

Yellow Gold (Soybean) Facing Weed Problem in India and Their Solutions for Sustainable Improvement of Productivity

Santosh Mujalde, S. K. Choudhar, Ranjeet

Received 20 February 2018; Accepted 18 March 2018; Published on 5 April 2018

Abstract Dominance of a habitat by the crop or weed depends on the rapidity of seed germination, seedling establishment and subsequent growth and development. Difference in photosynthetic area, root development and its growth largely determine the competitiveness of plants. The degree of weed competition is generally occurs between soybean and weed for three major natural resources i.e. water, light and nutrient. Weed infestation is one of the major problems in soybean cultivation which cause 37%, reduction in soybean yield as compared with insect 33%, disease 20 and other 05% respectively. These

are also shows the early stage of crops (15–25 DAS) are most critical stage for competition between soybean and weed. Farmers could be maintain lower weed populations in soybean field through adoptions of improved weed management methods i.e. mechanical, cultural, biological and herbicides. Any practice aimed at enhancing competitive ability of the crop against weeds can bring down the adverse effect of weeds on crops. Seedling vigor, early growth rate, tillering ability can give competitive advantage to the crop.

Keywords Competition, Crop growth, Weed management practices, Soybean.

Introduction

Soybean is one of the most important nutritious crops in the world. It has 40–44% protein, 30–32% carbohydrate and 20–22% oil. USA, France and Japan show huge interest in maximum utilization of natural resources like light, water and nutrients in oilseed crops such as soybean (Boyer 1982). India is the fifth major soybean producer in the world after the USA, China, Brazil and Argentina. But its share is only 3% of world production of soybean. In India soybean is cultivated in 8.2 million hectare and contributes 23% of oil production compared with groundnut 34% and mustard 26% ((National Productivity Council, New Delhi, India, 2009).

Santosh Mujalde, S. K. Choudhar, Ranjeet*
College of Agriculture, Indore,
Madhya Pradesh, India
e-mail : ranjeetwankhade@gmail.com
*Corresponding author

Table 1. Some outstanding examples of successful biological control of weeds.

Sl. No.	Targeted weeds	Insect
1	<i>Opuntia intermis</i> (prickly pear cactus)	<i>Cactoblastis cactorum</i> (pyralid moth)
2	<i>Parthenium hysterophorus</i> (Parthenium)	<i>Zygogramma bicolorata</i> (leaf beetles)
3	<i>Cyperus rotundus</i> (nut sedge)	<i>Althesapaecuta cyperi</i> (stem boring weevil) <i>Bactra minima</i> (stem borer)
4	<i>Eichhornia crissipes</i> (water hyacinth)	<i>Tilapia</i> sp. (herbivorous fish)

According to Tiwari et al. (1997), Madhya Pradesh, occupies an area of about 39.5 lakh ha with a production of about 25.7 lakh tonnes. The productivity of soybean in Madhya Pradesh is only 1130 kg/ha. Madhya Pradesh the soya state contributes about 70% of total production in India compared with Maharashtra (16.8%), Rajasthan (10.8%), Karnataka (0.8%), Uttar Pradesh (0.8%) and others (0.8%).

In India, soybean yield is 1.08 tonnes/ha, which is quite low, as compared to the World average of 2.31 tons/hectare (Masuda and Goldsmith 2009). The reason for the low productivity of soybean can be ascribed to a number of factors which are related to seed quality, plant protection measures and adoption of improved agro-technology, including weed control. Weed infestation is one of the major problems in soybean cultivation which cause 37%, reduction in soybean yield as compared with insect 33%, disease 20 and other 05% respectively (Arya 1994). Average yield losses due to weeds are given in Fig. 1.

What is weed

Definition of weed: A plant growing where it is not desired; or a plant grow out of place (The Encyclopedia Americana, 1962).

Main characteristics of weeds. Weed seeds germinate earlier than the crop seed, Weed seedlings grow faster and cover space earlier than crop plants, Weeds produce flower earlier and a lot of seeds as compared to crop, Weeds are more capable of germinating under adverse conditions.

Table 2. Some outstanding examples of successful biopesticides control of weeds.

Bioherbicide	Bioagent	Target weed
<i>Emmalocera</i> spp.	Stem boring moth	<i>Echinochloa</i> spp.
Tripose	Shrimp	<i>Echinochloa</i> spp.
<i>Bactra verutana</i>	Shoot boring moth	<i>Cyperus rotundus</i>

What type of weeds are found in soybean field

Many weeds interfere in growth and development of plant and cause poor yield of soybean. Generally weed affecting soybean divided is two groups.

Dicot weed

If a flowering plant has a taproot and leaves with dendritic branched veins, has petals in fours, fives or greater numbers and the seeds contain two cotyledons. Example: Lehsua (*Digera arvensis*), Jangli jute (*Corchorus olitorius*), Badi dudhi (*Euphorbia hirta*), Chollai (*Amaranthus viridis*), Hajardana (*Phyllanthus niruri*).

Monocot weed

If a flowering plant, has veins which follow the shape of the leaf without obvious branching, leaf margin not lobed except when lobed below the point of petiole insertion (sagitate or cordate), petals and other flower parts in whorls of three and a single cotyledon (or much endosperm and apparently no cotyledon). Example: Wild grass (*Dinebra arebica*), Jangli sawan (*Echinochloa colonum*), Bokhena (*Commellina bengalensis*) doob (*Cynodon dactylon*), Motha/Nut sedge (*Cyperus rotundus*) (Anonymous 2009).

Critical period of crop-weed competition

The critical period for crop-weed competition is the period from sowing up to which the crop has to be maintained in a weed free environment for remunerative crop production. Differences in final crop yield

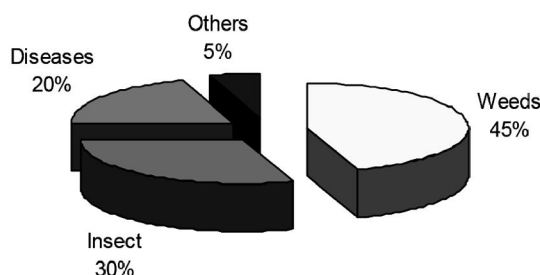


Fig. 1. Contribution of weeds in yield reduction of soybean.

due to weeding at this period and that due to weed free environment throughout the crop period will be marginal. The crop canopy in the early period develops leaf area adequate to smother the weed growth. Hence, weed competition in crop field is invariably severe in early stages of crop growth than at later stages. Generally, in a crop of 100 days duration, the first 20 days after sowing (DAS) should be maintained weed free for optimum yield. Critical periods of weed of competition for major crops are given in Fig. 2.

Why weed management is needed

Growth requirements of crops and weeds are identical. Therefore, when weeds are allowed to grow with crops, they compete with crop plants for all the growth factors, natural or costly inputs. Unfortunately, weeds absorb nutrients and moisture faster and smother the crop plants leading to reduced yield. It is estimated that losses due to weeds exceed losses from any other pest or disease. Due to this reason adoption of proper weed management technology is essential to improvement of productivity soybean (Chhonkar and Balyan 1999, Klingman 1994).

Materials and Methods

Mechanical, cultural, biological and chemical weed management methods are most important to minimize weed population and give highest production/unit area of soybean crops.

Mechanical methods

They are ancient method of weed control in the world. These methods are used by many farmers as a primary weed control technique in many crops. They include hand hoeing, hand pulling, tillage, digging, sickling and mulching. Choice of each method depends on the location, extent and habitat of weeds.

Hoeing

In this method bullock or tractor drawn wheel hoe or cycle hoe or light blade hoe are used for controlling weeds between crop rows. Hoeing twice is sufficient for controlling weeds in soybean, done at 20 and 35 days after sowing. It is effective against both dicot and monocot, which have shallow root system.

Hand pulling

When labor is readily available, pulling out of weeds by hand at 20 and 33 days after sowing is the cheapest method where weeds are scattered around in a way that makes herbicide use uneconomical or where herbicides are not effective on a particular weed species.

Tillage

Tillage operations such as ploughing, disking, harrowing and leveling all play important roles in seedbed preparation and destroy weeds before sowing.

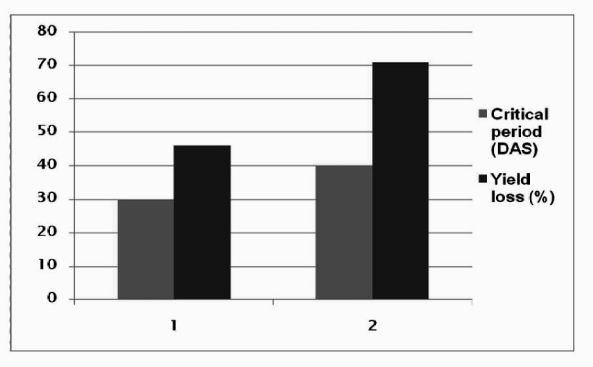


Fig. 2. Critical stages of soybean - weed competition and yield loss by weeds (1 = 25 DAS and 2 = 35 DAS).

Both types of weeds can be successfully controlled by (i) deep ploughing by mould board plough in summer and (ii) cross harrowing before sowing.

