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Effect of various weed management practices on wheat productivity under new alluvial zone

D. MUKHERJEE

Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya
Mohanpur-741252, Nadia, West Bengal

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ABSTRACT

A field experiment was conducted at District Seed Farm (AB Block), Kalyani under Bidhan Chandra KrishiViswavidyalaya during winter season of 2014 and 2015 in upland situation to study the effect of various weed management practices on the growth and yield of wheat. The experiment was carried out in a randomized block design with fourteen treatments in three replications. Amongst various integrated weed management practices, total weed density and dry weight at 30 days after sowing (DAS) lowest observed with the hoeing (20 DAS) + fenoxaprop ethyl @ 100g a.i.ha^{-1}, and showed parity with the stale seed bed fb 2,4 DEE @ 750 g a.i ha^{-1} and pendimethalin + hoeing at 20 DAS. However at 60 DAS, minimum weed population registered with hoeing (20 DAS) + metribuzin @175 g a.i.ha^{-1}, and was at par with the hoeing (20 DAS) + sulfosulfuran @ 25 g a.i ha^{-1} and stale seed bed fb 2,4 DEE @ 750 g a.i ha^{-1}. Total dry weight of weed at 60 DAS, least found with the hoeing (20 DAS) + metribuzin @175 g a.i.ha^{-1} and statistically similar with the stale seed bed fb 2,4 DEE @ 750g a.i. ha^{-1}, and notably better to all other treatments. LAI was considerably affected by various weed control measures and maximum LAI at 50 and 70 DAS, registered with the weed free situation and its showed parity with the hoeing (20 DAS) + metribuzin @175 g a.i.ha^{-1}, and considerably better to all other set of treatments. Amid various yield attributing characters, highest number of effective tillers registered with the weed free situation, and was at par with the hoeing (20 DAS) + sulfosulfuran @ 25 g a.i.ha^{-1}, hoeing (20 DAS) + metribuzin @175g a.i.ha^{-1} and stale seed bed fb 2,4 DEE @ 750 g a.i.ha^{-1}). Highest grain yield was observed with the weed free situation (3.92 t ha^{-1}), and was at par with the hoeing (20 DAS) + metribuzin @175 g a.i.ha^{-1}(3.78 t ha^{-1}) and hoeing (20 DAS) + sulfosulfuran @ 25 g a.i.ha^{-1} (3.56 t ha^{-1}). Nutrient uptake by crop and weeds, were significantly influenced by various treatments and maximum nutrient absorbed by weed free and hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}). Amongst various treatments, highest B:C ratio recorded with the hoeing (20 DAS) + metribuzin @175 g a.i.ha^{-1} (2.03) and was closely followed by stale seed bed fb 2,4 DEE @ 750g a.i.ha^{-1} (2.01).

***Keywords*: Herbicide, weed, wheat yield**

Wheat is an important winter cereal of India. NEPZ (north eastern plain zone) is not a traditional wheat growing area in India. However, at present, this crop has become a staple food crop next to rice and its consumption is gradually increasing because of change in food habit and economic prosperity. In spite of a wide range of adoptability, little attention has been paid towards wheat production and maximization of yield potential of this crop in this state (West Bengal, Bihar, Jharkhand *etc*.) and its share to national production is less than 1%. Productivity of 2.8 t ha^{-1} is also far below the national average of 3.14 t ha^{-1} (Anon. 2012-13). Wheat sowing time varies from October to December with temperature range of 10 to 32^{0}C. In life cycle of wheat all stages of development are sensitive to temperature (Satbhai *et al*., 2016). Weed growth become quite favorable under this temperature range. Amongst the various agronomic practices, weed control measure plays a significant role in maximizing the crop yield and productivity and help to maintain food basket (Mukherjee, 2005). Weeds are the major bottlenecks in realizing potential yield of wheat. Uncontrolled weeds are reported to cause up to 62 per cent reduction in wheat grain yield (Mukherjee, 2012) or even more depending upon the weed density, type of weed flora and duration of infestation. Chemical weed control is a preferred practice due to scarce and costly labour as well as lesser feasibility of mechanical or manual weeding (Singh *et al*., 2003). Further, sole chemical application for weed control become less effective, if weed could not be controlled at the initial growth phase of crop, particularly at the first irrigation stage of crop. Under such situation, a suitable combination of hoeing operation with clodinafop, fenoxaprop ethyl, sulfosulfuran, and metribuzin was needed. Combination of different herbicide have been recommended against complex weed flora, however some time its feasibility become question mark on succeeding crop sequence. With these facts in mind, intercultural operation (*i.e*. hoeing, hand weeding etc.) along with suitable dose of herbicide

