

WEED MANAGEMENT IN HORTICULTURAL CROPS : A REVIEW

*¹PATEL, T. U.; ²THANKI, J. D. AND ³PATEL, D. D.

DEPARTMENT OF AGRONOMY
N. M. COLLEGE OF AGRICULTURE
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI – 396 450

**E mail: tushagri.ank@nau.in*

¹Dr. Patel, T. U., Assistant Professor, College of Agriculture, NAU, Navsari

²Dr. D.D. Patel, Associate Professor, College of Agriculture, NAU, Navsari

³Dr. J.D. Thanki, Professor and Head, Agronomy, NMCA, NAU, Navsari

ABSTRACT

Weeds are unwanted and undesirable plants which interfere with the utilization of land and water resources and thus adversely affect human welfare. About 30,000 species of weeds have been listed in the world, out of which 18,000 cause serious damage in different ways resulting in considerable loss to agricultural production. The losses caused by weeds exceed the losses caused by any other category of agricultural pests. Of the total annual loss in agriculture produce, weeds account for 45 per cent. Therefore, the review pertaining to critical period of weed competition for important horticultural crops, type of weeds and methods of control is reviewed herewith herbicides recommended in major vegetables crops and weed management practices for orchards/tree plantation area, so that the using of all these practices and recommendations, one can mitigate the effect of weeds on agricultural produce.

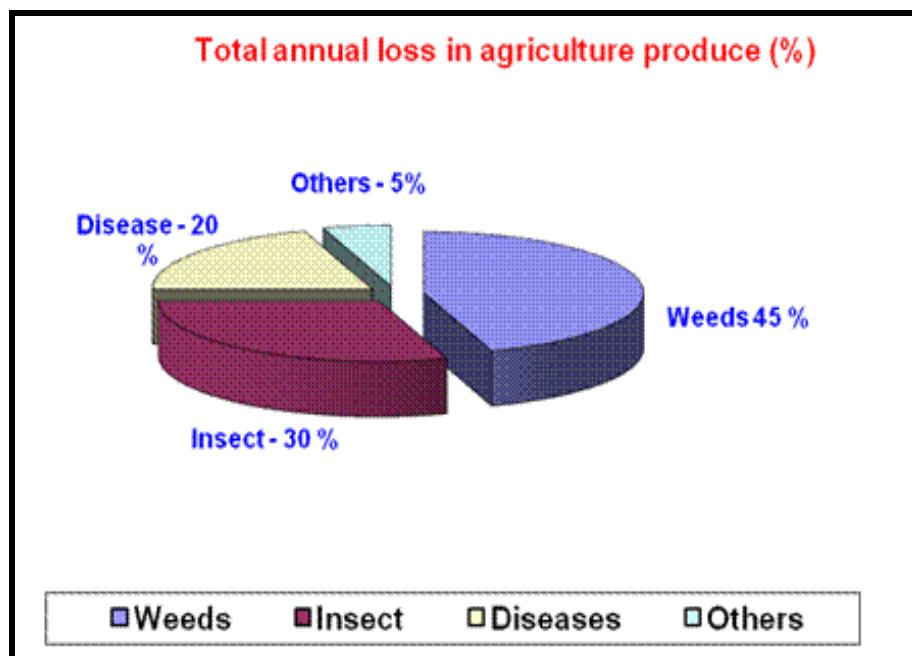
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INTRODUCTION

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. Weed ranked first among different agricultural pests causing crop loss. About 30,000 species of weeds have been listed in the world, out of which 18,000 cause serious damage in different ways resulting in considerable loss to agricultural production.

"One year seeding means seven years weeding"

Weeds are an important factor in the management of all land and water resources, but its effect is greatest on agriculture. The losses caused by weeds exceed the losses caused by any other category of agricultural pests. Of the total annual loss in agriculture produce, weeds account for 45 per cent followed by insects 30 per cent, diseases 20 per cent and other pests 5 per cent.



