



Weed Management in Organic Farming and different Methods of Weed Management

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Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. "Organic farming" is defined as production system which avoids or largely excludes the use of synthetically compounded fertilizer, pesticides, growth regulators and livestock feed additives. In a weed management approach under organic system, the central goal is to reduce weed competition and reproduction to a level that the farmer can accept. In many cases, this will not completely eliminate all weeds. Weed management should, however, reduce competition from current and future weeds by preventing the production of weed seeds and perennial propagules - the parts of a plant that can produce a new plant. Consistent weed management can reduce the costs of weed control and contribute to an economical crop production system

Introduction

Weeds compete with crop plants for mineral nutrients, moisture, light, space, etc, which adversely affect the growth and yield of the crop. Of the total loss of agriculture produce from various pests, weeds accounts for 45 per cent, insect pests 30 per cent, diseases 20 per cent and other pests 5 per cent. Data available on losses caused by uncontrolled growth of weeds show yield reduction of 35 per cent to 90 per cent in different crops and cropping situations. The average losses in crop yield on the country basis have been estimated at 15-30 per cent in wheat, 30-35 per cent in rice and 15-85 per cent each in maize, sorghum, pulses and oilseeds. But as farmers adopt some kind of weeding in field, it still leaves us with a conservative estimate of at least 10 per cent reduction in crop yields. This reveals that weeds are the costliest category of agricultural pests causes maximum yield losses and added labour costs than either insect pests or crop diseases. The critical period of weed crop competition is of paramount importance in life cycle of the crop from weed control point of view. The critical period of weed crop competition is different for different crops. Generally, a crop of 90 to 100 day duration, the first 30-35 days after sowing (DAS) should be maintained weed free for optimum yield. The critical period of weed crop competition for maize and sorghum 15-45 d DAS, rapeseed and mustard 15-40 DAS, soybean 20-45 DAS, kharif pulses 15-30 DAS, pigeon pea 15-60 DAS, groundnut 30-50 DAS, wheat 30-45 DAS, direct seeded rice 15-45 DAS, transplanted rice 30-45 DAS, chickpea 30-60 DAS, and sugarcane 30-120 DAS. For management of weed in organic systems, we rely only on non-chemical or ecological approaches. A farmer who manages weeds organically must be intimately familiar with the type of weeds and their growth habits to determine which control method to be employed. Its management begins with careful planning of the cropping system to minimize weed

problems, and seeks to utilize biological and ecological processes in the field and throughout the farm ecosystems to give crops the advantage over weeds. A brief description of these weed control methods is given as under.

Building up a good weed management system

Improvement in the effectiveness of PWC passes through the adoption of a global approach to weed problems. In practice, this means that PWC must necessarily rely on prior application of agronomic practices aimed to: (1) reduce weed emergence through the use of preventive methods (crop sequence choice, primary tillage, false seedbed technique, use of cover and/or smother crops); and (2) reduce weed competition through cultural methods that improve crop competitive ability (use of appropriate crop genotypes, transplants, sowing/ planting pattern, fertilization strategy).

Weed Prevention

Weed prevention comprises all measures which deny the entry and establishment of weeds in an area. In other words, all practices that help to discourage the weeds from becoming a problem over time, for the subject of weed prevention. Thus, any physical or chemical method employed with the main objective of not allowing the weeds to set viable seeds, is to be considered as a part of weed prevention. Weed prevention is very important as it reduces the farmers' efforts in controlling weeds later by physical or other methods of weed control and thereby saving lot of labour and cost involved in weed management. The weed preventive measures are extremely important against obnoxious weeds, as their control/ eradication is extremely difficult if once established in the crop field/non-cropped areas. Important preventive measures to be adopted are given as under:

- i. Sowing of clean seeds, free from weed seeds.
- ii. Avoiding feed material, containing weed seeds to the farm animals.
- iii. Avoid adding weeds to the manure pit. Always use well decomposed FYM / compost.
- iv. Use clean farm machineries free from weed seeds / propagules of weeds. Also, clean farm machinery thoroughly especially seed drills before moving it from one field to another one.
- v. Destruction of weeds emerged on bunds of fields, irrigation channels and non-cropped areas nearby the crop field.
- vi. Transplanting of seedlings free from germinating weeds.
- vii. Prohibiting the entry of livestock / cattle in infested areas with noxious weeds.
- viii. Destruction of weeds before flowering from roads, paths, barren lands and waste lands.
- ix. No shifting of soils from weed infested areas to another fields.
- x. Use vigilance. Inspect the farm frequently for any strange looking weeds. Destroy such patches of new emerged weeds by digging deep and burning it along with its roots.

