



Cornell University

IOWA STATE
UNIVERSITY

University of
Kentucky

OREI - Resilient Systems for Sustainable Management of Cucurbit Crops

Virtual Meeting #2

October 6th, 2020

Summary, Questions & Answers

SUMMARY OF 2020 SEASON RESULTS

In the meeting: Mark Gleason, Gwyn Beattie, Ajay Nair, Wendong Zhang, Nieyan Cheng, Heather Dantzker, Kephias Mphande, Sharon Badilla, Jose Gonzalez, Sarah Pethybridge, Kellie Damman, Sean Murphy, Mark Williams, Ric Bessin, Robby Brockman, Katie Fiske, Ford Waterstrat (Advisory Panel (AP)-KY), Jody Fisher (AP-IA), Crystal Courtens (AP-NY), John Bell (AP-KY), Gary Huber (AP-IA), Ben Saunders (AP-IA), David Stern (AP-NY), Kristine Lang (Coop-IA), Elisabeth Hodgdon (AP-NY).

Keywords: Cucumber beetle (CB), squash bug (SB), powdery mildew (PM), downy mildew (DM), bacterial wilt (BW), Cucumber Yellow Vine Disease (CYVD).

Digest

Experiments and results varied in each of the three states. IA and KY were able to run replicated experiments (with 4 replications per treatment), while NY established a non-replicated demonstration trial.

University of Kentucky (KY).

Acorn squash. Pollination trial. 120-ft-long triple row mesotunnels were installed to compare: full-season tunnels with purchased bumble bee hives added (“full-season”); complete removal of row covers for 2 weeks during bloom (“on-off-on”); removal of the ends of the row covers for 2 weeks during bloom (“open ends”); and permanent removal of the row covers when bloom began (“on-off”). Marketable yield was significantly higher in the open-ends treatment than the other treatments. **Pest and disease control trial.** To assess the impact of the mesotunnels and organic fungicide spraying on powdery mildew (PM), an experiment comparing “on-off-on” mesotunnels vs no tunnels, and sprayed vs unsprayed 30-ft-long triple row plots. Both mesotunnels and fungicide spraying significantly suppressed PM, and combining both practices gave the most suppression. The mesotunnel treatments had significantly higher yields in comparison with the no-tunnel treatments. **Weed management trial.** 4 weed-management strategies were compared in 30-ft-long triple row plots with on-off-on mesotunnels: teff grass at 3 different rates (12, 24, or 36 lb/A); and buckwheat (seeded at 90 lb/A), while using black plastic on the crop rows. Marketable yield did not differ significantly between treatments, but weed suppression was more effective for buckwheat and the two higher teff rates than for the lowest teff rate.

Muskmelon. Pollination trial. 30-ft-long triple row mesotunnels were installed to compare the same treatments previously described in the acorn squash-pollination trial. The “full season” treatment had significantly higher yield in comparison to “on-off-on” and “on-off” treatments, and “open-ends” treatment was intermediate.

Iowa State University (IA).

Acorn squash. Pollination trial. On triple-row, 150-foot-long mesotunnels 3 treatments were compared: “full-season”, “on-off-on”, and “open-ends”. The “on-off-on” and “open-ends” treatments depended on natural pollinators and the “full-season” treatment used bumblebees (1 hive per mesotunnel). Marketable yield was highest in the “on-off-on” treatment, lowest in the “full-season” treatment, and intermediate in the “open-ends” treatment. **Weed management trial.** 4 treatments were compared using 40-foot-long, triple row, full-season covered mesotunnels: polyethylene landscape fabric; teff grass as living mulch at 4 lb/A; and teff grass as living mulch at 8 lb/A; and bare ground (control). The landscape fabric treatment had the highest marketable fruit yield, with no significant differences with teff grass at 4 lb/A, while teff grass at 8 lb/A and bare ground treatments had the lowest yield and differed significantly from the landscape fabric treatment. However, weeds were controlled effectively by teff grass as well as by landscape fabric.

Muskmelon. Pollination trial. The treatments were the same as described above in the -ISU- acorn squash pollination trial. “Full-season” treatment had the highest yield, which differed significantly from the “on-off-on” treatment, while “open-ends” was intermediate. **Weed management trial.** The treatments were the same as described above in the -ISU- acorn squash weed management trial. Landscape fabric treatment was about twice as high in marketable fruit as the other treatments, although teff suppressed weeds almost as well as the landscape fabric did.

Cornell (NY). Due to restrictions consequence of the pandemic lockdown rules, NY was able to do only a nonreplicated demonstration trial, with both muskmelon and acorn squash. Landscape fabric was used between rows, and black plastic in the crop rows to control weeds. Two plots were established, one with row cover netting (“on-off-on”, with a purchased bumblebee hive inside) and the other two non-covered.

Acorn squash. Marketable yield was similar for the two treatments. Cucumber beetle and squash bug population was much higher in the non-covered plot, whereas aphid population built up under the mesotunnels by the end of the season. DM, PM, and CYVD severity, although low, was much higher in the non-covered than the mesotunnel plot.

Muskmelon. The number of marketable fruits in the covered plot was nearly 3 times higher than for the non-covered plot. Severity of BW, was much lower in the mesotunnel than the control. Although overall incidence was low, presence of PM and DM were higher in the covered plot.

Introduction to the meeting by Mark Gleason (PI):

-Each participant was self-introduced and Mark pinpointed the agenda for the meeting: 2020 season data results from each of the 3 states involved (KY, NY, and IA), and a period of open discussion at the end of the presentations.

-Mark invited the participants to use the Zoom chat feature or just say out loud any comment or question.

University of Kentucky trials – Acorn squash

Goal: optimize the mesotunnel system to find the best way to manage diseases (particularly powdery mildew) insect pests, weeds, and improve pollination.

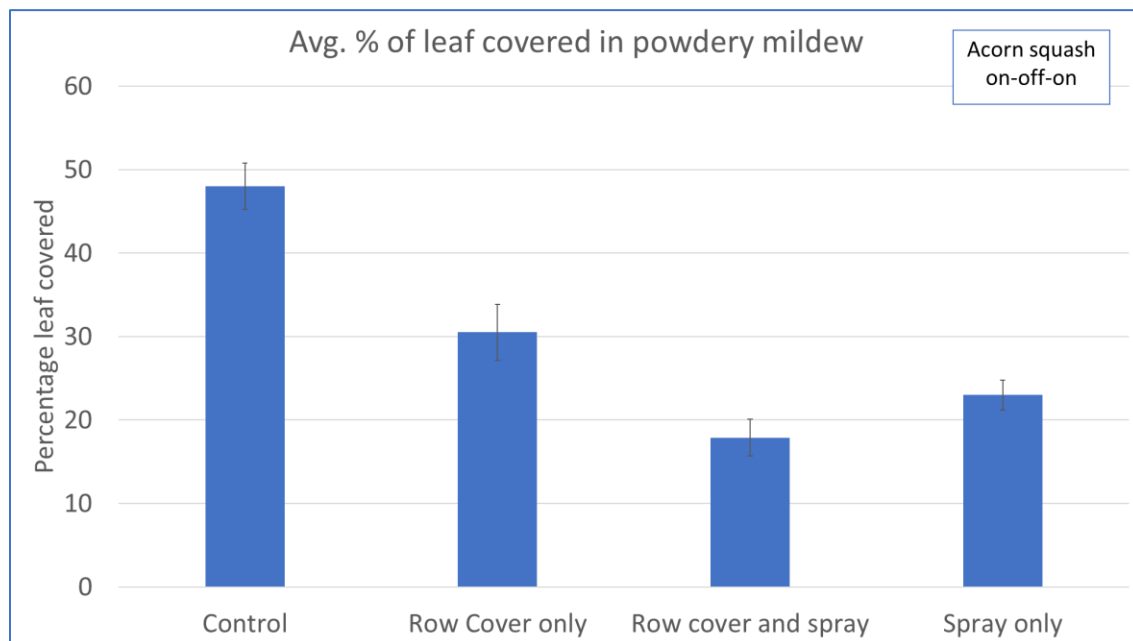
Katie Fiske:

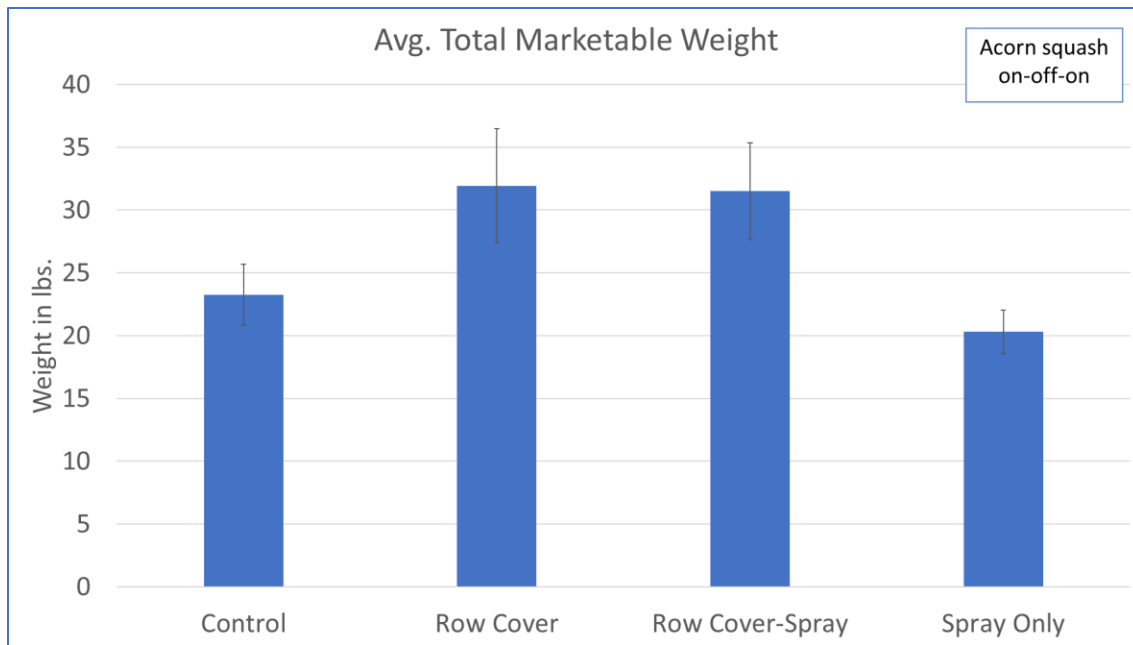
-All (row cover) treatments were under on-off-on pollination system, taking into consideration that the use of bee hives might not be an economic-viable option for farmers.

