Comparing Between-Row Mulches in Organic Muskmelon and Squash – Year 3

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Introduction

Organic matter mulches are an important multi-purpose tool in organic agriculture. These suppress weeds by competing for sunlight, moisture, and nutrients, and improve soil health by reducing erosion and increasing soil organic matter. For crops such as muskmelon and squash, mulches protect fruit from moist soil that contributes to fruit rot.

The goal of this trial is to compare the effects of different mulch types on weed suppression, soil organic matter, and yield in organic muskmelon and squash.

Materials and Methods

Experimental design was a randomized complete block, tested on muskmelon (cv. Athena) and acorn squash (cv. Table Ace). Treatments included living mulch (organic annual ryegrass plus medium red clover), crop-residue mulch (chopped organic corn stover), and bare soil. Mulch treatments were applied to soil alleys between plant rows. Subplots were three rows wide and 30 ft long, with four replications of each treatment.

Muskmelon and squash fields were rough tilled April 20, 2018, and compost was applied and incorporated April 26. On May 8, organic fertilizer was hand broadcast in plant rows and drip tape and black plastic mulch were laid with 6-ft row centers. On the same date, annual rye and red clover seed were broadcast and lightly buried using a rake. Solid-state irrigation was placed in the field and used May 9 to ensure germination of the rye and red clover. Stale seed bedding was practiced in the bare ground and crop-residue mulch subplots by cultivating alleys one week after laying plastic mulch. Corn stover was applied to a 6-in. depth in the crop-residue mulch subplots after cultivation.

Three-week-old muskmelon and acorn squash seedlings were hardened off under nylon mesh row covers (ProtekNet) May 18 and hand-transplanted May 22 with 2-ft in-row spacing. All subplots were covered with ProtekNet to prevent damage from pests and disease. Row cover fabric was supported by 3.5-ft tall metal hoops. Hoops were made by bending 10-ft lengths of 1-in. diameter conduit pipe with a QuickHoops™ 4 ft x 4 ft Low Tunnel Bender (Johnny's Selected Seeds). For natural pollination, row covers were removed for two weeks at the first sighting of female flowers. Row covers were reapplied after two weeks and remained in place until harvest began.

During the period when plants were uncovered, insecticides were applied for cucumber beetles, squash bug, and squash vine borer, based on results of insect scouting. Three plants in the center row of each subplot were scouted for cucumber beetles and squash bug once weekly when plants were uncovered. The economic threshold was one beetle or one squash bug egg mass, nymph, or adult/plant. A tank mix of pyrethrins, kaolin clay, and neem oil was sprayed if economic threshold was reached. For detection of squash vine borers, a pheromone trap was placed at plant height and scouted weekly. Bacillus thuringiensis was applied to squash plants only if a single squash vine borer moth was found in the field or in the pheromone trap.

Weeding was done in all treatments during the period when plants were uncovered. Hand weeding was done in the living mulch and crop-residue mulch treatments, while hoes were used in the bare ground subplots.

Weed sampling was done in all subplots after harvesting. Grass and broadleaf weeds were counted and collected from a randomly selected 2-ft x 3-ft area of each alley. Weeds were cut at the soil line if they could not be easily pulled with roots intact. Samples were dried in brown paper bags and weighed (Table 1).

To quantify soil reactive carbon levels in each treatment, soil samples were collected after harvesting by mixing four 6-in.-deep soil cores from both alleys of every subplot (Table 1). Samples were submitted to Cornell Soil Health Lab (G01 Bradfield Hall, 306 Tower Rd, Ithaca, NY 14853). Reactive carbon (POXC) is a type of soil carbon that is most readily broken down. It is the best measure to determine short-term changes in soil carbon content caused by soil management practices such as mulching.

Yield data were recorded from all 15 plants in the center row of each subplot. All marketable and non-marketable fruits were counted, graded, and weighed (Table 2).

Results and Discussion

The living mulch germinated successfully at the start of the season, but was quickly outcompeted by weeds. Weeding live mulch subplots during the non-covered period was extremely difficult due to inability to easily distinguish between the ryegrass mulch and grass weeds.

