Evaluating the Effectiveness of Locally Available Woodchips for Weed Control

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Abstract

A study was conducted to evaluate the effectiveness of locally available woodchips as organic mulch for weed control. The study was conducted on an urban farm located in Sandstone, Virginia, during the growing period from July1 through September 1, 2018. The experimental design was set up as a completely randomized design with two mulch treatments and control, replicated 5 times. The experimental plots were approximately 4 ft. by 50 ft. and included single and double shredded hardwood bark applied at a depth of 4 inches; and control (no mulch). Weed infestation was determined by visual observation as well as determining the fresh mass of weed followed by identification of species. A wooden quadrant measuring 0.41 m by 0.41 m (0.168 m²), was used to demarcate random locations on the experimental plots where weed samples were collected. The matric potential and soil temperature were recorded on a weekly basis. All plots were rain-fed with no supplemental irrigation applied. The results revealed that the average weed mass was significantly ($p<0.05$) higher for the control plots (286 g) compared to those with organic mulches (137g), with the most prevalent weeds species being crabgrass. The visual weed rating showed significantly higher ($p<0.05$) values for the control plots (62.7%) compared to those treated with mulch (26.5%). There was a linear increase in the weed rating for both control plots ($R^2=0.89$) and those treated with mulch ($R^2=0.86$). There was a correlation between the weed mass and the visual weed rating ($r=0.76$), suggesting that a relatively direct method of weed assessment (visual rating) would be applicable in estimating the weed mass. The matric head for the plots treated with mulch was significantly lower (more negative) ($p<0.05$) for the control plots (-7.97 cbar) compared to those with organic mulches (-1.48 cbar). This suggests significantly lower available water for the control plots compared to those treated with mulch. For the soil temperature however, there was no significant difference between the treatments. The yield for okra was significantly ($p=0.5$) higher for the plots treated with the mulch (2.59 Kgs) compared to the control (2.13 Kgs). We conclude that the locally available woodchips would provide the benefit of weed suppression, improved water holding capacity and hence the yield of okra crop.

Introduction

Weeds are defined as plants growing out of place or where they are not wanted. They prevent the plants that you want from growing properly and although some may look attractive, they take something away from the goal of growing a healthy garden. Some weeds do more than compete for water, sunlight and nutrients, in that they harbor insect pests. According to Schonbeck (2011) weed apply to any plant species that often becomes a pest, such as common chickweed, pigweeds or crabgrass. However, weed manuals also list plants such as clovers, fescue, hairy vetch, and Jerusalem artichoke – valued as forage, cover, or food crops when grown in the right context – as potential weeds. Indeed, "volunteer crops" such as buckwheat, rye, Japanese millet, corn, or soybean can become weeds when they self-seed and emerge in another part of the crop rotation when they are no longer wanted (Schonbeck, 2011). While it is typically not necessary to keep a garden completely free of weeds, vegetables and fruits grow better when they do not have to share resources with other plants. Some of the challenges created by weeds include: competition for light, water and soil nutrients. One of the main challenges of crop production, especially in organic systems, is weed management. Weed control ranks as the number one barrier to organic agricultural production (Kristiansen, Sindel and Jessop, 2007). Indeed, it is estimated that weed control can take up to 30-50 percent of production cost on small, intensely managed farms (Kristiansen, Sindel, and Jessop, 2007).

Farmers practicing more conventional forms of crop production have more tools at their disposal to address weed control than organic farmers. Some of the methods of weed control available to organic vegetable growers include: cover cropping, use of herbicides, tillage, solarization, mechanical removal and various types of mulching. A study by Olkowski and Klitz (1981) showed that wood chip mulch can be effectively used to significantly reduce weed stands. And, according to Chalker-Scott (2007), the advantages of using wood chips versus plastic mulch include: improved soil structure; enhanced gas transfer; enhanced water infiltration and retention; prevention of erosion and compaction; providing nutrients; suppressing pathogens and pests; enhanced beneficial organisms; Increased biodiversity; neutralize pollutants; reducing economic loss; more visually pleasing produce resulting in increased sales; and ease of application. Sønsteby et al. (2007) reported that wood mulch increased leaf potassium and phosphorus over three years of experimental period. It also increased the soil moisture significantly.

Materials and Methods

The study on the effectiveness of locally available woodchips for weed control was conducted at NANIH Farm and Garden, located on 37°31'19" North latitude and 77° 19' 19" West longitude. The experimental design for this study was a completely randomized design with two mulch treatments and control, replicated 5 times. Thus, a total of twenty experimental plots measuring approximately 4 ft. by 50 ft. or 200 ft.² (4,000 ft.² total) were established.