-Crop: Acorn squash.

1) Pest and Disease Control Experiment:

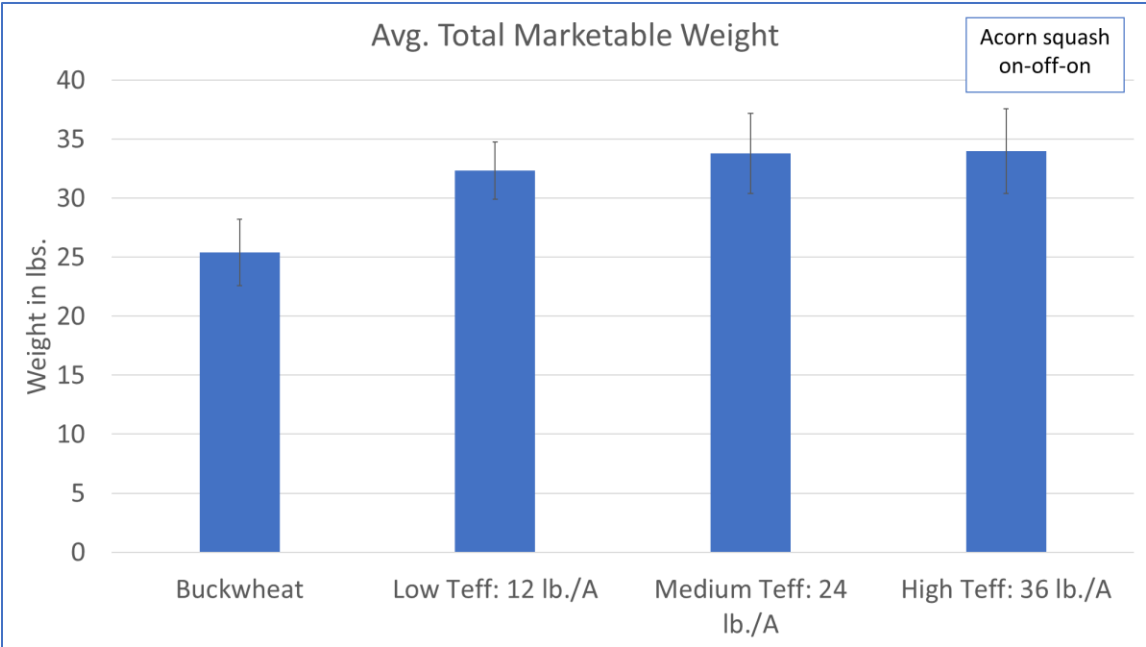
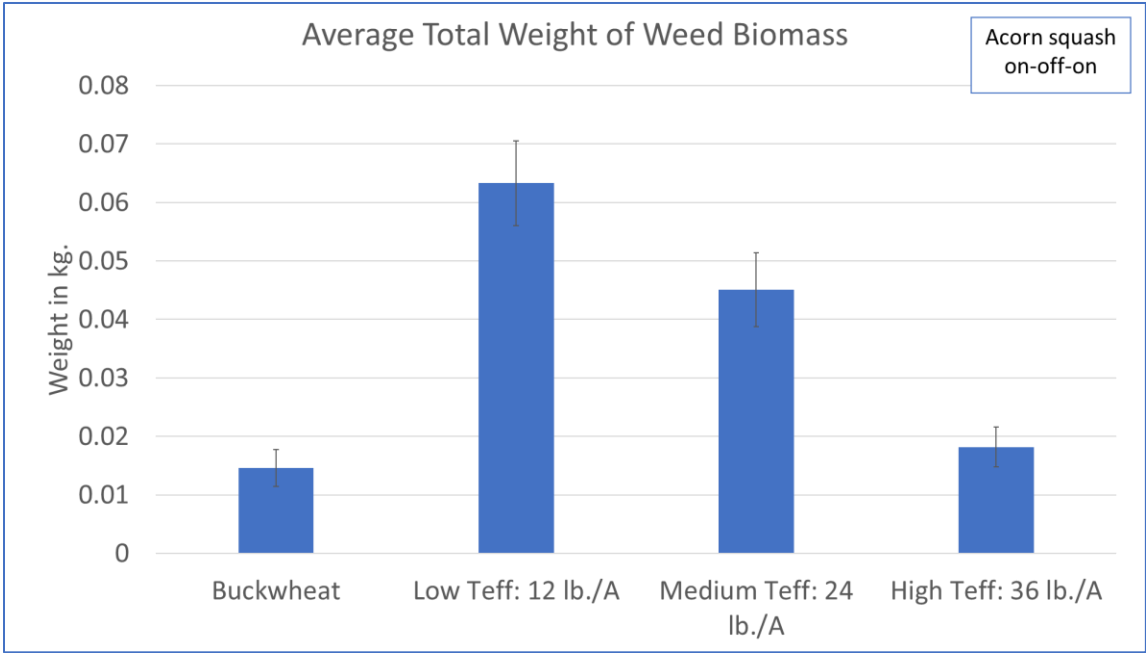
- a. Goal: determine how row covers impact pest and diseases and whether their use increases or decreases the need for spraying.
- b. Treatments: a) no row-covers and no spray, b) row cover only, c) row cover and spray, d) no row cover and spray only.
- c. Main results:
 - i. Powdery Mildew severity was bigger under the “control treatment”, followed by “row cover only”, and “spray only”. Row cover and spray treatment had the lowest % of leaf covered in powdery mildew.
 - ii. Average total marketable weight: Row cover and Row Cover-Spray treatments had the highest weights, suggesting that only by using row covers (without spraying) we could achieve very similar results to using row covers and spraying.





2) Cover Crop Experiment:

- a. Goal: evaluate the impact of cover crops on yield and weeds control.
- b. Treatments: Buckwheat (90 lb./A), Low-Teff (12 lb./A), Medium-Teff (24 lb./A), High-Teff (36 lb./A). Note: Teff seeds were coated.
- c. Weeds biomass samples were taken using a 1'x3' quadrant: 3 samples per furrow, 6 samples per plot.
- d. Main results:
 - i. Total weeds biomass: buckwheat and high-teff were better in suppressing weeds than the mid-teff and low-teff treatments.
 - ii. Not much differences were observed within treatments, but buckwheat yield tends to be lower probably caused by shading.
 - iii. Next year plans: using "John Bell" hoop system: a mower can be fitted in-between the furrows; and including weed fabric as an extra treatment.





"John Bell" hoop system.

Q&A:

Q: How many sprays and what spray?

A: Sprayed twice with Nordox fungicide.

Comment: We have used Timorex Act (tea tree botanical extract) in the past with good results.
(grower, KY)

Q: What did you do with the buckwheat at the end? Does it go to seed?

A: We didn't mow it, so yes, it went to seed.

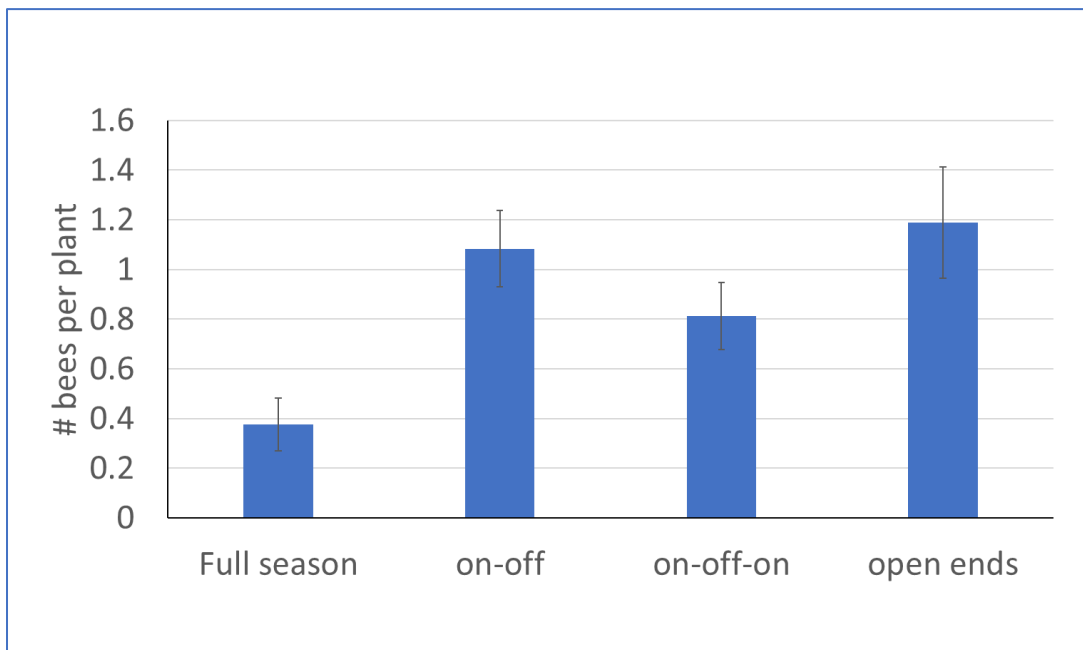
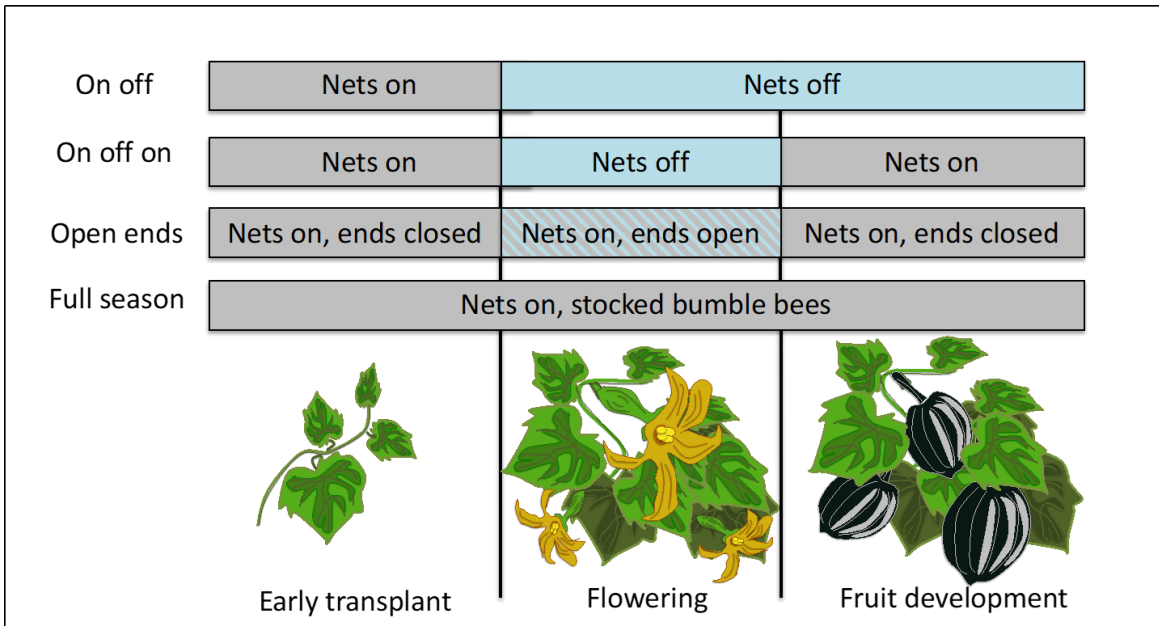
Q (grower): Are you spraying through the covering?

