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Short Communication

Efficacy of GOD H007 formulation on weeds in grasslands of Himachal Pradesh

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Abstract

A field experiment was conducted during *kharif* 2019 at the Research Farm of Department of Agronomy, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, to study the efficacy of new herbicide combination product GOD H007 (containing glyphosate 40% and pyrithiobac sodium 3%) for managing weeds in grasslands. The experiment was laid out in Randomised Block Design with three replications, and consisted of seven weed control treatments viz., GOD H007 at 860, 882 and 903 g/ha, pyrithiobac sodium 62.5 g/ha, glyphosate 820 g/ha, hand weeding and a weedy check. Application of this new herbicide combination product GOD H007 903 g/ha though remaining statistically alike with glyphosate 820 g/ha, resulted in significantly lowest total weed density and total weed dry matter at all the stages of observation except that at 30 days after spray (DAS) at which hand weeding proved to be a superior treatment. These three treatments also recorded higher weed control efficiency. However, significantly highest fresh and dry herbage yield at 60 DAS was recorded with the application of pyrithiobac sodium 62.5 g/ha. Application of this new herbicide GOD H007 903 g/ha showed promise to be effective for managing weeds in grassland.

Key words: GOD H007, weed control, grass land, glyphosate, pyrithiobac sodium.

Weeds are unwanted plants that interfere with the growth of desired plant species and human interests at a particular place and time. Weeds can reduce the quantity and the stand of desirable forage plants in grasslands. 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. However, not all weeds are detrimental to grasslands. In the early vegetative stage of growth, many weeds have nutritive values which may, in certain cases, be equal to or even greater than the desired forages. However, the forage qualities of weeds decline rapidly as the plants mature. All over the world grasslands are reported to be infested heavily with perennial weeds which are difficult to control. Grazing based livestock husbandry plays an important role in the rural economy of Himachal Pradesh and hence it is important to control these obnoxious vegetation so as to maintain the productivity of these grasslands. Glyphosate and paraquat are most commonly used herbicides in grasslands to free them from obnoxious vegetation. However, newer products are required to be developed and recommended to broaden the spectrum of weed control especially so when some of the prevalent herbicides are facing imminent bans by union government. GOD H007 is a new herbicide combination product containing glyphosate and pyrithcobac sodium which has been formulated to broaden the target group of weeds controlled by this product. The individual components of this combination product glyphosate and pyrithiobac sodium inhibit the activation of enzymes 5-enol pyruvylshikimate-3-phosphate synthase (EPSPS) and acetolactate synthase, respectively both of which are required for protein synthesis, thereby offering good control of target weed species. Both of these herbicides have been separately recommended for non-selective post-emergence control of wide

range of weeds in grasslands but little information is available with regards to their efficacy when used in combination. In view of the above facts the present investigation was undertaken to study the efficacy of this new combination product GOD H007 for controlling weeds in an established grassland.

A field investigation was carried out in established grassland located at the Experiment Farm of Department of Agronomy of CSKHPKV, Palampur ($32^0$6' N latitude, $76^0$3'E longitude) during *kharif* 2019. The soil of the experimental site was silty clay loam in texture, acidic in reaction (pH 5.6), low in available nitrogen (235 kg/ha), and medium in available phosphorus (16.9 kg/ha) and potassium (198 kg/ha). Seven weed control treatments consisting of three doses of this new herbicide combination product GOD H007 860, 882 and 903 g/ha, pyrithiobac sodium 62.5 g/ha, glyphosate 820 g/ha, hand weeding and weedy check were tested in Randomized Block Design with three replications. Herbicides were applied using 600 liters of water/ha with a flat fan nozzle attached to a knapsack sprayer as per treatment. Weed count and weed dry weight were recorded from two spots using a quadrate of 50 x 50 cm and expressed as number and g/m^2, respectively. The data on weed count and weed dry weight were subjected to square root transformation ($\sqrt{x+0.5}$) before statistical analysis, which was done as per Gomez and Gomez (1984). Weed control efficiency was calculated as per formula given by Mishra and Tosh (1979).

