



ISSN (E): 2277-7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2022; 11(5): 247-249  
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[www.thepharmajournal.com](http://www.thepharmajournal.com)  
Received: 02-03-2022  
Accepted: 06-04-2022

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## Yield and economics of soybean [*Glycine max* (L.) Merrill] as influenced by Pre and Post emergence herbicides

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### Abstract

A field experiment was conducted at Agricultural Research Station, Ummedganj, Kota during *kharif*, 2019 to study of comparative efficacy of herbicidal weed management practices in soybean (*Glycine max* L. Merrill). The ultimate aim of any soybean grower is to secure maximum net income out of the present production technology. Two hand weeding at 20 and 40 DAS gave significantly higher seed yield over herbicidal weed control. In the investigation maximum net return was fetched with hand weeding twice at 20 and 40 DAS (₹ 39571 ha<sup>-1</sup>) closely followed by application of Sodium acifluorfen 16.5% + Clodinafop propargyl 8% EC (premix) @ 165 + 80 g *a.i.* ha<sup>-1</sup> at 20 DAS (₹ 38204 ha<sup>-1</sup>). The benefit: cost ratio represents the profitability of the treatment with each rupee of investment. The benefit: cost ratio was highest recorded with application of Sodium acifluorfen 16.5% + Clodinafop propargyl 8% EC (premix) @ 165 + 80 g *a.i.* ha<sup>-1</sup> at 20 DAS was found more remunerative (1.61) than other herbicidal treatments including hand weeding (1.22).

**Keywords:** Herbicides, soybean, economics, net return, yield

### Introduction

Soybean [*Glycine max* (L.) Merrill] known as a wonder crop of twentieth century because it contains about 40-42 per cent high quality protein, 20-22 per cent edible oil, 20-30 per cent carbohydrates, 4.5 per cent minerals, 3.7 per cent fibre, 8.1 per cent water, large amount of phosphorus, high level of amino acids such as lysine, leucine, lecithin and vitamins. It is able to leave residual nitrogen effect for succeeding crop equivalent to 35-40 kgN/ha-1. Soybean can tolerate mild drought as well as floods. This characteristic has made soybean to fit well in sustainable agriculture. Soybean due to its various uses is rightly called "Golden Gift" of nature to mankind.

In India, soybean occupies an area of 10.83 M ha, with production potential of 10.93 million tonnes and average productivity of 1009 kg ha<sup>-1</sup> (Anonymous, 2018) [1]. In Rajasthan, soybean is grown as a major oilseed crop mainly in South-Eastern parts of Rajasthan during *kharif* season. It covers 9.21 lakh ha with an annual production of 8.94 lakh tons in the state (Anonymous, 2018) [1]. Weeds can cause significant seed yield losses in soybean (Jha *et al.*, 2014 and Singh *et al.*, 2014) [3, 8]. The economic analysis of weed control treatments was determined on per hectare area basis, which include the value of seed yield, value of straw yield, cost of cultivation, gross returns, net returns and benefit: cost ratio under different treatments.

### Material and Methods

The experiment was conducted during *kharif* season of 2019 at Agricultural Research Station, Ummedganj, Kota, which is situated in agroclimatic zone V (Humid South Eastern Plain) of Rajasthan. The experiment was laid out in Randomized Block Design with eight treatments, within three replications. The experiment comprises eight treatments *viz.* Pendimethalin 30% EC @ 1.0 kg *a.i.* ha<sup>-1</sup> as PE, Pendimethalin 30% EC + Imazethapyr 2% SL (premix) @ 960 g *a.i.* ha<sup>-1</sup> as PE, Sodium acifluorfen 16.5% + Clodinafop propargyl 8% EC (premix) @ 165 + 80 g *a.i.* ha<sup>-1</sup> at 20 DAS, Quizalofop-ethyl 5% EC @ 50 g *a.i.* ha<sup>-1</sup> at 20 DAS, Imazethapyr 10% SL @ 100 g *a.i.* ha<sup>-1</sup> at 20 DAS, Imazethapyr 3.75% + Propaquizafop 2.5% ME (premix) @ 50 + 75 g *a.i.* ha<sup>-1</sup> at 20 DAS, two hand weeding at 20 & 40 DAS and weedy check. The soil of the experimental site was clay loam in texture and the soil having medium fertility

status. Soybean variety RKS-113 (Kota Soya-1) was used as experimental material developed at Agricultural Research Station, Kota (Rajasthan). The value of economic produce seed yield and straw yield recorded for calculating the gross return. Existing minimum support price for soybean seed and market price was taken into consideration for determining the gross return under each treatment.

## Results and Discussion

### Yield

The data (Table 2) revealed that all weed control treatments recorded significantly higher seed and straw yield as compared to weedy check. Whereas, the lowest yield. The seed and straw yield were significantly higher under two hand weeding at 20 and 40 DAS followed by application of Sodium acifluorfen 16.5% + Clodinafop propargyl 8% (premix) @ 165 + 80 g *a.i.* ha<sup>-1</sup> at 20 DAS over weedy check. Which was statistically at par with application of Imazethapyr 3.75% + Propaquizafop 2.5% ME (premix) @ 50 + 75 g *a.i.* ha<sup>-1</sup> at 20 DAS and application of Pendimethalin 30% EC + Imazethapyr 2% SL (premix) @ 960 g *a.i.* ha<sup>-1</sup> as pre-emergence. The similar findings also reported by (Deshmukh *et al.*, 2014; Manjunath and Hosmath, 2016 and Kamble *et al.*, 2017) and Verma and Kushwaha, 2019 [2, 5, 4, 9].

