Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 06, Issue: 01 (JAN-FEB, 2026)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Herbicide Mixtures for Broad-Spectrum Weed Management in Soybean

*Karthik, A. N., Usha, N., Devaraj and Laxman Navi
University of Agricultural Sciences, GKVK, Bengaluru
*Corresponding Author's email: karthikandanur17@gmail.com

Soybean, *Glycine max* (Linn.) Merrill belongs family Fabaceae (Leguminosae), the subfamily Faboidaea (Papilionoideae). In India, it is known by several names as bhat, bhatman, bhatmas, kulthi, ramkulthi, bhut, kalitur, teliakuthi an gerakalay. It is an important crop worldwide because of its wide range of geographical adaptability, unique chemical composition, good nutritional value, functional health benefits and variety of end uses (food, feed and edible oil). It is extremely flexible (resilient) and performs better and can give profitable returns even under minimum input management practices. It is well suited under different cropping systems and improves soil fertility by fixing atmospheric nitrogen to the extent of 50-300 kg/ha and adds 1.0 -1.5 tonnes of leaf litter per season. Soybean is well known for their nutritional and health benefits. It contains about **40 good quality protein**, **20 % oil** having about 85% unsaturated fatty acids including 55% polyunsaturated fatty acids. 25-30% CHO and no almost starch, 4-5 % mineral, antioxidants (ascorbic acid 9-10 mg/100 g sprouted soybean, beta carotene 0.2 mg/100 g sprouts and about 0.3 % isoflavonoids). Because of all the qualities soybean is known as **Wonder Crop**, **Miracle Crop** and **Golden Bean**. The quality of soya protein is equivalent to that of animal protein and soybean is also a good source of dietary fibre, calcium, magnesium, phosphate, thiamine, riboflavin, niacin, etc.

Yield loss due to pest

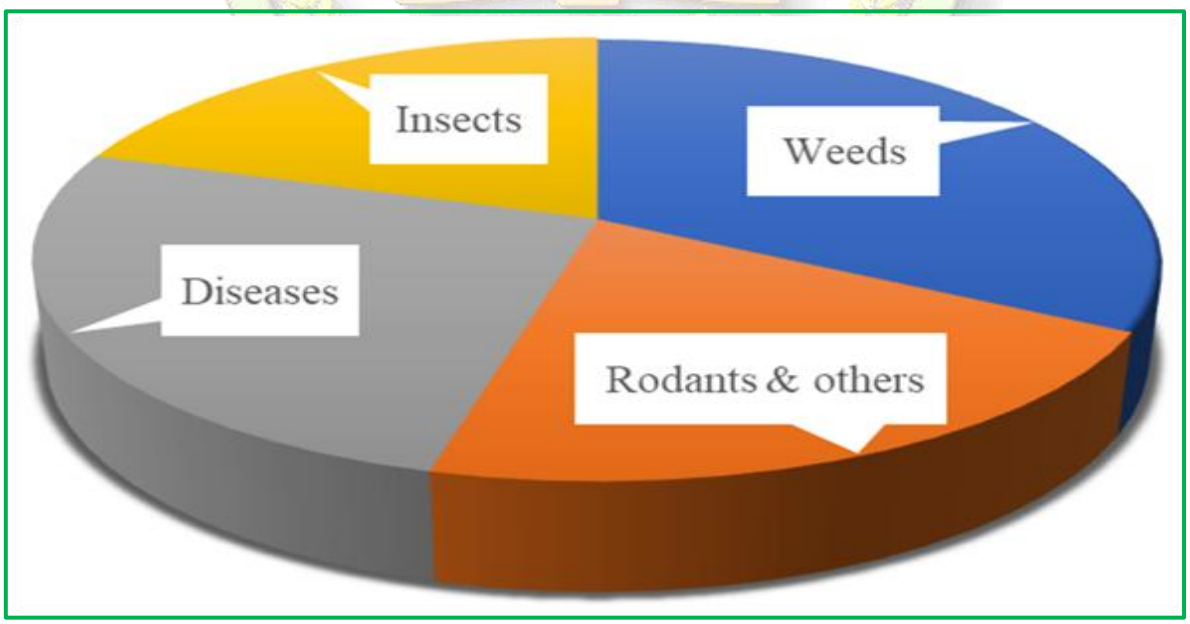


Fig. 1: Share of yield losses caused by pests

Weeds produced the highest incidence or loss (33%) when compared to insects (20%), Diseases (26%), Rodents and others (21%).

