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Managing Pests with Mesotunnels: Lessons Learned from Kentucky On-Farm Research

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Figure 1. Mesotunnels can be implemented in a variety of configurations and contexts. Mesotunnels can encompass (A) one, (B) two, (C) three, or more beds of crops. Row covers can be cut to a length of the grower's choosing.

The strategy of applying fine-mesh row covers (insect netting) over 3.5-ft-tall hoop structures, or mesotunnels (Figure 1, Figure 2), is an emerging technique for managing insect pests in specialty crop production (Nelson et al., 2023). Fine-mesh row covers trap less heat, allow for greater airflow, and are more durable than traditional spunbonded row covers (also known as fabric row covers or frost blankets) (Figure 3; Nelson et al., 2023; Übelhör et al., 2014). The bent conduit hoops used to construct mesotunnels (Figure 2B) are taller and sturdier than the wire hoops used to create low tunnels. Mesotunnels are intended to create a buffer space between crops and the row cover material, thereby preventing insects from feeding or laying eggs through openings in the mesh; reducing abrasion of plant material and damage to the row cover; and increasing airflow, which may reduce disease incidence. Note that depending on crop species and spacing, plants may fill the tunnel and come into contact with the row cover.

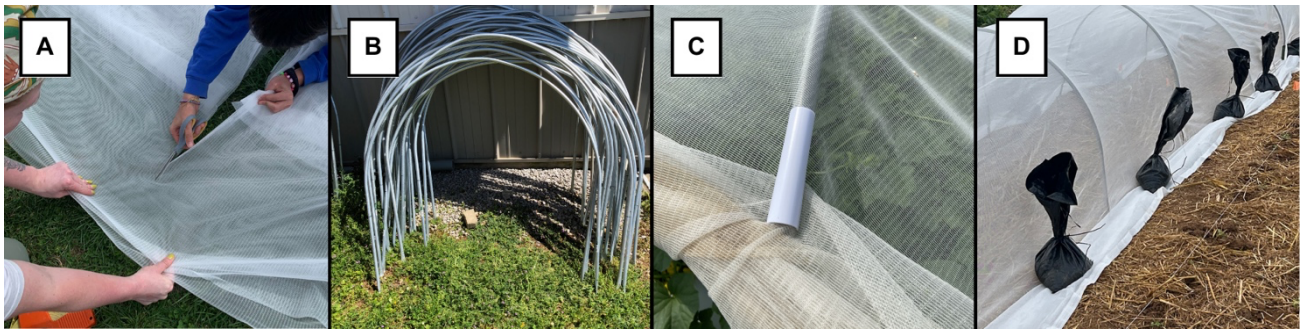

Figure 2. Components of a mesotunnel. (A) Fine-mesh row cover (here, 0.95x0.95-mm mesh size) is cut to size and secured over (B) 3.5-ft-tall bent conduit hoops. (C) Clips are used to attach the row cover to the hoops, while (D) weights (here, 10-lb sandbags) are placed along the edge of the row cover to form a seal with the ground.

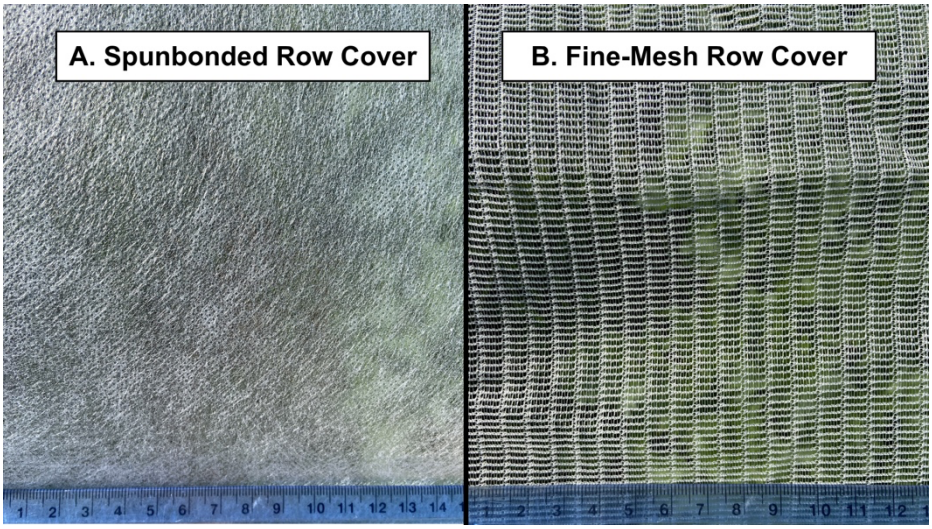

Figure 3. Row cover materials: (A) spunbonded and (B) fine-mesh (mesh size: 0.95x0.95mm).

Previous studies have shown that fine-mesh row covers deployed over mesotunnel structures reduced insect pest abundance and increased yield across a variety of horticultural crops (Brockman et al., 2020; Fiske et al., 2024; Mphande et al., 2024; Nelson et al., 2023). However, there are multiple challenges associated with the use of this technology (Figure 4).

Input Costs and Labor Requirements

Mesotunnels introduce additional input costs and labor requirements**.** In many cases, yield increases resulting from protection with mesotunnels may justify the added expenses. However, effects on yield may vary from season to season based on factors such as ambient pest and disease pressure, with variable effects on profitability (Fiske et al., 2024; Nelson et al., 2023).



Figure 4. Challenges with mesotunnels include: (A) added labor and material costs for installation; (B) weed management within mesotunnel systems; (C) secondary pest issues such as aphids; and (D) added labor to manage mesotunnels for pollination.

Weed Management

Weed management is a challenge in mesotunnel systems, often necessitating the removal of a portion or all of the row cover structure. This introduces labor requirements and potentially exposes plants to pests (Mphande et al., 2024).

