CHAPTER 8

Weed Management in Horticultural Crops

OBJECTIVES

After studying this chapter, students will be able to:

- Understand the principles of weed management and classification of weeds.
- Describe the different weed control methods.
- Select the suitable method of weed management for different horticultural crops.
- Plan various cultural practices for weed management in different crops.
- Decide on the most appropriate weed management system for a given situation.

INTRODUCTION

Weeds are the most costly category of horticultural pests, causing more yield losses and added labor costs than either insect pests or crop diseases. In particular, weeds are a constant fact of life in annual row crops, vegetables, and other horticultural crops.

Now certain questions may be arising in your mind. What is weed? How will we identify the weeds? What will happen if weeds are allowed to grow? How can we control weeds? You can face several questions of this category.

Horticultural crops are high value crops and the challenge of weed management is one of the important factors to successfully grow them. Weeds compete with crops for light, nutrients and water, resulting in stressed plants, poor fruit quality and yield. Stressed crops are also more susceptible to disease and insect problems, while excessive weed growth itself creates higher humidity in the foliage enhancing disease spread and inviting unwanted insects.

In fruit crops, weed pressure must be addressed throughout the life of the planting. When compared to annual crops, perennial culture is a greater challenge, as fall, spring, summer and winter weeds need to be managed efficiently. Understanding seasonal weed thresholds and integrating cultural and chemical management becomes even more important in year-round culture. However, because of different cultural requirements, each crop should be considered individually. In this chapter, we will study about weeds, their characteristics and harmful effects, classification of weeds and various methods of weed control.

In India, commercial use of herbicides came in 1980. During the period, the herbicides registered a significant growth than insecticides and fungicides. From a mere 2 per cent share of

the totalpesticide consumption in the seventies in India, herbicides now account for about 11 per cent ofthe pesticides market. While this is a very encouraging development, the herbicide consumptionin our country is still much less than that in developed countries, where herbicides constitute 40-50 per cent of the total pesticide consumption.

WHAT IS WEED?

Weeds are unwanted and undesirable plants which interfere with the utilization of land and water resources and thus adversely affect human welfare. They can also be referred as plants out of place.

Weeds compete with the beneficial and desired vegetation in crop lands, forests, aquatic systems etc. and pose great problem in non-cropped areas like industrial sites, road/rail lines, air fields, landscape plantings, water tanks and water ways etc.,

In the world there are 30,000 weed species, out of these 18,000 sps cause damage to the crops. JethroTullfirst coined the term weed in 1931 in the book "Horse Hoeing Husbandry"

Characteristics of weeds

- Weeds are prolific with abundant seed production potentialities e.g. *Chenopodium* spp., *Amaranthus* spp., etc.
- They are persistent and resistant to their control and eradication.
- Weed seeds remain dormant and viable for very long periods e.g. *Chenopodium* spp.
- Some weeds have very deep root system. They store foods in their rhizomes and reappear every year e.g. *Saccharum* spp., *Cyperus* spp.
- Weeds are hardy and can resist any adverse climatic, disease and soil conditions. They result ina severe crop-weed competition.
- Some of the weeds propagate vegetatively e.g. *Cynodon dactylon*.
- Some weed seeds are similar to crop seeds, therefore their separation becomes difficult.

Harmful effects of weeds

- Weeds compete with crop plants for water, space, light and mineral nutrients.
- Weeds reduce the quantity and quality of farm produce.
- Weeds impair the quantity and quality of animal products e g. thorny weeds with hooks entangle with wool of sheep which graze in pastures.

- Weeds harbour insect pests and diseases thus they act as reservoir of infection for cultivated crop plants.
- Weeds increase cost of labour and equipments which ultimately increase the cost of cultivation of crops.
- Weeds reduce the efficiency of farm equipments.
- Presence of some weeds like Saccharum spp. causes depreciation of land value.
- Some weeds are poisonous and cause health hazards to human beings and animals, for example, Parthanium spp.

