Optimizing Pollination of Muskmelon in Organic Mesotunnel Systems

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Introduction

Bacterial wilt disease of cucurbits, caused by *Erwinia tracheiphila*, is spread by spotted and striped cucumber beetles. Organic muskmelon growers are especially vulnerable to bacterial wilt because they lack reliable control measures. A new production system called mesotunnels (3.5-ft-tall, nylon-mesh-covered tunnels) has shown promising results in small-plot organic trials, with yield increases of 100-450 percent in muskmelon and acorn squash compared with "low tunnels" (1.5 ft tall and covered with spunbond polypropylene) or non-covered plots. Mesotunnels are more durable, breathable, and spacious than low tunnels, and provide protection during most or all of the growing season. Key challenges for mesotunnel systems are how to optimize pollination and control of foliar fungal diseases in organic production. The objective of this 4-yr study (2019 was year 1) is to optimize the use of bees for muskmelon pollination under mesotunnels in organic production.

Materials and Methods

Muskmelon (cv. Athena) seedlings were transplanted into 150-ft-long, 3-row subplots on 6-ft row spacing in a randomized complete block design. The three treatments were: 1) one bumble bee hive (Koppert, Inc.)/subplot; 2) two bumble bee hives/subplot with the ProtekNet® remaining in place all season, and 3) natural pollination (ProtekNet® was removed when female flowers appeared and replaced two weeks later). Visual observations of bee activity were made twice a day between 8 a.m. and 11 a.m. on three days/week during two weeks after female flowers appeared. Disease incidence and severity were scored from the center row of each subplot and recorded weekly. Number and weight of marketable fruit data were recorded at harvest on the center row of each 3-row subplot.

Results and Discussion

Preliminary results show natural pollination (with ProtekNet removed during bloom) resulted in about the same marketable yield as permanently covered mesotunnels that had one or two purchased hives/subplot (Table 1). The natural-pollination treatment had the most flower visits by bees and other insects, followed by the two-bumble bee-hive treatment, and then the one-bumble bee-hive treatment (Table 2). No bacterial wilt symptoms were seen during this trial. A fungal disease, Alternaria leaf spot, was observed late in the season. Severity of this disease was low, but disease incidence and severity were higher in the natural-pollination treatment than in permanently covered mesotunnels (Table 3). The final result for this trial—in the absence of cucumber beetle pressure and bacterial wilt, full-season mesotunnels did not offer an advantage over removal of covers for two weeks during bloom. These results also show more bee visits to flowers did not result in significant yield increase.

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Table 1. Effects of bumblebee stocking density on marketable yield of muskmelons under mesotunnels.

Treatment	Marketable yield[1]	Non-marketable yield[1]	Total yield[1]
One bumble bee hive[3]	9.7[2]	0.2	9.9
On-off-on[4]	9.7	0.1	9.8
Two bumble bee hives[5]	10.8	0.2	11.0
LSD (0.05)[6]	0.17	0.5	0.8

[1]Fruit weight in lb/plant.
[2]Pounds of fresh fruits at harvest/individual plant.
[3]One bumble bee hive was placed at the center of the subplot during bloom.
[4]Natural pollination where the ProtekNet® was removed when female flowers appeared and replaced two weeks later.
[5]Two bumble bee hives were placed 40 ft from each end of the mesotunnel during bloom.
[6]Means were separated using Tukey LSD.

Table 2. Effects of bumblebee population on bee pollination activity on muskmelon flowers under mesotunnels.

Treatment	Bumble bees[1]	Other bees[2]	Other insects[3]
One bumble bee hive[5]	4.0[4]	0.08	1.4
Two bumble bee hives[6]	6.6	0.08	1.4
On-off-on[7]	1.9	13.80	2.6
LSD (0.05)[8]	0.13	0.0	0.0

[1]Bumble bees observed in flowers/9 sq ft zone in 45 seconds period.
[2]Other bee species observed in flowers/9 sq ft zone in 45 seconds period.
[3]Other insects, not bees observed/9 sq ft zone in 45 seconds period.
[4]Number of bees or insects observed.
[5]One bumble bee hive was placed at the center of the subplot during bloom.
[6]Two bumble bee hives were placed at 40 ft from each end of the mesotunnel during bloom.
[7]Natural pollination where the ProtekNet® was removed when female flowers appeared and replaced two weeks later.
[8]Means were separated using Tukey LSD.

Table 3. Effects of mesotunnels on incidence and severity of Alternaria leaf spot fungal disease.

Treatment	Incidence[1]	Severity[2]
One bee hive[5]	0.39[3]	0.39[4]
Two bee hives[6]	0.39	0.39
On-off-on[7]	0.89	0.92
LSD (0.05)[8]	0.0	0.0

[1]Number of plants with disease symptoms/plot.
[2]Score of disease severity/9 sq ft zone on a scale of 0 to 5 (0 = 0; 1 = <1%; 2 = 1-5%; 3 = 5 – 15%; 4 = 15 – 30% and 5= >30%).
[3]Number of plants with disease symptoms.
[4]Score on a 0 to 5 scale.
[5]One bumble bee hive was placed at the center of the subplot during bloom.
[6]Two bumble bee hives were placed 40 ft from each end of the mesotunnel during bloom.
[7]Natural pollination where the ProtekNet® was removed when female flowers appeared and replaced two weeks later.
[8]Means were separated using Tukey LSD.