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Narrow & Broad leaves weed flora management in Soybean crop with novel herbicide combination CCP-1203 SC

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Abstract
A Field experiment was conducted during *Kharif* season 2016 and 2017 in farmer's field at Hatod, Indore (Madhya Pradesh) to study the narrow and broad leaves weed management efficacy of herbicide & its significance on yields of Soybean crop. Dominant weeds were: *Echinochloa colonum*, *Setaria glauca*, *Parthenium hysterophorus* and *Celosia indica* etc. The economic thresholds (number of weeds/unit area) with weed management practices varied between 4.6-48.4/m2. The treatment CCP-1203 SC @ 600 ml per acre was found best for efficient weed control activity among all the treatments even in comparison to other market standards. The weed free treatment recorded significant improvement in yield attributes.

Keywords: Soybean, *Echinochloa colonum*, Herbicides, Weeds

Introduction
Losses due to weeds have been one of the major limiting factors in soybean production. Weeds compete with crop for light, moisture and nutrients, with early-season competition being the most critical. The grain yield reduction due to the weed infestation in soybean may be up to 31- 84 percent (Kachroo *et al.* 2003) [7]. Most of the yield reduction due to weed competition occurs during the first six weeks after planting; therefore, major emphasis on control should be given during this period. Good soybean weed control involves utilizing all methods available and combining them in an integrated weed management system; but considering the present-day labour scarcity and their higher wages for cultural and mechanical weed control, the economics and feasibility of soybean cultivation is quiet disturbed. Hence the emphasis should be given to adapt the chemical methods of weed control to solve the problem of minimum available labour and their high cost. In this view the present investigation was conducted to find out the best suitable combination of different herbicides to control weeds in soybean with lower cost and higher grain yield.

Materials and Methods
An agronomic investigation was conducted at Farmers field of Hatod, Indore, Madhya Pradesh in Kharif 2016 & 2017 in randomized block design with eight treatments replicated thrice. The experimental site was located at 770 02' E longitudes and 20042' N latitude with average annual rainfall of 600-800 mm. The soil of experimental field was clayey and slightly alkaline in reaction with pH 7.5. Gross and net plot sizes were 5 m x 5.0 m and 5 m x 6 m, respectively. The soybean variety 'JS 335' was sown at 45 x 5 cm spacing on 2nd July of year 2016 & 10 July 2017. Treatment consist of recommended practice of weed control- post emergence application of quizalofop ethyl 400 ml/acre, Imazethapyr 400 ml/ac. The fertilizer dose of 30 kg N and 75 kg P per hectare was applied to crop through urea and single super phosphate as half of N and whole P at the time of sowing and remaining half of N was applied at 30 days after sowing. Protective irrigations were given to crop whenever dry spells appeared during the crop growth. Other plant protection practices for disease and pest control were also applied in similar manner for all the treatments. Regular biometric observations in respect of different weed parameters and growth attributes of crop were recorded at regular interval during the crop growth, however the observation data at peak growth stage i.e. 7, 14, 28, 42 DAS, is discussed in results and discussion.

The weed control efficiency was calculated by using the following formula:

WCE (%) = WC-WT/WC X 100

Where,
WCE = Weed control efficiency in percent,
WC = weed in control plot and
WT = weed in treated plot.

Results and Discussion

Effects on Weeds

The predominant weed flora at experimental site was: *Echinochloa colonum*, *Setaria glauca* among grasses and *Parthenium hysterophorus*, *Celosia indica* among dicot weeds.

Weed Count/m^2 and mortality percentage

The average data on weed count revealed that *Echinochloa colonum* had maximum infestation over *Setaria glauca*, *Parthenium hysterophorus* and *Celosia indica* during 2 years in weedy control plot. With regards to mortality percentage (Table-1a&1b) indicated that application of different herbicides controlled the weeds significantly and average mortality percentage of both narrow leaved weeds ranged from 80 to 95%.

Maximum mortality (95.8%) against *Echinochloa colonum* and other weeds was observed in CCP-1203 SC @ 600 ml per acre treated plots followed by CCP-1203 SC @ 500 ml per acre (80.8%), Quizalofop ethyl 5% EC @ 400 ml per acre (90.5%).

Maximum mortality of *Setaria glauca* (94.2%), *Parthenium hysterophorus* (93.6%) and *Celosia indica.* (93.9%) observed with CCP-1203 SC 600 ml per acre treated plots at 14 days after application.

Maximum mortality of *Echinochloa colonum* (95.9%) *Setaria glauca (92.7%), Parthenium hysterophorus* (90.9%) and *Celosia indica.* (90.8%) observed with 600 ml per acre treated plots at 28 days after application.

Post emergence application of Imazethapyr is responsible for inhibition of acetolactate synthase (ALS) or acetohydroxyacid synthase (AHAS) in broad leaf weeds which caused destruction of these weeds at 3-4 leaf stage (Chandel and Saxena 2001) [1]. Quizalofop-ethyl inhibit the activity of the acetyl-CoA carboxylase enzyme, which is necessary for fatty acid synthesis in grassy weeds. These effects of quizalofop for controlling weeds in soybean are in confirmation with the earlier results reported by Pandey et al. (2007) [3]. These results agreed to those of Pandey *et al.* The data (table 1 & 2) showed that all herbicides decreased weed density of both narrow leaved weeds significantly over in control plots during two years of study.

