Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 01, Issue: 04 (SEP-OCT, 2021)
Available online at www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Weed Management in Organic Farming

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About Organic Weed Management

Since the beginning of agriculture, farmers have fought with the presence of weeds in their fields. Weeds are a major issue because they reduce crop yields by increasing competition for water, sunshine, and nutrients, as well as serving as host plants for pests and diseases. Herbicides have been used by farmers to remove weeds from their crops since their creation. Herbicides not only enhanced agricultural yields, but they also reduced the time that it takes to get eliminated of weeds. Since the widespread usage of agro-chemicals has allegedly resulted in various environmental and health problems, some farmers are rekindling their interest in organic weed management approaches. Herbicide use has also been reported to cause some weed species to spread over fields in some situations because the weeds developed herbicide resistance. Furthermore, some herbicides have the ability to kill weeds that aren't harmful to crops, resulting in a loss of biodiversity for farmers. It's critical to remember that weeds will never be eradicated, only managed, under an organically seed control system.

Critical Period of Weed Control

This period has been defined as an interval in the life cycle of the crop when a must be kept weed – free to prevent yield loss. If weeds have been controlled throughout the critical period, the weeds that emerge later will not affect yield and can be controlled prior to harvest with a harvest and to burn down the weeds and desiccate the crop.

Critical Weed-free Period for Horticultural Crops

Crop	Critical Weed-free Period
Apples, new plantings	During May and June
Apples, bearing	Budbreak until 30 days after bloom
Beets	2-4 weeks after emergence
Cabbage, early	3 weeks after planting
Carrots	3-6 weeks after emergence
Cucumbers, pickling	4 weeks after seeding
Lettuce	3 weeks after planting
Onions	The whole season
Potatoes	4 weeks after planting

Squash	Early plantings compete better
Strawberries, new	During May and June
Tomatoes, fresh	36 days after transplanting
Tomatoes, seeded	9 weeks after seeding

Cultural Method

Crop Rotation

Crop rotation is the process of planting and harvesting different crops in a systematic order on the same piece of land. It's a crucial strategy for putting together a long-term weed control plan. Weeds grow in crops with similar growth requirements to their own, and cultural activities intended to help the crop may also help the weeds grow and develop. Monoculture, that is growing the same crop in the same field year after year, results in a build-up of weed species that are adapted to the growing conditions of the crop. When diverse crops are used in a rotation, weed germination and growth cycles are disrupted by variations in cultural practices associated with each crop (tillage, planting dates, crop competition, etc).

It is best to alternate legumes with grasses, spring planted crops with fall planted crops, row crops with close planted crops and heavy feeders with light feeders.

Cover Crops

Weeds will be suppressed by the crop's rapid growth and dense ground coverage. The inclusion of cover crops such as rye, red, clover, buckwheat and oilseed radish or over wintering crops like winter wheat or forages in the cropping system can suppress weed growth. Highly competitive crops can be produced as 'smother' crops in the rotation for a short time. Additionally, cover crop residues on the soil surface will suppress weeds by shading and cooling the soil. When choosing a cover crop, consideration should always be given to how the cover crop will affect the succeeding crop. In addition, decomposing cover crop residues may release allelo chemicals that inhibit the germination and development of weed seeds.

Intercropping

Growing a smother crop between rows of the main crop is known as intercropping. Weeds are suppressed by intercrops. However, intercropping as a seed control tool should be treated with caution. If there is competition for water or nutrients, the intercrops can drastically affect the main crop's yields.

Field Scouting

It involves the systematic collection of weed and crop data from the field (weed distribution, growth stage, population, crop stage etc). In the short term, the information is used to make quick weed control decisions in order to limit or avoid economic crop loss. Field scouting is critical in evaluating the success or failure of weed management programmes in the long run, as well as making sound decisions in the future.

Mulching

Mulching or covering the soil surface can prevent weed seed germination by blocking light transmission preventing seed germination. Seedling emergence can also be physically suppressed by allelopathic substances in the mulch. Mulches come in a variety of shapes and sizes. Three of the most prevalent are listed below.

