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Participatory Evaluation of Herbicides in Wheat in Western Terai, Nepal

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ABSTRACT

The yield losses due to weeds vary depending on the weed species, their density and environmental factors. For controlling weeds in wheat, the farmers rely on herbicides due to cost and time effectiveness. Keeping these facts in view a field experiment was conducted to identify appropriate herbicides for controlling weeds in wheat. The experiment was carried out at three locations of Kapilvastu, Rupandehi and Nawalparasi during 2016/17 and 2017/18. Pendimethalin 30 EC, Sulfosulfuron 30 g a.i ha^{-1} and control treatments were evaluated in the field of six farmers in an area of 330 m^2 for each treatment and were replicated six times. Wheat variety Tilottama was planted in the experiment. The fertilizer was applied at the rate of 100:50:50 N: P_2O_5: K_2O kg ha^{-1}. Weed populations were recorded at 30, 60 and 90 days after sowing in an area of 0.25 m^{-2} at three spots of each treatment and growth, yield attributes and yield data of wheat were collected and data were analyzed using Genstat statistical package. In 2016/17 Pendimethalin 1 kg a.i. ha^{-1} and Sulsosulfuron @ 25 g a.i. ha^{-1} and control (no herbicide spray) treatments were significantly difference for plant height, spike m^{-2} and grain yield but not significant for spike length and 1000 grains weight at Bimiha, Bhagdari and Nadawa sites. Both herbicides were found effective in controlling weed population. Whereas in 2017/18 Pendimethalin 30 EC. 1 kg a.i. ha^{-1} as pre-emergence and sulfosulfuron 30 g a.i. ha^{-1} as post emergence herbicides were found effective to suppress weed population. Plant height, spike length and 1000 grains weight variables were not significant but spikes m^{-2} and grains yield were significant Based on the pooled results it could be concluded that Pendimethalin 1 kg a.i. ha^{-1} and Sulsosulfuron @ 25 g a.i. ha^{-1} herbicides were found effective in controlling weed population and increased yield attributes and yield in wheat crop over weedy check

Keywords: Grain yield, weed management, weed population, wheat

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INTRODUCTION

Wheat (*Triticum aestivum* L) is the third major cereal crop after rice and maize in Nepal. It plays a major role in national food security. In Nepal, wheat covered 707505 hectares and produced 2185289 metric ton with a productivity of 3.09 Mt ha^{-1} (MoAD 2021). It is grown in the Terai, mid hill and high hills during the winter season. The increased wheat production was mainly due to the adoption of short stature high yielding varieties, increased fertilizers use, irrigation and herbicides. The high nutrient and water requirements along with the less competitive nature of these high-yielding dwarf varieties have provided a conducive environment for increased weed infestation. Weeds are regarded as most disdain to crop production and account for about one-third of total losses caused by all the pests. Weed infestation is one of the major factors limiting crop productivity. For realizing the full genetic yield potential of the crop, proper weed control is one of the essential ingredients. Weeds not only reduce the yield but also make the harvesting operation difficult. Therefore, for sustaining food grain production to feed ever the increasing population and ensuring food security, effective weed management is very essential. Competition by weeds for soil moisture, mineral nutrients and solar radiation are major constraints in enhancing wheat productivity. Uncontrolled weeds in wheat remove 30-40 kg N, 10-20 kg P and 20-40 kg ha^{-1} from soil (Mishra and Gupta 1995). Chemical weed control in wheat was best in producing a higher grain yield than hand weeding. Akhtar et al (1991) found that the application of grassy and broad leaf herbicides increased grain yield and yield components. Keeping this fact in view, field experiment was planned to control weeds and enhance productivity in wheat.

MATERIALS AND METHODS

The field experiment was conducted at rural municipality Suddodhan-6, Bimiha Kapilvastu, Siyari-2, Bhagdari, Rupandehi and Ram gram municipality-16, Nadawal, Nawalparasi. Pendimethalin 30 EC, Sulfosulfuron 30 g. a.i ha^{-1} and control treatments were evaluated in six farmers' fields in the area of $330m^2$ for each treatment and farmers were treated as replications. The released wheat variety Tilottama was planted on 5^{th} and 8^{th} Mansir during 2073/74 and 2074/75 respectively. 120 kg ha^{-1} seed was used for this variety. Chemical fertilizers were applied @ of 100:50:50 $N:P_2O_5:K_2O$ kg ha^{-1}. Fifty % nitrogen, a full dose of phosphorus and potash were applied during planting and the remaining 50% nitrogen was applied in two splits. First irrigation was applied 25 days after sowing. Weed management practices were followed as per treatments. Weed data were recorded using a quadrate of 0.25 m^{-2}. The weed population was counted in three spots of each treatment at 30, 60 and 90 days after sowing. Weed populations data were transformed using the square root transformation formula before statistical analysis. Growth, yield and yield attributing parameters spikes number m^{-2}, panicle length, plant height, 1000-grain weight and grain yield were recorded. The collected data were analyzed using GenStat statistical package. Mean data were compared at 0.05 % probability level.

