RESEARCH NOTE - NOTA DE INVESTIGACION

INFLUENCE OF *MI*-GENE RESISTANCE AND SOIL FUMIGANT APPLICATION IN FIRST CROP TOMATO ON ROOT-GALLING AND YIELD IN A SUCCEEDING CANTALOUPE CROP

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ABSTRACT

Rich, J. R., and S. M. Olson. 2004. Influence of *Mi*-gene resistance and soil fumigant application in first crop tomato on root-galling and yield in a succeeding cantaloupe crop. Nematropica 34:103-108.

Two field trials, one each in 2000 and 2001, were conducted to determine the effects of using combinations of *Mi*-gene resistant tomatoes and methyl bromide chemical alternatives on root galling and yield of a succeeding cantaloupe crop. The sites were on loamy sand soils in northern Florida U.S.A infested with *Meloidogyne javanica*. Chemical treatments served as main plots, each replicated six times, and *Mi*-gene resistant and susceptible tomato cultivars served as subplots. Soil fumigants applied in the tests were 1,3-D, 1,3-D + 17% chloropicrin, 1,3-D + 35% chloropicrin, and a standard methyl bromide + 33% chloropicrin treatment. The tomato and the succeeding cantaloupe crops were grown on polyethylene mulch and irrigated through drip tubing. In both the 2000 and 2001 tests, chemical treatments and use of *Mi*-gene resistant tomato cultivars reduced root galling on the tomato crop. Root galling on the subsequent cantaloupe crops were not affected by chemical treatment of the previous tomato crop, but cantaloupe yield was increased. Root galling on cantaloupe grown after resistant tomato cultivars was significantly reduced, and use of first crop *Mi*-resistant tomato increased cantaloupe yield and fruit number. Reduced root galling and increased yield of cantaloupe was generally found when using chemical soil treatment and *Mi*-gene resistance in a first tomato crop.

Key words: cantaloupe, chloropicrin, *Cucumis melo*, dichloropropene, *Lycopersicon esculentum*, *Meloidogyne javanica*, methyl bromide, root-knot nematode, soil fumigation, Telone, tomato.

RESUMEN

Rich, J. R., y S. M. Olson. 2003. Influencia del primer cultivo de tomates "*Mi*-gene" y alternativas al bromuro de metilo sobre agalladuras en las raíces y cosecha en el cultivo siguiente de melón. Nematropica 34:103-108.

Dos ensayos de campo, uno en 2000 y uno en 2001, fueron llevados a cabo para determinar los efectos del uso de combinaciones de tomates con resistencia del Mi-gen y alternativos químicos al bromuro de etilo sobre agalladuras en las raíces y cosecha en un cultivo de melón siguiente. Los sitios eran en un suelo francoso-arena en el Norte de Florida, EEUU, infestados con *Meloidogyne javanica*. Tratamientos químicos sirvieron como 'plots' mayores, cada uno replicado seis veces, y cultivares de tomates con el Mi-gen de resistencia y tomates sensibles sirvieron como sub-plots. Fumigantes de suelo aplicados eran 1,3-D, 1,3-D + 17% cloropicrina, 1,3-D + 35% cloropicrina, y un tratamiento estándar de bromuro de metilo + 33% de cloropicrina. Los cultivos de tomate y de melon following fueron cultivados usando cobertura de polietileno y regados usando riego de goteo. En ambos ensayos de 2000 y 2001, tratamiento con químicos y el uso de cultivares de tomate resistentes reducieron agalladuras en las raíces en el cultivo de tomate. Agalladuras en las raíces en los cultivos de melon no fueron afectadas por el tratamiento con quimicos del cultivo de tomate anterior, pero incrementó la cosecha de melon. Agalladuras en las raíces en melon cultivado después de los cultivares de tomate resitentes fue reducido significativamente, y el uso de tomate con la resistencia del Mi-gen primero, incrementó el número de frutas y la cosecha de melon. Reducción de agalladuras en las raíces y una cosecha más grande de melon fue generalmente encontrado usando tratamiento del suelo con químicos combinado con el uso de resistencia del Mi-gen en un cultivo anterior de tomate.

Palabras clave: melon, cloropicrina, *Cucumis melo*, dicloropropano, *Lycopersicon esculentum*, *Meloidogyne javanica*, bromuro de metilo, nemátodo agallador, fumigación del suelo, Telone, tomate.

INTRODUCTION

In Florida U.S.A, tomatoes (*Lycopersicon esculentum* Mill.) for the fresh market were grown on over 17 000 ha during the 2000-2001 year with a value exceeding 580 million U.S. dollars (Anonymous, 2002). The application of methyl bromide, sometimes with mixtures including chloropicrin, to control soilborne pests is a critical component in Florida tomato production (Noling and Becker, 1994). Methyl bromide, however, is scheduled for phase out by the year 2005 (Anonymous, 2000). Chemical alternatives to methyl bromide have been shown to be successful for management of plant-parasitic nematodes in Florida fresh market tomato production (Gilreath *et al.*, 1998; Rich *et al.*, 2003). However, other potentially useful nematode management techniques such as plant resistance have been little studied in Florida production (Rich and Olson, 1999).