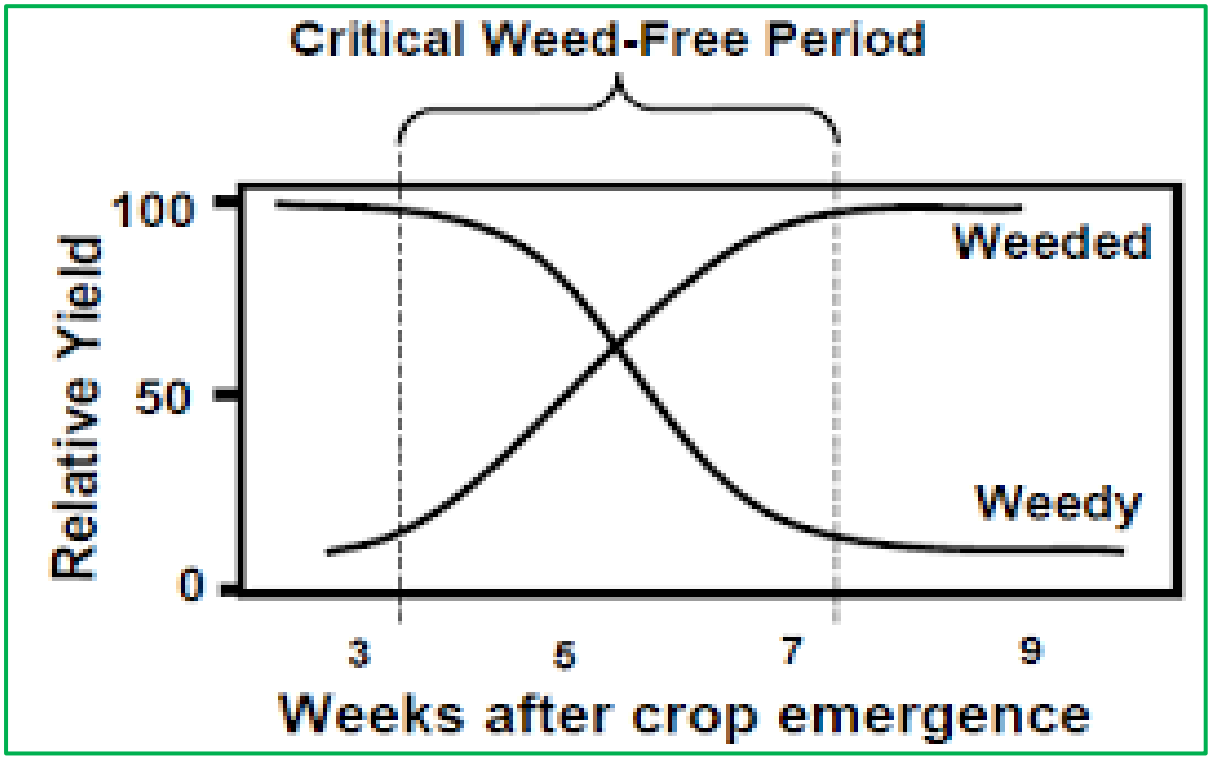


Fig. 2: Critical crop-weed competition for soybean

Critical Period of Weed Competition

1. The critical period of weed competition is the shortest period during crop growth when weeding results in the highest economic returns.
2. The crop yield level obtained by weeding during this period is almost similar to that obtained by the full seasons weed free conditions.
3. The critical period of weed competition is also defined as the period between early growth during which weeds can grow without affecting crop yield and the point after which weed growth does not affect the yield.
4. The critical period of weed competition is approximately 1/3rd of the duration of the crop.
5. For soybean it is from 20 to 40 DAS

