Alternative Weed Management Techniques for Greenhouse and Nursery Production

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Abstract:
Greenhouse and nursery producers in New York have highlighted weed management as a priority area for research and education. In response, we demonstrated the effectiveness of two alternative weed control practices – parboiled rice hull mulch and solarization. The rice hulls very effectively suppressed weed establishment if applied in a layer 0.75" thick, which is a result that growers can use to inform their management. Likewise, we demonstrated that solarization, even in non-ideal conditions, can achieve temperatures high enough to kill weed seeds, which growers commented would be helpful prior to planting.

Background and Justification:
There are very few herbicides approved for indoor use due to crop and human health risks. Not surprisingly, improving weed control was one of the main grower-highlighted priorities for topics to cover in the 2018 Greenhouse IPM In-depth held at Cornell University. In response, we led two non-chemical weed control demonstrations over the summer of 2018 that came to fruition during the Greenhouse IPM In-depth.

One of the demonstrations showcased the use of parboiled rice hulls as a mulch to suppress weeds in plant containers. This technique was popularized by a USDA study that found excellent control of bittercress and liverwort (Altland et al. 2016). These two weeds, along with yellow woodsorrel are the primary weeds of greenhouses due to their ability to spread propagative material. Bittercress and woodsorrel can eject seed several feet from their seedpods, while liverwort is gemmae are very easily spread by water movement. Altland et al. (2016) surmised that the rice hulls dry so quickly that they do not provide an adequate environment for germination. However, due to their light weight, they can only be used in non-windy (usually indoor) sites.

The second demonstration was of solarization – the use of clear plastic to super-heat the soil to kill weed seeds and some pathogens. This practice has been used for many years in hot climates like Israel, and is becoming widely used in California specialty crop production as an alternative to methyl bromide. Recent work in Maine has shown that solarization can be successful in temperate climates as well (Birthisel et al. 2018). This work showed that solarization can also be used in indoors, in fact, higher temperatures were achieved within a hoophouse. Several keys to solarization include 1) applying the plastic to bare, level soil, 2) applying plastic after a rain or irrigation, and 3) sealing the edges to retain heat.

Objectives:

The objectives of this project were to 1) investigate the effectiveness of rice hull mulch and solarization, 2) disseminate results through demonstration, video, and articles, and 3) measure intention to adopt these practices.

Procedures:
The rice hull mulch trial was setup in a similar manner as Altland et al. (2016) using 6" pots of sterile potting mix planted with iris bulbs and a layer of 0", 0.25", 0.5", or 0.75" of rice hulls spread on the surface. Fifty seeds or gemmae of hairy bittercress (*Cardamine hirsute*), yellow woodsorrel (*Oxalis stricta*), and common liverwort (*Marchantia polymorpha*) were spread on the surface of each pot, totaling 150 propagules per pot. Each treatment was replicated four times. Unfortunately, most of the iris bulbs were not viable and never emerged, so those that did emerge were clipped for consistency. Potting and seeding occurred on May 25, 2018 and weed cover and density were assessed on July 23, 2018.

The solarization demonstration was installed on July 10, 2018 outside the greenhouses of Cornell University's Plant Science Building in full sun. Salvaged hoophouse plastic was used for the solarized plot, while the control plot was left bare. Each plot measured 6' x 6'. Once temperature loggers (Onset Hobo MX Pendant) were buried 2" deep in each plot, the edges of the plastic were buried. The plots were located on turf, which can shade the ground, so temperatures were not as high as would likely have been achieved on bare soil.

Results and Discussion:
The thicker layers of rice hulls were most effective at suppressing weed establishment (Figure 1 and 2). The 0.5" layer suppressed most establishment and may be satisfactory to some growers, but we suggest the 0.75" layer, which suppressed nearly all weed establishment. Altland et al. (2016) found that 0.5" sufficed, but they used a lower seeding rate for their weeds. For the 0.75" layer, a $25 bag of rice hulls would cover around 77 square feet of potted surface area.