Digging

It is very useful to remove underground propagating parts of perennial weeds from deeper layers of soil. Digging is followed by hand pulling of the weed. Digging, a labor intensive method, is restricted to perennial weed control in small areas where other methods are not effective.

Sickling

Sickling by hand is used to remove top weed growth, to prevent weed seed production and to starve the underground parts. It is specially ideal on sloppy lands, where root system has to be left in the field to minimise soil erosion. If the soil condition does not permit use of implements or tools for controlling weed, especially at critical stages, sickling is usually followed. Herbicide needs can be considerably brought down by sickling before applying the herbicide.

Mulching

In this method farmers use crop residues like wheat or rice straw within rows at 25 – 30 days after sowing. Due to the smothering effect, weeds are not able to complete the biological process i.e. photosynthesis.

Some perennial weeds like *Cynodon dactylon*, *Sorghum halepense* are effectively managed by this method.

Results and Discussion

Cultural practices

Cultural practices provide best opportunity to control weed management in soybean crops. In this method combination and integration between crop management techniques take place.

Crop rotation

It is a system of more than two crops growing in one calendar year i.e. *kharif* soybean, *rabi* wheat and summer vegetable. In this system there is no chance for weed seed to germinate and complete its life cycle because the field is rotated crop by crop, through whole year.

Selection of varieties

In this system generally choose fast growing varieties like Jawahar soybean 9305 and Jawahar soybean 335. Many scientists reported that tall and quick growing varieties are more competitive with weeds than short or dwarf cultivars.

Table 3. Example of chemical weed management in soybean. Choose only one herbicide in above mentioned herbicides table and selected herbicide applied with 600 l of water to distribute the chemical equally and make this method successful.

Sl. No.	Herbicides name	Dose (a.i./ha)	Time of application	Weed control
1.	Fluchloralin 45% EC (Lasso)	1.2 kg	Pre Planting Incorporation (PPI)	Dicot weeds
2.	Pendimethalin (38.7 CS)	580.5 g	Pre Planting Incorporation (PPI)	Both dicot and monocot
3.	Pendimethalin 30% EC (Stomp)	750 g	Pre emergence (PE)	Dicot weeds
4.	Chlorimuron ethyl 25% WP (Kloben)	9.37 g	Post emergence (PoE) 18–22 days after sowing (DAS)	Dicot weeds
5.	Fenoxoprop ethyl 9% EC (Whipe Super)	67.5 g	Post emergence (18–22 DAS)	Monocot weeds
6.	Imazethapyr 70% WG (Pursuit)	70 g +Sticker @ 1.5 ml/liter of water Ammonium sulfate @ 2.0 g/liter of water	Post emergence (18–22 DAS)	Both dicot and monocot

Selection of seed

Always use high quality seed: i.e. clean, above 70% germination and vigor, because these seeds better compete with weeds and give per ha higher yield as compare to lower quality seed.

Time of sowing

It is known as zero input technology. Some specific time is very good for plant growth and its development. The best time of sowing for soybean in India between 25th June to 5th July.

Clean cultivation

Impliments are one of the important sources of weed dispersed disseminations from one field to other. So, before moving them all implements like seed drill, plough, hoe should be clean.

Method of sowing

A narrow spacing was advantageous than wide spacing (30 and 45 cm) in reducing weed competition and increasing soybean yield. Line sowing method of

soybean is very good as compared to broad cast method, because in line sowing weeds can be controlling in an easy way by the use of mechanical tools like hand hoe, blade hoe.

Plant population

During the growth period of the plant population should be maintained about 3, 20000- 3, 33000/ha to make optimum use of natural resources like, light, space and moisture.

Fertility management

10–12 tons/hectare well decomposed farm yard manure should be used 1 month before sowing of seed. Well fertilized soil provides favorable condition to plant growth and minimize the chance of weed establishment (Singh et al. 2006).

Biological control

It involves utilization of natural living organisms (bioagents) such as insects, pathogens and competitive plants to limit the weed infestation. The objectives of biological control are not eradication, but re-

duction and regulation of the weed population below the level of economic injury. A bioagent may be either specific or nonspecific. Specific bioagent attacks only one or two specific weeds, while the nonspecifics feed upon a variety of vegetation. The specific bioagents include, primarily insects and plant pathogens (Veeramani et al. 2000). The choice of pests and pathogens should meet certain criteria before they can be declared successful as bioagents. Important criteria are Host specificity, Fast damaging ability, Adaptability to new environment, Fasting ability for long period during periods of declining weed population, Efficient reproduction and Freedom from natural enemies.

The merits of biological control are relative cheapness, comparatively long lasting effects and least harm on the environment and the nontarget organisms. Some outstanding examples of successful biological control of weeds are given in Table 1.

