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Effect of Broad Spectrum Herbicides on Weed Dynamic, Yield and Economics of Soybean Production

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A B S T R A C T

The field experiment was conducted during *Kharif*, 2017 at Instructional farm of Rajasthan College of Agriculture, Udaipur. Experimental field was mostly dominated by grassy weeds namely; *Echinochloa colona*, *Cynodon dactylon*, *Digitaria sanguinallis* with broad leaf weeds; *Commelina benghalensis*, *Digera arvensis*, *Trianthim aportulcastrum*, *Amarathus viridis and Parthenium hysterophorus* and sedges; *Cyperus rotundus*. The results indicated that all the herbicidal treatments were significantly superior over weedy check with all parameters. The tank mix application of imazethapyr 75 g/ ha + propaquizafop 75 g/ha as post-emergence at 21 DAS recorded significantly lower weed density, weed dry weight, maximum weed control efficiency and significantly improved the growth characters, yield and yield attributing characters.

Introduction

Soybean (*Glycine max* L. Merill) popularly known as "wonder crop" of twenty first century is an important oilseed crops. It serves the dual purpose for being grown as an oilseed crop and pulse crop (Thakare *et al.*, 2015). It contains approximately 40-45 % protein and 18-22% oil and is a rich source of vitamins and minerals. Soybean also helps in maintaining soil fertility and fixes nitrogen symbiotically. The ecological conditions of the state are congenial for cultivation of soybean but the yield is substantially low (1007kg/ha), despite of the best management practices. Being a rainy season crop, the environment is more conducive for excessive weed infestation in soybean. Severe weed competition is one of the major constraints for low productivity of soybean. Weeds in general, cause competition stress on soybean growth, especially during the first 40 days after sowing. Weeds alone are responsible for reduction in weed yield of soybean to the range of 25 to 70% depending upon the weed flora and intensity (Sandil *et al.*, 2015). Sole application of herbicide as pre or post emergence fails to control diversified and subsequent flushes of weeds effectively (Tuti and Das 2011). Moreover, continuous use of single herbicide is known to result in the evaluation of herbicide resistance in weed species and shift in weed flora (Schutte *et al.*, 2017) So, there is need to apply some new post-emergence herbicides and their tank mix combinations like imazethapyr, propaquizafop

and quizalofop-ethyl to reduce weed menace and keep the crop free from weed competition during entire critical period of crop growth (Sandil *et al.,* 2015; Parmar *et al.,* 2016 Nirala *et al.,* 2016). Herbicide mixtures provide an opportunity for increasing herbicide efficiency and arresting all complex weed flora shift. Presently, imazethapyr is a very effective post emergence herbicide for controlling broad leaf and some grassy weeds in soybean. But its efficacy has not been tested with propaquizafop, quizalofop-ethyl and pendimethalin for wide spectrum weed control in soybean. Therefore, the present investigation is carried out to assess the efficacy of different herbicide when applied alone or in combination with other herbicides to provide weed free environment during entire growing period of soybean through easy, efficient and economically viable weed management practices.

Materials and Methods

Experiment was conducted during *Kharif,* 2017 at Instructional farm of Rajasthan College of Agriculture, Udaipurwhich is situated at $24^0$35' N latitude and $74^0$42' E longitude. The region falls under the agro climatic zone IVa of Rajasthan i.e. Sub-humid Southern Plain and Aravali Hills of Rajasthan. The experiment was arranged in a randomized block design consisting of nine treatment combinations i.e., weedy check, imazethapyr 100 g/ha PoE 15 DAS, pendimethalin 1000 g/ha PE, quizalofop-ethyl 75 g/ha PoE 15 DAS, propaquizafop 100 g/ha PoE 15 DAS, imazethapyr + imazamox (RM) 70 g/ha PoE 15 DAS, imazethapyr + pendimethalin (RM) 1000 g/ha PE, imazethapyr 75 g/ha PoE + quizalofop-ethyl 60 g/ha PoE 21 DAS (TM) and imazethapyr 75 g/ ha + propaquizafop 75 g/ha PoE 21 DAS (TM)replicated thrice. A knapsack sprayer fitted with a flat fan nozzle was used for herbicide application. Total rainfall received during crop growing season was 648.0 mm. The soil of the experimental site was low in available nitrogen, medium in organic carbon and phosphorus and high in available potassium. Soybean variety RKS-24 (Pratap Raj 24) was used as experimental material developed at ARS, Kota (Rajasthan).

