Research Journal of

Environmental Sciences

ISSN 1819-3412

Academic
Journals Inc.

www.academicjournals.com

Research Journal of Environmental Sciences 9 (7): 342-348, 2015
ISSN 1819-3412 / DOI: 10.3923/rjes.2015.342.348

Sequential Postemergence Applications for the Control of Yellow Nutsedge in Bermudagrass Turf

Masoumeh Sadi and Saeed Saeedipour
Department of Agronomy, College of Agriculture, Shoushtar Branch, Islamic Azad University, Shoushtar, Iran

Corresponding Author: Saeed Saeedipour, Department of Agronomy, College of Agriculture, Shoushtar Branch, Islamic Azad University, Shoushtar, Iran

ABSTRACT

Experiment was conducted in 2013 to evaluate various herbicide treatment regimes for POST yellow nutsedge control. Evaluated herbicides included metsulfuron-methyl+sulfosulfuron, Oxadiazon, Clothedim, Sicloxidim, Nicosulfuron+Rimsulfuron and untreated check. Evaluated treatments did not cause objectionable bermudagrass injury at any time. The highest and the lowest dry weight of turfgrass was achieved in Oxadiazon (211 g m^{-2}) and untreated plots (130 g m^{-2}), respectively. The results of this study indicate that satisfactory control of yellow nutsedge (>90%) obtained by post-emergence application of oxadiazon, clothedim or sicloxidim at the first time and repeat applications will not be required. Further, our results indicate that efforts to enhance yellow nutsedge control with metsulfuron-methyl+sulfosulfuron and nicosulfuron+rimsulfuron timings and repeat applications were inconsistent. These data confirm that the lower bermudagrass phytotoxicity was achieved with the sicloxidim treatment.

Key words: Bermudagrass phytotoxicity, post-emergence, yellow nutsedge control

INTRODUCTION

Yellow nutsedge, is common perennial sedge in turfgrass systems and grow best in above-normal soil moisture (Bendixen and Nandihalli, 1987; Bryson *et al.*, 1997; McCarty *et al.*, 2008; McElroy *et al.*, 2005a). Yellow nutsedge is more commonly observed in higher mowing heights (Summerlin, 1997). This species exhibits prolific vegetative growth and produces rhizomes and also produce basal bulbs, seed and tubers (McCarty *et al.*, 2008; Stoller *et al.*, 1972; Stoller and Sweet, 1987). Yellow nutsedge has been described as one of the world's worst weeds (Stoller and Sweet, 1987). Yellow nutsedge is able to survive cooler climates and is more widely distributed than purple nutsedge (Martinez-Ochoa *et al.*, 2004; McCarty *et al.*, 2008; Stoller and Sweet, 1987). This may be because of its ability to increase tuber starch, sugar and lipid content in response to temperature (Bendixen and Nandihalli, 1987). Unlike purple nutsedge, yellow nutsedge does not produce tuber chains. Yellow nutsedge is cultivated for edible tubers in southern Europe and Africa (Wills, 1987). The incidence of sedge species has increased in recent years in turfgrass systems likely due in part to changes in herbicide programs (Yelverton, 1996). Traditionally, chemical control is a effective method in weed control but there is not a selective herbicide for grassy control. Most herbicides used for weed control in turf areas are for control of broad leafed such as; 2,4-D, 2,4-DP, MCPP, MCPA, dicamba, triclopyr, carfentrazone, sulfentrazone, quinclorac (Busey, 2003). Few herbicide options are available for control of weed grasses in turf areas. The most common herbicide choice is a general purpose mixture comprised of two or three of the following individual herbicides or active ingredients; 2,4-D, MCPP (mecoprop); and dicamba (Emmons, 2008).