Weed Control Methods

Weed control in crop fields is the process of limiting any given weed infestation to the extent that it permits economic crop production. The objective here is to limit the growth of unwanted plants without any attempt to eliminate them from the scene. The extent to which a given weed growth should be limited will depend upon the cost involved in operation and the benefits anticipated from the operation. The methods employed in organic farming for weed management are dealt as under:

Good Crop Husbandry / Cultural Methods

- **Proper Planting Methods:** Any planting method that leaves the soil surface rough and dry will discourage early weed growth. For example, planting of winter grains in seed beds prepared after a pre sowing irrigation, it leaves top 3 to 5 cm soil above the crop

seeds in rough and dry tilth. Such a physical condition of soil defers the germination of the weeds. Likewise, in rainy season also farmer should complete their seed bed preparation and sowing of crops with minimum time lapse. Plough-planting and other minimum tillage planting methods have often proved very useful in minimizing early weed problems. In summer, furrow planting of crops is very useful method for reducing the weed problem.

- **Proper Planting Time:** Manipulating the sowing time of a particular crop earlier or later compared to conventional sowing time helps to minimize the weed infestation. For example, growing of maize, cotton 15 days before break of monsoon with the help of pre-sowing irrigation and late planting of suitable varieties in winter season reduces weed infestation.
- **Proper Crop Stand:** Wide and under populated crops are prone to heavy weed infestation which become difficult to control later. Therefore, practices like selection of proper seed, right method of sowing, adequate seed rate, protection of seed from insects, pests and diseases are very important to obtain proper and uniform crop stand capable of offering initial competition to the young weeds.
- **Selective Crop Stimulation:** Application of fertilizer as basal and top dressing to the crop helps in selective stimulation of crop plants which can withstand competition from weeds much better. If the soil is problematic, not suited much to the crop, use of proper soil amendments should be considered necessary to boost crop growth and, thus indirectly suppress the weeds.
- **Crop Rotation:** Parasitic weeds, as well as the crop associated weeds, can be discouraged by adopting well-conceived crop rotations. For example, a grassy weed like *Phalaris minor* can be easily discouraged by replacing wheat with a forage crop in alternate years.
- **Summer Fallowing:** In major parts of India there is clear cut solar energy rich dry period of summer available, which should be utilized for desiccation of rhizomes, tubers and roots of perennial weeds to death. Initial tillage of the field in summer for this purpose should encourage clod formation. These clods, which embody the weed propagules, upon drying, desiccate the weed propagules within, much better than a pulverized soil. Subsequent tillage operations should break these clods into smaller units to further expose the shrivelled weeds to the hot sun.
- **Reduction in Area under Bunds (levees):** Farmers often ignores the weeds on bunds and channels of crop fields and this becomes the important source of weed seed for propagation. Therefore, it is very important to reduce the area under bunds and channels.
- **Stale Seed Bed:** A stale seedbed is one where initial one or two flushes of weeds are destroyed before planting of a crop. This is achieved by soaking a well-prepared field with either irrigation or rain and allowing the seeds to germinate. At this stage a shallow tillage may be followed to destroy the dense flush of young weed seedlings. This may be followed immediately by sowing a desired crop. (ix) **Solarization:** This is another method of utilization of solar energy for the desiccation of weeds. In this method the soil temperature is further raised by 5-100 C by covering a pre-soaked fallow field with transparent plastic. The plastic sheet checks the long wave back radiation from the soil and also prevents loss of energy by hindering moisture evaporation. It is very good practice for high value crops as initial cost is very high.
- **Intercropping:** Several times intercropping helps in the suppression of at least the secondary growth of weeds that occurs after the intercrop has fully covered the ground. The weeds occurring before the intercrop has shaded the inter row spaces should be controlled by mechanical means. Cowpea, black gram and green gram are common

intercrops in India used to increase the total crop productivity and suppress the secondary growth of weeds.

- **Minimum Tillage:** It is now well accepted that the primary objective of any tillage programme on the farm is to control weeds. If the weeds were effectively controlled by some other method, the minimum tillage and zero tillage crop cultivation practices can be adopted. In India, however, the preplant tillage operations used for seedbed preparation are still the most practical means to obtain initially weed – free fields for sowing of the crops. An ideal physical soil condition for sowing of seed row crops is to obtain a firm tilth in the wide rows and a loose tilth in the inter rows. This will ensure rapid crop seed germination but slow weed emergence in the inter-row spaces.
- **Flooding and Drainage:** Submergence of weeds in water for some time destroys the weeds, when sufficient water is available and crop like rice can sustain under flooding conditions. In variance with flooding, drainage is used for controlling aquatic and semi – aquatic weeds in rice fields, channels, canals, and ponds. In rice fields, where both terrestrial and aquatic weeds may be common, a judicious combination of the two can be practiced.

Physical or Mechanical Methods The weeds are controlled with the help of suitable farm implements/ machineries operated by manual or animal or mechanical power depending on the type and intensity of weed flora. Following mechanical / physical methods of weed control are commonly practiced.

