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# Efficacy of broad spectrum post emergence herbicide combinations in soybean (*Glycine max* L. Merrill)

**KP Aher, Pawar SU, Koturwar MR and Gokhale DN**

**Abstract**
The field investigation entitled on efficacy of broad spectrum post emergence herbicide combinations in soybean (*Glycine max* (L.) Merrill)" was conducted during *kharif* 2021-22 at experimental farm, Department of Agronomy, College of Agriculture, VNMKV, Parbhani (M.S) with a view to study the effect of different broad spectrum post emergence herbicides on weed control in soybean as well as growth and yield of soybean. The experiment was laid out in Randomized Block Design. The experiment was carried out with seven weed management practices each treatment was replicated thrice. Treatment were $T_1$-PoE- Fluazifop-p-butyl 11.1% + Fomesafen 11.1% W/W SL @ 250 g a.i ha$^{-1}$, $T_2$- PoE- Imazethapyr 35% + Imazamox 35% WG @ 70 g a.i ha$^{-1}$, $T_3$- PoE- Sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 80 +165 g a.i ha$^{-1}$, $T_4$- PoE- Propaquizafop 2.5% + Imazethapyr 3.75% W/W @ 50 + 75 g a.i ha$^{-1}$, $T_5$- PoE- Fomesafen 12% + Quizalofop ethyl 3% SC @ 180 +45 g a.i ha$^{-1}$, $T_6$- Weed free and $T_7$- Weedy check. Results of study revealed that among the herbicide combinations the lowest weed count for both monocot and dicot weed and highest seed yield, as well as net monetary returns were recorded with post emergence application of Fomesafen 12% + Quizalofop ethyl 3% SC @ 180 +45 g a.i ha$^{-1}$ ($T_5$), PoE-Fluazifop-p-butyl 11.1% + Fomesafen 11.1% W/W SL@ 250 g a.i ha$^{-1}$ ($T_1$) and PoE- Sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 80 +165 g a.i ha$^{-1}$ ($T_3$). These treatments were comparable to weed free ($T_6$) and found to be significantly superior over rest of treatments of post emergence herbicide combinations for weed control in soybean.

**Keywords:** Soybean, weed management, herbicide combinations, post emergence, *kharif*

## Introduction
Soybean is known as "Golden bean" or "Miracle crop" of 20$^{th}$ century as it is richest, cheapest and easiest source of best quality protein and fat (Patil and Udmale, 2016) [13]. Crop losses due to weed competition are greater than those resulting from the combined effect of disease and insects. Weeds may encourage the development of diseases.

For sustaining food grain production to feed ever-increasing population and ensuring food security, effective weed management is very essential. (Singh *et al.* 2014) [5] Weeds use the available moisture, soil fertility, nutrients and compete for space & sunlight with the crops plants which result in yield reduction. In *Kharif* season, the weed competition is one of the most important causes of low yield, which estimated to be 31-84%. (Kachroo *et al*, 2003) [8].

Herbicide application is one of the greatest options for weed control in a timely manner. Herbicides now on the market are either pre-emergence and have a most of the time limited weed control scope. Furthermore, if farmers fail to apply these pre- emergence or pre-incorporated herbicides for one reason or another, they will need to use alternate post-emergence herbicides to control weeds. Currently many new pre-and post-emergence herbicide combinations for weed management in soybeans have recently been released in India, and they must be examined before being used in the field and their efficacy to control dominant weeds at different locations and their evaluation for field use. Considering these points this experiment was planned to evaluate performance of different post emergence herbicide combinations for weed control in soybean.

## Materials and Methods
Field experiment on efficacy of broad spectrum post emergence herbicide combinations in soybean (*Glycine max* (L.) Merrill)" was carried out on black soil during the *Kharif* season of 2021-22 at experimental farm, Department of Agronomy, College of Agriculture, VNMKV, Parbhani. The topography of the experimental plot was well uniform and levelled. The soil was black in colour, deep and fairly well drained.

