Assessment of Cotton Losses in Western Texas Caused by *Meloidogyne incognita*

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ABSTRACT

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Cotton yields increased an average of 25.7% in 80 field trials conducted over 16 yr in six counties of western Texas, where a soil fumigant was applied to control the cotton root-knot nematode. An analysis of 2,016 soil samples from fields in the six counties showed that 47.3% contained a population of root-knot nematodes. Annual cotton production in these counties was 839,800 bales (8-yr avg.). The calculated loss in the six counties was 85,600 bales.

Nematologists are frequently asked to estimate losses caused by nematodes in various crops or regions. The following reasons for measuring crop losses were included by LeClerg (8) and Horsfall and Cowling (4): 1) researchers can decide priorities; 2) administrators can have powerful data to present to legislators; 3) industry can have data to decide priorities in research and sales; 4) crop-reporting services can better forecast crop production; 5) Environmental Protection Agency can produce better cost/benefit ratios; 6) research agencies can better evaluate host-plant resistance, chemical efficacy, or development of pathogen biotypes; and 7) producers can make informed management decisions.

Precise data on actual crop loss is best obtained by field trials in which the control is kept as free of disease as possible (7). James (5) states that to assess crop loss to pathogens, two important links are yield comparisons of healthy and infested crops and a survey of the distribution of the pathogens.

Upland cotton (*Gossypium hirsutum* L.) is the major crop produced on the Southern High Plains of Texas (16 counties grouped by the Texas Department of Agriculture because of similar soil type, topography, and agricultural production). Cotton loss data from 80 research plots evaluated over 16 yr in six Southern High Plains counties are presented.

MATERIALS AND METHODS

A disease-free condition in all trials was simulated by use of the soil fumigants DBCP, which was suspended from use in 1977, or EDB. Chemicals were injected into beds at labeled rates when factors such as temperature, moisture, and land preparation were favorable for successful fumigation. Plot size ranged from two rows on 1-m centers × 30-m lengths with six replicates to 0.25 ha with four or more replicates. More than 20 cotton cultivars were planted in the trials during the 16 yr of testing; some cultivars had moderate nematode resistance. Plots were harvested with a mechanical stripper harvester.

Distribution of the cotton root-knot nematode, *Meloidogyne incognita* (Kofoid & White) Chitwood, was determined from 2,016 soil samples. Samples submitted to the laboratory for nematode analysis came from 678 individuals representing 17% of the farms in the six-county area. Each sample was a composite of four or more subsamples gathered from February through April. For nematode analysis, 250 g of soil was processed by the centrifugal-flotation method of Jenkins (6) and identified under a stereo microscope at ×40.

RESULTS

Yields in the fumigated plots were as high as three times that of the untreated control. The average increase for fumigated plots was 25.7% or a lint increase of 113 lb/A (126 kg/ha). Student's *t* distribution test predicted yield increases of 92–123 lb/A (103-138 kg/ha) ($P = 0.05$) over all years and locations.

Cotton root-knot nematode larvae (one or more larvae per 250 g of soil) were found in 47.3% of 2,016 soil samples taken in the survey of the six counties.

Fifteen additional field trials were conducted in the remaining 10 counties of the Southern High Plains. The result of these trials was an average yield increase of 22.6%. A survey of nematode distribution showed 42% of 949 soil samples containing root-knot nematodes.

DISCUSSION

Cotton losses to *M. incognita* occur in all cotton production regions of the world, although the magnitude of the losses is not clear. In six counties of the Southern High Plains of Texas, the average cotton production (8 yr) was 839,800 bales (1). Because yield losses caused by nematodes were 25.7%, and 47.3% of the soils contained a population of cotton root-knot nematodes, a possible loss of 12.1% (or 102,000 bales of cotton) can be projected. Because individual counties had different percent loss, percent infestation, and bale yield, each county was calculated separately, resulting in a total six-county loss of 85,600 bales (10.2%). Average annual cotton production for the 10 remaining counties was 961,000 bales. Assuming 22.6% to be an estimation of yield loss to nematodes and 42% of the cotton acres to contain root-knot infestations, a 9.5% loss (91,000 bales) could be projected.

Green (3) reported that in Midland County, TX, a county included in the Southern High Plains, 31 trials during 8 yr resulted in a lint increase of 116 lb/A (130 kg/ha) from fumigation for root-knot nematodes. Unpublished data from county extension agent reports in seven counties of the Northern Low Plains (adjacent to the Southern High Plains) resulted in a 31% yield increase from fumigation in 19 trials. Nematode infestation survey data were unavailable for these counties.

Plant-parasitic nematodes other than *M. incognita* were often identified in the survey soil samples. The genera most often found were *Pratylenchus hexincisus*, *Tylenchorhynchus* sp., and *Helicotylenchus* sp.; *Hoplolaimus galeatus*, *Xiphinema americanum*, and *Paratrichodorus* sp. occurred less frequently.

Soil samples taken in the test plots during the growing season contained mixed populations of these nematodes but rarely in sufficient numbers to suspect plant injury. When visual plant symptoms of stunted plants and thin stands were observed, the root systems invariably showed typical galling caused by root-knot nematodes. Undoubtedly, *M. incognita* was the principal causal agent.

Various soil microflora may be associated with nematodes in disease complexes on cotton, especially Fusarium wilt and seedling disease organisms. These organisms are present in the Southern High Plains soils and occasionally cause economic losses in cotton. The soil fumigants DBCP and EDB probably have little effect on

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control of these fungi other than controlling nematodes. Good and Feldmesser (2) state that DBCP may have limited herbicidal activity and EDB has insecticidal activity on wireworm and certain grubs, but they have no prolonged deleterious effect on soil microflora. Furthermore, a claim of fungicidal activity for these compounds is not included on their labels.

Three field tests were established near Lubbock, using the fungicide PCNB applied in the covering soil in combination with the DBCP fumigation (*unpublished*). The fungicide with the fumigant and the fumigant alone each increased cotton yields 57% over the control. The fungicide treatment in these tests gave no detectable yield response either with DBCP or when used alone.

When projecting loss data from field trials to loss estimates for an area or region, several uncontrollable variables should be considered: 1) soil fumigants do not create a nematode-free condition; 2) area production figures included production from farms where nematode controls were applied, ie, resistant cultivars, crop rotations, soil fumigants, or use of nonfumigant nematicides that are two-thirds as effective as soil fumigants (9); and 3) possible bias resulting from test site and soil sampling site selection, etc.

Clearly, *M. incognita* is an important factor in cotton production in western Texas. If only the six-county loss (85,600 bales) were projected to Texas production of 4,045,000 bales and U.S. production of 12,100,000 bales (8-yr/avg.), losses would be 2.12 and 0.71%, respectively.

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