EVALUATION OF ROOT-KNOT NEMATODE MANAGEMENT OPTIONS IN SAN JOAQUIN VALLEY COTTON

P.B. Goodell and J.W. Eckert
Cooperative Extension, University of California, Kearney Agricultural Center
Parlier, CA
P.A. Roberts
Department of Nematology, Univ. Calif
Riverside, CA

Abstract

There are a number of management options for root-knot nematode in the San Joaquin Valley. These include chemical control using fumigants and contact pesticides and cultural controls such as crop rotation and host plant resistance. We evaluated two Acala cultivars in fumigated and unfumigated areas, with and without aldicarb. Best yields for susceptible Maxxa cotton were attained with fumigation but was not significantly better than resistant NemX. No significant yield increase was noted with the use of Temik. In 1995 and 1996, five one-year rotations were evaluated including blackeye bean (*Vigna sinensis*, CB88), alfalfa (*Medicago sativa*, WL 525 HQ), Acala cottons (*Gossypium hirsutum*, Maxxa and NemX) and Pima cotton (*Gossypium barbendense*, S7). Bean, alfalfa, and NemX cotton resulted in significant yield enhancement the subsequent year and reduced the population of root-knot nematode compared to susceptible Acala Maxxa and Pima cottons. When NemX is grown over multiple years, no additional benefit in reducing root-knot nematode population is seen over a single year.

Introduction

Cotton is a key crop in the San Joaquin Valley taking up 1,000,000 acres of land and having a direct value of $1,000,000,000. Root-knot nematode (*Meloidogyne incognita*) is one of the major soil pests on sandy to sandy-loam soils and reduces yield by 31,369 bales worth $9,883,848 (Blasingame, 1997). Management options include crop rotation, chemical control, and use of host plant resistance (Goodell et al, 1995). The objective of the trials were to evaluate these options and develop an integrated approach to managing root-knot nematode in row crops in the San Joaquin Valley. This report summarizes three studies conducted between 1994 and 1997 conducted at the same location.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:143-145 (1998)
National Cotton Council, Memphis TN

Methods and Material

General Procedures

All studies were conducted at the UC Shafter Research and Extension Center in Kern County California on Hanford sandy loam soils during the period 1994-1997. Plant parasitic nematodes in the soil consisted primarily of root-knot nematode (*Meloidogyne incognita* race 3) with low levels of spiral and lesion nematodes. Bacterial feeders and omnivorous nematodes were also seen in soil samples.

Soil samples were taken preplant (Pi), mid-season and late season (Pf) and nematodes were extracted from 500 gm of soil using flotation-centrifugation (Jenkins, 1964). Lint was picked using single row spindle pickers. Roots were evaluated for galling using a weighted nematode rating (WNR) method (Garber et al, 1996). The varieties of Acala cottons used in these studies were Maxxa (susceptible) and NemX (resistant). The cotton field was managed in a manner reflective of standard practices. Insect and disease management practices were employed.

Plots were no smaller than four 40 inch rows by 20 feet but were variable depending on the trial and year. All trials used randomized complete block designs and were analyzed using ANOVA and LSD mean separation.

Host Plant Resistance Evaluation

A three year study was conducted to evaluate the new Acala cultivar NemX which possesses a high degree of resistance to root-knot nematode when compared to other Acala cottons (Ogallo et al, 1997; Goodell and. Montez., 1994). This trial was designed to examine the influence of successive years of either resistant or susceptible cotton on yield and root-knot nematode population development. All combinations ranging from three years of susceptible to three years of resistant cultivars were evaluated.

Crop Rotation Trials

To evaluate the value of one year rotations on yield and root-knot nematode populations, five crops were planted in 4 row plots 300 feet long in a randomized block pattern. Alfalfa (WL 525 HQ) and blackeye bean (CB88) are non-hosts for *M. incognita*, Acala cotton (NemX) is resistant, and Acala cotton (Maxxa) and Pima cotton (S7) are susceptible. The alfalfa was broadcast seeded on February 27, the blackeye beans were planted two rows per hill on May 23 and the three cotton varieties were all planted April 4. Standard cultural practices were employed for the crops except alfalfa which was mowed down several times during the growing season instead of harvest. The plots were rotovated in December in the direction of planting to reduce lateral movement of nematodes between plots. Bedding of the field was aligned with the prior years' bedding. Acala cotton variety Maxxa was planted to the entire plot area April 12, 1996 and harvested October 2.

Evaluation of Nematode Control Materials

During the period April 1990 and Fall 1996, 1,3 dichloropropene (Telone II) was suspended from use in CA. In order to compare the performance of Telone II, Temik, and host plant resistance, the following trial was established in 1997. Telone II was injected into designated beds at the rate of 5 gal per acre on February 7 on half the field in blocks 16 rows by 300 feet. After treated plots were completed and the injection system purged the remaining non treated plots were cultivated with the same piece of equipment. Maxxa and NemX cotton seed were planted on April 17. Temik 15 G (aldicarb) was band applied at the rate of 7 lb./a to designated plots during planting. Harvest took place on October 21.