The experiment was laid out in Randomized Block Design. The experiment was carried out with seven weed management treatments each treatment was replicated thrice. Treatment were $T_1$-PoE- Fluazifop-p-butyl 11.1% + Fomesafen 11.1% W/W SL@ 250 g a.i $ha^{-1}$, $T_2$- PoE- Imazethapyr 35% + Imazamox 35% WG @ 70 g a.i $ha^{-1}$, $T_3$- PoE- Sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 80 +165 g a.i $ha^{-1}$, $T_4$- PoE- Propaquizafop 2.5% + Imazethapyr 3.75% W/W @ 50 + 75 g a.i $ha^{-1}$, $T_5$- PoE- Fomesafen 12% + Quizalofop ethyl 3% SC @ 180 +45 g a.i $ha^{-1}$, $T_6$- Weed free and $T_7$- Weedy check. The gross and net plot size of each experimental unit was 5.4m x 4.5m and 4.5m x 4.2m, respectively and variety of soybean used for experimental study was MAUS-158. Sowing was done on 27th August 2021. Different observations were recorded *viz*., seed yield, gross monetary returns and benefit cost ratio, yield attributing character and weed count of soybean. An area of a 1 $m^2$ quadrate was fixed in each experimental plot and observations on weed count were recorded at 15, 30, 45 DAS. These weed samples were sun- dried for three days and then oven dried at 70 °C in oven to keep a consistent weight.

## Results and Discussion

### Weed count ($m^{-2}$)

### Weed count for Monocot and Dicot

Data presented in Table 1 indicated that the mean number of monocot and dicot weeds were influenced significantly by different weed management practices at 30 and 45 DAS.

Among herbicide combinations lowest monocot and dicot weed count was observed with PoE-Fomesafen 12% + Quizalofop ethyl 3% SC @ 180 + 45 g a.i/ha ($T_5$), PoE-Fluazifop-p-butyl 11.1% + Fomesafen 11.1% w/w SL @ 250 g a.i/ha ($T_1$) and was at par with PoE-Sodium acifluorfen 16.5% + Clodinofop propargyl 8% EC @ 80 + 165 g a.i/ha ($T_3$) which found significantly superior over rest of the treatments and comparable with weed free ($T_6$) while the highest monocot and dicot weed count recorded with weedy check ($T_7$). Lower weed density of monocot and dicot weeds in weed free was due to periodically disturbances of soil by removal of weeds with the help of hand tools in weed free and also in treatments with post-emergence herbicide combinations there was better control of weeds extended over later stage of crop growth. Several authors reported that the reduction of weed population under weed free. The results are in line with findings of Ghosh *et al*. (2020) [4], Chaudhari *et al*. (2017) [2] and Sandii *et al*. (2015) [10].

### Yield attributes and seed yield of soybean

Perusal data presented in Table 2 indicated that different weed management practices significantly influenced yield attributes and seed yield of soybean. The highest number of pods per plant, seed yield $plant^{-1}$ and seed yield per ha was recorded with (1720 kg $ha^{-1}$) weed free ($T_6$) treatments it was significantly superior over rest of treatments and statistically at par with PoE- Fomesafen 12% + Quizalofop ethyl 3% SC @ 180 + 45 g a.i/ha ($T_5$), PoE-Fluazifop-p-butyl 11.1% + Fomesafen 11.1% w/w SL @ 250 g a.i/ha ($T_1$) and PoE-Sodium acifluorfen 16.5% + Clodinofop propargyl 8% EC @ 80 + 165 g a.i/ha ($T_3$). Lowest seed yield was observed in treatments weedy check ($T_7$). Similar trend was observed in number of pods $plant^{-1}$ and number of Seeds $pod^{-1}$

This might be due to least competition offered by weeds for nutrients and moisture at crucial growth stages under treatment weed free and broad spectrum post emergence herbicide combinations which ultimately improved all yield attributes. Singh *et al*. (2014) [5], Kadam *et al*. (2018) [6] and Jha *et al*. (2014) [14] reported similar findings was observed in seed yield of soybean as influenced by weed management treatments.

