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Effect of different weed management practices on weed dynamic, yield and economics of soybean production

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ABSTRACT

A field experiment was conducted to study the effect of different weed management practices on weed dynamics, yield and economics of soybean (*Glycine max* L.var. *JS-335*) production. Experiment was carried out in randomized block design consisting of thirteen weed management practices replicated thrice (pre-emergence and post-emergence application of herbicides, cultural and mechanical weed management practices). Experimental field was mostly dominated by grassy weeds namely; *Sorghum halepense*, *Cynodon dactylon, Digitaria sanguinallis* with broad leaf weeds and sedges. Total weed population and weed dry matter production was significantly highest in weedy check plot. Two hand weeding at 20 and 40 Days after sowing (DAS) with highest weed control efficiency (84.29 %) recorded lowest weed population and weed dry matter accumulation with highest values of growth and yield attributes, seed and stalk yield. Pre-emergence (PE) application of pendimethalin 1.0 kg ha^{-1} supplemented by hand weeding at 40 DAS was next best treatment to record lower weed population, weed dry matter accumulation and higher seed yield with the weed control efficiency of 80.83 %. Pendimethalin 1.0 kg ha^{-1} as pre-emergence followed by (*fb*) quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS highly efficient for dominating grassy weed; *Sorghum halepense* produced comparable seed and stalk yield with lower cost of cultivation and recorded highest net return (711.22 $ ha^{-1}) and benefit: cost ratio (1.51) over all other treatments with mean that 1 $ investment can fetch 1.51 $ net return thus proving more economical and profitable weed management practice among all treatments.

INTRODUCTION

Soybean (*Glycine max* L. Merrill) 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. 2006). It contains approximately 40-45 % protein and 18-22 % oil (Goyal et al. 2012) and is a rich source of vitamins and minerals.Soybean also helps in maintaining soil fertility and fixes 61–337 kg N ha^1 symbiotically (Salvagiotti et al. 2008). Majority of the peoples in the South Asia suffers from protein-energy malnutrition. Because of the great nutritional significance of soybean, it can be potential dual purpose crop to meet the protein and oil requirement and protect people from malnutrition. Thus with the increasing demand of soybean as the source of edible oil, protein and other industrial products like soya meal, feed source and global demand for the biodiesel production as source of fuel, its production and productivity is to be increased but that is limited by various biotic and a biotic factors . One of the major constraints in soybean production is crop-weed competition (Vollman et al. 2010); being rainy season crop it suffers heavily due to the competitive stress of the grasses, broad leaf weeds and sedges. Billori et al. (1999) reported that the existence of weeds depending upon their types, intensity and duration of competition with crop, causes about 35-70 % reduction in yield of soybean due to its slow initial growth, available soil moisture and congenial temperature.Weed

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infestation removed 21.4 kg N and 3.4 kg P ha^{-1} in soybean (Pandya et al. 2005). The problems become more critical when farmers do not get their field weeded at right time either due to the manpower shortage or due to incessant rains which results into lower productivity of soybean. The conventional method of the weed control particularly manual and mechanical weeding are oldest, followed by most of the farmers and they efficiently control diverse weed flora but they are difficult to practice on large scale on account of higher cost, frequent escalation in wages, declining efficiency due to continuous rain and shortage of labor at critical stages of the crop-weed competition and increasing trend of large scale farming compels us to search an alternative means to manage the weeds effectively. Number of herbicides available in the market namely; pendimethalin, imazethapyr, fenoxaprop-p-ethyl, quizalofop-p-ethyl, halosulfuron have been available in the market .The effectiveness of these herbicides either alone or in combination with mechanical and cultural methods to control diverse weed flora in different geographical location are to be tested. Use of proper herbicide at right time, in right dose, by right method and with an appropriate sprayer had shown added advantages over manual and mechanical weed control in many of cases. Some of the herbicides are selective and may allow escaping other types of weed flora. So application of single herbicide may not be sufficient to provide weed free environment to soybean. Thus, better weed management in soybean should involve utilization of all available and feasible methods combining them in an integrated manner for lower weed load and higher sustainable yield. Hence effectiveness of different pre and post-emergence herbicides alone or combinations of herbicides with cultural and mechanical methods are needed to be tested for the better benefit of farmers. In the view of limited research in this aspect, this experiment was carried out to find out effectiveness of different weed management practices in integrated manner in soybean production.