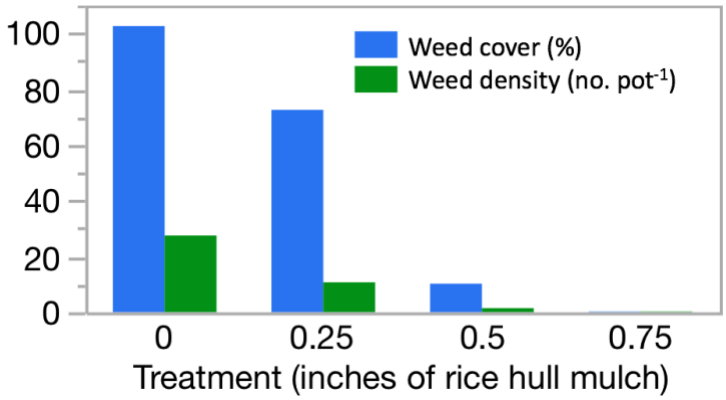

Figure 1. Effect of parboiled rice hull mulch on weed establishment. Weeds included hairy bittercress, yellow woodsorrel, and common liverwort. The weed assessments were conducted 60 days after establishment.

Figure 2. Photograph of the effect of several rates of rice hull mulch on weed establishment.

The solarization was very effective at killing the existing vegetation (Figure 3) and although the vegetation likely prevented the ground from warming to its potential, it still warmed to over 120 degrees F (Figure 4), warm enough to likely kill many weed seeds in the top few inches of soil.

Overall, the demonstrations and resulting YouTube videos were successful in educating growers about rice hull mulch and solarization. Several growers mentioned their intention of trying out rice hull mulch or using old hoophouse plastic to reduce weed seedbanks prior to planting.

Figure 3. Photograph of the solarized plot immediately after the plastic was removed.

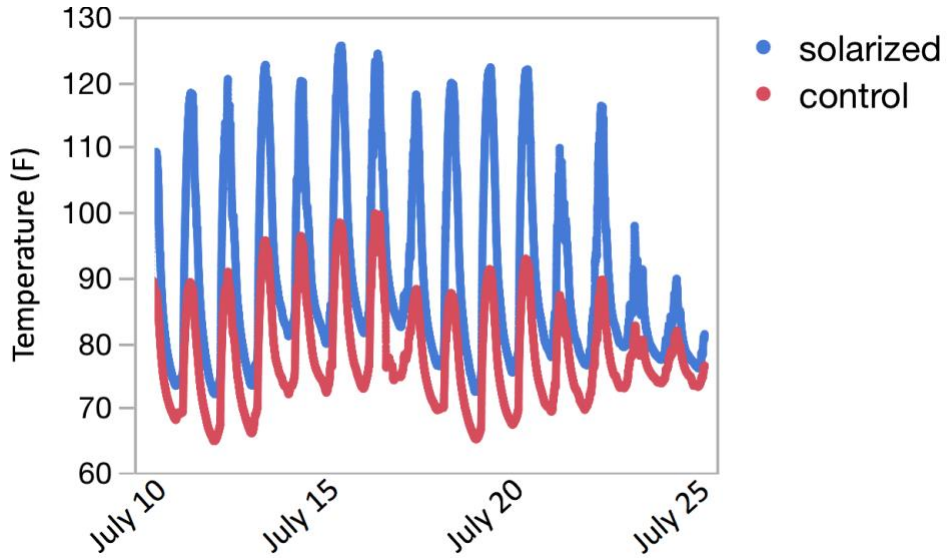

Figure 4. Soil temperature at 2" depth over the course of the demonstration.

Literature Cited:

Altland, J.E. Boldt, J.K. and Krause, C.C. (2016) Rice Hull Mulch Affects Germination of Bittercress and Creeping Woodsorrel in Container Plant Culture. American Journal of Plant Sciences, 7, 2359-2375

Birthisel SK, Gallandt ER, Cunha AES (2018) Solarization and Tarping for Weed Management on Organic Vegetable Farms in the Northeast USA. Available online at https://articles.extension.org/pages/74713/solarization-and-tarping-for-weed-management-on-organic-vegetable-farms-in-the-northeast-usa

Project Locations:

Tompkins Co, NY
Ontario Co, NY

Resources Developed:

Presentation, Greenhouse IPM In-depth, NYSIPM, Ithaca, Tompkins Co, Weed management in greenhouses 101, 7/25/18

Video, Brown B. Rice Hull Mulch for Greenhouse Container Production. Available online at https://www.youtube.com/watch?v=0eV0HC5LmZ0, 9/20/2018

Video, Brown B. Soil Solarization for Weed Control. Available online at https://www.youtube.com/watch?v=8ZCYMOTg_kU&t=1s, 9/20/2018

Additional Photographs: