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C. D. Ranney

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Fusarium Wilt Of Cotton

Can Be Controlled With
Resistant Varieties
Or
Soil Fumigation

Mississippi State University
AGRICULTURAL EXPERIMENT STATION

HENRY LEVECK, Director

STATE COLLEGE

MISSISSIPPI

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FUSARIUM WILT OF COTTON CAN BE CONTROLLED WITH RESISTANT VARIETIES OR SOIL FUMIGATION

By C. D. RANNEY

In spite of available control measures, Fusarium wilt remains one of the most destructive diseases of cotton in Mississippi. In the last three crop years this disease has caused losses of approximately 22,800 bales each season. At a nominal value of \$135.00 per bale, this means an entirely unnecessary loss of over \$3,000,000 has occurred each year. During this period numerous adapted varieties of cotton resistant to this disease have been available commercially. In addition to this method of control, work conducted in the late 1940's by the Mississippi Agricultural Experiment Station showed the positive value of controlling this disease by soil fumigation with nematocides.

Unlike many other cotton diseases, Fusarium wilt requires some help in attacking the cotton plant. It is an opportunist that depends on damage or wounds from some source to give it an entrance to the plant. While close cultivation causes some root damage, the main assistants to this disease are nematodes. Nematodes are microscopic parasitic worms that feed on the small cotton roots.

In addition to weakening the plant by their feeding action, the nematodes produce wounds that the wilt fungus utilizes as doorways to the cotton plant. While soil fumigation is somewhat effective in killing the wilt fungus in the soil, the main action of the nematocide is in reducing the nematode populations.

With the present program of acre-

¹Plant Pathologist, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, in cooperation with the Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Mississippi.

age control, cotton is increasingly following cotton on the more productive sandy loam soils. This practice is causing the severity of wilt to increase.

Procedure

In 1960 tests were undertaken to study the value of both resistant varieties and soil fumigation in reducing losses due to wilt under present production practices. Test sites were selected on land that exhibited moderate to very severe losses due to the wilt-nematode complex in 1959. A site near Mayersville, Mississippi, incurred moderate losses while locations near Shaw and Clarksdale, Mississippi, sustained severe losses in 1959. The experimental plots were prepared and fertilized in the manner normally used in cotton production in these areas. The tests were set up as randomized blocks and replicated 5 times at Mayersville and Shaw. At Clarksdale 4 replications were utilized. The soil was fumigated on a 40" row basis with nematocides, Nema-gon (1,2-dibromo-3-chloropropane) and D-D (1,3-dichloropropane and 1,2-dichloropropane), 10 to 21 days prior to planting with application equipment recommended for nematode control. For convenience only two nematocides were used in these tests. There are several other nematocides available commercially that are just as effective as the materials tested.

Mr. Earl B. Minton, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, at Auburn, Alabama, identified the nematode populations at the three locations as follows:

Location	Nematodes per pint of soil				
	Root knot	Stubby root	Root lesion	Tobacco stunt	Total parasitic nematodes
Mayersville	1500	200	40	0	1740
Shaw	800	4500	510	100	5910
Clarksdale	7000	265	10	0	7275

Results

The test at Mayersville was conducted on plant-four, skip-four cotton. In this test, Deltapine 15 was used as the susceptible variety, Deltapine Fox 4 as an example of a tolerant variety, and Auburn 56 as a highly resistant variety. Under the moderate disease situation that developed here, Deltapine Fox 4 without any nematocide treatment yielded 164 pounds more lint per acre than the susceptible Deltapine 15, and Auburn 56, without additional treatments, returned 132 pounds more than the Deltapine 15

check. Both Deltapine 15 and Fox 4 showed marked yield increases, 69 to over 200 pounds of lint, from the nematocide treatments. Only small increases were obtained with the nematocide treatments in the disease resistant Auburn 56 plots.

Cotton in the test near Shaw, Mississippi, suffered severely from drought during much of the growing season. From mid-July to early September only a trace of rainfall was noted in this field, resulting in low yields. In spite of the lower yields, substantial increases

Table 1. Effect of cotton varieties and nematocides on the yield of cotton in a fusarium wilt-nematode situation near Mayersville, Mississippi, in 1960.

