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Short communication

Control of purple nutsedge (*Cyperus rotundus* L.) using glyphosate and 2,4-D sodium salt

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Abstract

An experiment was conducted to investigate the efficacy of two systemic herbicides, viz., glyphosate and 2,4-D Na salt at varying doses and combinations for the control of purple nutsedge (*Cyperus rotundus* L). The lowest dose (1.5 kg ai ha^{-1}) of both herbicides gave complete control of shoot growth and there was no re-growth up to six weeks after spraying. Tuber dry weights also showed drastic reduction following herbicide application and glyphosate at 2.0 kg ai ha^{-1} recorded the least values. Data on tuber germination, however, indicated probable reinfestation, necessitating repeated application or the use of herbicidal mixtures for a complete kill of the weed.

Key words: Herbicidal mixtures, systemic herbicide, tuber germination, tuberisation

Nutgrass or purple nutsedge (*Cyperus rotundus* L.) is a persistent and prolific weed occurring in the agricultural areas of tropics and subtropics. Its growth habit and mode of propagation pose special problems for control. Although hand weeding and deep digging are generally adopted as control measures, sprouts reappear within 48 h of hand weeding and/or deep digging. A wide range of herbicides in disparate quantities have been tried for nutsedge control, including glyphosate, a non-selective translocated, post-emergent herbicide capable of controlling perennial weeds with complex underground vegetative systems. Yet, location-specific studies on nutsedge control are not available from southern Kerala and hence the present study was undertaken to standardize the herbicidal treatments for effective control of this pernicious weed.

The field experiment was conducted at the College of Agriculture, Vellayani during September-December, 1998. The soil of the experimental site was kaolinitic isohyperthermic Rhodic Haplustox. The site was cleared and plots of 5 x 4 m were laid out in three replications. For getting homogeneous nutsedge populations, uniformly sized tubers were dug out from the infested fields and planted at a spacing of 15 cm in 20 cm rows to obtain approximately 400 plants per plot. The experimental variables included three concentrations of glyphosate (1.5, 2.0 and 2.5 kg ai ha^{-1})—with and without $(NH_4)_2SO_4$, three levels of 2, 4-D Na salt (1.5, 1.75 and 2.0 kg ai ha^{-1})—with and without urea, and three combinations of glyphosate+2,4-D Na salt, along with an unweeded check (Table 1). The treatments were arranged in a randomized block design. Aqueous herbicidal solution was sprayed uniformly over the foliage of nutsedge one month after planting (6-8 leaf stage) using a pneumatic sprayer with flood-jet nozzle. For this, the spray volume was worked out after calibration and the herbicide quantities were calculated as per the experiment protocol (Table 1). Observations on fresh and dry weights of shoot and tuber were taken at weekly intervals. To test the germination potential of tubers after spray, 10 tubers per treatment were collected randomly, at both 30 and 45 days after spraying and were germinated in petri-dishes.

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Although during the first two weeks after spraying none of the herbicide treated plots showed any significant effect on shoot dry weight (range: 0.91 to 1.87 and 0.65 to 2.11 g m^{-2} respectively at one and two weeks after spraying), there was drastic reduction in all herbicide-treated plots at three weeks after treatment compared to the control (Table 1). Furthermore, shoot dry weight was 'zero' in plots treated with glyphosate at 1.5 and 2.5 kg ai ha^{-1}, 2,4-D at 1.75 kg ai ha^{-1} +1% urea and the glyphosate+2,4-D combinations. By the fourth week, however, all herbicide treatments recorded complete foliage kill, whereas the weedy check recorded significant shoot dry matter accumulation. Earlier, Thakur et al. (1993) also observed that glyphosate and 2,4-D (1.0 and 1.5 kg ai ha^{-1}) killed purple nutsedge and checked regeneration up to 360 days after spraying.

Tuber dry weights from the treated plots were comparable to that of unsprayed plot initially (first week of spraying). At later stages, however, all herbicide treated plots recorded drastic reduction in tuber dry weights (Table 1). From this, it could be deduced that when treated with the herbicides, further tuberisation is probably prevented. Indeed, the tubers rotted and crumbled making it impossible to collect them. Beltrao et al. (1983) also reported similar observations.

