

Weed Management Strategies in Organic Agriculture and Natural Farming

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ABSTRACT

The growing emphasis on environmental protection has led to the adoption of sustainable farming practices such as organic agriculture and natural farming, which avoid synthetic inputs and rely on eco-friendly methods. Among the major challenges in these systems is weed management, as weeds cause the highest yield losses globally. Organic systems integrate preventive, mechanical, cultural, and biological methods to manage weed populations below economic thresholds. These methods do not completely eliminate weeds but effectively controls them while preserving soil health, promoting biodiversity, and maintaining long-term sustainability.

INTRODUCTION

The rising concern of the environment protection has prompted us to shift towards sustainable practices which work with nature to maintain the balance of

the ecosystem. Organic agriculture and natural farming are the widely accepted agriculture practices for environment conservation. Weeds are the major biotic stress experienced by the

plant which results in maximum yield losses in any production system. Overall, weeds produced the highest potential loss (34%), with animal pests and pathogens being less important (losses of 18 and 16%) worldwide (Oerke, 2006). Their effective management is the absolutely necessary for a profitable farming system.

Since organic /natural farming excludes the use of any synthetic or off farm inputs like herbicides, fertilizers, pesticides etc. so, this makes weed management in these practices a challenging task. These practices therefore make a smart integration of preventive, mechanical, cultural and biological methods to manage weeds on the field to bring their population below economic threshold level. The methods employed are hand weeding, soil solarization, mulching, crop rotation, cover crops, catch crops, trap crop, intercropping, allelopathy etc.

Strategies adopted for weed management

1. Preventive measures:

Prevention aims at prohibiting weeds entry and further spread in the farm ecosystem. This requires understanding of weed biology for proper identification and knowledge of weed life cycle to devise management strategies to prevent their reproduction and spread. The key preventive measures include –

- **Use of Clean and Certified Seed:** Weed-free, certified crop seeds should only be used. Contamination of wheat with little seed canary, has become a major cause of both short- and long-distance weed dispersal (Singh, 2007).
- **Clean Farm Machinery and Equipment:** Sanitation of all tillage and harvesting equipment should be done before use. Weeds like field bindweed, Johnsongrass, sandbur, and Palmer amaranth often spread through contaminated machinery.

- **Eliminate Weeds Before Seeding:** Weeds should be eliminated before setting of seeds to reduce the soil seed bank and future infestations.
- **Manage Weeds in Non-Crop Areas:** Fencerows, ditches, and areas used for animal bedding, feed and fodder should be kept weed free. Some weed seeds retain their viability even after passing through the animal digestive system.
- **Use Fully Rotted Manure:** Well-decomposed manure (at least 4–5 months old) should only be used, as partially rotted manure can introduce viable weed seeds into fields (Singh and Singh, 2005).
- **Continuous Field Monitoring:** Regular scouting and weed identification are essential for early detection and timely management (Patil and Bainade, 2022).
- **Understanding Weed Population Dynamics:** A sound knowledge of how weed populations respond to different control methods helps in formulating effective long-term crop and weed management strategies.

2. Mechanical measures:

It is the oldest method used for weed control which involves use of tools to control weeds by cutting and pulling out weeds. It is the most efficient way to manage weeds in organic/natural farming. The morphology of the crop and the weeds determines the appropriate implement to use. Inter-row brush weeder are seen to be more efficient for horticultural use, tools like fixed harrows are better suited for arable crops. The competitiveness of the crop and the stage of the weed's growth determine the best time to use mechanical weed control. It includes –

- **Hand weeding** – It refers to removal of weeds either manually or by using tools

like khurpi or sickle. It effectively controls annuals and biennials.

- **Hand hoeing** – It refers to cutting the crown part of the weeds. Annuals and biennials can effectively be controlled. *Convolvulus arvensis* which has shallow root system can be controlled.
- **Tillage** – It controls weeds by causing injury to stem and root. This reduces their competitive and regenerative capacity. Tillage cause weed seed burial leading to failure in emergence which results in low weed intensity in subsequent season following ploughing.
- **Mulching** – Mulching causes exclusion of sunlight from the environment, which reduces weed problems by preventing weed seed germination or by suppressing the growth of emerging seedlings. Mulching materials used are black or white polythene sheets and natural materials like paddy husk, ground nut shells, saw dust etc. It is effective against annual weeds and perennial weeds like *Cynodon dactylon* and *Sorghum halepense*.
- **Soil solarization** – Solarization involves heating the soil to destroy nuisance organisms like weed seeds, fungi, bacteria and nematodes. The soil is covered with very thin polyethylene sheets of 20-25mm thickness during the hottest part of the summer month for 2-4 weeks which raises the temperature to 55- 60°C over unfilmed control field. It is effective against weeds which are produced from seeds. Solarization is found to be highly effective in controlling parasitic weed like *Orabanche spp.* from 70-100 per cent. Arora and Tomar (2012) reported reduction in the total weed flora in solarized soil compared to non-solarized soil.

