

Rice Hulls For Weed Control In Container Crops

By Dr. James Altland, USDA-ARS

The USDA-ARS in Wooster, OH, has begun a new five-year research program to develop weed management options for herbicide-sensitive crops. This is a multi-pronged approach to develop a wide variety of tools for weed control in production settings where herbicides are either not labeled or cannot be used safely.

A very promising part of this project thus far has been the use of parboiled rice hulls as a mulch in containers. Riceland Foods, Inc. has been marketing their parboiled rice hulls for weed management in horticulture crops, and some nursery producers in Ohio have already successfully used rice hulls for weed control. The goal of our research was to determine, in controlled research, what quantity of rice hulls provided effective weed control of liverwort (*Marchantia polymorpha*) and bittercress (*Cardamine flexuosa*) (Image 1).



Image 1: Bittercress is especially difficult to control in propagation houses and other covered structures where herbicide use is limited.

A Few Basic Points

Before I get into the details of our experiments and results, it's important to review some basic concepts on how mulches provide weed control. Seeds of container weeds are small, and must germinate on or near the container substrate surface. When you cover the substrate surface with mulch, small weed seeds don't have enough stored energy to grow through the mulch and establish themselves on the surface. This is primarily how mulches provide weed control, at least temporarily. The problem is that most

mulches don't provide long-term weed control because the mulch itself becomes an excellent substrate for weed germination. After the mulch is applied, new weed seeds that land on the surface of the mulch will soon germinate in the mulch itself. A truly effective mulch, especially for container production, is one that persists for a long period of time and offers an inhospitable site for weed seed germination.

Effective mulches for container crops should have a combination of the following properties: they provide little or no available nutrients, they dry quickly after irrigation, and they resist decomposition. Weed seeds require available nutrients to establish successfully. They may germinate in the absence of nutrients, but they will fail to develop much past the cotyledon stage without sufficient nutrition. This is especially true for container weed species, which again all have, very small seeds. Nitrogen is the key nutrient that must be available for successful seedling establishment. Thus, compost materials often make poor mulches (especially in landscape situations). The high nutrient content of many compost materials will actually increase weed growth.

An effective mulch will not retain water. This seems contradictory to what we have learned about mulches in the past. To be clear, it is acceptable, and even desirable, for a mulch to reduce evaporation and thus preserve water in the substrate. However, the mulch itself should not retain water. Weed seeds require water to trigger germination. Moist mulch will allow this to happen more quickly than if it dries rapidly. Furthermore, most organic materials will have sufficient porosity to promote root growth of the newly germinated weed as long as sufficient water is available to sustain root growth. A mulch that does not retain water itself will make germination and weed establishment unlikely. Mulches that dry quickly after irrigation or rain are inhospitable to weed establishment.

It almost goes without saying that mulches must resist decomposition. If the mulch decomposes, the barrier is lost and weeds are free to germinate. Unfortunately, abundant fertilization and irrigation are conducive to organic matter decomposition. The nature of nursery and greenhouse crop production renders many mulch products unacceptable due to decomposition after just a few weeks in production.

To review, the ideal mulch will be low in nutrient composition, retain little water even after irrigation, and resist decomposition. With that in mind, let's look at some recent experiments to see how effective rice hulls are in preventing liverwort and bittercress establishment, two of the most problematic weeds in nursery production.

Will Fertilizers Affect Rice Hull Mulch?

The first experiment we conducted examined bittercress and liverwort growth in containers with 0, ¼, ½, and 1 inch of rice hulls applied to the surface. We filled 48 containers with standard greenhouse growing substrate and applied each rice hull treatment (mulch depth) to 12 containers. Of the 12 containers, six were placed on a bench that received overhead irrigation with regular tap water twice daily, and six were placed on a bench that received overhead irrigation with a standard commercial water soluble fertilizer injected (100 ppm N) twice daily. We applied liverwort gemmae (spores) to the surface of the container weekly to encourage liverwort establishment. We applied bittercress seed to the surface twice, immediately after applying the mulch and about 4 weeks later. We observed weed control in the pots to determine if rice hulls could prevent these weeds from establishing.

