

High Tunnel Pest Exclusion System Part II: Lessons from on-farm demonstrations

This bulletin provides data and information from on-farm demonstrations on the use of high tunnel pest exclusion (HTPE) systems. HTPE systems use shade cloths as a more *permanent barrier system* around high tunnels to exclude insect pests. Mention of company names and/or products doesn't mean an endorsement.

The information in this bulletin is provided through the results of the Southern SARE Professional Development Program for the Alabama Cooperative Extension Model State Plan.

Learn more about HTPE systems through the bulletin: [High Tunnel Pest Exclusion System: A novel strategy for organic crop production in the South.](#)

SARE funds projects that are economically profitable, environmentally sound, and improves the social and economic health of farm communities.

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With the increasing demand for local foods across the Southeast, an increasing number of beginning, as well as experienced producers are producing vegetable crops for direct and whole sale markets. For example, in Alabama, there are a large number of producers with single or double high tunnels who sell locally at the farmers markets and on-farm retail. There are also some new farmers that have multi-bay high tunnel crop production systems who sell a variety of crops at wholesale prices.

Fueled by the increasing consumer awareness about organic foods, high tunnel producers have shifted to alternative pest management systems. In the organic farming model, pests (insects, weeds, and pathogens) are known as the yield-limiting factors that must be managed. Uncontrolled levels of pests result in over 50 percent crop loss. High tunnels not only extend the production season for the producer, but they also extend the life cycle of insect pests that may linger on longer compared to open field (check out the pest management section of the [High Tunnel Crop Production Handbook](#)). From the insect management perspective, it is extremely critical to adopt pest prevention practices; the high tunnel pest exclusion (HTPE) system is one of the best relatively-low cost pest preventive practices. This HTPE technology uses a variety of shade cloths for a relatively permanent pest prevention strategy.

Past Successes

In 2015, the first Southern SARE bulletin titled, “[High Tunnel Pest Exclusion System: A novel strategy for organic crop production in the South](#)” provided the basic description of the HTPE system. That bulletin described the differences between knitted lock-stitch fabric with wide openings (manufactured by Poly-Tex, MN) versus monofilament shade cloths with narrow openings (manufactured by Farmtek, IA) (**Fig. 1** and **Fig. 2**).



Fig. 1 shows the difference between knitted lock-stitch shade cloth with wide openings compared to monofilament shade cloths with narrow openings in Fig. 2.

That bulletin outlined the need for careful choice of these shade cloths and the basic installation process so that pests are not able to enter high tunnels and reach the crops. Researchers also hinted at the issue with natural enemy exclusion with a monofilament shade cloth with narrow openings. At that point the researchers only had a few experiences to share from on-farm research. With continued funding from Sustainable Agriculture Research & Education (SARE) coordination and Producer Grants, researchers have now made significant progress in understanding pros and cons of the HTPE system by cooperating with several producers across the state. This bulletin focuses on recent successes with pest exclusion; a separate paper will describe new recommendations for integrating beneficial insects.

Study Methodology

Since 2014, researchers have successfully conducted several replicated laboratory studies to explore the effectiveness of 30, 40, and 50 percent shade cloths manufactured by Poly-Tex and Farmtek to stop insect pests without stopping all beneficial insects. Using small-scale models of high tunnels, the laboratory studies strongly indicated the improvement in crop quality from tightly fitted 40 and 50 percent shade cloths that excluded leaffooted bugs (**Fig. 3** and **Fig. 4**). Prepared with this information and additional SARE funding, the researchers approached several key producers in Alabama for on-farm evaluation of the HTPE system.

HTPE improves crop quality by stopping leaffooted bugs!

Shade cloth supplier: Poly-Tex, MN
Shade cloth with wide openings.



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Quality improvement of okra (Fig. 3) and green beans (Fig. 4) protected from leaf-footed bugs using a 50 percent shade cloth.

