

## Integrated Weed Management

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**Introduction.** People that are successful weed managers practice integrated weed management by preventing weed seed reproduction or introduction of material contaminated with weed seed.

It cannot be overemphasized that no one tool is responsible for the success of a weed management program, as it must be an integrated program utilizing cultural and mechanical weed control tools in a coordinated effort to control weeds. The best case scenario for a farmer is a field with few weeds. How do we arrive at this happy situation? The story starts with a discussion of IPM.

### STRATEGIES AND TACTICS FOR IPM

**Prevention.** If a pest is not present in a field, then preventing invasion is best. The priority of prevention is to pull up new weeds you've never seen before. However, prevention also means stopping any and all weed seed production.

**Sanitation.** This is control of weeds in the areas surrounding a field such as drainage ditches, roads and other non-crop areas are important to prevent invasion from areas surrounding the field. This is especially important for management of wind-blown weed seed from species like common groundsel or sowthistle.

**Field selection.** For some crops such as strawberry or lettuce, there are no tools available to control perennial weeds such as field bindweed or yellow nutsedge. Therefore fields used to grow many horticultural crops must be carefully selected to avoid these difficult weeds.

### PUTTING IPM INTO PRACTICE ON WEEDS.

Here we discuss techniques such as: **cultural techniques, barriers, burning or uprooting.**

Cultural techniques. Examples of cultural techniques are the use of transplants instead of direct seeded crops. Transplants are larger and less susceptible to weed competition than seeded crops. Other examples of cultural techniques include crop rotations. For example vegetable crops grown in rotation with crops that have more effective weed control programs will help to keep the field clean of weeds. The constantly changing conditions that occur as the field is rotated from crop to crop allow no one weed species to become predominant.

Mulches. These are barriers to weed growth that consist of plastic or paper tarps, fiber mats, straw or other organic material. Mulches serve multiple functions, such as warming the soil, protecting the crop foliage and fruit from the soil, enhancing moisture retention and weed control. Synthetic mulches are available in black, brown, clear, green, white and yellow. Clear plastic mulches result in the poorest weed control because they permit the greatest amount of light to penetrate the plastic that allows weed germination and growth under the plastic. Black, brown and green mulches block light effectively and are recommended. Organic mulches such as wood chips, chopped straw and rice hulls are sometimes used to control weeds. To control weeds effectively the mulch must be at least 2 inches deep.

Soil solarization. One of the most difficult tasks of weed control is to kill ungerminated weed seeds in the soil. Soil solarization is a non-chemical that kills both soil borne diseases and weed seeds.



Figure 1. Soil solarization with clear polyethylene tarp prior to planting strawberry.

Soil solarization involves placing a clear polyethylene plastic sheet over the soil that is moist and well tilled (fig. 1). The plastic sheet needs to be kept in place 4 to 8 weeks. Soil solarization should be practiced during summer when solar radiation is highest to be most effective in the shortest period of time. Incoming radiant energy is trapped under the clear plastic. The moisture in the soil helps to distribute the heat so that it is more uniform. Soil solarization is less effective in cooler climates such as coastal areas that have frequent fog in summer months.

Solarization kills weed seed by exposure to heat for a critical period of time, which is why treatment is required for 4 to 8 weeks – to allow time for the soil temperature to meet this critical heat kill, especially at depth. Moisture helps by holding heat in the soil and by germinating seed so that they are more readily killed by solarization. Ungerminated seed are also killed, but they are more susceptible when moist and swollen. Time also increases the chance that heat will penetrate deeper into the soil and kill more weed seed.

**Water management.** There are a number of ways that water management can assist in reducing weed pressure such as buried drip irrigation and preplant irrigation.

Buried drip irrigation. Drip tape buried below the soil surface can provide moisture to the desirable plants and minimize the amount of moisture that is available to weeds on the surface. Drip irrigation tape buried 6-8 inches below the surface of the bed can irrigate the crop and minimize the amount of moisture that is available to weeds on the surface. If

properly managed, this technique can provide significant weed control during the dry months of the year.

Preplant irrigation and shallow tillage. Preplant irrigation, that is the watering of the field in the days or weeks before planting, can be used to manage weeds. After listing of raised beds, pre-plant irrigation of dry soil, followed by an interval of one to three weeks to dry the field, then followed by shallow tillage to create a smooth planting bed, is essential during field preparation for small seeded crops. This practice kills many weeds that emerge during the interval between irrigation and shallow tillage. The weed control objective of preplant irrigation is to get weeds to germinate before crop planting, when it is easier and more economical to control them, than during the crop production season when weed removal is more difficult and costly.