Variety	Treatment	Material	Gallons per acre	Pounds of lint per acre ¹	Net gain due to varieties		Net gain due to nematocide treatments	
					Pounds	Dollars ²	Pounds	Dollars ²
Deltapine 15		Check ³	—	771	—	—	—	—
		Nemagon	½	960	—	—	189	+ 46.70
		Nemagon	1	935	—	—	164	+ 31.20
		D-D	8	840	—	—	69	+ 10.70
Deltapine Fox 4		Check ³	—	935	164	+ 49.20	—	—
		Nemagon	½	1117	—	—	182	+ 44.60
		Nemagon	1	1141	—	—	206	+ 43.80
		D-D	8	1139	—	—	204	+ 51.20
Auburn 56		Check ³	—	903	132	+ 39.60	—	—
		Nemagon	½	955	—	—	52	+ 5.60
		Nemagon	1	998	—	—	95	+ 10.50
		D-D	8	937	—	—	34	+ .20

See Table 3 for footnotes.

Table 2. Effect of cotton varieties and nematocides on the yield of cotton in a severe fusarium wilt-nematode situation near Shaw, Mississippi, in 1960.

Variety	Treatment	Material	Gallons per acre	Pounds of lint per acre ¹	Net gain due to varieties		Net gain due to nematocide treatments	
					Pounds	Dollars ²	Pounds	Dollars ²
Deltapine 15		Check*	—	95	—	—	—	—
		Nemagon	½	129	—	—	34	+ .20
		Nemagon	1	149	—	—	54	+ 1.80
		D-D	8	132	—	—	37	+ 1.10
Deltapine Fox 4		Check*	—	136	41	+ 12.30	—	—
		Nemagon	½	173	—	—	37	+ 1.10
		Nemagon	1	180	—	—	44	+ 4.80
		D-D	8	195	—	—	59	+ 7.70
Auburn 56		Check*	—	160	65	+ 19.50	—	—
		Nemagon	½	200	—	—	40	+ 2.00
		Nemagon	1	189	—	—	29	+ 9.30
		D-D	8	203	—	—	43	+ 2.90

See Table 3 for footnotes.



Figure 1. The effect of varieties on control of the Fusarium wilt-nematode complex. At the top, Deltapine 15, in the center, Deltapine Fox 4, at the bottom, Auburn 56.

were obtained with the tolerant and resistant varieties. Forty-one pounds of lint with Deltapine Fox 4 and a 65 pound increase with Auburn 56 were found. While the nematocidal treatments gave definite yield increases, the increased yield in several cases was not sufficient to offset the cost of the treatments.

This test points out one of the risks that should be considered concerning the relatively high cost nematocidal treatments under dry-land farming. Use of nematocidal treatments represents a high per-acre investment prior to planting, adding to the capital risked in a cotton program. In this case, if the interest on the treatment cost were considered, perhaps several of the plus returns for treatment would not be real.

The test at Clarksdale was also subject

to severe damage from the wilt-nematode complex. In this test susceptible varieties are represented by Deltapine Smoothleaf, tolerant varieties by Deltapine Fox 4, intermediate resistant varieties by Rex and highly resistant varieties by Auburn 56. The results again emphasize the value of resistant varieties in reducing disease losses. When compared with the susceptible Deltapine Smoothleaf variety, Deltapine Fox 4 gave a yield increase of 87 pounds of lint, Rex gave an increase of 126 pounds and Auburn 56 returned a 198 pound increase. In this test, under more normal rainfall conditions, when nematocidal treatments were used with Deltapine Smoothleaf and Fox 4 excellent increases in yield were obtained resulting in returns of 28 to 60 dollars per acre.

Table 3. Effect of cotton varieties and nematocides on the yield of cotton in a severe fusarium wilt-nematode situation near Clarksdale, Mississippi, in 1960.