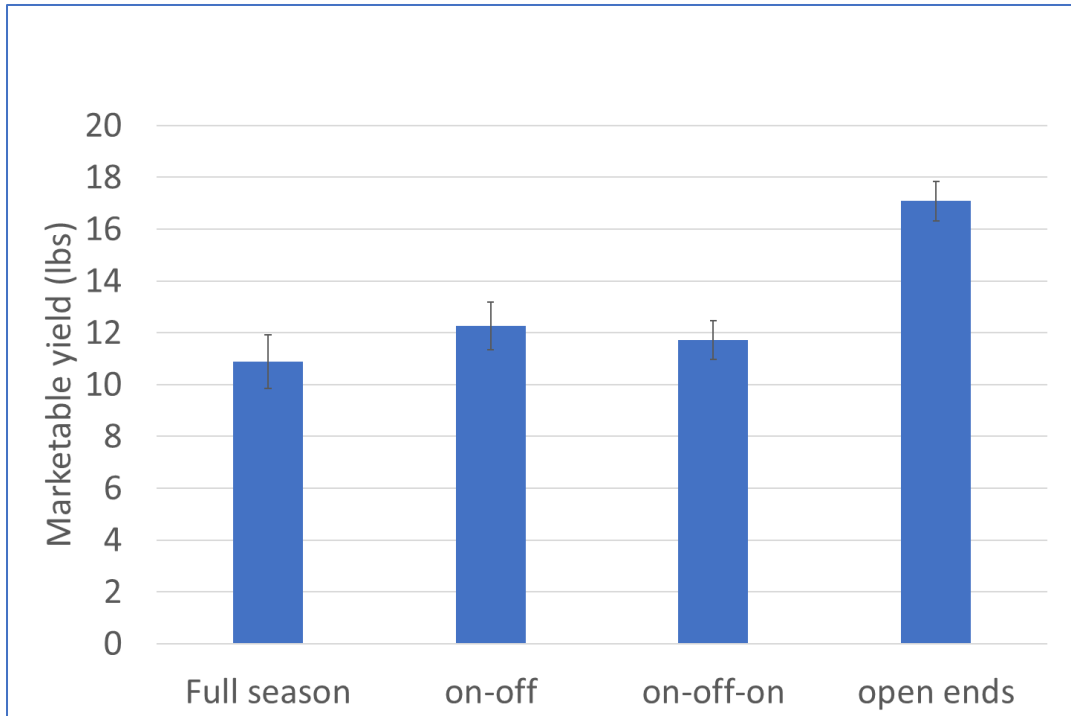
A: Yes, we sprayed through the net. In the past, they have tested for coverage. It is slightly reduced, but it is supposed to be getting through the net.

University of Kentucky trials – muskmelon

Robby Brockman:

- 1) **Pollination studies** in acorn squash and (Athena) muskmelon:
 - a. Treatments (in both crops): “on-off”, “on-off-on”, “open ends”, “full season”.
 - i. Row covers were installed and taken off when plants started to flower (except in full-season treatment).
 - ii. On-off-on was off during 3 weeks.
 - iii. In open ends treatment the ends were open during 3 weeks also.
 - iv. Full season row cover treatment had 1 bumble bee hive stocked inside.
 - v. Plots were 120 ft long in acorn squash and 30 ft long in melon.
 - b. Main results in acorn squash:
 - i. Higher bee abundance in open-ends and on-off treatments, followed by on-off-on.
 - ii. Open ends treatment had higher yields than the other 3 treatments. Probably due to the interaction of the row cover on the entire season, plus good pollination.
 - iii. Yield data is a 3-plants sample.
 - c. Main results in muskmelon:
 - i. Full-season treatment had the higher yield, followed by open-ends.
 - ii. Bee activity was higher in these two treatments.
 - iii. Differences in yield between the two crops could be due to smaller plots in the muskmelon trial, thereby achieving better yield in full-season treatment in muskmelon when comparing to what’s observed in acorn squash.
 - iv. Yield data is lb. per meter squared.
 - v. Yield data will be normalized to an acre.





Q&A:

Q: is “bumble bee” treatment label the same as “full-season”?

A: Yes. Full-season row cover with 1 bumble bee hive.

Q: With on-off-on, how difficult is it to put the coverings back on? Especially after the plants grow big? Is that a challenge?

A: Yes, we had that challenge, especially with the larger plot size. With acorn squash, yes, a challenge. Less so with the muskmelons. We had pulled the nets to the side and acorn squash were all over the vines, not easy.

Idea: Would net removal and replacement be easier on long plots if nets were rolled to ends rather than sides?

Cornell University – demonstration trials (muskmelon & acorn squash)

Kellie Damman (Cornell/NY):

-Cornell was shut down because of the pandemic so they were not able to conduct any larger replicated trials this year.



-A small demonstration trial was set up with 'Honey Bear' acorn squash and 'Athena' muskmelon.

-Four plots (50'x26') were installed.

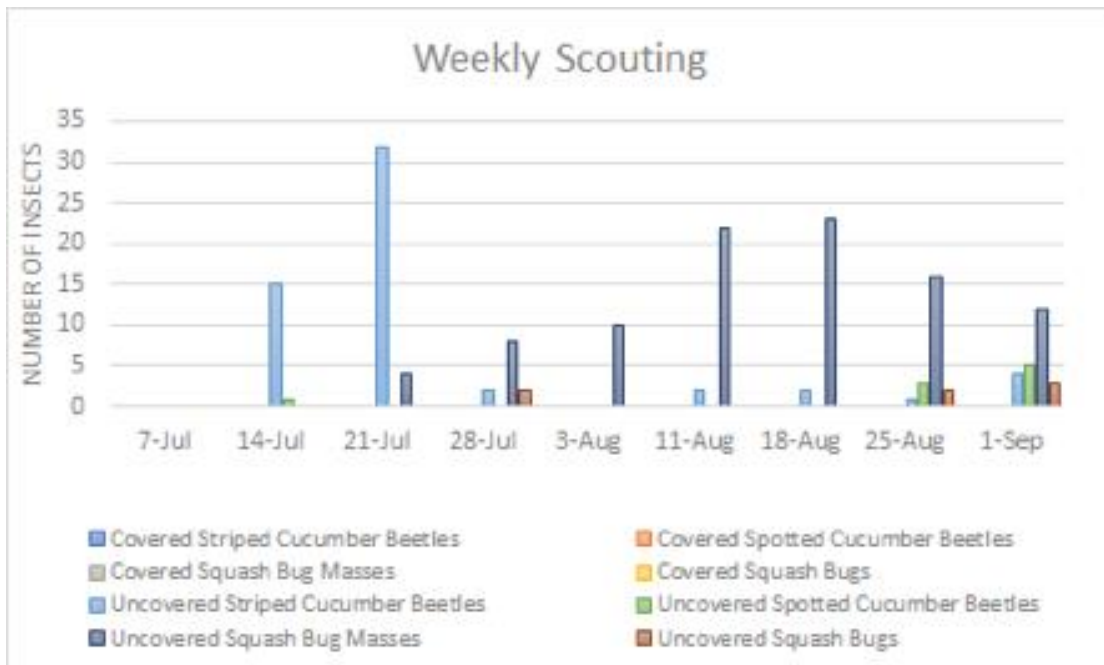
-Treatments: Mesotunnel and non-covered.

-Harvest and disease data were taken from all 17 plants in the center rows.

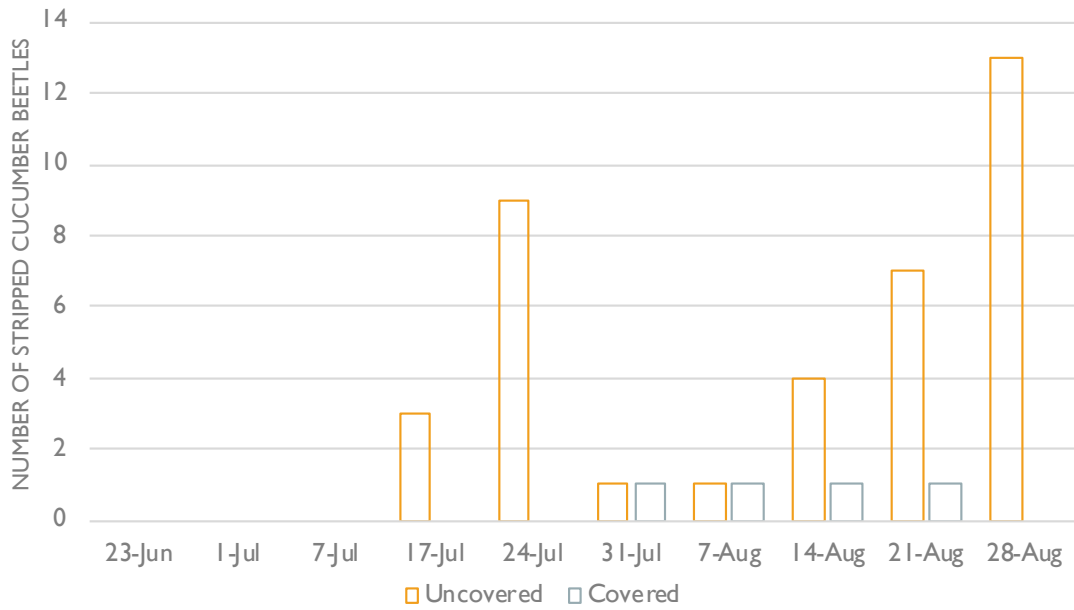
-Insect pest data was taken from 9 plants in the center rows.