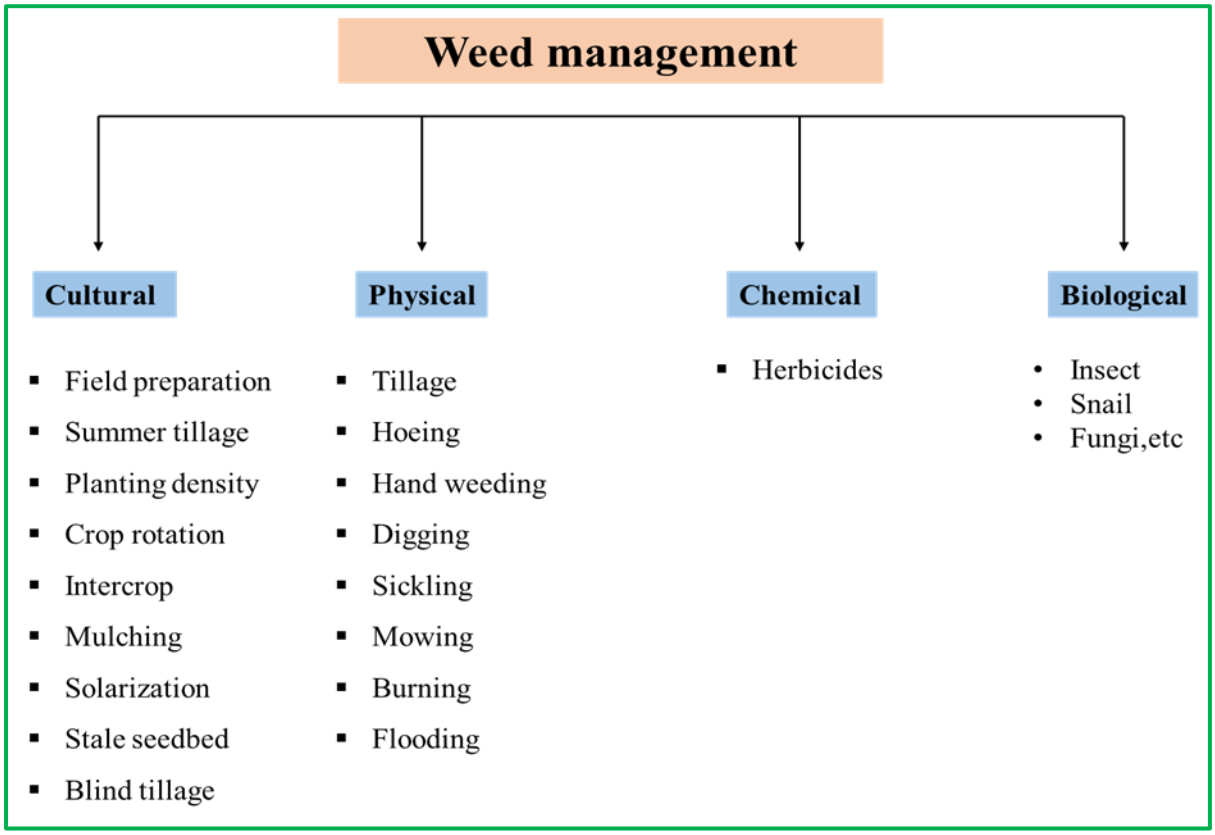
Thus, efficient weed management is an essential prerequisite for increasing crop productivity.

Weed management

There are four major methods to manage weeds in crops those are cultural, physical, chemical and biological method. Hand weeding and hoeing are common practices for weed control. However, scarcity of labour or continuous rains often prevents timely weed control, under such situations, the application of herbicides offers an alternate and equally effective method of weed control. Among these methods, the chemical method of weed control by using herbicides is gaining more importance due to its benefits over other methods of weed control.

Benefits of chemical method

1. Herbicides can be applied for weed control in crop rows and where cultivation is impossible.
2. Pre-emergence herbicides provide early-season weed control.
3. Cultivation & manual methods of weed control may injure the root system.
4. Herbicides reduce the need for pre-planting tillage. They are extremely useful in minimal\zero tillage.
5. Herbicides can control many perennials weed which cannot be controlled by other methods. Eg: *Cyperus* sp.,



Several herbicides *viz.*, Pendimethalin, Imazethapyr, Quizalofop, Alachlor, *etc*. were in use for controlling weeds associated with soybean, but these have not been found effective in controlling all types of weeds. Hence, there is a need to mix herbicides to achieve broad spectrum weed control in soybean.

Herbicide mixture

The concept of herbicide mixture probably dates back to 1 960s when the phenoxy alkanoic acids used to be formulated together. The research on herbicide mixture, however, has gained momentum after there were reports of weed flora shift and herbicide-resistance in weeds in some countries of the world, Herbicide mixture is believed to be an important tool towards management of herbicide-resistance in weeds. It, if not completely prevents the development of resistance in weeds, certainly delays it. Formulating a herbicide mixture, therefore, requires a clear understanding of the compatibility and interaction of the component herbicides to be used in the mixture. For weed control in cereals, new herbicides such as chlorsulfuron, metsulfuron-methyl, bensulfuron-methyl, and chlorimuron-ethyl of the sulfonylureas, almost from the beginning, have been developed in combinations with other herbicides or viewed as additives by the trade and farmers (Martin, 1987). Mixed formulation of chlortoluron + bifenox, isoproturon + trifluralin, isoproturon + bromoxynil + ioxynil, isoproturon + bromoxynil + ioxynil + mecoprop and isoproturon + bromoxynil + mecoprop are also available for the combined control of grass and broad-leaved weeds in cereals. However, studies relating to bio-efficacy, selectivity and persistence of herbicide mixture require to be taken up more in the forth-coming years and similarly, the farmers may be advised to resort to herbicide mixtures instead of using a single herbicide repeatedly. Herbicide mixture, despite having an immense beneficial role, has some limitations. Two selective herbicides may turn non-selective and hence become more toxic than either of the component herbicides. As a result, the normally tolerant crops may fall susceptible to a herbicide mixture. However, this demerit could be merit under non-crop situations to manage difficult-to-control weeds with reasonably lower total active ingredient. The herbicide mixture may also show an antagonistic response and there may exist a physical incompatibility between the component herbicides as well. These limitations, however, do not debar/prevent herbicide mixture from use. The efficiency of a mixture should be