MATERIALS AND METHODS

A field experiment was conducted during rainy season of AD 2015 at Agricultural Research Farm of Tirhut College of Agriculture, Dholi (Muzaffarpur), a campus of Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India. Geographically it is situated at 25.98°N latitude and 85.6°E longitude and at an elevation of 52.18 m.a.s.l. The average monthly maximum and minimum temperature during the experimentation ranged from 32.58 °C to 33.6 °C and 20.94°C to 26.28 °C respectively. The maximum rainfall of 367.4 mm was in four rainy days recorded during the 34th Augustian week.The meteorological data for the growing season of crop during 2015 is presented in Table 1. Soil analysis result (Table 2) shows that soil of the experimental plot was sandy loam, alkaline in reaction (pH 8.47), low in organic carbon (0.48 %), available N (219.36 kg ha^{-1}), P_2O_5 (17.57 kg ha^{-1}) and K_2O (121.01 kg ha^{-1}).Thirteen weed management practices namely; Pendimethalin 1.0 kg ha^{-1} as PE (T_1), imazethapyr 100 g ha^{-1} at 20 DAS (T_2), fenoxaprop-p-ethyl 80 g ha^{-1} at 20 DAS (T_3), quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS (T_4), halosulfuron 67.5 g ha^{-1} at 20 DAS (T_5), pendimethalin 1.0 kg ha^{-1} PE *fb* imazethapyr 100 g ha^{-1} at 20 DAS (T_6), pendimethalin 1.0 kg ha^{-1} PE *fb* fenoxaprop-p-ethyl 80 g ha^{-1} at 20 DAS (T_7), pendimethalin 1.0 kg ha^{-1} PE *fb* quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS (T_8), pendimethalin 1.0 kg ha^{-1} PE *fb* halosulfuron 67.5 g ha^{-1} at 20 DAS (T_9), pendimethalin 1.0 kg ha^{-1} PE *fb* hand weeding at 40 DAS (T_{10}), pendimethalin 1.0 kg ha^{-1} PE *fb* weeding by wheel hoe at 40 DAS (T_{11}), weed free (hand weeding twice at 20 and 40 DAS) (T_{12}) and weedy check (T_{13}) were taken under randomized block design with three replications. The individual plot size was 22.5 m^2. One meter distance was maintained between the replications and individual plots were separated by 0.5 m distance. The soybean variety "JS-335" was sown in the month of July at a spacing of 45 cm× 5 cm using the seed rate of 75 kg ha^{-1} and crop was harvested in the month of October. Recommended dose of 30 kg N, 60 kg P_2O_5, 20 kg K_2O and 20 kg S was applied as basal dose through Urea (46% N), Di-ammonium phosphate (DAP) (18% N and 46% P_2O_5), Muriate of potash (MOP) (60 % K_2O) and Elemental Sulphur (90 % S) respectively. Full dose of N, P, K and S were applied as basal dose. Seed was treated with thiram 2 g + bavistin 1.0 g kg^{-1} seed, followed by inoculation with *Rhizobium japonicum* culture (7 g kg^{-1} of seed) at the time of sowing. Pre-emergence application of herbicides was done at 2 DAS and post-emergence application was done at 20 DAS with the help of Knapsack Sprayer having flat-fan nozzle forming solution at the rate of 600 Lha^{-1}. Weed count was recorded by placing a 0.5 m^2 quadrate at four random places in each plot, weeds were uprooted from these quadrates and after drying them in hot air oven (72°C for 72 hr), weed dry weight was recorded. Data on weed parameters and plant growth parameters were recorded at 30, 60, 90 DAS and yield attributes were recorded at harvest and yield was recorded thereafter. Weed control efficiency was calculated on the basis of dry weight of weed recorded. Weed index was calculated by comparing the seed yield from treated plot and check plot using following formula.

