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Scaling-up Row Covers for Management of Bacterial Wilt of Muskmelon

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Abstract
Row covers are an effective tool in protecting muskmelons from early season frosts, wind damage, fungal diseases, and cucumber beetles, which transmit bacterial wilt caused by Erwinia tracheiphila.

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Scaling-up Row Covers for Management of Bacterial Wilt of Muskmelon

RFR-A1207

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Introduction

Row covers are an effective tool in protecting muskmelons from early season frosts, wind damage, fungal diseases, and cucumber beetles, which transmit bacterial wilt caused by *Erwinia tracheiphila.*

Row covers are typically handled manually. They are deployed at transplanting and then retrieved at anthesis (the date where 50% of the plants have female flowers). Manual handling of row covers is so labor-intensive that their use has been largely restricted to small fields on small-scale farms.

ISU showed previously that a 10-day delay after anthesis can provide season-long protection against bacterial wilt, but these studies were done on small plots (30-ft-long row segments). What growers need is a way to scale-up the use of row covers to larger-size fields. This step will require methods to mechanize the handling of row covers.

Fortunately, technology now exists that could allow this mechanization. A hoop layer (Model 95 by Mechanical Transplanter Inc., Michigan) and a row cover retriever (Hi-Wer System by Frösö Trädgârd AB, Sweden) show potential to sharply reduce labor requirements and cut costs.

This report shows the first-year results of a two-year multi-state effort, with University of Kentucky, to optimize the benefits of row cover use for larger-scale muskmelon farmers. We examined 1) the impacts of row covers on insect and disease control and yield in organic and conventional crop management, and 2) the labor costs and feasibility of mechanical versus manual deployment and retrieval of row covers.

Materials and Methods

Main plots of management (conventional vs. organic) and row cover handling (mechanical vs. manual deployment and retrieval) were replicated once and row cover treatments were replicated 4 times within each variable for a total of 48 subplots (2 management methods × 2 row cover handling methods × 3 row cover treatments × 4 replications). A double split plot, randomized block experimental design was used (Figure 1).

Three row cover treatments were as follows: 1) no row covers (NRC) (control), 2) row covers deployed at transplanting and removed at anthesis (RCA), and 3) row covers deployed at transplanting and removed ten days after anthesis with ends opened at anthesis (RC10).

Conventional and transitioning organic land was used for the experimental plot at the Muscatine Island Research Farm in Fruitland, Iowa. On May 17, 32-day-old transplants of Athena muskmelon were planted 21 in. apart in black plastic with seven foot centers. Wood mulch was placed around the organic transplants immediately after planting for weed control. Spunbond polypropylene row covers (Agribon® AG-30) were installed the same day of transplant by either manual or mechanical deployment using the Model 95 tractor attachment. Row covers were removed manually or with the Hi-Wer System. Timing of each process was assessed on at least ten 100-ft-long plots (Table 1).

For conventionally managed plots, Curbit® and Sandea® were sprayed April 30 as a pre-emergent herbicide; Equus® (insecticide) and Cabrio® (fungicide) were sprayed on June 24. Weed management for both organic and conventionally managed field was continued between rows via manual hoeing. Organically certified insecticides Entrust® and Pyganic® and fungicides Cuprafix® and wettable sulfur were available for the organically managed plots; however, no pesticides were applied during the season.

Populations of striped and spotted cucumber beetles were monitored every two weeks from transplant to the beginning of harvest using visual scouting throughout the entire plot. Fruit set was assessed on the day that row covers were removed for treatment 3 (RC10). Bacterial wilt was assessed on the day before first harvest. Melons were harvested every other day for three weeks from July 12 to August 1, from a pre-determined 25-ft-long section within each subplot containing 15 plants. The weight and number of fruit harvested from each subplot were recorded.

