Weed Management in Soybean through Post Emergent Herbicides

ABSTRACT

Weed infestation is a complex and regular threat to soybean production all over the world. Successful weed control is most important factor for fruitful soybean production, because losses due to weeds have been one of the major limiting factors in soybean production. Hence a study was carried out using post emergent herbicides at College of Agriculture,Raichur.during kharif 2020 and 2021.The experiment was laid in randomized complete block design with three replications, and it consists of twelve treatments (viz., Clorimuron ethyl @ 37.5 g a.i, Imazethapyr + Imazamox @ 100 g a.i, Propaquizafop + Imazethapyr @ 100 g a.i, Profoxydim (at three doses viz., 35, 55 and 75 g a.i and another three set of these doses were added with adjuvant @ 2ml/liter of water), Propaquizafop @ 75 g a.i., and weed free check and weedy checks were also maintained. Results were indicated that among the herbicide treatments, combi products *viz.,*Imazethapyr + Imazamox @ 100 g a.i, Propaquizafop + Imazethapyr @ 100 g a.i. suppressed the weed density effectively and increased the weed control efficiency (88.41 % and 84.14%) next to weed free check. Yield parameters like number of pods per plant, test weight and grain yield also recorded higher in Imazethapyr + Imazamox @ 100 g a.i.(31.93,82.19g and 1622 kg ha^{-1}) among the herbicides tested. BC ratio was recorded significantly higher in Imazethapyr + Imazamox @ 100 g a.i.(3.29) and it was on par with weed free check(3.22). From this trial, it can be concluded that broad spectrum or combi products like Imazethapyr + Imazamox can be used as a effective post emergent herbicide in soybean to suppress both monocot and dicot weeds

Keywords: [soybean, herbicides, weed control efficiency, weed dry matter, grain yield}

1. INTRODUCTION

Soybean [*Glycine max* (L.)] is popular as golden bean has become the miracle crop of 21st century. It serves the dual purpose for being grown both as an oilseed crop and pulse crop as well (Thakare *et al*., 2006). It is an excellent health food containing 40 to 44 per cent good quality protein, 20 per cent cholesterol free oil, 20 per cent carbohydrates and 0.69 per cent phosphorus. It also fixes atmospheric nitrogen (45 to 60 kg ha^{-1}) through root nodules and adds about 0.5 to 1.5 ton organic matter per hectare through leaf fall (Kanase *et al*., 2006). However, it is reported that reduction in soybean yield due to weed infestation varies from 27 to 77 per cent (Gogoi *et al*., 1991), depending on type of weed, soil, seasons and weed infestation intensities. Some have reported the yield decline as high as 84 per cent (Kachroo *et al*., 2003). *Ambrosia artemisiifolia* L. (common ragweed), *Chenopodium album* L. (common lambsquarters), *Sonchus oleraceus* L. (annual sowthistle), *Echinochloa crusgalli* L. (barnyardgrass) and *Beckmannia syzigachne* (American sloughgrass) were reported to be the dominant weeds in soybean fields.

Effective weed management in soybean (*Glycine max* L.) cultivation is essential to protect soybean growth and yield from weed competition during the growing seasons. Soybean is vulnerable to weed interference because the seeds are sown with wide spacing to develop branches and to allow the canopy to expand fully during the late growth stage (Wax and Pendleton, 1968; Yelverton and Coble, 1991; Hock *et al*., 2006). The late canopy closure allows weeds to be established more easily in soybean than in other crops (Carey and Defelice, 1991; Nelson and Renner, 1998; Harder *et al*., 2007). To effectively manage weed infestations in soybean, various weed management methods, including herbicide application, tillage practices and crop rotation are used in combination (Vivian *et al.,* 2013). The traditional method of weed control *i.e.,* hand weeding is expensive, tedious and time consuming. Today, there is a great manual labor shortage and a rise in wage scale. Weeding also becomes difficult due to unfavourable weather, wet soil and unavailability of labour. The weed control methods can be modified based on the field conditions. Under such circumstances, chemical weed control is necessary to decrease cost and to increase soybean productivity. This crop is a large herbicide consumer and almost 90 per cent of the planted area in India is herbicide-treated. Use of effective herbicides in suitable dose remains the pertinent choice for controlling the weeds. Commercially many of herbicides are emerging in the agrochemical markets. Hence the herbicides which suppress the weeds effectively needs to be test. In this context a some of new herbicides molecule were evaluated in Soybean crop