Aquatic weeds are very harmful because:

- They impede water flow in canal, channels, rivers, etc.
- They impede drainage
- They are menace to fisheries and other aquatic animals.
- They prevent or spoil the recreational value of the water bodies.
- They pose pollution problem in water.

CLASSIFICATION OF WEEDS

Weeds may be classified in many ways. Some of the classifications are mentioned below:

A. Classification according to life cycle

- Annual weeds (a) Kharif (rainy season) weeds (b) Rabi (winter season) weeds
- Biennial weeds
- Perennial weeds

I. Annual weeds

Kharif annuals: These annuals generally appear with the onset of monsoon and the life cycle is completed within the rainy season. Few examples are : *Echinochloa colonum, Echinochloa crusgalli, Setaria glauca, Digitaria sanguinalis*, etc.

***Rabi* annuals:** These annuals start growing up with lowering of temperature in winter and coincide with the life cycle of the rabi crops. These weeds complete their life cycle before the summer season starts. Examples are *Phalaris minor, Avena fatua, Chenopodium album, Aesphodelus tenuifolius*, etc.

In addition to these annuals, there are few plants which complete their life cycle in 2 to 4 weeks. Such annuals are known as short lived annuals e.g. *Phyllanthus niruri* (Hazardana)

II. Biennial weeds

The weeds which complete their life cycle in two years are called biennials. In first year they complete their vegetative growth and store food while in the second year their reproductive growth or seed formation is completed followed by the death of the plant e.g. *Daucus* spp.

III Perennials weeds

These are the weeds which complete their life cycle within 3 or more than 3 years. They are capable of growing/propagating by means of seeds, through under groundstolons, roots andsuckers *e.g. Cynodon dactylon, Saccharum spontaneum*, etc.

B. Classification according to plant family

Graminae: *Cynodon dactylon, Saccharum spontaneum, Echinochloa crusgalli, Phalaris minor, Avena fatua ,etc.*

Solanaceae: *Solarium nigrum, Solanum xanthocarpum, etc.*

Eupkorbiaceae: *Euphorbia hirta, Phyllanthus niruri, etc.*

Liliaceae: *Aesphodelus tenuifolius*

Chenopodiaceae: *Chenopodium album*

Convolvulaceae: *Convolvulus arvensis, Ipomoea spp.*

C. Classification according to cotyledon characteristics

With the discovery of 2,4-D as selective translocated herbicide in 1940's, led to a strong recognition of two great classes, namely, the monocot and the dicot weeds. In general, monocot weeds were found to be resistant to 2,4-Dwhile dicot weeds were susceptible to it. The dicot weeds are often referred to as *broad leaf weeds* and monocot weeds as *narrow leaf or grassy weeds*. The exception to this are *sedges* and cattails which although have narrow leaf yet are not grassy weeds.

Grasses	Sedges
Stem is hollow except at nodes	Stem Angular & solid
Ligulate	Does not posses ligules
Alternate or opposite leaves	Leaves in whorls around the stem
Eg, Digitaria, Cynadon	Cyprus, Scirpus

Character	Monocots	Dicotds
Leaves	Narrow and upright	Broad & horizontal
Venation	Parallel	Reticulate
Retention of herbicide	Less	More
root system	Adventitious	Tap root
Growing point	Open	Open
Cambium (conductive tissue)	Scatered	Intact
Examples	Grasses or Narrow leaved weeds	*Amaranthus spp., Chenopodium album, Convolvulus arvensis, Phyllanthusniruri, Partheniumhysterophorus, Xanthium strumarium*

D. Classification according to habitat

Depending upon the place of their occurrence, weeds can be classified as:

- Crop land weeds
- Fallow land weeds
- Grassland, pasture or rangeland weeds
- Non-cropped land weeds
- Aquatic weeds
- Forest and woodland weeds
- Lawn and garden weeds
- Orchard and vineyard weeds, and
- Plantation weeds.

This classification is important because for each situation different weeds control measures are usually employed even though the target weed species may be the same.