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

where: DWC- Weed dry weight (g/m^2) in control plot, and

DWT- Weed dry weight (g/m^2) in treated plot

The dominant weed flora in the experimental area consisted of *Imperata cylindrica, Plantago lanceolata, Phylanthus niruri, Erigeron canadensis, Cynodon dactylon, Trifolium repens, Bidens pilosa, Ageratum conyzoides and Cerastium fountanum*. Similar type of flora has also been observed by Angiras (2014) in grasslands under mid hill condition of Himachal Pradesh. Different weed control treatments significantly influenced the total weed count at different stages of observation (Table 1), except at the start of the experiment at which all treatments were at par with each other. Significantly lowest total weed count at 15 days after spray (DAS) was recorded in hand weeding treatment while highest value was recorded in weedy check. Among the herbicide treatments, application of GOD H007 903 g/ha had significantly lower total weed count while pyrithiobac sodium 62.5 g/ha recorded significantly higher total weeds count at 15 DAS. However at the later stages of observation (30 and 45 DAS) application of new combination product GOD H007 903 g/ha, remaining at par with glyphosate 820 g/ha, recorded significantly lower total weed count as compared to other treatments while at 60 DAS GOD H007 903 g/ha proved even better than glyphosate 820 g/ha. The lower doses of new combination product (860 and 882 g/ha) were not found to be that effective as its higher dose for controlling weeds in grassland. Pyrithiobac sodium 62.5 g/ha was least effective amongst all the herbicide treatments and resulted in significantly higher total weed count at all the stages. These findings are in close conformity with the findings of Corbett *et al* (2004).

Total weed dry weight followed the similar trend as the total weed count, with hand weeding recorded significantly lower weed dry weight at 15 DAS while at all the later stages of 30, 45 and 60 DAS, application of GOD H007 903 g/ha recorded significantly lowest total weed dry weight though this treatment was at par with glyphosate 820 g/ha at 30 and 45 DAS. Application of pyrithiobac sodium 62.5 g/ha proved least effective and recorded significantly higher total weed dry weight at all the stages of observation though even this treatment was significantly better than weedy check. The results so obtained can be attributed to the effective control of weeds with this new combination product containing glyphosate and pyrithiobac sodium, which when used together showed synergistic effect and resulted in reduced species wise weed density and biomass which ultimately resulted in significantly lower total weed count and weed biomass.

Weed control efficiency followed the trend similar to the total weed count and total weed dry weight with GOD H007 903 g/ha showing higher efficiency for controlling weeds at 30 DAS as well as at later stages followed by glyphosate 820 g/ha while pyrithiobac sodium recorded lowest weed control efficiency at all the stages of observation. This was because

Table 1. Effect of treatments on total weed count (No./m^2) and total weed dry weight (g/m^2) at different stages of observation

Treatment	Dose (g/ha)	Total weed Count (No/m^2)					Total weed dry weight (g/m^2)				
		Before spray	15 DAS	30DAS	45DAS	60DAS	Before spray	15 DAS	30DAS	45DAS	60 DAS
GOD H007 64.5% SG	860	16.76 (281.33)	11.95 (142.67)	10.82 (117.33)	12.07 (145.33)	14.53 (210.67)	14.29 (204.45)	10.03 (100.57)	8.43 (70.88)	9.65 (92.88)	11.98 (143.07)
GOD H007 64.5% SG	882	16.75 (280.00)	10.84 (117.33)	9.57 (92.00)	11.09 (122.67)	13.07 (170.67)	14.50 (209.77)	8.63 (74.17)	7.22 (51.68)	8.78 (76.59)	10.84 (117.03)
GOD H007 64.5% SG	903	16.79 (281.33)	8.80 (77.33)	7.33 (53.33)	8.58 (73.33)	10.98 (120.00)	15.03 (225.47)	6.82 (46.35)	5.08 (25.31)	6.09 (36.84)	8.64 (74.40)
Pyrithiobac sodium 10% EC	62.5	16.01 (256.00)	15.93 (253.33)	17.56 (308.00)	19.02 (361.33)	20.53 (421.33)	14.36 (205.97)	13.71 (187.37)	14.73 (216.52)	16.30 (265.32)	17.78 (315.71)
Glyphosate 41% SL	820	17.45 (305.33)	13.43 (180.00)	7.93 (62.67)	9.19 (84.00)	12.08 (145.33)	15.25 (232.76)	10.92 (118.89)	5.55 (30.47)	6.62 (43.77)	9.56 (91.19)
Hand weeding	-	17.63 (310.67)	7.05 (49.33)	12.98 (168.00)	16.08 (258.67)	18.56 (344.00)	15.45 (238.21)	4.34 (18.56)	8.33 (69.04)	12.83 (164.29)	15.70 (246.16)
Weedy check	-	16.45 (270.40)	17.86 (318.67)	20.40 (416.00)	22.23 (494.67)	23.62 (557.33)	14.40 (207.57)	15.12 (228.12)	16.77 (280.93)	18.83 (354.55)	20.17 (406.25)
SEm±		0.45	0.33	0.43	0.45	0.28	0.34	0.31	0.22	0.34	0.22
LSD (P=0.05)		NS	1.03	1.33	1.39	0.87	NS	0.94	0.67	1.04	0.67

Values in parentheses are the means of original values; Data transformed to square root transformation ($\sqrt{x+0.5}$); DAS: days after spray

pyrithiobac sodium is effective in controlling only broadleaved weeds with little or no effect on grassy weeds. Rest of the treatments were also superior to weedy check in terms of weed control efficiency.