Rice hulls at ½ or 1 inch depth provided 100% weed control (Figure 1) (Image 2). No weeds grew in these pots. In containers with ¼ inch of rice hulls, both bittercress and liverwort grew, albeit a lot less than the un-mulched pots. This may have something to do with the way we applied the rice hulls. For the 1 inch mulch depth, we carefully weighed the containers before and after applying rice hulls to a depth of 1 inch. The weight of rice hulls in those pots was 44 g. So, for the pots receiving ½ inch of rice hulls, we simply weighed 22 g of rice hulls for each pot, and 11 g for the ¼ in pots. This seemed a fair, consistent, and accurate way to



Image 2: Rice hull mulch provides excellent control of bittercress and liverwort. From left to right are covered with 1, ½, ¼, and 0 inches of parboiled rice hulls.

meter out the rice hulls. In doing this, we observed that ½ and 1 inch treatments were completely and thoroughly covered with rice hulls. However, the ¼ inch depth left some gaps in the mulch layer so that you could see the substrate surface through the mulch. Invariably, it was in these gaps that liverwort and bittercress found a footing and successfully established.

Based on our earlier discussion on the role of nutrition in weed seedling establishment, you might expect weed growth to be more vigorous on the bench with fertilizer injected into the irrigation stream. And you'd be correct, that's exactly what happened. Weeds in the non-mulched pots (no rice hulls) that received fertilizer were a lot larger than those in the control pots with no fertilizer. However, to my surprise, rice hulls applied at ½ or 1 inch depth provided perfect liverwort and bittercress control even with fertilizer injected into the irrigation stream. Quite frankly, this surprised me a great deal. I was expecting weeds to germinate into the rice hulls as long as fertilizer was applied via the irrigation system. But they never did in the 8 week trial.

After observing this trial for several weeks, I was impressed with how quickly the rice hulls dried following irrigation. Since nitrogen was not limiting in these pots, I concluded that it must have been the water that was limiting. Perhaps the rice hulls dry too quickly for weed seed to successfully germinate and establish? We didn't have any sensors or fancy gadgets to measure moisture levels in the rice hulls. However, we irrigated all these pots twice daily, and we could see with our own eyes how quickly the rice hulls dried after irrigation. We could also see the weed seed and liverwort gemmae (reproductive spores) sitting on the surface of the rice hulls without ever germinating or establishing (Image 3).



Image 3: Rice hulls make an inhospitable site for weed germination. This photo shows oxalis seed (in red circles) on the substrate surface, still unable to germinate after 6 weeks.

Would A Canopy Affect Mulch Stability?

The first experiment was done in 6 inch azalea pots filled with media, but with no plants other than the weeds. For the second

experiment, we hypothesized that with a plant growing in the pot, the shade from the canopy might cause the rice hulls to remain wetter for a longer period of time, and thus be more conducive to weed establishment. We were wrong!

The second experiment was set up similar to the first experiment, using the same pots and rice hull treatments. In this experiment, all pots received irrigation injected with a complete fertilizer, twice daily. Half of the containers were filled and mulched similar to the first experiment, the other half of the containers were filled, potted with a single Knockout rose liner, then mulched.

The results of the second experiment were similar to the first experiment. Containers with ½ or 1 inch of rice hull mulch had few or no weeds. In one of the containers with ½ inch rice hulls, a small colony of liverwort established. Upon closer examination, we observed that the liverwort grew in a small region of the pot with a gap in the rice hulls where the substrate below was exposed. It's likely that the surface of the substrate was irregular and not made perfectly level at the time of potting. When the mulch was applied, the rice hulls formed a level surface but a high peak in the substrate poked up through the rice hull barrier. Of all the pots we mulched, this was rare. However, it shows that any exposed substrate will be conducive to weed growth, and weeds (using Murphy's Law) will find that small exposed site to successfully establish.

Contrary to what we expected, weed control within the pots with a rose plant was as good or better compared to the pots with no rose. The rice hulls did, in fact, dry a little more slowly in containers with the rose canopy, but not slowly enough to allow for weed establishment. At the conclusion of the experiment, the weeds that were growing in these pots were smaller than those that grew in the pots with no rose. Reduced growth in the rose pots was likely due to competition from the roses.