Pollination

Pollination is hindered by row covers, which exclude pollinator insects as well as pest insects. Strategies to overcome this issue include either opening the ends of or removing the row cover temporarily or for the remainder of the season after flowering; stocking mesotunnel structures with commercially purchased bee colonies; or using parthenocarpic crop varieties that do not require pollination (Athey et al., 2022; Mphande et al., 2024: Pulliam et al., 2025; Rojas et al., 2011). Note that this challenge only applies to crops that depend on or benefit from pollination to produce fruits (e.g. cucurbits, such as melons; solanaceous crops, such as eggplant; and berry crops). For crops that do not require pollination, such as leafy greens, row covers may be kept sealed for the entire growing season.

Secondary Pests

Secondary pest problems may occur in mesotunnel systems, due in part to exclusion of natural enemies. Aphids may infiltrate fine-mesh row covers and experience rapid population expansion in the absence of their predators (Böckmann, 2022).

Efficacy

Efficacy varies across a spectrum of crops and insect pests. Because variable effects on yield across different crops complicate cost-benefit calculations, it is **important to consider a given farm or garden site's past pest pressure when determining whether and over which crops to implement mesotunnels**. Fine-mesh row covers have been found to increase yield relative to crops grown in open-field conditions in studies of beans (Larkin, 2025), brassica crops (Böckmann, 2022; Brockman et al., 2020; Clark et al., 2024; Dhakal & Nandwani, 2020; Ester et al., 1994), cucurbits (Fiske et al., 2024; Larkin, 2025; Nelson et al., 2023), and potatoes (Merfield et al., 2019). However, studies of broccoli (Nair et al., 2019), carrot (Böckmann, 2022), garden beet (Larkin, 2025), and eggplant (Losekamp et al., 2026) have shown inconsistent or no yield benefits from coverage with fine-mesh row covers. Field studies of fine-mesh row covers have found that they effectively exclude harlequin bug (Clark et al., 2024), squash bug (Pethybridge et al., 2024), cucumber beetles (Mphande et al., 2024: Pulliam et al., 2025), Mexican bean beetle (Larkin, 2025), and spotted wing Drosophila (Kuesel et al., 2019), but results are mixed for flea beetles (Brockman et al., 2020; Losekamp et al., 2026).

Adoption and Public Awareness

Finally, adoption and public awareness of this practice are low. A 2025 survey of organic vegetable farmers revealed that, among farmers who use row covers for insect pest exclusion, 42% implement fine-mesh row cover materials and less than one third use mesotunnels as a support structure (Hollis & Dentzman, 2025).

Research Project

The Crops Under Cover project, an interdisciplinary collaboration between researchers at University of Kentucky, Iowa State University, Cornell University, and The Organic Center, is a USDA Organic Agriculture Research and Extension Initiative (OREI) Program-funded initiative to explore solutions to some of these challenges. More information about the project can be found at https://cropsundercover.mgcafe.uky.edu/ (Figure 5). As part of this initiative, on-farm research was carried out at twenty-one growing sites, in collaboration with participating growers, across the state of Kentucky in

2025. The goal of these on-farm experiments was to assess the effects of mesotunnels on pest insect abundance and crop yield, as well as growers' perceptions of the practice. Kentucky farmers and gardeners tested paired mesotunnel and control plots at their growing sites. Participants were interviewed at the end of the study to assess their perceptions of fine-mesh row covers as a pest management strategy. Lessons gleaned through interviews with the participants in this study are discussed here.

Figure 5. QR code linked to Crops Under Cover project website.

Materials and Methods

Participants in the on-farm study were recruited at a grower meeting, through direct invitations to past participants of on-farm row cover studies by the Gonthier Agroecology Lab in the Department of Entomology at the University of Kentucky, and through word of mouth. Recruitment took place during January and February of 2025. Participants selected crops and planting dates that were appropriate for the needs of their operations. The period of data collection for the study lasted from March until November of 2025. Participants received two $500 honorariums and were provided with mesotunnel materials to keep after completion of the study.

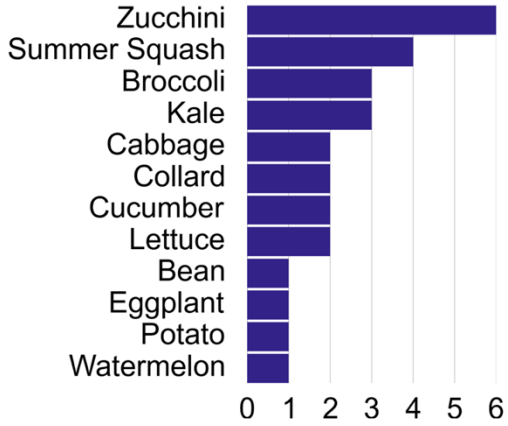

Figure 6. Crops grown for the study. Bars show the number of paired plantings of each crop.

All participants in the study were specialty crop growers in Kentucky who followed organic farming practices. Growing sites were located in both urban and rural locations, with sites concentrated in and around Lexington, Louisville, and Bowling Green.

Participants represented a spectrum of growing practices and operational scales. Most participants had prior experience with row covers; outside of the experimental plots in the study, half of the participants used row covers in their farming operations. Twenty-two participants initiated the study, with twenty completing the interview stage.

The study followed a paired-plot design with one replication of each treatment (mesotunnel and open-field control) per participant and crop. Participants were permitted to establish mesotunnel and control plots of different sizes. They were asked to grow the same crops concurrently in both plots; locate the plots in close proximity; and include at least five plants in each plot. Mesotunnel plots tended to be larger than the corresponding control plots, with average areas of 110.9-ft^2 and 89.3-ft^2, respectively.