At each farm, the shade cloths were tightly installed under the rolling side-walls and also part of the end walls to keep insects away with adequate ventilation. Producers attached the shade cloths (custom-prepared by Poly-Tex) to the side walls either using grommets or stapling the shade cloth to wooden boards. The end walls were put on like a curtain and secured on the sides either with Velcro or grommets with nails (**Fig. 5**). Some producers also have the fabric secured all around the high tunnel with a special door on the end-wall for entering. In all farms, the shade cloth installation was done after removing all crops from the high tunnel and pest observations were carried out on freshly planted crops. Control plots were planted outside the high tunnel. Besides direct scouting of crops, the researchers used sticky wing pheromone traps inside and outside the netted high tunnels to monitor and compare moth numbers.

Securing netting on the end-walls



Fig. 5. On-farm methods for securing shade cloth to the end walls of the high tunnels.

Overall Findings from HTPE Studies

Table 1 summarizes the benefits of a HTPE system based on laboratory and field observations. This is called ‘selective exclusion’ and is defined as the ability of the shade cloth to exclude target pests with minimum reduction in beneficial insects. As indicated earlier, a 50 percent shade cloth with wide openings (Poly-Tex) did not exclude all natural enemies tested, but slowed down or stopped leaffooted bugs.

What pests can the shade cloths exclude?

	Insect stage	30% FarmTek (fine openings)	30% Grainger (wide openings)	40% FarmTek (fine openings)	40% Poly-Tex (wide openings)	50% FarmTek (fine openings)	50% Green-Tek (wide openings)
Laboratory studies:							
Leaffooted bugs (Okra)	Adults	Yes	No	Yes	No	Yes	Yes
Leaffooted bugs (Beans)	Adults	Yes	No	Yes	No	Yes	Yes
On-farm studies:							
Stink bugs	Adults	Yes	No	Yes	No	Yes	Yes
Cabbage/soybean loopers	Moths	Yes	No	Yes	Yes	Yes	Yes
Corn earworm	Moths	Yes	No	Yes	Yes	Yes	Yes
Tobacco budworm	Moths	Yes	No	Yes	Yes	Yes	Yes
Beet/fall armyworms	Moths	Yes	No	Yes	Yes	Yes	Yes
Squash vine borer	Moths	Yes	No	Yes	Some	Yes	Most
Cucumber beetles	Adults	No	No	Yes	No	Yes	No

Table 1. Pests excluded with shade cloths based on on-farm and laboratory studies.

Other Findings

- Major moth species with 3 to 4 cm wingspan, that include armyworms and loopers, are too large to get through a 40 or a 50 percent shade cloth. A 50 percent shade cloth can nearly eliminate them from a high tunnel. Watch for egg masses that may be laid on the fabric – remove them to reduce the chance of small caterpillars getting into the structure.
- Significant reduction in the number of squash vine borer (**Fig. 6**) was noticed with a 40 or a 50 percent shade cloth which should come as good news for organic high tunnel producers and market gardeners. When monitored using sticky pheromone traps, only a few male moths may be able to crawl through a 40 percent shade cloth, but those moths don't cause any crop damage and are not able to mate with females.
- We have observed the complete exclusion of cabbage butterflies (imported cabbageworm) inside the netted tunnels on farms that routinely experienced cabbageworm outbreaks in open tunnels. HTPE systems can increase profitability of leafy green producers with a high quality crop.

- Leaffooted bugs explore surfaces really well and they can exploit any opening in the netting if it is not properly installed. A well-installed HTPE system with 50 percent shade cloth excludes most leaffooted bugs and stink bugs. Make sure to keep the fabric repaired at all times.
- FarmTek Sun Blocker can exclude many natural enemies that include lacewings and lady beetles. This may cause aphids and whiteflies to increase inside the netted tunnel. Release lacewing larvae inside the tunnel in sufficient numbers before a pest outbreak occurs. Full details regarding the integrated use of natural enemies with an HTPE system will be available in the third bulletin.