RESULTS AND DISCUSSION

During 2073/74, pendimethalin 1 kg a.i. ha^{-1} and Sulsosulfuron @ 25 g a.i. ha^{-1} and control (no herbicide spray) treatments were significantly different for plant height, spike m^{-2} and grain yield but not significant for spike length and 1000 grains weight at Bimiha, Bhagdari and Nadawa sites. Pendimethalin 1 kg a.i. ha^{-1} and Sulsosulfuron @ 25 g a.i. ha^{-1} were comparable but statistically superior over control in production of plant height, spike m^{-2} and grain yield at all three locations (Table1, 2 and 3). Whereas weed population were significantly different at

30, 60 and 90 days after sowing in different weed management practices. Pendimethalin 1 kg a. i. ha^{-1} and Sulfosulfuron 30 g a.i. ha^{-1} were found effective to control weed population (Table 4). Kumar et al (2007) also reported that the application of Sulfosulfuron @ 25 g a.i. ha^{-1} reduced density and dry weight of weed to the extent of 70% at different growth stages of wheat. Similarly, Punia et al (1996) also concluded in their studies that different herbicides lowered weed density. The results of the experiment are given in the tables below.

Table 1. Influences of different herbicides on yield attributes and yield of wheat at Bimiha, Kapilvastu, 2073/074

Treatment	Plant height (cm)	Spikes m^{-2}	Spike length (cm)	1000 grain weight (gm)	Grain yield (kg ha^{-1})
Pendimethalin	94.4	305	12.3	43.3	4486
Sulfosulfuron	96.5	287	11.3	43.7	4117
Control	89.3	235	11.5	42.7	3343
F-test	**	**	ns	ns	**
LSD (<0.05)	2.19	33.0	1.5	2.68	267.7
CV (%)	1.0	5.2	5.6	2.7	3.0

Table 2. Influences of different herbicide on yield attributes and yield of wheat at Bhagdari, Rupandehi, 2073/074

Treatment	Plant height (cm)	Spikes m^{-2}	Spike length (cm)	1000 grain weight (gm)	Grain yield (kg ha^{-1})
Pendimethalin	89.7	309	10.3	44.1	4155
Sulfosulfuron	88.3	291	11.0	43.2	4258
Control	85.0	266	10.0	43.0	3160
F-test	**	**	ns	ns	**
LSD (<0.05)	2.92	18	1.2	1.9	423.1
CV (%)	1.5	2.8	3.2	2.2	4.8

Table 3. Influences of different herbicide on yield attributes and yield of wheat at Nadawa Nawalparasi, 2073/074

Treatment	Plant height (cm)	Spikes m^{-2}	Spike length (cm)	1000 grain weight (gm)	Grain yield (kg ha^{-1})
Pendimethalin	89.4	312	10.3	43.1	4400
Sulfosulfuron	87.1	298	9.7	42.6	4050
Control	82.3	265	10.5	40.2	3200
F-test	**	**	ns	ns	**
LSD (p<0.05)	3.4	39.3	1.4	2.3	446.2
CV %	1.7	8.5	6.1	2.4	5.1

Table 4. Influences of different herbicides on weed populations during 2073/074

Treatment	Weed populations (0.25 m^2)								
	Kapilvastu			NawalParasi			Rupandehi		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
Pendimethalin	2.8 (8)	2.8 (8)	2.5 (6)	4.4 (19)	4.2 (18)	2.9 (8)	4.2 (18)	3.57 (12.7)	2.63 (7)
Sulfosulfuron	10.9 (124)	6.5 (46)	6.3 (40)	16.6 (275)	7.1 (51)	6.2 (40)	12.2 (158)	5.47 (30.7)	6.33 (40)
Control	11.1 (127)	12.6 (161)	10.4 (108.3)	16.4 (269)	9.8 (98.7)	8.6 (76)	12.3 (157)	10. 7 (114)	10.43 (109)
F-test	**	**	**	**	*	*	*	*	**
LSD (<0.05)	3.31	3.64	1.9	1.05	3.15	2.82	5.28	2.54	2.28
CV (%)	16.7	22.1	13.1	3.7	19.7	21.0	23.4	17.0	16.6