Participants were afforded wide latitude to select crops and growing practices that were appropriate for the needs of their growing operations. Participants typically selected crops with which they had experienced insect pest problems in past seasons. Some participants elected to grow more than one crop; at initiation, there were 28 crop-grower combinations (Figure 6). Most growers chose to grow cucurbit (n = 13; cucumber, summer squash, watermelon, and zucchini) or brassica (n = 10; broccoli, cabbage, collard, and kale) crops. There were five plantings of crops in other families.

The research team visited each growing site to help plant and install the mesotunnel structures. Mesotunnels were constructed by embedding 3.5-ft-tall hoops made from bent EMT conduit in the soil at a 6-in depth and approximately 3.5-ft between-hoop spacing. Greenhouse clamps (0.75-in snap-on greenhouse plastic clamps, Bootstrap Farmer, Paris, Texas, USA) secured the fine-mesh row covers (mesh size: 0.95x0.95-mm; ExcludeNet, Tek-Knit Industries, Montreal, Quebec, Canada) to the exterior-facing sides of the hoops. Ten-pound sandbags were placed along the edges of the mesotunnels to form a seal between the row cover and the ground. Following establishment of the experiment, the participants managed the crops (including weeding, watering, and harvesting) in accordance with their standard farming practices. The research team provided technical support as needed.

The lead researcher conducted interviews with each participant at the end of their growing season, following a set script. Interview questions focused on the participants' experiences in the study and perceptions of fine-mesh row covers as a pest management strategy. With participants' permission, the interviews were recorded, transcribed, and analyzed. Quotes from participants are lightly edited for clarity. The study was approved as an exempt study by the University of Kentucky Institutional Review Board in December 2024 (IRB Number: 100267). Participant information was de-identified for data analysis.

Participant Interview Results

In interviews, participants described benefits of mesotunnels, including effective control of insect pests, high-quality crops, and durability of the mesotunnel compared to alternative row cover support structures. They also recounted operational challenges, including inconsistent pollination within mesotunnels, disease, secondary pest pressure, ergonomic challenges, and the cost of materials as a barrier to entry. Some effects of mesotunnels provided both benefits and challenges: for instance, accelerated plant growth within mesotunnels was associated with the benefit of earlier harvest times as well as the challenges of rapid weed growth and crowding of crop plants within the tunnels. Participant 15 said of row covers, “The benefits, the positives, outweigh the negatives.” Many participants shared this opinion: when asked whether they would use fine-mesh row covers again, nineteen out of 20 participants (95%) responded affirmatively.

Benefits of Mesotunnels: Common Themes

Reduction of Insect Pests

With a few exceptions, participants found that mesotunnels reduced insect pest abundance and damage. When asked to share their main takeaways from the study, five participants highlighted that fewer insects were present in the mesotunnels compared to the open fields. Participant 13 said of the row cover, “I think it really reduced insects on the covered plants.” Participant 16 noted, “I don't use any pesticides or other pest management strategies on my plants, and if I had grown that broccoli without row covers, they would have just been completely eaten through” (Figure 7).

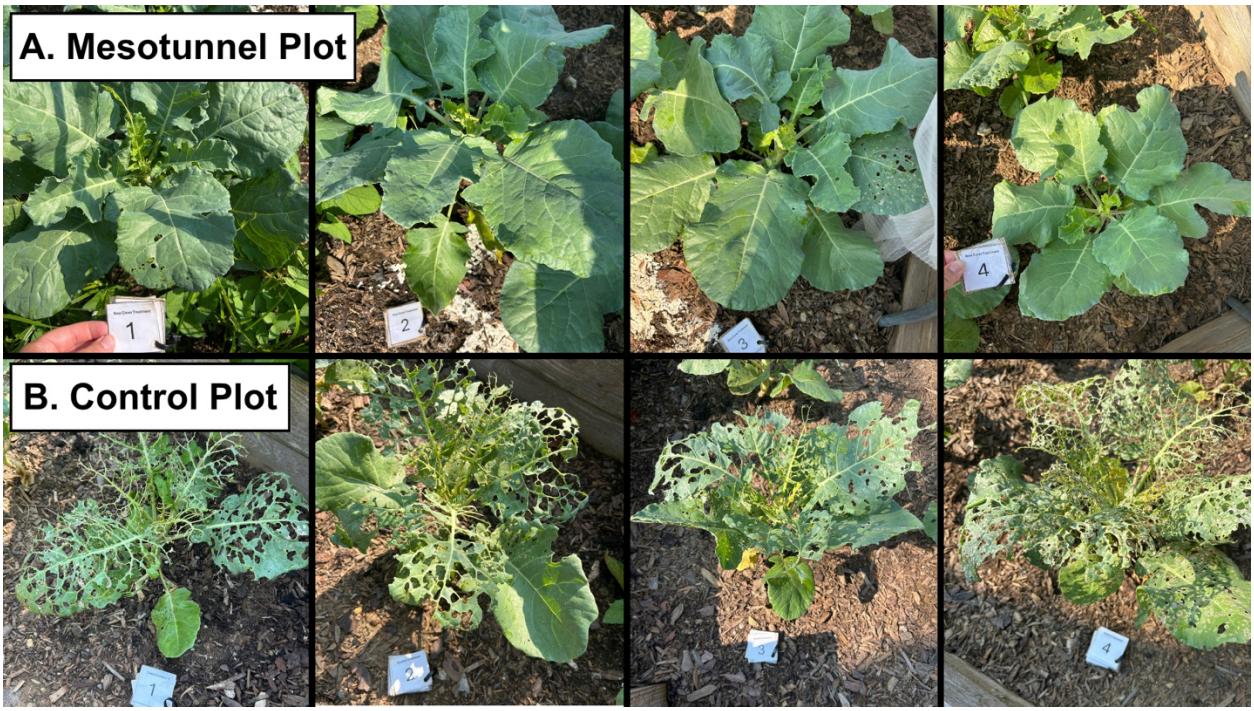

Figure 7. Broccoli plants in Participant 16's (A) mesotunnel and (B) control plot. Plants without covers sustained extensive feeding damage from caterpillars.

