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Effect of post-emergence herbicide Cycloxydim 20% EC on weed dynamics and yield in soybean (*Glycine max L.)*

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Abstract: A field experiment to study the effect of post-emergence herbicide Cycloxydim 20% EC on weed dynamics and yield of soybean was carried out at Main Agricultural Research Station, Dharwad during *kharif* 2014, comprising with three replications and ten treatments which was laid in Randomized Complete Block Design. Weed free check was recorded significantly lower total weed population, total weed dry weight, higher weed control efficiency, yield and yield attributes when compared to weedy check. Among the herbicide treatments Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} was recorded significantly higher seed yield (30.13 q ha^{-1}), haulm yield (34.03 q ha^{-1}), number of pods $plant^{-1}$ (55.80), seed yield $plant^{-1}$ (14.02 g), gross returns (₹ 102495 ha^{-1}), net returns (76627 ha^{-1}) and B:C ratio (3.96). While, lower total number of monocot weeds, total weed dry weight and higher weed control efficiency (%) at 60 DAS and harvest were recorded with Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} and it was on par with Cycloxydim 20% EC @ 100 g a.i. ha^{-1}. The treatment Chlorimuron 25% EC @ 37.5 g a.i. ha^{-1} at 15 DAS + one intercultivation at 20-25 DAS recorded significantly lower number of dicot weeds, weed dry weight and higher weed control efficiency (%) at 40 DAS and it was on par with Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} with respect to weed dry weight and weed control efficiency.

Key words: Chlorimuron, Cycloxydim, Post-emergence, Soybean, Weed control-efficiency, Weeds

Introduction

Soybean (*Glycine max L.)* is an important oilseed crop containing 40-42 per cent protein and 20 per cent oil. Besides these, it contains complete protein, carbohydrates, fats, vitamins (A, B and D) and folic acid as well as minerals including calcium and iron required for good nutrition. Soybean is a major oil seed crop of the world grown in an area of 118.01 million hectare with production of 315.06 million tonnes and productivity of 2.67 t ha^{-1} (Anonymous, 2015). In India it is grown over an area of 10.02 million hectare with production of 11.64 million tonnes and productivity of 1062 kg ha^{-1} (Anonymous, 2015). The crop has high yielding capacity but its productivity in India is comparatively low when compared with world. Among several factors responsible for lower productivity and the yield due to weed infestation which is one of the major factors. The crop is mainly cultivated during *kharif* season and is infested with various grassy, sedge and broad leaved weeds which emerge simultaneously with the crop plants and rob essential nutrients, space, moisture and sunlight causing substantial loss in yield. The weed, if not controlled during critical period of crop-weed competition, there may be reduction in the yield of soybean from 58 to 85 per cent depending upon type of weeds and weed intensity (Upadhyay *et al.,* 2012; Pratiksha *et al.,* 2013). The critical crop-weed competition lies between 15 to 45 days after sowing (DAS). To avoid competition during the early growth stages, soybean field should kept free from weeds for the first 30-40 days after sowing; after that the crop cover and takes care of emergent late shift of weeds and are smothered by the lush canopy of soybean crop.

Weed control through hand weeding is tedious and labour consuming. So, there is a need to evaluate the new herbicide molecules for control of the weed flora in soybean. The herbicides presently available for soybean are either pre-emergence or pre plant incorporated but farmers do not visualize the use of post emergence herbicides because they will not control mainly grass weeds such as *Cynodon dactylon, Echinochloa colonum, Dinebra retroflexa* and *Digitaria sanguinallis*. But these grassy weeds cause greater loss in yield of soybean crop than broad leaved which is estimated to the extent of 35-55 per cent (Tiwari *et al*., 2006). Therefore, the post emergence herbicides are the only option to control weeds under such situations. Hence, new broad spectrum post emergence herbicides are required to control mainly grassy weeds in crops like soybean. Looking to the present need of post-emergence herbicides for higher soybean yield, the experiment was conducted to study the effect of post-emergence herbicide Cycloxydim 20% EC on weed dynamics and yield parameters in soybean.