Email: dhiman_mukherjee@yahoo.co.in

become an effective measure for broad spectrum weed control in wheat field. Hence, the present investigation was carried out to evaluate the efficacy of different herbicide either alone or combination with other intercultural method against mixed weed flora in wheat under new alluvial zone of West Bengal.

MATERIALS AND METHODS

The field experiment was conducted at District Seed Farm (AB Block), Kalyani under Bidhan Chandra KrishiViswavidyalaya during winter season of 2014 and 2015 in upland situation. The farm is situated at approximately 22°56´N latitude and 88°32´E longitude with an average altitude of 9.75 m above mean sea level (MSL). The soil of the experimental field was loamy in texture and almost neutral in reaction having pH 7.2, organic carbon 0.43per cent, available nitrogen 232.8kg, available phosphorus 23.6 kg and available potassium 233.6 kg ha^{-1}. The experiment was carried out in a randomized block design, replicated in thrice with fourteen treatment combination (*viz*. hoeing (20 and 40 DAS), pendimethalin (@1 kg a.i.ha^{-1}), clodinafop (@ 60 g a.i ha^{-1}), fenoxaprop ethyl (@ 100g a.i.ha^{-1}, sulfosulfuran (@ 25 g *a.i*.ha^{-1}), metribuzin (@175 g a.i.ha^{-1}), stale seed bed fb 2,4 DEE (@ 750 g a.i.ha^{-1}), pendimethalin + hoeing at 20 DAS, hoeing (20 DAS) + clodinafop (@ 60 g a.i.ha^{-1}), hoeing (20 DAS) + fenoxaprop ethyl (@ 100g a.i.ha^{-1}), hoeing (20 DAS) + sulfosulfuran (@ 25 g *a.i*.ha^{-1}), hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}), weed free and weedy check). Amongst all the treatments combination stale seed bed fb 2,4 DEE (@ 750 g a.i.ha^{-1}) was an effective weed control measure, mostly practices by progressive farmers. Wheat cultivar K 0307 was used for this experiment. The sowing of crop was done on 28th November, 2014 and 25th November, 2015 with recommended seed rate of 100 kg ha^{-1} using 150 kg N, 60 kg P_2O_5 and 40 kg K_2O ha^{-1}.All herbicide treatments were applied 28 days after sowing (DAS) except pendimethalin which was applied 3 DAS, with the help of knapsack sprayer fitted with flat fan nozzle at spray volume of 500 l ha^{-1}. Weed population and weed dry weight were recorded at 30 and 60 DAS by placing a quadrate of 50 x 50 cm randomly at two spots in each plot. Data on weed count and weed dry weight were subjected to square root transformation before statistical analysis. The uptake of major nutrients in weed was worked out by multiplying per cent nutrient content with dry matter accumulation at harvest. The dry matter was then computed in terms of kg ha^{-1}. The dried crop seed and straw samples were subjected to nitrogen, phosphorus and potassium content as per standard procedure (Lindner, 1944; Richards, 1968 and Jackson, 1973, respectively). The uptake of N, P and K by wheat was worked out by multiplying their content in grain and straw with yield, respectively, and the total uptake was computed by summing up the uptakes by grain and straw. The experimental data were analyzed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance of overall difference among treatments by the F test and conclusions were drawn at 5 per cent probability level (Gomez and Gomez, 1984). Benefit: cost ratio (B: C) was obtained by dividing the gross income with cost of cultivation. The effect of treatments was evaluated on pooled analysis basis on yield attributes, yields, nutrient uptake and economics.