Alternative to Pesticides

Nine participants discussed the utility of mesotunnels as a tool to reduce pesticide use. Participant 6 shared, "I love the fact that I didn't have to even spray horticultural oil, or anything like that. I mean, we're organic. So, anything that I do spray is OMRI certified... But I don't even think I'd have to use anything on it at all, which is sweet." Participant 15 placed a high value on feeling that produce was safe to eat directly from the garden. "I try not to use sprays on any of my food… Even if they do say that it's natural… I don't want to have to worry about chemicals." To Participant 4, row covers represented a lower-risk alternative to pesticides. "Even if the chemicals are all fine, they're all natural - we just don't do it because… we just don't have the expertise. We don't want to screw the land up… so we do more basic things from that standpoint."

Multiple participants voiced a desire to avoid applying pesticides to protect beneficial insects. To manage insect pests, Participant 7 relies heavily on crop rotation and providing habitat for natural enemies. Participant 7 saw an opportunity to completely replace pesticides with row covers. "The only pesticide I use, ever, anymore is *Bacillus thuringiensis*. And if I could keep from using that, then I could become a completely zero-pesticide farm, period. That would be great."

Increased Quality of Crops

Most participants agreed that the mesotunnels provided favorable results for the quality of the plants. Participant 4 was impressed by the increased yield and rate growth of zucchini in the mesotunnel treatment. “I anticipated that it would help with insect control. I don't think I anticipated the difference in the look and health of the plants.” Participant 15 said that with the mesotunnel, “the quality of your produce is better in the long run.”

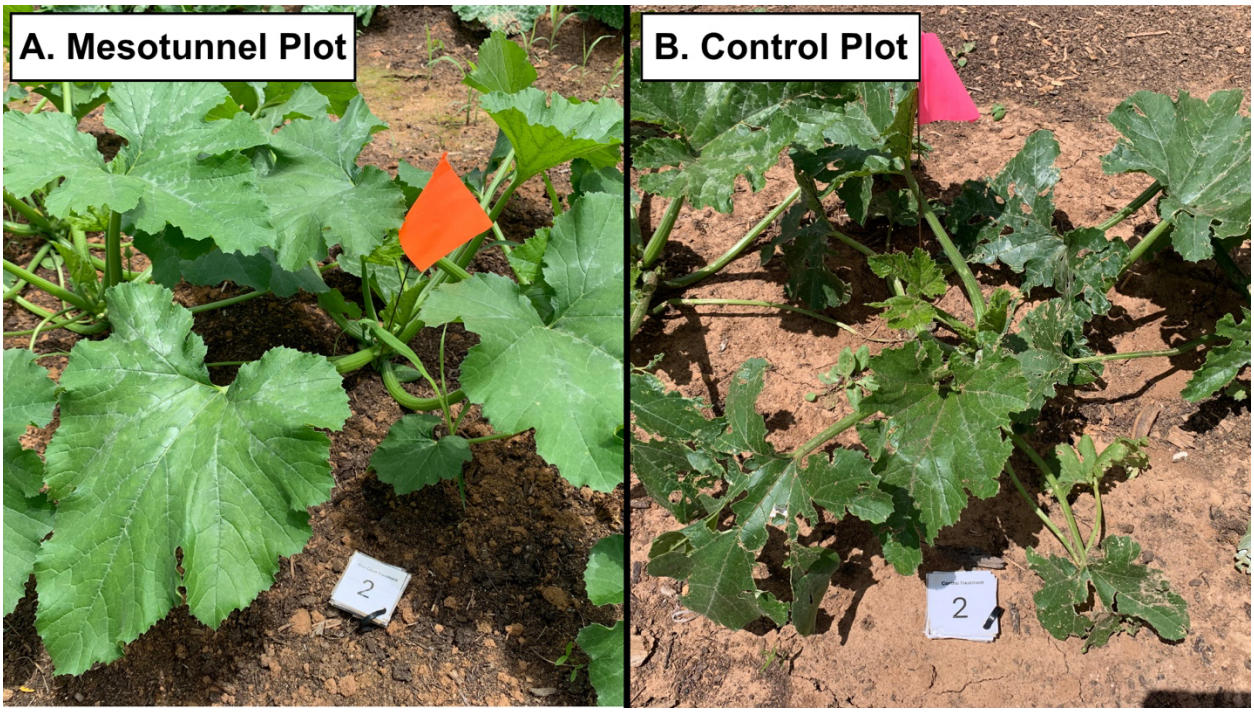

Figure 8. Zucchini plants in Participant 7’s (A) mesotunnel plot and (B) control plot following a hailstorm. Leaves of plants without covers were damaged, while plants in the mesotunnel treatment were not.

Protection from Weather Damage

Participants noticed that the mesotunnels often provided protection from abiotic stressors, including hail, wind, and sun damage. In spring 2025, a severe storm brought hail to Participant 7’s growing site. The hail tore holes into the leaves of uncovered plants, but those under the cover remained unscathed (Figure 8). Participant 19 noted that “having the net provided a buffer: cover [from] heavy wind damage and wind scarring to the vegetables.” Several participants reported that the mesotunnels seemed to protect crops from sun scalding. Participant 8 observed, “One thing about the row covers that I liked… when we had those high heat days, I felt that the squash probably did the best because they had some type of protection from the sun, versus my other plants that got sun scorched.” Participant 4 concurred that the protection from the sun increased zucchini fruit quality. “It had less sun scalding because the plants were just more prolific. The leaves were covering the fruit... I think the mesh itself acted as sort of

a sun barrier, too, between the two. It did look prettier, the fruit looked more market ready."