1. Living Mulch

Living mulch is usually a plant species that grows densely and low to the ground such as clover. Planting living mulches before or after the establishment of a crop is possible. It's critical to destroy and till in, or control living mulch, so it doesn't compete with the crop. Before transplanting broccoli, a live mulch of Portulaca oleracea was sown to reduce weeds without affecting crop yield. The primary goal of living mulch is usually to improve soil structure, aid fertility, or reduce pest problems, with weed control being a benefit.

2. Organic Mulches

Weed management can be achieved with things like straw, bark, and composted material. Because the expense of purchased mulches can be prohibitive, depending on the amount needed to reduce weed emergence, it is recommended that the material be grown on the farm. Newspaper and straw are used in an effective but labour-intensive technique. The ground is covered with two layers of newspaper, followed by a covering of hay. it is important to make sure the hay does not contain any weeds seeds. Biodegradability is an advantage of organic mulches. (Photographs are downloaded from internet and not authors own captured)

Growing of Ribbed gourd in black polythene mulch

Planting Patterns

Crop population, spatial arrangement, and the choice of planting materials can suppress weed growth. For example, studies have shown that narrow row widths and a higher seeding density will reduce the biomass of later-emerging weeds by reducing the amount of light available for weeds located below the crop canopy. Similarly, fast growing cultivars can have a competitive edge over the weeds.

Variety Selection

It should select propagated materials from weed free.

Tillage System

Studies have found that almost 75% of the seedbank was concentrated in the upper 5 cm of soil in no-till fields. In the mouldboard plough system however, the seedbank is more uniformly distributed over depth. Other conservation tillage systems are intermediate to these two systems.

Weed seedling emergence is often more uniform shallow buried weed seeds and may result in better weed control. Weed seeds closer to the soil are more likely to be eaten or damaged by insects, animals, other predators and disease-causing organisms.

Sanitation

It also is possible to prevent numerous new weeds from being introduced onto the farm and to prevent emerging weeds from producing large quantities of seed. Weed seeds and problematic weed species can be considerably reduced by using clean seed, cutting weeds around the boundaries of fields or after harvest to prevent weeds from going to seed, and completely decomposing manure before application. It is even possible to selectively hand-eradicate isolated outbreaks of new weeds, effectively avoiding future infestations. Planting clean, high-quality seed is essential to crop success. Other sanitation factors to consider would include thorough cleaning of any machinery which might have been used in weedy fields, and the establishment of hedgerows to limit windblown seeds.

Nitrogen Fertility

Nitrogen fertilizer can influence the competition among crops and weeds and in the subsequent crops. For example, nitrate is known to promote seed germination and seed production in some weed species. Nitrogen fertilisation may result in increased weed growth instead of increased crop yield. Nitrogen placed selectively in a band can favour the crop over the weed. Weed suppression can be improved by using legume leftovers instead of chemical nitrogen fertiliser to fulfil the crop's nitrogen needs. Legume results release nitrogen slowly, reducing the growth of undesirable weeds.

Water Management

Water supply management is key to weed control in a vegetable procedure. There are a number of ways that careful irrigation management could also help you reduce weed load on the crops:

Pre-germination of weeds
Planting to moisture
Buried drip irrigation

Mechanical Weed Control

Mechanical removal of weeds is both time consuming and labour-intensive but is the most effective method for managing weeds. The choice of implementation, timing, and frequency will depend on the structure and form of the crop and the type and number of weeds. Cultivation involves killing emerging weeds or burying freshly shed weed seeds below the depth from which they germinate. It is important to remember that any ecological approach to weed management begins and ends in the soil seed bank. The sol seedbank is the reserve of weed seeds present in the soil. Observing the composition of the seedbank can help a farmer make practical weed management decisions. Burial to 1 cm depth and cutting at the soil surface are the most effective ways to control weed seedlings mechanically.

Mechanical weeders include cultivating tools such as hoes, harrows, tines and brush weeders, cutting tools like mowers and stemmers, and dual-purpose implements like thistle-bars. The choice of implement and the timing and frequency of its use depends on the morphology of the crop and the weeds. Implements such as fixed harrows are more suitable for arable crops, whereas inter-row brush weeders are considered to be more effective for horticultural use. The brush weeder is mainly used for vegetables such as carrots, beetroot, onions, garlic, celery and leeks. The optimum timing for mechanical weed control is influenced by the competitive ability of the crop and the growth stage of the weeds.