Note: Data in the parentheses indicates original values

In 2074/75 results showed that Pendimethalin 30 EC.1 kg a.i. ha^{-1} as pre-emergence and Sulfosulfuron 30 g a.i. ha^{-1} as post-emergence herbicides were found effective to suppress weed population (Table-8). Plant height, spike length and 1000 grains weight were not significant but spikes m^{-2} and grains yield were significant at Bimiha, Kapilvstu. Whereas, at Bhagdari, Rupandehi and Nadawa, Nawalparasi, plant height was not affected but the rest of the variables were found to be affected. Spike m^{-2} and grain yield variables were significant differences. Pendimethalin 30 EC. 1 kg a.i. ha^{-1} and Sulsosulfuron 30 g. a.i. ha^{-1} were comparable for grain yield across three locations but statistically superior over control (Table 5, 6 and 7). In pooled analysis during 2073/74 and 2074/75, plant height, spike length, and thousand kernel weight variables were not significant but spikes m^{-2} and grain yield variables were significantly affected by herbicide treatments. Pendimethalin 30 EC. 1 kg a.i. ha^{-1} and Sulsosulfuron treatments were at par but both treatments were superior over control for spikes m^{-2} and grain yield production. The weedy check produced lesser spikes due to competition with wheat for available resources resulting in lesser tillers. Baldha et al (1998) and Sohail et al (1993) also reported similar results. They observed that the application of herbicides significantly influenced the number of tillers m^{-2}. Similarly, the increased yield in herbicide-treated plots was due to efficient weed control and thus the crop utilized all the available resources. The higher grain yield was also reported in herbicide-treated plots by Tanveer et al (1993), Hassan et al (2003) and Tunio et al (2004).

Table 5. Influences of different herbicides on yield attributes and yield of wheat at Bimiha, Kapilvastu, 2074/075

Treatments	Plant height (cm)	Spikes m^{-2}	Spike length (cm)	1000 grain weight (gm)	Grain yield (kg ha^{-1})
Pendimethalin	90.1	263	12.0	39.43	3053
Sulfosulfuron	91.2	308	11.13	41.9	3550
Control	88.9	225	11.47	41.57	2857
F-test	ns	**	ns	ns	**
LSD (<0.05)	8.62	29.9	1.67	5.05	310.8
CV (%)	4.2	5.0	6.4	5.4	4.3

Table 6. Influences of different herbicide on yield and yield attributes at Bhagdari, Rupandehi, 2074/075

Treatments	Plant height (cm)	Spikes m^{-2}	Spike length (cm)	1000 grain weight (gm)	Grain yield (kg ha^{-1})
Pendimethalin	89.67	301	11.86	40.33	3495
Sulfosulfuron	88.67	298	11.16	39.67	3477
Control	88.33	266	10.56	39	3143
F-test	ns	**	**	*	**
LSD (<0.05)	1.19	15.97	0.57	0.92	157.2
CV (%)	0.6	2.4	2.2	1.0	2.1

Table 7. Influences of different herbicide on yield and yield attributes at Nadawa Nawalparasi, 2074/075

Treatments	Plant height (cm)	Spikes m^{-2}	Spike length (cm)	1000 grain weight (gm)	Grain yield (kg ha^{-1})
Pendimethalin	89.33	303	11.86	40.0	3712
Sulfosulfuron	88.67	283	11.3	39.67	3512
Control	86.67	236	10.8	38.67	2745
F-test	ns	*	*	*	**
LSD (<0.05)	2.87	31.12	0.49	0.75	342.1
CV (%)	1.4	8.2	1.9	0.8	4.3

Table 8. Influences of different herbicides on weed populations at during 2074/75

Treatment	Weed populations (0.25 m^2)								
	Kapilvastu			Nawalparasi			Rupandehi		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
Pendimethalin	4.27 (18.3)	4.84 (23)	5.34 (28.3)	2.94 (8.3)	3.68 (13.3)	3.93 (15.3)	3.55 (12.7)	4.19 (17.3)	4.4 (19.3)
Sulfosulfuron	9.35 (87)	4.71 (22)	4.93 (24)	9.99 (99.3)	3.53 (12)	3.89 (14.7)	10.89 (120.3)	4.18 (17)	4.52 (20)
Control	10.63 (115.3)	13.08 (171.3)	13.49 (181.7)	11.09 (122.7)	12.36 (152.3)	12.64 (159.3)	11.45 (132.7)	13.37 (178.7)	13.68 (186.7)
F-test	**	**	**	**	**	**	**	**	**
LSD (<0.05)	2.96	2.16	1.58	1.11	1.04	0.89	3.32	1.56	0.62
CV (%)	16.2	12.7	8.9	6.2	7.1	5.8	17	9.5	3.7

Note: Data in the parentheses indicates original value

CONCLUSIONS

Based on the two-year's results inference can be made that Pendimethalin @1 kg a.i. ha^{-1} and Sulsosulfuron @ 25 g a.i. ha^{-1} can effectively control the weeds and increase the grain yields of wheat.

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AUTHORS' CONTRIBUTION

Mathura Yadav formulated the project and prepared the manuscript. Bisheswor Prasad Pandey, Narayan Khatri and Vishnu Prasad Chaurasiya carried out field experiments and contributed to manuscript preparation

CONFLICTS OF INTEREST

The authors have no any conflict of interest to disclose.

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