1. Project name and contact information

Project Title: Mulching tomatoes for maximum production and minimum labor and material costs
Grant number: FNE 06-573
Mailing address: 60 Gatehouse Road, New Paltz, New York 12561-3705
Phone number: 845-255-1052
E-mail address: farmerdan@hvi.net or brookfarm@hvi.net

2. Goals

Tomatoes are often mulched during organic and conventional production, using the preferred mulch of choice, polyethylene sheeting. This frequent use of this type of mulch, however, poses several environmental concerns. Polyethylene sheeting is derived from petroleum and is only functional for one growing season. This plastic mulch must also be disposed of safely after each season. By exploring the economic output and costs of alternative mulches, the routine use of polyethylene sheeting as a preferred mulch can be avoided.

Because of environmental concerns with the manufacturing and disposal of this polyethylene sheeting, as well as the need to dispose of it after each growing season, we want to know whether alternatives perform as well or better. We will compare tomato production using two natural mulches (compost and straw) and two synthetic mulches (plastic and ground cover) and no mulch at all, for a total of five treatments. We will then compare the biomass output and economic feasibility of these mulches, in order to potentially identify alternative mulches to polyethylene sheeting in organic and conventional production of tomatoes.

3. Farm profile

Brook Farm is located in New Paltz, New York, and serves as a model of small-scale sustainable agriculture. It is a community supported agriculture program, operating solely through share purchases, funds generated from produce sale, as well as grants and donations. The farm relies on organic production techniques and strives to develop a program that utilizes both environmentally and economically sustainable methods. The farm is comprised of 70 acres, which is utilized for crop production and pasture for livestock. In an effort to maintain an economically feasible and sustainable operation, the farm looks for ways to improve crop yield and soil health while reducing reliance on outside sources of fertilizer. Therefore, the compost mulch treatment used in the experiment was composted on site and composed of manure generated from this and other local farms.

4. Participants

The project leader and farm director is Dan Guenther. The technical advisor for our project is Richard S. Feldman, Ph.D. from the Department of Environmental Science & Policy at Marist College, located in Poughkeepsie, New York. His role in the project was constructing experimental design, overseeing and participating in the data collection and maintenance of the tomato crops and mulches, as well as analyzing the collected data. Based upon prior work by Richard S. Feldman, and others, it is expected that over a

period of a few years, landscape fabric will prove to be a more economical alternative to polyethylene sheet mulch in a permanent bed system.
Several student cooperators have assisted in the project over the past two-year span, including Erin Spada, Amanda Rollizo, Janna Saltsman and Erin Kelly through Marist College. Collectively, they maintained the tomato crops, weeded the mulch beds, collected biomass output and labor data and analyzed the results of the tomatoes grown during the past two seasons.

5. Project activities

Two rows of plant beds were set aside for this experiment. Prior to transplanting the seedlings, the beds were readied through extensive weeding, and this labor input was recorded. The cost and crop yield effects of five mulch treatments were studied, with three replicates of each treatment. The treatments were as follows: polyethylene sheeting, landscape fabric (woven polypropylene), compost, straw, and bare soil as a control. These treatments were assigned randomized positions within the beds. Prior to laying each treatment, each 20 foot treatment bed was prepared by laying one inch of compost fertilizer.

In 2007, two varieties of tomato plants were used; Moskvich and Juliet. Moskvich is a large slicing tomato, while Juliet is a smaller paste variety. This was a change from previous years (2006), during which time Red Agate variety had been produced instead of Juliet. Extensive end-rot necessitated switching to the Juliet paste variety, which was a massive improvement on crop yield. Each treatment plot contained 10 tomato plants total, divided into two separate sections, each containing 5 of each of the two varieties. Individual plants were spaced two feet apart. In addition, 1 quart of compost was mixed into the soil in each planting spot.

The polyethylene sheeting was laid and secured with ground staples, and 6 inch holes were cut for each plant. Additional small holes were cut into this lining to allow for greater water penetration. The durable landscape fabric was laid the first year only, and in subsequent years required that it only be properly re-secured. The compost treatment was laid 2 inches thick, and the straw treatment was laid at a thickness sufficient to cover all soil.

Each week a volunteer tended the crops and maintained the mulch treatments. This included weeding, and this labor time was recorded for later economic analysis of the viability of each mulch treatment. As the harvesting season approached, the biomass output of each variety and treatment was measured and recorded. Twice during the growing season, an organic pesticide "Terracycle" was sprayed on the plants.