Results and Discussion

Effect on weeds

The results showed that weed control methods markedly reduced crop-weed competition. The experimental data revealed that post-emergence application of imazethapyr 75 g/ ha + propaquizafop 75 g/ha at 21 DAS resulted the lowest density of monocot (2.78/m^2), dicot (1.59/m^2) and total weeds (3.13/m^2) at 30 DAS compared to weedy check (8.42, 6.65 and 10.71/m^2) respectively. At 30 and 60 DAS, minimum dry matter of both monocot and dicot weeds were recorded under application of imazethapyr 75 g/ ha + propaquizafop 75 g/ha. Among dicots, the next treatment in the order of superiority imazethapyr 75 g/ha + quizalofop-ethyl 60 g/ha as PoE at both the stages was found best.

Maximum weed control efficiency of monocot, dicot and total weeds was observed with post emergence application of imazethapyr 75 g/ ha + propaquizafop 75 g/ha. The herbicide combination of imazethapyr + propaquizafop and imazethapyr + quizalofop-ethyl were more effective and had activity on a wide spectrum of weeds including grasses and broadleaf weeds in soybean thus their performance is directly proportional to the weed control efficiency. The higher weed control efficiency under these treatments could be attributed to the lower weed population and total weed dry matter as well. These results were corroborated with the finding of Habimana *et al.,* (2013), Sandil *et al.,* (2015), Panda *et al.,* (2015) and Patel *et al.,* (2016) (Table 1).

Table.1 Effect of herbicides on weed dry matter and weed control efficiency at 60 DAS

Treatments	Weed dry matter (g/m^2) at 60 DAS			Weed control efficiency (%)		
	Monocots	Diocots	Total	Monocots	Diocots	Total
Imazethapyr 100 g/ha PoE at 15 DAS	11.79	7.31	19.10	76.43	76.65	76.52
Pendimethalin 1000 g/ha PE	13.48	11.54	25.02	73.06	62.88	69.24
Quizalofop-ethyl 75 g/ha PoE at 15 DAS	8.30	20.48	28.78	83.41	34.12	64.61
Propaquizafop 100 g/ha PoE at 15 DAS	6.37	12.34	18.71	87.26	60.13	76.93
Imazethapyr + imazamox (RM) 70 g/ha PoE at 15 DAS	13.01	7.90	20.91	73.99	74.79	74.30
Imazethapyr + pendimethalin (RM) 1000 g/ha PE	11.61	10.34	21.94	76.78	66.99	73.01
Imazethapyr 75 g/ha PoE + quizalofop-ethyl 60 g/ha (TM) PoE at 21 DAS	8.86	3.05	11.91	82.32	90.25	85.36
Imazethapyr 75 g/ ha + propaquizafop 75 g/ha (TM) PoE at 21 DAS	5.16	1.43	6.59	89.64	95.45	91.89
Weedy check	50.20	31.21	81.41	0.00	0.00	0.00
SEm±	0.74	0.68	0.92	-	-	-
CD (P=0.05)	2.21	2.04	2.76	-	-	-

