

Mulching with Large Round Bales between Plastic-covered Beds

John Wilhoit and Tim Stombaugh, Biosystems and Agricultural Engineering, and Timothy Coolong, Horticulture

Introduction

The use of plastic mulches and drip irrigation has become common for vegetable production in Kentucky and in many parts of the United States and the world due to the benefits of moisture conservation, weed control within the planting row, and the alteration of the soil temperature, enhancing the productivity of many crops. Weed control between the rows of plastic can still be a significant challenge, however, especially for organic vegetable growers because the use of herbicides is prohibited in organic production. One method of non-chemical control is to mulch heavily between rows of plastic with organic materials such as hay and straw. However, breaking down and spreading large numbers of square bales is too labor intensive for many growers. Large round bales are better suited to mulching between rows of vegetables because the bales can be unrolled to peel off layers that are about the right thickness for mulch. Since manual spreading of the mulch material is drastically reduced when unrolling round bales, using them for mulching can reduce the labor requirements considerably; however, it is still very labor intensive to handle and roll them out manually.

Commercially available tractor three-point hitch mounted bale unrollers are used to pick up and transport round bales and roll them out for feeding livestock. These implements carry the bale along the centerline of the tractor, so they cannot be used to unroll bales between rows of plastic because there is not enough space to drive the tractor between the rows. In order to make it possible to use a bale unroller to roll out round bales for mulching between plastic-covered rows, modifications were made to a bale unroller by extending the toolbar and adding another mast and lower hitch



Figure 1. Offset bale unroller unrolling a round bale of hay between rows of plastic.

point. The modifications offset the bale a sufficient distance for the tractor to straddle the row of plastic and unroll the bale in the space between adjacent rows of plastic (Figure 1). Another feature of the offset bale unroller is a hydraulic top link that increases in length as the bale gets smaller, pivoting the arms gripping the bale downward to keep the bale on the ground. This keeps the toolbar high enough to prevent damage to the plants or the plastic covering the bed. For more information about the design of the offset bale unroller, see University of Kentucky Cooperative Extension Service publication AEN-117 *Modifying a Bale Unroller for Mulching between Plastic-covered Beds*.

Large round bales were used to mulch watermelon plots for several seasons at the University of Kentucky Horticulture Research Farm using the offset bale unroller. The implement was also taken to several farms in Kentucky and Virginia

in 2012 to work with farmers mulching with large round bales. The following are a compilation of many of our experiences and recommendations for the practice of using large round bales for mulching between plastic-covered beds.

Sources of Baled Material and Weed Control Effectiveness

There are a number of considerations related to the sources of baled material and weed control effectiveness.

- Round bales of mixed grass hay are readily available in most areas, while wheat straw may also be available in areas where wheat is harvested.
- Old or spoiled hay that is no longer good for animal feed can be a low-cost alternative for mulching with hay.
- The weed control effectiveness of mulches depends to a large extent on the thickness of the mulch material.

The thicker the mulch, the more effective the weed control is likely to be, but the cost goes up because more mulch material is required.

- Weed control effectiveness can also be affected by the possibility of introducing weed seed with the mulch. This has been a concern with using hay mulch (as opposed to straw), but straw from harvested grain can introduce grain seed that can also be a weed problem. Differences in the sources of hay can have an effect on the potential for introduced weed. Hay for mulching should probably be from first cuttings if possible, from fields that are as weed free as possible.

Field Trial Results

To address some of these considerations, mulching trials were conducted with different hay and straw treatments between plastic-covered beds planted with watermelon in 2009 and 2010 at the University of Kentucky Horticulture Research Farm, Lexington, Ky. The specific objectives of the study were to:

1. Investigate the potential for seed to be introduced by mixed grass hay, compared to that from wheat straw.
2. Investigate whether the age of the mulching material (freshly cut versus one year old) has an effect on weed suppression.
3. Investigate the effect mulch thickness on weed suppression.

Round bale treatments in 2009 included new mixed grass hay (NH), new wheat straw (NS), and year-old mixed grass hay (OH). The watermelon seedlings

were planted in beds covered with 48-inch wide black plastic on 8-foot centers in 2009. In 2010 the treatments were the same with the addition of year-old wheat straw (OS), and the watermelon seedlings were planted in plastic-covered beds on 7-foot centers. The new and old hay bales came from the same field, and both were first cuttings. The treatments were applied in two thicknesses, one rolling the bales out once (1X, approximately 4-inch thickness) and the other rolling bales out twice (2X, approximately 8-inch thickness). The treatments were applied to the plots soon after they had been mechanically cultivated to leave the bare ground between the rows of plastic clean of weeds. The cultivation was done right before the vines starting running, a common practice used by growers. Mulch biomass mass amounts were measured the day after application by collecting and weighing all of the mulch between two boards spaced 3 feet apart in between the edges of the plastic. This mulch was returned to the area from which it was removed. Weed control effectiveness was assessed at the end of the growing season by collecting the entire above-ground weed material from fixed areas in the plots and oven-drying the material to determine biomass dry matter.