1) Acorn squash insect pest results:

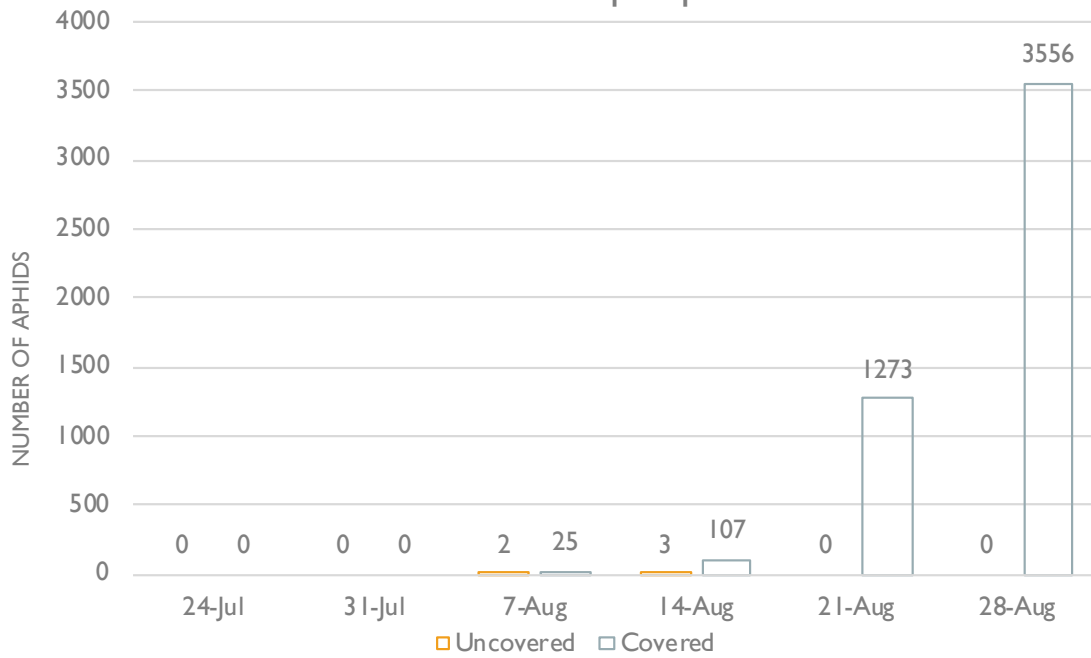
- a. Main pests observed were cucumber beetles and squash bugs.
- b. Weekly scouting: two peaks observed for cucumber beetle population: one at mid-July and the second at the end of August.
- c. A peak of squash bug egg masses was observed in mid-August.
- d. Insect trap data: same two peaks observed in cucumber beetle population.
 - i. A spike of aphid population was observed toward the end of the season (starting August 21st).
 1. Many plants collapsed due to the high aphid population.



Cucumber beetles on insect traps

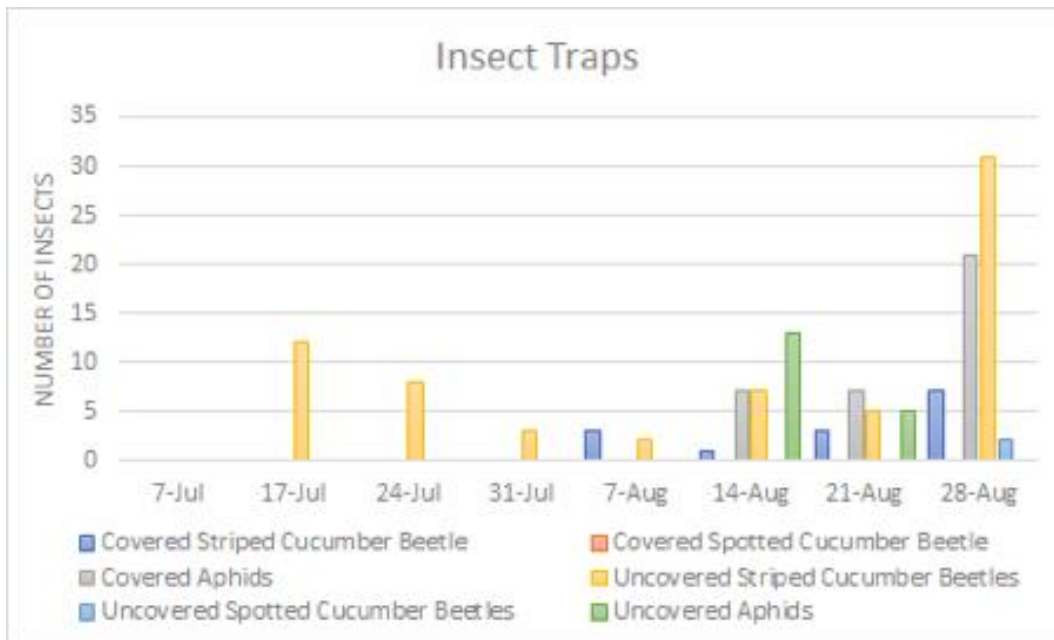
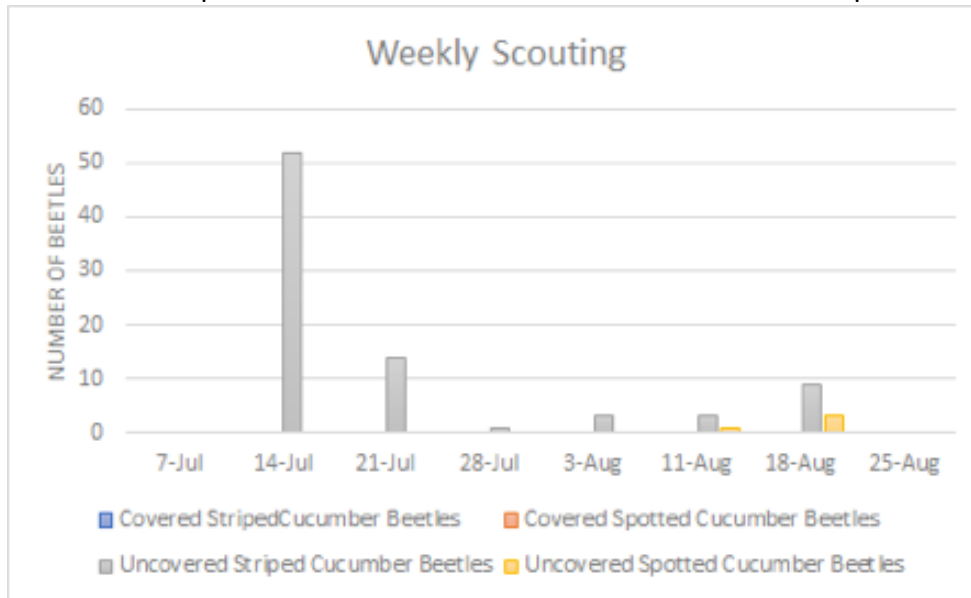


Insect traps: aphids



2) Muskmelon insect pest results:

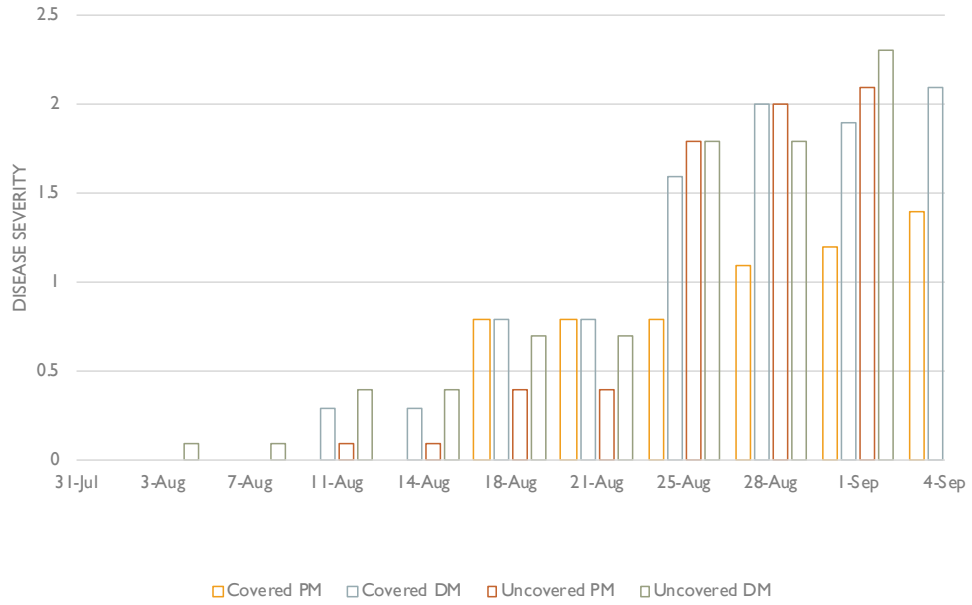
a. Same two peaks of cucumber beetles observed as in acorn squash.



