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Purple nutsedge management by using herbicides alone and in combinations

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ABSTRACT

A field experiment was conducted during summer season of 2015-16 at Junagadh (Gujarat) to evaluate efficacy of a herbicides (halosulfuron-methyl, ethoxysulfuron, glyphosate) and their combinations (glyphosate + halosulfuron, glyphosate + ethoxysulfuron) in managing purple nutsedge (*Cyperus rotundus* L.) under non-crop situation. Maximum purple nutsedge control (92.20%) at 30 days after spraying (DAS) and the lowest regeneration (5.76%) at 60 DAS was recorded with tank-mix glyphosate 1230 g/ha + halosulfuron-methyl 33.75 g/ha at 30 days after emergence (DAE), which was at par with halosulfuron-methyl 80 g/ha at 30 DAE (91.50% and 7.76%, respectively) and halosulfuron-methyl 67.5 g/ha at 30 DAE (89.53% 8.48%, respectively). Ethoxysulfuron 15 g/ha at 30 DAE resulted in significantly the lowest nutsedge control (12.84%) at 30 DAS and the highest regeneration (62.22%) at 60 DAS. The herbicides and their mixtures applied for control of nutsedge during summer season have non-significant effect on plant height and dry matter/plant of succeeding crops, *viz*. groundnut, pearlmillet, cotton and sesame

Purple nutsedge (*Cyperus rotundus* L.) is one of the most troublesome invasive weeds in tropical and subtropical climates and has been described as the world's worst perennial weed. It reproduces predominately by basal bulbs, rhizomes, and tubers, which allow it to flourish under a wide range of growing conditions. Purple nutsedge forms tuber chains where several tubers (2-6 or more) are connected together by means of a slender rhizome-like thread of vascular tissue.

Research studies indicated that post-emergence herbicides, *viz*. glyphosate (Ameena *et al*. 2013), glufosinate-ammonium (Shivashenkaramurthy *et al*. 2008), halosulfuron-methyl (Rathika *et al*. 2013), ethoxysulfuron (Pal *et al*. 2008), trifloxysulfuron-sodium (Gannon *et al*. 2012), imazosulfuron (Riar and Norsworthy 2011), bensulfuron-methyl (Saha 2009), azimsulfuron (Yadav *et al*. 2011), sulfentrazone (Brecke *et al*. 2005), *etc*. have been found very effective for control of purple nutsedge. However, very few among these herbicides are registered for use in India. The sulfonyl urea herbicides, *viz*. halosulfuron-methyl and ethoxysulfuron are registered in the country (Shaik and Subramanyam 2017). Hence considering the problem, an experiment was carried out to test the bioefficacy of halosulfuron-methyl, ethoxysulfuron and glyphosate for managing purple nutsedge.

A field experiment was conducted at College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) during summer season of 2015-16 in non-cropped condition. The soil of the experimental plot was clayey in texture and slightly alkaline in reaction as well as low in available nitrogen, available phosphorus and medium in available potash. The experiment, comprising of 10 treatments was laid out in a randomized block design with three replications. The post-emergence spray was done at 30 DAE using knapsack sprayer with flood-jet nozzle. The spray volume of herbicide application was 500 L/ha. The nutsedge control (%) was calculated based on nutsedge count before spray and 30 days after application (DAA).

$$\text{Control (\%)} = 100 - \left(\frac{\text{Nutsedge density 30 DAA}}{\text{Nutsedge density before spray}} \times 100\right)$$

The regeneration (%) was computed on the basis of dead nutsedge count 30 DAA and sprouted nutsedge count at 60 DAA.

$$\text{Regeneration (\%)} = \frac{\text{Sprouted nutsedge density 60 DAA}}{\text{Dead nutsedge density 30 DAA}} \times 100$$

The field bioassay was carried out to ascertain the residual effect of herbicides applied to control nutsedge in summer season on succeeding crops, *viz.* groundnut, pearl millet, cotton and sesame. One row of each crop was grown in each fixed plot during *Kharif* season and plant height and dry matter/plant were recorded at 30 days after sowing of the crops. The data were subjected to statistical analysis by adopting appropriate analysis of variance (Gomez and Gomez 1984). Wherever the F values found significant at 5 per cent level of probability, the critical difference (CD) values were computed for making comparison among the treatment means.

Effect on nutsedge

Nutsedge density was almost similar in all the plots before herbicides spray (at 30 DAE) (**Table 1**). Different treatments have significantly influenced weed density at 30 DAS. Significantly the lowest weed density (2.33/m^2) was observed with application of halosulfuron-methyl 80 g/ha at 30 DAE, which was found statistically comparable to that of tank-mix glyphosate 1230 g/ha + halosulfuron-methyl 33.75 g/ha at 30 DAE and halosulfuron-methyl 67.5 g/ha at 30 DAE. Similarly, different herbicidal treatments did impart their significant influence on nutsedge control. Significantly the highest nutsedge control (92.2%) at 30 DAS was recorded with tank-mix application of glyphosate 1230 g/ha + halosulfuron-methyl 33.75 g/ ha at 30 DAE, which remained statistically at par with halosulfuron-methyl 80 g/ha at 30 DAE (91.5%) and halosulfuron-methyl 67.5 g/ha at 30 DAE (89.5%). Among the various herbicidal treatments, ethoxysulfuron 15 g/ha at 30 DAE resulted in significantly the lowest nutsedge control (12.8%) at 30 DAS.