Weed control efficiency (%) = [(Dry weight of weeds in weedy check plot-Dry weight of weeds in treated plot)/Dry weight of weeds in treated plot] ×100

Weed index (%) = [(Yield obtained from minimum weed competition plot -Yield obtained from treated plot)/ Yield obtained from minimum weed competition plot] ×100

Biological yield and Harvest index were calculated by using following formula.

Biological yield = Stalk yield + Seed yield

Harvest index (%) = (Seed yield/ Stalk yield) × 100

Data on weed count and weed dry weight were subjected to square root ($\sqrt{(x+0.5)}$) transformation to make analysis of variance more valid as suggested by Chandel (1984). Data pertaining to various parameters were subjected to statistical analysis by using software OPSTAT. The results were then interpreted logically to drive definite inference.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been presented under the following headings:

Effect on weeds:

The experimental field was infested with different weed flora of grasses, sedges and broad leaf weeds. Grassy weeds were most dominating over broad leaf weeds and sedges. Among grasses, *Sorghum halepense* was most predominant weed in the experimental field. Other weed species found were *Cynodon dactylon, Digitaria sanguinallis*, *Eleusine indica, Dicanthium annulatum* among the grasses and *Phyllanthus niruri, Physalis minima, Parthenium hysterophorus, Leucas aspera, Cleome viscose* and *Croton sparsiflorus* among the broad leaf weeds. *Cyperus rotundus* was the only sedge found in the experimental plot.

Result revealed that weed free (hand weeding twice at 20 and 40 DAS) recorded significantly lowest weed population and weed dry matter accumulation than all other treatments at 30, 60 and 90 DAS but was found at par with the treatment T_{10} (pendimethalin 1.0 kg ha^{-1} as PE *fb* hand weeding at 40 DAS) only at 60 and 90 DAS. This might be due to complete removal of weed by hand weeding twice which drastically reduced total weed population and thus recorded lowest total weed dry weight and highest weed control efficiency (84.29%).This finding is in close conformity with finding of Patel et al.(2015) and Kushwah and Vyas (2005). They also reported that two hand weeding at 20 and 40 DAS in soybean field showed higher weed control efficiency (WCE) of 90.05 % and 96.29 % during 2001 and 2002 respectively.

Among the chemical treatments pendimethalin 1.0 kg ha^{-1} as PE *fb* quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS also showed better result with lower weed population and weed dry weight and was found equally effective as T_{11} (pendimethalin 1.0 kg ha^{-1} as PE *fb* weeding by wheel hoe at 40 DAS) and T_7 (pendimethalin 1.0 kg ha^{-1} as PE *fb* fenoxaprop-p-ethyl 80 g ha^{-1} at 20 DAS). Pre-emergence application of pendimethalin resulted into death of weed seedling before or shortly after emergence. Thereafter post-emergence application of quizalofop-p-ethyl and fenoxaprop-p-ethyl effectively controlled most dominating grassy weed particularly *Sorghum halepense* in the experimental field and thus lowered weed population and weed dry weight. Weedy check plot recorded highest weed population and weed dry matter production over all other treatments at all the stages of observation. The highest weed index (66.97%) was recorded in the weedy check plot. Lower weed index in other plots having herbicidal treatments alone or in combination with manual or mechanical method might be due to better weed control in these treatments providing congenial environment for crop growth which ultimately increased the seed yield of soybean crop. Similar results were also reported by Wadafale et al. (2011).

Effect on yield attributes and yield.

Highest value of all yield attributing characters namely; no of pods plant^{-1}, no of seeds pod^{-1} and seed index (100-seed weight) among all the treatments were recorded under weed free plot (hand weeding twice at 20 and 40 DAS). T_{10} (Pendimethalin 1.0 kg ha^{-1} as PE *fb* hand weeding

Table 1. Meteorological data during the crop growing season 2015.

Month	Average Temperature (° C)		Average RH (%)		Rainfall (mm)
	Maximum	Minimum	Maximum	minimum	
July	32.86	26.28	95.16	74.68	93.20
August	33.60	25.98	96.45	80.08	511.80
September	33.20	25.63	96.45	75.10	155.60
October	32.58	20.94	97.96	69.50	0.00

Source :"Agromet. Advisory Services", Department of Agronomy,Dr. Rajendra Prasad Central Agricultural University, Pusa (Samastipur), India.