2. MATERIAL AND METHODS

A field experiment was carried out at college of Agriculture, Raichur during Kharif seasons of 2020 and 2021. which is located in North-Eastern Dry zone (Zone 2) of Karnataka (16o 12' N, 77o 20' E, 389 msl), The soil of the experimental site was medium black soil. Experimental design followed was randomized block design replicated thrice. There were twelve treatments, mainly post emergent herbicides *viz*., Clorimuron ethyl @ 37.5 g a.i, Imazethapyr + Imazamox @ 100 g a.i, Propaquizafop + Imazethapyr @ 100 g a.i, Profoxydim (at three doses *viz.,* 35, 55 and 75 g a.i and another three set of these doses were included with adjuvant @ 2ml/liter of water), Propaquizafop @ 75 g a.i., and along with these ten post emergent herbicides, one weed free check and weedy checks were maintained. Herbicides were applied in the soybean crop with knapsack sprayer and the sprayed at 2-3 leaf stage. Weeds from one square meter quadrant was removed from each plot at 60 days after spraying, and shade dried and kept in hot air oven till the weeds weight become constant, then the dry weight of weeds taken, and expressed as g m^{-2}, weed control efficiency was calculated using following formula

$$\text{Weed control effici} \times 100\ (\%) = \frac{\text{Dry weight of weeds in weedy check- Dry weight of weeds in the treated plot}}{\text{Dry weight of weeds in weedy check}} \times 100$$

Plot wise soybean grain yield were recorded and expressed in kg/ha. Data was statistically analyzed.

3. RESULTS AND DISCUSSION

Weed dry matter at 60 days after application of herbicide spray (Table-1) was shown that, among the ten herbicide treatments, Profoxydim (at three doses viz., 35, 55 and 75 g a.i and another three set of these doses were included with adjuvant @ 2ml/liter of water), Propaquizafop @ 75 g a.i., were helped in suppressing only monocot weeds in both the year and in pooled data, whereas, Clorimuron ethyl @ 37.5 g a.i,(7.32 g) did not reduced monocot weed dry weight indicating no effect on monocot weeds. Combi-products of herbicide molecule *viz.,* Imazethapyr + Imazamox @ 100 g a.i (3.79 g),which was comparable to weed free check (2.89). Combi- product Propaquizafop + Imazethapyr @ 100 g a.i (4.10) reduced weed dry weight and which was comparable with propaquizafop and proxydim herbicides. Monocot weed dry weight observations indicated better performance of post emergent herbicide Imazethapyr + Imazamox @ 100 g a.i

The results of dicot weed dry weight revealed that dicot weed dry weight was significantly lower in weed free check (o.778g) which was on par with Clorimuron ethyl @ 37.5 g a.i,(7.32 g) and Imazethapyr + Imazamox @ 100 g a.i (0.99g) and Propaquizafop + Imazethapyr @ 100 g a.i (1.07). Whereas, dicot weed dry weight was significantly higher in untreated control (2.01) and rest of the herbicides treatments were on par with it. Hence, weed free check and Imazethapyr + Imazamox @ 100 g a.i would results in reduced total weed dry matter, because they reduced dry matter both in monocot and dicot weeds.