RESULTS AND DISCUSSION

All the weed control measures significantly influence weed population at 30 and 60 DAS (days after sowing). Amongst various treatments, minimum grassy weed population was registered with hoeing (20 DAS) + fenoxaprop ethyl (@ 100g a.i. ha^{-1}) and was considerably better to all other control measures except weed free situation. Least broad leaf weeds (BLW) population at 30 DAS were found with hoeing (20 DAS) + fenoxaprop ethyl (@ 100g a.i. ha^{-1}) and pendimethalin+ hoeing at 20 DAS and were significantly better to all other treatments except stale seed bed fb 2,4 DEE (@ 750g a.i.ha^{-1}) and weed free situation. At 30 DAS, least dry weight of grasses was observed with the stale seed bed fb 2,4 DEE (@ 750 g a.i.ha^{-1}) and was at par with the weed free situation and statistically superior to all other integrated weed management practices. Least dry weight of BLW at 30 DAS, recorded with weed free situation and was at par with the stale seed bed fb 2,4 DEE (@ 750 g a.i.ha^{-1}) and hoeing (20 DAS) + fenoxaprop ethyl (@ 100g *a.i*.ha^{-1}) and statistically better to rest of the treatments. Grassy weed population at 60 DAS, lowest recorded with hoeing (20 DAS) + clodinafop (@ 60 g a.i.ha^{-1}) and showed parity with the hoeing (20 DAS) + fenoxaprop ethyl (@ 100 g a.i.ha^{-1}) and clodinafop (@ 60 g a.i.ha^{-1}). BLW at 60 DAS, lowest observed with the stale seed bed fb 2,4 DEE (@ 750 g a.i.ha^{-1}) and significantly better to all other treatments except weed free situation. Further, table 1 revealed that amongst various weed control measures, dry weight of grasses at 60 DAS, was least with the stale seed bed fb 2,4 DEE (@ 750 g a.i.ha^{-1}) and was statistically similar with pendimethalin + hoeing at 20 DAS, hoeing (20 DAS) + clodinafop (@ 60 g *a.i*.ha^{-1}), hoeing (20 DAS) + fenoxaprop ethyl (@ 100g a.i.ha^{-1}), hoeing (20 DAS) + sulfosulfuran (@ 25 g a.i.ha^{-1}) and hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}). Dry weight of BLW at 60 DAS, least found with the stale seed bed fb 2,4 DEE (@ 750 g a.i. ha^{-1}) and was at par with the hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}), and significantly

Table 1: Effect of treatments on weed density and dry weight at different stages (pooled)