Mulch biomass amounts were determined as a check on the thickness of the mulch applied. The results in tons/acre are shown in Figures 2 and 3. In 2009, because of the wider row spacing, there was a gap between the layers of mulch rolled out from the bales and the edges of the plastic that had to be filled in by hand. Also, the freshly-baled wheat straw did not roll out in layers; it essentially fell

apart when the net wrap was taken off, so the straw mulch treatment plots mostly had to be spread by hand. Despite the extent of manual spreading required, the biomass amounts applied were fairly consistent, although the amount in the double thickness treatment plots tended to be somewhat less than twice that in the single thickness plots. In 2010, there was a heavy rain the in the afternoon after the mulch treatments were applied, and many of the bales rolled out in much thicker layers than they had the previous year. Both of these factors contributed to the mulch biomass being much heavier than in 2009. The double mulch thickness was especially high for all of the mulches except the new straw. The straw mulches tended to be lighter than the hay mulches both years. Also as in 2009, the bales of new straw would not roll out in layers, but interestingly the bales of old straw would.

All of the mulch treatments provided significantly better weed suppression than the control (no mulch) both years (Figures 4 and 5). The results for the new versus old hay and straw were inconsistent. The double thickness of mulch gave significantly better weed control, but the single thickness was still quite effective, indicating that a single thickness of mulch is sufficient. The mixed grass hay in general had fewer weeds than the wheat straw, primarily because there was a lot of wheat grass that sprouted in the plots mulched with wheat. The weed control effectiveness of the mulch treatments decreased considerably through the season, but was considerably better than no mulch (Figure 6), and it seemed to be sufficiently effective for good watermelon production.

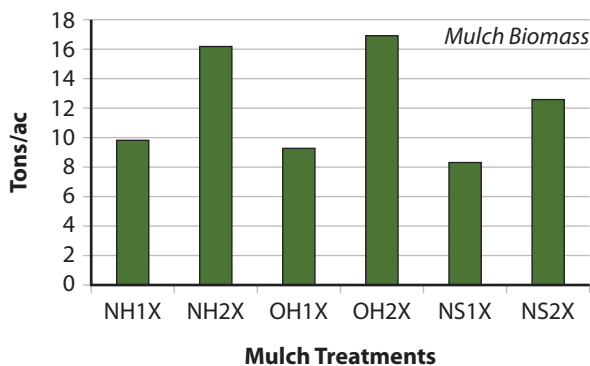


Figure 2. Mulch biomass amounts for different treatments in 2009.

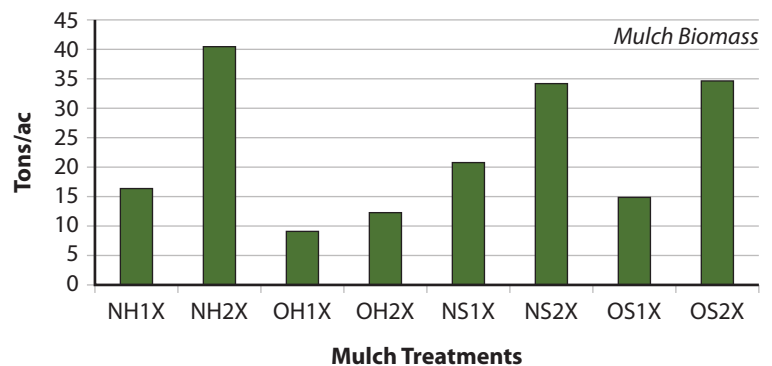


Figure 3. Mulch biomass amounts for different treatments in 2010.

Introduced weed seed did not seem to be a problem with the mixed grass hay that we used, but we did see some indication of the potential for a weed problem from grain seed in the straw, as mentioned above. For full details and statistical analysis for this study, see "Weed Control Effectiveness of Hay and Straw Mulches Between Plastic-covered Beds," 2010 Fruit and Vegetable Research Report (PR-608).

Further Considerations Related to Baled Material

Other important considerations related to the baled material include availability, cost, and efficiency of the mulching operation. Round bales of mixed grass hay are less expensive than straw in some areas, but not in others. Round bales of grass hay are more available and less expensive in good harvest years, but scarce and much more expensive in drought years. Old or spoiled hay may be available at little or no cost. However, in our experiences, the large rotted spot at the bottom of old round bales that have been stored on the ground outdoors tends to make the bales unroll poorly. Large amounts of hay are left in clumps until the bale is rolled out past the depth of the rot spot. How well the bales roll out in layers is an important consideration for efficiency. We have found that round bales of fescue-based mixed grass hay tend to roll out in better matted layers than other types of grasses. Conversely, we have found that freshly-baled wheat straw tends not to be matted at all, so that a third to half of the bale may fall off when the netting or strings are first cut off the bale. There seems to be better matting (and therefore better unrolling) with year-old bales of wheat straw. The more clumping there is, whether because of rot spots or because of poor matting, the more work is required to spread mulch material by hand. Coverage is another consideration related to both cost and efficiency. In general, the round hay bales we have used have unrolled to a length of 250-300 feet.

