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Short Communication

Bio-efficacy and phytotoxicity of glyphosate 41% SL on weed flora and its effect on soil microbial activities in non-cropped area

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ABSTRACT

A field experiment was conducted during *Kharif* 2019 at the Research Farm of Department of Agronomy, College of Agriculture CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, to study the bio-efficacy and phytotoxicity of glyphosate 41% SL in non-cropped areas. The experiment was laid out in Randomised Block Design with three replications and consisted of eight weed control treatments including glyphosate 41% SL @ 1.0, 2.0, 3.0, and 4.0 Lha^{-1}, glyphosate 71% SG @ 3.0 kg ha^{-1}, glyphosate (Monsanto) @ 2.0 kg ha^{-1}, and weedy and weed free checks. Major weeds noted were *Imperata cylindrica, Paspalum conjugatum*, *Erigeron canadensis, Cynodon dactylon, Ageratum conyzoides,* and *Polygonum alatum*. The results revealed that on the non-cropped land, weeds can be controlled effectively with the application of glyphosate 41% SL @ 3.0 L ha^{-1} and 4.0 L ha^{-1}, with the least effect on microbial population.

Keywords: Glyphosate, weed control, non-cropped land, microbial activity.

INTRODUCTION

Weeds present one of the greatest challenges to natural resource management. They can alter entire communities and ecosystems, substantially degrading important ecosystem services such as forage for wild and domestic herbivores, water and soil quality, recreational values, and wildlife habitat. Traditionally weed management in natural areas has focused on removing the target weed under the assumption that its impacts would dissipate and the system would recover following control or suppression of the invader. Weeds reduce the quantity and the stand life of desirable forage plants in pastures. These unwanted plants are often more aggressive than existing or desired forage species and compete for light, water, and nutrients. In later stages of maturity, weeds can also reduce the quality and palatability of the forage available for livestock grazing. In the early vegetative stage of growth, many weeds have nutritive values which may be in certain cases equal to or greater than the desired forages. However, the forage qualities of weeds decline rapidly as the plants mature. In Himachal Pradesh non-cropped land occupies about 80% of the geographical area due to the unique physiographical features of the state (Rana *et al.* 2015). Glyphosate and paraquat are the most commonly used herbicides in non-cropped areas to free them from obnoxious vegetation. Therefore, the present study was planned to study the bioefficacy of glyphosate 41% SL (All Clear) on weed flora in the non-cropped area and to study its effects on microbial activity.

MATERIALS AND METHODS

A field investigation was carried out at the Experiment Farm of Department of Agronomy of CSKHPKV, Palampur (32°6′ N, 76°3′) during *Kharif* 2019. The experimental site was established on non-cropped land, the soil of which was silty clay loam in texture, acidic in reaction (pH 5.6), low in available nitrogen (245.8 kg ha^{-1}), and medium in available phosphorus (18.8 kg ha^{-1}), and potassium (210 kg ha^{-1}). Eight weed control treatments consisting viz, glyphosate 41% SL 1.0 L ha^{-1}, 2.0 L ha^{-1}, 3.0 L ha^{-1}, and 4.0 L ha^{-1}, glyphosate 71% SG 3.0 kg ha^{-1}, glyphosate 41% SL (Roundup of Monsanto Company), weed-free check, and weedy check were tested in Randomized Block Design with three replications. Herbicides were applied using 600 liters of water/ha with a flat fan nozzle attached to a Knapsack sprayer as per schedule. Weed count and weed dry weight were recorded from two spots using a quadrate of 50 x 50 cm and expressed as number and g/m^2, respectively. The data on weed count and weed dry weight were subjected to square root transformation ($\sqrt{x+0.5}$).

Weed control efficiency was calculated as per the formula given by Mishra and Tosh (1979).

$$\textit{Weed control of efficiency}\,(\%) = \frac{DWC - DWT}{DWC} \times 100$$

Where, DWC is the weed dry weight (g m-^{2}) in the control plot, and DWT is the weed weight (g m^{-2}) in the treated plot.

RESULTS AND DISCUSSION

The dominant weed flora in the experimental area consisted of *Imperata cylindrica, Paspalum conjugatum*, *Erigeron canadensis, Cynodon dactylon, Ageratum conyzoides,* and *Polygonum alatum*. A similar type of flora has been observed by Angiras (2014) in pasturelands under the mid-hill conditions of Himachal Pradesh. Different weed control treatments significantly influenced the total weed density at different stages of observations (Table 1). Significantly lowest weed count was recorded in the weed-free check while the highest value was recorded in weedy check at all the stages of observations (Table 1). At 30 days after spray, glyphosate 41% SL 3.0 L ha^{-1} behaved statistically similar to glyphosate 41% SL 4.0 L ha^{-1}, glyphosate 71% SG 3.0 kg ha^{-1}, and weed-free check, resulted in significantly lower weed density as compared to other treatments. Glyphosate 41% SL at 2.0 kg ha^{-1}and glyphosate (Roundup) 2.0 kg ha^{-1} were the next best treatments in this regard. Similarly, at 45 days after spray, glyphosate 41% SL 4.0 L ha^{-1} behaved statistically similar to glyphosate 41% SL 3.0 L ha^{-1}, glyphosate 71% SL 3.0 kg ha^{-1}, glyphosate (roundup) 2.0 L ha^{-1}, and weed-free check resulted in significantly lower total weed density as compared to other treatments. Whereas at 60 days after spray, glyphosate 41% SL 4.0 L ha^{-1} behaving statistically alike with weed-free check recorded significantly lower weed density as compared to other weed control treatments. Glyphosate 41% SL 3.0 L ha^{-1} and glyphosate 71%