Treatments	Density of weeds (no. m^{-2})				Dry wt. of weeds (g m^{-2})				Total weed population (no. m^{-2})		Total dry wt. of weeds (g m^{-2})	
	30 DAS		60 DAS		30 DAS		60 DAS					
	Grasses	BLW	Grasses	BLW	Grasses	BLW	Grasses	BLW	30 DAS	60 DAS	30 DAS	60 DAS
Hoeing (20 & 40 DAS)	3.32 (7.98)	4.17 (13.47)	6.74 (38.90)	5.31 (23.11)	1.95 (2.11)	1.91 (1.98)	4.02 (12.36)	3.64 (9.89)	5.13 (21.45)	8.37 (62.01)	2.52 (4.09)	5.22 (22.25)
Pendimehtalin @1 kg *a.i.*ha^{-1}	3.55 (9.31)	3.89 (11.51)	5.12 (21.36)	6.55 (36.55)	1.59 (1.19)	1.96 (2.13)	3.48 (8.89)	4.01 (12.33)	5.06 (20.82)	8.11 (57.91)	2.32 (3.32)	5.11 (21.22)
Clodinafop @ 60 g *a.i.*ha^{-1}	3.83 (11.11)	4.64 (17.11)	4.82 (18.65)	7.44 (48.11)	2.03 (2.33)	3.45 (8.68)	4.41 (15.32)	4.26 (14.11)	5.81 (28.22)	8.67 (66.76)	3.82 (11.01)	5.92 (29.43)
Fenoxaprop ethyl @ 100 g *a.i.*ha^{-1}	4.02 (12.38)	4.48 (15.88)	5.35 (23.56)	6.13 (31.69)	2.45 (3.81)	2.53 (4.11)	3.35 (8.11)	3.61 (9.66)	5.82 (28.26)	7.93 (55.25)	3.31 (7.92)	4.72 (17.77)
Sulfosulfuran @ 25 g *a.i.* ha^{-1}	3.74 (10.53)	4.78 (18.33)	5.45 (24.55)	6.57 (36.87)	2.60 (4.43)	3.18 (7.18)	3.23 (7.44)	3.75 (10.58)	5.87 (28.86)	8.34 (61.42)	3.91 (11.61)	4.74 (18.02)
Metribuzin @175 g *a.i.*ha^{-1}	3.63 (9.77)	4.38 (15.03)	5.99 (30.11)	6.91 (41.03)	1.92 (2.01)	2.65 (4.61)	3.35 (8.11)	4.26 (14.11)	5.48 (24.81)	8.93 (71.14)	3.07 (6.62)	5.21 (22.22)
Stale seed bedfb 2,4 DEE @ 750 g *a.i.* ha^{-1}	2.76 (5.12)	1.33 (0.69)	5.53 (25.32)	4.46 (15.69)	1.27 (0.59)	0.80 (0.09)	2.55 (4.21)	2.87 (5.61)	2.91 (5.81)	6.90 (41.01)	1.32 (0.68)	3.63 (9.82)
Pendimethalin+ hoeing at 20 DAS	2.53 (4.11)	2.04 (2.36)	5.12 (21.35)	5.43 (24.33)	1.60 (1.22)	1.52 (1.05)	2.88 (5.66)	3.50 (8.98)	3.04 (6.47)	7.26 (45.68)	2.01 (2.27)	4.33 (14.64)
Hoeing (20 DAS) +clodinafop @ 60 g a.i. ha^{-1}	3.17 (7.11)	3.55 (9.32)	4.29 (14.33)	6.80 (39.65)	1.92 (2.03)	2.28 (3.16)	2.74 (5.02)	4.04 (12.56)	4.55 (16.43)	7.85 (53.98)	2.78 (5.19)	4.69 (17.58)
Hoeing (20 DAS) + fenoxaprop ethyl @ 100g *a.i.* ha^{-1}	1.95 (2.11)	2.04 (2.36)	4.69 (17.56)	7.48 (48.69)	1.51 (1.02)	0.94 (0.19)	2.55 (4.22)	4.94 (19.69)	2.61 (4.47)	8.64 (66.25)	1.60 (1.21)	5.39 (23.91)
Hoeing (20 DAS) + sulfosulfuran @ 25 g *a.i.* ha^{-1}	2.37 (3.56)	3.17 (7.11)	4.97 (19.96)	4.78 (18.32)	2.03 (2.33)	2.25 (3.08)	3.07 (6.63)	2.95 (5.98)	3.83 (11.07)	6.69 (38.28)	2.83 (5.41)	4.05 (12.61)
Hoeing (20 DAS) + metribuzin @175 g *a.i.* ha^{-1}	3.17 (7.11)	3.83 (11.12)	4.85 (18.90)	4.15 (13.33)	1.76 (1.58)	2.38 (3.52)	2.64 (4.58)	2.24 (3.02)	4.77 (18.23)	6.18 (32.23)	2.76 (5.21)	3.26 (7.16)
Weed free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
Weedy check	10.23 (94.65)	9.32 (77.78)	13.50 (168.98)	14.75 (203.03)	5.63 (26.36)	4.92 (19.55)	7.16 (44.33)	9.34 (78.12)	13.63 (172.43)	19.79 (372.01)	7.28 (45.91)	11.57 (122.45)
SEm (±)	**0.15**	**0.26**	**0.19**	**0.21**	**0.21**	**0.18**	**0.22**	**0.24**	**0.17**	**0.49**	**0.25**	**0.32**
LSD (0.05)	**0.42**	**0.76**	**0.58**	**0.70**	**0.54**	**0.39**	**0.59**	**0.66**	**0.48**	**1.48**	**0.69**	**0.95**

Note: Data were subjected to square root transformation, Figures in parentheses indicate original values

Table 2: Effect of treatments on WCE, WI, growth and yield wheat (pooled)