Weed control efficiency was recorded significantly higher in weed free check (98.64%). Among the herbicide molecules tested Imazethapyr + Imazamox @ 100 g a.i (88.41%) recorded significantly higher percentage of weed control efficiency followed by Propaquizafop + Imazethapyr @ 100 g a.i (84.14%) because of their very effective control over both monocot and dicot weeds. Similarly, Vyas and Jain (2003) found that highest weed control efficiency and lowest weed biomass was recorded in two hand weeding followed by Imazethapyr + Imazamox treatments. Similar performance of combi herbicide molecule on monocot and dicot weeds was reported by Jadhav and Kashid (2019) at Pune. Rest of the herbicides, Profoxydim (at three doses viz., 35, 55 and 75 g a.i and another three set of these doses were included with adjuvant @ 2ml/liter of water) and propoquizafop were affected only monocot weeds, and Clorimuron ethyl @ 37.5 g a.i,(7.32 g) was effective only to dicot weeds,reported lesser weed control efficiency.

Results on the effect of weed management in soybean crop was shown that Yield parameter (viz., number of pods per plant and test weight) and grain yield (Table 2) were significantly higher in weed free check (33.87, 84.77g and 1768 kg ha^{-1} respectively), because reduced weed dry weight helped in maintaining reduced crop weed competition and recorded significantly lower weed control efficiency. Among the herbicide treatments Imazethapyr + Imazamox @ 100 g a.i recorded significantly higher number of pods, test weight and grain yield (31.93, 82.19g and 1622 kg ha^{-1}) followed by Propaquizafop + Imazethapyr @ 100 g a.i (31.09,77.76g and 1510 kg ha^{-1}) because of their effectiveness in controlling both monocot and dicot weeds and better weed control efficiency. Similarly at Vyas and Jain(2003) also reported the highest seed yield in combi product imazamox + imazethapyr and it was significantly on a par with weed free check.

Weed management significantly influenced the economics of soybean production (Table 3) and revealed that weed free check was recorded significantly higher gross return and net return (Rs. 123760, Rs.85275 per hectare) because of higher grain yield, but BC ratio was on par with herbicide treatment Imazethapyr + Imazamox @ 100 g a.i. This is attributed by higher cost involved in weed free check. Post emergent herbicide Imazethapyr + Imazamox @ 100 g a.i was recorded significantly higher BC ratio (3.29) over rest of the treatments, though the gross return and net return (Rs. 113540, Rs.75611 per hectare) were lesser than weed free check, due to reduced cost of weed management. Significantly lower economic parameters were recorded with untreated control due to lower grain yield because of sever crop weed competition occurred in the treatment. Pratiksha Mishra *et al.* (2013) shown that application of Imazethapyr + Imazamox as post emergent recorded higher net return and B C ration because of their low cost of weed management along with good economic yield.

4. CONCLUSION

Weed management in soybean crop helps in achieving profitable grain yield and return. Among the weed management practices manual weeding is very effectively control weeds and encourages vigorous growth of crop by reducing crop weed competition and giving good aeration to crop. But because of higher cost involved in manual weeding, it reduces margin of profit to farmers. Hence, use of herbicides having effectiveness both for monocots and dicots are very much helpful in suppressing weed competition and getting higher yield with reduced weed management cost, and also in the time of acute labour scarcity and in the event of rainy period manage weeds timely. In that context among the herbicides tested in the present trial, herbicide Imazethapyr + Imazamox @ 100 g a.i. performed better in controlling weeds and getting yield and profit.

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Table 1- Effect of different post emergent herbicide molecules on weed parameters at 60 days after application of herbicides in soybean production