E. Classification according to their seriousness as a pest

Common weeds: Those weeds which can be controlled by ordinary good farm weed controlpractices. These are mostly annuals and biennials.

Noxious weeds: Those weeds which are difficult to control because of an extensive perennialroot system or because of other characteristics that make them persistent.

The noxious weeds are again divided into two categories:

Prohibited noxious weeds : *Circium arvensis* (Canada thistle), *Agropyron repens*

(Quack grass), *Sorghum halepense* (Johnson grass).

Restricted noxious weeds : *Cuscuta* spp. (Dodder), *Convolvulus arvensis* (Field

bindweed), *Allium vineale* (Field garlic), *Cynodon dactylon* (Bermuda grass).

List of common weeds in Horticultural crops:

Echinochloa colonum,Cyperus esculentus, Cyperus rotundus, Digitaria sanguinalis, Eleusine indica,Cynodon dactylon, Amaranthus viridis, Phyllanthus niruri

Ageratum conyzoides, Setaria glauca, Phalaris minor, Avena fatua, Poa annua

Vicia sativa, Medicago denticulate, Ageratum conyzoides, Lantana camara

Imperata cylindrical, Rosa moschata, Berberis, Rubus spp.

Cyperusrotundus

Sorghum halepense

Lantana

Convolvulus arvensis

CRITICAL PERIOD OF WEED CONTROL

This period has been defined as an interval in the life cycle of the crop when it must be kept weed - free to prevent yield loss. The crop yield level obtained by weeding during this period is almost similar to that obtained by the full seasons weed free conditions. Horticulture crops are very sensitive to weed competition, and need to be kept weed-free, from planting, emergence or bud break, until the end of their critical weed -free period. For example, the critical weed free period for bearing apple plants is bud break until 30 days after bloom while in potatoes; it is 4 weeks after planting. If the crop is kept weed-free for the critical period, generally no yield reduction would result. Again, weeds emerging after the critical weed-free period will not affect yield, but control efforts after this time may make harvest more efficient, or reduce weed problems in subsequent years in perennial crops.

WEED MANAGEMENT

Weed control and weed management are the two terms used in weed science. Weed control is the process of limiting infestation of the weed plant so that crops can be grown profitably.

Weed management includes prevention, eradication and control by regulated use, restricting invasion, suppression of growth, prevention of seed production and complete destruction. Thus

weed control is one of the aspects of weed management. The various methods of weed control employed in horticultural crops are described as under:

A. Preventive methods

Prevention of introduction and spread of the weeds in an entirely new locality is termed as preventive method. For the matter, it is essential to know that how weed disseminates. Generally, weed spread through the seeds of previous crop, irrigation water, implements and animals etc. If these are taken into account, there will be a check on the spread of the weed. By taking following measures, weed spread can be prevented from entering into a new locality:

1. Sowing of weed-free clean seed. The seeds, contaminated with weed seed, are a good source of spread of the weed. It becomes hard to separate the weed-seed from the crop-seed. For example, cruciferous crops like radish, cauliflower, cabbage, broccoli etc. are even well mixed with the seeds of satyanashi(Argemone maxicana). Such impure seeds should be discarded for use. Seed act is in force which by imposing laws, help regulates the quality of seed.

2. Use of clean implements. While operating agricultural implement like cultivator, harrow, seed drill etc. in weed infested field, care must be taken that multiplication parts of weeds like rhizome, bulb, tubers, stem etc. are not being carried along. The agricultural implements should be cleaned properly.

3. Removal of weed along canal and irrigation channel. Weed seeds get transported through water and reach the field. Removal of weed growing along the sides of canal or irrigation channel is necessary.

4. Care in transplanting of seedlings/plantlets. Many horticultural plants like all transplanted vegetables, flowers, and fruits are transplanted in the field with soil attached to their roots. Infestation of soil with weed may contaminate a new field.

