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Strip-tillage and Row Cover Use in Organically and Conventionally Grown Summer Squash

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Abstract

Growing summer squash in a more sustainable way involves multiple management practices. Cover crops often are incorporated into the soil before planting a cash crop. However, they can also be "rolled" and used as a ground cover throughout the growing season. The cash crop is planted in small, tilled strips within the residue. This "strip-tillage" technique provides a weed-controlling, moisture-retaining mat that does not need to be removed at the season's end, as plastic mulch does. The reduction in tillage can improve soil structure and health.

Keywords

Horticulture, Plant Pathology and Microbiology

Disciplines

Agricultural Science | Agriculture | Horticulture | Plant Pathology

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Introduction

Growing summer squash in a more sustainable way involves multiple management practices.

Cover crops often are incorporated into the soil before planting a cash crop. However, they can also be “rolled” and used as a ground cover throughout the growing season. The cash crop is planted in small, tilled strips within the residue. This “strip-tillage” technique provides a weed-controlling, moisture-retaining mat that does not need to be removed at the season’s end, as plastic mulch does. The reduction in tillage can improve soil structure and health.

Row covers are placed over seedlings at planting to provide a better microclimate and a physical barrier to pests. This can help young plants grow more rapidly and reduce insect-spread disease early in the season. Row covers must be removed before pollination.

This report focuses on the first-year results of a two-year, multi-state effort with University of Kentucky, Pennsylvania State University, and Ohio State University. The goal is to determine the effects of strip-tillage and row covers on squash production in terms of plant biomass, yield, weed pressure, and pest management.

Materials and Methods

A double split-plot, randomized block experimental design was used. Main plots of management method (organic vs. conventional) and tillage (strip-tillage in rolled rye vs. conventional till with plastic mulch) were replicated once each and row cover treatment (row cover vs. no row cover) was replicated four times within each of these variables for a total of 32 subplots (2 management methods × 2 tillage methods × 2 row cover treatments × 4 replications).

Fields were planted with 50 lb/acre of cereal rye in October 2012. In May 2013 (at rye anthesis), the rye in the conventional till with black plastic plots was mowed with a rotary mower and incorporated into the soil. In the strip-tillage plots, the rye was rolled using an I & J chevron-patterned back-mounted roller crimper. On June 3, 2013, a Hiniker strip-tiller was used to establish strips in the strip-tillage plots. A plastic mulch layer established raised beds and laid black plastic in the conventional till plots. The wet spring prevented earlier access to the field. On June 4, 26-day-old Lioness summer squash plants were transplanted. Plants with no row cover received either an imidichloprid drench or a foliar spray of Entrust with Cidetrack-D. Spunbond polypropylene row covers (Agribon-30) were applied to the row cover treatments at transplant. Row covers were removed from squash plants at the onset of female flowers on June 26.

Organic plots were managed using organic fertilizer and sprays, conventional plots were managed with conventional fertilizer and sprays. All plots were scouted weekly for pests and disease. Plots were sprayed for squash vine borer when a pheromone trap placed ~1,000 ft from the field collected adult moths. The threshold for squash bugs was one egg mass/plant. The threshold for cucumber beetles was an average of one insect/plant. Labeled pesticides were applied with backpack sprayers.

Squash were harvested from July 2 to August 16, 2013, twice weekly, and assessed for marketability.

Results and Discussion

*Plant biomass***.** Squash plant biomass was greater (P<0.0001) from black plastic conventionally tilled plots than from strip-tillage plots (Figure 1). Black plastic and tillage increase soil temperature, which enhances plant growth. The use of row covers on black plastic conventionally tilled plots did not affect plant biomass; however, row covers did result in greater plant biomass in strip-tillage treatments (P=0.02).

Weed biomass. Weed biomass tended to be greater in black plastic conventionally tilled treatments than in strip-tillage treatments (Figure 2). This reflects the weed growth in pathways between the plastic strips and the weed-suppressive nature of rolled rye.

Marketable yield. After accounting for management, black plastic conventionally tilled plots produced significantly more (P=0.002) squash by weight than strip-tillage treatments (Figures 3, 4). The difference between tillage treatments was greater in organic than conventional squash. Row cover usage did not affect squash yield weight per plot (P=0.55). Row covers increase air temperature; however, they cut down light transmission and could detrimentally affect pollination and fruit set.

Pest management. No differences in insects or diseases were observed among management, tillage, or row cover treatments. However, row covers reduced the number of spray applications by half (Table 1).

Conclusions

Black plastic performed better than strip-tillage. Row covers did not affect yield, but eliminated three pesticide applications.

Table 1. Pesticide applications used in 2013 based on pest or disease presence in squash. In each of the four columns, left is row cover (RC) treatment, right is no row cover. 2x signifies spray was applied twice.