- **Mowing and slashing** – Mowing is the uniform cutting of growth from the entire area up to the ground level. It is more useful in cropped area than in non-cropped area. Slashing is the cutting of weeds little above ground level using a knife and a sword.
- **Burning-** It is the cheapest method to eliminate unwanted mature vegetation in non- cropped area and range lands. Plant dies as a result of coagulation of protoplasm.
- **Cheeling and Digging** – It controls weeds by removing underground propagating parts of the weeds from deeper layers of the soil.

3. Cultural measures:

Cultural weed control involves use of any technique that aims at maintaining field conditions such that weeds are less likely to establish themselves or increase in number. It makes use of agricultural practices that makes crop more competitive against weeds.

- **Time of sowing** – Sowing of the crop before germination of weeds or after the emergence of the weeds gives the crop a competitive advantage. On advance/normal sowing of the crop, it gains growth over the weeds and exert smothering effect on weeds. Moreover, due to unfavourable growing conditions created by the crop, the weeds though germinate, but fails to attain its proper growth and hence overthrown by the crop.
- **Crop Rotations** – It helps to control weeds by disrupting weed life cycle. This helps to control crop bound or crop associated weed. In rotation of crops the ecological needs of the associated weeds are not satisfied, and as a result weeds are suppressed. The variation in cultural practices of each component of rotation

cause disruptions to weed germination and growth cycles. *Phalaris minor* can be managed by rotating wheat with other Rabi crops such as berseem, potato, raya or gobhi sarson, winter maize, oats (fodder), sugarcane, etc. and also by early sowing of wheat in October (Ravisankar et al, 2017).

- **Trap crop** – These are the crops grown to trap the weeds. They act as false host stimulating the weeds to germinate and then weeds die in the absence of the host. It helps to control parasitic weeds like *Striga* and *Orbanche*.
- **Catch crop** – Catch crop are susceptible to weeds. These are grown and ploughed into the field before flowering of weeds. Sudan grass reduces infestation of *Striga hermonthica* in sorghum.
- **Cover crop** – Cover crop prevents the weed growth by quick growth and shading of the ground thus blocking the sunlight from reaching the surface. These can either be grown as live plants or applied as residue on the ground surface. Also, on decomposition cover crops could release allelochemicals which will inhibit the germination and development of weed seeds.
- **Stale seed bed** – In this method weed seeds in the surface layer of the soil are induced to germinate and emerge before cropping and then destroyed to eliminate a part of weed population by pre plant shallow tillage. It involves destruction of 2-3 flushes of weed by ploughing before sowing of the crop. It is adopted when the germination of the crop and weeds are synchronized.

4. Biological measures:

It involves the use of natural enemies of weed plants to control the germination of weed seeds or the spread of established plant. It aims

to bring down the weed population below economic threshold level (ETL). Natural enemies used are weeds, parasites, predators, pathogens, duck, deleterious rhizobacteria (DRB), snail, fish etc. This is achieved either by introduction of host specific, exotic natural enemies or mass production of native natural enemies like fungi, bacteria, virus etc. Some promising examples in Indian context include; control of *Eupatorium odorata* by leaf eating caterpillar, *Lantana* spp. by *Telenomia scrupulosa*, *Salvania molesta* by *Pablinia achminata* (grass hopper); water hyacinth by *Neochetina eichhornea* and *N. bruchi*; Parthenium by *Zygogramma bicolorata*.

Allelopathy

Weeds are suppressed due to inhibiting action of allelochemicals produced by certain crops like rye, sunflower, buckwheat, black mustard and sorghum etc. These are called allelopathic crops and can be incorporated either as cover crop, mulch, intercrop or in rotation. Sorghum water extract (sorgaab) contains allelochemicals like gallic acids, protocateuic acid, syringic acid, benzoic acid, dhurrin, sorgoleone. Similarly, sunflower water extract contains chlorogenic acid, isochlorogenic acid, scopolin etc. these chemicals have significant effect on weed suppression.

Bioherbicides

Bioherbicides are plant-based herbicides derived from plant sources and are non-selective in nature. They need to be applied either prior to crop emergence or transplanting, or post-directed application in established crops. These herbicides control broad leaved weeds better than grasses and annuals better than perennials. They destroy the plant's waxy cuticle and cell walls causing desiccation and rapid wilting. It includes corn gluten meal, mustard meal, clove oil, vinegar and D-limonene.

CONCLUSION

Weed management in organic agriculture and natural farming requires an integrated approach that emphasizes ecological balance and sustainability. By combining preventive, mechanical, cultural, and biological methods, farmers can effectively control weeds while preserving soil health and biodiversity. These strategies not only reduce dependency on synthetic herbicides but also contribute to long-term agricultural sustainability and environmental conservation. It is important to understand that in an organic/natural farming, weeds could never be eliminated but only managed to bring their population below the economic injury level and focuses on maintaining the biodiversity of farm ecosystem.

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