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Poster #17

Evaluation of Alternative Pesticides and Mulching for Organically-Grown Watermelons in Puerto Rico

Note: This paper was presented as Poster #17 "Organic Watermelon Yield is Affected by Alternative Pesticides and Mulching".

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ABSTRACT.
There is an increasing interest in organic horticulture in Puerto Rico. One of the main limitations for organic production is the scarcity of local research for production recommendations. Research was conducted to evaluate mulching for weed suppression and alternative pesticides for disease management in an organic watermelon system in Lajas, Puerto Rico. Plots were either not mulched or mulched with freshly-cut grass straw. The alternative pesticides were (1) a blend of oils of rosemary, clove, thyme and wintergreen, mixed with lecithin and buthyl lactate (Sporan®), (2) hydrogen dioxide (OxiDate®), (3) an oil extract from the tea tree *Melaleuca alternifolia*) (Timorex®), (4) a clarified Hydrophobic Extract of neem (*Azadirachta indica*) oil (Trilogy®), (5) mint and rosemary oils mixed with wintergreen oil, vanillin, lecithin and buthyl lactate (Ecotrol®), (6) potassium bicarbonate (Milstop®), (7) *Bacillus pumilis* strain QST 2808 (Sonata®), (8) *B. subtilis* strain QST 713 (Serenade®), (9) whole milk (10% solution in water), (10) a garlic (*Allium sativum*) extract (Garlic Barrier®), (11) (Javelin®) mixed with a copper fungicide (NuCop®) alternated with *B. thuringiensis* (Agree®) mixed with a copper fungicide (NuCop®), and (12) a check treated with water. The organic pesticides were applied weekly at recommended rates. Downy mildew was the prevalent disease throughout the season. Watermelon yield was significantly higher in mulched plots than in non-mulched plots, due to weed suppression by the mulch. Among the organic pesticide treatments resulting in the highest crop yields were hydrogen dioxide, *Bacillus pumilis* strain QST 2808, the garlic extract, and the *Melaleuca alternifolia* oil extract. These results provide valuable information for weed and disease management in organic and ecological watermelon systems in tropical regions.

KEYWORDS: Biopesticides; *Cyperus rotundus*; downy mildew; ecological pesticides.

INTRODUCTION

Interest in produce grown organically or ecologically has been increasing in Puerto Rico (Morales-Cotto and Morales-Payan, 2007a and 2007b), but scarcity of research-founded recommendations for organic and ecological production in Puerto Rico hinders the productivity and expansion of crops grown in non-traditional systems.

Organic and ecological watermelons are among the fruits that Puerto Rican consumers are interested in purchasing, more so if they are grown in the island (unpublished survey data by Morales-Payan and collaborators).

In Puerto Rico, watermelon (*Citrullus lanatus*) had a farm gate worth of approximately $2 million in the fiscal year 2006-2007 (Puerto Rico Department of Agriculture, 2008), and most of it is still grown in conventional systems. Management of weeds, diseases, and pests are among the main concerns of watermelon growers in Puerto Rico.

Weeds, particularly purple nutsedge (*Cyperus rotundus*) may be devastating to watermelon if allowed to grow unchecked or poorly managed (Roque et al., 2006; Wszelaki and Brunner, 2006). Diseases are commonly a threat to watermelons in Puerto Rico, especially fungal diseases in the southwestern region of the island (Wszelaki and Brunner, 2006). Little is known regarding the effect of crop protection inputs and practices on organic/ecological watermelon production systems in Puerto Rico.

The objective of this research was to determine the effect of mulching for weed management and application of alternative pesticides allowed in certified organic production on the yield and quality of watermelons grown as a transitioning crop in Puerto Rico. The objective of this research was to evaluate mulching and alternative pesticides for weed and disease management in watermelons grown following organic regulations in the conditions of southwestern Puerto Rico.

MATERIALS AND METHODS

Field research was conducted with transplanted 'Crimson Sweet' watermelon at the Experiment Substation of the University of Puerto Rico-Mayaguez in Lajas during June-August 2007. The treatments (mulching x alternative pesticide combinations) were established in a split-plot randomized complete block design with four replications. The large plots were either not mulched or mulched with freshly cut grass. The subplots were pesticides allowed in certified organic systems, applied according to the US National Organic Program regulations.