### Economics

In the experiment, net return and B: C ratio increased by all weed management practices as compared to weedy check. Two hand weeding at 20 and 40 DAS recorded maximum net return (₹ 39571 ha<sup>-1</sup>), which was at par with application of Sodium acifluorfen 16.5% + Clodinafop propargyl 8% EC

(premix) @ 165 + 80 g *a.i.* ha<sup>-1</sup> (₹ 38204 ha<sup>-1</sup>), application of Imazethapyr 3.75% + Propaquizafop 2.5% ME (premix) @ 50 + 75 g *a.i.* ha<sup>-1</sup> at 20 DAS (₹ 36804 ha<sup>-1</sup>), application of Pendimethalin 30% EC + Imazethapyr 2% SL (premix) @ 960 g *a.i.* ha<sup>-1</sup> as pre emergence (₹ 34561 ha<sup>-1</sup>) and application of Imazethapyr 10% SL @ 100 g *a.i.* ha<sup>-1</sup> at 20 DAS (₹ 33981 ha<sup>-1</sup>). The increase in net income was due to increase in seed yield with optimum cost of cultivation. The benefit: cost ratio was highest recorded with application of Sodium acifluorfen 16.5% + Clodinafop propargyl 8% EC (premix) @ 165 + 80 g *a.i.* ha<sup>-1</sup> at 20 DAS was found more remunerative (1.61) than other herbicidal treatments including hand weeding (1.22). Results of the present investigation corroborate the finding of (Panda *et al.*, 2017) and (Sandil *et al.*, 2015) [6, 7].

### Summary

The results of carried out experiment revealed the weed management through two hand weeding at 20 and 40 DAS gave significantly higher seed yield and net returns over herbicidal weed management. Amongst herbicides, application of Sodium acifluorfen 16.5% + Clodinafop propargyl 8% EC (premix) @ 165 + 80 g ha<sup>-1</sup> or Imazethapyr 3.75% + Propaquizafop 2.5% ME (premix) @ 50 + 75 g ha<sup>-1</sup> resulted in significantly higher seed yield and net return over other herbicides and herbicide mixtures. Therefore, under ample availability of man power, weed control in soybean should be done through manual weeding at 20 and 40 DAS while under scarcity of labour, application of Sodium acifluorfen 16.5% + Clodinafop propargyl 8% EC (premix) @ 165 + 80 g ha<sup>-1</sup> and Imazethapyr 3.75% + Propaquizafop 2.5% ME (premix) @ 50 + 75 g ha<sup>-1</sup>.

**Table 1:** Effect of herbicides on economics of various treatments

Treatments	Net returns (₹ ha <sup>-1</sup> )	B:C ratio
Pendimethalin 30% EC @ 1.0 kg <i>a.i.</i> ha <sup>-1</sup> as PE	25350	1.07
Pendimethalin 30% EC + imazethapyr 2% SL (premix) @ 960 g <i>a.i.</i> ha <sup>-1</sup> as PE	34561	1.42
Sodium acifluorfen 16.5% + clodinafop propargyl 8% EC (premix) @ 165 + 80 g <i>a.i.</i> ha <sup>-1</sup> at 20 DAS	38204	1.61
Quizalofop ethyl 5% EC @ 50 g <i>a.i.</i> ha <sup>-1</sup> at 20 DAS	29370	1.24
Imazethapyr 10% SL @ 100 g <i>a.i.</i> ha <sup>-1</sup> at 20 DAS	33981	1.47
Imazethapyr 3.75% + propaquizafop 2.5% ME (premix) @ 50 + 75 g <i>a.i.</i> ha <sup>-1</sup> at 20 DAS	36804	1.54
Hand weeding at 20 & 40 DAS	39571	1.22
Weedy check	5859	0.26
SEm±	1622	0.07
CD at 5%	4921	0.20
CV (%)	9.22	9.52

**Table 2:** Effect of herbicides on seed yield, straw yield and biological yield

Treatments	Seed yield (kg ha <sup>-1</sup> )	Straw yield (kg ha <sup>-1</sup> )	Biological yield (kg ha <sup>-1</sup> )
Pendimethalin 30% EC @ 1.0 kg <i>a.i.</i> ha <sup>-1</sup> as PE	1225	1792	3017
Pendimethalin 30% EC + imazethapyr 2% SL (premix) @ 960 g <i>a.i.</i> ha <sup>-1</sup> as PE	1475	2128	3603
Sodium acifluorfen 16.5% + clodinafop propargyl 8% EC (premix) @ 165 + 80 g <i>a.i.</i> ha <sup>-1</sup> at 20 DAS	1550	2233	3783
Quizalofop ethyl 5% EC @ 50 g <i>a.i.</i> ha <sup>-1</sup> at 20 DAS	1325	1930	3255
Imazethapyr 10% SL @ 100 g <i>a.i.</i> ha <sup>-1</sup> at 20 DAS	1425	2091	3516
Imazethapyr 3.75% + propaquizafop 2.5% ME (premix) @ 50 + 75 g <i>a.i.</i> ha <sup>-1</sup> at 20 DAS	1520	2190	3710
Hand weeding at 20 & 40 DAS	1800	2592	4392
Weedy check	700	1028	1728
SEm±	40.53	63.72	102.44
CD at 5%	122.93	193.28	310.69
CV (%)	5.10	5.52	5.26

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