Sulfosulfuron is a selective herbicide for control of annual and perennial grass and broadleaf weeds in highly managed turf sites (Senseman, 2007; Watschke *et al*., 2013). Select warm and cool-season turfgrasses have exhibited tolerance to sulfosulfuron up to 105 g ha^{-1} (Anonymous, 2010c; Lycan and Hart, 2004; Willis *et al*., 2007). Zabihollahi *et al*. (2008) was studied postemergence herbicides efficacy on bermudagrass (*Cynodon dactylon*) control in turf mixture of landscape and reported that Fenoxaprop-p-ethyl at 60 g ai ha^{-1} is the best herbicide for bermudagrass control. It was reported that among dual-purpose herbicides, sulfosulfuron (EC75%) 27 g ha^{-1} and nicosulfuron ((SG 4%) l.5 g ha^{-1} by having 76.36 and 56.95 biomass (% of untreated control) had the most and the least effect on turf species (Norouzi *et al*., 2013). Oxadiazon or the mixture of acetochlor and oxadiazon had good control of weeds in lawns and turf. Acetochlor had largest negative effects on growth of lawns and turf (Wang *et al*., 2003). Turfgrass and smooth crabgrass response to flazasulfuron, foramsulfuron, metsulfuron, rimsulfuron, sulfosulfuron and trifloxysulfuron-sodium, applied 1 and 3 weeks after and before seeding was studied by Willis *et al*. (2007). They were reported that herbicides applied 3 Weeks After Seeding (WAS) generally more injurious than when applied 1 WAS. Foramsulfuron, metsulfuron and sulfosulfuron are safe to apply 1 and 3 WAS, causing no reduction in turf cover.

Nicosulfuron is a postemergence sulfonylurea herbicide labeled for use in corn (*Zea mays* L.) and controls many difficult to control grassy weeds and some broadleaf weeds at rates of 17.5-70 g ai ha^{-1} (Bhowmik *et al*., 1992). A single application of Nicosulfuron controlled over 90% of quackgrass (*Elythigia repens* (L.) Gould) five Weeks After Treatment (WAT) and provided greater than 80% control one year later (Bhowmik *et al*., 1992). Metsulfuron controls several broadleaf weeds in bermudagrass (Anonymous, 2010b). Kelly and Coats (2000) reported that metsulfuron alone controlled virginia button weed as effectively as, 2,4-D and combining the two herbicides was not advantageous, if metsulfuron was applied at 32 g ha^{-1} or higher. Bradley *et al*. (2004) reported that metsulfuron controlled broadleaf plantain (*Plantago major* L.), buckhorn plantain (*Plantago lanceolata* L.) and wild carrot (*Daucus carota* L.) 70-90%. When, applied alone or in combination with 2,4-D, metsulfuron reduced herbaceous broadleaf plant ground cover at several locations (Meyer and Bovey, 1990). Metsulfuron applied alone is not injurious to bermudagrass (Anonymous, 2010a).

As above mentioned herbicide efficacy may be governed by the effect of herbicide placement and site of uptake and action. Effects of selective herbicide placement on sedge control have been previously reported for certain herbicides (McElroy *et al*., 2003; Nandihalli and Bendixen, 1988; Reddy and Bendixen, 1988). However, information regarding the response of sedge species to currently available herbicides is limited. The objective of this research was to determine the efficacy of some postemergence herbicides on yellow nutsedge growth, determine the optimal timing for sequential applications and determine the safety of these herbicides on bermudagrass turf.

MATERIALS AND METHODS

Field experiments were initiated during the autumn of 2013 and 2014 at Ahwaz in Khoozestan Province, Iran (32°3´N, 48°50´E). The climate is arid and semi-arid with a mean annual rainfall of 198.4 mm and the average of annual minimum and maximum 9.5 and 48.3°C, respectively. The soil was a clay loam texture, pH of 7.2, soil electrical conductivity was 1.2 ds m^{-1} and 0.3% organic matter content. The available phosphorous and potassium were 10.2 and 150 ppm, respectively. Research was performed on established yellow nutsedge infestations present in a common bermudagrass rough maintained at a height of 5.4 cm. Plots measured 1.5 by 1.5 m and were arranged in a randomized complete block design with four replications. Yellow nutsedge cover (50-90%) within each plot was determined at the time of initial herbicide application through grid counts using a 0.3 m^2 grid (25 intersecting points) tossed into each plot. All experimental areas were mowed 24 h before herbicide application and once 10 days thereafter. There was no rain or irrigation during the 24 h period after herbicide treatment.

Herbicide treatments included 3 times spraying with metsulfuron-methyl+sulfosulfuron (Total® WG80%) 40 g ha^{-1}, Oxadiazon (Ronstar® EC12%) 2 L ha^{-1}, Clothedim (Select super® EC 12%) 1 L ha^{-1}, Sicloxidim (Focus® EC10%) 2 L ha^{-1}, Nicosulfuron+Rimsulfuron (Ultima® WG75%) 175 g ha^{-1} and untreated check.

