Inter and intra row weed and its effect: A review

ABSTRACT

In India, weeds are one of the major biological constraints that limit crop productivity. Weeds are ubiquitous to most crops. Most agricultural soils contain millions of weed seed per hectare, and if left unmanaged, weeds greatly reduce crop yields by competing with the crop for nutrients, light, and water. Unlike most other agricultural weeds, pests are present every year in every field and require some degree of management for optimum crop yields and profitability. Weeds can directly reduce crop yields, reduce crop quality, and increase harvest costs. Crop losses due to weeds result in reduced yields and quality and increases in harvest costs.

Keywords: *weed, weed effect, weed loss*

1 INTRODUCTION

India has huge amount of agriculture land area, so massive residues are produced here (Makavana et al., 2018).A weed can be thought of as any plant growing in the wrong place at the wrong time and doing more harm than good and it is used more nutrient (Balas et al., 2022C). Weeds are the major biological constraints that bad effect on crop growth and productivity (Balas et al., 2022B). But what are weeds? Weeds are most simply defined as "[a] plants out of place." A more poetic description was provided by Ralph Waldo Emerson who declared that "a weed is a plant whose virtues have not yet been discovered." Indeed, the ongoing search for genetic materials from plants that may prove to be beneficial confirms the need for a flexible perspective in managing those plants we call weeds. Weeds comprise the first stage of plant succession following soil disturbance and removal of native vegetation. From the time man first started manipulating crop plants to grow in designated areas rather than gathering food from nature, controlling competing vegetation became a primary task. Planting crops in rows facilitated cultivation and weeding options. Row spacing was largely based on the width of the particular animal or machine that would be used to cultivate the crop. India ranks second worldwide in horticulture produces. The scenario of horticultural crops in India has become very encouraging (Agravat et al., 2018).

Method

1.1 Classification of weeds

Out of 2, 50,000 plant species, weeds constitute about 250 species, which are prominent in agricultural and non-agricultural system. Under world conditions about 30000 species is grouped as weeds.

Based on life span

Based on life span (Ontogeny), weeds are classified as Annual weeds, Biennial weeds and Perennial weeds.

A. Annual Weeds

Weeds that live only for a season or a year and complete their life cycle in that season or year are called as annual weeds.

These are small herbs with shallow roots and weak stem. Produces seeds in profusion and the mode of propagation is commonly through seeds. After seeding the annuals die away and the seeds germinate and start the next generation in the next season or year following. Most common field weeds are annuals. The examples are

i. Monsoon annual

   a. Commelinabenghalensis, Boerhaviaerecta

ii. Winter annual

   Chenopodium album

Commelina benghalensis	Boerhavia erecta	Chenopodium album

Pic 1. Photographs showing small herbs

B. Biennials

It completes the vegetative growth in the first season, flower and set seeds in the succeeding season and then dies. These are found mainly in non-cropped areas.

Eg. Alternanthera echinata, Daucus carota

C. Perennials

Perennials live for more than two years and may live almost indefinitely. They adapted to withstand adverse conditions. They propagate not only through seeds but also by underground stem, root, rhizomes, tubers etc. And hence they are further classified into

i. **Simple perennials:** Plants propagated only by seeds. Eg. Sonchus arvensis

ii. **Bulbous perennials:** Plants which possess a modified stem with scales and reproduce mainly from bulbs and seeds. Eg. Allium sp.

iii. **Corm perennialsb:** Plants that possess a modified shoot and fleshy stem and reproduce through corm and seeds. Eg. Timothy (Phleum pratense).

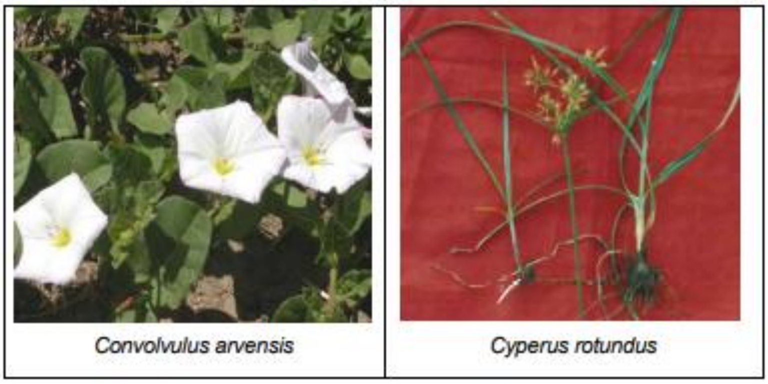
Sonchus arvensis	Phleum pratense

Pic 2.*Photographs showing* Perennial herbs

iv. **Creeping perennials:** Reproduced through seeds as well as with one of the following.

