

## **Organic/Non-Chemical Weed Management Options in Strawberries.**

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Organic production of strawberry in coastal California has been increasing. Weed control can exceed \$ 2,500/acre annually in organic production and depends on costs and availability of labor for hand-weeding. For successful weed management in organic strawberry long-term planning and use of multiple tactics are necessary with consideration of their cost-effectiveness.

*Field selection.* Strawberry is a poor competitor with weeds. When possible, fields infested with perennial weeds (such as field bindweed or yellow nutsedge) should be avoided since no cost-effective control tools are available for those in organic systems. Evaluation of weed species and densities in the field over time helps direct the control strategies. Weeds common in strawberry production are described in the UC IPM site (<http://ipm.ucanr.edu/PMG/r734700111.html>) and are either present in the soil seed bank or deposited from reproductive plants in and outside the field.

*Pre-irrigation* before bedding stimulates germination of non-dormant weeds which can be controlled by subsequent tillage prior to planting and thus will not compete with strawberry.

*Sanitation* efforts such as working in the least weedy areas of the field first (and weedy-last) and cleaning equipment can minimize movement of weed propagules with soil and equipment to new areas. Also, control wind-dispersed weeds before flowering near your field to prevent their seed movement in to the field during the season.

*Plastic mulches* regardless of color (except blue and transparent) provide excellent control of most annual weeds. However, weeds will continue to germinate and compete with strawberry plants in planting holes. Reducing size of planting hole minimizes deposits and competition from weeds in them.

Yellow nutsedge shoots penetrate through plastic regardless of color and grow through these holes. *Barriers to nutsedge shoot penetration* (such as water resistant/coated paper, paper protected by plastic from moisture or weed barrier fabric) can completely prevent nutsedge shoot germination as long as their integrity persist during the season. The annual costs of barriers range from \$800 to \$2,000/acre.

*Application of steam* to soil has been very effective in controlling propagules of most annual species (75-100%) and yellow nutsedge (80-85%). Steam provides multiple benefits with disinfestation of soil from soil borne pathogens, insects or nematodes. Costs of steam application are estimated at \$3,500-\$4,000 but recent improvements in application technology aim at reducing these costs.

*Use of weed-free substrates* for strawberry production ensures that no weeds are present at planting; however wind-dispersed weed seeds deposited to wet substrate surface will germinate and compete with strawberry and should be removed. Organically acceptable substrate systems also intend to exclude pathogens and insect pests from the root zone and with proper fertigation management can ensure fruit yields similar to those in fumigated soil. However, the annual costs of these systems range from \$5,000 to \$8,000/acre.

*Anaerobic soil disinfestation (ASD)* is an increasingly common practice in organic production that relies on maintaining anaerobic conditions for 3-5 weeks with easily degradable carbon source following by aeration and planting. The changes in chemical, microbiological and physical soil environment can control or suppress some pathogens and greatly improve strawberry production. ASD efficacy for weeds is limited to warm soils (>65 F at 6 inch depth), common in southern California. Properly conducted ASD can reduce densities of most annual broadleaf weeds 50-80% while suppression of perennial weeds has been limited and carbon source dependent. Costs of ASD with rice bran as carbon source are currently \$2,800-3000/acre.

*Soil solarization* to control weeds is only effective when soil temperatures are at least 122°F consistently for 30-45 days. In coastal California, where most strawberry is grown it is usually cooler and the solarization is not considered reliable for weed control.

*Organic herbicides* are typically non-selective contact materials that are oils or acids that do not translocate and have no activity on weed prooagules in soil. They are applied to germinated/growing weeds before planting and to furrows after planting with adequate protection from drift to susceptible strawberry plants. Thus, good spray coverage improves control and dense weed stands are difficult to penetrate. An example of recently registered organic herbicide is a mix of caprylic and capric acids ('Suppress') that at 6-9% by volume controlled burning nettle, goosefoot and lambsquarter 85-100% when weeds were at 2-6 leaf stage. 'Suppress' did not control yellow nutsedge or field bindweed, though reduced their above-ground biomass temporarily. Herbicide application at the edges of furrows near plastic mulch can be especially valuable since proximity of mulch prohibits cultivation of those areas. Organic herbicides are most effective when weeds are small and loose efficacy even at increased rates when weeds mature.

*Herbicidal soil amendments* such as mustard seed meal, *Brassica* spp. residues or some composts can inhibit weed germination and emergence. Caution should be taken when considering application rates and timing to prevent any phytotoxic effects to strawberry crop.

*Crop rotations* provide opportunity for cultivation of germinated weeds (limited to furrows only in plasticiculture strawberry) and depletion of soil seedbank. Rotation to caneberries under plastic tunnels prevents weed germination in dry furrows (>60% of the area). Dense stands of vegetable crops grown from transplants can be complete with weeds, while *Brassicaceae* family crops can have inhibitory effect on weed germination due to exudation of allelochemicals.

*Cover crops* in strawberry furrows and surrounding areas are inexpensive (\$15-25/acre seed costs) and can suppress weeds through competition and prevent new seed deposits. However, they need to be managed by mowing or organic herbicides to prevent interference with strawberry production. Even after termination cover crop residue can aid in weed control and, additionally, reduce soil erosion and losses with runoff from irrigation or rain.

Organic/non-chemical weed management in strawberry is an on-going challenge, but with consideration of field site and weed composition long-term strategies can be developed to manage weed population below the damaging threshold for strawberry production.