r. No.	Treatment details	a.i (g)	Dry weight of monocot weeds (g) @ 60 DAA			Dry weight of Dicot weeds (g) @ 60 DAA			Weed control Efficiency (%) @60 DAA		
			2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
1	Weed free check	-	2.91 (0.12)	2.87 (0.06)	2.89 (0.09)	0.81 (0.16)	0.74 (0.05)	0.78 (0.11)	98.25	99.02	98.64
2	Clorimuron ethyl	37.5	7.57 (13.06)	7.08 (11.02)	7.32 (12.04)	0.78 (0.10)	0.76 (0.07)	0.77 (0.09)	33.91	43.50	38.70
3	Imazethapyr + Imazamox	100	3.80 (1.61)	3.78 (1.58)	3.79 (1.59)	0.99 (0.48)	0.99 (0.48)	0.99 (0.48)	88.87	87.95	88.41
4	Propaquizafop + Imazethapyr	100	4.16 (2.35)	4.05 (2.11)	4.10 (2.23)	1.08 (0.66)	1.07 (0.65)	1.07 (0.65)	84.39	83.90	84.14
5	Profoxydim	35	5.73 (6.41)	5.52 (5.85)	5.62 (6.13)	1.91 (3.15)	1.87 (2.98)	1.89 (3.07)	52.07	52.75	52.41
6	Profoxydim	55	5.46 (5.68)	5.32 (5.35)	5.39 (5.51)	1.93 (3.21)	1.83 (2.86)	1.88 (3.04)	56.26	57.66	56.96
7	Profoxydim	75	5.35 (5.35)	5.07 (4.66)	5.21 (5.01)	1.94 (3.25)	1.82 (2.82)	1.88 (3.04)	57.73	61.53	59.63
8	Profoxydim+ MSO Adjuvant @ 2ml/liter of water	35	5.06 (4.59)	4.95 (4.35)	5.00 (4.47)	1.92 (3.17)	1.81 (2.77)	1.86 (2.97)	62.23	63.49	62.86
9	Profoxydim + MSO Adjuvant @ 2ml/liter of water	55	4.88 (4.11)	4.86 (4.14)	4.87 (4.13)	1.88 (3.05)	1.78 (2.68)	1.83 (2.87)	65.38	65.14	65.26
10	Profoxydim+ MSO Adjuvant @ 2ml/liter of water	75	4.46 (3.04)	4.54 (3.19)	4.50 (3.12)	1.87 (3.02)	1.78 (2.68)	1.83 (2.85)	70.44	66.30	68.37
11	Propaquizafop	75	4.67 (3.51)	4.61 (3.39)	4.64 (3.45)	1.92 (3.21)	1.81 (2.77)	1.87 (2.99)	66.78	66.10	66.44
12	Untreated Control		8.23 (15.40)	8.17 (15.23)	8.20 (15.31)	2.19 (4.32)	2.01 (3.55)	2.10 (3.94)	0.00	0.00	0.00
	S.Em+		0.238	0.227	0.253	0.142	0.137	0.147	0.872	0.958	0.870
	C.D. (p=0.05)		0.699	0.665	0.74	0.415	0.403	0.42	2.	2.	2.

					3			9	557	811	553
	C.V.		9.846	9.145	11.276	11.254	11.131	12.553	11.145	13.275	11.031

* Figures in parentheses are original values which were transformed to square root of x+0.5

Table 2- Effect of different post emergent herbicide molecules on yield parameters of soybean

r. No.	Treatment details	a.i (g)	No.pods per plant			Test weight (g)			Soybean grain yield (kg/ha)		
			2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
1	Weed free check	-	34.13	33.60	33.87	85.38	84.15	84.77	1804	1732	1768
2	Clorimuron ethyl	37.5	21.75	21.16	21.46	52.75	50.97	51.86	969	873	921
3	Imazethapyr + Imazamox	100	32.33	31.52	31.93	82.62	81.75	82.19	1659	1585	1622
4	Propaquizafop + Imazethapyr	100	31.40	30.78	31.09	80.43	79.08	77.76	1546	1473	1510
5	Profoxydim	35	25.43	22.84	24.14	76.43	74.23	75.53	1152	1010	1081
6	Profoxydim	55	25.53	23.81	24.67	76.83	75.11	76.08	1163	1018	1091
7	Profoxydim	75	25.78	23.95	24.87	77.05	75.53	76.40	1175	1021	1098