Furthermore, there was a significant reduction in the germination of tubers collected from the treated plots at 30 days after spraying (0 to 32% for the herbicide-treated plots as against 91% in the control; Table 1). For the tubers collected at 45 days, however, there was an increase in the germination percentage, implying that the herbicidal control of the weed may be temporary. The results, nevertheless, show that herbicides consistently prevented the sprouting of tubers and such effects were more pronounced in the glyphosate+2,4-D combinations (Table 1). The herbicide mixtures not only

Table 1. Dry weights of purple nutsedge shoots and tubers and the germination capacity of tubers as affected by different herbicidal treatments

Chemicals and their doses (kg ai ha^{-1})	Shoot dry weight (g m^{-2})[1]		Tuber dry weight (g m^{-2})			Germination of tubers (%) collected at			
	2 weeks[2]	3 weeks	2 weeks	3 weeks	6 weeks	30 DASP[3]		45 DASP[3]	
Glyphosate (1.5)	1.15	0.0	2.62	1.07	1.11	2.36	(8.85)	46.5	(43.04)
Glyphosate (2.0)	1.23	0.40	3.55	1.97	1.13	2.36	(8.85)	68.9	(56.14)
Glyphosate (2.5)	1.07	0.00	2.73	2.36	1.15	0.00	(0.00)	24.97	(29.98)
Glyphosate (1.5) + 0.5% $(NH_4)_2$ SO_4	0.84	0.14	3.13	2.89	1.94	0.00	(0.00)	61.96	(51.92)
Glyphosate (2.0) + 0.5% $(NH_4)_2$ SO_4	0.90	0.07	3.12	2.73	1.38	5.11	(13.07)	32.8	(34.99)
Glyphosate (2.5) + 0.5% $(NH_4)_2$ SO_4	0.81	0.006	2.90	3.27	1.64	0.00	(0.00)	13.93	(21.92)
2,4-D Na salt (1.5)	1.02	0.10	3.39	2.94	1.79	45.99	(42.68)	32.8	(34.99)
2,4-D Na salt (1.75)	1.05	0.007	3.60	3.33	1.89	9.25	(17.70)	13.93	(21.92)
2,4-D Na salt (2.0)	0.65	0.07	3.31	3.13	1.65	32.29	(34.61)	13.93	(21.92)
2,4-D Na salt (1.5)+ 1% urea	0.98	0.07	2.96	3.51	2.25	25.00	(29.98)	32.8	(34.99)
2,4-D Na salt (1.75)+ 1% urea	1.08	0.00	3.26	3.54	1.87	2.36	(8.85)	13.93	(21.92)
2,4-D Na salt (2.0) + 1% urea	0.90	0.003	3.08	2.65	2.49	9.25	(17.70)	19.40	(26.14)
Glyphosate (1.5) + 2,4-D Na salt (2.5)	1.04	0.00	3.34	2.12	1.62	0.00	(0.00)	5.11	(13.07)
Glyphosate (2.0) + 2,4-D Na salt (2.5)	1.31	0.00	3.23	2.14	1.17	2.36	(8.85)	2.36	(8.85)
Glyphosate (2.5) +2,4-D Na salt (2.5)	0.87	0.00	3.02	1.97	1.34	0.00	(0.00)	0.00	(0.00)
Unsprayed check	2.11	8.28	5.82	19.52	26.18	90.75	(72.27)	73.7	(59.16)
SEm (±)	-	0.43	0.46	1.10	0.63	8.44		4.58	
CD (0.05)	NS	0.71	1.34	3.16	1.83	24.38		13.23	

[1] Shoot dry weights were 'zero' for the herbicidal treatments at four weeks after sowing.

[2] Weeks refer to the number of weeks after spraying and DASP means 'days after spraying'

[3] Percentage values correspond to three weeks after sowing; angular transformed values are presented parenthetically

showed the lowest sprouting percentage but also had substantially lower values than that of other treatments implying more effective and long-lasting weed control for such treatments. A possible explanation for this is the more effective translocation of glyphosate to primary and secondary tubers owing to the auxinic effect of 2,4-D at sublethal concentrations. This is consistant with the results of Manickam and Gnanamoorthy (1994), who also observed a similar effect. It should, however, be noted that in the present study, the nutsedge population was established by planting tubers and the herbicide application was done at one month after sowing. Therefore, it is likely that most of the tubers were probably in an active stage of development so that the herbicides could be translocated with ease, which in turn, curbed further tuberisation. However, in a naturally infested area, presence of dormant tubers may complicate the situation and it may be necessary to have repeated spraying for complete weed kill as suggested by Charles (1995).

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