a. Rhizome: Plants having underground stem – Sorghum halapense

b. Stolon: Plants having horizontal creeping stem above the ground – Cynodondactylon



Pic 3.*Photographs showing*Creeping perennials

c. Roots: Plants having enlarged root system with numerous buds – Convolvulus arvensis

d. Tubers: Plants having modified rhizomes adapted for storage of food – Cyperus rotundus

1.2 Classification of Weeds into Inter and Intra Row

Klooster (1982) stated that there is an increased interest in mechanical weed control, and that the weeds in the row are the biggest problem. Kouwenhoven (1992) states that with inter-row weed control 60-70% of the surface is treated. He notes that intra row weed control is difficult and weeds closely surrounding the crop are almost impossible to control using existing intra row weeding techniques such as ridging or brushing.

Life cycles of weed species are described as summer annuals, winter annuals, biennials, or perennials (Ross and Lembi 2007). Summer annuals will emerge in the spring of the year and grow through the summer until fall when they produce seed and die, while winter annuals tend to emerge in the fall and overwinter to flower, set seed, and die in the spring. Biennials require 2 years to complete their life cycle from seedling to new seed, and perennials live longer than 2 years. Study on the development of a small capacity (5kg) fixed bed reactor pyrolyser for shredded cotton stalk as feed stalk (Makavana and Sarsavadia, 2018).

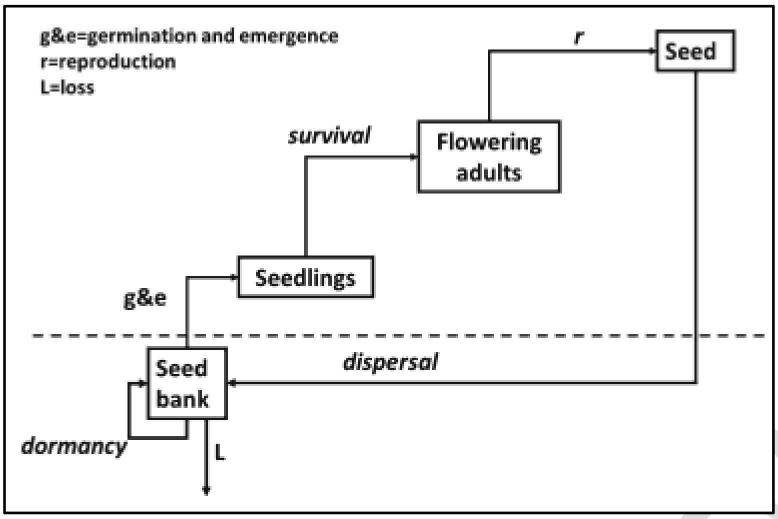


Fig.1:Population dynamics of an annual weed species showing stages (boxes) and transitions (arrows) among stages. Dashed line indicates above and below soil surface

Population dynamics of a weed species are described using a series of stages and transitions that a plant goes through during a year. Stages are those observable conditions of a plant such as seed, seedling, and flowering plant, while transitions are rates of germination and emergence, proportion of seedlings that survive to become flowering plants, and rate of reproduction by flowering plants to produce new seed (Fig.1). With annual weed species, the seed is the key stage in order for the population to perpetuate into the following year. Anderson (2005)highlighted three stages and transitions to target for weed control, that is, (1) enhancing the natural loss (L) of weed seeds in the soil seed bank, (2) reducing weed seedling establishment (survival), and (3) minimizing seed production by individual plants that survive to maturity (r) (Fig.1).