The treatments included single and double shredded hardwood bark applied at a depth of 4 inches; and Control (no mulch). The four inch thickness was adopted since it was found to be effective in a previous study by Olkowski and Klitz (1981). The treatments included single and double shredded hardwood bark applied at a depth of 4 inches; and Control (no mulch). Weed infestation was determined by monitoring the population density and identification of the species. Multiple vegetables and herbs were planted including tomatoes, basil, onions, zinnias, okra, kale, melons, cucumbers, and summer squash. Harvestable and marketable yield for each of these crops were recorded at harvest time for each experimental plot.

Weed infestation was determined by monitoring the population density and identification of the species. Visual rating scores for percentage of weed coverage in each plot were recorded on a weekly basis. In addition, weed samples were collected using a wooden quadrant measuring 0.41 m by 0.41 m (0.168 m²) from each experimental plot. In the laboratory, weed identification was also done and the fresh weight recorded for each sample. The procedure was repeated weekly until 12 weeks for the plots with applied mulch and those without (control plots). In most cases the control plot was situated next to the treated plot with the same vegetable, herb or flower being grown. The data collected for weed mass, visual weed rating, and crop yield were subjected to analysis of variance (ANOVA).

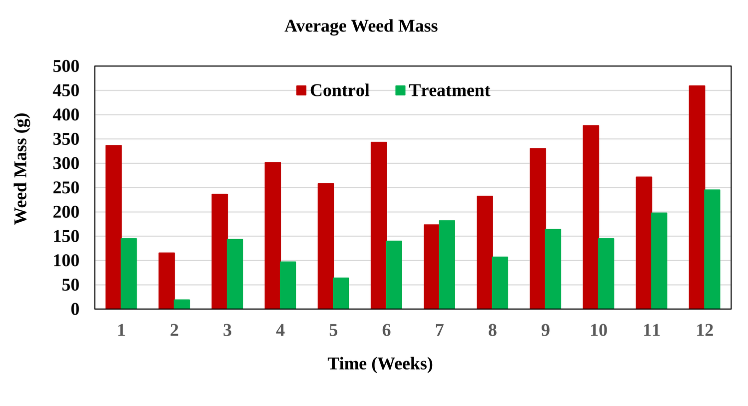

Figure 1: Average weed mass

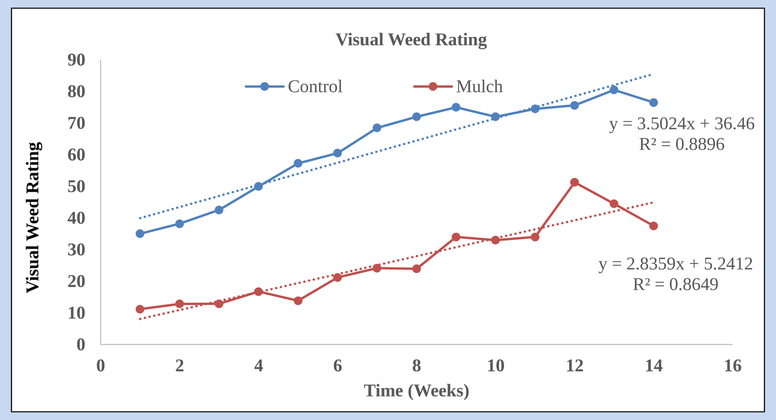

Figure 2: Visual weed rating

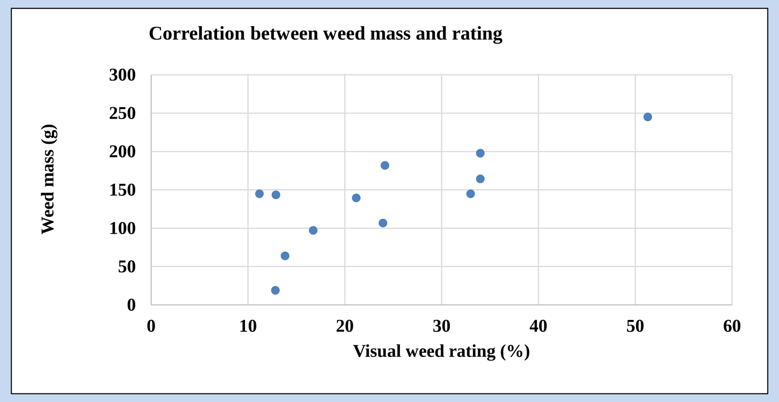

Figure 3: Correlation between weed mass and rating

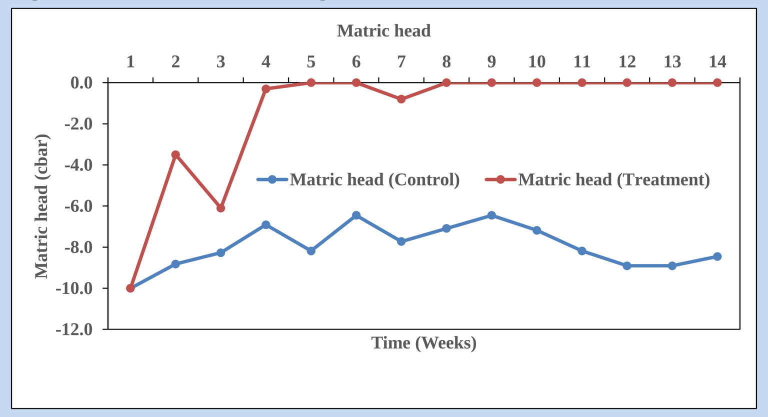

Figure 4: Matric head

Results

The results for the mass of weeds (g) for the experimental plots with applied organic mulch and those without during the experimental period, are shown (Figure 1). The results revealed that the average weed mass was significantly ($p<0.05$) higher for the control plots (no mulch) compared to those that with organic mulches. The results for the visual weed rating during the experimental period are shown in Figure 2. Statistical analysis revealed that the weed ratings were significantly higher ($p<0.05$) for the control plots compared to those treated with mulch. The average ratings for the control plots ranged from 35.1% to 80.5%, with a mean of 62.7%. For the plots treated with mulch, the average ratings ranged from 11.2% to 51.3%, with a mean of 26.5%. For both treatments, the lowest ratings were observed during the first week of the experiment. For the control plots, the highest weed ratings were observed in week 13, while for the treated plots, this was observed in week 12. There was a linear increase in the weed rating for both control plots ($R^2=0.89$) and those treated with mulch ($R^2=0.86$).