Horticulture is defined as the growing of fruits, vegetables and flowers. Horticulture industry is observed to be an important sub-sector of Indians' economy. In addition to provision of food, it also generates foreign exchange, creates employment and provides raw materials for processing industries. The major aspect of horticultural industry is quality product. Poor quality and low yields results from many factors such as high temperatures, low relative humidity, low rainfall which causes drought, low solar radiation which reduces the photosynthetic ability of crops and weed infestation. Generally, farmers do not understand the negative implications of weeds in term of yield losses and the cost of its control. Weed control has been observed as one of the most important practices in crop production because good weed control will ensure maximum yield and high quality of farm produce. Since most horticultural crops are very slow in growth especially at the early stages of

their establishment, it becomes imperative to begin weed control early enough in order to ensure high yields and quality. The first step in weed management is to understand the weeds and their life cycles, consult their identification guides. Weeds can be categorised by their life cycles and management strategies developed accordingly. Annual weeds complete their life cycles in one year and reproduce solely by seeds. The perennial weeds live for more than two years and can reproduce by seed or vegetative structures such as stolons, rhizomes, corms, tubers, bulbs and roots. Because perennial weeds are difficult to manage in vegetables, it is better not to use a field with severe perennial weed problems. Many non-chemical weed management methods are simple farming practices. These practices are of increasing importance due to consumer concerns about pesticides residues, environmental pollution from pesticides and non availability of some of the older herbicides.

Effect of weed on horticultural crops

Weeds compete with crops for water, nutrients, space, light and oxygen resulting into a delay in maturity and low yields. In agriculture weeds are very important because they lower yields as high as 50 per cent. In some cases, yield losses may be as high as up to 90 per cent under heavy infestation on some crops such as maize, rice millet, cowpea and groundnut. Generally, these losses occur as a result of reduced yield, quality, harbouring of pests/diseases, allelopathic effects on crops and interference of major farm operations such as weeding, fertilizer application, herbicide application and harvesting. Research Studies have demonstrated that up to 80 per cent yield losses in okra as a result of infestation by *Imperata cylindrical*. Reports also showed that weeds reduce onion bulbs, heads in lettuce and cabbage and fruit size in apple (*Malus* spp). Weeds serve as many hosts for pests and diseases, causing phyto-sanitary problems. The aphid (*Aphis gossipi*) which is known to transmit a viral disease called potato leaf roll and potato mosaic has been found to live in (*Eleusine indica*) as a host. Removal of such a weed has been found to reduce the incidence of this pest on potatoes. *Commelina* spp has been found to serve as a host for banana virus diseases and also harbours the banana root nematode (*Meloidogyne incognita*). Weeds also act as carry over's of pests from season to season. Some weeds have shown

allelopathic effects on some crops. *Centrosema* spp. has allelopathic effects on banana. Weeds have also been observed to interfere with farm operations like weeding and harvesting making movement difficult and in crops like potatoes with underground structures; they result in a number of tubers being left in the ground during harvest. These result in severe yield loss and act as volunteer crops in subsequent seasons as well as early inoculums for major diseases. Weeds have also been shown to block waterways and impede movement. Most of these weeds are not host specific because they infest both fruits and vegetables. It is therefore very difficult to draw a clear cut boundary between fruit and vegetable or flower weeds.

In case of tree plantation, weed control is most essential in rings and in continuous 1.5 to 3.0 m strips down the tree rows. Here the weeds, in addition to competing with the trees, interfere with fruit picking, tree pruning, and other horticultural operations. Also, they increase damage to the surface tree roots by diseases and rodents. Further, weeds in orchards may lead to a more severe frost bite in fruits because of reduced radiation from the soil. Ultimately, the fruit trees may be crowded out by the weeds. Densely planted tall trees may smother weeds but they are no more acceptable in modern horticulture. Today's orchards are very much open type in which control of weeds is essential.

Potential yield losses due to weeds

Sr. No.	Crop	Yield reduction
1	Potato	25-35
2	peas	70-80
3	Carrot	67
4	Onion	42-71
5	Tomato	61

Critical period of weed competition for important horticultural crops

Sr. No.	Crops	Days From Sowing
1.	Onion	30-75
2.	Garlic	30 -70
3.	Cabbage	30-45
4.	Cauliflower	30-45
5.	Okra	15-30
6.	Tomato	30-45
7.	Chilly	30-45
8.	Brinjal	20-60
9.	Tomato	20-60
10.	Carrot	15-20

Type of weeds:

Annual weeds

Annual weeds can be a serious problem and cause severe yield losses and quality in vegetable crops. They may not adversely affect yield and quality of perennial crops like fruits if moisture, nutrients, light and other production factors are not limiting. Suggested that banana suffers little competition from annual broad-leafed weeds and advised that some species of such weeds could be managed to serve as soil cover.