The alternative pesticides evaluated were (1) a blend of oils of rosemary, clove, thyme and wintergreen, mixed with lecithin and buthyl lactate (Sporan®), (2) hydrogen dioxide (OxiDate®), (3) an oil extract from the tea tree *Melaleuca alternifolia*) (Timorex®), (4) a clarified hydrophobic extract of neem (*Azadirachta indica*) oil (Trilogy®), (5) mint and rosemary oils mixed with wintergreen oil, vanillin, lecithin and buthyl lactate (Ecotrol®), (6) potassium bicarbonate (Milstop®), (7) *Bacillus pumilis* strain QST 2808 (Sonata®), (8) *B. subtilis* strain QST 713 (Serenade®), (9) whole milk (10% solution in water), (10) a garlic (*Allium sativum*) extract (Garlic Barrier®), (11) (Javelin®) tank-mixed with a copper fungicide (NuCop®) alternated with *B. thuringiensis* (Agree®) tank-mixed with a copper fungicide (NuCop®), and (12) a check treated with water. The alternative pesticides were applied weekly at label recommendation rates.

The experimental units were raised soil beds 6 m long containing 10 watermelon plants each. The crop was transplanted onto the experimental units the same day the mulching was laid on the plots, and the watermelon was managed following practices allowed under the US National Organic Program standards. Weed density, disease

incidence and severity, and pest density and damage were evaluated weekly one or two days prior to treatment reapplication. Fruit yield (fruit number and weight) were determined at harvest. Fruit grade (size, internal and external color, flesh firmness and soluble sugar concentration) were determined in post-harvest. Analysis of variance and separation of means were conducted on the resulting data.

RESULTS AND DISCUSSION

The prevalent weed during the first month was after crop transplanting was purple nutsedge (*Cyperus rotundus*). Mulching significantly affected purple nutsedge density by one month after crop transplanting, which reached approximately 500 shoots per m^2 in non-mulched plots, and approximately 100 shoots in mulched plots (data not-shown).

Downy mildew (caused by *Pseudoperonospora cubensis*) was the prevalent disease throughout the season. Alternative pesticides had significant effects on the extent of damage caused by downy mildew on watermelon. The leaf area damaged by downy mildew by the fruit enlargement stage was as low as 22% and as high as 95% (data not shown). Insect and mite presence during the watermelon season was insignificant.

Watermelon yield was significantly higher in mulched plots than in non-mulched plots, due to weed suppression by the mulch. On average, in non-mulched plots, yield was approximately 55% lower than in mulched plots, regardless of the pesticide applied (data not shown).

Most pesticide treatments had no measurable impact on disease severity and on watermelon yield. However, the copper/Bt treatment resulted in lower yields than the check (which may be partially attributable to copper toxicity)(Figure 1). In contrast, the hydrogen dioxide treatment resulted in the highest yields among all the treatments. Aside from the hydrogen dioxide treatment, among the organic pesticide treatments resulting in the highest crop yields were *Bacillus pumilis* strain QST 2808, the garlic extract, and the *Melaleuca alternifolia* oil extract (Figure 1).

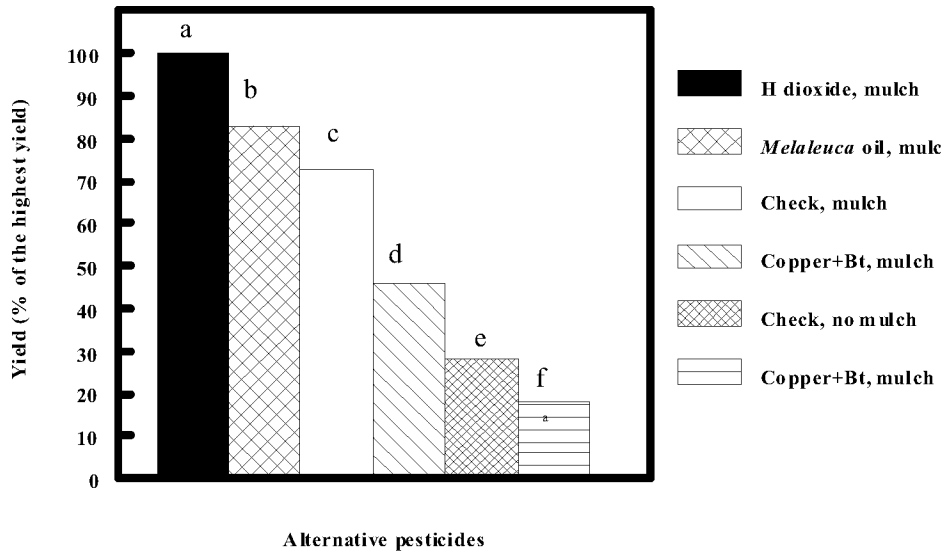

Figure 1. Effect of selected alternative pesticides and mulching on the yield of organically-grown watermelon in Lajas, Puerto Rico, in 2007.

In summary, in this research we found that (1) mulching significantly reduced purple nutsedge density and interference with organically-grown watermelon, and that (2) several alternative pesticides (mainly hydrogen dioxide) were efficacious reducing downy mildew severity and helped increase watermelon yield. In future studies, the best treatments from this research will be compared to other weed management practices and other alternative pesticides, to generate more information useful to organic and ecological watermelon growers in Puerto Rico and similar locations.

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