Results and Discussion

Bacterial wilt. Muskmelons with bacterial wilt were first observed in the plots on June 20. Row cover removal timing was a significant factor in incidence of bacterial wilt ($P < 0.0001$). RC10 row cover treatments had significantly less wilt (Figure 2). There was a significant ($P = 0.0434$) spatial effect, where the western row of plots (column 1) had the highest level of bacterial wilt (22% of plants) and the eastern row (column 12) had the lowest level of bacterial wilt (3%) (Figure 1). Therefore, row cover deployment timing was not assessed using bacterial wilt percentages.

Fruit set. Opening the ends of the row covers allowed pollination of the flowers within about 20 feet from the ends only. Extending the row cover period for 10 days also shielded the plants from the harsh environment. Thus delay of row cover removal both delayed and increased ($P < 0.05$) fruit set (Figure 3). Fruit set did not differ among row cover deployment or management methods.

Yield. Total harvest weight differed ($P < 0.0001$) with row cover treatment. In comparison with NRC, RC10 had 25 percent more total yield and average fruit size was 13 ounces larger. Delay in fruit maturity in the 10-day delay removal (RC10) led to problems with increased insect pest pressure, however. Insect damage (direct feeding injury to the rind) reduced the quality of late-maturing fruit. As a result, our 2013 trials will incorporate better late-season cucumber beetle control. The total weight of melons from each 25-ft section (15 plants) did not differ significantly ($P > 0.05$) between row cover deployment method and management method.

Row cover deployment. The hoop layer reduced the deployment of 100 ft of row cover by 4 minutes, compared with manual deployment. The time savings obtained by mechanically laying the hoops was offset by troubleshooting (occasionally manually securing the ends of the wire hoops into the soil) and the need for two people to operate the tractor and place the wires in the hoop laying apparatus (Table 1). However, the edges were more easily and quickly secured in the soil because the Model 95 dug a ditch along the edge of the plastic, which was easily filled when burying the row cover edges.

Row cover retrieval. The Hi-Wer system reduced the retrieval of each 100-ft-long row cover by 10 minutes. Pulling the row cover edges from the soil was more difficult for the mechanical deployment treatment because they had been more securely buried (Table 1). Winding the row cover onto the spool was fast and without complication. Pre-formed (hoop-shaped) wires used in the manual methods were more difficult to organize and store than the self-straightening hoop wires used in the mechanical hoop layer. A plastic bale cover was placed over the spool for winter protection, whereas the row covers from the manual retrieval method required storage in barrels to protect them from animal damage.

Although additional improvements in the apparatus are needed before row covers can be easily mechanically deployed, mechanization showed great potential to help producers realize the benefits of row covers for melons. This study also supported previous findings that a 10 day delay offers extended protection from bacterial wilt, but opening ends does not allow for pollination beyond 20 ft from the opening.

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Table 1. Number of people and labor minutes required for each 100 ft of row cover deployment and removal using manual vs. mechanical means.

		Manual		Mechanical	
Task	**Duty**	**Number of people**	**Labor (min:sec)**	**Number of people**	**Labor (min:sec)**
Deployment	Erect hoops[a]	1	8:00	3[b]	8:00
	Position fabric[c]	6	4:00	6	4:00
	Secure edges[d]	2	6:00	2	2:00
Subtotal			18:00		14:00
Removal	Pull edges[d]	1	1:45	1	2:00
	Roll fabric	2	4:00	2	2:00
	Store fabric	2	6:00	1	0:15
	Remove hoops[e]	1	2:00	1	1:45
	Store hoops	1	4:00	1	1:00
Subtotal			17:45		7:00
Total			35:45		21:00

[a]Mechanical layer uses recoiling wire and manual methods uses preformed hoops.
[b]Requires driver, hoop placer, and hoop replacer (varied problems of hoops not being securely placed in soil).
[c]On the day of experiment high winds (~40 mph), it required a large number of people to keep row covers from blowing away during installation. Typically requires 3 or 4 people.
[d]Ditch made along edge of plastic by hoop layer made securing easier and pulling edges more difficult.
[e]~ 25 hoops/100 ft.