- Tillage:** The primary function of any tillage operation is to control weeds. Preplant tillage is constituted of both primary (using disc plough, MB plough, etc.) and secondary tillage (using cultivator, disc harrow, etc.). The primary tillage helps to control weeds by burying the existing weeds, bringing the weed seeds to soil surface for germination followed by destructions by suitable secondary tillage. Post plant tillage operations done by different implements like spike tooth harrow, rotary hoe cultivator, wheel-hoe, blade harrow, etc. are found very useful to control weeds at initial stage of crop growth. These implements are very effective and economic as compared to other methods like hand pulling, hand hoeing, etc. These implements are also very useful in breaking the soil crust and also conserve soil moisture.
- Hand Weeding:** It is the oldest method of weed control. It is time consuming, labour intensive and often costlier than herbicidal method of weed control. It effectively controls annual weeds, but not perennial weeds. Perennial weeds growing prostrate, rosette and horizontal are frequently cut off at soil surface by this method leaving plant parts (rhizomes, tubers, bulbs, stolons, etc) in the soil, may rejuvenate/ regenerate after some time. Hand weeding may skip / leave unweeded weeds mimics to crop plants and growing within the crop rows. The availability of manual labourers during the peak period of field operation is a big problem for hand weeding.
- Hoeing:** Hoeing is a post-planting intercultural operation, very effective against annual weeds but not for perennial weeds, since it cannot control the underground vegetative parts of perennial weeds.

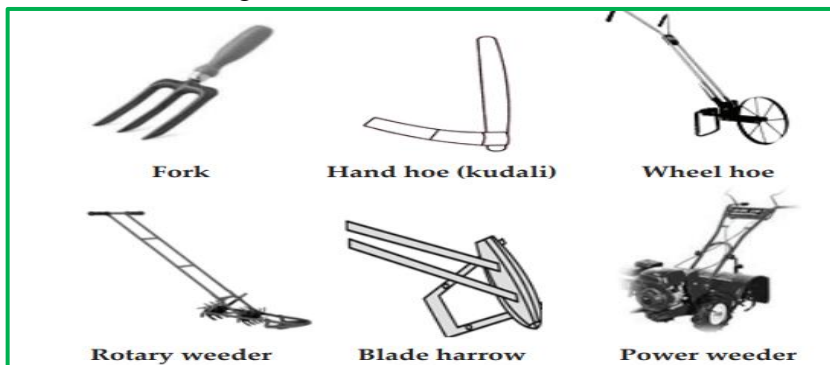


Fig. Commonly Used Weeding/ Hoeing Implements

Hoeing is comparatively faster operation requiring less man power compared to hand weeding. It may, however,

leave some weeds growing within the crop rows. High cost and availability of labour in these days also discourage its adoption. The important implements for hoeing include, fork, hand hoe, blade harrow, rotary weeder, wheel hoe, power weeder, etc., as given in Fig.

- iv. **(vi) Mowing:** Mowing is cutting of uniform growth of weeds from entire area at the ground level. It prevents weed seed production and dissemination through concurrent control of existing weeds or wild vegetation. Mowing is usually practiced in non-crop areas, lawns, and gardens, but it can also prove useful in removing weeds from rows of certain established crops. Common mowing tools used are sickle, lawn-mower and reciprocating type rotary-bar mower.
- v. **(vii) Mulching:** The weeds are covered artificially with different types of mulches viz., straw, stover, leaves, saw dust and dry grasses, etc. These mulches restrict the aeration and light penetration to weeds and thus, they kill. This method is followed in row crops. Recently use of black plastic mulch also becoming popular as they are very effective for the purpose.

Biological Methods

The biological control of weeds involves the use of living organisms, or biological entity, such as insects, herbs eating fish, pathogens, and competitive plants to check their infestation. The objectives of biological weed control is not eradication of weeds, but to keep weed population below the level of economic damage. Specific bioagent attacks only one or two specific weeds while the non-specific feed upon a variety of vegetations. The specific bio-agents include, primarily insects and plant pathogens. The choice of pests and pathogens should meet certain criteria before they can be said as successful bio-agent.

Criteria of a Successful Bio-agent: A successful bioagent should meet the following criteria—

- i. **Host Specificity:** The bio-agent employed for weed control should be strictly host specific and it should not feed on other plant species, particularly the economic ones. The bio-agents, mainly insects, released so far for control of a particular weed has successfully passed the starvation tests' before they left the laboratories for field use. In starvation test the insect prefer to die than feed upon the plant species other than target weed.
- ii. **Bio-agent Hardiness:** The bio-agent used for should be hardy enough to suit the new environment in which it was released. Further the bio-agent should also have the capacity to survive when there is shortage of food for short and long periods.
- iii. **Feeding Habit:** The destructive capacity of a bio-agent on weed should be very high so that its small population could destroy large weed population. Insects feeding on flowers and seeds have been found more host specific and efficient in control of weeds.
- iv. **Ease of Multiplication:** High rate and ease of natural reproduction of bio-agent is important in insects, pathogens, snails, and competitive plants, but very much unwanted in case of grass carp as their excessive population may compete with cultivated fish.

Conclusion

Effective weed management is the major challenge for successful organic farming. Organic farming uses a different type of tool for weed management. Important weed control methods or weed management practices followed in relation to organic farming includes preventive measures, good crop husbandry/ cultural methods, physical or mechanical methods and biological methods. Thus, it is necessary to devise organic system of weed control comprising of cultural, mechanical, biological and physical practices to manage weeds without synthetic herbicides and chemicals which promote weed suppression, rather than weed elimination.