Results

In the three year comparison of NemX and Maxxa cottons, inclusion of NemX into a rotation increased yield potential in this heavily infested field (Figure 1). As the number of years in which NemX was included increased, there is a trend toward increasing yield. NemX was very effective in decreasing root-knot nematode populations below maintenance levels in all trials during this period (Figure 2).

One year crop rotations significantly improved the yield of Maxxa when non-hosts or NemX were grown the previous year (Figure 3). NemX performed as well as cowpea or alfalfa in reducing the population while Pima proved no advantage in reducing root-knot nematode compared to Maxxa (Figure 4).

In comparing the host plant resistance and nematicides, NemX cotton was the most important factor in yield ($P>.0001$), followed by Telone ($P>.0511$), and Temik ($P>.0928$). Significant interactions occurred only with Telone and NemX ($P>.01$). NemX yields were similar regardless of treatment (Figure 5). Maxxa yield improved with either Temik or Telone but yield best with both. NemX prevented the root-knot nematode population from significant increase compared to Maxxa under any control situation (Figure 6). For Maxxa, the lowest final root-knot nematode population was found with Telone but this level was greater than any of the NemX plots, regardless of treatment. The amount of galling is reflected in these final populations. In all cases NemX had less galling than Maxxa for the same treatment. However, the NemX check had more damage then the Maxxa and Telone treatment (Figure 7).

Discussion

The release of NemX cotton in 1995 for commercial use has provided a major new tool in management of root-knot nematode in the San Joaquin Valley. While not immune to root-knot nematode, this variety does possess significant self-protection while reducing root-knot nematode populations. Its performance is equal to crop rotation choices, thus adding options for growers looking for management strategies. In these trials, one year of NemX provided a level of population reduction which did not improve under subsequent years of NemX. Switching back to Maxxa following NemX will maintain the resistance of this cultivar over time. NemX is not immune to root-knot nematode invasion and population development (Figure 7) and rotating between the varieties is a strategy to protect against root-knot nematode breaking resistance to NemX.

These trials have established that root-knot nematode is manageable with cultural techniques. While fumigation with Telone II did improve Maxxa yield significantly over unfumigated, the estimated cost of application and material is prohibitive for most cotton growers. Temik did not perform as well as in earlier trials (Munier and Goodell, 1996), due perhaps to the higher initial populations and Fusarium wilt pathogens present in the field. Temik apparently provides initial protection of developing root system but allows the root-knot nematode population to build during the season.

Of particular importance is the value host plant resistance not only as self protection for cotton yield but also as part of a larger root-knot nematode management strategy. Cotton, itself, is useful in a vegetable and field crop rotation because it filters all root-knot nematodes except *M. incognita*. The use of host plant resistance now provides an opportunity to also reduce that population for subsequent susceptible crops such as carrots, tomatoes, lima beans, melons, and sugar beets. In some cases the reduction may be sufficient for control while in more susceptible crops, the amount of chemical control might be reduced.

Acknowledgments

This work is supported in part by a grant from Cotton Incorporated, CA State Support Committee. Appreciation for the management of the cotton plots by Mr. John Peterson of UC Shafter Research and Extension Center is acknowledged.

References

Blasingame, D. 1997. Cotton disease loss estimates. 1997 Proceedings of the Beltwide Cotton Conferences. Vol. 1:130-131.

Garber, R.H., J.E. DeVay, P.B. Goodell, and P.A. Roberts. 1996. Cotton Diseases and nematodes. In: Cotton Production Manual. S. Johnson Hake, T.A. Kerby, and K.D. Hake, editors. UC DANR Publication 3352. 417 pp.Goodell, P.B., J.W. Eckert, D. J. Munier, and S. Wright. 1995. Integrated management of *Meloidogyne incognita* on San Joaquin Valley cotton. 1995 Proceedings of the Beltwide Cotton Production Research Conferences. Vol.1: 214-216

Goodell, P.B. and G.H. Montez. 1994. Acala cotton tolerance to southern root-knot nematode, *Meloidogyne incognita*. 1994 Proceedings of the Beltwide Cotton Production Research Conferences. Vol. 1: 265-267.

Jenkins, W.R. 1964. A rapid centrifugal-flotation technique for separating nematodes from soil. Plant Disease Reporter 48:692.

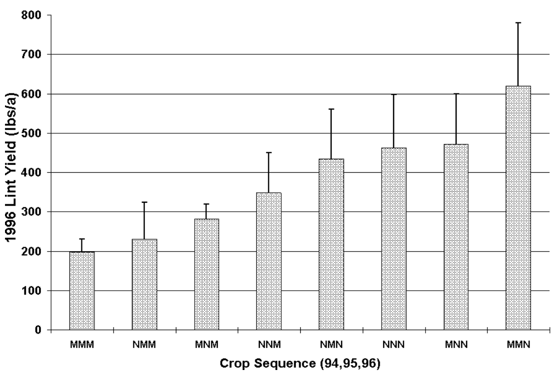

Figure 1. Results of various combinations of resistant and susceptible cotton over three years on yield. N= NemX and M=Maxxa cotton