Treatments were initiated on October 5, 2014 with sequential applications made 4 and 8 WAIT (weeks after initial treatment). Treatments were applied using a CO_2-pressurized backpack sprayer equipped with two XR8003VS flat-fan extended-range spray tips (Teejet, Spraying Systems Co., North Ave. and Schmale Rd., Wheaton, IL 60129) and calibrated to deliver 304 L ha^{-1} at 276 kPa.

Data collected included bermudagrass phytotoxicity and yellow nutsedge control based on grid counts was evaluated at three times throughout duration of the experiment. Visual assessments of plant and weed injury were made 10 days after herbicide application using a scale of European System of Weed Control and Crop injury Evaluation (Burrill *et al*., 1976) with some modified that scale of 0-100% was used, where 0 = no injury, >70% = acceptable control and 100 = completely killed (Table 1) (Uddin *et al*., 2014).

Dry weight of turf grass and yellow nutsedge were recorded by oven-dried at 70°C for 72 h at three sampling stages. For quantitative analysis, Weed Control Efficacy (WCE) was determined by percent weed control in the treated plot in comparison with that of untreated plot:

$$WCE = \frac{a - b}{a} \times 100$$

where, a is the weed biomass in control treatment (weed free) and b is the weed biomass in sprayed treatment. Finally, all the data were subjected to statistical analysis using SAS computer software after arcsine transformation of percent weed control data and LSD test was performed at the 5% probability level for mean comparison (SAS).

RESULTS AND DISCUSSION

Bermudagrass phytotoxicity exceeded 9% on observation of 8WAIT in all herbicide treatments but all bermudagrass recovered within 7 d of herbicide application. At 8 WAIT, the maximum turf injury was observed at Ultima (175 g ha^{-1}) by 19.34% with no significant difference with Total (40 g L^{-1}), followed by Ronstar (2 L ha^{-1}) and Select super (1 L ha^{-1}). The least damage by 9.45% observed in Focus (2 L ha^{-1}) herbicide. Norouzi *et al*. (2013) reported that Poa had high resistance to Acetyl coenzyme A carboxylase (ACCase) inhibitor herbicides. The same result was reported by

Table 1: Treatments and application dates

Treatments	Trade names (%)	Rates	Application date
Untreated	-	-	-
Metsulfuron-methyl+Sulfusulfuron	Total® WG80	40 g ha^{-1}	5 Oct.+3 Nov.+1 Dec.
Oxadiazon	Ronstar® EC12	2 L ha^{-1}	5 Oct.+3 Nov.+1 Dec.
Clothedim	Select super® EC 12	1 L ha^{-1}	5 Oct.+3 Nov.+1 Dec.
Sicloxidim	Focus® EC10	2 L ha^{-1}	5 Oct.+3 Nov.+1 Dec.
Nicosulfuron+Rimsulfuron	Ultima® WG75	175 g ha^{-1}	5 Oct.+3 Nov.+1 Dec.

Table 2: Injury rating scale of weed and turf

Rating scales	Injury to weeds (%)	Effect on weeds	Effect on crop
1	100	Complete kill	No effect
2	91-99	Very good	Very light symptoms
3	71-90	Good	Light symptoms
4	51-70	Sufficient in practice	Symptoms not reflected in yield
5	41-50	Medium	Medium
6	31-40	Fair	Fairly heavy damage
7	11-30	Poor	Heavy damage
8	1-10	Very poor	Very heavy damage
9	0	No effect	Complete kill

Table 3: Control of yellow nutsedge present in bermudagrass turf and bermudagrass phytotoxicity at third application time

	Application times			
	IT	4 WAIT	8 WAIT	
Treatments	Control (%)			Turf injury (8 WAIT) (%)
Untreated	0^{e}	0^{d}	0^{d}	0^{e}
Total	61.37^{c}	55.15^{b}	41.61^{b}	17.80^{a}
Ronstar	91.54^{a}	99.16^{a}	95.50^{a}	14.61^{b}
Select super	86.86^{b}	95.34^{a}	90.52^{a}	11.33^{c}
Focus	90.50^{a}	98.04^{a}	91.72^{a}	9.45^{d}
Ultima	44.47^{d}	39.79^{c}	31.42^{c}	19.34^{a}

Means within a column followed by the same lowercase letter are not significantly different at $p \leq 0.05$ according to Fisher's protected LSD test. IT: Initial treatment, WAIT: Weeks after initial treatment

Zabihollahi *et al.* (2008). McElroy *et al.* (2005b) found that MSMA, clopyralid and quinclorac did not injure seedling bermudagrass, while diclofop, metsulfuron, 2,4-D and dicamba injured seedling bermudagrass.