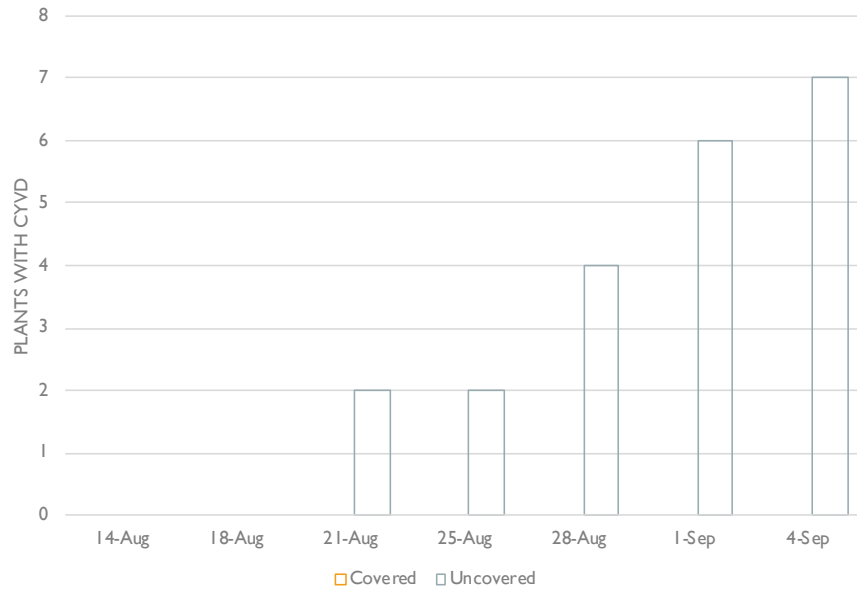
3) Acorn squash disease results:

- a. Downy mildew came in late in the season: hot and dry summer. No severe damage appeared.
- b. Spray regimen: Kocide 3000 Organic, Cueva, and Double Nickel spray rotation.
- c. Cucurbit yellow vine disease (CYVD): an exponential increase was observed starting mid-August in the non-covered treatment.

Powdery and Downy Mildew Over Time

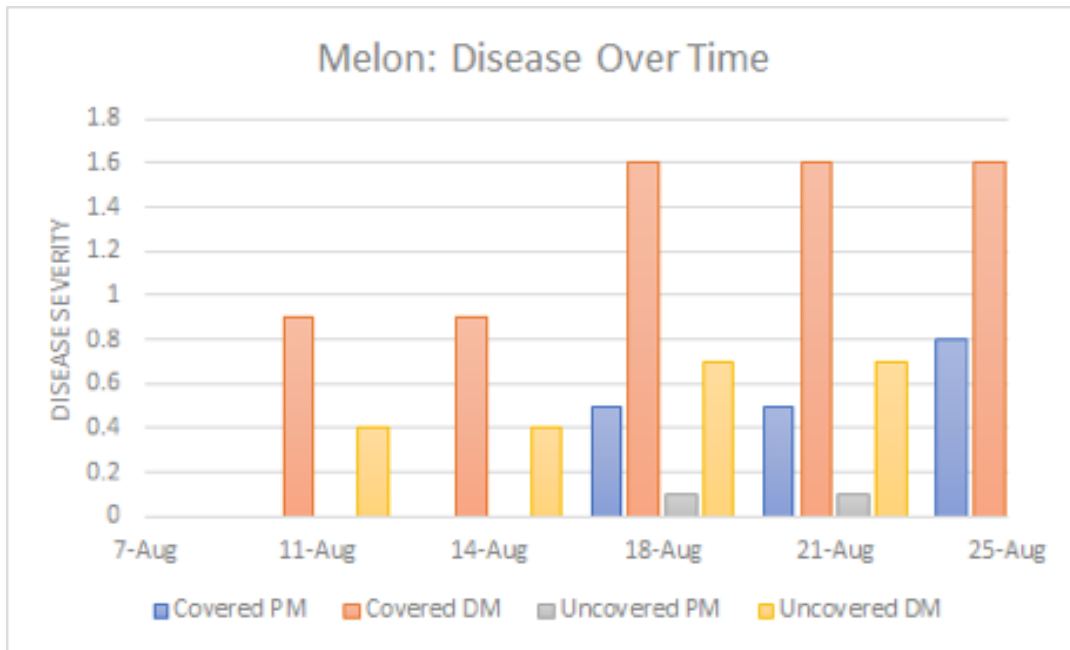


Squash: Cucurbit Yellow Vine Disease

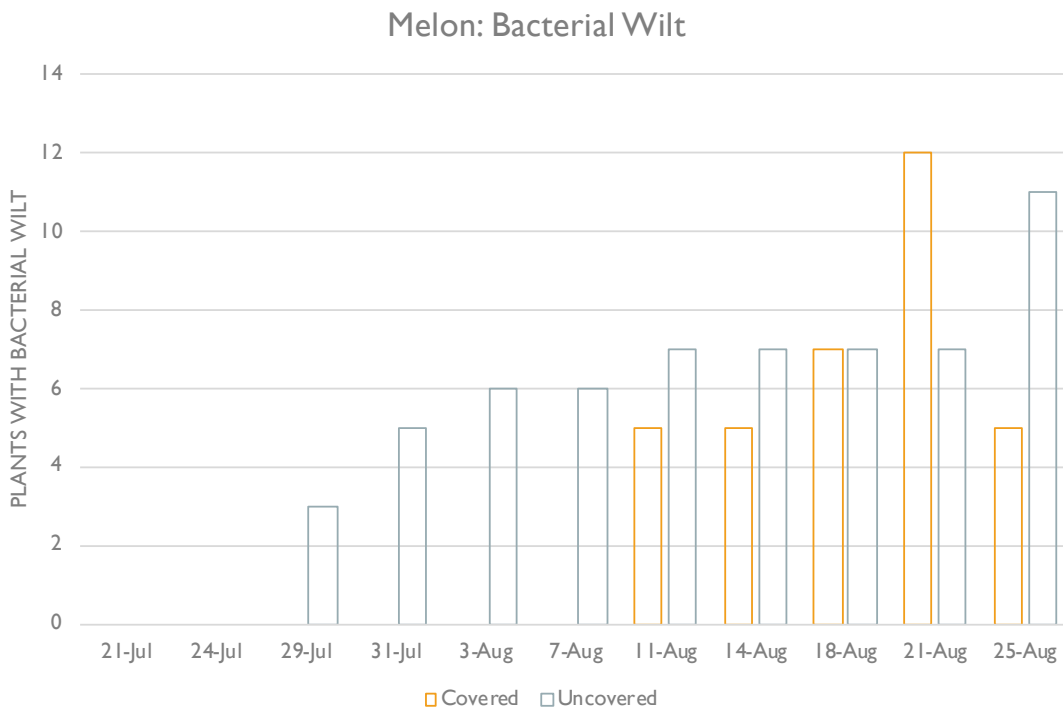


- 4) Muskmelon disease results:
 - a. Similar story as with acorn squash.
 - i. More downy mildew was observed in the non-covered treatment than in the mesotunnel treatment, however.

- ii. Bacterial wilt was observed in both treatments toward the end of the season, especially in the non-covered treatment.



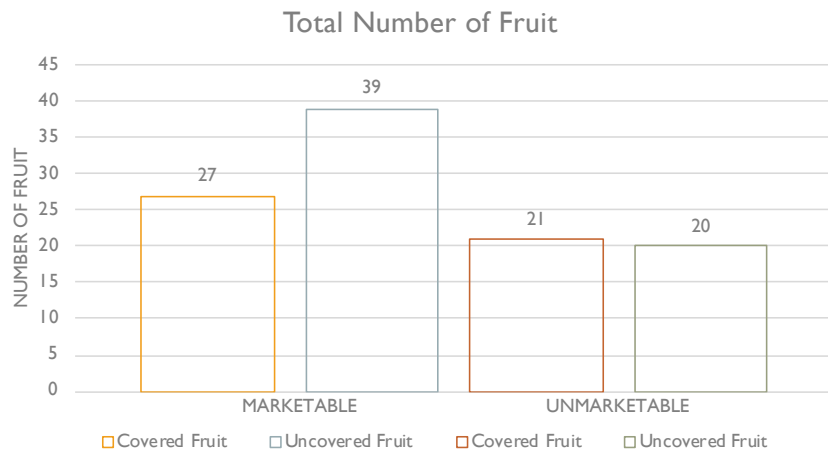
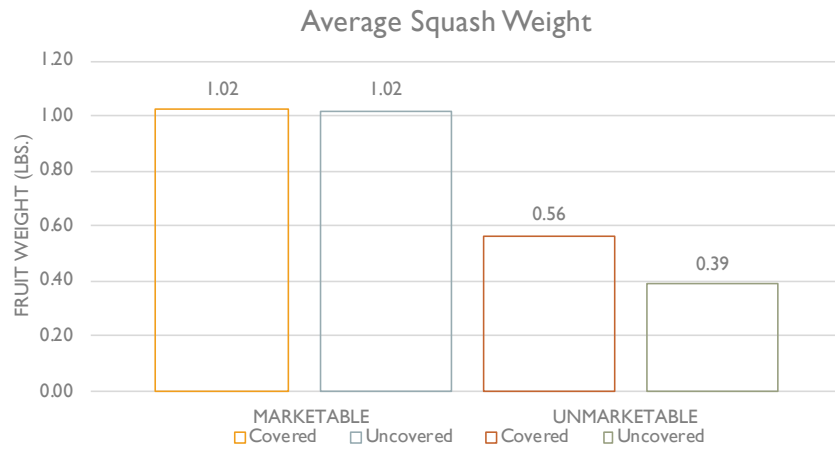
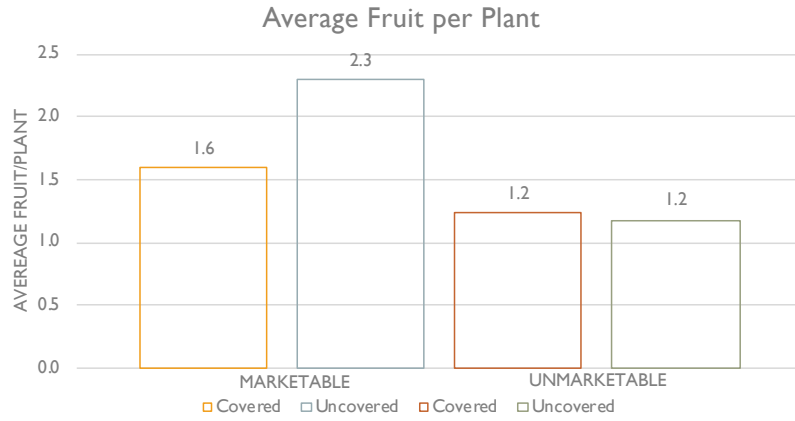
Downy mildew data.