Weeds have very fast growth rates as compared to crops and if not treated or managed properly, theydominate the field and adversely effecton crop production and human welfare at large. Weeds directly reduce profits by hindering harvest operations and producing chemicals that are harmful to crop plants. Weeds are always associated with human endeavor's and because huge reductions in crop yields (Fig 1), increase cost of cultivation, reduce inputs use efficiency, act as alternate hosts for several insect pests, diseases and nematodes. The importance of their management seldom requires any mention especially under the present day high input farming systems. The composition and competition by weeds are dynamic in nature and dependent on soil, climate, cropping and management factors. Significant portion of farmer's time is wasted for weeding of crops.Weeds can also reduce the value of the harvested crop such as lowering protein levels in grain and decreasing fruit or seed size. The presence of weeds in the harvested crop may also lower the value of the crop. Jointed goat grass (Aegilops cylindrica) in wheat (Triticum aestivum) seed, puncture vine (Tribulus terrestris) burs and nightshade (Solanum sp.) berries in green peas (Pisum sativum), nightshade stains on beans (Phaseolus vulgaris), and horseweed (Conyza canadensis) oil distilled with peppermint (Mentha piperita) oil are examples of weeds contaminating and lowering the value of the harvested crop.

Necessity for Weed Control

Karnkal (2013) studied the weeding operations and opined that intercultural operation controls unwanted plants between the rows which consume more fertilizers and reduce the crop yield. Controlling weed is one of the serious, problems faced by the farmers. The reduction in the yield due to weeds alone is estimated about 30-60 % depending upon the crop and location, and one third of the cost of cultivation is being spent for weeding alone. Chavan *et al*. (2015) opined that weeds compete with crops for essential nutrients. In agriculture, it's a very difficult task to weed out unwanted plants manually as well as animal operated equipment's which may further lead to damage of main crop. Agricultural mechanisation entails the use of various power sources as well as improved farm tools and equipment in order to reduce human and animal drudgery, improve cropping intensity, precision, and timeliness of crop input utilisation, and reduce losses at various stages of crop production (Agravat et al., 2023). Farmers have been using manual device for weeding operation, they were time consuming, laborious, boring, tedious and costly also (Balas et al., 2018A). More than 33 % of the cost incurred in cultivation is diverted to weeding operations there by reducing the profit share of farmers.

RESULTS AND DISCUSSION

Crop losses due to weeds vary by crop, weed species, location, and farming system (Bridges 1992; Swinton *et al*. 1994). Weeds not only compete for nutrients, light, and water but can also harbor pests (nematodes, insects, pathogens) of the crop reducing potential yields and quality further (Boydston *et al*. 2008).

Loses Due to Weeds

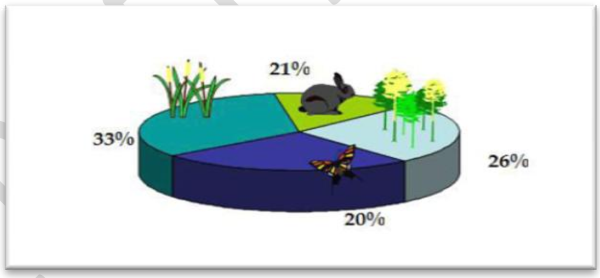


Fig. 2: Share of losses caused by weeds

Smith (1961) reported that the weed competition is a serious problem in almost all rainy seasons' crops causing the losses in yield ranging from 9 to 60 % or more. Grist (1976) reported that the weeds affect the microclimate around the plants harbor diseases and pests, increases the cost of production, plug irrigation and drainage canals and lower the quantity and quality of crop and showed that the competition of one grass plant (Echinocloacrusgalli) per square foot reduced yield of rice by 25 %. Murthy and Gowada (1996) reported that the percent yield losses due to weed competition for the first one month, two month and entire crop season were 23.7 %, 35.4 % and 40.8 % respectively.Moorthy and Das (2002) reported that the weeds compete severely light, nutrients, moisture and space. The yield losses are closely ranging from 50-97 %. Charudattan and Dinoor (2000) reported that the weeds compete severely for nutrients and depending upon the intensity of weed growth, deletion of nutrients may be up to 86.5 kg N, 12.4 kg P and 134.5 kg K per ha. Chauhan *et al*. (2014) reported that, in Asian countries, weedy rice, the unwanted plants of Oryza sativa competing with cultivated rice and these plants produce stained grains reduce rice yield from 16 % to 74 %. Bhan *et al*. (1999) estimated that weeds in India reduce crop yields by 31.5 per cent (22.7 per cent in winter and 36.5 per cent in summer and kharif seasons respectively). In other studies, weeds were reported to cause up to one-third of the total losses in yield, besides impairing quality of produce and causing health and environmental hazards (Anon., 2013). In a survey, Indian weed scientists estimated losses due to weeds from 10 per cent to 100 per cent (Table 1). Even a conservative estimate of about 10 per cent loss would amount to a loss of food grains valued at approximately US $ 13 billion (Yaduraju, 2012). Losses of this magnitude due to weeds may occur in plantation crops, fruits, vegetables, grasslands, forestry and aquatic environments. The total economic losses will be much higher, if indirect effects of weeds on health, losses of biodiversity, nutrient depletion, grain quality, etc. are taken into consideration.