Table 2. Physico-chemical properties of the soil of the experimental site 2015

S.N.	Properties	Content	Catagories	Method used
		Physical properties		
1	Sand (%)	50.47		International pipette method
2	Silt (%)	37.81		International pipette method
3	Clay (%)	11.72		International pipette method
4	Texture class	Sandy loam		Triangular diagram method
		Chemical properties		
5	Free $CaCO_3$ (%)	24.0	Calcareous	Rapid titration method
6	EC(dSm^{-1} at 25°C)	0.31	Medium	Conductivity bridge method
7	pH	8.47	Alkaline	Glass electrode pH meter method
8	Organic carbon (%)	0.48	Low	Walkley and Black method
9	Available N (kg/ha.)	219.36 kg/ha.	Low	Alkaline potassium permanganate method
10	Available P_2O_5 (kg/ha.)	17.57 kg/ha.	Low	Olsen's method
11	Available K_2O (kg/ha.)	121.01 kg/ha.	Low	Neutral normal ammonium acetate method

at 40 DAS) and T_8 (pendimethalin 1.0 kg ha^{-1} as PE *fb* quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS) were also found equally effective with respect to higher value of all these yield attributing characters. Weed free (hand weeding twice at 20 and 40 DAS) produced highest seed and straw yield over all other treatments which may be ascribed to the effectiveness of this method to control all sorts of weeds during the critical period of crop-weed competition. Idangpungi et al.(2005); Meena et al. (2012) also reported similar findings. T_{10} (Pendimethalin 1.0 kg ha^{-1} as PE *fb* hand weeding at 40 DAS) was next best treatment to record higher seed and straw yield than all other treatments but was found at par with T_8 (pendimethalin 1.0 kg ha^{-1} as PE *fb* quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS) and T_7 (pendimethalin 1.0 kg ha^{-1} as PE *fb* fenoxaprop-p-ethyl 80 g ha^{-1} at 20 DAS). Higher value of all the yield attributing characters as well as seed and straw yield recorded in these treatments might be due to lower weed population, which reduced crop weed competition for soil moisture, nutrients, solar radiation and space during active crop growth period resulting into more efficient nutrient absorption for facilitating better crop growth as the pre-emergence application of pendimethalin effectively reduced weed load during early stage and post-emergence application of quizalofop-p-ethyl and fenoxaprop-p-ethyl was highly effective to kill most dominating grassy weed; *Sorghum halepense* during later stage. Similar findings were also reported by Kushwah and Vyas (2005). They also advocated that among post-emergence herbicides, quizalofop ethyl at 50 g ha^{-1} gave higher grain yield as compared to weedy check as it controlled grassy weed effectively. Lowest seed yield was observed in weedy check plot which was due to severe competition stress right from crop establishment to the end of critical period of crop weed competition, leading to poor crop growth, inferior yield attributes and ultimately lowest yield.

Economics of soybean production.

Weed free (hand weeding twice at 20 and 40 DAS) recorded significantly highest gross return (1290.49 \$ ha^{-1}) over all other treatments. Pendimethalin 1.0 kg ha^{-1} as PE *fb* hand weeding at 40 DAS was found to be next best treatment to record higher gross return (1188.87 \$ ha^{-1}) than other treatment but was found at par with pendimethalin 1.0 kg ha^{-1} as PE *fb* quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS (1181.14 \$ ha^{-1}). Pendimethalin 1.0 kg ha^{-1} as PE *fb* quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS produced significantly highest net return (711.23 \$ ha^{-1}) over all other treatments but was at par with hand weeding twice at 20 and 40 DAS (672.11\$ ha^{-1}). Again, pendimethalin 1.0 kg ha^{-1} as PE *fb* quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS produced highest benefit: cost ratio (1.51) over all other treatments with mean that \$ 1 investment can fetch \$ 1.51 net return. Significantly lowest gross return (457.28 \$

Table 3. Effect of weed management practices on total weed population, total weed dry weight, weed control efficiency and weed index.