HTPE on-farm study: Squash vine borer

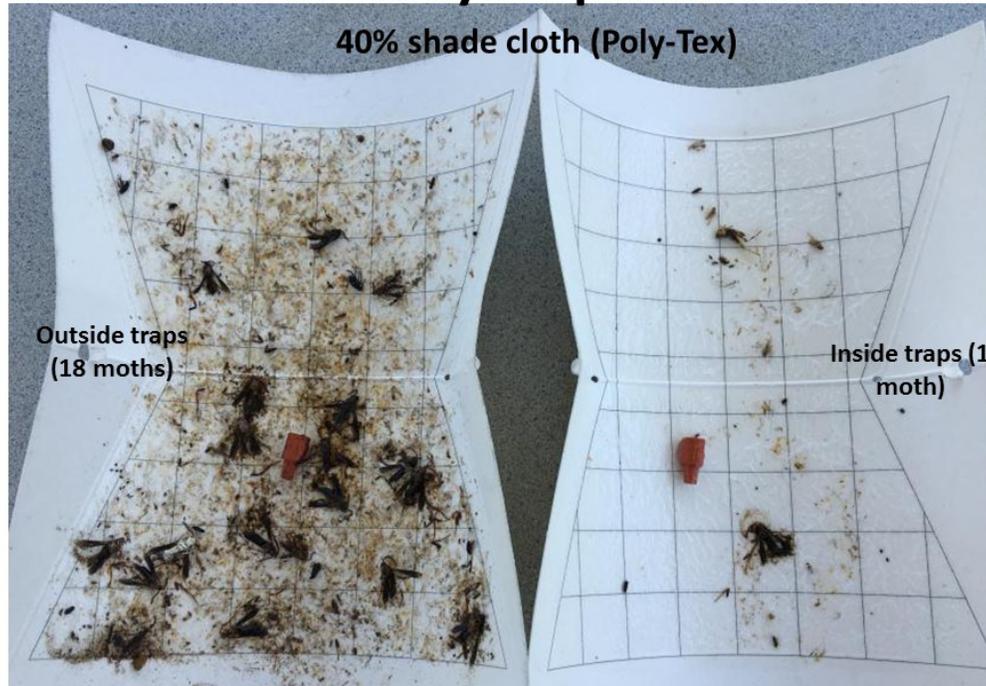


Fig. 6. Major reduction in squash vine borer moth numbers using 40 percent shade cloth as a permanent pest exclusion system in a high tunnel.



Fig. 7. Producers Russell Bean (left) with S&B Farms in south Alabama and Steve Carpenter with Jack-O-Lantern Farms in north Alabama have custom-fitted HTPE systems with immediate reduction in pest numbers.

Producer Recommendations

- A 50 percent woven shade cloth (with wide openings) appears to be a good choice for several common insect pest species. Install the fabric tightly under the side walls in order to allow maximum air movement. Secure the end wall fabric using Velcro or grommets that may come pre-installed with a custom-cut netting (**Fig. 5**).
- Always install netting when there is no crop inside the high tunnel. Starting out clean is very important to avoid trapping insects inside.
- Take care when weeding around the fabric. Do not use a mechanical weed killer too close to the shade cloth.
- Till the soil inside the tunnel and around the border. Get rid of weeds as much as possible. These two steps help reduce grasshoppers getting trapped inside the tunnel.
- It is a good idea to limit the number of visitors entering a netted tunnel. A netted tunnel is like a greenhouse where an insect pest may accidentally enter and get trapped resulting in infestation hot-spots. Insects and mites can hitchhike on clothes resulting in rapid spread.
- Readers wanting more information about the HTPE system should look for informative YouTube videos available in the [HTPE Training Module](#) on the Alabama Vegetable IPM [website](#). It is also a good idea to integrate sorghum and sunflower trap crop systems outside the tunnel to distract sucking insect pests and attract natural enemies. Look for the [trap crop training module](#) for more information and contact the primary author for more information.
- Market gardeners can use low-cost temporary pest exclusion systems using light fabric, for example, [Super Light Insect Barrier](#) sold by GardensAlive, Lawrenceburg, IN. This and other similar fabric is very effective in the early season for protecting vegetable seedlings from aphids, flea beetles, and grasshoppers.
- Always contact the Cooperative Extension Service in your state and county for proper pest identification before developing a site-specific IPM plan suitable for your farm or garden.

Additional Reading

- [High Tunnel Crop Production Handbook](#) (iBook available for FREE download)
- [High tunnel pest exclusion \(HTPE\) system for vegetable production - SARE Bulletin](#) (2015)

High Tunnel IPM training modules:

- [High tunnel pest exclusion system](#)
- [Net house vegetable production](#)

Producer testimonial:

<https://youtu.be/MkLri24qzt8>

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