Perennial weeds

Perennial weeds are generally very difficult to control and pose a more serious problem in perennial fruit crops. If uncontrolled, may results in great yield loss and quality. Example

of perennial weeds in horticultural crops includes grasses like *Cynodon dactylon*, *Cyperus rotundus*, *Cyperus esculentus*, *Panicum* spp., *Imperata cylindrica*, *Mimosa* spp. etc. Generally weeds do not pose a serious problem in flower industry because most cut flowers are grown in greenhouses on flower beds or container media. Before planting, the media is treated with pre-emergence herbicides like trifluralin and benfluralin to destroy any weed material that could have been brought along with the media. As a result, weeds are never a major problem during the growing period. Very few weeds emerge and the species may depend on the weed flora of the area from which the growing media was obtained.

Some common perennial weeds of fruit and vegetables

Kharif season		Rabi season	
Sr.	Weeds name	Sr.	Weeds name
1.	<i>Amarathus</i> spp.	1.	<i>Asphodelus tenaifolius</i>
2.	<i>Alternanthera sessilis</i>	2.	<i>Anagallis arvensis</i>
3.	<i>Ageratum cynyzoides</i>	3.	<i>Chenopodium album</i>
4.	<i>Brachiaria eraciformis</i>	4.	<i>C. murale</i>
5.	<i>Cyperus rotundus</i>	5.	<i>Cuscuta</i> spp.
6.	<i>Cemmelina benghalensis</i>	6.	<i>Convolvulus arvensis</i>
7.	<i>Celosia argentea</i>	7.	<i>Cynodon dactylon</i>
8.	<i>Cynodon dactylon</i>	8.	<i>Cyperus rotundus</i>
9.	<i>Digiteria ciliaris</i>	9.	<i>Euphorbia hirta</i>
10.	<i>Dactyoctum aegyptium</i>	10.	<i>Fumaria parviflora</i>

11.	<i>Degera arvensis</i>	11.	<i>Lathyrus aphaca</i>
12.	<i>Echinochloa colonum</i>	12.	<i>Melilotus indica</i>
13.	<i>Eleusine indica</i>	13.	<i>Orobancha spp.</i>
14.	<i>Phyasalis minima</i>	14.	<i>Portulaca spp.</i>
15.	<i>Phyllanthus niruri</i>	15.	<i>Tribulus terrestris</i>
16.	<i>Trianthema spp.</i>	16.	<i>Tridax procumbens</i>
		17.	<i>Xanthium strumarium</i>
		18.	<i>Ischaemum pilosum</i>

Methods of weed control:

Physical and cultural methods

Manual and mechanical weeding involves the use of hand tools such as machete, cutlass, hoe, animal and motor traction to control weeds in the field or farm. Shallow weed control is usually used to control shallow rooted weeds such as annual grass and broad-leaved weeds, where as deep weed control is used to control deep rooted weeds such as perennial weeds. The frequency of weeding a crop may depend upon the degree of weed infestation in the field. For example, when cowpea was weeded twice in the field it resulted in higher yields under heavy weed infestation, where as when tomato was weeded twice under heavy weed infestation, the yield realised from it was not as high as that obtained from cowpea. Three (3) consecutive weeding were found to be very necessary for tomato to give a higher yield equivalent to cowpea. However, both manual and mechanical weeding are generally easy to perform, but in most cases are unable to control perennial weeds such as *Commelina* spp., *Cyperus* spp. among others.

Mowing/slashing, hand pulling, intercropping, burning and mulching

Mowing/slashing is a common method employed in controlling weeds in fruit orchards, where as hand pulling is commonly used in vegetables and flower production. In vegetables, it applies on closely broadcasted crops like carrots, tomatoes, eggplants, watermelons and sweet melons

because hardly crops sustained injuries from this method. Intercropping is widely practised in India to control weeds. It involves planting two or more crops in the same field at the same time or season. This results in higher crop stand, which significantly reduces weed infestation. Though, most farmers do it to increase their yield. Some common intercropping systems include tomatoes and onions, peppers and tomatoes, egg-plants and onions etc. reported that burning is also very common as a method of weed control, mainly used as a method of bush clearing before planting crops. Mulching involves using different types of materials such as black polythene, dry straw and other crop residues for weed control and moisture conservation. Dry grass and black polythene are used to control weeds in vegetables which were found to reduce weeds up to 78%. In Philippines, dry straw is used in combination with manual weeding to control weeds in vegetables, while in India, sugar cane trash is used to control weeds in crop areas. Mulching generally prevents the germination of light sensitive weeds like *Ageratum conyzoides*, *Portulaca oleraceae* etc.