thoroughly investigated with several combinations of the different herbicides across doses and the mixture, which is an efficient one with good compatibility and synergistic action should be recommended for use, simply understanding the chemistry of herbicides and making their mixture may not serve the purpose. It needs repeated field experimentation for a good recommendation. First experiments have to be undertaken with tank-mixes and later ready-mix may be prepared/manufactured by the companies with the best tank-mix combination. of course, there lies a difference between the processes of making ready-mix and tank-mix.

- ❖ Mechanical or chemical mixing of two or more herbicides having a different mode of action and varying levels of activity and selectivity forms a herbicide mixture
- ❖ Herbicides of the same class or different classes having similar mode of action are not ideal for herbicide mixture
- ❖ Even having a similar spectrum of weed control should not be opted for mixing

Kinds of herbicide mixtures

- ✔ Factory-mix/pre-mix/ready-mix
- ✔ Field-mix/tank-mix

Factory-mix/pre-mix/ready-mix

A mixture of desired herbicides is prepared in the factory itself with definite proportions.

Examples (used in soybean):

- Fluazifop-p-butyl 11.1 % + Fomesafen 11.1 % SL (Flusiflex, Salvatore)
- Imazethapyr 35 % + Imazamox 35 % WG (Adue, Jodi, Bingo, Odyssey)
- Pendimethalin 30 % + Imazethapyr 2 % EC (Jwala, Nakabandi, Iguana 32)
- Propaquizafop 2.5 % + Imazethapyr 3.75 % (Shaked)
- Quizalofop-ethyl 10 % EC + Chlorimuron ethyl 20 % WP (Max-soy)
- Sulfentrazone 20 % + Clomazone 30 % WP (Authority)

Field-mix/tank-mix

Mechanical mixing of two or more herbicides before their application in the field.

Examples:

- Haloxyfop + Imazethapyr
- Imazethapyr + Propaquizafop-ethyl
- Propaquizafop-ethyl + Chlorimuron-ethyl

Effects of herbicide mixture interactions

When two or more chemicals accumulate in the plant, they may interact and bring out responses. These responses are classified as additive, synergistic, antagonistic and enhancement effects.

- **Additive effect:** It refers to the combined action of component herbicides in the mixture when the total effect of the mixture = the total effect of the component herbicides when applied independently. (AB) = (A) + (B)
- **Synergistic effect:** It is derived from the cooperative action of two or more herbicides in a mixture. (AB) > (A) + (B) Mixture effect of herbicide is more than the effect of herbicides A and B independently.
- **Antagonistic effect:** The decrease in the normal biological activity of one or all component herbicides in a mixture is referred to as an antagonistic effect. If (A) > (B) then (AB) < (A)
- **Enhancement effect:** It generally occurs when adjuvant is mixed with the active ingredient in the formulation and it increases the efficacy of herbicide than obtained with the active ingredient alone.

Advantages of herbicide mixtures

- ✔ Controls broad spectrum weeds
- ✔ Prevents/avoids shift in weed flora
- ✔ Avoids/delays development of resistance in weeds

- ✔ Increases the weed control efficiency
- ✔ Reduced dosage of herbicides per unit area
- ✔ Because of the reduced rate of application reduced residue in crop and environment
- ✔ Reduces cost of application of herbicides

References

1. Anonymous, 2021, Agricultural statistics at a glance 2021, Directorate of economics & statistics, New Delhi, *Report*, pp. 87-89.
2. Rao, A. N. and Chauhan, B. S., 2015, Weeds and weed management in India-A Review. Weed Science in the Asian Pacific Region. Indian Society of Weed Science, Hyderabad, pp. 87-118.