8	Profoxydim+ MSO Adjuvant @ 2ml/liter of water	3 5	26.08	25.24	25.6 6	77.26	76.31	76.8 3	1 211	1 154	1 183
9	Profoxydim + MSO Adjuvant @ 2ml/liter of water	5 5	26.11	25.30	25.7 1	77.34	76.44	77.0 6	1 220	1 165	1 193
10	Profoxydim+ MSO Adjuvant @ 2ml/liter of water	7 5	26.45	25.71	26.0 8	77.68	76.82	77.3 9	1 265	1 181	1 223
11	Propaquizafop	7 5	26.78	25.90	26.3 4	77.95	76.89	62.8 0	1 273	1 192	1 233
12	Untreated Control		19.05	18.80	18.9 3	48.70	46.93	23.4 7	7 87	7 13	7 50
	S.Em+		0.556	0.550	0.55 3	0.964	0.952	0.98 6	3. 992	3. 910	3. 912
	C.D. (p=0.05)		1.631	1.612	1.62 2	2.828	2.792	2.89 1	1 1.710	1 1.467	1 1.474
	C.V.		10.41 5	10.55 7	10.4 93	11.28 0	11.199	12.4 65	1 1.227	1 1.694	1 1.268

* Figures in parentheses are original values which were transformed to square root of x+0.5

Table 3- Effect of different post emergent herbicide molecules on economics of soybean production

r. No.	Treatment details	a .i (g)	Gross returns (Rs/ha)			Net returns (Rs/ha)			B C Ratio		
			2020	2021	Poo led	202 0	2021	Po oled	20 20	20 21	Po oled
1	Weed free check	-	1262 80	1212 40	123 760	880 95	8245 5	852 75	**3.3 1**	**3.1 3**	**3.2 2**

2	Clorimuron ethyl	3 7.5	6783 0	6111 0	644 70	354 45	2721 9	313 32	**2.0 9**	**1.8 0**	**1.9 5**
3	Imazethapyr + Imazamox	1 00	1161 30	1109 50	113 540	822 97	7561 1	789 54	**3.4 3**	**3.1 4**	**3.2 9**
4	Propaquizafop + Imazethapyr	1 00	1082 20	1031 10	105 665	727 35	6611 9	694 27	**3.0 5**	**2.7 9**	**2.9 2**
5	Profoxydim	3 5	8064 0	7070 0	756 70	479 55	3650 9	422 32	**2.4 7**	**2.0 7**	**2.2 7**
6	Profoxydim	5 5	8141 0	7126 0	763 35	486 25	3696 9	427 97	**2.4 8**	**2.0 8**	**2.2 8**
7	Profoxydim	7 5	8225 0	7147 0	768 60	493 65	3707 9	432 22	**2.5 0**	**2.0 8**	**2.2 9**
8	Profoxydim+ MSO Adjuvant @ 2ml/liter of water	3 5	8477 0	8078 0	827 75	520 85	4658 9	493 37	**2.5 9**	**2.3 6**	**2.4 8**
9	Profoxydim + MSO Adjuvant @ 2ml/liter of water	5 5	8624 0	8155 0	838 95	534 55	4725 9	503 57	**2.6 3**	**2.3 8**	**2.5 0**
10	Profoxydim+ MSO Adjuvant @ 2ml/liter of water	7 5	9086 0	8267 0	867 65	579 75	4827 9	531 27	**2.7 6**	**2.4 0**	**2.5 8**
11	Propaquizafop	7 5	9366 0	8344 0	885 50	607 65	4903 9	549 02	**2.8 5**	**2.4 3**	**2.6 4**
12	Untreated Control		5509 0	4991 0	525 00	249 05	1821 9	215 62	**1.8 3**	**1.5 7**	**1.7 0**
	S.Em+		7628	7921	147	696	1181	105	**0.1**	**0.1**	**0.1**

					1	9	3	0	**77**	**86**	**76**
	C.D. (p=0.05)		2237 2	2323 2	431 6	204 40	3464 5	308 0	**0.5 2**	**0.5 4**	**0.5 2**