**Colquitt County:** A field trial was established in a commercial field planted to DP 555BR in Colquitt County. Treatments included a) unsprayed plots, b) plots that received only thiophanate methyl (Topsin 4.5F, 1.25 pt/A), c) plots that received only dicrotophos (Bidrin) (8 fl oz/A) and d) plots that received both thiophanate methyl and dicrotophos on each spray date. The experimental design was a randomized complete block with four replications. Each plot was 16 rows wide by 100 ft. Treatment applications were begun at first bloom (approximately 50% of the plants in the study had one open bloom) on 28 June. Subsequent applications were made on 12 July, 26 July, and 9 August. During the season 25 bolls were examined from each plot on multiple dates to evaluate for stinkbug feeding injury. Hardlock was assessed in each plot by removing all of the cotton bolls in 3 ft of row and comparing the number of hardlocked locules to the total number of locules from that sample area. Stink bug damage was assessed from 25 bolls (diameter approximately the size of a quarter) on 15 July, 23 July, 30 July, 6 August, and 13 August. Plots were harvested (four center rows from each plot) and the yield was recorded.

**Sun Belt Expo, Colquitt County:** A small-plot trial was conducted at the Sun Belt Expo near Moultrie, GA. Each plot was planted to DP 555BR and was four rows wide by 50 ft in length. Treatments were the same as for the Colquitt County sites; however only three fungicide applications were made to these plots. Applications of thiophanate methyl (Topsin 4.5F) and dicrotophos (Bidrin) were made on 2 July, 20 July, and 30 July. Hardlock was assessed as described above prior to harvest. Damage from stinkbug feeding was not evaluated in this trial. Plots were taken to yield and harvested on 1 October.

**RDC Pivot, Coastal Plain Experiment Station, Tift County:** This small-plot trial was similar to that at the Sun Belt Expo noted above. The cotton variety ST 5599BR was planted on 28 April. Treatment applications were initiated on 29 June and were repeated on 14 and 27 July. Plots were assessed for stinkbug damage and for hardlock. Sink bug damage was assessed from 10 bolls (approximately the diameter of a quarter) on 6 July, 12 July, 19 July, and 26 July. Plots were harvested on 20 September.

**Berrien County:** A large-plot on-farm trial was conducted in a commercial field planted to DP 555Br on 28 April in Berrien County. Applications of thiophanate methyl (Topsin 4.5F, 1.25 pt/A) were made at first bloom on 5 July and then again on 19 July, 2 August, and 16 August. Dicrotophos (6 fl oz/A) was applied to all plots on 19 July and 16 August. Hardlock was evaluated prior to harvest and all plots were taken to final yield. Plots were harvested on 7 October.

**Gibbs's Farm, Tift County:** A small-plot trial was established at the Gibbs's farm on the Coastal Plain Experiment Station near Tifton, GA. Plots were planted to DP 458BR. Each plot was four rows wide by 40 ft in length. Applications of thiophanate methyl (TM85 WDG, 0.5 or 0.75 lb/A) were made at first bloom, 2 July, and then again on 9 July, 16 July, 23 July, 30 July, and 13 August. Bidrin (8 fl oz/A) was applied to all plots on 2 July, 16 July, and 30 July. Plots were rated for hardlock prior to harvest on 4 October.

**Midville Station, Burke County:** Small plots similar to those above were established at the Southeast Georgia Research and Education Center near Midville, GA. The trial was planted to DP 555BR. Treatments of Topsin-M, 0.5 and 1.0 lb/A, were applied beginning at first bloom and then on a biweekly basis for a total of four applications. Hardlock was assessed on 7 October and plots were harvested on 13 October.

Data were analyzed using SAS Proc GLM. Means in these studies were separated using Fisher's protected least significant differences at  $p=0.05$ .

## Results

The cotton production region of Georgia was buffeted by multiple hurricanes and tropical storms prior to harvest in 2004 which made timely harvest difficult. In addition, yield in some of these trials may have been reduced because of the impact of these storms.

