

Organic Weed Management in Walnut Orchards

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Controlling weeds in organic farming systems requires the use of many techniques and strategies in order to achieve economically acceptable weed control and yields. Weeds can always be pulled or cut out, but the question is simply how much can a grower spend in terms of time and money to reduce weed pressure. The more a grower is able to reduce weed pressure (seed and perennial propagules) the more economical it is to produce crops.

Research indicates that without some form of weed control, crop yields and plant vigor will be greatly reduced. In organic farming, weed control is only one goal of a weed management system. A good organic weed management plan should present a minimum erosion risk, provide a "platform" for the movement of farm equipment, not impact adversely on pest management or soil fertility, while minimizing weed competition for water and nutrients. The following is an overview of some organically acceptable weed control practices available for walnut orchards.

If you choose not to use synthetic and systemic pesticides then you should go the extra distance to try to keep the orchard as clean as possible. Techniques that reduce the contribution of weeds to the weed seed bank over time reduce weed pressure and can contribute to reduced weeding costs over time. Ideally, no weed should be allowed to go to seed because they can aggravate weed problems for many years in the future. As an example, seed of common purslane has been shown to remain viable for over 20 years in the soil, while black mustard seed survives for over 40 years. The longevity of weed seed in combination with the large numbers of seed produced by individual plants (i.e. 100,000 per plant for large purslane or barnyardgrass plants) can lead to long-term build up of enormous seed banks in the soil. Establishing a policy of keeping after weeds can be useful. Careful weed management during the season and during the off season can be helpful as well.

Mulches

One control method is through the use of an organic mulch. The mulch blocks light, preventing weed germination or growth. Many materials can be used as mulches including plastics or organic materials such as municipal yard waste, wood chips, straw, hay, sawdust, and newspaper. To be effective, a mulch needs to block all light to the weeds; therefore different mulch materials vary in the depth necessary to accomplish this. Organic mulches must be maintained in a layer four or more inches thick. Organic mulches breakdown with time and the original thickness typically reduces by 60 percent after one year. Because the mulch layer needs to be present year-round to be effective, and interferes with harvest operations, this method is only practical in non-bearing walnut orchards.

Cover crops can be grown in the middles and in the spring, "Mow-and-Throw" the mulch in the tree rows. This works well if the mulch layer is thick. Weeds that emerge through the mulch can be controlled using an organic contact herbicide or hand weeding.

The additional benefits of mulches are significant. The mulch conserves moisture by reducing evaporation. Soil temperature is better maintained and organic material is added to the soil on breakdown. Weed germination is greatly impeded and growth diminished. Some grasses will survive the mulching but are shallow rooted and can be easily pulled out. Partially rotted straw or hay which is not otherwise of use can be utilized but must come from fields which have not used pesticides or chemical fertilizers. Weed control by mulching is not the only organic option but may be worth considering.

Cultivation

Cultivation is probably the most widely used method of weed control in organic systems. Mechanical cultivation uproots or buries weeds. Weed burial works best on small weeds, while larger weeds are better controlled by destroying the root-shoot connection or by slicing, cutting, or turning the soil to separate the root system from contact with the soil. Cultivation is effective for summer and winter annual weeds, but is not as effective against summer perennial weeds like johnsongrass, nutsedge, bermudagrass, and morning glory. Cultivated orchards need to be smoothed and firmed prior to harvest.

In most orchards, use of cultivation is limited to the orchard middles because the presence of permanent sprinklers and/or use of raised berms precludes cross-cultivation. Close or deep cultivation should be avoided to minimize the risk of root and crown injury which can lead to infection by crown gall disease. Shallow cultivation also helps avoid bringing more weed seeds near the surface to germinate.

Night tillage may help to reduce weed germination according to an Oregon study (Scopel et al. 1994). Many weeds require a flash, micro-seconds in duration, of red light in order to germinate. It is thought that weed seeds get this flash when suspended with soil during tillage. In the Oregon study, a 4- to 5-fold enhancement of weed germination can occur from exposure to light as in daylight tilling. After night tilling, only those seeds left on the soil surface will germinate, which still can be quite a few. Because of seeds left on the soil surface, it may take several tillages to see much affect. Regardless of whether it works or not, at worst you just lose a little sleep. The Oregon study showed that most summer annual weeds like pigweed, lambsquarters, and barnyardgrass respond favorably to night tillage, as do many winter annual species.

Organically Acceptable Herbicides

In recent years, several organic, contact-type herbicide products have appeared on the market. These include the soap-based product, Scythe™, (produced by Mycogen), clove oil products (Matran II produced by EcoSmart), and acetic acid/citric acid products, AllDown (produced by Summerset). All these products will damage any green vegetation contacted including the leaves and young stems of walnut trees, though they are safe as directed sprays against woody stems and trunks. Because these herbicides only kill contacted tissue, good coverage is essential. Thus, adding an organically acceptable surfactant is recommended. Because these materials lack residual activity, repeat applications will be needed to control new flushes of weeds.

Food grade acetic acid (vinegar) is organically acceptable and when used as a soil supplement, controls small annual weeds. The higher the concentration of acetic acid, the better it works, although food grade typically is 8% acetic acid or less. Repeat treatments are often necessary as there is no residual activity. Generally, vegetation is sprayed to wet, which may require high volumes (\$\$\$) if weed density is high.