Table.2 Effect of herbicides on yield attributes of soybean

Treatments	Number of pods /plant	Number of seeds/pod	Pod length (cm)	Test weight (g)	Seed Yield (kg/ha)	Haulm Yield (kg/ha)	Net returns (₹/ha)	B C ratio
Imazethapyr 100 g/ha PoE at 15 DAS	24.70	2.30	4.67	76.70	1396	1703	29169	1.34
Pendimethalin 1000 g/ha PE	29.86	2.36	4.86	80.36	1518	1874	33960	1.58
Quizalofop-ethyl 75 g/ha PoE at 15 DAS	29.16	2.34	4.81	80.16	1438	1755	30848	1.43
Propaquizafop 100 g/ha PoE at 15 DAS	26.70	2.30	4.74	79.60	1348	1692	28843	1.41
Imazethapyr + imazamox (RM) 70 g/ha PoE at 15 DAS	27.12	2.32	4.72	79.93	1618	1732	36769	1.71
Imazethapyr + pendimethalin (RM) 1000 g/ha PE	27.80	2.40	4.76	80.12	1462	1709	31181	1.42
Imazethapyr 75 g/ha PoE + quizalofop-ethyl 60 g/ha (TM) PoE at 21 DAS	31.98	2.46	4.90	83.99	1678	1949	38303	1.70
Imazethapyr 75 g/ ha + propaquizafop 75 g/ha (TM) PoE at 21 DAS	32.10	2.40	4.96	85.10	1724	2182	41478	1.92
Weedy check	16.67	2.18	4.08	50.67	631	846	3241	0.16
SEm±	1.18	0.04	0.15	0.74	59.81	82.33	1910	-
CD (P=0.05)	3.53	0.13	0.46	2.23	179.32	246.82	5726	-

Propaquizafop is a post emergence, systemic and selective herbicide use to control of annual and perennial grassy weeds in broadleaf crops. It belongs to aryloxphenoxypropionics (APPs) group of herbicide and systematically gets translocated to plant meristems. Herbicidal gets absorbed by the foliage within one hour of spraying and inhibits fatty acid synthesis (ACCease).Results corroborate with the findings of Renjith and Sharma *et al.,* (2014), Ramprakash *et al.,* (2016) Parmar *et al.,* (2016), Nagre *et al.,* (2017).

Effect on crop

Imazethapyr 75 g/ha + propaquizafop 75 g/ha treatment recorded maximum number of branch/plant, number of pods/plant, pod length and test weight. The maximum seed yield (1724 kg/ha) was recorded under imazethapyr 75 g/ ha + propaquizafop 75 g/ha over all other weed control treatments. Tank mix application of imazethapyr 75 g/ ha + propaquizafop 75 g/ha resulted in maximum haulm yield (2182 kg/ha) which was statistically at par with imazethapyr 75 g/ha + quizalofop-ethyl 60 g/ha. Alike seed and haulm yield biological yield (3906 kg/ha) was also recorded maximum under imazethapyr 75 g/ ha + propaquizafop 75 g/ha.It is established fact that least crop weed competition during the early phase of crop growth exerts an important regulatory function on complex process of yield formation due to better availability of water, space and nutrient to the crop plant. It also helps in improving aeration and nutrient uptake by plant resulting in higher metabolic activity. The better expression of yield attributes in herbicide and manually weeded plots might be due to poor resurgence frequency and growth of weeds in these treatments. Hence, weeds were unable to compete with the crop plants for different growth factors. Improvement in yield attributes occurred when weeds were controlled in the early growth stages particularly during critical growth period either manually or chemically, which scaled down competition and created congenial micro-environment for better establishment and growth of the crop (Table 2).

Post-emergence application of imazethapyr 75 g/ha + propaquizafop 75 g/ha (TM) at 21 DAS recorded the highest seed yield (1724 kg/ha) and net return (₹ 41478) however, this treatment was at par with imazethapyr + quizalofop-ethyl and imazethapyr + imazamox. Imazethapyr + propaquizafop did not cause any phytotoxicity to soybean crop. Similar findings was also reported by Bhan and Kewat, (2002) and Prachand *et al.,* 2014.

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