# Improving Row Cover Systems for Organic Management of Bacterial Wilt in Muskmelon and Squash – Year 2

**RFR-A1712**

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## Introduction

Bacterial wilt causes major losses in organic cucurbit crops (muskmelon, cucumber) throughout Iowa and the eastern United States. Striped and spotted cucumber beetles transmit the disease. Disease-causing bacteria (*Erwinia tracheiphila*) survive in beetle hindguts and enter plants when their infected frass touches feeding wounds or floral nectaries. After infection, plants wilt and die within two weeks.

To prevent beetles from feeding on cucurbits and spreading bacterial wilt, organic growers often cover plants with spunbond polypropylene row covers (Agribon™, Reemay®) in the first several weeks after transplanting. The row covers are suspended over low wire hoops (1.5 ft tall), and edges are secured using soil. When female flowers develop, row covers are removed to allow for pollination. From then until harvest, cucumber beetles are controlled with insecticides.

Despite their widespread use, the traditional "low tunnel" systems have practical limitations. The need to remove spunbond row covers for pollination and to avoid overheating plants limits the benefits to a short window of time early in the growing season. The organic insecticides used to control beetles after removing row covers are weak and easily washed away by rain. They require frequent reapplication, costing growers precious time and money.

The objective of this study is to redesign row cover systems to achieve full-season protection against bacterial wilt and minimize dependence on insecticides. A new nylon mesh row cover material (ProtekNet) and tall hoop supports (3.5 ft) made of 1-in.diameter galvanized conduit pipe were used to test two slightly different "mesotunnel" systems. The mesh holes of ProtekNet allow ventilation to prevent overheating, yet are small enough to exclude cucumber beetles. Additionally, fungicides can be sprayed through it.

## Materials and Methods

Experimental design was a latin square, tested on both acorn squash (cv. Table Ace) and muskmelon (cv. Athena). Treatments included the standard-practice low tunnel-spunbond row covers on wire hoops removed at flowering (ARA); part-season ProtekNet (PSP) mesotunnel on conduit hoops removed at flowering and replaced two weeks later; full-season ProtekNet (FSP) mesotunnel on conduit hoops with bumble bees placed under row covers at flowering; and a no-row cover (NRC) control. Subplots were three rows wide and 30 ft long, with four replications of each treatment.

Ten-ft lengths of conduit pipe were bent using a QuickHoops™ 4 ft x 4 ft Low Tunnel Bender (Johnny's Selected Seeds). ProtekNet mesh size was .07 x .04 in. Bumble bee hives (Class C Natupol) from Koppert Biological were protected from rain and sun by placing them on several bricks and then covering the bee box with ventilated plastic laundry baskets.

On April 11, 2017, plots were rough tilled. Compost was applied to plots and tilled May 9. On May 15, organic fertilizer was broadcast in plant rows, then drip tape and black plastic mulch were laid. One week later, alleys were cultivated and corn stover was laid to a 6-in. depth. Two-week-old muskmelon and acorn squash seedlings were hardened off under ProtekNet May 22 and transplanted May 31. Plants were spaced 2 ft apart with 6 ft between row centers. Row cover treatments were applied on the same date as transplanting, and rock bags were used to secure row cover edges to the soil.

Insecticides were applied to uncovered subplots based on results of insect scouting (Table 1). Scouting for cucumber beetles and squash bugs occurred twice weekly until plants developed six leaves, then once weekly. Three counts from a 0.5- by 0.5-meter area in the center row of each subplot were averaged for each treatment. Economic threshold for cucumber beetles was 0.5 beetle/sample area until plants developed six leaves, then one beetle/sample area. Economic threshold for squash bugs was one egg mass, nymph, or adult/sample area for the entire season. A pheromone trap was placed at plant height and scouted weekly for squash vine borer moths. Bt was sprayed if a single moth was found. To control cucumber beetles and squash bugs, a tank mix of kaolin clay, pyrethrins, and neem oil was sprayed.

Bacterial wilt incidence was recorded weekly in the center row of all subplots, with final incidence recorded immediately before harvest (Table 1). A DNA-based assay called PCR was used to confirm presence of *E. tracheiphila* in samples of wilting plants. Marketable and non-marketable fruit were harvested from the center row of each subplot, then counted and weighed (Table 1).

