

Evaluation of Options for Weed Control in Organic Vineyards, Vegetables, and Berry Cropping Systems

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Abstract: Studies were conducted in organic vineyards, broccoli, spinach, blackberry, and strawberry cropping systems. Treatment comparisons included steam, plow, cultivator, and an organic herbicide in the vineyards; white mustard and soybean seed meal at 0.5 and 2 t/ac in broccoli and spinach; recycled paper mulch of two thicknesses (1 and 2 mm) in blackberry; and recycled paper mulch and black plastic mulch in strawberry. In the vineyards, the mechanical weed control treatments were the most cost-effective. In the broccoli and spinach study, mustard seed meal at 2 tons/ac provided considerable weed control and reduced hand weeding time compared to the other treatments. In the blackberry study, the recycled paper mulch provided up to two months of weed control. In the strawberry study, both plastic and recycled paper mulch provided similar weed control. However, the soil temperature under the paper mulch was on average 1° C cooler than under the plastic mulch.

Introduction: Weed management in organic cropping systems is a challenge due to the lack of registered herbicides that are effective and economic as in conventional cropping systems. Therefore, alternative tools for weed management need to be evaluated in organic cropping systems. These tools include mechanical and thermal weed control, use of mulches, and use of allelopathic substances to name a few. Similarly, there are a few new postemergence broad-spectrum herbicides labeled for use in organic cropping systems. However, the efficacy and economics of these tools have not been tested adequately in field studies. This paper will summarize the findings of several separate field studies conducted in organic vineyards, spinach, broccoli, blackberry, and strawberry cropping systems.

Materials and Methods, Results, and Discussion:

Organic vineyards: Studies were conducted in 2010 and 2011 in organic raisin and wine grape vineyards in Fresno and Madera County, respectively. Treatment comparisons included non-weeded control, two mechanical weed control methods (French plow and Bezzerides tree and vine cultivator), steam, and an organic herbicide (d-limonene; Greenmatch®). The experiments were designed as split-plots with these treatments as main-plots followed by an additional weed control treatment one month later as sub-plots. By far, the greatest level of weed control was provided by the mechanical treatments. When the plots were hand hoed as the sub-plot treatment, compared to the time required for hoeing in the non-treated plots, the plowed plots required 55 to 75% less while the cultivated plowed plots required 30 to 60% less time to hoe in the raisin grape vineyards. Similarly, in the wine grape vineyard, hoeing time was reduced by 50 to 75% in the cultivated plots compared to those non-treated plots. Such differences did not occur in the herbicide or steam treated plots as the time required to hoe the plots with these treatments was generally similar to the non-treated control. However,

none of the treatments affected vine growth, grape yield, or quality in either of the vineyards indicating that established vineyards had a higher threshold for weeds. Total weed control costs in the plowed, cultivated, steam-treated, and the herbicide-treated plots in the raising vineyard was approximately \$80, \$85, \$170, and \$250/acre, respectively. In the wine grape vineyard, the total weed control costs in the cultivated, steam-treated, and herbicide-treated plots were approximately \$55, \$125, and \$200/ac, respectively. Therefore, the mechanical treatments were by far the best weed control treatment and may remain the most cost-effective weed control method in organic vineyards till better alternatives are developed.

Organic blackberries: Studies were conducted in 2011 and 2012 in the certified-organic plots at the Fresno State University farm. The objective of the study was to compare recycled paper mulch (EcoCover LLC, Huntington Beach, CA 92647) of two thicknesses (1 mm and 2 mm) with non-treated plots during blackberry establishment phase. Square mulch mats measuring 0.2 m² were placed around each blackberry plant on the soil surface immediately after crop planting in April and staked. The plants were surface drip irrigated and the mats were placed on top of the drip tape. Weekly measurements on plant height, soil water content and soil temperature (at 12 cm depth) were taken. At the end of each month, weed density and weed biomass was evaluated.

Weed biomass in May (one month after planting) was 51% and 49% lower in the 2 mm and 1 mm mulch, respectively compared to the plots without mulch. Weed densities in June (two months after planting) were also lower by 72% and 65% in the 2mm and 1mm mulch, respectively compared to no mulch. However, there were no differences in weed density or weed biomass between the two mulch types. There were no differences in weed density or biomass between any of the treatments thereafter. Therefore, the mulches were successful in providing weed control during the first few months of this experiment. Weed emergence in all the plots was very low after June, hence no differences were found between the treatments. Although data was not taken on weed control, the mulch was still intact till the end of the year providing some level of weed control. Therefore, it is possible that the paper mulch will provide weed control for a longer period of time.