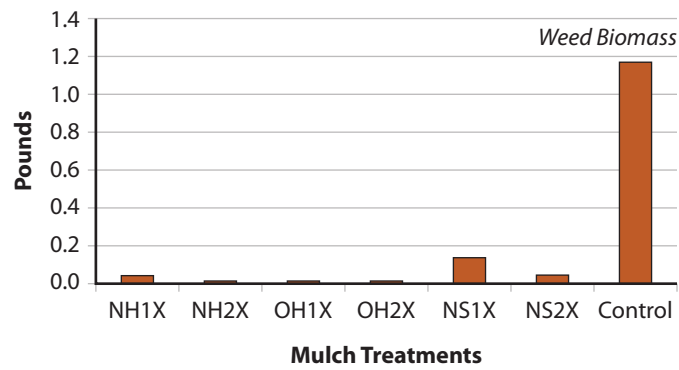


Figure 4. Weed control with different mulch treatments in 2009.

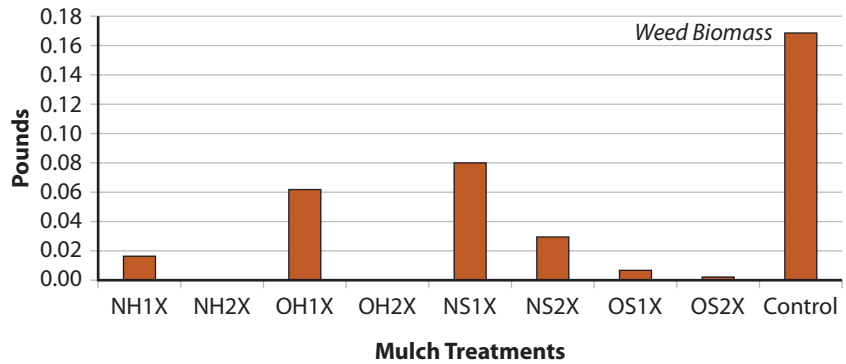


Figure 5. Weed control with different mulch treatments in 2010.



Figure 6. Weed control in mulched plots (left side) versus unmulched control (center-right).



Figure 7. Clamping position for lifting bale off the ground for transport with small tractor.



Figure 8. Round bales used to mulch between rows of plastic at Waterpenny Farm in Springfield, Va.

On-Farm Experiences with the Offset Bale Unroller

We took the offset bale unroller to several different farms in 2012 to gain some on-farm experiences and to get feedback from growers. All of the farms where we took the offset bale unroller used tractors with only a single remote outlet available, so an additional double hydraulic control valve was used so that both hydraulic cylinders could be operated. The valve is described and considerations about its use are discussed in another publication about the design of the offset bale unroller.

On one of the farms, the tractor was too small to be able to lift the bale completely off the ground for transport (without unrolling it) when the bale unroller arms were clamped in the center of the bale. To overcome this limitation, the arms could be used to clamp on the bale below and to the rear of the bale center point so that it wedged against the toolbar (Figure 7). The bale could then be lifted and transported (without unrolling) to position it at the edge of the field, and then the clamping arms could be repositioned in the center of the bale for the unrolling operation. The offset bale unroller can be used with tractors with either a Category I or II three-point hitch system but, in general, a minimum 35 hp tractor should be used with the implement.

Waterpenny Farm in Sperryville, Va., is large-scale market grower operation with over 8 acres of vegetable production on plastic-covered raised beds. It is more common to use mulch for weed control between the rows with vining crops, since there is no other means of weed control once the vines start running, but Waterpenny Farm mulches all of their vegetables, rolling out more than 200 bales of mixed-grass hay each year (Figure 8). They recognize a number of advantages to the practice of mulching with round bales that justify the expense and extra work. These advantages include keeping fruit off the bare soil, so the fruit stays cleaner, needs less washing, and the chances for rot are reduced; reducing splashing of bare soil which can be a benefit in reducing disease pressures; and adding organic material to the soil. They also feel that it helps reduce compaction from tractor and foot traffic, provides habitat for beneficial insects and microbes, and reduces erosion. The people at Waterpenny Farm thought that the offset bale unroller increased the efficiency of their bale unrolling operations so much that they plan to fabricate one for their farm. To see a video of bale-unrolling operations using the offset bale unroller at Waterpenny Farm, go to <http://www.youtube.com/watch?v=S0QRqjJwMB4&feature=youtu.be>.