Treatments	**Weed control efficiency (%)**		**Weed index (%)**	**Plant height (cm)**	**LAI**		**Effective tiller ($no.m^{-2}$)**	**Earhead length (cm)**	**Grain yield ($t\ ha^{-1}$)**	**Total biomass production ($t\ ha^{-1}$)**
	30 DAS	**60 DAS**			**50 DAS**	**70 DAS**				
Hoeing (20 & 40 DAS)	91.11	81.83	47.03	76.32	2.09	2.69	173.38	8.64	2.23	4.33
Pendimehtalin @1 kg *a.i.*ha^{-1}	92.85	82.74	33.25	80.64	2.48	2.96	179.37	9.24	2.81	4.85
Clodinafop @ 60 g *a.i.*ha^{-1}	76.04	76.07	39.19	79.53	2.19	2.68	164.17	7.95	2.56	5.12
Fenoxaprop ethyl @ 100 g *a.i.*ha^{-1}	82.71	85.58	46.56	76.53	2.11	2.55	171.93	8.44	2.25	4.15
Sulfosulfuran @ 25 g *a.i.* ha^{-1}	74.70	85.36	28.50	82.34	2.51	3.04	175.65	8.72	3.01	5.69
Metribuzin @175 g *a.i.*ha^{-1}	85.64	81.91	44.42	81.11	2.11	2.62	165.21	7.16	2.34	5.25
Stale seed bedfb 2,4 DEE @ 750 g *a.i.* ha^{-1}	98.56	92.07	18.29	87.32	2.80	3.20	186.68	8.86	3.44	6.02
Pendimethalin+ hoeing at 20 DAS	95.17	88.01	19.00	86.11	2.39	3.01	177.33	9.71	3.41	6.39
Hoeing (20 DAS) + clodinafop @ 60 g a.i. ha^{-1}	88.74	85.66	41.81	74.14	2.64	3.23	158.33	8.34	2.45	5.14
Hoeing (20 DAS) + fenoxaprop ethyl @ 100g *a.i.* ha^{-1}	97.44	80.51	32.30	78.67	2.92	3.26	168.33	8.15	2.85	5.63
Hoeing (20 DAS) + sulfosulfuran @ 25 g *a.i.* ha^{-1}	88.21	89.73	15.44	81.02	2.89	3.29	194.28	9.39	3.56	6.09
Hoeing (20 DAS) + metribuzin @ 175 g *a.i.* ha^{-1}	88.96	93.84	10.21	86.34	3.06	3.68	190.19	8.97	3.78	7.06
Weed free	1100.00	100.00	-	89.66	3.19	3.96	207.37	9.14	4.21	7.11
Weedy check	-	-	57.24	74.19	2.04	2.39	151.11	8.56	1.80	4.11
SEm (±)	**2.01**	**2.23**	**3.98**	**1.69**	**0.05**	**0.08**	**9.05**	**0.98**	**0.14**	**0.23**
LSD (0.05)	**5.64**	**6.11**	**9.45**	**4.05**	**0.17**	**0.29**	**26.52**	**NS**	**0.39**	**0.73**

Table 3: Effect of different treatments on nutrient uptake by plant and economics of wheat (pooled)