Muskmelon. Living mulch resulted in a significantly greater mean number and mean dry weight of weeds than bare ground and corn stover. There was no treatment effect on the mean amount of reactive carbon in soil or the mean weight or number of marketable fruit. There was no treatment effect on the mean number of non-marketable fruit, but bare ground yielded the highest mean weight of non-marketable fruit.

Acorn squash. Results for weed pressure and POXC in squash were consistent with findings in muskmelon. Living mulch resulted in a significantly greater mean number and mean dry weight of weeds than bare ground and corn stover. There was no treatment effect on the mean amount of reactive carbon in soil. There was no treatment effect on the mean number or weight of both marketable and non-marketable fruit.

Although chopped corn stover did not statistically outperform bare ground for weed control, numerically it led to a much smaller mean number and weight of weeds. Stale seed bedding at the start of the season as well as weeding during the non-covered period may be crucial to the success of these systems. Due to time constraints, stale seed bedding was not practiced in the living mulch subplots to provide the rye and red clover adequate time to establish prior to transplanting. Weeding was easiest in the chopped corn stover and extremely difficult in the living mulch. Living mulch may be more effective on land with a lower weed seed bank.

Acknowledgements

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Table 1. Weed pressure and soil reactive carbon in three mulch treatments in muskmelon (cv. Athena) and acorn squash (cv. Table Ace) in 2018 at Iowa State University Horticultural Research Station, Ames, IA.

Field	Treatment[a]	Broadleaf and grass weeds[b] Mean number	Broadleaf and grass weeds[b] Mean dry weight	Reactive carbon in soil[c]
Muskmelon	Bare ground	47.5 a	148.4 a	606.9 a
	Corn stover	1.1 a	26.9 a	641.0 a
	Live mulch	334.8 b	852.3 b	580.1 a
Acorn squash	Bare ground	64.4 a	66.1 a	477.8 a
	Corn stover	1.8 a	1.7 a	537.8 a
	Live mulch	721.0 b	1219.9 b	466.0 a

[a]The live mulch treatment consisted of rye and red clover seeded at rates of 48 lb/acre and 12 lb/acre, respectively. Treatments were arranged in a randomized complete block with four replications/treatment. ProtekNet row cover was applied to all subplots at transplant, removed at the start of female flowering, and then replaced after two weeks. Muskmelon and acorn squash data were analyzed separately.
[b]Values are treatment averages of number or weight of weeds/square meter (m^2). Weight is expressed in grams. Means in a column followed by the same letter do not differ significantly ($P < .05$) based on Tukey's honestly significant difference critical values.
[c]Reactive carbon (milligrams of permanganate oxidizable carbon per kilogram of soil).

Table 2. Yield data in three mulch treatments in muskmelon (cv. Athena) and acorn squash (cv. Table Ace) in 2018 at Iowa State University Horticultural Research Station, Ames, IA.

Field	Treatment[a]	Marketable yield[b] Mean number	Marketable yield[b] Mean weight (lb)	Non-marketable yield[c] Mean number	Non-marketable yield[c] Mean weight (lb)
Muskmelon	Bare ground	44.3 a	256.7 a	56.3 a	260.6 a
	Corn stover	29.3 a	178.5 a	57.0 a	218.1 ab
	Live mulch	23.3 a	124.2 a	47.3 a	162.0 b
Acorn squash	Bare ground	67.5 a	120.6 a	68.3 a	67.8 a
	Corn stover	72.8 a	132.6 a	60.8 a	67.7 a
	Live mulch	57.0 a	101.2 a	43.5 a	48.5 a

[a]The live mulch treatment consisted of rye and red clover seeded at rates of 48 lb/acre and 12 lb/acre, respectively. Treatments were arranged in a randomized complete block with four replications/treatment. ProtekNet row cover was applied to all subplots at transplant, removed at the start of female flowering, and then replaced after two weeks. Muskmelon and acorn squash data were analyzed separately.
[b,c]Values are treatment averages of number or weight per 90 row-ft. Weight is expressed in pounds. Non-marketable yield includes all fruit culled due to improper size or ripeness, rot, sun scald, or damage caused by rodents, insects, and disease. Means in a column followed by the same letter do not differ significantly ($P < .05$) based on Tukey's honestly significant difference critical values.