Correctly Orienting Bales for Unrolling

To get round bales to unroll in layers as the bale is rolled along the ground, the bale must be facing in the correct direction. It can be difficult to tell whether the bale is oriented correctly just by looking at it. In our work with the offset bale unroller, we have developed a fairly simple way to judge the correct orientation of the bale for clamping onto it with the bale unroller. In the correct orientation, the sharp ends of the stems of the baled material on the top half of the bale should be pointing in the direction of the tractor. An easy way to judge the direction that the sharp ends are pointing is to rub the palm of the hand along the top half of the bale on the end, in the direction shown (Figure 9). If oriented correctly, you will feel the sharp ends of the stems against the palm. If it is oriented incorrectly, the baled material will be smooth against the palm. In this case, the bale can be turned around 180° relatively easily by two people, or the tractor can be repositioned. Implementing this method of correctly determining bale orientation will help eliminate the need for bale or tractor repositioning and will make bale unrolling operations more efficient.

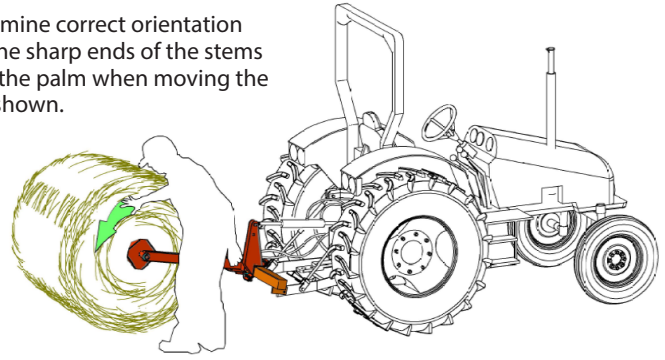
Caution When Mulching with Hay

There is one particular hazard associated with mulching with hay that growers need to be aware of and avoid. Herbicides with the active ingredient aminopyralid (ex. Forefront, Milestone) are sometimes used on pastures for controlling broad-leaf weeds. The active ingredient in this family of herbicides may persist for several years in cut hay, and hay from fields treated with these herbicides can kill or severely injure vegetable crops if used for mulch. Even manure from cattle grazing on fields treated with these herbicides, or compost from hay or such manure, can harm vegetable plants. Anyone considering using hay for mulching between rows of plastic needs to be absolutely sure that the hay is from fields that have not been treated with these herbicides.

Summary and Conclusions

Mulching between rows of plastic used for vegetable production can be an effective practice for controlling weeds, especially for organic production where the use of herbicide is prohibited. There are other benefits besides weed control to mulching in this way, including keeping the fruit off the soil and therefore cleaner and reducing the chances for rot, reducing splashing that can increase disease pressures, and adding organic matter to the soil. Large round bales lend themselves very well to the application of mulching rows of vegetables because

Figure 9. Test to determine correct orientation of bale for unrolling. The sharp ends of the stems should be felt against the palm when moving the hand in the direction shown.



the bales can be unrolled to peel off layers that are about the right thickness for mulch. An innovative implement that offsets the bale so that it can be unrolled between the rows while the tractor straddles the row can make the practice of mulching with round bales considerably more efficient.

Round bales of mixed fescue-based grass hay seem to be a good choice for mulching because they roll out in good matted layers and they are often cheaper than other materials such as straw. There are concerns about introducing weed seed when mulching with hay or straw, but this did not seem to be a problem with the hay we used in our field trials. We used good, first cutting hay in our trials, but introduced seed could be more of a problem with mixed grass hay cut later in the season or from grass harvested in later growth stages. We did note considerable sprouting of wheat seed when we mulched with straw. Old or spoiled hay that is no longer good for animal feed can be a low-cost alternative for mulching with hay, but in our experience it is

difficult to get it to roll out effectively because of the substantial rot spot where it has been sitting on the ground. Hay and straw mulches provided effective weed control for watermelon production in our field trials. The use of mulches is well-suited to the production of vining crops because it can provide continuing weed control after the vines fill in the space between rows, a time when essentially no other weed control measures (other than hand-pulling weeds) can be applied. Some growers like to mulch all of their vegetable crops, however, because of the added benefits besides weed control, mentioned above. Mulching with round bales might be a particularly good option for vegetable growers who have round bales from their own farms. For vegetable growers with round bales from a source they can be sure of, mulching between rows of plastic could be a practice with significant weed control and other benefits. Using an offset bale unroller could make bale unrolling operations for mulching in this way considerable more efficient.

Graphics provided by David Ash and design and fabrication work provided by Carl King, Biosystems and Agricultural Engineering Department, University of Kentucky.

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