Materials and Methods

The field experiment with ten weed control treatments and three replications laid out in Randomized Complete Block Design was undertaken at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad (Karnataka) during *kharif* season of 2014. The treatments comprised of Cycloxydim 20% EC @ 50 g a.i. ha^{-1} (T_1), Cycloxydim 20% EC @ 75 g a.i. ha^{-1} (T_2), Cycloxydim 20% EC @ 100 g a.i. ha^{-1} (T_3), Cycloxydim 20% EC @ 50 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} (T_4), Cycloxydim 20% EC @ 75 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} (T_5), Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} (T_6), Imazethapyr 10% SL @ 100 g a.i. ha^{-1} (T_7), Chlorimuron 25% EC @ 37.5 g a.i. ha^{-1} at 15 DAS + one intercultivation at 20-25 DAS (T_8), weed free check (T_9) and weedy check (T_{10}). The experimental soil was black clayey soil (Vertisol) with the pH 7.5, organic carbon (0.53%), available N (252 kg ha^{-1}),

Table-1: Total number of monocot, dicot weeds and total weed population m^{-2} at different growth stages in soybean as influenced by application of post emergence herbicides

Treat-	Monocot weeds (m^{-2})				Dicot weeds (m^{-2})				Total weed population (m^{-2})			
ments	20 DAS	40 DAS	60 DAS	Harvest	20 DAS	40 DAS	60 DAS	Harvest	20 DAS	40 DAS	60 DAS	Harvest
T_1	7.60(57.33)	7.01(48.67)	7.95(62.67)	7.98(63.33)	6.23(38.67)	7.90(62.00)	8.78(76.67)	9.64(92.67)	9.92(98.00)	10.69(114.00)	12.08(145.33)	12.79(163.33)
T_2	7.73(59.33)	6.41(40.67)	7.34(53.33)	7.46(55.33)	5.73(32.67)	8.23(68.00)	9.08(82.00)	9.78(95.33)	9.76(94.67)	10.54(111.33)	11.91(141.33)	12.59(158.00)
T_3	7.52(56.00)	5.76(32.67)	6.75(45.33)	7.35(54.00)	6.05(36.67)	8.19(66.67)	9.11(82.67)	9.86(96.67)	9.79(95.33)	10.12(102.00)	11.62(134.67)	12.53(156.67)
T_4	7.38(54.00)	7.09(50.00)	7.52(56.00)	7.98(63.33)	6.26(38.67)	7.78(60.00)	9.15(83.33)	9.58(91.33)	9.76(94.67)	10.66(113.33)	12.10(146.00)	12.71(161.33)
T_5	7.29(52.67)	6.17(38.00)	7.28(52.67)	7.91(62.00)	6.36(40.00)	8.23(67.33)	9.51(90.00)	9.72(94.00)	9.86(96.67)	10.40(108.00)	12.18(148.67)	12.77(162.67)
T_6	7.29(52.67)	5.20(26.67)	6.30(39.33)	6.96(48.00)	6.40(40.67)	7.81(60.67)	9.26(85.33)	10.08(101.33)	9.82(96.00)	9.51(90.00)	11.53(132.67)	12.48(155.33)
T_7	7.86(61.33)	7.60(57.33)	8.51(72.00)	8.31(68.67)	5.98(35.33)	6.45(41.33)	7.81(60.67)	9.15(83.33)	9.96(98.67)	10.06(100.67)	11.76(138.00)	12.56(157.33)
T_8	7.11(50.00)	7.51(56.00)	9.58(91.33)	9.79(95.33)	4.39(19.33)	4.21(17.33)	6.40(40.67)	7.56(56.67)	8.44(70.67)	8.75(73.33)	11.60(134.00)	12.46(154.67)
T_9	3.79(14.00)	3.12(9.33)	3.32(10.67)	3.61(12.67)	2.53(6.00)	1.61(2.67)	2.26(6.00)	2.59(6.67)	4.80(22.67)	3.51(12.00)	4.10(16.67)	4.40(19.33)
T_{10}	7.69(58.67)	9.40(88.00)	10.54(110.67)	11.19(124.00)	6.87(46.67)	9.15(83.33)	10.18(103.33)	10.91(118.67)	10.45(108.6)	13.26(175.33)	14.96(223.33)	15.93(253.33)
S.Em±	0.39	0.18	0.23	0.23	0.31	0.30	0.36	0.29	0.24	0.26	0.27	0.26
CD(P=0.05)	1.15	0.53	0.67	0.69	0.91	0.89	1.07	0.85	0.72	0.77	0.80	0.77