Treatments	Total weeds population(no.m^{-2})			Total weeds dry weight (g m^{-2})			Weed control efficiency (%)			Weed index (%)
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	
T_1- Pendimethalin 1.0 kg ha^{-1} as PE.	7.58 (57.01)*	9.32 (86.66)	10.41 (108.00)	4.75 (22.03)	8.63 (74.42)	10.93 (119.11)	52.05	49.10	41.20	33.74
T_2-Imazethapyr 100 g ha^{-1} at 20 DAS	7.90 (62.00)	8.69 (75.00)	9.85 (96.67)	5.01 (24.62)	7.67 (58.41)	9.89 (97.38)	46.40	60.05	51.93	28.02
T_3 -Fenoxaprop-p-ethyl 80 g ha^{-1} at 20 DAS	8.07 (64.66)	8.59 (73.34)	9.63 (92.34)	4.84 (22.95)	7.28 (52.55)	9.21 (84.28)	50.03	64.06	58.39	25.83
T_4 -Quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS	7.73 (59.34)	8.12 (65.67)	9.33 (86.63)	4.56 (20.29)	6.78 (45.46)	8.78 (76.37)	55.84	68.91	62.30	20.52
T_5-Halosulfuron 67.5 g ha^{-1} at 20 DAS	9.56 (91.00)	9.91 (97.73)	10.86 (117.64)	6.36 (40.00)	10.27 (105.03)	12.54 (156.71)	12.92	28.17	22.64	41.14
T_6 –Pendimethalin 1.0 kg ha^{-1} as PE *fb* imazethapyr 100 g ha^{-1} at 20 DAS	7.19 (51.33)	8.15 (65.99)	9.30 (86.00)	4.57 (20.48)	6.83 (46.18)	8.89 (78.95)	55.41	68.42	61.02	21.80
T_7 -Pendimethalin 1.0 kg ha^{-1} as PE *fb* fenoxaprop-p-ethyl 80 g ha^{-1} at 20 DAS.	7.24 (52.01)	8.08 (65.00)	8.97 (80.00)	4.18 (17.01)	6.74 (45.12)	8.68 (74.89)	62.97	69.14	63.03	13.37
T_8 -Pendimethalin 1.0 kg ha^{-1} as PE *fb* quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS	6.87 (46.66)	7.86 (61.30)	8.79 (76.97)	3.86 (14.42)	6.53 (42.19)	8.42 (70.43)	68.61	71.15	65.23	8.83
T_9- Pendimethalin 1.0 kg ha^{-1} as PE *fb* halosulfuron 67.5 g ha^{-1} at 20 DAS	6.87 (46.66)	7.59 (57.33)	8.93 (79.30)	4.55 (20.25)	7.90 (61.92)	10.07 (100.90)	55.93	57.65	50.19	29.96
T_{10}-Pendimethalin 1.0 kg ha^{-1} as PE *fb* hand weeding at 40 DAS.	7.52 (56.00)	5.11 (25.67)	6.41 (40.67)	4.72 (22.02)	4.40 (18.90)	6.25 (38.83)	52.06	87.08	80.83	8.22
T_{11}-Pendimethalin 1.0 kg ha^{-1} as PE *fb* weeding by wheel hoe at 40 DAS	7.67 (58.34)	6.30 (39.33)	7.54 (57.33)	4.75 (22.07)	6.24 (38.48)	8.43 (70.61)	51.95	73.63	65.14	16.18
T_{12}-Weed free (hand weeding twice at 20 and 40 DAS).	3.82 (14.33)	4.91 (23.67)	5.86 (34.17)	2.16 (4.24)	4.19 (17.11)	5.68 (31.82)	90.77	88.30	84.29	-
T_{13}-Weedy check.	10.31 (106.00)	11.84 (139.67)	12.93 (166.67)	6.81 (45.94)	12.11 (146.22)	14.25 (202.56)	-	-	-	66.97
SEm ±	0.21	0.23	0.21	0.15	0.27	0.31	2.87	3.19	3.08	1.63
CD (P=0.05)	0.61	0.66	0.62	0.43	0.79	0.91	8.36	9.56	9.00	4.76

* Figures in the parenthesis are original value; data were subjected to square root ($\sqrt{(x+0.5)}$ transformation before statistical analysis. PE: Pre-emergence, *fb*: Followed by, DAS: Days after sowing, SEm: Standard error of mean

Table 4. Effect of different weed management practices on yield attributes, yield of soybean and economics returns.