Mi-gene resistance in tomato (*Lycoperscion esculentum*) has been used for more than 35 years. and has proven useful for management of *Meloidogyne arenaria*, *M. incognita*, and *M. javanica* (Roberts, 1992). Until recently, however, the *Mi* gene had not been incorporated into commercially acceptable fresh market tomato cultivars nor tested in tomato production systems in Florida (Rich and Olson, 1999). With the impending loss of methyl bromide, however, this resistance could become an important nematode management tool in Florida tomato production. Additionally, use of *Mi*-gene resistance could potentially reduce nematode damage in second crops commonly grown in Florida after the primary tomato crop. For example, use of *Mi*-gene resistance in tomato could allow for reduced rates of chemical alternatives to methyl bromide or extend their effectiveness to a second crop following tomato (Ornat *et al.*, 1997; Colyer *et al.*, 1998). Thus, two studies were conducted to determine efficacy of chemical soil treatment, *Mi*-gene resistance, and the combination in a first crop tomato and second cantaloupe cropping system to reduce root galling and yield losses caused by *Meloidogyne javanica*.

Two field trials were conducted, one in 2000 and another in 2001, at the University of Florida North Florida Research and Education Center, Quincy on a loamy sand soil (78% sand, 14% silt and 8% clay; pH 6.5). Each site was moderately infested with the root-knot nematode, *Meloidogyne javanica*. Before chemical treatment in the spring of each year, soil was moldboard plowed and double-disced in early March, and fertilizer was applied broadcast at the rate of 196-62-196 kg/ha of N-P_2O_5-K_2O and disc-incorporated. The soil fumigant applications were made using nitrogen gas as the propellant through a flow meter system. Applications of the chemicals were made with a single row bed press through 3 chisels spaced 30 cm apart on a 0.91 m-wide raised bed in 1.82 m wide rows and injected to 25 cm deep. Polyethylene mulch (1.25-mil) and double wall drip tubing were laid concurrently with chemical application. Black polyethylene mulch was used in the spring tomato trials, and the same mulch was sprayed with white paint for the fall cantaloupe crop.

The 2000 and 2001 trials contained the same soil fumigant treatments plus non-treated controls (Table 1). Chemical treatments and controls were main plots, each replicated six times, and *Mi*-gene resistant and susceptible tomato cultivars served as subplots. In both tests, plots were one row wide and 12.2 m long. Tomato cultivars used in the 2000 test were 'Sanibel' (resistant) and 'FL 47' (susceptible), and in the 2001 test, 'BHN 577' (resistant) and 'BHN 444' (susceptible) tomatoes were used. Tomato spotted wilt virus (TSWV) was severe in the 2000 test, and tomato cultivars were changed for the second year of the test to take advantage of TSWV resistance in the BHN cultivars. Tomatoes were transplanted 51 cm apart in the row 18-21 days after fumigation and produced according to standard cultural practices for Florida production. Root gall ratings were conducted at the end of harvest in tomato from four plants in each plot. Root galling was estimated on a 0-10 scale where 0 = no root galling and 10 = 100% of the root system galled. 'Athena' cantaloupe (*Cucumis melo*) was transplanted in both years after tomato harvest and spaced 51-cm-apart in the previous test beds. Root gall index ratings at final cantaloupe harvest were conducted as described earlier. In the 2001 test, cantaloupe yields were collected from 8 plants in each plot, and plots were harvested six times. Data were analyzed with ANOVA and means separated with the Least Significant Difference test ($P \leq 0.05$).

RESULTS AND DISCUSSION

In the 2000 test, application of methyl bromide + 33% chloropicrin (Mbr + 33% Pic) or 1,3-dichloropropene (1,3-D) + 17% chloropicrin (Pic) reduced root galling in

Table 1. Influence of chemical soil treatments and *Mi*-gene resistance on root galling caused by *Meloidogyne javanica* in first crop tomato followed by a cantaloupe crop, 2000.

Treatment	Formulation kg or L/ha[w]	Root-galling[x] Tomato	Root-galling[x] Cantaloupe
Mbr + 33% Pic	392 kg	0.71 a[y]	3.56 a
1,3-D + 17% Pic	327 L	0.79 a	3.98 a
1,3-D + 35% Pic	327 L	1.56 ab	4.96 a
1,3-D	224 L	1.75 ab	5.44 a
Control	—	2.75 b	4.73 a
Tomato Variety			
Sanibel (R)[z]	—	0.17 a	2.99 a
FL 47 (S)	—	2.86 b	6.10 b

[w]Chemical rates are broadcast equivalent but only one-half of the area (in-bed) was treated; chemicals included 1,3-dichloropropene (1,3-D), methyl bromide (Mbr), and chloropicrin (Pic).
[x]Root gall ratings were based on a 0-10 scale where 0 = no galling and 10 = dead plants due to extensive galling.
[y]Column means followed by the same letter are not significantly different ($P \leq 0.05$) according to the Least Significant Difference test.
[z](R) indicates *Mi*-gene resistance and (S) indicates susceptibility to root-knot nematodes; data averaged across chemical treatments.

the first crop tomato (Table 1). Root galling in the 1,3-D + 35% Pic or 1,3-D alone treatments did not differ from the other chemical treatments or the control. The resistant 'Sanibel' tomato showed significantly lower root galling than the susceptible 'FL 47'. In the subsequent cantaloupe crop, root galling was not different among chemical treatments or the control. However, cantaloupe grown after resistant 'Sanibel' showed a significant reduction in root galling compared to those grown after susceptible 'FL 47'.