Hand hoes, push hoes and hand-weeding are still used when rouging of an individual plant or patch of weed is the most effective way of preventing the weed from spreading. Hand-weeding may also be used after mechanical inter-row weeding to deal with weeds left in the crop row.

Blind, 'over-the top' cultivation controls very small weeds, just germinated or emerged, before and sometimes after planting. The entire surface of the fields is worked very shallow using flex-time cultivators (e.g., Lely weeder or rotary hoes, Inter-row cultivations with a rotary hoe in pinto beans (*Phaseolus vulgaris* L.) gave adequate weed control without reducing plant stand or injuring the crop.

The hoe-ridger is specifically designed to achieve intra-row control in sugar beet, Thistle-bars are simple blades used to undercut perennial weeds with minimal soil disturbance. The brush weeder, is used primarily for inter-row weeding of vegetable crop.

Shallow between-row cultivators such as basket-weeders, beet-hoes, or small sharp sweeps are used to cut off and uprrt small weeds after the crop is up. These can get very close to the crop when it's small, without moving much soil into the row, and may be the only tools used on delicate crops like leafy greens, As vigorous crops grown, soil can be thrown into the row to bury in – row weeds using rolling cultivates (e.g. Lilliston), spyder wheels (e.g. Bezzerides), large sweeps or hilling disks. Some of these tools can be angled to pull soil away from the row when plants are small and later turned around to throw soil back on the row during subsequent cultivators.

Thermal Weed Control

Flamers

Flamers are effective for weed control. Thermal weed control includes the use of flaming equipment to crate direct interaction between the flame and the plant. This method works by rupturing plant cells whenever the sap rapidly expands in the cells. Occasionally thermal control involves the outright burning down of the weeds. Flaming can be used before crop emergence to give the crop a competitive advantage or after the crop has emerged. However, flaming in the crop production cycle may damage the crop. Despite the high initial equipment cost, flame for weed management may be less expensive than hand weeding.

Soil Solarization

During summer and fall, organic farmers sterilize their soil through solarization. In this process, a clear plastic film is placed over an area after it has been tilled and tightly sealed at the edges. Solarization works when the heat crated under the plastic film becomes intense enough to kill weed seeds.

Infrared Weeders

Infrared weeders are a type of flame weeder in which the burners heat ceramic or metal surfaces to generate infrared radiation that is directed at the weeds. To eliminate weeds, some weeders utilise a combination of infrared and direct flame. Flame weeders are thought to be

more effective in general because they produce higher temperatures, although burner height and plant stage are also critical considerations. Infrared weeders cover a smaller area than traditional flame weeders, but they may take longer to heat up.

Freezing

Freezing would be advantageous only where there is an obvious fire risk from flaming. Liquid nitrogen and solid carbon dioxide (dry ice) can be used for freezing weeds.

Various test systems using electrocution, microwaves and irradiation have also been evaluated for weed control purposes, but high energy inputs, slow work rates and the safety implications for operators have hampered developments. Lasers have been shown to inhibit the growth the *Eichornia crasispes* (water hyacinth) but did not kill the weed completely. Weed control using ultraviolet light has been patented but remains at an experimental stage.

Biological Weed Control

Biological control would appear to be the natural solution for weed control in organic agriculture.

Allelopathy

Allelopathy is the direct or indirect chemical effect of one plant on the germination, growth or development of neighbouring plants. I is now commonly regarded as component of biological control. Species of both crops and weeds exhibit this ability. Allelopathic crops include barley, rye, annual ryegrass, buckwheat, oats, sorghum, Sudan sorghum hybrids, alfalfa, wheat, red clover, and sunflower. Vegetables, such as horseradish, carrot and radish, release particularly powerful allelopathic chemicals from their roots. Suggestions have been made that allelochemicals and other natural products or their derivatives could form the basis of bioherbicides. However, it is unclear whether the application of natural weed killing chemicals would be acceptable to the organic standard authorities.

