Improving Row Cover Systems for Organic Management of Insect Pests and Diseases in Muskmelon and Squash – Year 3

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Introduction

Three key pests make organic production of muskmelon and squash extremely difficult in Iowa. Striped and spotted cucumber beetles kill squash and melon seedlings from feeding damage, as does vector bacterial wilt in muskmelon. Squash bug causes feeding damage in squash and vectors cucurbit yellow vine disease. Squash vine borer kills squash when larvae destructively burrow through stems.

Low tunnels and insecticides are commonly used to manage these pests. Low tunnels consist of a spunbond polypropylene row cover (Agribon™) suspended over freshly planted seedlings on 1.5-ft-tall wire hoops. The edges of the row cover fabric are secured to the ground using soil or bags of rock or sand, and the low tunnels protect plants from pests. The row cover is permanently removed when female flowers appear so pollinators can access flowers and to avoid overheating plants. After row cover fabric is removed, insecticides are used to manage pests.

Although this system is widely used, it has practical limitations. The row cover fabric is not durable and often requires annual replacement. Furthermore, the benefit as a highly effective pest barrier is limited to a short window of time early in the growing season. The organic insecticides used after the row cover is removed are ineffective and require frequent reapplication.

The aim of this study is to redesign row cover systems to achieve full-season protection against pests and diseases 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 pests. Additionally, fungicides can be sprayed through the mesh holes.

Materials and Methods

Experimental design was a randomized complete block, tested on 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; part-season ProtekNet mesotunnel on conduit hoops removed at flowering and replaced two weeks later; full-season ProtekNet mesotunnel on conduit hoops with bumble bee hives placed under row covers at flowering; and a no-row cover control. Subplots were three rows wide and 30 ft long, with four replications of each treatment.

Ten-foot 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 (Startup) from Koppert Biological were placed on bricks and covered with ventilated plastic laundry baskets for protection from rain and sun.

Plots were rough-tilled April 20, and compost was applied and tilled-in April 26. On May 18, organic fertilizer was broadcast in plant rows, and drip tape and black plastic mulch were laid on 6-ft row centers. On the same date, 3-week-old muskmelon and acorn squash seedlings were hardened off under ProtekNet. On May 23, alleys were cultivated and corn stover was laid to a 6-in. depth. On the same date, seedlings were transplanted with 2-ft. in-row spacing. Row cover treatments were applied on the same date as transplanting, and rock bags were used to secure row cover edges to the soil.

Organic 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 thereafter. Three counts from a 0.5 x 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 tank mix of kaolin clay, pyrethrins, and neem oil was sprayed for cucumber beetles and squash bugs. Squash vine borer moths were scouted weekly using a pheromone trap placed at plant height. The threshold for a Bt spray was one squash vine borer moth.

Incidence of disease and pest injury was recorded weekly in the center row of all subplots, with final incidence recorded immediately before harvest (Table 1). All fruit were harvested from the center row of each subplot, then counted, weighed, and graded (Table 1).

Results and Discussion

Muskmelon. Full-season ProtekNet (FSP) and part-season ProtekNet (PSP) produced nearly double the mean weight and number of marketable fruit compared with low tunnels (ARA) and significantly outperformed the non-covered control (NRC). There was no treatment effect for the mean weight of non-marketable fruit, but the mean number of non-marketable fruit was significantly lower in both mesotunnels than in NRC. FSP had no incidence of disease or pest injury. FSP and PSP had significantly less incidence than NRC but did not outperform ARA. NRC required three insecticide applications while the other treatments required zero.

Acorn squash. The mean number and weight of marketable fruit was highest in full-season mesotunnels (FSP). There was no treatment effect for the mean number or weight of non-marketable fruit. Incidence of disease and pest injury was the lowest in FSP and FSP also required no insecticides. Insecticide applications totaled 4, 7, and 11 for PSP, ARA, and NRC, respectively.

In conclusion, full-season mesotunnels resulted in a large increase in marketable yield of both crops compared with low-tunnel or non-covered treatments. The relative contributions of more efficient pollination and more effective pest and disease control under these full-season tunnels still is to be determined.

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Table 1. Disease and pest injury 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 2018 at Iowa State University Horticultural Research Station, Ames, Iowa.

			No. of insecticide sprays[c]		Marketable yield[d]		Non-marketable yield[e]	
Crop	**Treatment[a]**	**Mean % incidence of disease and pest injury[b]**	**Cucumber beetle or squash bug**	**Squash vine borer**	**Mean number**	**Mean weight**	**Mean number**	**Mean weight**
Muskmelon	FSP	0 a	0	n/a	72.8 a	396.9 a	109.5 a	325.7 a
	PSP	5 a	0	n/a	59.3 a	345.7 a	83.3 a	180.4 a
	ARA	37 ab	0	n/a	34.5 ab	179.5 ab	138.8 ab	239.1 a
	NRC	70 b	3	n/a	17.3 b	84.6 b	200.3 b	257.7 a
Acorn squash	FSP	10 a	0	0	114.0 a	188.9 a	70.5 a	79.1 a
	PSP	68 b	2	2	39.8 b	70.1 b	53.3 a	53.1 a
	ARA	66 b	5	2	42.0 b	69.8 b	67.5 a	67.3 a
	NRC	87 b	9	2	15.0 b	24.5 b	54.8 a	46.7 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 randomized complete block 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 in all uncovered squash subplots upon reaching economic threshold.

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

[e]Values are averages of number or weight of fruit/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.