5. Use of well rotten manure. Weed seeds have good viability. The seeds of hirankhuri *(Convolvulus arvensis)* remain viable for as long as 50 years. Doob *(Cynodon dactylon)* and motha *(Cyperus rotundus)* seeds viability last for two and five years respectively. For making manure, the cowdung is heaped. If the heaping period is short, the seeds do not lose its viability and grow in the field wherever manure is applied. Hence, only well-rotten manure should be used.

6. Avoiding passing of cattle from weed infested area. Grazing in weed infested field followed by allowing passage of cattle in new field, favours dissemination of weed seeds. The weed-seed after passing through alimentary canal of the animal, comes out through dung where it gives rise to weed. Some weed seeds also stick with the legs and skins of the animals and get transported to some other place where they germinate and grow as weed.

7. Crop management practices : All such practices which favour the growth of main crop only disfavour the growth of weed. The following management practices have smothering effect on weed and must find place in crop land to prevent weed spread:

- Proper crop rotation prevents establishment of weeds.
- Higher plant population per unit area smother the growth of weed.
- Proper placement of fertilizer in the root zone of the seed favours the growth of crop. The weeds deprive of nutrients and crop growth is restricted.
- Fast and vigorous growing varieties by virtue of their larger leaf canopy cause smothering effect on the growth of weed. Such crops should receive preference to prevent spread of the weed.

8. Enforcement of weed laws. In India, many noxious weeds grow in the fields and pose great economic and health hazards. Noxious weeds are those perennial weeds which are reproduced by seeds, stem, roots and other reproductive parts as well and are very difficult to *control*. *Parthenium hysterophorus, Striga* sp., *Cyperus rotundus*, *Cynodon dactylon* etc. are noxious weeds that grow in many horticultural crops. In India, no weed laws are in force except in Karnataka where Parthenium has been declared as a noxious weed. Weed laws help the farmers to avoid the use of mislabelled or contaminated seeds and also help in legally prohibiting weed from entering into the country.

9. Quarantine laws. Quarantine laws impose legal restrictions on the movement of agricultural materials. Had there been adequate quarantine laws, the *Parthenium* and *Argemone* which widely grow in vegetable and flower fields may not have been introduced in our country. Creating isolation between widely weeds infested area and new area is essential by enforcing and observing quarantine properly.

10. Use of pre-emergence herbicides. Herbicides which are used before the emergence of weeds either before or after planting of crop, is a good preventive measure for preventing weed infestation. Such herbicides either inhibit seed germination or kill young seedlings before they get established.

B. Curative methods

1. Eradication of weeds

This method implies complete destruction of weeds. Weed eradication is achieved by killing existing plants and destroying the viability of all organs of multiplication. This may be desirable and economical only when the weed is extremely noxious and persistent and makes the cultivation

difficult or precludes bringing new area under cultivation. Eradication is not possible in one season or year as some weed seeds may have viability for as long as 50 years.

The underground parts can be destroyed by tillage or with soil sterilants. A soil sterilant, however, renders the soil incapable to support plant growth for several years.

When weeds are widespread and not feasible to eliminate, control measure would be more practicable and should be given preference.

2. Control of weeds

Weed control refers to minimizing the infestation of weed so that the crop can be cultivated successfully. The various methods of controlling weeds are as under:

(a) Mechanical/Physical method

In this method, weed control is done using tillage, hoeing, hand weeding, digging, cheering, mowing, burning, flooding, mulching etc.

(i) Tillage: It removes the weed from the soil. It causes injury to root and pruning to shoot of weed. The weeds in tilled field lose their regenerative capacity. Weeds are also get buried at the time of tillage. The effectivity of tillage in controlling weed depends upon a number of factors. A field infested with deep rooted perennial grasses like thatchgrass(*Imperata cylindrica*), motha (*Cyperus rotundus*), quackgrass (*Agropyron repens*) having sufficient food reserve in their underground rhizomes and tubers, needs more cultivation with deeper ploughing than a newly infested field with annuals.

(i) Hoeing : Itis widely used weeding tool for centuries. Hoe is quite effective in controlling weed in row crop. It is very useful for annual and biennial weeds. In case of perennials, it destroys the aerial growth. The underground growth is not much affected.