Treatments	Nutrient uptake by crop ($kg\ ha^{-1}$)			Nutrient uptake by weeds ($kg\ ha^{-1}$)			Cost of cultivation (000, ₹ ha^{-1})	Net returns (000, ha^{-1})	B: C ratio
	N	P	K	N	P	K			
Hoeing (20 & 40 DAS)	444.12	12.21	42.36	8.51	1.51	7.01	34.25	21.48	1.63
Pendimehtalin @1 kg *a.i.*ha^{-1}	667.14	16.34	58.85	5.90	0.93	4.21	26.78	22.89	1.85
Clodinafop @ 60 g *a.i.*ha^{-1}	663.31	15.43	57.13	6.84	1.16	5.12	27.87	22.01	1.79
Fenoxaprop ethyl @ 100 g *a.i.*ha^{-1}	550.16	13.22	48.51	8.23	1.44	6.78	26.25	21.54	1.82
Sulfosulfuran @ 25 g *a.i.* ha^{-1}	770.21	17.28	58.25	3.11	0.79	3.06	27.65	25.08	1.91
Metribuzin @175 g *a.i.*ha^{-1}	555.23	14.1	51.26	8.02	1.21	6.32	25.87	22.51	1.87
Stale seed bedfb 2,4 DEE @ 750 g *a.i.* ha^{-1}	779.94	18.18	61.23	2.61	0.51	2.30	28.09	30.08	2.01
Pendimethalin+ hoeing at 20 DAS	777.59	17.96	60.27	2.81	0.71	2.36	30.65	29.54	1.96
Hoeing (20 DAS) + clodinafop @ 60 g a.i. ha^{-1}	559.64	15.11	55.38	7.12	1.43	5.62	30.89	21.06	1.68
Hoeing (20 DAS) + fenoxaprop ethyl @ 100g *a.i.* ha^{-1}	768.70	16.86	59.05	4.53	0.81	3.54	29.81	23.50	1.79
Hoeing (20 DAS) + sulfosulfuran @ 25 g *a.i.* ha^{-1}	880.26	17.69	65.52	3.75	0.59	2.21	31.84	28.07	1.88
Hoeing (20 DAS) + metribuzin @175 g *a.i.* ha^{-1}	82.37	18.34	67.54	2.55	0.45	1.91	29.50	30.21	2.03
Weed free	886.89	19.89	70.83	0.00	0.00	0.00	41.04	31.31	1.76
Weedy check	440.65	11.23	41.56	22.11	4.01	15.36	24.57	16.94	1.69
SEm (±)	**2.87**	**1.01**	**2.36**	**0.42**	**0.11**	**0.35**			
LSD (0.05)	**6.98**	**3.75**	**7.95**	**1.15**	**0.29**	**1.01**			

better to all other treatment except weed free situation. Amongst various integrated weed management practices, total weed density and dry weight at 30 DAS, lowest observed with the hoeing (20 DAS) + fenoxaprop ethyl (@ 100g a.i.ha^{-1}) and showed parity with the stale seed bed fb 2,4 DEE (@ 750 g a.i.ha^{-1}) and pendimethalin + hoeing at 20 DAS. With the perusal of table 1 revealed that, with various integrated weed control measures, total weed population at 60 DAS, lowest registered withhoeing (20 DAS) + metribuzin @175 g a.i.ha^{-1}, and was at par with the hoeing (20 DAS) + sulfosulfuran @ 25 g a.i.ha^{-1} and stale seed bed *fb* 2,4 DEE @ 750g a.i. ha^{-1}. Total dry weight of weed at 60 DAS, lowest found with the hoeing (20 DAS) + metribuzin @175g *a.i.*ha^{-1} and statistically similar with the stale seed bed fb 2,4 DEE (@ 750g a.i. ha^{-1}), and notably better to all other weed management practice (Table 1).

Amongst various integrated weed management practices, highest WCE at 30 DAS registered with the stale seed bed fb 2,4 DEE @ 750 g a.i ha^{-1} and was at par with the hoeing (20 DAS) + fenoxaprop ethyl @ 100g a.i.ha^{-1}, and pendimethalin + hoeing at 20 DAS. At 60 DAS, peak WCE found with the hoeing (20 DAS) + metribuzin @175 g a.i.ha^{-1} and showed parity with the hoeing (20 DAS) + sulfosulfuran @ 25 g a.i.ha^{-1}, pendimethalin + hoeing at 20 DAS and stale seed bed fb 2,4 DEE (@ 750 g a.i. ha^{-1} (Table 2). However, lowest weed index was registered with the hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}) and showed parity with hoeing (20 DAS) + sulfosulfuran @ 25 g a.i. ha^{-1}, stale seed bedfb 2,4 DEE @ 750 g a.i. ha^{-1} and pendimethalin + hoeing at 20 DAS.

