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Double-cropping Muskmelons with Nematode-resistant Tomatoes Increases Yield, but Mulch Color Has No Effect

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Abstract. **A study was conducted in Summer 1996 and 1997 to determine the residual effects of planting nematode-resistant vs. susceptible tomato (*Lycopersicon esculentum* Mill.) cultivars and use of white vs. black polyethylene mulch on the growth and yield of a subsequent muskmelon (*Cucumis melo* L.) crop. Tomato cultivars were planted in early April and harvested in June and early July. Muskmelons were planted in late July on the same beds. Muskmelons, planted after the nematode-resistant tomato cultivar Celebrity, produced significantly greater marketable yield and more fruit per hectare in both years than did muskmelons planted after the nematode-susceptible tomato cultivar Heatwave. Plant dry weight of muskmelons was greater and the percentage of their galled roots was smaller when planted after nematode-resistant tomatoes than when planted after nematode-susceptible ones. Mulching tomatoes with black or white polyethylene had no significant effect on growth, yield, and root galling of subsequent muskmelon crops.**

Southern root-knot nematodes, *Meloidogyne incognita* (Kofoid & White) Chitwood, significantly reduce yields of many horticultural crops. Recent estimates by Nugent and Dukes (1997) indicated that annual losses in muskmelons due to nematode injury in the United States can exceed $40 million. Development of commercial tomato cultivars resistant to root-knot nematodes has reduced the risk of losses from this pest without environmental damage. However, no muskmelon cultivars with high resistance to root-knot nematodes are commercially available to provide similar protection (Bernhardt et al., 1988; Nugent and Dukes, 1997. Muskmelon growers use nematicides to control this pest, but their use may be restricted or completely eliminated in the future.

The Norwood sandy loam soil prevalent in the Red River Valley in northwest Louisiana is prone to nematode buildup because of continuous farming with susceptible crops. Random samples of these soils had a population density of ≈5000 *M. incognita* juveniles/500 cm^3 of soil (Hanna et al., 1993). The number of root-knot nematodes was significantly lower in plots previously planted with nematode-resistant tomatoes than in those planted with nematode-susceptible tomatoes (Hanna et al., 1993). Previous research indicated that double-cropping cucumbers with nematode-resistant tomato cultivars can be a viable alternative to soil treatment with nematicides for improving cucumber yield in root-knot nematode-infested soil (Hanna et al., 1994).

The long growing season in the southern United States offers the potential for double-cropping of existing mulched and drip-irrigated beds. Double-cropping tomatoes with cucurbits reduces production costs by enabling succeeding crops to use the existing polyethylene mulch, drip tape, and fertilizers applied to the first crop (Hanna, 1993; Hewitt and Zimet, 1987). Black polyethylene is preferred for growing spring-season tomatoes because of its warming effect on the soil, but heat accumulation under the black mulch during sunny days in mid-to late summer or early fall is thought to limit its use for a double-cropping system (Graham et al., 1995). This study was conducted to determine the influence of nematode-resistant vs. susceptible tomato cultivars mulched with black or white polyethylene on growth and yield of succeeding crops of muskmelons.