available P_2O_5 (32 kg ha^{-1}) and available K_2O (278 kg ha^{-1}). Soybean variety 'DSb 21' was sown on 15th July 2014 by dibbling method with 30 x 10 cm spacing using seed rate of 62.5 kg ha^{-1}. The recommended fertilizers i.e. 40:80:25 kg N, P_2O_5 and K_2O ha^{-1} were applied at the time of sowing. The total rainfall received during crop growth period was 604.2 mm and was received in well distributed pattern in 51 rainy days. Spraying of Bavistin @ 1 ml l^{-1} and Karate @ 0.5 ml l^{-1} twice was done to control disease and insect-pests during crop growth period. The post-emergence herbicide Chlorimuron was sprayed at 15 DAS and other herbicides such as Cycloxydim and Imazethapyr were sprayed at 25 DAS. The herbicides were sprayed with knapsack sprayer using 750 litres of spray solution per hectare. Weed population and weed dry weight m^{-2} were recorded at 20, 40, 60 DAS and at harvest based on which weed control efficiency was calculated. The quadrate of 0.25 square meters was used to count the weeds in each plot. The data collected on weeds were transformed through the square root transformation "X+0.5 for statistical analysis (Meena *et al.*, 2011). The various yield parameters such as number of pods $plant^{-1}$, seed yield $plant^{-1}$, seed yield and haulm yield were recorded at harvest stage of soybean.

Results and Discussion

The important weeds among monocot were *Cynodon dactylon, Digitaria sanguinalis* and *Dinebra retroflexa* while among the dicot weeds

Table-2: Total weed dry weight (g m^{-2}), weed control efficiency (%) at different growth stages in soybean and weed index as influenced by application of post emergence herbicides

Treat-	Total weed dry weight (g m^{-2})				Weed control efficiency(%)			Weed
ments	20 DAS	40 DAS	60 DAS	Harvest	40 DAS	60 DAS	Harvest	index (%)
T_1	3.18 (9.70)	5.18 (26.37)	6.71 (44.49)	8.07 (64.77)	57.03	48.79	43.37	25.84
T_2	3.34 (10.68)	4.89 (23.43)	6.50 (41.88)	7.94 (62.61)	61.70	51.94	45.37	25.99
T_3	3.38 (11.01)	4.72 (21.83)	6.26 (38.71)	7.82 (60.66)	64.37	55.40	47.27	20.25
T_4	3.30 (10.45)	5.24 (27.01)	6.68 (44.17)	7.99 (63.40)	56.02	49.37	44.95	22.93
T_5	3.32 (10.56)	5.06 (25.07)	6.82 (46.15)	7.93 (62.40)	58.76	46.77	45.58	20.15
T_6	3.41 (11.13)	4.32 (18.21)	6.19 (37.97)	7.59 (57.21)	68.84	56.46	50.14	10.38
T_7	3.35 (10.79)	4.94 (24.00)	6.63 (43.50)	7.89 (62.01)	60.48	50.05	46.14	24.22
T_8	2.85 (7.64)	3.96 (15.25)	6.31 (39.41)	7.73 (59.35)	74.74	54.79	48.36	16.39
T_9	1.86 (2.96)	1.83 (2.85)	2.15 (4.23)	2.49 (5.91)	95.40	95.09	94.86	-
T_{10}	3.62 (12.62)	7.87 (61.55)	9.36 (87.11)	10.74(114.95)	-	-	-	59.71
S.Em±	0.85	0.15	0.20	0.23	2.16	2.75	2.82	2.74
CD (P=0.05)	NS	0.44	0.60	0.69	6.42	8.18	8.39	8.14

Table-3: Yield attributes, yield and economics of soybean as influenced by application of post emergence herbicides

Treat-ments	No. of pods $plant^{-1}$	Seed weight $plant^{-1}$(g)	100 seed weight (g)	Seed yield (q ha^{-1})	Haulm yield (q ha^{-1})	Harvest index (%)	Gross returns (ha^{-1})	Net returns (ha^{-1})	B:C ratio
T_1	48.80	10.87	10.83	24.96	28.43	46.74	84932	59564	3.35
T_2	48.87	11.34	11.16	24.92	28.67	46.49	84825	59207	3.31
T_3	51.53	12.92	11.21	26.83	30.21	47.04	91266	65398	3.53
T_4	49.40	11.48	11.26	25.95	29.02	47.26	88256	62888	3.48
T_5	51.13	11.67	11.92	26.85	29.74	47.48	91271	65653	3.56
T_6	55.80	14.02	11.44	30.13	34.03	46.95	102495	76627	3.96
T_7	50.47	12.45	11.41	25.50	29.85	46.07	86826	59978	3.23
T_8	51.47	11.76	11.42	28.12	32.06	46.72	95681	69450	3.65
T_9	60.00	15.31	12.44	33.65	36.86	47.72	114362	79964	3.32
T_{10}	31.93	7.29	10.58	13.56	15.66	46.45	46168	21770	1.89
S.Em±	1.29	0.41	0.42	0.91	1.11	0.34	3107	3107	0.12
CD (P=0.05)	3.84	1.23	NS	2.71	3.31	NS	9232	9232	0.36