Various treatments have significant influence on dead nutsedge density at 30 DAS and regenerated nutsedge density at 60 DAS (**Table 2**). Post-emergence spray of halosulfuron-methyl 67.5 g/ha at 30 DAE recorded significantly the highest dead nutsedge density (32.67/m^2), which remained statistically at par with tank-mix spray of glyphosate 1230 g/ha + halosulfuron-methyl 33.75 g/ha at 30 DAE. The treatments, *viz.* halosulfuron-methyl 80 g/ ha at 30 DAE, ethoxysulfuron 25 g/ha at 30 DAE and glyphosate 1230 g/ha + halosulfuron-methyl 33.75 g/ ha at 30 DAE recorded significantly less number of regenerated nutsedge at 60 DAS as compared to the other treatments. The per cent regeneration of nutsedge was significantly influenced by different treatments. Significantly lowest regeneration (5.76%) at 60 DAS was observed under tank-mix spray of glyphosate 1230 g/ha + halosulfuron-methyl 33.75 g/ ha at 30 DAE, which remained statistically at par with halosulfuron-methyl 80 g/ha at 30 DAE (7.76%) and halosulfuron-methyl 67.5 g/ha at 30 DAE (8.48%). Among the various herbicidal treatments, ethoxysulfuron 15 g/ha at 30 DAE resulted in significantly lowest nutsedge control (12.84%) at 30 DAS and the highest regeneration (62.22%) at 60 DAS. These results are in conformity with findings of Rathika *et al.* (2013) and Desai *et al.* (2017).

Residual effect on succeeding crops

Herbicides and their mixtures applied for control of nutsedge during summer season have non-significant effect on plant height and dry matter/plant of succeeding crops, *viz*. groundnut, pearlmillet, cotton and sesame.

Table 1. Effect of herbicides on nutsedge control 30 days after spray (DAS)

Treatment	Nutsedge density at 30 DAE (no./m^2)	Nutsedge density at 30 DAS (no./m^2)	Nutsedge control (%)
Halosulfuron 55 g/ha	32.33	8.00	75.25
Halosulfuron 67.5 g/ha	36.33	3.67	89.53
Halosulfuron 80 g/ha	23.33	2.00	91.50
Ethoxysulfuron 15 g/ha	33.67	29.33	12.84
Ethoxysulfuron 20 g/ha	29.67	23.00	22.14
Ethoxysulfuron 25 g/ha	20.67	15.67	24.70
Glyphosate 2460 g/ha	28.33	14.67	47.70
Glyphosate 1230 g/ha + halosulfuron 33.75 g/ha	31.00	2.33	92.20
Glyphosate 1230 g/ha + ethoxysulfuron 10 g/ha	22.33	13.33	39.96
Unweeded check	34.00	43.33	-27.99
LSD (p=0.05)	NS	7.73	5.43

Table 2. Effect of herbicides on nutsedge regeneration 60 days after spray (DAS)

Treatment	Dead nutsedge density at 30 DAS (no./m^2)	Regenerated nutsedge density at 60 DAS (no./m^2)	Regeneration (%)
Halosulfuron 55 g/ha	24.33	3.67	15.19
Halosulfuron 67.5 g/ha	32.67	2.67	8.48
Halosulfuron 80 g/ha	21.33	1.67	7.76
Ethoxysulfuron 15 g/ha	4.33	2.67	62.22
Ethoxysulfuron 20 g/ha	6.67	2.33	35.56
Ethoxysulfuron 25 g/ha	5.00	1.67	33.33
Glyphosate 2460 g/ha	13.67	3.00	22.41
Glyphosate 1230 g/ha + halosulfuron 33.75 g/ha	28.67	1.67	5.76
Glyphosate 1230 g/ha + ethoxysulfuron 10 g/ha	9.00	2.67	28.97
Unweeded check	-9.33	0.00	0.00
LSD (p=0.05)	8.28	1.22	7.31

Table 3. Residual effect of herbicides on *kharif* groundnut, pearlmillet, cotton and sesame at 30 days after sowing

Treatment	Groundnut		Pearlmillet		Cotton		Sesame	
	Plant height (cm)	Dry matter/ plant (g)	Plant height (cm)	Dry matter/ plant (g)	Plant height (cm)	Dry matter/ plant (g)	Plant height (cm)	Dry matter/ plant (g)
Halosulfuron 55 g/ha	7.19	11.31	18.92	8.89	11.49	15.35	14.02	10.48
Halosulfuron 67.5 g/ha	8.08	11.88	19.34	9.44	11.68	15.95	12.80	9.77
Halosulfuron 80 g/ha	7.77	13.07	20.38	8.95	12.13	17.82	13.60	10.55
Ethoxysulfuron 15 g/ha	7.43	11.47	19.65	8.84	11.81	15.30	13.13	11.73
Ethoxysulfuron 20 g/ha	8.16	11.56	20.49	9.38	12.18	16.45	14.13	9.95
Ethoxysulfuron 25 g/ha	8.23	12.20	21.33	10.18	12.54	15.44	13.75	10.63
Glyphosate 2460 g/ha	7.79	13.06	19.83	9.46	11.89	17.81	13.63	11.26
Glyphosate 1230 g/ha + halosulfuron 33.75 g/ha	7.95	11.34	20.55	8.86	12.20	15.10	13.85	10.45
Glyphosate 1230 g/ha + ethoxysulfuron 10 g/ha	8.28	12.02	21.36	9.15	12.55	16.17	14.30	11.34
Unweeded check	7.88	12.37	20.42	9.45	12.15	16.72	14.23	11.27
LSD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Effective control of purple nutsedge under non-cropped condition could be achieved by spraying either tank-mix glyphosate 1230 g/ha + halosulfuron-methyl 33.75 g/ha or halosulfuron-methyl 80 g/ha or halosulfuron-methyl 67.5 g/ha at 30 days after emergence without leaving residual effect on succeeding crops (groundnut, pearlmillet, cotton and sesame) on medium black calcareous clayey soil of South Saurashtra Agro-climatic Zone of Gujarat.

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