The results from the six field trials are presented in Table 1 through Table 5. The value for the "% tight-locked bolls" was assessed as the number of hardlocked locules collected from 3 feet of a single row divided by the total number of locules in the sample multiplied by 100%. The value for the "% boll damage" represents the mean value for assessments made on 10 or 25 bolls per plot on four or five dates during the season. Yield is reported as either lint or as seed cotton.

## Discussion

The severity of hardlock in the field trials assessed in this study can be described as moderate in most situations, low in Midville, and moderate-to-high at the Sun Belt Expo. Treating plots with thiophanate methyl, dicrotophos, or a combination of the two did not reduce the severity of hardlock or increase yields. In this study, the untreated controls did not have any greater level of hardlock than did those that received treatments. Also, the untreated controls yielded as well as any other treatment. Although there were numerical increases in yield in some situations, the differences were not statistically significant. Each of the trials in this study was affected by multiple tropical storms and hurricanes. The effect of these storms on the severity of hardlock and on yield is unknown.

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Table 1. Percent severity of hardlock in four field trials in 2004.

Treatment	% hardlock within 3 ft of row							
	Colquitt County		Sun Belt Expo		RDC Pivot		Berrien County	
Untreated control...	35.9	A	62.6	A	44.9	A		
Topsin 4.5F (1.25 pt/A).....	33.4	A	51.7	A	47.9	A		
Bidrin (8 fl oz/A).....	31.8	A	59.2	A	50.4	A	33.2	A
Topsin 4.5F + Bidrin.....	38.3	A	64.4	A	49.7	A	37.2	A

Numbers within the same column followed by the same letter are not significantly different at  $p=0.05$  as determined with Fisher's protected LSD.

Table 2. Lint yields (lb/A) from four field trials in 2004.

Treatment	Yield (lb lint/A)							
	Colquitt County		Sun Belt Expo		RDC Pivot		Berrien County	
Untreated control...	1111	A	1053	A	1097	A		
Topsin 4.5F (1.25 pt/A).....	1176	A	878	A	1107	A		
Bidrin (8 fl oz/A).....	1160	A	930	A	1152	A	1092	A
Topsin 4.5F + Bidrin.....	1234	A	978	A	1078	A	1163	A

Numbers within the same column followed by the same letter are not significantly different at  $p=0.05$  as determined with Fisher's protected LSD.

Table 3. Mean percent boll damage attributed to feeding damage by stink bugs from samplings (10 or 25 bolls) during the 2004 season.

Treatment	Colquitt County		RDC Pivot	
Untreated control.....	4.05	A	11.7	ABC
Topsin 4.5F (1.25 pt/A).....	3.05	A	19.2	A
Bidrin (8 fl oz/A).....	1.15	B	3.3	C
Topsin 4.5F + Bidrin.....	1.25	B	10.8	ABC

Numbers within the same column followed by the same letter are not significantly different at p=.05 as determined with Fisher's protected LSD.

Table 4. Percent severity of hardlock in two field trials in 2004.

Treatment	% hardlock within 3 ft of row			
	Gibbs Farm*		Midville	
Untreated control.....	42.7	A	9.0	A
TM85 (0.5 lb/A).....	35.7	A		
TM85 (1.0 lb/A).....	37.0	A		
Topsin M (0.5 lb/A).....			5.4	A
Topsin M (1.0 lb/A).....			4.8	A

\*TM85 WDG was applied to these plots weekly for six applications. Bidrin was applied biweekly for a total of three applications.

Numbers within the same column followed by the same letter are not significantly different at p=.05 as determined with Fisher's protected LSD.

Table 5. Yield in pound per acre of seed cotton from two trials in 2004.

Treatment	Yield (seed cotton, lb/A)			
	Gibbs Farm*		Midville	
Untreated control	1745	A	3424	A
TM85 (0.5 lb/A)	1745	A		
TM85 (1.0 lb/A)	1759	A		
Topsin M (0.5 lb/A)			3652	A
Topsin M (1.0 lb/A)			3041	B

\*TM85 WDG was applied to these plots weekly for six applications. Bidrin was applied biweekly for a total of three applications.

Numbers within the same column followed by the same letter are not significantly different at p=.05 as determined with Fisher's protected LSD.