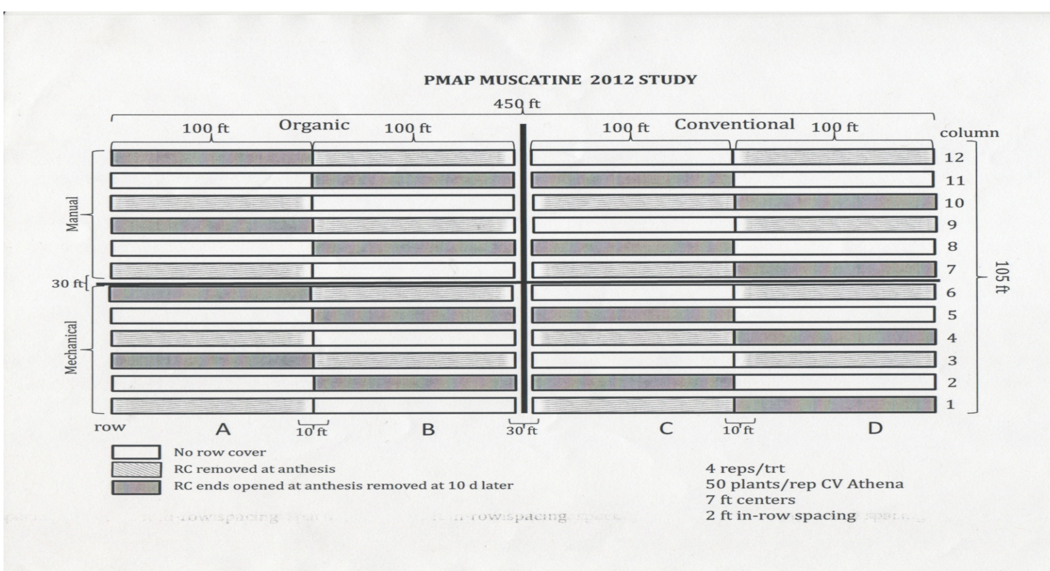

Figure 1. Plot map comparing row cover removal treatments in organic vs. conventional management using manual vs. mechanical row cover deployment and retrieval.

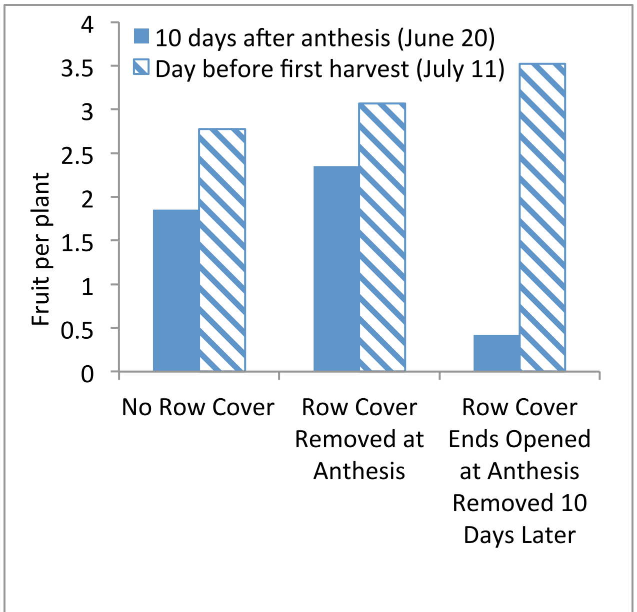

Figure 2. Percent bacterial wilt by row cover treatments two days before harvest.