Table 1: Yield reduction caused by weed in different crops

Name of crops	**% Yield reduction**	**Reference**
Direct seeded paddy	45-90	Singh (2014)
Transplanted paddy	15-38	Singh (2014)
Maize	28-93	Malviya and Singh (2007); Singh (2014)
Sorghum	6-40	Singh (2014)
Finger millet	26-27	Pradhan *et al.* (2012)
Redgram	20-47	Singh (2014)
Soybean	40-60	Jha and Soni (2013); Singh (2014)
Wheat	26–38	Das (2008); Verma *et al.* (2015); Das *et al.*(2012)
Chickpea	15-25	Kewat (2014)
Pea	20-30	Kewat (2014)
Mustard	15-30	Kewat (2014)
Groundnut	20–50	Rathore *et al.* (2014)
Sesame	50-75	Bhadauria*et al.* (2012); Duary and Hazra (2013); Rathore *et al.* (2014)
Sun flower	30-64	Rathore *et al.* (2014)
Castor	15-25	Rathore *et al.* (2014)
Cotton	74-96	Verma *et al.* (2015)
Jute	58-70	Ghorai *et al.* (2013)
Coriander	20-50	Yadav *et al.* (2013)
Sugarcane	40-67	Chauhan and Srivastava (2002); Pratap *et al.* (2013)
Brinjal	49-90	Reddy *et al.* (2000); Kunti and Singh

		(2012)

Due to the negative impact of weed competition, they are removed or killed using different weeding techniques. A Canadian survey of crop losses due to weeds in 58 commodities reported average annual losses of $984 million due to weeds (Swanton *et al.* 1993). Lentil (Lens culinaris) and cranberry (Oxycoccus sp.) crops had the greatest percent yield loss due to weeds (25 %), whereas the major crops of corn (Zea mays), soybean (Glycine max), hay, wheat, potato (Solanum tuberosum), canola (Brassica napus), and barley (Hordeum vulgare) had the greatest monetary value losses.Density was increased by 3.91 times and calorific value was increased by 1.19 times (Makavana et al.,2020).

Most fields are infested with multiple weed species which interact resulting in a combined effect on the crop. Crops vary in their ability to compete and tolerate weeds. Soybean yield was reduced more by weeds than corn yields in previous studies (Swinton *et al.* 1994). The fuel consumption of the tractor while using automated weeder was measured by auxiliary tank method (Balas, et al. 2018B. Onions (Allium cepa) lack a competitive crop canopy to shade weeds and are susceptible to nearly total crop loss due to uncontrolled weeds (Williams *et al.* 2007).In a study, the loss due to soil erosion was assessed to be 13.6 per cent and that due to insect and disease was 35.8 per cent while the loss due to weeds alone was estimated about 16 to 42 per cent depending on the crop and location (Duary and Hazra, 2013). In some cases, delay and negligence in weeding operation may also cause complete crop failure (Singh, 1988). Removal of weeds consumes 25 per cent labour i.e. 900-1200 man- hour per ha during the cultivation season (Padole, 2007). Around one third of the cost of cultivation is spent on weeding alone when carried out manually (Duary and Hazra, 2013).

Weed, which is affect both on productivity and profitability of rain fed agriculture that accounts for a major share in cost of agricultural production, If not controlled properly. More than 33 % of the cost incurred in cultivation is diverted to weed there by reducing the profit share of farmers (Chavan *et al*., 2015).

CONCLUSION

- Weeds reduce the productivity, increase the cost of cleaning and overall adversely affect the value of the land and thereby affecting the farmer’s energy, time or money (Parish, 1990).
- Weeds in crop field compete for soil nutrients, soil moisture, sunlight (Tollenaar and Wu, 1999)
- Due to weeds, space, water and other ecological factors are use, in unmeaning full throughout the whole growing seasons (Maxwell and O’Donovan, 2007).
- Some weed species are dangerous to livestock and release toxins through the soil which endanger other plants (Marer, 2000).

Without a proper weed management program, weeds will affect crop yield and quality, resulting in reduced revenue for the grower.

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