Table 1a: Effect of various treatments on species wise various weed flora in Soybean crop

Treatments	Doses (g/Acre)	Total Weed density (No./m2) and Percent weed control at 14 DAS (Kharif season 2016 & Season 2017)															
		Echinochloa colonum				*Setaria glauca*				*Parthenium spp.*				*Celosia spp.*			
		2016	2017	Av.	% C	2016	2017	Av.	% C	2016	2017	Av.	% C	2016	2017	Av.	% C
CCP-1203 SC	400 ml	15.7	17.3	16.5	75.7	4.6	6.3	5.45	60.8	10	11.3	10.65	56.5	12.7	10.2	11.45	63.7
CCP-1203 SC	500 ml	9.4	16.7	13.05	80.8	3.2	4.6	3.9	71.9	4.7	7.3	6	75.5	8.4	5.7	7.05	77.6
CCP-1203 SC	600 ml	1	2.1	1.55	97.7	0.2	1.4	0.8	94.2	0.9	2.3	1.6	93.6	2.3	0.9	1.6	94.9
CCP-1203 SC	700 ml	2	1	1.5	97.8	0.4	0.9	0.65	95.3	0.9	2.1	1.5	93.8	2.7	1.3	2	93.8
Quizalofop ethyl 5 EC	400 ml	7.3	5.6	6.45	90.5	3.7	5.1	4.40	68.3	21.5	25.3	23.4	4.44	24.8	21.6	23.3	26.3
Imazethapyr 10 SL	400 ml	12.2	14.5	13.35	80.3	1.7	3.2	2.45	82.4	22.3	25.3	23.8	2.98	12.2	14.5	13.35	57.6
Unweeded Check	-	60.3	75.5	67.9	-	12.5	15.3	13.9	-	22.5	26.5	24.5	-	37.5	25.5	31.5	-

*DAS Days after sowing, % C Percent control over check, Av. Average

Table 1b: Effect of various treatments on species wise various weed flora in Soybean crop

Treatments	Doses (g/Acre)	Total Weed density (No./m2) and Percent weed control at 28 DAS (Kharif season 2016 & Season 2017)															
		Echinochloa colonum				*Setaria glauca*				*Parthenium spp.*				*Celosia spp.*			
		2016	2017	Av.	% C	2016	2017	Av.	% C	2016	2017	Av.	% C	2016	2017	Av.	% C
CCP-1203 SC	400 ml	18.5	24.5	21.5	70.5	7.8	11.7	9.75	40.5	12.2	14.7	13.45	50.9	15.5	12.7	14.1	60.3
CCP-1203 SC	500 ml	12.5	18.5	15.5	78.7	4.7	8.3	6.5	60.4	6.7	9.3	8	70.8	12.5	8.2	10.35	78.8
CCP-1203 SC	600 ml	2.3	3.7	3	95.9	0.9	1.5	1.2	92.7	1.7	3.3	2.5	90.9	4.2	2.32	3.26	90.8
CCP-1203 SC	700 ml	2.1	3.3	2.7	96.3	0.4	1.7	1.05	93.6	1.3	2.7	2	92.7	3.7	1.7	2.7	92.4
Quizalofop ethyl 5 EC	400 ml	15.3	5.6	10.45	85.7	4.3	7.1	5.7	65.2	24.3	28.3	26.3	4.00	29.3	27.3	28.3	20.3
Imazethapyr 10 SL	400 ml	19.5	23.7	21.6	70.4	2.7	5.3	4	75.6	24.7	28.7	26.7	2.6	36.7	30.7	33.7	5.1
Unweeded Check	-	65.5	80.5	73	-	15.3	17.5	16.4	-	25.5	29.3	27.4	-	38.5	32.5	35.5	-
*DAS Days after sowing,% C Percent control over check, Av. Average																	

*DAS Days after sowing % C Percent control over check, Av. Average

Table 2: Effect of various weed management treatments on 100 grain weight and plot yield (qt/ac) (*Kharif* season 2016 & Season 2017)

Treatments	Doses (g/Acre)	Percent Increase in 100 grain weight and yield (Qt/ac) at Harvesting							
		100 grain weight				Yield (qt/ Ac)			
		2016	2017	Av.	% I	2016	2017	Av.	% I
CCP-1203 SC	400 ml	12.97	13.10	13.45	3.12	3.71	3.95	3.83	30.54
CCP-1203 SC	500 ml	13.20	13.70	13.75	5.23	3.90	4.10	4.00	33.5
CCP-1203 SC	600 ml	13.65	13.85	14.3	8.88	4.26	4.35	4.30	38.13
CCP-1203 SC	700 ml	14.20	14.40	14.31	8.94	4.15	4.30	4.22	36.96
Quizalofop ethyl 5 EC	400 ml	14.17	14.45	14	6.92	3.70	3.95	3.82	30.36
Imazethapyr 10 SL	400 ml	13.90	14.10	13.85	5.92	3.80	4.05	3.92	32.14
Unweeded Check	-	12.97	13.10	13.03	-	2.43	2.90	2.66	-

*DAS Days after sowing% I Percent Increase over check, Av. Average

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