Rapid Plant Growth

In interviews, six participants emphasized the accelerated growth rate of plants grown under mesotunnels. Participant 20 described the increased vigor of potato plants in the mesotunnel plot: "The plants looked healthy and also grew larger under the cover… I mean they were visibly six to eight inches taller than the plants outside." The increased speed of plant growth reduced the time from planting to first harvest for some crops. Participant 17 observed of their lettuce crop, "The growth rate was drastically different between what was covered, and what was uncovered… The covered sections were running about a week and a half, maybe two weeks ahead of what was left out." Participant 4 sells produce at a farmers' market and noted, "If you're looking to make money, that's a big deal, the ones that first had tomatoes or first whatever… that's a selling point right there."

Season Extension

In addition to reducing the time from transplant until harvest, several participants found that mesotunnels extended the length of time that crops could be harvested. Participant 12, an experienced farmer who had previously used fine-mesh row covers on cucurbit and solanaceous crops, advised, "If space is an issue on your farm... being able to extend a single harvest and not have to continually succession-plant is something to consider."

Durability of Materials

Several participants praised the durability of the mesotunnel structure and the provided row cover. Participants who had previous experience with row covers noted that durability can vary widely across products, affecting the number of times that a row cover can be reused. Participant 3 remarked, "The overall quality of the row cover is pretty good. I thought that was the best I've used in the past. Some insect covers just tend to fade away kind of quick. It's very fragile, so you'll tend to poke holes in it. This stuff is pretty durable." Participant 10 agreed: "That [row cover is] very durable… The others I've tried in the past have been kind of delicate, so this one's much easier to move around and not tear up."

However, the row cover provided for the study, which had a mesh size of 0.95x0.95-mm, came with tradeoffs. Participant 13, who had past experience with the row cover product used in this study, explained, "One of the things for this row cover is that it's super durable, [but] there are other drawbacks, like I wish the mesh size was a little bit smaller to keep flea beetles out, but we have it at the farm and have used it for five crops

continuously. And, honestly, I don't know if any of the row covers we've used have significant tears."

Other participants had favorable views of the durability of the hoop structure used to create the mesotunnels (Figure 2B). Participant 7 operates a four-season farm and has extensive experience using row covers for frost protection, implemented as floating row covers or over low tunnels. "The amount of space that [the mesotunnel] provided, I think it's far better than just a standard wire hoop… You can do less of the hoops, the larger ones, which I like." Participant 17 was enthusiastic about incorporating the hoops into their farm operation. "We're looking to go full-on on the EMT hoops… we're gonna add that to all of our brassica type and lettuce type productions, whether it's in nylon mesh for insects or at a minimum, a shade cloth, or probably in some cases both."

Challenges with Mesotunnels: Common Themes

Variability Across Trials

Although on average crops grew larger and produced greater yield in mesotunnel conditions, this did not hold true for all plantings in the study. Efficacy was context-dependent and likely influenced by cultivar selection, the insect pests present, the physiological responses of crop plants to the changes in light and microclimate under row covers, and susceptibility of the crops to diseases. The variability observed in this study translates into challenges for growers in weighing the likely costs and benefits of implementing mesotunnels on different crops.

Participant 7 grew both cucurbits and beans under the mesotunnel. While the cucurbits showed yield improvements with the mesotunnel treatment, Participant 7 said, "If anything, I think it had a negative effect on the beans. I feel like the plants that were under the experimental conditions were a little leggier." Participants 1, 11, and 18 had grown both brassica and cucurbit crops under fine-mesh row covers; all three shared more positive perceptions of the effects of row covers on brassica crops than cucurbits. Participant 12, who had multiple years of experience using fine-mesh row covers on a commercial farm, reported positive results for eggplant, squash, and zucchini, but found fine-mesh row covers to be most important for protecting cucumbers from bacterial wilt-vectoring cucumber beetles. "Now we'll never grow a cucumber outside of the netting… you get the bacterial wilt, which you can't do anything about." Participant 14 contrasted the outcome of their kale trial for this study to previous experience using row covers to protect leafy greens. "They were more effective on the kale than on romaine or a salad mix… I saw more of a difference between the harvest weights there than I would if I would have used it on greens." Participant 14 attributed the greater benefit that kale

would receive from mesotunnels to higher insect pest pressure for brassica crops relative to lettuce.

Pollination

Yield varied more for pollinator-dependent cucurbit crops than for brassicas, which could be managed with a sealed mesotunnel from planting until harvest. Most participants managed pollination in the mesotunnels by clipping open the ends of the mesotunnel when plants began flowering (Figure 9). Several participants observed yield penalties for cucurbits grown in mesotunnels, which they attributed to low rates of pollination.



Figure 9. Open-ends pollination strategy. The end of the row cover is secured open with clips and sandbags to allow pollinators to access the plants in the mesotunnel.

Some participants who tested mesotunnels on cucurbits felt that the open-ends pollination strategy was less effective when implemented at a small scale. Participant 1 tested the row cover on cucurbits in a 9-ft-long backyard raised bed and described challenges with pest management when using the open-ends strategy. The small footprint of Participant 1's mesotunnel meant that when the ends were opened, pests had easy access to the plants, whereas with a larger mesotunnel at a commercial farm, Participant 1 expected that "if there were any squash bugs or vine borers, they probably only went so far, and they probably didn't go all the way to the end… When you have so many [plants], the squash bugs don't even need to go that far because they found what they needed early on... So, you almost can sacrifice a few of the plants upfront." Participant 1 expected that for backyard farming, a taller structure than the mesotunnel would provide plants more room to grow and pollinators more open space to navigate to flowers. "I just think that when it comes to cucurbits, the structure might look a little bit different in a backyard."