In table 1 to 3: DAS: Days after sowing , NS : Non-significant, Figures in the parenthesis indicate original values, $(x+0.5)^{1/2}$ transformed data

Treatments: T_1 - Cycloxydim 20% EC @ 50 g a.i. (active ingredient) ha^{-1}; T_2 - Cycloxydim 20% EC @ 75 g a.i. ha^{-1}; T_3 - Cycloxydim 20% EC @ 100 g a.i. ha^{-1}; T_4 - Cycloxydim 20% EC @ 50 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1}; T_5 - Cycloxydim 20% EC @ 75 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1}; T_6 - Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1}; T_7 - Imazethapyr 10% SL @ 100 g a.i. ha^{-1}; T_8 - Chlorimuron 25% EC @ 37.5 g a.i. ha^{-1} at 15 DAS + one intercultivation at 20-25 DAS; T_9 – Weed free check; T_{10} – Weedy check

Digera arvensis, Corchorus oletorius, Mullugo pentaphylla, Commelina benghalensis, Parthenium hysterophorus, Abutilon indicum, Phyllanthus niruri and *Euphorbia hirta* were found and among the sedges *Cyperus rotundus* was found in the experimental area. Among the weeds, the monocot weeds were predominant (53.98%) in experimental field compared with dicot weeds (42.95%) at 20 DAS.

Effect of post emergence herbicides on weed dynamics: Among the herbicide treated plots application of Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} has recorded lower total number of monocot weeds at all the stages of crop growth and Chlorimuron 25% EC @ 37.5 g a.i. ha^{-1} at 15 DAS + one intercultivation at 20-25 DAS recorded significantly lower total number of dicot weeds at all stages of crop growth (Table 1). The selective action is the reason for better control of monocot and dicot weeds with the post emergence application of Cycloxydim (100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1}), Chlorimuron (37.5 g ha^{-1}) and Imazethapyr (100 g a.i. ha^{-1}) respectively. These results are in conformity with the findings of Anderson (1990), Kushwah and Vyas (2005) and Tiwari *et al.* (2007). The treatment Chlorimuron 25% EC @ 37.5 g a.i. ha^{-1} at 15 DAS + one intercultivation at 20-25 DAS has recorded significantly lower total weed population, lower total weed dry weight and higher weed control efficiency at 40 DAS and it was on par with Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1}. At 60 DAS and harvest, the treatment of Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} were recorded lower total weed population, lower total weed dry weight and higher weed control efficiency and remained on par with all other herbicide treatments but significantly superior over weedy check. The higher total weed population, weed dry weight, weed index and lower weed control efficiency recorded in weedy check (Table 1 & 2). Mukesh Kumar and Das (2008) and Prachand *et al.* (2014), quoted similar findings.

Effect of post emergence herbicides on yield and its attributes: All the herbicide treatments produced significantly higher yield compared to weedy check (Table 3). Weed free check recorded significantly higher seed yield (33.65 q ha^{-1}) when compared to all other treatments. Among the herbicide treatments application of Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} has recorded higher number of pods $plant^{-1}$ (55.80), seed yield $plant^{-1}$ (14.02 g), seed yield (30.13 q ha^{-1}) and haulm yield (34.03 q ha^{-1}). This may be attributed to excellent control of mainly grassy weeds at critical stage of crop by post-emergence herbicides. However, this treatment remained on par with Chlorimuron 25% EC @ 37.5 g a.i. ha^{-1} at 15 DAS + one intercultivation at 20-25 DAS (T_8) with respect to seed and haulm yield. These results were in conformity with Venkatesh *et al.* (2008) and Upadhyay *et al.* (2012). Significantly lower seed yield was recorded in weedy check. This may be attributed to severe crop weed competition stress right from crop establishment to the end of critical period of crop growth.