(ii) Hand weeding : It is done by pulling out weeds from the field. Pulling out is done with the help of khurpi. Hand weeding is effective against annuals and biennials. The perennial weeds along with underground portion are not pulled out completely and hence they regenerate in the field. In fields which cannot be sprayed with weed controlling chemicals, can be made weed free using hand weeding.

(iii) Digging : Itis practised especially for the removal of shrubby and stubby woody *perennials. Prosopis juliflora* (Kikar), *Calotropis gigantia* (Aak or Madar), *Zizyphus nummularia* and *Z. rotundifolia* (Jharber) etc. which grow in horticultural crops in arid regions are removed by digging pit. This is ofcourse, costly and time consuming but very useful technique for the removal of very hard perennial woody weeds.

(iv) Cheering : Itis done using cheer hoe similar to a spade with long handle. It cuts and scraps the above-ground weed growth. As the underground part of the weed is left undamaged, cheering is not useful in perennial crops which are regenerated by roots, tubers, rhizome etc. Cheering is widely used in India in plantation crops, particularly in tea.

(v) Mowing : Itis practised to keep the growth of weed under check especially in lawn. The process of mowing is achieved by mower machine and hand blade havinglong cutting edge of about 1 metre. This method is successful only in case of short weeds growing close to the ground.

(vi) Burning : Itis very powerful technique of weed control in uncultivated field. It destroys aerial portion of the weed directly through flame of the fire and underground portion through the heat effect.

(vii) Mulching : It is getting popularity in controlling weed in a variety of horticultural crops. It excludes light from photosynthetic portion and. thus, inhibits the top growth of weeds. Mulching is very effective against annual crops. The mulches of straw, saw dust, paddy husk, paper, plastic etc. are common in use. The mulches should be about 10 to 15 cm thick for better efficacy.

Materials such as black polyethylene have been used for weed control in a range of crops. Plastic mulches have been developed that filter out photo synthetically active radiation, but let through infrared light to warm the soil. These infrared transmitting mulches have been shown to be effective to control weeds

(b) Cultural methods

In this method, attempt is made to control weed by practising agronomic practices. Crop and other practices done to grow the crop are modified in a manner so as to have minimum growth of weeds. The following cultural methods are practised to control weeds:

(i) Selection of crop

- Selection of crop should be such that it may grow fast leaving weed behind.
- The crop should absorb nutrients from lower as well as upper stratum of soil.
- It should have less requirement of nutrients.
- Water requirement should be minimum.
- The crop duration should be less.
- The crop should have dense canopy so that it may smother weed.

(ii) Crop rotation : Crop rotation involves alternating different crops in a systematic sequence on the same land. It is an important strategy for developing a sound long term weed control program. Weeds tend to thrive with crops of similar growth requirements as their own and cultural practices designed to contribute to the crop may also benefit the growth and development of weeds. 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).

Within a rotation, crop choice will determine both the current and the potential future weed problems that a grower will face. Traditionally, potato (*Solanum tuberosum L.*) was included in the rotation to reduce weed problems before a less competitive crop was grown. Crop choice is complicated further by the need to consider soil fertility levels within the cropping sequence and to include fertility building periods in the rotation. Variations in crop and weed responses to soil nutrient levels can also play an important part in weed management. The inclusion of a fallow period in the rotation is known to reduce perennial weeds. 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.

(iii) Use of compost or manure : Decomposition of compost or manure starts after addition in the soil. While decomposition, organic acids like uric acid is produced. Such produce prevents the growth of weed.

(iv) Allowing the land to fallow : In the fallow land the weed is deprived from moisture and nutrients. In the absence of moisture these weeds fail to grow. Now-a-days, with intensive cultivation especially in vegetables, it becomes very hard to leave the field fallow. Continuous cropping favours the growth of weed.