Organic broccoli and spinach: Studies were conducted in 2010 and 2011 in the certified-organic plots at the Fresno State University farm. The objective of the experiment was to compare the effects of white mustard and soybean seed meals on weed control in broccoli and spinach. Mustard and soybean seed meals were soil-incorporated at two rates (0.5 and 2 tons/ac) two weeks prior to crop planting. Weed densities and hand-weeding time were recorded twice during the growing seasons and weed biomass was determined at crop harvest. Total weed emergence was reduced by approximately 50 to 95% and 40 to 45% 3 and 6 weeks after planting (WAP) of broccoli and spinach, respectively, in the 5 ton/ac mustard meal treated-plots compared to the 0.5 ton/ac soybean seed meal-treated plots. Time required for hand-weeding at 3 and 6 WAP was also reduced by up to approximately 80% and 50%, respectively with the 2 ton/ac mustard meal compared to the 0.5 ton/ac soybean seed meal treatment. Although the mustard seed meal provided substantial weed control, the treatment still will have to be supplemented with other weed control methods for season-long weed control.

Organic strawberries: Studies were conducted in 2012 in the certified-organic plots at the Fresno State University farm. The objective of the study was to compare recycled paper

mulch (EcoCover LLC, Huntington Beach, CA 92647) with black plastic mulch. Each plot was covered with either black plastic or recycled paper mulch. Both these materials were staked to the ground. Some plots were left without any mulch for comparative purposes. The experiment was designed as a randomized complete block. The plants were surface drip irrigated and the tapes were placed under the mulch. Weekly measurements on soil temperature and water content (measured at 12 cm depth) were taken in early part of the growing season and in late summer. Weed density and weed biomass was taken several times during the growing season.

Both mulch types provided complete control of weeds except for a few weeds next to the plants in the planting holes. Differences in soil temperature and moisture content were observed at various times during the growing season (Fig. 1). Soil temperature under the recycled paper mulch was generally lower than under the plastic mulch or the non-mulched plots on average by about 1° C. Soil moisture content was generally similar between the two mulch systems, but in late summer the soil moisture under the plastic mulch was much lower than in the other treatments (Fig. 1). These differences in soil temperature and moisture, however, did not affect crop yield as there were no differences between the two mulch systems in berry yield over the growing season.

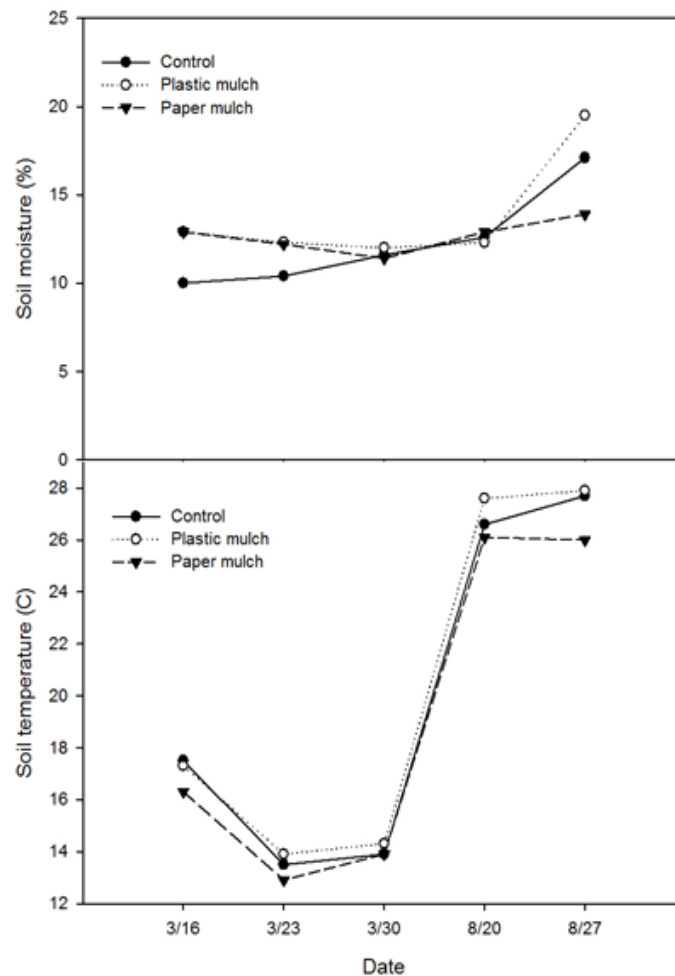


Figure 1. Soil moisture and temperature at 12 cm depth in the various treatments at various times of the year.