In the 2001 test, all chemical treatments significantly reduced root galling in tomato compared to the untreated control (Table 2). The 1,3-D + 35% Pic and Mbr + 33% Pic treatments produced greatest root gall reductions. Root galling in the resistant 'BHN 577' tomato was significantly reduced compared to the susceptible 'BHN 444' tomato. In the cantaloupe second crop, root galling was not significantly affected by first crop chemical treatment compared to the non-treated control. However, all chemical treatments numerically lowered root galling on cantaloupe. Use of the resistant 'BHN 577' tomato in the first crop significantly reduced root galling in the cantaloupe second crop compared to planting of susceptible 'BHN 444' tomato.

Cantaloupe yields in 2001 were significantly improved by all chemical soil treatments (Table 3). Fruit numbers, however, were improved by only the 1,3-D + 35% Pic and 1,3-D + 17% Pic treatments, and weight per fruit was not affected by any chemical treatment. Previous use of resistant tomato 'BHN 577' significantly increased cantaloupe yield, fruit number and weight per fruit. Data from these tests show a similar comparative value of the three chemical treatments to methyl bromide to reduce root galling in a first tomato crop similar to results of others (Gilreath *et al.*, 1998; Rich *et al.*, 2003). Less value from any of the chemical treatments

Table 2. Effect of chemical soil treatments and *Mi*-gene resistance on root galling caused by *Meloidogyne javanica* in first crop tomato followed by a cantaloupe crop, 2001.

Treatment	Formulation kg or L/ha[w]	Root-galling[x]	
		Tomato	Cantaloupe
1,3-D + 35% Pic	327 L	0.42 a[y]	3.36 a
Mbr + 33% Pic	392 kg	0.94 ab	3.79 a
1,3-D + 17% Pic	327 L	1.27 ab	3.83 a
1,3-D	224 L	2.85 b	4.75 a
Control	—	5.23 c	6.22 a
Tomato Variety			
BHN 577 (R)[z]	—	0.34 a	2.76 a
BHN 444 (S)	—	3.94 b	6.03 b

[w]Chemical rates are broadcast equivalent but only one-half of the area (in-bed) was treated; chemicals included 1,3-dichloropropene (1,3-D), methyl bromide (Mbr), and chloropicrin (Pic).

[x]Root gall ratings were based on a 0-10 scale where 0 = no galling and 10 = dead plants due to extensive galling.

[y]Column means followed by the same letter are not significantly different ($P \leq 0.05$) according to the Least Significant Difference test.

[z](R) indicates *Mi*-gene resistance and (S) susceptible to root-knot nematodes; data averaged across chemical treatments.

Table 3. Second crop cantaloupe yield, fruit number, and fruit weight following treatment of first crop tomato with soil applied chemicals with and without use of *Mi*-gene resistance in a site infested with *Meloidogyne javanica*, 2001.

Treatment	Formulation kg or L/ha[x]	Plot yield kg/ha	Fruit number	Wt. (kg) per fruit
1,3-D + 35% Pic	327 L	31.3 a[y]	18.4 a	1.70 a
Mbr + 33% Pic	392 kg	30.9 a	16.6 ab	1.86 a
1,3-D + 17% Pic	327 L	33.7 a	18.3 a	1.84 a
1,3-D	224 L	27.9 a	16.1 ab	1.73 a
Control	—	20.3 b	12.3 b	1.65 a
Tomato Variety				
BHN 577 (R)[z]	—	32.5 a	17.4 a	1.87 a
BHN 444 (S)	—	25.3 b	15.3 b	1.65 b

[x]Chemical rates are broadcast equivalent but only one-half of the area (in-bed) was treated; chemicals included 1,3-dichloropropene (1,3-D), methyl bromide (Mbr), and chloropicrin (Pic).
[y]Column means followed by the same letter are not significantly different ($P \leq 0.05$) according to the Least Significant Difference test.
[z](R) indicates *Mi*-gene resistance and (S) susceptible to root-knot nematodes; data averaged across chemical treatments.

was found when a second crop was grown without additional treatment. However, the use of *Mi*-gene resistant tomato significantly reduced root galling and increased yield in the succeeding cantaloupe crop. Data presented herein agree with those of others (Ornat *et al.*, 1997; Colyer *et al.*, 1998) who found yield benefits in second crop cucumber when using *Mi*-gene resistance in a preceding tomato crop.

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