Biological control method

This method involves the use of biotic organisms such as insects, mites, pathogens, birds, fish and grazing animals to control weeds. Though, it is not yet well developed and is of little value as a weed control method in horticultural crop production. The only

common method used by most farmers which does not attach any value is grazing, where animals such as sheep, goats and cattle are taken to the field for grazing. This helps suppress weeds, especially where good browsers like goats are the main livestock being grazed.

Chemical control method

This method also involves the use of herbicides for weed control. It has been widely adopted now days in fruit, vegetable and flower production. A number of pre-emergence herbicides of different selectivity are being used. In fruits a number of herbicides are being used, the choice depends on the prevailing weed species. Where perennial weeds are the major problem, systemic herbicides are used. For example, dalapon and glyphosate have been widely used to control perennial weeds like *C. dactylon*, *D. scalarum*, *Cyperus* spp. and *P. Clandestinum*. Other herbicides in use include the growth regulator types (2,4-D, 2,4-DB, MCPA), paraquat,

simazine, atrazine and diuron. These are used to control annual broad-leaved and grass weeds as well as perennial weeds depending on their selectivity. For example, 2, 4-D has been effectively used to control broad-leaved weeds as post-emergence applications. Chemical control is relatively poorly developed in vegetable crops as they tend to be grown on relatively small areas, hence making use of herbicides expensive and uneconomical. But if used with care, herbicides destroy weeds with minimal disturbance to the soil and less adverse effects on crops. Thus, they offer a good weed control alternative to cultural/mechanical methods in horticultural crop production. With this method, less labour is required; this allows transfer of labour to other activities since horticulture industry is labour intensive. This reduces the drudgery experienced in hand weeding by women who are mainly involved in weed control operations.

Herbicides recommended in major vegetables crop

Crop	Herbicide	Rate of Application (kg ai/ha)	Time of Application	Types of Weed Control
Okra	Fluchloralin	1-1.5 + HW 45 DAS	PPI	AG, BI
	Pendimethalin	1-1.5 + HW 45 DAS	PE	AG, BI
	Alachlor	2-2.5	PE	AG, BI
	Oxyfluorfen	0.1-0.25	PE	AG, BI
Brinjal	Fluchloralin	1-1.5 + HW 45 DAS	PPI	AG, BI
	Pendimethalin	1-1.5 + HW 45 DAS	PE	AG, BI
	Alachlor	1-1.5 + HW 45 DAS	PE	AG, BI
	Oxyfluorfen	0.1-0.25	PE	AG, BI
	Oxadiazon	1.0	PE	AG, BI
Chillies/ Capsicum	Fluchloralin	1-1.5 + HW 45 DAS	PPI	AG, BI
	Pendimethalin	1-1.5 + HW 45 DAS	PE	AG, BI
	Oxadiazon	1.0	PE	AG, BI
	Oxyfluorfen	0.1-0.25	PE	AG, BI
Cole crops	Alachlor	2.5 + HW 45 DAS	PE	AG, BI
	Oxyfluorfen	0.1-0.25	PE	AG, BI
	Pendimethalin	1-1.5 + HW 45 DAS	PPI	AG, BI