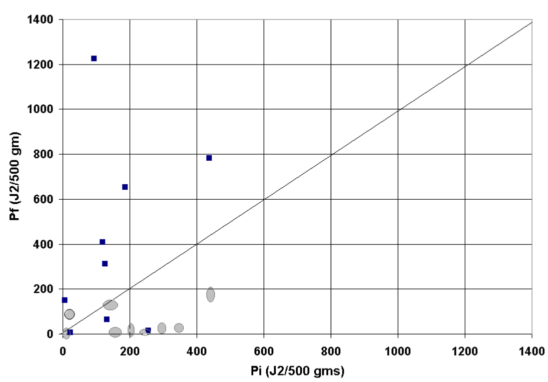

Figure 2. Root-knot nematode reproductive capacity of two varieties. Diagonal line represents maintenance line for root-knot nematode population. Pi is spring population and Pf is late season population.

Munier, D., P.B. Goodell, and J.W. Eckert. 1996. Root-knot nematode management with different rates of Temik at planting. 1996 Proceedings of the Beltwide Cotton Production Research Conferences. Vol. 1: 257-258.

Ogallo, J.L., P.B. Goodell, J. Eckert, and P.A. Roberts. 1997. Evaluation of NemX, a new cultivar of cotton with high resistance to *Meloidogyne incognita.* Journal of Nematology: 29 (4). In press.

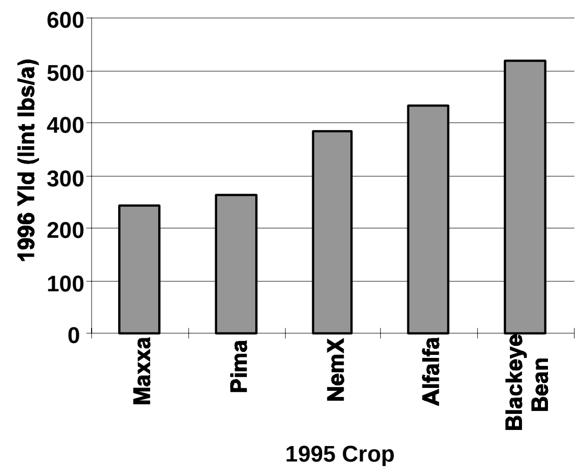

Figure 3. Influence of one year crop rotation of either blackeye beans, alfalfa, NemX, Maxxa, or Pima S7 on Maxxa yield the subsequent year.

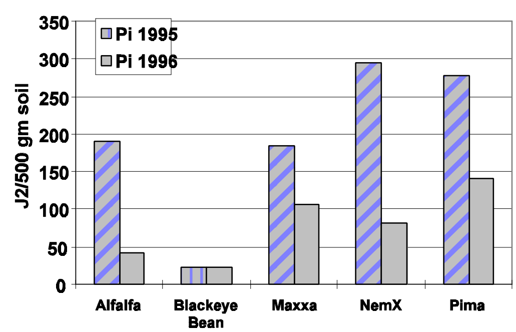

Figure 4. Influence of one year crop rotation of either blackeye beans, alfalfa, NemX, Maxxa, or Pima S7 on root-knot nematode populations the subsequent year.

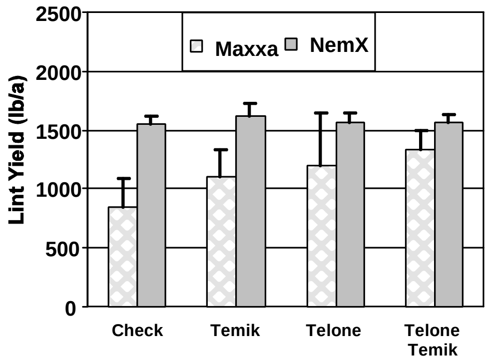

Figure 5. Influence of various management practices on yield of cotton.

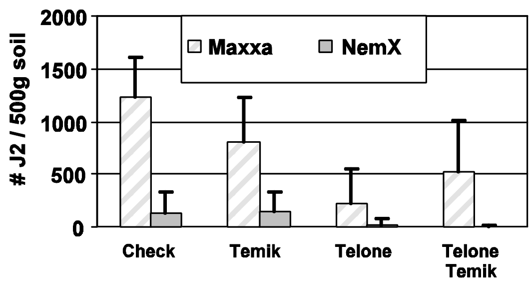

Figure 6. Influence of various management practices on root-knot nematode populations in cotton.

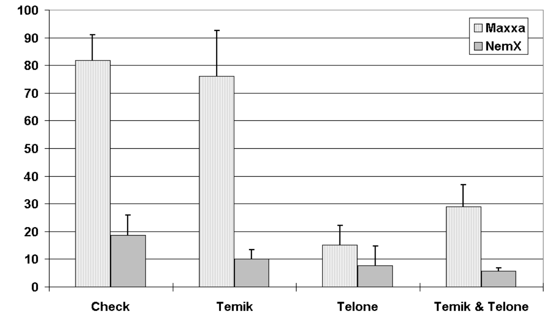

Figure 7. Root damage caused by root-knot nematode as measured by weighted nematode rating (WNR) and influenced by various control practices.