Herbicide treatment main effects were observed for yellow nutsedge control at IT, 4 and 8 WAIT (Table 2). Ronstar and Focus (2 L ha^{-1}) 4 WAIT, Ronstar, Focus and Select super exhibited 90-99% control 4 and 8 WAIT (Table 3). Felix and Boydston (2010) observed similar control of yellow nutsedge (92-99%) with imazosulfuron applied PRE and POST at 0.34-0.56 kg ai ha^{-1} 42 DAIT. Yelverton *et al.* (2003) reported similar purple nutsedge control (>85%) 4 WAIT with applications of flazasulfuron at 0.025-0.1 kg ai ha^{-1}.

Four and Eight weeks (4 and 8 WAIT), sequential application of Ronstar (2 L ha^{-1}) controlled yellow nutsedge 99 and 95%, whereas similar control (90-91%) was observed with a single application of Ronstar and Focus (2 L ha^{-1}) followed by Select super 4 and 8 WAIT (Table 3). Baumann *et al.* (2004) observed similar control (80-85%) 104 DAT with sequential applications of sulfosulfuron at 0.05-0.1 kg ai ha^{-1} and halosulfuron at 0.07 kg ai ha^{-1}. Season-long yellow nutsedge control (90-95%) has been observed with sequential applications of sulfosulfuron at 0.078 kg ai ha^{-1} (Brecke *et al*., 2007). Hinton and Yelverton (2003) observed greater control (>90%) 12 WAIT with sequential applications of trifloxysulfuron at 0.03 kg ai ha^{-1}. Application 2 or 3 times for sequential Ronstar and Focus rather than 1 time, increased yellow nutsedge control. However, control with these treatments was not statistically different from control with a single application (Table 3). Sequential applications made several weeks later may allow for increased herbicide uptake due to the presence of more leaf tissue after regrowth. Yellow nutsedge produces rhizomes and also produce basal bulbs and tubers used to store carbohydrates for emergence and growth in subsequent years. Effective yellow nutsedge control is likely limited by absorption and translocation of applied herbicides. Leys and Slife (1988) reported 58% of applied ^{14}C metsulfuron was readily absorbed by wild garlic (*Allium vineale* L.) 144 h after application and 16% of that absorbed material translocated out of the treated leaf. Troxler *et al.* (2003) observed 53% or less of applied ^{14}C-trifloxysulfuron was absorbed by yellow nutsedge (*Cyperus esculentus* L.) and purple nutsedge (*C. rotundus* L.) 96 h after treatment.

Table 4: Dry weight of yellow nutsedge and turfgrass influenced by different post-emergence herbicides

Treatments	Application times IT	4 WAIT	8 WAIT	Turf (8 WAIT)
	----------(g m^{-2})----------			
Untreated	8.0[a]	9.50[a]	7.0[a]	130[c]
Total	2.7[b]	4.30[b]	4.1[b]	161[bc]
Ronstar	0.5[c]	0.12[c]	0.2[c]	211[a]
Select super	1.2[c]	0.40[c]	0.5[c]	195[a]
Focus	1.1[c]	0.20[c]	0.4[c]	185[ab]
Ultima	4.2[b]	6.10[b]	4.6[b]	144[c]

Means within a column followed by the same lowercase letter are not significantly different at $p \le 0.05$ according to Fisher's protected LSD test

Unlike turfgrass, the least yellow nutsedge control was observed in Ultima (75 g ha^{-1}) followed by Total (40 g L^{-1}) at all application (Table 3). For herbicides inhibiting acetolactate synthase (ALS), absorption and translocation within the plant determines whole plant activity (Shaner and Singh, 1997). Because branched chain amino acid pathways are most active in meristematic regions (Shaner and Singh, 1997), ALS herbicide translocation to rhizomes is imperative for acceptable control or viability reduction. A sequential application of Total herbicide applied at IT provided 61% yellow nutsedge control whereas sequential applications applied 4 or 8 WAIT provided approximately 6-14% less control. Similarly, in Ultima herbicide, a sequential application applied at IT provided 44% yellow nutsedge control, but when sequential treatments were applied 4 or 8 WAIT, control was reduced to 5-13%. Increased control at IT may have been due to allowing sedge species to grow suitably, whereas the repeat application, 4 and 8WAIT may not be adequate to observe regrowth from previous application.