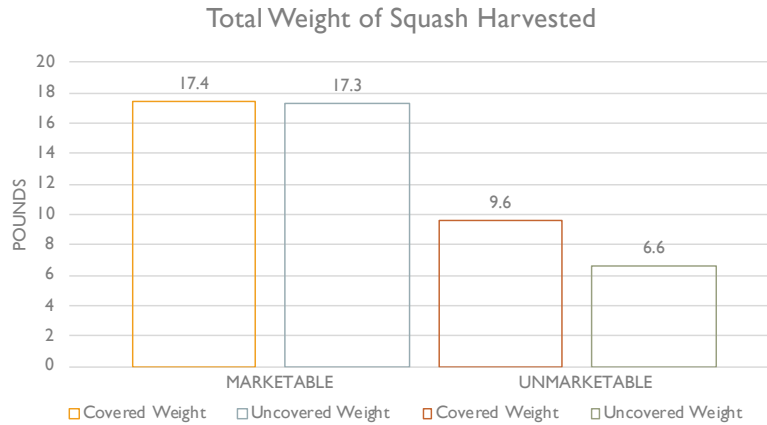


5) Acorn squash harvest:

- a. Non-covered treatment had slightly higher marketable fruit yield than the covered treatment.

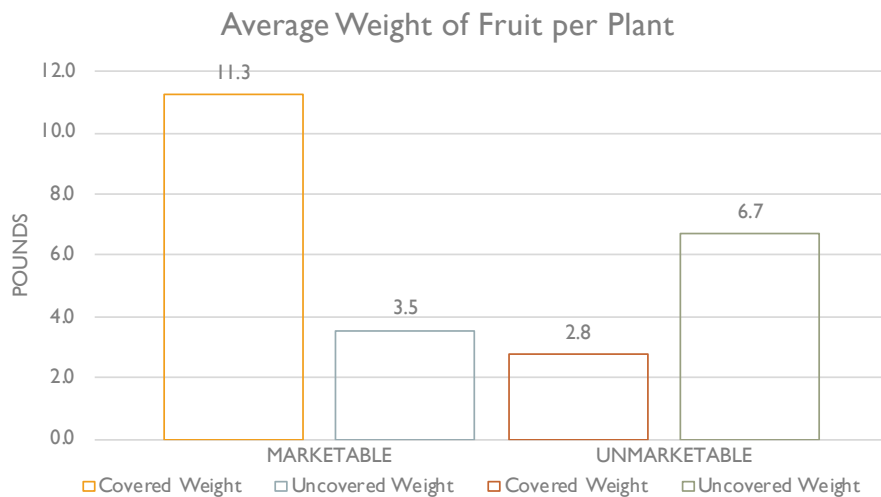
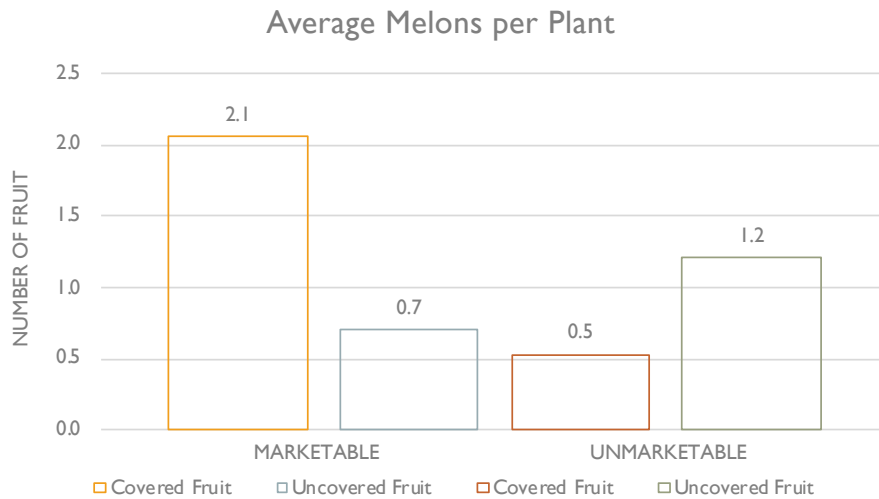
- b. Covered treatment had less fruits per plant and a smaller number of fruits per plant.
- c. Plants grew very large and row cover might have restricted fruit production.

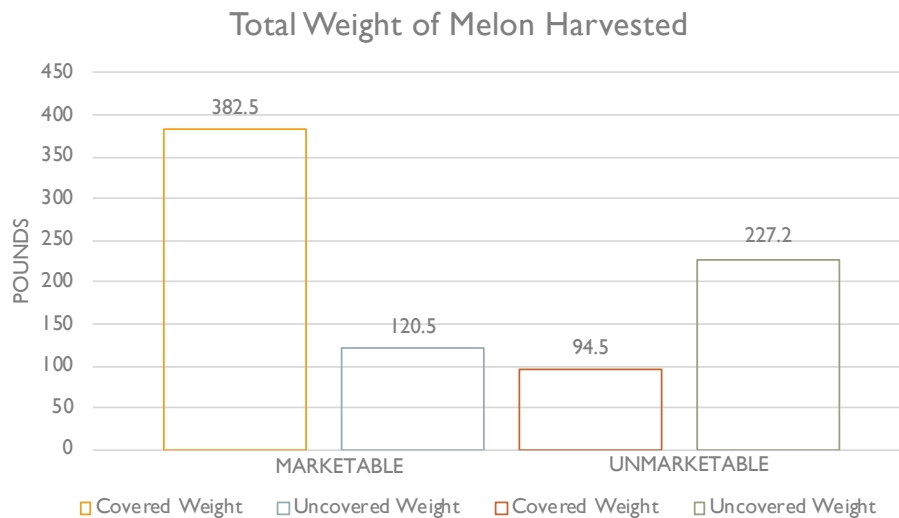
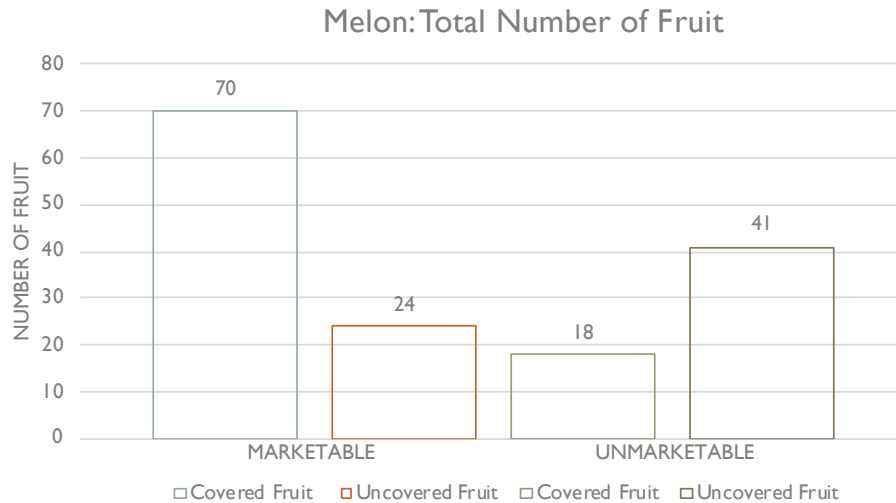




6) Muskmelon Harvest:

- The average number of muskmelons and the weight of the fruit were significantly higher in the covered in comparison to the non-covered plot.
- More non-marketable fruit observed in non-covered plot.
- Total marketable yield was significantly higher in the covered plot.





7) 2021: planning to do replicated experiments on pollination, weed suppression, and pest and diseases.

Q&A:

Q (panel member): The muskmelon yields were significantly higher in the covered plots. What are your labor estimates there? Is the work worth it?

A: Yes – that’s the main question we want to decipher. Very labor intensive.

Comment: That’s an area for [our socio-economics team]. That’s our big question. We will be doing analyses from all our data to provide answers.

Iowa State University trials - muskmelon

Kephas Mphande (ISU):

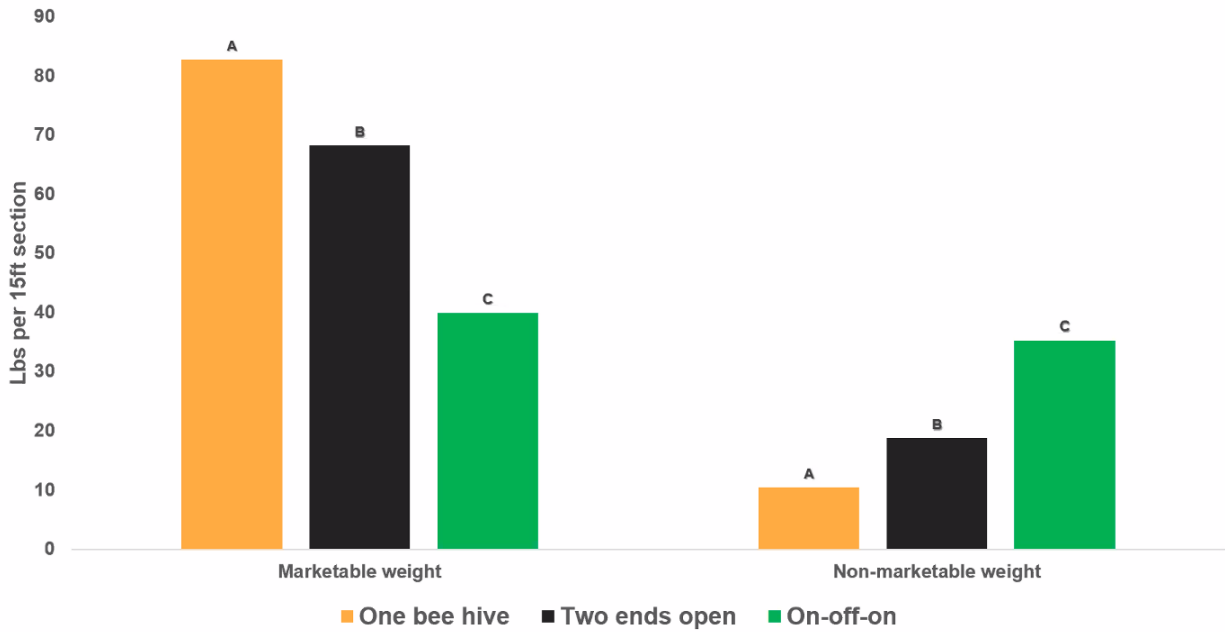
1) Pollination trial:

- a. Treatments: “one bumble bee hive”, “Two ends open”, and “on-off-on”.
- b. Plots were 150 ft long.
- c. In the two ends open treatment, the ends were open at bloom (40 days after transplant approximately), and were kept open for 2 full weeks. Same timing was used in the on-off-on treatment.
- d. Harvest data:
 - i. Marketable yield was significantly higher in the one bumble bee hive treatment, followed closely by the two ends open treatment.
 - ii. Higher non-marketable yield observed in on-off-on.
- e. Diseases:
 - i. Bacterial wilt and Alternaria leaf spot disease (ALS) observed this year.
 - ii. Higher bacterial wilt and ALS incidence present in the on-off-on treatment.
 - iii. Lowest incidence of both diseases observed in the one-hive (full season covered) treatment. Possibly due to dryer conditions inside the mesotunnels.