Management	Organic				Conventional			
tillage	Strip		Plastic		Strip		Plastic	
Cucumber beetle	RC	Entrust Cidetrack-spray	RC	Entrust Cidetrack-spray	RC	Admire drench	RC	Admire drench
Squash Vine Borer	RC	2x Entrust Pyganic	RC	2x Entrust Pyganic	RC	2x Asana	RC	2x Asana
Squash bug	2x Entrust Pyganic Soap	2x Entrust Pyganic Soap	2x Entrust Pyganic Soap	2x Entrust Pyganic Soap	2x Pounce	2x Pounce	2x Pounce	2x Pounce
Powdery mildew	Neem oil	Neem oil	Neem oil	Neem oil	Equus Nova	Equus Nova	Equus Nova	Equus Nova
Applications	3	6	3	6	3	6	3	6

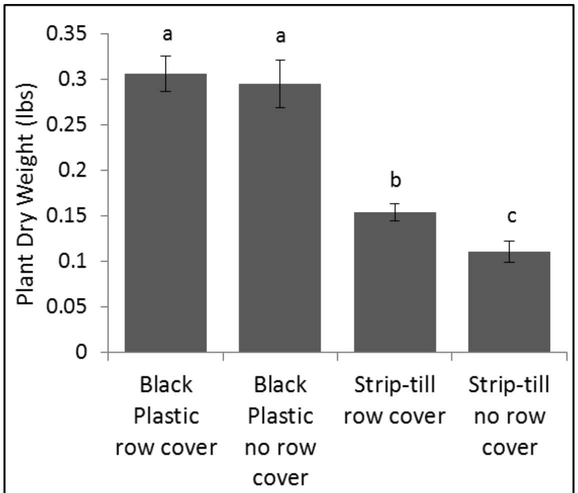

Fig 1: Squash plant biomass samples taken July 2, 2013. Three plants taken from each plot (including roots, excluding fruit) and oven dried. Conventional and organic combined. Mean separation at $P \leq 0.05$.

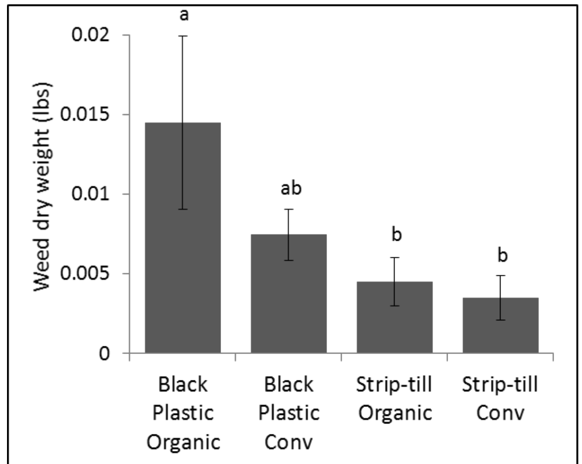

Fig 2: Squash weed biomass samples taken July 8, 2013. Average shoot and root dry weight from $0.25 m^2$, two samples per plot between rows. Row cover and no-row cover data are combined. Mean separation at $P \leq 0.05$.

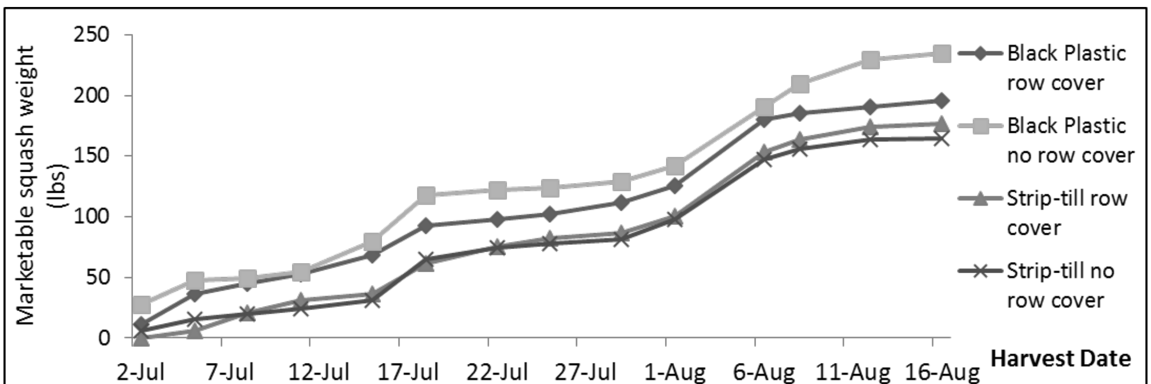

Fig 3: Convention squash. Cumulative marketable squash harvest weights per plot. Marketable squash were 6-9" long and without major defects.

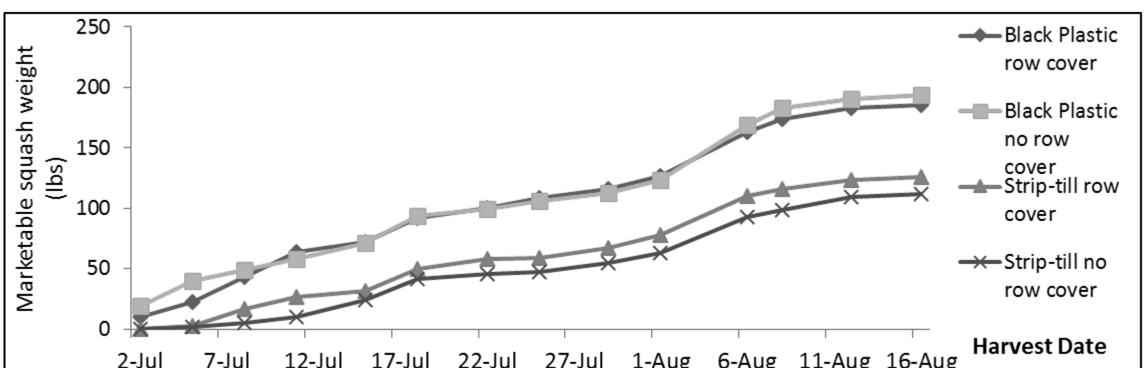

Fig 4: Organic squash. Cumulative marketable squash harvest weights per plot. Marketable squash were 6-9" long and without major defects.