Dry weight of turfgrass and yellow nutsedge: Based on our results, herbicides type had a significant effects on dry weight of turfgrass. The maximum dry weight of turfgrass was achieved in Ronstar treatment (211 g m^{-2}) and the lowest dry weight (130-144 g m^{-2}) found in untreated accompanied with Ultima treatments. No significant difference was observed among Ronstar, Select super and Focus on turfgrass dry weight (Table 4). Dry weight of yellow nutsedge was significantly inhibited by all treatments. Untreated plot had the highest dry weight at all application time and the lowest dry weight found in Ronstar treatment. However there was no significant difference found among Ronstar, Select super and Focus treatments on yellow nutsedge dry weight at all sequential application (Table 4).

CONCLUSION

This study indicates Ronstar, Focus or Select super can provide acceptable yellow nutsedge control in turf environments including bermudagrass, although repeat applications will not be required. Further, our results indicate that efforts to enhance yellow nutsedge control with Total and Ultima timings and repeat applications were inconsistent. These data confirm that the lower bermudagrass phytotoxicity was achieved with the Focus treatment.

REFERENCES

Anonymous, 2010a. Certainty® herbicide product label. Monsanto Company Publication No. 71016G5-6, Monsanto Company, St. Louis, MO., pp: 1-6.

Anonymous, 2010b. Dismiss® herbicide product label. FMC Corporation, Philadelphia, PA., pp: 1-5.

Anonymous, 2010c. Metsulfuron herbicide specimen label. Arysta Life Science North America Corp, Cary, NC.

Baumann, P.A., F.T. Moore and M.E. Matocha, 2004. Purple nutsedge (*Cyperus rotundus* L.) control from sulfosulfuron applications to turfgrass. Proc. South. Weed Sci. Soc., 57: 98-112.

Bendixen, L.E. and U.B. Nandihalli, 1987. Worldwide distribution of purple and yellow nutsedge (*Cyperus rotundus* and *C. esculentus*). Weed Technol., 1: 61-65.

Bhowmik, P. C., B.M. O'Toole and J. Andaloro, 1992. Effects of nicosulfuron on quackgrass (*Elytrigia repens*) control in corn (*Zea mays*). Weed Technol., 6: 52-56.

Bradley, K.W., E.S. Hagood Jr., K.P. Love and R.D. Heidel, 2004. Response of biennial and perennial weeds to selected herbicides and prepackaged herbicide combinations in grass pastures and hay fields. Weed Technol., 18: 795-800.

Brecke, B.J., K.C. Hutto and J.B. Unruh, 2007. Sulfosulfuron: Weed management and turfgrass tolerance. Proc. South. Weed Sci. Soc., 60: 114-114.

Bryson, C.T., R. Carter, L.B. McCarty and F.H. Yelverton, 1997. Kyllinga, a genus of neglected weeds in the continental United States. Weed Technol., 11: 838-842.

Burrill, L.C., J. Cardenas and E. Locatelli, 1976. Field Manual for Weed Control Research. International Plant Protection Center Oregon State University, Oregon, Pages: 60.

Busey, P., 2003. Cultural management of weeds in turfgrass. Crop Sci., 43: 1899-1911.

Emmons, R.D., 2008. Turfgrass Science and Management. Delmar Publishers, New York, USA.

Felix, J. and R.A. Boydston, 2010. Evaluation of imazosulfuron for yellow nutsedge (*Cyperus esculentus*) and broadleaf weed control in potato. Weed Technol., 24: 471-477.

Hinton, J.D. and F.H. Yelverton, 2003. Purple nutsedge control in bermudagrass with sulfonylurea herbicides. Proc. South. Weed Sci. Soc., 56: 104-104.

Kelly, S.T. and G.E. Coats, 2000. Postemergence herbicide options for Virginia buttonweed (*Diodia virginiana*) control. Weed Technol., 14: 246-251.

Leys, A.R. and F.W. Slife, 1988. Absorption and translocation of ^{14}C-chlorsulfuron and ^{14}C-metsulfuron in wild garlic (*Allium vineale*). Weed Sci., 36: 1-4.