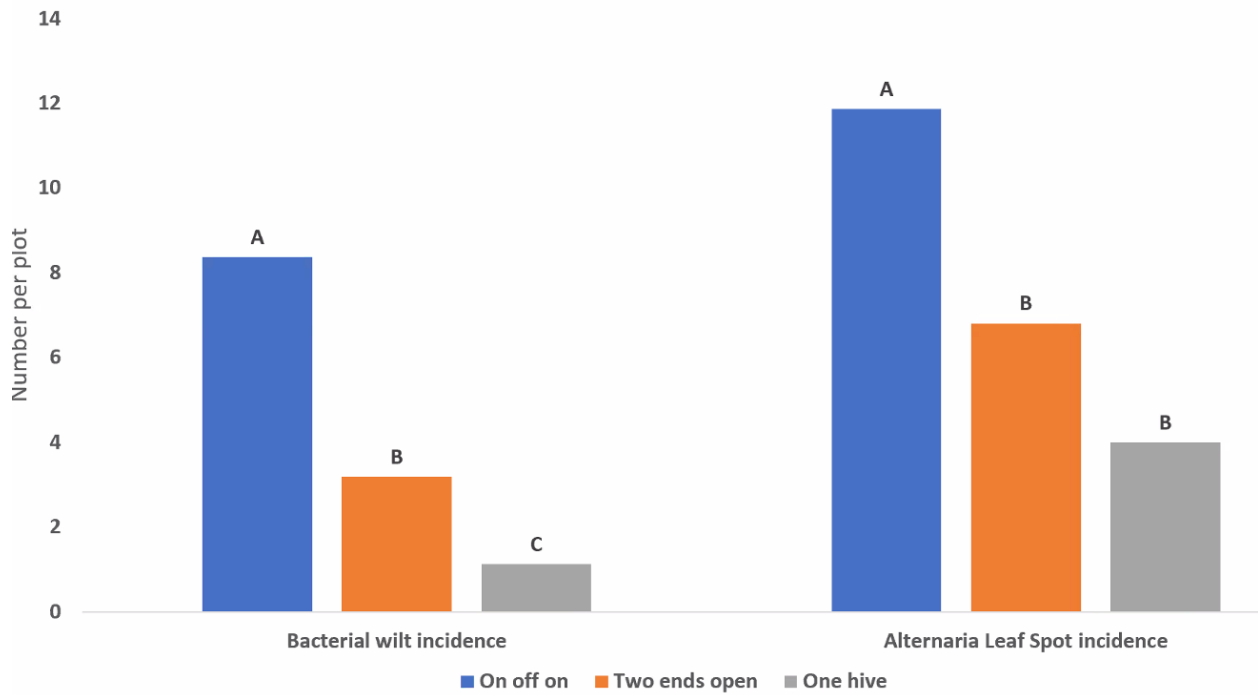
2) Mulch trial:

- a. Treatments: “weed fabric”, “low-teff (4 lb./A)”, “high-teff (8 lb./A), and “bare ground”.
- b. Harvest data:
 - i. Marketable yield in weed fabric treatment doubled the rest of the treatments.
 - ii. Teff competed with the cash crop for nutrients and light.
- c. Weed biomass data:
 - i. No significant differences between the teff and weed fabric.

2020 Pollination Trial Muskmelon Fruit Yield- ISU

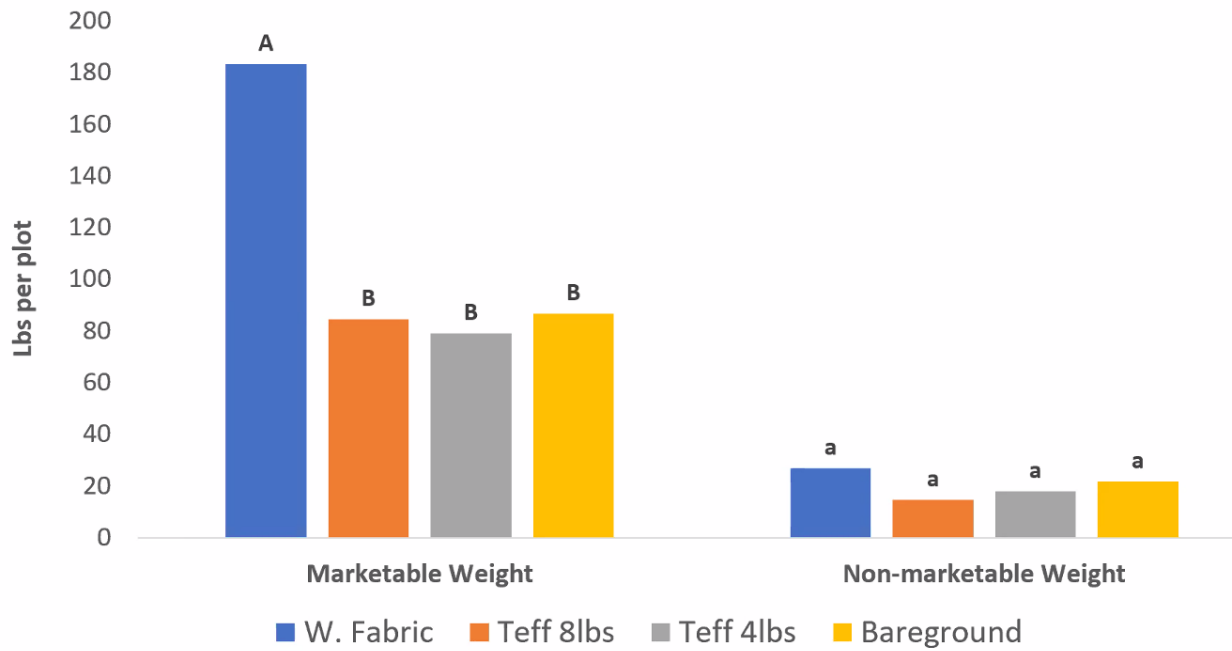


2020 Pollination Trial Disease Incidence in Muskmelon - ISU

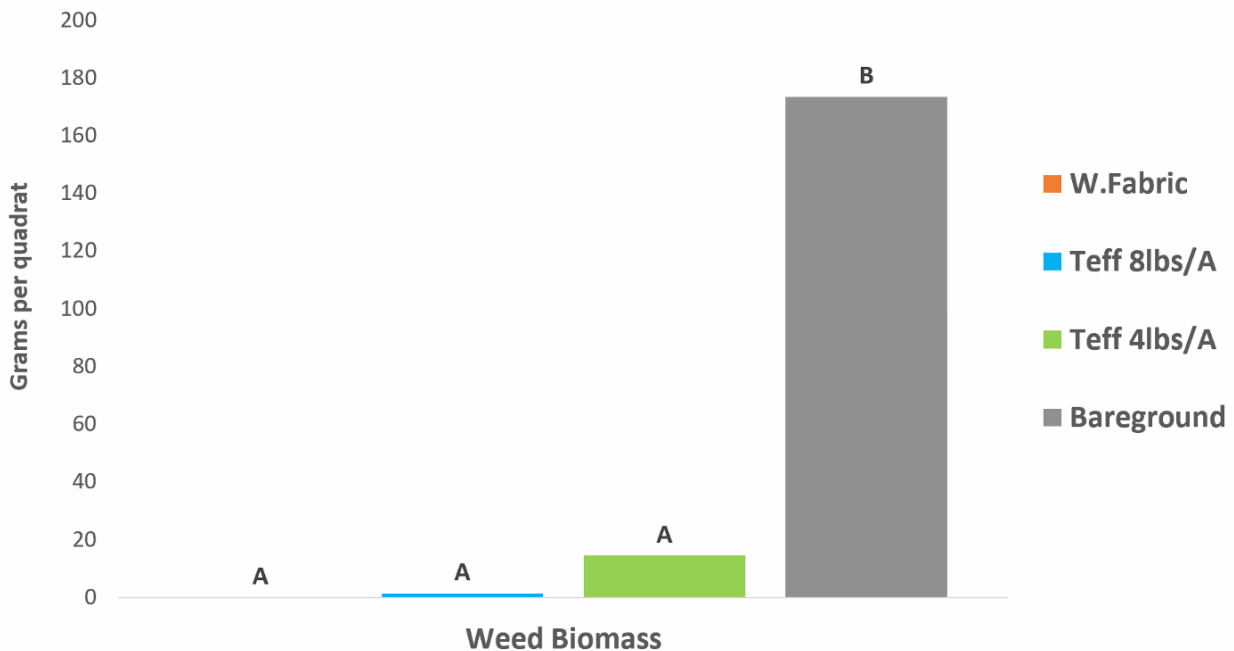




2020 Mulch Trial Fruit Yield in Muskmelon- ISU



2020 Mulch Trial Weed Biomass in Muskmelon- ISU



Q&A:

Q (grower): Is teff a challenge to put out and also are there challenges with germination?

A: We didn't face any trouble with germination this year. We sowed teff a week before (muskmelon) transplant and irrigated it using sprinklers at seeding. We had no issue with germination. We had very good coverage of the Teff. In the past, with ryegrass and clover, we didn't have good germination, so this year we irrigated it.

Q (grower): What did you use to irrigate?

A: We used sprinklers. Just one time.

Q (grower): If a person sowed seeds ahead of rain, would that work? (Without irrigation)

A: [Next time] we will try to seed during transplant and not irrigate.

Q (grower): How tall does the Teff grow? Is mowing needed?

A: It grows really tall. At some point you can't see the crop inside the tunnel. Best if we can slow it by mowing it maybe once, so we can control it a bit.