### Economics

### Gross monetary return (₹$ha^{-1}$)

The data on mean gross monetary return (₹$ha^{-1}$) of soybean is presented in Table 2. All weed management practices resulted higher gross return over weedy check. Data indicated that weed free ($T_6$) recorded highest gross return (₹70170) which were statistically at par with PoE-Fomesafen 12% + Quizalofop ethyl 3% SC @ 180 + 45 g a.i/ha ($T_5$), PoE-Fluazifop-p-butyl 11.1% + Fomesafen 11.1% w/w SL @ 250 g a.i/ha ($T_1$) followed by PoE- Sodium acifluorfen 16.5% + Clodinofop propargyl 8% EC @ 80 + 165g a.i/ha ($T_3$) and found significantly superior over rest of the treatments.

This might be due to weed free situation during crop-weed competition period, vigorous growth of crop was favored due to better partitioning of assimilates and their relative accumulation, finally results into higher yields as well as high gross monetary returns. These resulted were in conformity with Andhale *et al*. (2019) [1], Sandii *et al*. (2015) [10] and Thakare *et al.* (2015) [14].

### Net monetary returns

Data on mean net monetary returns (₹$ha^{-1}$) of soybean is presented in table 2. Maximum net return of received with the treatment PoE-Fomesafen 12% + Quizalofop ethyl 3% SC @ 180 + 45 g a.i/ha ($T_5$), it was found statistically at par with weed free ($T_6$), PoE-Fluazifop-p-butyl 11.1% + Fomesafen 11.1% w/w SL @ 250 g a.i/ha ($T_1$) and PoE- Sodium acifluorfen 16.5% + Clodinofop propargyl 8% EC @ 80 + 165 g a.i/ha ($T_3$) while significantly superior over rest of treatments. The least net monetary returns were recorded by weedy check ($T_7$).

Application of herbicides recorded better net return it was mainly due enhanced yield which was comparable with weed free and reduced cost of cultivation along with control of monocot and dicot weeds. Similar result were reported by Chaudhari *et al*. (2020) [2], Lodha (2018) [9] and Kumar *et al.* (2018) [7].

### Benefit: Cost Ratio (B:C ratio)

Weed management practices influenced the benefit cost ratio. Among the weed management practices treatment PoE-Fomesafen 12% + Quizalofop ethyl 3% SC @ 180 + 45 g a.i/ha ($T_5$) recorded maximum benefit: cost ratio (2.42) than weed free ($T_6$). Minimum benefit: cost ratio (1.41) recorded with treatment weedy check ($T_7$).

The difference in B: C ratio were due to the variation in cost for treatments comprising with hand weeding as well as herbicide. The similar findings were obtained by Rupareliya *et al.* (2020) [12], Lodha *et al.* (2018) [9] and Deshmukh *et al.* (2014) [3, 11].

## Conclusion

Among the different broad spectrum post emergence herbicide combinations post emergence application of Fomesafen 12% + Quizalofop ethyl 3% @180 + 45g a.i $ha^{-1}$($T_5$), PoE- application of Fluazifop-p-butyl 11.1% +

Fomesafen 11.1% @ 250 g a.i ha$^{-1}$ ($T_1$) and PoE- application of Sodium acifluorfen 16.5% + Clodinofop propargyl 8% @ 80 + 165 g a.i ha$^{-1}$ ($T_3$) found highly effective in controlling monocot and dicot weed in soybean compared to rest of treatment as well as highly productive, profitable and comparable to weed free.