6. Results (production)

In the 2006 growing season, the highest biomass output of the Moskvich variety came from the straw and compost mulch treatments; total tomato yields from these two treatments were found to be 23.4 kg and 22.8 kg, respectively. In contrast, the bare soil treatment performed the poorest, yielding only 10.5 kg total of Moskvich for the season. The compost and straw mulch treatments also yielded the highest biomass output of Red Agate tomatoes (20.6 kg and 16.4 kg); however in this case, the compost mulch treatment was found to perform significantly better than straw. Polyethylene sheeting was actually

found to produce the lowest yields of Red Agate, though this figure was not significantly different from the yields of bare soil or landscape fabric.

Overall, compost produced the highest yields with the least amount of variance, bare soil performed the poorest, straw produced slightly higher yields than did plastic, but both showed a great amount of variance. Landscape fabric showed great consistency in crop output, but overall yielded low levels of produce.

In summation, in production of both the slicing and paste tomato varieties, compost mulch was found to offer the best performance for maximizing crop yields.

7. Conditions

N/A

8. Economics (results – labor)

Cost of labor is a significant factor in deciding where and how to allocate energy and resources, especially for a small farm such as Brook Farm. Throughout the course of this research, "labor" was defined to include preparing soil, hoeing, transplanting seedlings, laying and securing mulches, and weeding. Based on data from the 2007 growing season, the treatment which required the greatest input of labor was found to be bare soil (no mulch), requiring a total of approximately 170 minutes per person. The greatest portion of this time was invested in weeding. The performances of the compost and straw mulches were found to be compatible to each other, requiring a cumulative labor input of between 108 and 113 minutes per person for each of the two treatments. The polyethylene sheeting reduced total labor per person to 60.75 minutes for the entire growing season; however the landscape fabric ground cover performed the best, reducing labor time investment to only 23 minutes per person. In terms of economics and labor input, the main advantage that use of synthetic landscape fabric possesses is that its durable weave allowed it to remain in place between growing seasons, thereby significantly reducing the amount of labor that had to be invested in the spring in readying the soil and ridding it of weeds before transplantation of the seedlings could occur. In terms of weed control, both of these two treatments (polyethylene sheeting and landscape fabric) were found to perform equally well; however the polyethylene sheeting required a greater portion of time to lay and secure, and had to be re-secured through the season, while the landscape fabric did not. In addition to the increased labor associated with polyethylene sheeting, the fact that new sheeting had to be purchased for each season resulted in increased costs. Therefore, from an economic standpoint, synthetic landscape fabric was found to be the best alternative.

9. Assessment

The results from two consecutive years of research have clearly shown that there are superior alternatives to use of conventional plastic sheeting as mulch, in terms of both crop yield, and material and labor cost. While compost mulch has shown itself to be the best alternative for increasing production, and landscape fabric has been shown to be the best alternative for reducing costs, at the moment we can only speculate on how these findings will translate into long term effects (costs and benefits). For example, what will be the effect of leaving landscape fabric in place for successive seasons on soil quality? As such, we believe the next step towards determining ways of reducing costs and

increasing production while simultaneously improving soil quality would be to analyze the physical, chemical, and biological effects of the different mulch treatments on soil quality over the long-term.

10. Adoption

In light of the findings from this research, the farm plans to continue its use of compost as an alternative mulching technique, making use of landscape fabric and straw where feasible.

11. Outreach

In conjuncture with Richard S. Feldman of the Department of Environmental Science and Policy and James Helmreich of the Department of Mathematics at Marist College, Erin Spada and Amanda Rollizo of Marist College completed a formal poster describing the project's research and findings, which was displayed in the college's science building. The results will also be publicized in the form of their continued implementation at the farm, which operates under the help of CSA members from the community and offers educational opportunities and field trips for students and others interested in becoming involved in small scale farm production, or interested in learning about alternative production techniques. In April the farm will be hosting an on-site composting workshop (see flyer, attached).

12. Report Summary

Due to concerns with the material and labor costs and environmental concerns regarding the use and disposal of the conventional mulch polyethylene sheeting, the purpose of this project was to compare and evaluate alternative mulching techniques for crop production and cost to the farmer. To do this, 5 mulch treatments (straw, compost, polyethylene sheeting, landscape fabric, and bare soil) were compared in regards to tomato production and labor time per person. Two different varieties of tomato were used in this experiment (slicing and paste) and each treatment was replicated three times. Over two growing seasons, biomass output and labor input were recorded for the different mulch treatments. Results showed compost to be the best mulch type for increasing produce yields, while landscape fabric was shown to be the best alternative for reducing labor and material costs over the long-term. In assessing these findings, it has been determined that the next possible step would be to evaluate the effects of these different mulches on the physical, chemical, and biological components of the soil throughout the growing season, in order to further improve crop quality and yield.

Janna Saltsman and Erin Kelly
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