Iowa State University trials – acorn squash



Sharon Badilla (SU):

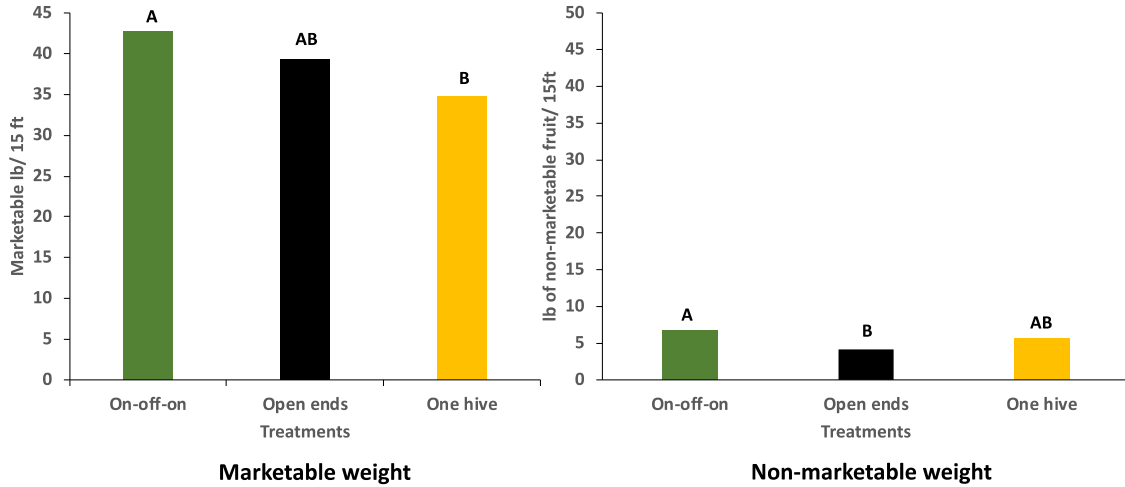
1) Pollination trial (acorn squash):

- a. Treatments: “on-off-on”, “open ends”, and “one hive” (full season covered).
- b. Harvest data:
 - i. Highest yield was in on-off-on treatment, significantly exceeding the one hive treatment.
 - ii. The one hive treatment had lower yield. Possibly because plant growth rapidly filled the mesotunnels, limiting flower visibility and flight patterns for the bees.
 - iii. On-off-on treatment also had the highest yield of non-marketable fruit, mostly due to small size or immaturity of these fruit..

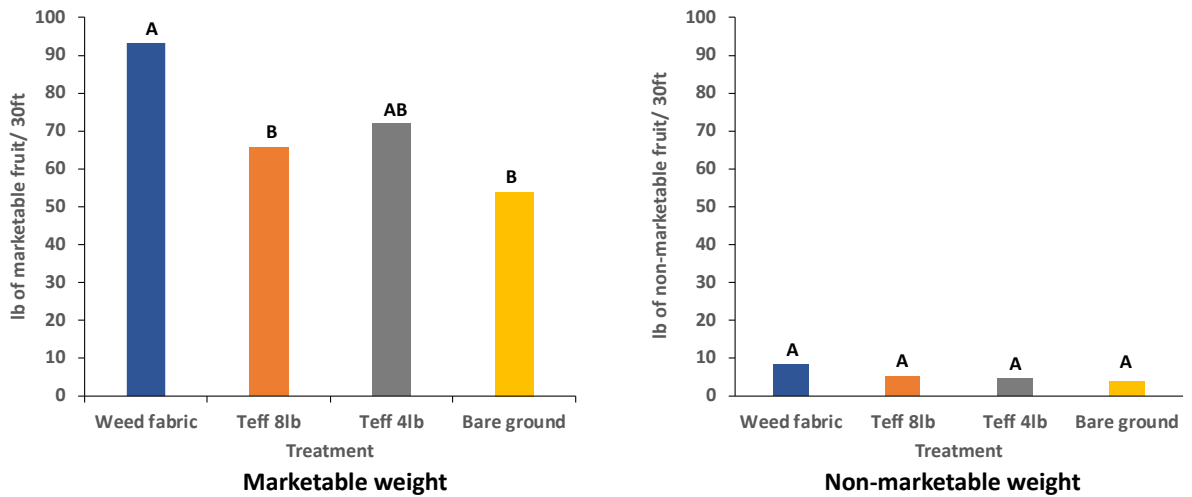
2) Mulch trial (acorn squash):

- a. Treatments: “weed fabric”, “teff (8 lb./A)”, “teff (4 lb./A)”, and “bare ground”.
- b. Harvest data:
 - i. Weed fabric had the highest yield, followed by teff (4 lb./A). Bare ground had the lowest marketable fruit yield.
- c. **Weed biomass data:**
 - i. Higher weeds suppression with teff at 8 lb./A.

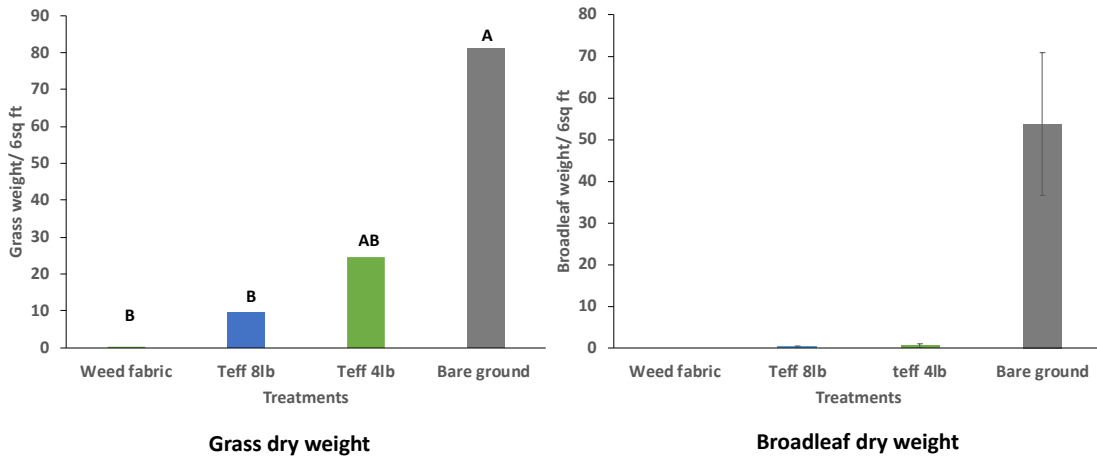
Pollination trial: Acorn Squash Yield-ISU 2020



Mulch trial: Acorn Squash Yield-ISU 2020



Mulch trial-Acorn Squash: dry shoot biomass of weeds-ISU 2020



Q&A:

Q: Are there plans for measuring pest incidence?

A: We did that. We saw in the on-off-on we got more cucumber beetles than with open ends or one hive. But here in Iowa we don't have the subspecies of *Erwinia tracheiphila* that affects the acorn squash, so bacterial wilt of acorn squash is uncommon. We didn't see any squash bug.

OPEN DISCUSSION PERIOD:

Q: When is a good time to establish teff?

A: When teff was small (emerged, about 1 week after sowing), we saw some damage from the tractor that was used in transplanting.

A: As a result, we plan to seed at transplant rather than a week before, to avoid the necessity of re-seeding (which we did in 2020) after transplanting.

Comment: Other teff experiences? It's new to us [in Iowa]. Kentuckians have more experience. Our rates are a whole lot lower than what the folks at U. Kentucky use. But [we got] really good weed control with 8 lbs. Teff.

Comment (panel member): The data looks very promising. I'm glad we have data from more than one state because of what happened in Iowa (Derecho storm) [Or the shut-down because of the pandemic in NY].

Q (grower): In New York, all of us included the control of the standard practices of the grower, e.g., mesotunnels or standard field practices. So, for mine we included mesotunnels and also

all uncovered as we normally would. Will that be standard practice to use that kind of [standard practice control] as check moving forward? Rather than on off on as control, would it be preferable to use just off?

A: That's worth discussing. One factor is space and availability of certified organic ground. In Iowa we are shoehorning into available space that is certified. So that's a challenge. Good idea for sure. In a number of these cases, we need to think hard about our controls. [There is an] argument for using the same treatments in each state, but also different situations in each state. Climate, pest pressure. We'll continue to discuss. These data give us a lot of food for thought.

Q (panel member): I'm wondering about landscape fabric vs. poly covering. Is it worth the extra labor/expense? vs. regular black poly?

A: That's an area where there's still lots of work to do. E.g., Teff, can we mow the teff strips between the rows? The landscape fabric – the key is how expensive. In my mind – some of the long-term goals of this project are trying to maximize profit rather than yield, and minimizing yield loss. Those are the two factors. Trying all these then do the economics on that over time. Risk and profitability.

Comment: Pulling staples (for holding down landscape fabric) is not a popular job. Labor is considerable, as is risk of machinery damage from stray staples in a future year.

Comment (grower): We use sandbags. Much easier.

Comment: Good point. Maybe that's the way we should go. We were using staples because that's what they do in landscaping. Easier to overlook a staple than a sandbag. Good suggestion.

Comment (panel member): We use landscape fabric for flower cultivation. We bury the edges at the ends.

Comment: That's another option. Wondering about labor for sandbags also. Burying works very well. Can mow, no staples.

Comment (grower): Good point on comparing profitability not just yield. To take it one step farther: it's hard to measure but Teff is a living root vs. using plastic and cloth, where the entire field you have no living roots other than your crop. Hard to measure long term benefit but when sowing, have to account for that which is hard to measure; half the field growing something to be turned in and incorporated.

Comment: So, there's a soil quality question.

Comment (grower): Yes, from an organic farming perspective – we look at sustainability, viability, profitability over 5, 10 years or a lifetime or doing this- there has to be positive benefit to sowing cover crop between each row vs not using it. It could be hard to measure this effects on an annual basis but I think it's something to be considered. Maybe some estimations about carbon contribution. Good direction to go. May play out differently too.

Comment: Good point. Another project that examined biochar for soils. Soil organic carbon and N leaching. Relying on grad students and growers to get the data.

Comment: We are thinking on how to look at the short-term impacts, then extrapolate to longer term.

[End of discussion]

For more information, comments, or questions please reach us out:

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