Recent work has examined essential oils as potential herbicides (Tworkoski 2002). It was found that clove oil or cinnamon oil at concentrations of 1 to 5%, controlled most small weeds. In studies conducted this summer, clove oil at 3% mixed with water provided 100% control of small barnyardgrass plants. A surfactant was added to assist spread of the material. If these materials are applied through a green sprayer (Weed Seeker® - only green tissue is treated), the amount of material and the cost could be reduced.

Another organic herbicide that has appeared on the market in the last few years is corn gluten meal, which is sold under many trade names. It is expensive and has failed to provide even minimal weed control in the vast majority of California trials. Organic herbicides are expensive at this time and may not be affordable for commercial orchard production. Finally, approval by one's organic certifier should also be checked in advance as use of such alternative herbicides is not cleared by all agencies. The efficacy of all these materials is much less than synthetic herbicides.

Weeder Geese

Geese have been used for weed management in a large number of crops for many years. All types of geese will graze weeds. There is considerable literature citing their use in strawberries and occasional mention of usage in orchards. Investigators at Michigan State studied the impacts of populations of domestic geese and chickens in a non-chemical orchard system. Geese were observed to feed heavily on weeds—especially grasses.

Geese prefer grass species and will eat other weeds and crops only after the grasses are gone and they become hungry. If confined, they will even dig up and eat Johnsongrass and bermudagrass rhizomes. They appear to have a particular preference for bermudagrass and johnsongrass—weeds that can be especially troublesome in orchards.

Care must be exercised when using geese to avoid placing them near any grass crops, i.e. corn, sorghum, small grains, etc. as this is their preferred food. Certain other crops might also be vulnerable, such as tomatoes when they begin to color, thus requiring that geese be removed from tomato fields at certain times. Geese also require water (drinking not swimming), shade during hot weather and protection from dogs. Portable fencing helps to keep them in the area you want them work and also keeps dogs and other predators out. Young geese work best, as their major interests are eating and sleeping – older geese prefer to fight and make more geese.

Although geese are mentioned in this report, other animals such as sheep or goats can also be used. Sheep will effectively remove all weeds down to ground level. Goats are browsers, and must be carefully managed to avoid damage to trees.

Flame Weeding

Flamers can be used for weed control with propane-fueled models being most common. Heat causes the cell sap of plants to expand, rupturing the cell walls; this process occurs in most plant tissues at about 130° F. Weeds must have less than two true leaves for greatest efficiency of the burner. Grasses are harder to kill by flaming because the growing point is below the ground. After flaming, weeds that have been killed change from a glossy to a matte finish. This occurs very rapidly in most cases. Foliage that retains a thumb print when pressure is applied between your thumb and finger has been adequately flamed. Typically, flaming can be done at three to five mph through fields, although this depends on the heat output of the unit being used. Repeated flaming can likewise be used to suppress perennial weeds such as field bindweed. Care must be taken to avoid igniting dry vegetation, which could injure the vines, or start a wildfire.

The specific flaming angle, flaming pattern, and flame length vary with the manufacturer's recommendations, but range from 30° to 40°, at 8 to 12 inches above the base of the plants, with flame lengths of approximately 12 to 15 inches. Best results are obtained under windless conditions, as winds can prevent the heat from reaching the target. Early morning or evening is the best time to observe the flame for adjustment. Flame Engineering, Inc. and Thermal Weed Control Systems, Inc. manufacture both hand and tractor mounted flame weeding equipment.

In a study comparing control of weeds by flaming, species and growth stage were the most important variables. One weed which was resistant to flaming was *Malva neglecta*, (cheeseweed), with little or no control. To control annual weeds at later developmental stages (> 6 true leaves), a single pass flame treatment was not sufficient. For *Chenopodium album*, (lambsquarters), three subsequent treatments were necessary for 95 % control. For the flame control of *Taraxacum officinalis*, (dandelion), the developmental stage is also crucial. Small plants were killed by one flaming, while bigger plants, often survived (69 % control) four flamings. If flame tolerant or perennial weeds occurred, only 76% weed reduction was achieved after four treatments. In an orchard with mainly annual weeds, three treatments controlled 95% of weeds.

Flame weeding is often associated with problems such as high energy consumption, low driving speed and irregular weed control. Another alternative for non-chemical weed control is based on hot steam. High-temperature water provides a form of thermal weed control, yet eliminates the danger of flame application in arid regions where open fires are a hazard. Two companies, Waipuna Systems Ltd. from New Zealand, and Aqua Heat from Minneapolis have developed equipment that delivers super-heated water from a boom or spray nozzle attached to a diesel- fired boiler. (Aqua Heat did not have a web site and may no longer be in business). The high pressure and hot water damages the cellular structure and kills weeds within several hours or few days. First signs of the effectiveness are change of leaf color and plant withering. In general, steam has been shown to be less effective than flaming. Even with a temperature of 4500 C the steam was not able to control all weeds. Factors affecting the use of steam were: age of weeds, slow application speed, amount of steam applied, and cost of propane fuel. Stem weeders range in price from \$9,000 to \$35,000.

Weed Mapping

Weed distribution is not uniform; patches of weeds, particularly perennials, should be managed individually. A global positioning system (GPS) unit can be used to map the population and treatment can be made to that area at a lower cost than treating the whole orchard. By mapping the weed patches, follow up evaluations can be made and further treatments applied as needed.

References

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