Seeds of annual weeds typically germinate and emerge only from the top 1 to 2 inches of soil. Preplant irrigation can be used to deplete the upper soil layers of “germinable” weed seeds (nondormant seeds that germinate after watering). By depleting weed seeds in the upper soil layers, we are using field soil as a mulch to control germinable weed seeds from deeper soil layers. This is why it is important to not till the preirrigated beds deeply, to not risk movement of germinable weed seed to the soil surface from deeper soil layers. This process works by establishing a clean soil layer depleted of weed seed close to the soil surface (Fig. 2).

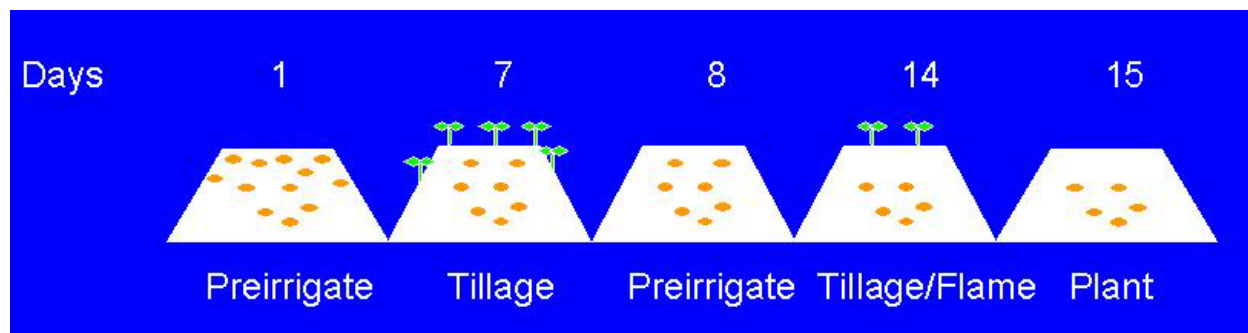


Fig. 2. Weed removal using preirrigation followed by tillage or flaming. The schedule of events is preirrigation on days 1 and 8 followed by shallow tillage or flaming on days 7 and 14.

### **Burning or uprooting.**

These methods involve burning of the weed foliage with herbicides or propane flaming. Uprooting involves traditional cultivation and hand weeding.

Herbicides. Primarily here we talk about glyphosate or Roundup. Use 2% v/v for annual weeds, or 2.6 ounces Roundup per gallon of spray.

Selective flaming. A directed flame or a hooded burner can be used to kill weeds while protecting the crop from injury. Flaming has been used in organic vegetable crops to remove weeds from stale seedbeds prior to seeding or after seeding but prior to emergence such as in onion. Flaming has also been effective in landscapes to control weeds on bare soil and along fencerows and pavement cracks, but care must be taken to avoid fires.



**Cultivators.** Sled-mounted cultivators can give very accurate control in row plantings. Sleds require more tractor power to pull than gauge-wheel cultivators but provide greater precision for vegetable row-crop production. Guide wheels (cone wheels, rubber guide wheels, etc.) also can improve the precision of cultivations if set up properly (fig. 3). Sled cultivators are generally rear-mounted on the tractor. Cultivators can also be set up on tool bars mounted between front and rear wheels of a row crop tractor with an off-center driver seat and steering column to allow for easy viewing by the operator.



Figure 3. Row-crop cultivators may include combinations of bed knives, rolling baskets and duckfoot sweeps.

**Hand-weeding.** Precision cultivation and herbicide use will not eliminate all weeds. Hand weeding removes those last few weeds missed by other methods, which if allowed to go to seed, will replenish the seedbank and reinfest the field. Prevention of weed seed production is desired, especially of those, which are aggressive competitors (or prolific seed producers). Hoeing or shoveling out occasional Johnsongrass plants is often more practical than spraying them.

**Summary.** Any single intervention to control weeds will place selection pressure on the weed population in any given field. Use of multiple interventions in an integrated manner is the most effective means by which to manage weeds in a sustainable and long term basis. The problem is that short-term economic constraints faced by growers make it harder to convince them to take a more long-term view.