Effect of post emergence herbicides on economics: Economics of various weed control treatments indicated that significantly higher gross (114362 ha^{-1}) and net income (79,964 ha^{-1}) was recorded with weed free check compared to weedy check and it was on par with Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} (76,627 ha^{-1}). Significant differences were observed in B: C ratio due to different weed control treatments. Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} was recorded significantly higher B: C ratio (3.96) compared to all other treatments and was followed by Chlorimuron 25% EC @ 37.5 g a.i. ha^{-1} at 15 DAS + one intercultivation at 20-25 DAS (3.65). The higher net returns in weed free check and Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} could be attributed to greater seed yield and lowest cost of cultivation. Similarly, the variations in B: C ratio could be attributed to cost of cultivation and gross returns. On the contrary, the lower net returns and B: C ratio were recorded in weedy check (1.89) due to lower gross returns which in turn due to significantly the lower seed yield of soybean (Table 3). Similar findings were reported by Tiwari *et al.* (2007), Suresh *et al.* (2008) and Prachand *et al*. (2014).

Among the different herbicide treatments, application of Cycloxydim 20% EC @ 100 g a.i. ha^{-1} + Adjuvant @ 2 ml l^{-1} found superior with respect to weed control efficiency, lower weed dry weight, total weed population m^{-2}, yield and yield attributes, gross and net returns in soybean crop. Further, B: C ratio was also higher in this treatment. So the application of Cycloxydim 20% EC @ 100 g a.i. ha^{-1} along with adjuvant helps in effective control of monocot weeds thereby increasing the yield of soybean resulting in higher net return to the farmer.

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References

Anderson, C.R.: Cycloxydim - A new selective post-emergence herbicide for control annual and perennial grasses in broad leaved crops. *Proc. 9th Australian Weeds Conf.*, Adelaide (1990).

Anonymous: Directorate reports and summary tables of experiment, AICRP on soybean. Directorate of Soybean Research, Indore (2015).

Kushwah, S.S. and Vyas, M.D.: Herbicidal weed control in soybean (*Glycine max*). *Indian J. Agron.,* **50**: 225-227 (2005).

Meena, D.S., Baldev Ram, Chaman Jadon and Tetarwal, J.P.: Efficacy of imazethapyr on weed managementin soybean. *Ind. J. Weed Sci.,* **43**: 169-171 (2011).

Mukesh Kumar and Das, T.K.: Integrated weed management for system productivity and economics in soybean (*Glycine max*) – wheat (*Triticum aestium*) system. *Ind. J. Agric.,* **53**: 189-194 (2008).

Prachand, S., Kubde, K.J. and Bankar, S.: Effect of chemical weed control on weed parameters, growth, yield attributes, yield and economics in soybean (*Glycine max*). *American-Eurasian J. Agric. Environ. Sci.,* **14**: 698-701 (2014).

Pratiksha, M., Singh, S., Babu, S. and Pal, D.: Bioefficacy of some early post emergence herbicides in soybean. *Ann. Agric. New Series*, **34**: 81-87 (2013).

Suresh, K., Angiras N.N., Rana, S.S. and Arvind S.T.: Evaluation of doses of some herbicides to manage weeds in soybean (*Glycine max* L.). *Ind. J. Weed Sci*., **40**: 56-61 (2008).

Tiwari, D.K., Dubey, O.P., Baghel, S.S. and Agarwal, S.B.: Bioefficacy of post-emergence herbicides for control of grassy weeds in soybean (*Glycine Max L. Merrill*). *Int. J. Agric. Sci.,* **2**: 54-55 (2006).

Tiwari, D.K., Khan, J.A. and Khamparia, N.K.: Evaluation of efficacy of post-emergence herbicides in soybean (*Glycine max*). *Ind. J. Agron.*, **52**: 74-76 (2007).

Upadhyay, V.B., Singh, A. and Rawat, A.: Bioefficacy of post emergence herbicides in soybean. *Ind. J. Weed Sci.*, **44**: 261-263 (2012).

Venkatesh, M.M., Babalad, H.B., Patil, V.C., Patil, B.N. and Hebsur, N.S.: Bioefficacy and phytotoxicity evaluation of Imazethapyr in soybean. *Ind. J. Weed Sci.,* **40**: 214-216 (2008).