The data on effect of different treatments on the fresh and dry herbage yield in grassland at 60 DAS has been given in Table 2 which reveals that application of pyrithiobac sodium 62.5 g/ha resulted in significantly highest fresh and dry herbage yield of grass. Application of lower dose of this new herbicide (860 g/ha) also gave higher fresh and dry herbage yield as compared to its higher doses of 882 and 903 g/ha. Hand weeding treatment resulted in significantly lowest fresh and dry herbage yield as the entire plot was cleared of all vegetation before the start of the trial. Pyrithiobac sodium effectively controlled the broad leaved weeds and had little effect on grasses and hence its application resulted in higher yield while glyphosate had adverse effect on both grassy and broad leaved weeds and hence lower yield when either glyphosate or this new product having glyphosate was applied.

The data on effect of different weed control treatments on chemical properties of soil (pH, electrical conductivity and available nitrogen, phosphorous and potassium) (Table 3) revealed that pH and EC was not significantly influenced by weed control treatments while the available nitrogen, phosphorous and potassium content at final stages of observation was significantly influenced. Significantly higher values of available N, P and K was recorded under GOD H007 903 g/ha through this treatment remained statistically similar with lower doses of this new combination product as well as glyphosate 820 g/ha. Application of these herbicides resulted in lowest weed biomass as well as herbage

Table 2. Effect of treatments on weed control efficiency (%) and herbage yield (q/ha) of associated grasses

Treatment	Dose (g/ha)	Weed control efficiency			Herbage yield (q/ha)	
		30DAS	45DAS	60DAS	Fresh	Dry
GOD H007 64.5% SG	860	74.77	73.80	64.78	110.63	52.53
GOD H007 64.5% SG	882	81.60	78.40	71.19	108.51	51.46
GOD H007 64.5% SG	903	90.99	89.61	81.69	106.24	50.31
Pyrithiobac sodium 10% EC	62.5	22.93	25.17	22.29	134.62	67.13
Glyphosate 41% SL	820	89.16	87.65	77.55	103.88	50.36
Hand weeding	-	75.42	53.66	39.41	75.76	35.99
Weedy check	-	0.00	0.00	0.00	85.62	44.44
SEm±		-	-	-	1.09	0.43
LSD (P=0.05)		-	-	-	3.36	1.32

DAS: days after spray

Table 3. Effect of treatments on chemical properties of grassland soil after the harvest of associated grasses

Treatment	Dose (g/ha)	pH	EC(ds/m)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
GOD H007 64.5% SG	860	5.25	0.18	239.65	18.01	158.33
GOD H007 64.5% SG	882	5.27	0.18	240.26	18.17	160.32
GOD H007 64.5% SG	903	5.28	0.18	241.19	18.35	163.94
Pyrithiobac sodium 10% EC	62.5	5.23	0.18	238.58	17.75	157.71
Glyphosate 41% SL	820	5.27	0.18	241.10	18.30	163.05
Hand weeding	-	5.20	0.18	237.07	17.44	156.74
Weedy check	-	5.23	0.18	234.57	17.29	156.04
SEm±		0.03	0.01	0.78	0.24	1.37
LSD (P=0.05)		NS	NS	2.41	0.73	4.23

yield which resulted in lower uptake of all the three nutrients and hence higher content of these nutrients in soil.

The data on the effect of different treatments on biological properties of soil (Table 4) revealed significant influence on bacterial, fungal and actinomycetes count at the final stages of observation. Application of GOD H007 903 g/ha and glyphosate 820 g/ha resulted in significantly higher count of bacteria, fungi and actinomycetes in soil while lower values were recorded in weedy check and hand weeding treatment. Application of this new herbicide combination product as well as glyhosate was effective in killing the weeds as well as grasses and these microbes flourished on the dead biomass of weeds as well as grasses. The results also indicate that the new herbicide combination product is safe for the soil microbes.

From the present study it can be concluded that this herbicide combination product GOD H007 903 g/ha can be effectively used for controlling weeds in grasslands.

Conflicts of interest: The authors declare that they have no conflict of interest in this paper.

Table 4. Effect of treatments on soil biological properties of grassland soil after the harvest of associated grasses

Treatment	Dose (g/ha)	Bacteria (CFU×10^5/g of soil)	Fungi (CFU×10^4/g of soil)	Actinomycetes (CFU×10^4/g of soil)
GOD H007 64.5% SG	860	81.00	47.67	51.67
GOD H007 64.5% SG	882	82.33	48.33	56.00
GOD H007 64.5% SG	903	85.33	54.67	60.00
Pyrithiobac sodium 10% EC	62.5	77.67	47.00	52.67
Glyphosate 41% SL	820	84.33	54.33	59.67
Hand weeding	-	77.00	43.33	50.67
Weedy check	-	76.33	43.00	50.00
SEm±	0.96	1.74	1.14	
LSD (P=0.05)	2.95	4.73	7.74	

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