The allelopathic effect can be used to an advantage when oats are sown with a new planting of alfalfa. Allelopathy from both the alfalfa and the oats will prevent the planting from being choked with weeds in the first year. Buckwheat is also well known for its particularly strong weed suppressive ability. Planting buckwheat on weed problem, fields can be an effective clean-up technique. Some farmers allow the buckwheat to grow for only about six weeks before ploughing under. This not only suppress and physically destroys, weeds; it also releases phosphorus and conditions the soil.

Beneficial Organisms

Little research has been conducted on using predatory r parasitic microorganisms or insects to manage weed populations. However, this may prove to be a useful management tool in the future. Natural enemies that have so far been successful include a weevil for the aquatic weed Salvinia, a rust for skeleton weed and probably the most famous, a caterpillar (*Cactoblastis* sp.) to control prickly pear. There is also considerable research effort aimed at genetically engineering fungi (myco-herbicides) and bacteria so that they are more effective at controlling specific weeds. Myco-herbicides are a preparation containing pathogenic spores applied as a spray with standard herbicide application equipment.

Weeds are subject to disease and insect attacks just as crop are. Most biological control of weeds occurs in range or non-crop areas. As a result, biological control has little relevance for vegetable growers. Geese have been used for weed control in trees, vine, and certain row crops. Most types of geese will graze weeds, but Chinese weeder geese are considered the best for row crops. Chinest weeder geese are smaller than other types and tend to walk around delicate crop plants rather than over them. Geese prefer grass species and

rarely eat crops. If confined, geese will even dig up and eat Johnson grass and Bermuda grass rhizomes. Care must be taken to avoid placing geese near any grass crops such as corn, sorghum, or small grains, as this is their preferred food. Fruiting vegetables, such as tomatoes when they begin to colour, might also be vulnerable, so geese would have to be removed from tomato fields at certain times. Geese require drinking water, shade during hot weather, and protection from dogs and other predators.

Use of biocontrol agents for weed control

Name of the weed	Bioagent
Cyperus rotundus	*Bactra verutana*
Ludwigia parviflora	*Haltica cynea* (Steel blue beetle)
Parthenism hysterophorus	*Zygrogramma bicolarata*
Lantana camara	*Crocidosema lantana, Teleonnemia scrupulosa*
Opuntia dilleni	*Dactylopius tomentosus, D. Indicus* (cochineal scale insect)
Eichhornea crassipes	*Neochetina eichhornea, N. Bruchi* (Hyachinth weevil) *Sameodes alliguttalis* (hyancinth moth)
Salvinia molesta	*Crytobagus singularis* (weevil) *Paulinia acuminate* (grass hopper), *Samea mutiplicalis*
Alternanthera philoxaroides	*Agasides hygrophilla* (flea beetle) *Amynothrips andersoni*
Tribulus terrestris	*Microlarinus lypriformis, M. lareynii*
Solanum elaegnifolium	*Frumenta nephalomicta*

Use of fish for weed control

Name of the weeds	Fish
Lemma, Hydrilla, Potamogeton	Grass carp or white amur
Algae	Silver carp, common carp

Use of competitive plants for weed control

Name of the weeds	Competitive plants
Parthenium hysterophorus	*Cassia sericea*
Typha sp.	*Brachiaria mutica*

Commercial mycoherbicides

Trade name	Pathogen	Target weed
Devine	*Phyophthora palmivora*	*Morreria odorata* (Strangler vine) in citrus
Collego	*Colletotrichum gleosporoides f.sp. aeschynomene*	*Aeschynomene virginica* (northen joint vetch) in rice and soyabean
Biopolaris	*Biopolaris sorghicola*	*Sorghum halepense* (Johnson grass)
Biolophos	*Streptomyces hygroscopius*	General vegetation(non-specific)
LUBAO 11	*Colletotrichum gleosporoides* f.sp. *Cuscuttae*	Cuscutta sp. (Dodder)
01	*Alternaria cassiae*	*Cassia abtusifolia*
ABG 5003	*Cercospora rodmanii*	*Eichhornea crassipes* (water hyancinth)