Other cucurbit growers in the study who implemented mesotunnels over a single bed of crops observed that yield diminished towards the midpoint of the mesotunnel, which they attributed to impeded pollinator movement due to dense foliage (Figure 10). In Participant 13's trial, plants grew larger than expected in the mesotunnel, filling the available space with foliage. "I've absolutely seen in the middle of the row cover, that's where I had the least amount of fruit." In the future, Participant 13 planned to grow cultivars with more compact growth forms to counteract this effect. Participant 3, who implemented a 100-ft-long mesotunnel over a single bed, noticed a similar phenomenon of decreasing yield toward the midpoint of the tunnel. Participant 3 planned to incorporate more empty space in the form of walkways into future mesotunnels to assist the movement of pollinators, explaining, "Maybe having the row cover over the walkways would have helped… because I did see some struggles with pollination just halfway through the tunnel." Participant 12, who had used mesotunnels to protect cucurbit plantings in past seasons, explained "I have noticed in the past some pollination issues… [which have not] been as bad this year… This year, I did a wider spacing of planting, so it's not so crowded in there. So, I think the pollinators that are getting in there are able to do a better job."

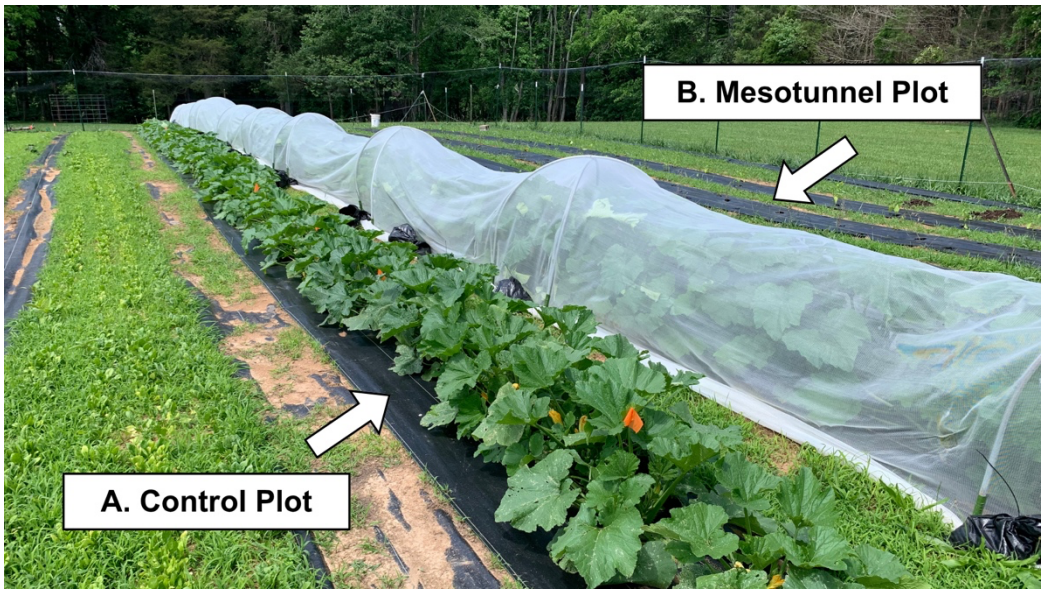

Figure 10. (A) Control and (B) mesotunnel single-bed plantings of summer squash. At this site, yield decreased towards the middle of the planting due to limited pollination. The movement of insect pollinators may have been impeded by the dense foliage of the plants.

Spacing and Plant Growth

Cucurbit crops tended to grow larger in the mesotunnel than in open field conditions. This phenomenon created various management problems for participants, including reduced efficacy for insect exclusion and reduced rates of pollination. Participants identified reduced planting density as a potential solution. Participant 3 recommended,

“Always just account for a little more space, I would say... I didn't expect those zucchini [in the mesotunnel] to get as big as they did.” Participant 8, who had tested the mesotunnel over a single bed of cucurbits, advised widening the mesotunnel structure to cover more than one bed of crops and incorporating a walkway between beds to provide space for the movement of pollinators.

Challenges with plant spacing were not exclusive to participants who grew cucurbits. Participant 16, who grew broccoli in raised beds for the experiment, stated, “Whatever is under the row cover will get really big.” In Participant 16’s trial, the plants under the row cover grew vigorously, with some plants shading out others. In the future, Participant 16 plans to incorporate more empty space into the mesotunnel to accommodate increased plant growth.

The added space required for the structure of the mesotunnel, including hoops and sandbags, created a challenge for some growers who utilized permanent beds and walkways. Participant 6 grew kale in a mesotunnel located on the outermost bed of a garden plot consisting of beds separated by narrow walkways. Participant 6 advised thinking about the location of the mesotunnel in relation to other crops and infrastructure in advance of planting. "I thought the setup was excellent... But one of the benefits was that I had it on the end [of the garden]. When the other crop started growing… the tomatoes were on the other side, and when I wasn't really able to crawl around on that side [of the mesotunnel], I could still access it, because it was on the end [of the garden]. If you’re just going to do one in the middle of something, I would definitely make it a crop that doesn't need a lot of space or put it on the end." Participant 4, who farms on less than two acres, noted, “We tend to cram stuff in just because we have limited space… I just think the netting and the hoops, it limits some of your access, so it makes spacing that much more important.”

Weed Management

Weed management in mesotunnel systems often requires labor to prevent weed emergence, such as for the installation of landscape fabric (Figure 11C), plastic mulch, or cover crops (Figure 11D). In research studies, plasticulture-cover crop systems (Figure 11D) have been used successfully to suppress weeds; however, this strategy was not tested by any participants in the present study (Mphande et al. 2024). Many participants in the study used other ground covers to prevent weed emergence. About one third of the experimental plots were established on landscape fabric; about one fifth were mulched with organic materials, such as wood chips (Figure 11B); and the remainder were planted into bare ground (Figure 11A).