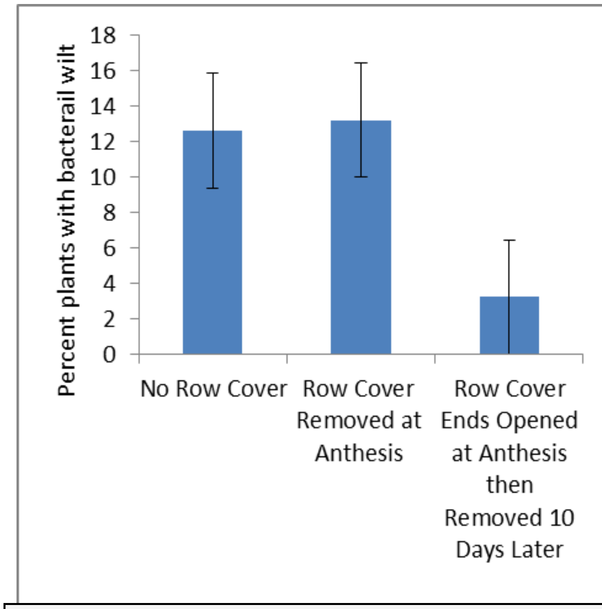

Figure 3. Mean number of fruit per plant of three row cover treatments immediately after last row cover removal (June 20) and one day before first harvest (July 11).

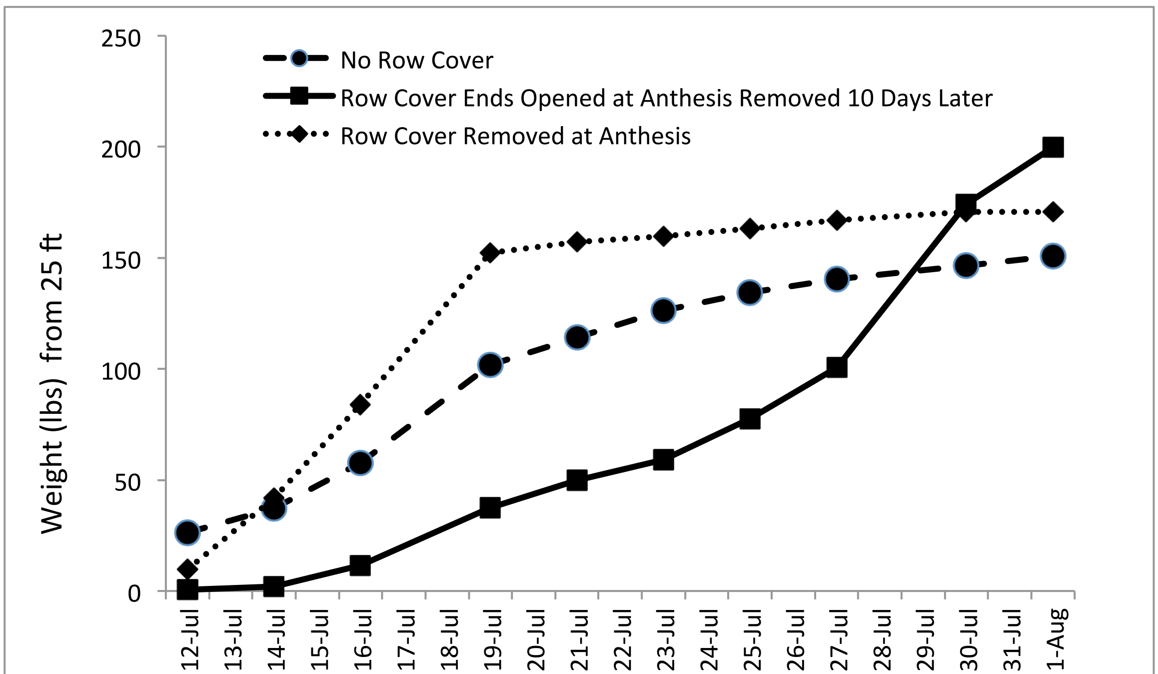

Figure 4. Cumulative weight over time of melons harvested from 25-ft sections with three row cover treatments.