(v) Water management

Effective water management is a key to control weeds in horticultural crops. There are a number of ways that careful irrigation management can help you reduce weed pressure on your crops:

Pre-germination of weeds : In pre-germination irrigation or rainfall germinates weed seeds just before the cash crop is planted. The newly germinated weeds can be killed by light cultivation or flaming. Pre-germination should occur as close a possible to the date of planting to ensure that changes in weather conditions do not have an opportunity to change the spectrum of weeds (cool vs. warm season) in the field.

Planting to moisture is similar to pre-germination irrigation. After weeds are killed by cultivation, the top 2 to 3 inches of soil are allowed to dry and form dust mulch. At planting, the dust mulch is pushed away and large-seeded vegetables such as corn or beans can be planted into the zone of soil moisture. These seeds can germinate, grow, and provide partial shading of the soil surface without supplemental irrigations that would otherwise provide for an early flush of weeds.

Drip irrigation can provide moisture to the crop and minimize the amount of moisture that is available to weeds closer to the surface. If properly managed, this technique can provide significant weed control during dry period.

(vi) Sowing time : Later sown crop grows slowly and resumes less growth due to limited availability of growth period. Such types of growth allow the weed to grow vigorously leaving sufficient space and light for weed.

(vii) Orientation of sowing/transplanting : Sowing or transplanting should be done in such a manner that there may be maximum shade in the field. In shade, weeds fail to grow for want of photosynthesis.

(c) Chemical methods

In this method, chemicals are used for weed control. The chemicals employed for weed control are commonly referred to as weedicides or herbicides. Chemical weed control functions on the basis of the fact that certain chemicals are capable of killing weeds without any significant injury to the crops.

The discovery of 2, 4-D in the early 1940's has revolutionized the chemical method of weed control. ***Marth*** and ***Mitchell*** of U.S.A. in 1944 were the first workers to introduce it as a herbicide.

A large number of herbicides are now available commercially to tackle various weed problems. A herbicide may be selective or non-selective. A selective herbicide kills a particular type of weed or plant. For example, 2,4-D (selectively toxic to broadleaf weeds). A non-selective herbicide (for example, Paraquat, Glyphosate) kills the whole

- Herbicides applied anytime before the weed seedlings emerge through the soil surface are known as pre-emergence herbicides. For example, Simazine.
- Herbicides applied after the crop seedlings (or weed seedlings) have emerged through the soil surface are known as post-emergence herbicides. For example, 2,4-DB, bromoxynil.
- Herbicides that are applied before planting the crop - typically from several days to just before planting are known as pre-plant herbicides. For example, EPTC, Glyphosate

vegetation on which it is applied. Nonselective Herbicides (also known as Broad spectrum) are formulated to control both broadleaf and grass weeds. According to the type of action, herbicides may be classified as contact or translocated. The contact herbicide kills the plant parts where it comes in contact (for example, Simazine), whereas the translocated (Systemic) herbicide goes into the plant system and affects the whole plant (for example, Glyphosate). Use contact herbicides on annual weeds while systemic herbicides are more effective on perennial weeds than contact herbicides

The chemical weed control offers following advantages :

- In crop rows, where harrowing or cultivation is impossible, herbicides can be easily applied to control weeds.
- Herbicides give quick response in terms of checking the growth of weed and by that time crop gets an escape and grow.
- Hand weeding injures the root system of crop also and thus damages the crop.
- Herbicides reduce the need of preplanting tillage. In case of minimum tillage, herbicides are very much successful.
- The use of herbicides reduces the requirement of manual labour.

Control measures of weeds infesting fruit, vegetable and flower crops are given in table below:

Crop	Recommended herbicide	Dose (kg/ha)
Mango	Diuron or	2.25
	Atrazine or	4.00
	Oxyfluorfen	4.00
	Paraquat	12.00
	Glyphosate	6.00
Banana	Diuron or	2.25
	Simazine or	4.00
	Oxyfluorfen	4.00
	Paraquat or	12.00
	Glyphosate	6.00
Apple	Atrazine or	5.00
	Simazine or	5.00
	Diuron	5.00
	Paraquat	3.00

Crop	Recommended herbicide	Dose (kg/ha)
Tomato	Alachlor	3.00
	Fluchloralin	3.00
Brinjal	Fluchloralin	1.50
Onion	Fluchloralin	2.00
Potato	Metribuzin	1.00
Rose	Diuron or	1.20
	Oxyfluorfen or	1.00
	Atrazine	3.00
Gladiolus	Fluchloralin	2.00

(d) Biological methods

Reduction in infestation of weeds by direct or indirect actions of biological entities such as plants, parasites, predators and pathogens is covered under these methods.