With growth parameter, maximum plant height was observed with the weed free situation and was at par with the hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}), and considerably better to all other weed control measures. A perusal of data on LAI presented in table 2 reveals that the LAI was significantly affected by various weed control measures. LAI varied from 2.04 to 3.19 at 50 DAS and 2.39 to 3.96 at 70 DAS. With various treatments, maximum LAI at 50 and 70 DAS, registered with the weed free situation and its showed parity with the hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}), and significantly better to all other set of treatments. The results are in consistent with the findings of Angiras and Sharma (1996) who noted that the LAI significantly varies with different treatments, because of its influence in reducing the weed biomass and weed growth rate and increasing CGR of the crop. Singh *et al*. (2005) had also reported similar results.Amid various yield attributing characters, utmost number of effective tillers registered with the weed free situation, and was at par with the hoeing (20 DAS) + sulfosulfuran (@ 25 g a.i ha^{-1}), hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}) and stale seed bedfb 2,4 DEE (@ 750 g a.i. ha^{-1}), and statistically superior to all other control measures. Earhead length failed to produce any major response with various weed control measures, however, highest ear length found with the pendimethalin + hoeing at 20 DAS and was followed by weed free situation. Maximum grain yield was observed with the weed free situation (3.92 t/ha), and was at par with the hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}) (3.78 t ha^{-1}) and hoeing (20 DAS) + sulfosulfuran (@ 25 g a.i ha^{-1}) (3.56 t ha^{-1}). Higher grain yield of wheat was owing to effective control of weeds and higher growth and yield attribute of wheat. This corroborate with the finding of Kumar *et al*. (2013). Lowest grain yield was recorded with the weedy check (1.80 t ha^{-1}), and was 117.7, 110.2 and 97.7 % less grain yield compared to weed free, hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}) and hoeing (20 DAS) + sulfosulfuran(@ 25 g a.i. ha^{-1}) treatments, respectively (Table 2). Highest total biomass production registered with the weed free situation (3.92 t/ha), and was at par with the hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}) (3.78 t ha^{-1}) and pendimethalin + hoeing at 20 DAS (6.39 t ha^{-1}). These treatments gave 72.9, 71.7 and 55.4 per cent more biomass yield compared to weedy check plot, which registered least biomass yield.

Nutrient uptake by crop and weeds, were significantly influenced by various weed management practices (Table 3). Highest nitrogen uptake by wheat crop was registered with the weed free situation and was at par with the hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}), hoeing (20 DAS) + sulfosulfuran (@ 25 g a.i. ha^{-1}) and stale seed bed fb 2,4 DEE (@ 750 g a.i. ha^{-1}). Amongst various weed control measures, utmost uptake of phosphorus recorded with the hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}), and was at par with the weed free situation, hoeing (20 DAS) + sulfosulfuran (@ 25 g a.i. ha^{-1}), hoeing (20 DAS) + fenoxaprop ethyl (@ 100g a.i.ha^{-1}) and stale seed bedfb 2,4 DEE (@ 750 g a.i. ha^{-1}). With various weed control treatments, more uptake of potassium recorded with the hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}), and was at par with the weed free situation, hoeing (20 DAS) + sulfosulfuran (@ 25 g a.i. ha^{-1}), pendimethalin + hoeing at 20 DAS and stale seed bed fb 2,4 DEE (@ 750 g a.i. ha^{-1}).Nutrient uptake by weeds, differ significantly with various control measures. Highest uptake of all primary nutrients, registered with the weedy check, and statistically poor to all other control measures. Lowest nitrogen uptake by weeds was registered with the hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}) and was at par with the hoeing (20 DAS) + sulfosulfuran (@ 25 g a.i. ha^{-1}). Further, least phosphorus and potassium consumption by weeds was observed with hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}) and was at par with the hoeing (20 DAS) + sulfosulfuran (@ 25 g a.i. ha^{-1}), stale seed bedfb 2,4 DEE (@ 750 g a.i. ha^{-1}) and pendimethalin + hoeing at 20 DAS (Table 3). Due to higher grain and total biomass production, owing to effective weed control, hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}) resulted in highest net return. This was followed by stale seed bedfb 2,4 DEE (@ 750 g a.i. ha^{-1}) and hoeing (20 DAS) + sulfosulfuran (@ 25 g *a.i.* ha^{-1}). Amongst various treatments, highest B:C ratio recorded with the hoeing (20 DAS) + metribuzin (@175 g a.i.ha^{-1}) (2.03) and was closely followed by stale seed bed fb 2,4 DEE (@ 750 g a.i. ha^{-1}) (2.01).

Hoeing at 20 DAS + metribuzin @175g a.i.ha^{-1} gave maximum wheat yield and was followed by hoeing at 20 DAS + sulfosulfuran @ 25g a.i. ha^{-1} and stale seed bed *fb* 2,4 DEE @ 750g a.i. ha^{-1}. These treatments gave higher growth and yield attributes along with higher yield indicating better resource utilization in good weed management practices.

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