**Table 1:** Mean weed count (m$^{-2}$) at 15, 30 and 45 DAS as influenced by different treatments

| Tr. No | Treatments | 15 DAS | | 30 DAS | | 45 DAS | |
|---|---|---|---|---|---|---|---|
| | | Monocot | Dicot | Monocot | Dicot | Monocot | Dicot |
| $T_1$ | PoE- Fluazifop-p-butyl 11.1% + Fomesafen 11.1 W/W SL@ 250 g a.i/ha | 19.87 *(4.56) | 13.33 (3.78) | 4.16 (2.2) | 2.73 (1.93) | 6.80 (2.79) | 4.83 (2.41) |
| $T_2$ | PoE- Imazethapyr 35% + Imazamox 35% WG @ 70 g a.i/ha. | 20.53 (4.64) | 13.50 (3.80) | 10.33 (3.36) | 11.21 (3.49) | 16.85 (4.22) | 12.46 (3.66) |
| $T_3$ | PoE- Sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 80 +165 g a.i/ha. | 20.33 (4.61) | 12.91 (3.72) | 4.60 (2.36) | 3.10 (2.02) | 7.03 (2.83) | 4.90 (2.42) |
| $T_4$ | PoE- Propaquizafop 2.5% + Imazethapyr 3.75% W/W @ 50 + 75 g a.i/ha. | 19.93 (4.57) | 13.51 (3.80) | 12.28 (3.64) | 12.58 (3.68) | 18.45 (4.41) | 13.71 (3.83) |
| $T_5$ | PoE- Fomesafen 12% + Quizalofop ethyl 3% SC @ 180 +45 g a.i/ha | 20.50 (4.63) | 13.33 (3.78) | 4.00 (2.23) | 2.35 (1.83) | 6.39 (2.71) | 4.66 (2.37) |
| $T_6$ | Weed free | 20.20 (4.60) | 12.84 (3.70) | 2.71 (1.92) | 1.66 (1.63) | 3.50 (2.12) | 2.81 (1.95) |
| $T_7$ | Weedy check | 20.64 (4.65) | 13.74 (3.83) | 35.85 (6.07) | 29.38 (5.51) | 51.67 (7.25) | 43.68 (6.68) |
| S.E.± | | 1.02 | 0.60 | 0.64 | 0.51 | 1.18 | 0.73 |
| C.D. at 5% | | NS | NS | 1.98 | 1.59 | 3.64 | 2.27 |
| General mean | | 20.28 | 13.31 | 10.56 | 9.00 | 15.61 | 12.43 |

*The value in parenthesis are transformed by $\sqrt{x}+1$

**Table 2:** Yield attributes, seed yield and economics of soybean as influenced by different treatments

| Tr. No | Treatments | No. of Seeds pod$^{-1}$ | No. of pods plant$^{-1}$ | Seed yield Kg ha$^{-1}$ | Net Monetary Returns (₹ha$^{-1}$) | Gross Monetary Returns (₹ ha $^{1}$) | B:C ratio |
|---|---|---|---|---|---|---|---|
| $T_1$ | PoE- Fluazifop-p-butyl 11.1% + Fomesafen 11.1 W/W SL @ 250 g a.i/ha | 2.24 | 26.01 | 1587 | 36712 | 64964 | 2.31 |
| $T_2$ | PoE- Imazethapyr 35% + Imazamox 35% WG @ 70 g a.i/ha. | 2.18 | 22.64 | 1376 | 27710 | 56391 | 2.01 |
| $T_3$ | PoE- Sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 80 +165 g a.i/ha. | 2.24 | 25.54 | 1492 | 32619 | 61272 | 2.13 |
| $T_3$ | PoE- Propaquizafop 2.5% + Imazethapyr 3.75% W/W @ 50 + 75 g a.i/ha. | 2.07 | 21.16 | 1259 | 22890 | 51942 | 1.81 |
| $T_5$ | PoE- Fomesafen 12% + Quizalofop ethyl 3% SC @ 180 +45 g a.i/ha | 2.27 | 26.46 | 1671 | 40080 | 68799 | 2.42 |
| $T_6$ | Weed free | 2.31 | 27.17 | 1720 | 36918 | 70170 | 2.11 |
| $T_7$ | Weedy check | 2.04 | 17.14 | 895 | 10747 | 36697 | 1.41 |
| S.E.± | | 0.42 | 1.03 | 75.08 | 1304 | 2922 | - |
| C.D. at 5% | | NS | 3.17 | 231.34 | 4018 | 9001 | - |
| General mean | | 2.19 | 23.73 | 1427.64 | 29668 | 5865 | 2.02 |

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