(i) Plants as bio-agents of weed control : The differential growth habits, adaptiveness and competitiveness of the plant over weed, forms the basis of weed control by growing a particular crop. Crops which grow vigorously have an advantage over slow growing ones which are sensitive to weed. These competitive crops, also known as smothering crops, are very effective in weed control. Growing of corn and ginger either alone or in combination, has smothering effect on the growth of weed. They grow more rapidly and fill inter-row space with their canopy faster than the weed. This gives smothering effect on the weed growth.

(ii) Parasites, predators and pathogens : In this method, the natural enemies of plants like insects and disease causing organisms are used. Insects kill the weed by exhausting the plant food reserves and through destruction of photosynthetic parts.

Of the wide range of enemies, insects have been proved effective. Parasites like viruses, higher plants and fungi that develop only on live plants are also potent agents of weed control.

Lantana camera weed has been controlled successfully by the larvae of *Crocidosema lantana*-the totricid moth, which bores into flower-stem; *Agromyza lantanae*, the seed fly which eats flower and fruit and *Thecla echion* which destroys flower. *Cuscuta spp.* (dodder) which grows on old fruit plants is controlled successfully by insect *Melanagromyza cuscutae* and *Smicronyx cuscutae*. Nutgrass or Motha (*Cyperus rotundus*), grows in almost all horticultural crops is controlled by insect *Bactra vermosana*.

The larvae of insect *Diacrisia obliqua* feed voraciously on *Parthenium hysterophorus* and destroys the whole plant.

Pathogenic organisms damage the host plants through enzymatic degradation of cell constituents, production of toxins, disturbance of hormone system, obstruction in translocation of food and minerals and malfunctioning of physiological processes. As a result plants die.

The fungi *Alternaria macrospora* and *Puccinia heterospora* control anode (*Anoda cristata*), a weed of malvaceae family. The fungi cause significant reduction in plant height, seed pod per plant, seed per pod and seed per plant. Fungus *Cercospora roclmanii* is effective against water hyacinth (*Eichhornia crassipes*) a problematic aquatic weed for waternut or singhara and lotus.

ACTIVITY/EXERCISE

1. Know the weeds growing on the farms in your locality and prepare a herbarium by collecting samples of different weeds of your area.
2. Summarize the impact of common weeds growing in orchard, vegetable farm and wastelands.
3. Identify possible and potential approaches to practical weed management in predominant horticultural crops of your area.

CHECK YOUR PROGRESS

1) Define weed. What are the characteristics of weeds?
2) What is critical period of weed control? List five commonly found weeds in horticultural crops.
3) Differentiate between the followings:
   a. Annual and biennial weeds
   b. Common and noxious weeds
   c. Selective and non-selective herbicides
   d. Contact and Tran located herbicides
   e. Monocot and dicot weeds
4) Write the various methods of weed control and discuss in brief the chemical method of weed control in horticultural crops.

5) Write short notes on the following

a. Tillage

b. Crop Rotation

c. Biological method of weed control

d. Harmful effects of weeds

e. Water management to control weeds in horticultural crops.

FILL IN THE BLANKS

1. Weeds are ……. and ……..to their control and eradication.
2. The weeds which complete their life cycle within 3 or more than 3 years are known as……
3. Weeds compete with crop plants for……., ……. and ……...
4. A ……..herbicide kills a particular type of weed or plant.
5. A herbicide which goes into the plant system and affects the whole plant referred to as……

SUGGESTED FURTHER READINGS

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