Table 1. Effect of weed control treatments on total weed count (No./m^2) and total dry weight (g/m^2) accumulation by weeds at different stages in non – cropped area

Treatment	Dose (g/ha)	Weed count (No./m^2)				Weed dry weight (g/m^2)			
		Before spray	30 DAS	45 DAS	60 DAS	Before spray	30 DAS	45 DAS	60 DAS
Glyphosate 41% SL	1.0 L ha^{-1}	11.1 (122.7)	9.5 (89.3)	11.1 (122.7)	12.7 (161.3)	7.9 (61.5)	5.6 (30.5)	7.3 (51.8)	8.4 (70.0)
Glyphosate 41% SL	2.0 L ha^{-1}	11.2 (125.3)	2.5 (5.3)	3.7 (13.3)	5.7 (32.0)	7.9 (60.8)	1.7 (1.8)	2.7 (6.4)	3.9 (14.5)
Glyphosate 41% SL	3.0 L ha^{-1}	11.4 (129.3)	1.0 (0.0)	2.7 (6.7)	3.7 (13.3)	8.0 (62.4)	1.0 (0.0)	1.8 (2.1)	2.4 (4.9)
Glyphosate 41% SL	4.0 L ha^{-1}	11.1 (121.3)	1.0 (0.0)	1.8 (2.7)	1.0 (0.0)	7.9 (60.8)	1.0 (0.0)	1.4 (1.1)	1.0 (0.0)
Glyphosate 71% SG	3.0 kg ha^{-1}	11.0 (120.0)	1.0 (0.0)	2.3 (5.3)	4.4 (18.7)	7.7 (58.7)	1.0 (0.0)	1.7 (2.3)	3.1 (8.4)
Glyphosate 41% SL (Roundup of Monsanto)	2.0 L ha^{-1}	10.4 (108.0)	2.3 (5.3)	2.9 (8.0)	5.6 (30.7)	7.5 (55.8)	1.7 (2.0)	2.3 (4.5)	4.0 (15.1)
Weedy Check	Untreated control	11.1 (122.7)	12.6 (157.3)	14.1 (197.3)	16.0 (256.0)	7.8 (60.5)	9.0 (79.7)	10.5 (109.2)	11.6 (133.8)
Weed free check		11.1 (123.3)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	8.0 (62.3)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)
CD 5%		NS	0.86	1.16	0.98	NS	0.37	0.56	0.46

Values in the parenthesis are the means of original values; Data subjected to $\sqrt{x+1}$ square root transformation; DAS= Days after spray.

Table 2. Effect of weed control treatments on weed control efficiency (%) in non-cropped area

Treatment	Dose (g/ha)	Weed control efficiency			Count (x 10^3 CFU / g soil)		
		30 DAS	45 DAS	60 DAS	Bacteria	Actinomycetes	Fungi
Glyphosate 41% SL	1.0 L ha^{-1}	61.7	52.5	47.6	44.0	17.5	10.4
Glyphosate 41% SL	2.0 L ha^{-1}	97.7	94.1	89.1	43.2	17.8	9.5
Glyphosate 41% SL	3.0 L ha^{-1}	100	98.0	96.3	42.2	16.6	8.6
Glyphosate 41% SL	4.0 L ha^{-1}	100	98.9	100	41.5	16.5	8.0
Glyphosate 71% SG	3.0 kg ha^{-1}	100	97.8	93.7	42.1	16.2	8.0
Glyphosate 41% SL (Roundup of Monsanto)	2.0 Litre/ha	97.4	95.8	88.7	42.9	17.4	9.6
Weedy Check	Untreated control	-	-	-	45.0	17.6	12.3
Weed free check		100	100	100	45.6	17.8	11.9
Initial value		-	-	-	44.5	16.8	12.0

SG 3.0 kg ha^{-1} were the next best treatments in this regard. This might be due to the translocative nature of glyphosate which allows this herbicide to move throughout the plant to kill all meristems. Similar findings have also been reported by Bhowmick (2010) for effective control of a wide range of weeds by glyphosate.

Weed biomass was also significantly influenced by different weed control treatments at all the stages of observation (Table 1). All the weed control treatments were significantly superior in reducing the weed biomass as compared to weedy check at all the stages of observations. Post-emergence application of glyphosate 41% SL 4.0 L ha^{-1} behaving statistically alike with glyphosate 41% SL 3.0 L ha^{-1}, glyphosate 71% SG 3.0 kg ha^{-1} and weed-free check resulted in significantly lower weed biomass as compared to other treatments at 30 and 45 days after application. However, at 60 DAS this treatment behaved statistically alike with weed-free check only. These findings are in close conformity with the findings of Corbet *et al* (2004). Maximum weed control efficiency was recorded with glyphosate 41% SL 4 L ha^{-1} and weed-free check. However, all the doses of glyphosate (tested and check) except glyphosate 41% SL 1.0 L ha^{-1} recorded weed control efficiency of more than 90% indicating effective control of weeds (Table 2). These results conform with the findings of Kumar and Ghosh (2015). The data on soil microbial activities at 30 days after spray revealed that there was a negligible decrease in microbial population and the same will recover with time.

CONCLUSION

The study indicated that weeds in non-cropped land can be controlled effectively with glyphosate 41% SL 3.0 and 4.0 kg ha^{-1} with the least effect on microbial population.

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