## Results and Discussion

*Muskmelon*. Full-season ProtekNet (FSP) and part-season ProtekNet (PSP) mesotunnels yielded a significantly higher mean weight of marketable muskmelon than the non-covered treatment, but there was no significant treatment effect for the mean number of marketable fruit. On average, FSP had fewer non-marketable fruit than the low tunnel (ARA). FSP also had a lower mean weight of non-marketable fruit compared with PSP and ARA. In a year with minimal disease pressure from bacterial wilt, there was no treatment effect for bacterial wilt incidence, and there was none or very low incidence for all treatments. FSP required zero insecticide applications, PSP and ARA required one, and NRC required six.

*Acorn squash.* The full-season (FSP) and part-season (PSP) ProtekNet mesotunnels had a higher mean number and weight of marketable squash than the non-covered treatment (NRC), but did not outperform the low tunnels (ARA). FSP required zero insecticide applications, while PSP, ARA, and NRC required 3, 5, and 9 applications, respectively. There was no treatment effect for non-marketable fruit, and there was zero bacterial wilt incidence in all subplots.

Although there was no statistically significant improvement in the number or weight of marketable fruit between mesotunnels and low tunnels, the full-season mesotunnel nearly doubled the mean number and weight of muskmelon and squash compared with the low tunnel. Considering that zero insecticide sprays were required to achieve a higher yield, the full-season ProtekNet mesotunnel showed promise for growers hoping to reduce insecticide use while maximizing marketable yield.


## Acknowledgements

Thank you to the Gleason lab and Horticulture Research Station crew for their outstanding help and great attitudes.

**Table 1. Bacterial wilt incidence, number of insecticide sprays, and yield data for four organic row cover treatments in muskmelon (cv. Athena) and acorn squash (cv. Table Ace) in 2017 at ISU Horticultural Research Station, Ames, IA.**

| | | | Insecticide sprays[c] | | Marketable yield[d] | | Non-marketable yield[e] | |
|---|---|---|---|---|---|---|---|---|
| **Crop** | **Treatment[a]** | **Mean % bacterial wilt incidence[b]** | **Cucumber beetle or squash bug** | **Squash vine borer** | **Mean number** | **Mean weight** | **Mean number** | **Mean weight** |
| Muskmelon | FSP | 0 a | 0 | n/a | 56.3 a | 313.9 b | 45.0 a | 128.9 a |
| | PSP | 0 a | 1 | n/a | 59.3 a | 285.7 b | 81.8 ab | 282.6 b |
| | ARA | 0 a | 1 | n/a | 31.5 a | 142.5 ab | 93.0 b | 330.6 b |
| | NRC | 5 a | 6 | n/a | 21.0 a | 105.0 a | 80.3 ab | 238.7 ab |
| Acorn squash | FSP | 0 a | 0 | 0 | 96.8 b | 152.1 b | 93.8 a | 132.4 a |
| | PSP | 0 a | 2 | 1 | 84.0 b | 127.5 b | 109.5 a | 157.1 a |
| | ARA | 0 a | 3 | 2 | 49.5 ab | 74.6 ab | 92.3 a | 131.1 a |
| | NRC | 0 a | 7 | 2 | 20.3 a | 30.2 a | 66.0 a | 85.4 a |

[a]Treatments were full-season ProtekNet (FSP), part-season ProtekNet removed for two weeks at the start of flowering (PSP), Agribon removed at flowering (ARA), and no row cover (NRC). Treatments were arranged in a latin square design with four subplots/treatment. Muskmelon and acorn squash data were analyzed separately.

[b]Means in a column followed by the same letter do not differ significantly ($P < 0.05$) based on Tukey's honestly significant difference critical values.

[c]Values represent total number of sprays for each pest group. Uncovered treatments were scouted for cucumber beetles and squash bugs and sprayed with a combination of kaolin clay, neem oil, and pyrethrins upon reaching economic threshold for either or both pests. A pheromone trap was checked weekly for squash vine borer moths, and Bt was sprayed on the base of each plant in all uncovered squash subplots when reaching economic threshold.

[d]Values are averages of number or weight of fruit/90-row-ft. Weight is measured in pounds.

[e]Values are treatment averages of number or weight of culls/90-row-ft. Includes fruit culled due to any combination of insect damage, disease, poor pollination, small size, sunscald, rodent damage, irregular netting, and other deformities.