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Short communication

Effect of herbicides on weeds, grain yield and soil health in wheat

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The productivity wheat (*Triticum aestivum* L.) in eastern Uttar Pradesh is very low due to the continuous adoption of cereal-cereal (rice-wheat) cropping system, poor weed management, poor soil health and imbalance fertilizer use. Weed reduce wheat yield up to 60% if not controlled at the critical stages of crop (Angiras *et al.* 2008). Chemical weed control is a preferred practice due to unavailability of labour and high labour costs. Also there is lesser feasibility of mechanical or manual weeding in wheat. There is a need to evaluate such molecules of herbicides, which are safe to soil health. The effect of herbicide application on soil health (microbial environment) is a great concern as it may affect the microbial growth (Kumar *et al.* 2014). Continued application of large quantities of herbicides may bring about lasting changes in soil micro flora, and affecting its fertility level, respectively (Rangaswami and Bagyaraj 2004). Keeping all these view, the present investigation was carried out to find out herbicidal effect on soil health and yield of wheat.

The field experiment was conducted during *Rabi* 2014-15 at Narendra Deva University Agriculture & Technology, Kumarganj, Faizabad (UP). The soil of the experimental field was silt loam having pH 8.1, EC 0.23 dSm, organic carbon 3.1 g/ kg, available N 120 kg/ha, available P 16.5 kg/ha, available K 247 kg/ha, bacteria 37.14 cfu/g, fungi 11.38 cfu/g and actinomycetes 8.19 cfu/g respectively. The experiment was laid out in a randomized block design with three replications having 12 treatments, *viz*. isoproturon 1.0 kg/ha, sulfosulfuron 0.025 kg/ha, metribuzin 0.2 kg/ha, clodinafop 0.06 kg/ha, pendimethalin + metribuzin (1.0+0.175 kg/ha), pendimethalin + sulfosulfuron (1.0+0.018 kg/ha), sulfosulfuron + metsulfuron (0.03 + 0.002 kg/ha), pinoxaden + metsulfuron (0.06 + 0.004 kg/ha), mesosulfuron + idosulfuron (0.012 + 0.0024 kg/ha), clodinafop + metsulfuron (0.06 + 0.004 kg/ha), two hand weeding and unweeded control. Wheat variety '*PBW-502'* was sown on 9th December 2014 in rows at 20 cm apart using seed rate at 125 kg/ha. Recommended dose of fertilizers 120:60:60 kg N:P;K/ha and herbicides were applied as per treatments. Growth, yield and weed density were recorded after harvesting the crop. Rhizospheric soil sample were collected randomly from the top layers of the soil depth (0-15 cm) from each plot for soil health studies by using standard methods.

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Effect on weed density and yield of crop

Among different herbicides, application of pendimethalin + metribuzin 1.0 + 0.175 kg/ha followed by pendimethalin + sulfosulfuron 1.0 + 0.018 kg/ha were found better on plant height (62.40 and 61.30 cm) and grain yield [4.24 and 4.16 t/ha] of wheat. However minimum weed density (50.29/m) was also recorded in the same treatment. This may be due to effective control of weeds under this treatment.

Different weed control treatments increased N, P and K uptake over unweeded control (**Table 1**). Among different weed control measures, maximum uptake of N (102.41 kg/ha), P (23.73 kg/ha) and K (130.20 kg/ha) was recorded under T_5. It might be due to the fact that herbicides reduced crop-weed competition and enhanced the availability of nutrients (Singh *et al.* 2015).

Weed control measures did not affect the physical, chemical and microbial properties of soil significantly after harvesting the crop (**Table 2**). However, the microbial population (bacteria, fungi and actinomycetes) at 50 DAS were affected due to application of herbicides. But after harvest of the crop, there was no toxic effect on microbial population. This was mainly due to degradation of herbicides by micro-organism and degraded products serves as a carbon and energy sources due to which at harvest stage microbial population tended to improve. Among different weed control management, two hand weeding recorded maximum microbial population. This might be due to effect of aeration and sunlight into the soil with intercultural operation. Tiwari *et al.* (2012) and Priya *et al.* (2015) also reported the similar results.

Table 1. Herbicidal effect on plant height, no. of tillers, weed density, grain yield, B:C ratio and nutrient uptake of wheat.