Treatments	No. of pods Plant^{-1}	No. of seeds pod^{-1}	100- seed Weight (g)	Seed yield (t ha^{-1})	Straw yield (t ha^{-1})	Yield loss (%)	Gross return ($ ha^{-1})	Net return ($ ha^{-1})	B: C ratio
T_1- Pendimethalin 1.0 kg ha^{-1} as PE.	31.10	2.09	9.36	1.298	2.972	33.74	881.13	438.88	0.99
T_2-Imazethapyr 100 g ha^{-1} at 20 DAS	33.00	2.15	9.39	1.410	3.037	28.02	948.45	512.41	1.18
T_3 -Fenoxaprop-p-ethyl 80 g ha^{-1} at 20 DAS	33.10	2.17	9.41	1.453	3.064	25.83	974.40	539.56	1.24
T_4 -Quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS	34.90	2.19	9.44	1.557	3.114	20.52	1036.46	595.87	1.35
T_5-Halosulfuron 67.5 g ha^{-1} at 20 DAS	30.20	1.92	9.35	1.153	2.694	41.14	785.15	360.45	0.85
T_6 –Pendimethalin 1.0 kg ha^{-1} as PE *fb* imazethapyr 100 g ha^{-1} at 20 DAS	34.60	2.18	9.42	1.532	3.096	21.80	1021.29	555.92	1.19
T_7 -Pendimethalin 1.0 kg ha^{-1} as PE *fb* fenoxaprop-p-ethyl 80 g ha^{-1} at 20 DAS.	35.70	2.21	9.47	1.697	3.206	13.37	1121.12	656.96	1.42
T_8 -Pendimethalin 1.0 kg ha^{-1} as PE *fb* quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS	35.70	2.22	9.48	1.786	3.401	8.83	1181.14	711.23	1.51
T_9- Pendimethalin 1.0 kg ha^{-1} as PE *fb* halosulfuron 67.5 g ha^{-1} at 20 DAS	32.00	2.02	9.37	1.372	2.887	29.96	919.80	465.78	1.03
T_{10}-Pendimethalin 1.0 kg ha^{-1} as PE *fb* hand weeding at 40 DAS.	36.00	2.24	9.49	1.798	3.419	8.22	1188.87	648.85	1.2
T_{11}-Pendimethalin 1.0 kg ha^{-1} as PE *fb* weeding by wheel hoe at 40 DAS	34.80	2.20	9.45	1.642	3.154	16.18	1087.14	605.83	1.26
T_{12}-Weed free (hand weeding twice at 20 and 40 DAS).	38.84	2.27	9.52	1.959	3.619	-	1290.49	672.11	1.09
T_{13}-Weedy check.	29.00	1.53	8.94	0.647	1.880	66.97	457.28	44.34	0.11
SEm ±	1.25	0.11	0.22	0.053	0.168	1.63	31.79	20.08	0.09
CD (P=0.05)	3.66	0.33	NS	0.154	0.491	4.76	92.77	58.61	0.26

PE: Pre-emergence, *fb*: Followed by, DAS: Days after sowing,SEm: Standard error of mean, CD: Critical difference

ha^{-1}), net return (44.34 $ ha^{-1}) and benefit: cost ratio (0.11) among the treatments was realized under weedy check condition as a result of higher crop weed competition which reduced the soybean yield significantly.

CONCLUSION

Based on this experiment it can be concluded that two hand weeding at 20 and 40 DAS reduced weed population and weed dry matter production in soybean field and thus recorded higher yield attributes and yield of soybean. However from the economic point of view and labor shortage condition during critical period of crop weed competition of soybean, pendimethalin 1.0 kg ha^{-1} as PE *fb* quizalofop-p-ethyl 50 g ha^{-1} at 20 DAS was considered superior and may be suggested to realize higher yield, net return and benefit: cost ratio especially under grassy weed particularly *Sorghum halepense* dominated field condition.

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