Materials and Methods

Studies were conducted in Summer 1996 and 1997 (July to Oct.) on a Norwood sandy loam soil at the Red River Research Station, Bossier City, La. 'Celebrity' (nematode-resistant) and 'Heatwave' (nematode-susceptible) tomatoes were transplanted on black or white polyethylene-mulched and drip-irrigated plots (raised beds) in early April of each year. Fertilizer rates and other cultural practices consisted of standard recommendations for growing staked tomatoes for fresh market production (Boudreaux, 1998). Following plant removal after the last harvest of tomatoes in early July, the plots were sprayed with *N*-(phosphonomethyl)glycine (glyphosate) at 3.4 $kg \cdot ha^{-1}$ to kill existing vegetation and expose the mulched plots to sunlight. 'Athena' muskmelon was seeded in nematode-free soilless mix (Pro-Mix BX; Premier Brands, Yonkers, N.Y.) on 1 and 8 July 1996 and 1997, respectively. Muskmelon seedlings were transplanted during the third week of July in both years into 1.5 × 10-m tomato plots, with 45 cm between plants within rows. The experimental design was a 2 × 2 factorial, arranged in a randomized complete-block with three and four replications in 1996 and 1997, respectively. Muskmelons were double-cropped with nematode-resistant vs. susceptible tomato cultivars that were mulched with black vs. white polyethylene. Muskmelons were fertilized by injecting 17 $kg \cdot ha^{-1}$ N (50 kg ammonium nitrate 34N–0P–0K) through the drip irrigation system at the third leaf stage and again 3 weeks later. They were harvested at the natural abscission (slip) stage nine times in 1996 and seven times in 1997, evaluated for grade according to U.S. Dept. of Agriculture standards (U.S. Dept. of Agriculture, 1968), and then weighed. Fruit that were well formed, well netted, and free from decay, damage, and sunscald were graded as marketable. Fruit that were deformed, cracked, rotten, or weighed less than 500 g were considered to be culls. All plants in each plot were removed without root or fruit after the last harvest, oven-dried at 71 °C for 5 d, and weighed. The root system of each plant was carefully removed and freed from sand and/or dirt. Healthy roots were separated from galled ones and the percentage of galled roots was calculated. Data were subjected to analysis of variance (SAS Institute, 1994).

Results and Discussion

Muskmelons planted after the nematode-resistant tomato cultivar Celebrity produced significantly higher marketable yields and greater number of fruit/ha than did those planted after the nematode-susceptible tomato cultivar Heatwave in both years (Table 1). Percentage of culls was not significantly affected by treatment in either year. Plant dry weight was greater and percentage of galled roots was smaller for muskmelons planted after the nematode-resistant than after the nematode-susceptible tomatoes (Table 1). Mulch color had no significant effect on muskmelon marketable yield, fruit number, percentage of culls, plant dry weight, or the percentage of galled roots (Table 1). Interactions between mulch color and previous

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Table 1. Influence of tomato cultivar grown in a first crop and mulch color on yield and other traits of muskmelons grown as a second crop.

	Marketable yield ($t \cdot ha^{-1}$)		Fruit no./ha		Culls (%)		Dry wt (g/plant)		Galled roots (%)	
Treatment	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Previous cultivar										
Nematode resist.	48.0	43.3	21,501	16,172	9.4	4.6	225.8	251.1	2.0	3.1
Nematode suscp.	35.0	35.3	16,919	12,971	9.2	8.5	133.6	205.4	70.3	52.5
Significance	**	*	*	*	NS	NS	*	***	**	***
Mulch color										
Black	43.0	40.3	19,902	15,076	8.8	6.1	179.1	232.2	34.3	27.3
White	40.0	38.3	18,518	14,067	9.9	7.0	180.3	224.4	38.0	28.3
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

^{NS,*,**,***}Nonsignificant or significant at $P \leq 0.05$, 0.01, or 0.001 respectively.

tomato cultivar on muskmelon yield were nonsignificant (interactions not shown).

Considerable effort has been made to breed for root-knot nematode resistance in *Cucumis* species, but limited progress has been made (Fassuliotis, 1967; Nugent and Dukes, 1997). Alternatives to chemical control of root-knot nematode in *Cucumus* species must be found. Those alternatives include resistant cultivars and improved cultural methods. The results of this study indicate that double-cropping muskmelons with a nematode-resistant tomato cultivar can be an effective cultural method to improve muskmelon yields in soils that have a history of root-knot nematode.

Producing early spring fresh market tomatoes on black polyethylene mulch is a well-established cultural practice (Sweeney et al., 1987). Hanna (2000) reported that soil temperature was higher under black than under white polyethylene mulch, but it had no significant effect on yields of cucumbers double-cropped with tomatoes. Results of this study indicate that growth and yield of muskmelons were similar when planted on black or white polyethylene mulch.

In conclusion, double-cropping muskmelons with a nematode-resistant tomato cultivar appears to be a good cultural practice to improve muskmelon yield in nematode-infested soil regardless of the color of the polyethylene used to mulch the previous tomato crop.

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