Although herbicides are effective for weed control, either has been increasing concern about their safety for food products, their adverse effect on environment and widespread resistance to herbicides. These factors along with rising prohibitive costs have provided the impetus to develop alternative weed management strategies. In this context, biological control as an alternative or supplemental weed management appears to play a major role in crop production. A bioherbicide is a plant pathogen used for weed control through application of its inoculum. A list of biopesticides is given in Table 2.

Chemical methods

Use of chemicals for weed control offer great potential in crop production. Chemical weed control functions on the basis that certain chemicals are capable of killing some plants (weeds) without significantly affecting other plants (crops). Such chemicals are called herbicides. Some selected chemicals offer great potential to weed control in soybean production Table 3. Chemical weed control functions on the basis that certain chemicals are capable of killing some plants (weeds) without significantly affecting other plants (crops) (Srinivasa et al. 1995). Such chemicals are called herbicides (Singh et al. 2006).

Chemical weed control has some definite advantages over other methods. Most effective compared with other methods of weed control, Highly suitable for closely spaced crops, Suitable for adverse soil and climatic conditions, Provides early season or zero day weed control, Controls the weeds without any mechanical injury to the associated standing crop, Reduces the need for repeated cultural operation during the crop season and Controls even many perennial weeds which can not be effectively controlled by other methods. Some of the drawbacks with chemical control of weeds are that they must be applied at proper time, they have harmful residues which may affect succeeding crops and require minimum technical knowledge.

Integrated weed management

Good soybean weed control would be possible with utilizing two or more methods combining them in an integrated weed management system. i.e. 2 hand weedings at 20 and 40 days after sowing or fluchloralin @ 1 kg as pre-plant incorporation + 1 hand weeding at 30 days after sowing or mulching with wheat and mustard straw @ 10 tonnes/ha between the rows just after sowing effectively controlled the weeds in soybean and gave similar seed yield of statistical order but superior to the other weed control treatments (Table 3). Mulching in soybean recorded the highest grain yield of succeeding wheat and lowest was recorded in weedy check of soybean (Idapuganti et al. 2006).

Conclusion

Soybean is the most important nutritious crop in the world and it is established as one of the major *kharif* season field crop in Madhya Pradesh, India. It has resulted economical crop because of comparatively good economic returns / unit area obtained by the farmers from its cultivation (Dubey 1998). This brought the revolution in rural areas with regard to improvement in the living conditions of the farmers. The advance crop production technologies significantly minimize the competition between soybean and weed, as they gave a new direction to the crop to achieve higher productivity of soybean.

References

- Anonymous (2009) Herbiseed brief weed guide No. 17, www.herbiseed.co.
- Arya MPS (1994) Crop weed competition in soybean (*Glycine max*) with special reference to *Oxalis latifolia*. Ind J Agron 39 (1) : 136—139.
- Boyer Whitson (1982) Weeds of the West. Western Society of Weed Science. p. ix. ISBN 0-941570-13-4.
- Chhonkar RS, Balyan RS (1999) Competition and control of weed in soybean. Weed Sci 47 (1) : 107—111.
- Dubey MP (1998) Growth, yield and economics of soybean (*Glycine max*) as influenced by weed control methods and row spacing's. Ind J Agron 43 (3) : 540—545.
- Idapuganti, Rana DS, Pachauri DK (2006) Integrated weed management in soybean (*Glycine max*) and its residual effect on succeeding wheat (*Triticum aestivum*). Ind J Agric Sci 76 (2) : 156—164.
- Klingman TE (1994) Influence of planting date on weed interference on plant growth and productivity. Weed Sci 42 : 61—65.
- Masuda Tadayoshi, Goldsmith Peter D (2009) World soybean production. Area harvested, yield, and long-term projections. Int Food and Agribusiness Manag Rev 12 (4) : 143—162.
- Singh Pratap, Nepalia V, Tomar SS (2006) Effect of weed control and nutrient management on soybean (*Glycine max*) productivity. Ind J Agron 51 (4) : 314—317.
- Srinivasa KASS, Rao Veeraraghavaiah Ravuri, Martin Luther M, Rao KL (1995) Weed management in soybean (*Glycine max*). Ind J Agron 40 (4) : 711—712.
- The Encyclopedia Americana (1962) American Corporation. N.Y. pp 28.
- Tiwari PN, Kailashia DS, Chourasia SK (1997) Efficiency of weed control measures of grain yield and economic return from soybean. Jawaharlal Nehru Agric Univ Res Rev 1 : 124—125.
- Veeramani A, Palchamy A, Ramasamy S, Rangaraju G (2000) Integrated weed management in soybean (*Glycine max*) under different moisture regimes and population densities. Ind J Agron 45 (4) : 740—744.