Variety	Treatment	Material	Gallons per acre	Pounds of lint per acre ¹	Net gain due to varieties		Net gain due to nematocidal treatments	
					Pounds	Dollars ²	Pounds	Dollars ²
Deltapine Smoothleaf	Check*	---	---	359	---	---	---	---
	Nemagon	1/2	1/2	558	---	---	199	+ 49.70
	Nemagon	1	1	520	---	---	161	+ 30.30
	D-D	8	8	593	---	---	234	+ 60.20
Deltapine Fox 4	Check*	---	---	446	87	+ 26.10	---	---
	Nemagon	1/2	1/2	573	---	---	127	+ 28.10
	Nemagon	1	1	686	---	---	240	+ 54.00
	D-D	8	8	638	---	---	192	+ 47.60
Rex	Check*	---	---	485	126	+ 37.80	---	---
	Nemagon	1/2	1/2	559	---	---	74	+ 12.20
	Nemagon	1	1	629	---	---	144	+ 25.20
	D-D	8	8	470	---	---	— 15	— 14.50
Auburn 56	Check*	---	---	557	198	+ 59.40	---	---
	Nemagon	1/2	1/2	557	---	---	0	— 10.00
	Nemagon	1	1	556	---	---	— 1	— 18.30
	D-D	8	8	569	---	---	12	— 6.40

¹Calculated using average lint percents as given in Table 6 Mississippi Cotton Variety Tests for 1959. Mississippi Agricultural Experiment Station Bulletin 589.

²This figure is based on the following assumptions:

1. Equal cost of planting seed.
2. Lint value of 30 cents per pound.
3. Cost of material and application per acre as follows:
 1/2 gallon of technical Nemagon \$10.
 1 gallon of technical Nemagon \$18.
 8 gallons of technical D-D \$10.

*No nematocidal treatment.

Discussion

The results of the variety and nematocide tests conducted in 1960 emphasize the value of using practices that will reduce losses due to the Fusarium wilt-nematode complex. The utilization of varieties with tolerance or resistance to this disease is the most economical means of reducing disease losses. Where large areas are involved this is also the most feasible method. In general, cotton varieties can be grouped in four categories in respect to their reaction to the wilt-nematode complex:

Susceptible — Deltapine Smoothleaf, Deltapine 15, Stardel, Delfos 9169 and Stoneville 3202.

Tolerant—Deltapine Fox 4, Coker 124-C, and Stoneville 7.

Moderately resistant—Rex, Empire W. R., Dixie King, Plains, and Coker 100A.

Highly resistant—Auburn 56.

In addition to having a high level of resistance to Fusarium wilt, the variety Auburn 56 also exhibits resistance to damage from the root-knot nematode. In areas where the disease is light to moderate good control can be expected with tolerant or moderately resistant varieties. Under conditions of severe losses better results can be expected with va-

rieties exhibiting higher levels of resistance such as Auburn 56.

The proper use and application of nematocides will also markedly reduce losses due to this disease complex. In many instances only a small area of a field is subject to damage. Under conditions such as this a spot treatment using nematocides is very practical. This practice, with repeated use, will reduce the nematode populations and limit the spread of the disease within a field.

Summary

Tests at three locations re-emphasized the value of using either resistant varieties or soil fumigation with nematocides to reduce losses due to Fusarium wilt-nematode disease of cotton.

The most economical means of control is with the use of adapted varieties which are resistant to this disease complex. In all of the tests, tolerant or resistant varieties gave marked increases in yield.

When soil fumigation with nematocides was used, increases in both yield and net value of susceptible and tolerant varieties were obtained. Proper use and application of nematocides offers an excellent means of reducing losses in spots or small areas in large plantings.



Figure 2. The effect of nematocide treatment on control of the *Fusarium* wilt-nematode complex. In the foreground is a plot without nematocide treatment, behind this are plots treated with: 1 gallon of Nemagon, 8 gallons of D-D, and $\frac{1}{2}$ gallon of Nemagon respectively. In each plot the variety is Deltapine 15.