Tomato	Metribuzin	0.5-1.0	PE and POE	AG, BI, NS
	Fluchloralin	1-1.5 + HW 45 DAS	PPI	AG, BI
	Oxadiazon	1.0	PE	AG, BI
	Alachlor	1-2	PPI	AG, BI
	Oxyfluorfen	0.1-0.25	PE	AG, BI
Peas	Fluchloralin	1-1.5	PPI	AG, BI
	Pendimethalin	1-1.5	PE	AG, BI
	Alachlor	0.75 + HW 45 DAS	PE	AG, BI
Potato	Paraquat	0.5	POE	AG, BI, NS
	Metribuzin	0.5-1.0	PE and POE	AG, BI, NS
	Pendimethalin	1-1.5	PE	AG, BI
	Alachlor	2-2.5	PE	AG, BI
	Oxyfluorfen	0.1-0.25	PE	AG, BI
Onion	Alachlor	1-1.5	PE	AG, BI
	Fluchloralin	1-1.5 + HW 45 DAS	PPI	AG, BI
	Pendimethalin	1-1.5 + HW 45 DAS	PE	AG, BI
	Oxyfluorfen	0.1-0.25	PE	AG, BI
	Oxadiazon	1.0	PE	AG, BI
Coriander	Pendimethalin	1-1.5	PE	AG, BI
Bean	Alachlor	2-2.5	PE	AG, BI
	Fluchloralin	1-1.5	PPI	AG, BI
	Pendimethalin	1-1.5	PE	AG, BI
Root crops	Alachlor	1-1.5	PE	AG, BI
	Fluchloralin	1-1.5	PPI	AG, BI
	Pendimethalin	1-1.5	PE	AG, BI
	Oxyfluorfen	0.1-0.25	PE	AG, BI
Fenugreek	Fluchloralin	1-1.5	PPI	AG, BI
	Pendimethalin	1-1.5	PE	AG, BI

Weed management practices for orchards/tree plantation area

Tree bases, where freedom from weeds is most essential, are not easily accessible to mechanical cultivation. It may cause injury to the lower fruiting branches and shallow feeding roots of the trees. For this reason herbicidal control is important for ring weeding under the fruit trees. In between the tree rows, both cultivators and herbicides could be used with similar results, depending upon their economic viability. Also, suitable cover crops and sods may be grown in between the tree rows for weed suppression. Such sods should be kept low by mowing. Some gardeners like to grow vegetables in orchards,

which indirectly induces them to maintain weed free conditions. But intercropping of any kind in orchards may be undesirable in part of the year when the demand of orchard trees for mineral nutrients and water is high. At this time, black polythene mulches of 400 gauges can be used more effectively in smothering the weeds in orchards.

There has been considerable progress in the development and use of herbicides in orchards, particularly around the tree bases. The selectivity of herbicides to orchard trees may be achieved in any of the following four ways.

- i) The inherent tolerance of the plant to the herbicide; instance apple to simazine.
- ii) Failure of herbicides such as paraquat and diquat to penetrate the bark of trees
- iii) Directed and protected application of herbicides
- iv) Use of limited leaching herbicides, such as dichlobenil.

Important herbicide recommendations in orchards

Herbicide	Type of Treatment	Remarks
I. Contact Herbicides (with no soil residues):		
Herbicidal oils	Directed spray around the tree bases	Avoid drift to the tree trunks.
Paraquat/diquat	Directed spray around the tree bases	Drift will not damage woody stems. To obtain residual control, paraquat can be combined with simazine in tolerant crops like apple and peach.
II. Soil Active Herbicides :		
Terbacil (2-10 kg/ha)	Directed spray	Use for ring weeding in two years' or older apple, peach and citrus orchards
Simazine (1-2 kg/ha)	Preemergence to weeds	Use in citrus, apple, and other deciduous orchards, as well as in nuts and vineyards. Established apple and pear are tolerant up to 5 kg/ha simazine, once in two years.
Diuron (1-3 kg/ha)	Preemergence to weeds	Use in apple, pear, peach, citrus, banana, and pineapple plantations, as well as in vineyards. Vineyards can tolerate up to 3.5 kg/ha of diuron.
Monuron (1-2 kg/ha)	Preemergence to weeds	It is used in citrus groves in low rainfall areas only.
Dalapon (1%)	Directed spray	It is used for ring weeding four years' or older apple and pear orchards. Also, citrus and vineyards can be treated while these are dormant.
2,4-D (1-2 kg/ha)	Directed and protected spray	Fruit trees with exposed suckers should not be treated with it. Avoid ester formulations of 2,4-D. Apply as inverts or with drift control agents to avoid spray drift hazards.
Gluphosate (kg/ha)	Directed spray	Apply 2-3 times in the season for ring weeding of orchards, It can also be used to clean interrows of strawberry, fig, and banana orchards, particularly for Bermuda grass control.

CONCLUSION

Weeds are unwanted and undesirable plants which causes serious damage in different ways resulting in considerable loss to agricultural production. Of the total annual loss in agriculture produce, weeds account for 45 per cent. The

knowledge of weed management in horticultural crops with effective control measures with proper/selective herbicide alone or in combination with other method may result in effective control of the weed plants.

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