The correlation between the weed mass and the visual weed rating was done for the plots treated with mulch (Figure 3). The results revealed a relatively high correlation ($r=0.76$), suggesting that a relatively direct method of weed assessment (visual rating) would be applicable in estimating the weed mass. The method seems to be applicable for the mulched plots than the control (results not shown), due to the relatively higher variability of the weed species for the latter.

The matric head values for the plots treated with mulch versus the control are shown (Figure 4). The values were significantly ($p<0.05$) lower, that is more negative, for the control plots (-7.97 cbar) compared to those treated with organic mulches (-1.48 cbar). For the plots treated with mulch, the matric head values increased from -10 cbars to 0 cbars (saturation) during the first 5 weeks. The values remained almost constant at 0 cbars for the rest of the study period, suggesting the soil remained saturated or nearly saturated. For the control plots, there was an increase in matric head values from -10 cbars to -6.9 cbars during the first three weeks. Hence, the value fluctuated between -6.5 to -8.9 cbars through the rest of the experimental period. Matric head is a measure of how tightly the water is bound to the soil matric and hence a measure of how much energy the plant root have to expend to absorb that water. This suggests significantly lower available water for the control plots compared to those treated with mulch.

The yield results for one of the test crops (okra) shows the impact of applying the mulch treatment (Figure 5). This was significantly ($p=0.5$) higher for the plots treated with the mulch (2.59 Kgs) compared to the control (2.13 Kgs) plots. There was a progressive yield increase from week 1 to week 10, where the maximum yield was observed for either of the control and treated plots. It is apparent that the impact of the mulch treatment was more pronounced later in the season, from the 10th week of the study, compared to the beginning. This could have been as a consequence of the weed pressure increase with time, presenting a stiffer competition for resources (water and plant nutrients) around the 10th week of the study period.

Conclusion and Recommendations

Based on the results obtained from this experiment, it is clear the additional of organic mulch suppresses the weed, which is a significant constraint in sustainable and organic systems. Elimination of weed competition with crops enhanced the yield of several crops, especially okra. We conclude that the locally available woodchips would provide the benefit of weed suppression, improved water holding capacity and hence the yield of okra crop.

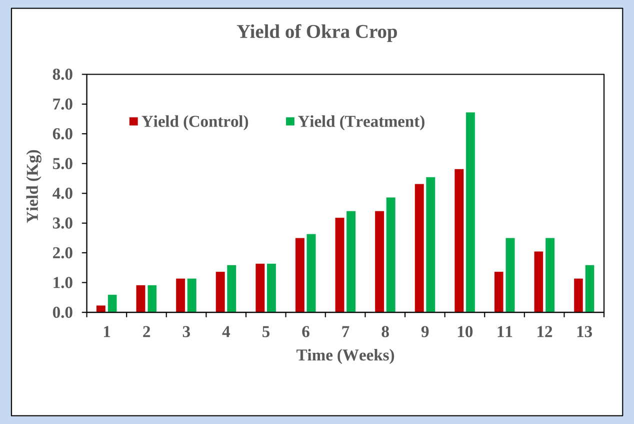

Figure 5: Yield of okra crop

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