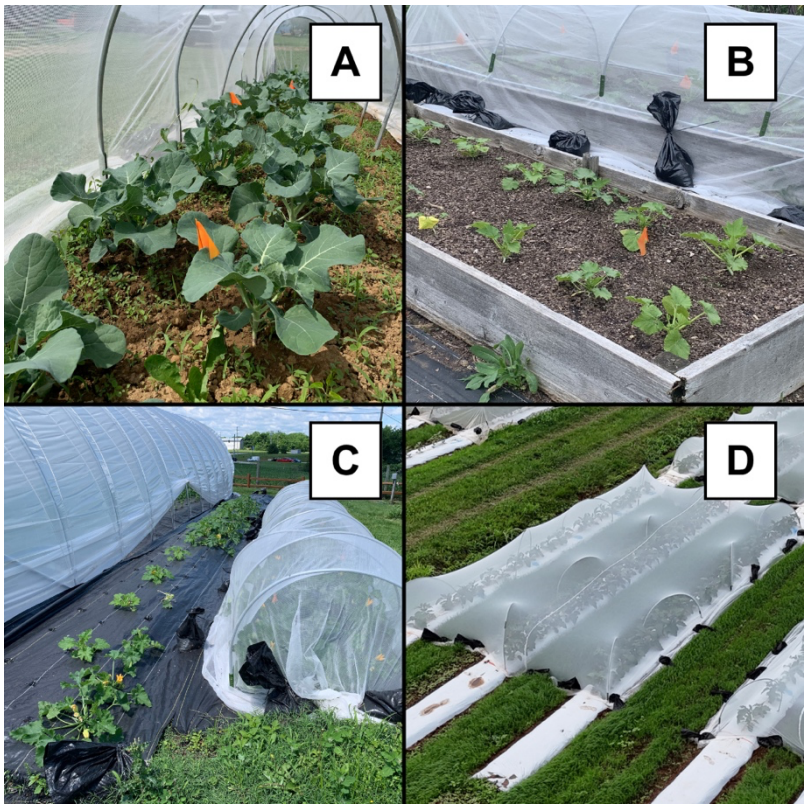

Figure 11. Various weed management strategies can be deployed in mesotunnel systems. In this study, participants either (A) left the ground bare at transplanting, pulling weeds by hand as needed; (B) used organic mulch, such as wood chips; or (C) transplanted crops (here, teff) seeded between beds.

Of those participants who implemented mulch or bare ground, several reported that weed pressure was greater in the mesotunnel plots. Participant 13 said, “I found it interesting that weeds have an easier time taking hold under the row cover, even though the covered [and] non-covered rows have been mulched the same.” Participant 13 attributed this phenomenon to higher relative humidity under the mesotunnel compared to open field conditions.

Organic-compliant methods for weed control in mesotunnels include suppression using machinery (e.g. mowing) or via hand removal. Often, suppression of weeds entails removing the row cover entirely or crawling under the mesotunnel structure (Fiske, 2024; Mphande et al., 2024). Most participants in the program farmed on one acre or less and had limited access to farm machinery, with the majority removing weeds by hand. Participant 6 said of managing weeds in a mesotunnel system: “The maintenance aspect is a little more. You know, when you have a regular row, you can go in and hoe and pull up the weeds, but with the row cover, it's a little bit more challenging.”

Ergonomics

Installing, maintaining, and removing mesotunnel materials is labor-intensive. Removing the clips and sandbags to access the crops for weeding or harvesting introduced

ergonomic challenges for some participants. Participant 5 said, “Moving the bags and clips is time and labor intensive… The row covers protect the crop, but it's hard to access the crops. The clips were challenging to remove.” Participant 6 had a similar reaction: “I have arthritis in my hand, so taking the [clips] off the [hoops] was challenging for me.”

Without completely removing the row cover, participants found it necessary to kneel while pulling weeds or harvesting crops. This presented another ergonomic challenge. Participant 6 advised, “Definitely get one of those little kneeling pad things… if you are older, get some knee pads and do some yoga on the day you're going to harvest and weed that, because it is a lot of kneeling and bending over.”

Several participants highlighted the difficulty in working alone to remove and fold row covers for storage when not in use. Participant 18, who had previous experience using fine-mesh row covers, held positive views of the practice but viewed ergonomic challenges as one of the biggest disadvantages. “I wouldn't change anything about the method or the system, because my life has been changed by it. But I would definitely look at trying to save my body ergonomically with trying to fold [the row cover].”

Secondary Pest Pressure

Several participants encountered secondary pest problems when using the mesotunnels, including aphids, caterpillars, slugs, and snails. One factor that may contribute to the development of certain pest species is high relative humidity, which can be increased inside mesotunnels (Übelhör et al., 2014). Participant 17 observed an infestation of slugs in their late-spring lettuce planting, which they linked to a rainy spring season and higher relative humidity in the mesotunnel treatment than the open field.

In certain cases, insects that might otherwise be suppressed by natural enemies can become prolific under fine-mesh row covers (Böckmann, 2022). Aphid nymphs can fit through mesh openings as small as 0.15x0.35-mm (London et al., 2020), which might exclude larger predatory insects. Participant 12 observed high aphid density in their mesotunnel treatment early in the season. “We certainly had issues last year and some this year [with] aphids, especially with the eggplant… we have a really good parasitic and beneficial insect population on our farm… but having the netting on there excludes them as well.”

