TRAP CROPPING FOR MANAGING NEMATODES ON CARROTS IN CALIFORNIA

Becky B. Westerdahl*, University of California, Davis, CA 95616
Joe Nunez, University of California Cooperative Extension, Bakersfield, CA 93307
John D. Radewald, University of California, Riverside, CA 92521

Root-knot nematodes (*Meloidogyne* sp.) are widely distributed throughout California and are the most important nematode pest of carrot (*Dacus carotae).* In addition, stubby root nematode (*Paratrichdorus* sp.) is found statewide, often in association with root-knot nematode, and needle nematode (*Longidorus africanus*) is important in the Imperial Valley. Current control methodology relies on the use of Metam sodium and Telone II. Metam sodium, for example, was used on 33% of California's carrot acreage in 1997 and Telone II was used on 10%. Although Methyl bromide is no longer registered on carrots, it was used on 1% of California's carrot acreage in 1997.

Trap cropping is a nematode management technique that has been tested periodically since the late 1800's. A susceptible host is planted and larvae of a sedentary parasitic nematode such as root-knot are induced to enter and establish a feeding site. Once this has occurred, and the female begins to mature, she is unable to leave the root. The plants are then destroyed before the life cycle of the nematode can be completed, trapping nematodes within the root. By itself, trap cropping is not likely to provide the same level of control as a chemical nematicide such as Telone II, because not all nematodes are induced to enter the roots. However, the potential for loss of registration of this and other chemical nematicides for various environmental reasons is great enough that an IPM approach using two or more techniques in combination, that will each provide partial control of the nematode population is warranted. For example, although by itself, DiTera does not appear to provide a high enough level of control for commercial use in carrots, in combination with another technique such as trap cropping, a higher level of control could be expected.

Materials and Methods: In 2006, two trials were established. One was at the UC Shafter Research and Extension Center (SREC) in Kern County in a field with a history of root-knot nematode (*Meloidogyne incognita*). The previous crop was cotton (*Gossypium hirsutum*). The second trial was at the UC South Coast Research and Extension Center (SCREC) in Orange County in a field with an established population of root-knot nematode (*Meloidogyne javanica*). The previous crop was sugarbeets (*Beta vulgaris*).

The SREC trial consisted of 12 treatments. Telone II was injected on May 17, 2006. The carrot trap crop was planted on May 17, 2006, followed by germination one week later. On June 26, 2006 some treatments received RoundUp or tillage. On July 2, 2006, some treatments received tillage, DiTera DF treatments were applied, and the final carrot crop was planted. The trial was harvested on January 11, 2007.

The SCREC trial consisted of 10 treatments. The carrot trap crop was planted May 17, 2006 and germination was one week later. Telone II was injected on May 17, 2006. RoundUp and tillage

treatments were conducted on May 31, and June 7, 2006. Planting and DiTera treatments were conducted on June 22, 2006. The trial was harvested on November 15, 2006.

Seeded plots and wet fallow treatments were watered daily or every other day as needed to maintain required moisture for germination and growth. Each treatment consisted of 5 replicates in a randomized complete block design. Single row plots were 14 feet long plus a 3 foot buffer on either end.

Trials were sampled for nematodes pre-plant to establish the level of the population, and at harvest. Soil samples consisted of 12, 1 inch diameter cores per replicate to a 12 inch depth. Nematode extraction was by elutriation followed by sugar centrifugation. Harvested carrots were graded into 4 categories: 1) marketable without nematode damage, 2) marketable with nematode damage, 3) not marketable with nematode damage, and 4) not marketable without nematode damage. Carrots in each category were counted and weighed. For data analysis, categories 1 and 2 were combined to determine marketable carrots. Data were analyzed with Analysis of Variance (ANOVA) followed by Fisher's Least Significant Difference Test. Percent values were arcsin transformed prior to analysis.

Results and Discussion: In the Shafter trap crop trial, Telone II had a greater number of marketable carrots than several other treatments ($p=0.05$). Fallow followed by RoundUp and tillage had a greater total weight of carrots than several other treatments. Telone II had a greater percentage of marketable carrots based on weight or number of carrots than several other treatments ($p = 0.1$).

South Coast Research and Extension Trial. The following treatments had a greater weight of marketable carrots than the untreated: Telone II, Wet fallow + Roundup2 + till3 + Ditera ($p = 0.1$), Carrot + till2 + Ditera ($p = 0.05$), and Carrot + Roundup2 + till3 + Ditera ($p = 0.1$). The following treatments had a greater number of marketable carrots than the untreated ($p = 0.05$): Telone II, Wet fallow + Roundup2 + till3 + Ditera, Carrot + till2 + Ditera, Carrot + Roundup2 + till3 + Ditera, Carrot + Roundup2 + till3 + Ditera ($p = 0.05$). The following treatments had a greater percentage of marketable carrots based on weight than the untreated ($p = 0.05$): Telone II, Wet fallow + Roundup2 + till3 + Ditera, Carrot + till2 + Ditera, Carrot + Roundup2 + till3, and Carrot + Roundup2 + till3 + Ditera. At $p = 0.1$, the additional following treatments had a greater percentage of marketable carrots based on weight than the untreated: Wet fallow + Roundup2 + till3, Carrot + till2, and Carrot + Roundup2. The following treatments had a greater percentage of marketable carrots based on number of carrots than the untreated ($p = 0.05$): Telone II, Wet fallow + Roundup2 + till3 + Ditera, Carrot + till2 + Ditera, Carrot + Roundup2 + till3, and Carrot + Roundup2 + till3 + Ditera. At $p = 0.1$, the additional following treatments had a greater percentage of marketable carrots based on number of carrots than the untreated: Wet fallow + Roundup2, Wet fallow + Roundup2 + till3, and Carrot + Roundup2. Telone II ($p = 0.05$) and Carrot + till2 + Ditera ($p = 0.1$) had lower nematode levels at harvest than the untreated.

In the trap crop trial at Shafter, Telone II was the only treatment to provide statistically significant increases in yield over the untreated. The trial at South Coast Research and Extension Center was more successful with quite a few treatments out yielding the untreated in several harvest categories. The addition of DiTera to trap cropping resulted in statistically significant

increases in weight and number of marketable carrots. The wet fallow treatment, in which a carrot trap crop was not planted, but the weeds that germinated served to trap nematodes within the roots, when used in combination with DiTera, also produced a statistically greater yield of marketable carrots than the untreated. With respect to percent marketable carrots, a wet fallow treatment alone even without the addition of DiTera produced a greater yield of carrots. These results indicate that a pre-irrigation to germinate weeds, followed by RoundUp or tillage two weeks after the irrigation, could provide a degree of nematode control.