Closing Thoughts

Our experiments showed that rice hull mulch provides effective weed control when used at ½ to 1 inch depth. Reducing the depth to ¼ inch resulted in some gaps in the rice hull barrier, and invariably weed establishment. Riceland Foods, Inc. provides a horticultural grade of parboiled rice hulls for the greenhouse and nursery industry. They recommend a depth of 1 ½ to 2 inches for effective weed control. Not only is that recommendation impractical in all but the largest nursery containers, it is excessive considering that we found ½ inch to be an effective depth.

The most exciting, and surprising, aspect of this initial stage of research has been the effectiveness of rice hull mulch even when fertilizer was injected through the irrigation system. The stability and effectiveness of rice hull mulch with constant feed fertilization lends it to being useful in most nursery, greenhouse, and propagation systems.

The Organic Materials Review Institute (OMRI) considers parboiled rice hulls as a product suitable for certified organic production. This certification may vary by source, however, so if you are interested in using rice hull mulch in your organic produc-

tion system, verify that the specific rice hull product you intend to purchase has the OMRI certification.

Other Random Observations

Fungus gnats were problematic in the greenhouse where this research was conducted. However, the fungus gnats seemed to avoid containers with rice hulls. In conversation with entomologists in our unit, they explained that lack of water in the rice hull mulch is likely the primary reason it seemed to suppress fungus gnats. The rapidly drying rice hulls inhibited weed germination and fungus gnats. How about killing two birds with one stone?!

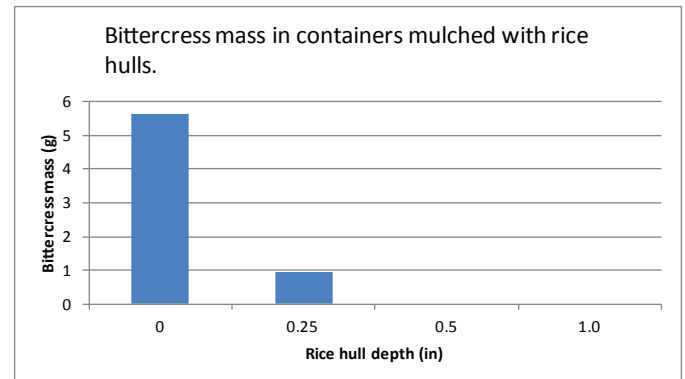


Figure 1. Rice hulls at depth of ½ to 1 inch provided 100% bittercress control.

The experiments described here were conducted for 8 weeks. So our claims of excellent weed control can only really be inferred for crops that are grown for approximately 8 weeks, including perennials, propagation liners, groundcovers, etc. Our research doesn't test the stability and effectiveness of rice hulls for longer periods of time. That said, the rice hulls in our experiments after 8 weeks looked as fresh as the day they were applied.

We attempted to evaluate rice hull mulch in #3 containers for up to 12 months on our nursery gravel pad. This site is outdoors, with no protection from wind and rain. After plants were growing for about 2 weeks, a fairly typical Ohio thunderstorm blew the rice hulls into the next county. That experiment was terminated. Based on this observation, I don't expect this product to be very useful outside of hoop-houses or similarly protected structures.

More Results Are Forthcoming

There are other aspects of using rice hull mulch that we are currently exploring. What effect does rice hull mulch have on substrate pH? Rice hulls have previously been shown to be high in phosphorus and potassium. Will using rice hulls affect the nutrition of the crops being grown? How will rice hull mulch affect plant water use and irrigation rates? Look for the answers to all these questions in upcoming articles.

Dr. James Altland is a Research Horticulturist with the USDA-ARS in Wooster, OH. He can be reached by email at james.altland@ars.usda.gov. Mention of any commercial product in this article is for educational purposes only, and should not be considered an endorsement by USDA-ARS.

*“PBH gives us
weed control
from day one.”*

*“We topdress containers with PBH
at potting to ensure season-long weed
control and significantly reduce hand
weeding. With increasing labor costs
and unpredictable weather patterns,
we were looking for just such a tool to
supplement our herbicide program.*

*We also use PBH in our mix to
maintain porosity. It works two ways
for us.”*



Tom Demaline, owner
Willoway Nurseries

With four million containers at Willoway Nurseries in Avon, Ohio, Tom Demaline values the benefits of PBH Nature's Media Amendment. We think you will, too.



870-673-5575
www.riceland.com