Growers can use the fact that many natural enemy insects are too large to move through the mesh openings of row covers to their advantage by releasing natural enemies inside of mesotunnels. In this study, no biocontrol agents were released within the experimental plots. However, ongoing research at the University of Kentucky has

found promising results from releasing ladybugs and green lacewings inside mesotunnels for aphid control (https://cropsundercover.mgcafe.uky.edu/).

Cost

Cost of mesotunnel materials – in particular, fine-mesh row cover - may be a barrier to adoption (Hollis & Dentzman, 2025b). In this study, participants were provided with mesotunnel materials and a stipend for participating. Several participants cited cost as a factor that would influence their decision to purchase more mesotunnel materials in the future. Participant 9 operates a community supported agriculture program and had previous experience using row covers for pest management. Despite holding favorable views of row covers, Participant 9 viewed cost as a barrier to expanding the practice in their operation. “I have thought, fleetingly, about purchasing more, but I could not purchase 300 feet of it, and why would you buy anything less than that anyway?” Per unit area, fine-mesh row covers are less expensive when purchased in bulk; however, the cost to purchase and ship a 328-ft-long by 26-ft-wide roll (in 2025, over $1500 USD) can be prohibitively expensive for growers and may provide more row cover than a single small-scale grower would need. Collaboration between multiple growers to place a single bulk order for row cover could help offset the high upfront cost.

Multiple participants identified cost-benefit analysis as a key consideration. Participant 12 highlighted the importance of crop selection when considering whether to use a mesotunnel. “Weigh out the cost-benefits… if you had to choose, lean towards a higher value crop." When asked about acquiring more mesotunnels in the future, Participant 4 explained that their decision-making would incorporate a variety of factors, including upfront costs and potential benefits to the crop. “I think that depends on cost. Yeah, clearly, the netting helped… If there's something that we can do that's efficient, that is affordable, that allows our plants to better thrive… because you spend a lot of money and a lot of time putting that stuff in the ground.”

Participant 19 noted that using mesotunnels entails not only an upfront cost for materials, but also a commitment to additional time and labor in the future. “Get the maximum out of the use… make sure you do something that is manageable, because although [the mesotunnel] helps, it’s another physical input, not just a financial input, [because] you know you’re going to have to take the row cover off, make sure you reset it, make sure it’s nice and tight. But you know, other than that, the benefit is a better product. So, just weighing your scale on efficiency versus cost and time.”

Cost-benefit calculations with mesotunnels may be muddied by ecological ramifications that are not easily assigned a dollar value. Participant 20, who tested the mesotunnel on potatoes, operates a diversified vegetable farm that follows organic growing practices. Participant 20 discussed the intangible benefits of using mesotunnels to disrupt pest life cycles: “Because of our succession planting, we're perpetuating extra generations of

these pests, and they're getting worse, so I think this could be a really good tool to break that cycle… In this particular case with the potato beetles… is the value of trying to break that cycle so we're not creating pests for tomatoes and eggplants, other crops. That is probably as valuable to me as just protecting the potatoes. That starts becoming a little bit intangible as far as when you're trying to figure costs and things. I think that's something that has to be factored it, because it's a benefit."

Conclusions

Mesotunnels hold potential as an Integrated Pest Management tool for Kentucky specialty crop growers, especially those who practice organic farming principles. In this study, specialty crop growers – including full- and part-time commercial farmers, operators of community gardens, and home gardeners – tested mesotunnels against an uncovered control in their own growing operations, uncovering benefits and tradeoffs with the practice in the process. In interviews with twenty participants, common themes emerged. Benefits of mesotunnels included pest control, reduced need for pesticides, crop quality improvements, protection of the crops from severe weather, accelerated plant growth, season extension, and durability of the structure. Challenges included inconsistent effects across trials, pollination, spacing, weed management, plant diseases, ergonomics, secondary pest pressure, and cost of materials.

Interviews with participants suggested that further research is needed to resolve challenges that they encountered. Unresolved research questions include:

- How can we optimize pollination strategies for pollinator-dependent crops grown in small-scale (e.g. single-bed) mesotunnels?
- How can we make mesotunnel materials more affordable and accessible for growers?
- How can we modify mesotunnel structures to improve usability, especially for growers with limited access to labor and equipment?
- Which biocontrol agents are most effective when released in mesotunnels to control secondary pests?
- How should growers modify plant spacing to maximize yield in mesotunnels?
- Which weed management strategies are most effective for small-scale mesotunnels?

Despite these unresolved questions, participants developed positive impressions of mesotunnels as a pest management tool. Ninety-five percent of participants planned to continue using mesotunnels after the study. Their experiences yielded key takeaways:

- Mesotunnels consistently provided yield benefits and quality improvements for crops that are not pollinator-dependent (e.g. leafy greens).

- Participants observed that mesotunnels generally protected crops from insect pests, although there were some secondary pest challenges – especially aphids.
- Participants praised bent EMT conduit hoops as a durable alternative to wire low tunnel hoops.

Finally, participants shared recommendations for the optimal use of this technology:

- To obtain the greatest benefits, mesotunnels should be used on high-value crops with a history of pest management challenges.
- Anticipate increased plant growth, especially with larger crops, and adjust plant spacing accordingly.
- To get the most use out of mesotunnels, implement across multiple crops in a rotation.
- Increasing personnel decreases the difficulty of installing and removing mesotunnels.
- Don’t be afraid to modify the system (such as the height of the hoops or system for securing the row cover) to meet individual needs.

For more research results and tips and tricks for using mesotunnels, visit https://cropsundercover.mgcafe.uky.edu/.

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Photos:

Elaine Losekamp: Figure 1: A, B; Figure 2: A, B, D; Figure 8, 9; Figure 11: A-C

Mario Reyes: Figure 1: C; Figure 11: D;

Kathleen Fiske Pulliam: Figure 2: C; Figure 3,

Amelia McCurry: Figure 7

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