Treatment	Plant height (cm)	No. of tillers/ plant	Weed density at 60 DAS ($m^{/2}$)	Grain yield (t/ha)	B-C ratio	Nutrient uptake (kg/ha)		
						N	P	K
Isoproturon 1.0 kg/ha	56.90	4.65	(92.42) 9.67	3.23	1.41	76.46	16.85	101.1
Iulfosulfuron 0.025 kg/ha	57.40	5.10	(92.38) 9.66	4.47	1.55	82.50	17.99	106.0
Metribuzin 0.2 kg/ha	57.10	4.92	(111.66) 10.66	3.34	1.47	77.61	16.97	102 3
Clodinafop 0.06 kg/ha	56.20	4.50	(97.66) 9.93	3.31	1.39	77.58	16.78	100.8
Pendimethalin + metribuzin (1.0 + 0.175 kg/ha)	62.40	5.92	(50.29) 7.16	4.24	1.95	102.41	23.73	130.2
Pendimethalin + sulfosulfuron (1.0 + 0.018 kg/ha)	61.30	5.80	(56.93) 7.61	4.16	1.93	98.35	22.87	128.1
Sulfosulfuron + metsulfuron (0.03 + 0.002 kg/ha)	60.10	5.75	(65.30) 8.14	3.97	1.84	93.03	21.40	121.5
Pinoxaden + metsulfuron (0.06 + 0.004 kg/ha)	60.20	5.72	(76.74) 8.82	3.84	1.76	89.12	20.27	118.3
Mesosulfuron + idosulfuron (0.012 + 0.0024 kg/ha)	58.70	5.50	81.68) 9.09	3.80	1.69	89.93	19.71	116.8
Clodinafop + smetsulfuron (0.06 + 0.004 kg/ha)	58.10	5.34	(82.27) 9.13	3.78	1.67	89.62	19.60	115.9
Two hand weeding	63.50	6.06	(0.00)1.00	4.47	1.83	107.48	25.48	134.1
Unweeded control	55.70	4.20	(199.4)14.15	2.86	1.20	64.67	14.30	90.6
LSD (p=0.05)	3.95	1.14	-	.385	-	1.55	0.80	2.2

Table 2. Herbicidal effect on physical properties of soil, nutrient available and microbial population of wheat

Treatment	Physical properties of soil (After harvest)				Available nutrient (kg/ha) (After harvest)			Microbial population (gm soil)					
								Bacterial (cfu x 10^7)		Fungi (cfu x 10^4)		Actinomycetes (cfu x 10^4)	
	Bulk density (g/cm^3)	pH	EC (dSm)	O C (g/kg)	N	P	K	50 DAS	After harvest	50 DAS	After harvest	50 DAS	After harvest
Isoproturon 1.0 kg/ha	1.33	8.05	0.23	3.2	126.7	17.2	234.1	22.5	27.7	4.5	7.8	4.1	6.2
Iulfosulfuron 0.025 kg/ha	1.31	8.10	0.24	3.4	128.6	17.9	236.5	23.6	28.4	5.2	8.5	4.2	6.3
Metribuzin 0.2 kg/ha	1.32	8.05	0.21	3.1	127.8	17.2	235.6	23.4	28.2	4.9	8.2	4.1	6.2
Clodinafop 0.06 kg/ha	1.33	8.05	0.23	3.2	125.9	16.8	233.4	21.5	26.0	4.2	7.1	3.9	6.0
Pendimethalin + metribuzin (1.0 + 0.175 kg/ha)	1.28	8.20	0.22	3.5	134.0	19.0	242.8	29.8	34.6	7.2	10.5	5.7	7.8
Pendimethalin + sulfosulfuron (1.0 + 0.018 kg/ha)	1.28	8.20	0.23	3.5	133.9	18.9	241,5	29.5	34.5	6.4	9.5	5.4	7.5
Sulfosulfuron + metsulfuron (0.03 + 0.002 kg/ha)	1.29	8.10	0.24	3.4	132.4	18.7	240.0	28.2	34.2	6.2	9.5	5.1	7.2
Pinoxaden + metsulfuron (0.06 + 0.004 kg/ha)	1.30	8.05	0.25	3.2	131.7	18.6	239.5	26.4	32.5	5.7	9.0	4.9	7.0
Mesosulfuron + idosulfuron (0.012 + 0.0024 kg/ha)	1.30	8.05	0.21	3.3	131.1	18.3	238.7	25.5	32.0	5.4	8.7	4.7	6.8
Clodinafop + smetsulfuron (0.06 + 0.004 kg/ha)	1.31	8.10	0.22	3.3	129.8	18.2	237.1	24.1	30.2	5.1	8.5	4.4	6.5
Two hand weeding	1.27	8.00	0.25	3.6	135.2	19.2	244.5	43.5	45.9	11.5	11.7	8.3	8.7
Unweeded control	1.34	8.10	0.22	3.2	124.5	16.7	232.2	39.8	41.2	11.2	11.4	8.1	8.2
LSD (p=0.05)	NS	NS	NS	NS	2.3	1.4	1.9	1.34	0.90	1.01	0.96	0.69	0.82

SUMMARY

Application of pendimethalin + metribuzin 1.0 + 0.175 kg/ha was found most suitable for increasing growth, yield, nutrient uptake and economics. However, two hand weeding was found most effective for improving soil health. Microbial population was found affected at 50 DAS it was gain increased by the harvest time. hand weeding recorded maximum population.

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