Lycan, D.W. and S.E. Hart, 2004. Relative tolerance of four cool-season turfgrass species to sulfosulfuron. Weed Technol., 18: 977-981.

Martinez-Ochoa, N., S.W. Mullis, A.S. Csinos and T.M. Webster, 2004. First report of yellow nutsedge (*Cyperus esculentus*) and purple nutsedge (*C. rotundus*) in Georgia naturally infected with Impatiens necrotic spot virus. Plant Dis., 88: 771-771.

McCarty, L.B., J.W. Everest, D.W. Hall, T.R. Murphy and F. Yelverton, 2008. Color Atlas of Turfgrass Weeds. 2nd Edn., John Wiley and Sons, New York, USA., pp: 19-31.

McElroy, J.S., F.H. Yelverton, S.C. Troxler and J.W. Wilcut, 2003. Selective exposure of yellow (*Cyperus esculentus*) and purple nutsedge (*Cyperus rotundus*) to postemergence treatments of CGA-362622, imazaquin and MSMA. Weed Technol., 17: 554-559.

McElroy, J.S., F.H. Yelverton, M.G. Burton and C. Brownie, 2005a. Habitat delineation of green and false-green kyllinga in turfgrass systems and interrelationship of elevation and edaphic factors. Weed Sci., 53: 620-630.

McElroy, J.S., G.K. Breeden, F.H. Yelverton, T.W. Gannon, S.D. Askew and J.F. Derr, 2005b. Response of four improved seeded bermudagrass cultivars to postemergence herbicides during seeded establishment. Weed Technol., 19: 979-985.

Meyer, R.E. and R.W. Bovey, 1990. Influence of sulfonylurea and other herbicides on selected woody and herbaceous species. Weed Sci., 38: 249-255.

Nandihalli, U.B. and L.E. Bendixen, 1988. Toxicity and site of uptake of soil-applied imazaquin in yellow and purple nutsedges (*Cyperus esculentus* and *C. rotundus*). Weed Sci., 36: 411-416.

Norouzi, M., F. Meighani and H.R. Sasanfar, 2013. The possibility of application of dual-purpose herbicides in five turf species of Kentucky bluegrass, red fescue, perennial ryegrass, bermudagrass and asianponysfoot. Iran. Weed Sci. Cong., 2: 688-692.

Reddy, K.N. and L.E. Bendixen, 1988. Toxicity, absorption, translocation and metabolism of foliar-applied chlorimuron in yellow and purple nutsedge (*Cyperus esculentus* and *C. rotundus*). Weed Sci., 36: 707-712.

Senseman, S.A., 2007. Herbicide Handbook. 9th Edn., Weed Science Society of America, Lawrence, Pages: 217.

Shaner, D.L. and B.K. Singh, 1997. Acetohydroxyacid Synthase Inhibitors. In: Herbicide Activity: Toxicology, Biochemistry and Molecular Biology, Roe, R.M., J.D. Burton and R.J. Kuhr (Eds.). IOS Press, Burke, VA., pp: 69-110.

Stoller, E.W., D.P. Nema and V.M. Bhan, 1972. Yellow nutsedge tuber germination and seedling development. Weed Sci., 20: 93-97.

Stoller, E.W. and R.D. Sweet, 1987. Biology and life cycle of purple and yellow nutsedges (*Cyperus rotundus* and *C. esculentus*). Weed Technol., 1: 66-73.

Summerlin, J.R., 1997. Biological response of six sedge species to various mowing heights. M.S. Thesis, North Carolina State University, Raleigh, NC.

Troxler, S.C., I.C. Burke, J.W. Wilcut, W.D. Smith and J. Burton, 2003. Absorption, translocation and metabolism of foliar-applied CGA-362622 in purple and yellow nutsedge (*Cyperus rotundus* and *C. esculentus*). Weed Sci., 51: 13-18.

Uddin, M.K., A.S. Juraimi, M.R. Ismail, R. Othman, M.S. Ahmad-Hamdani and A.A. Rahim, 2014. SEAWATER: An alternative grassy weed control method for post emergence herbicides in tropical turfgrass. Pak. J. Agric. Sci., 51: 153-160.

Wang, Q., Z. Zhang and Y. Meng, 2003. Influence of several pre-emergence herbicides on growth of lawns and turf and their weed controlling effects. Grassland China, 25: 38-41.

Watschke, T.L., P.H. Dernoeden and D.J. Shetlar, 2013. Managing Turfgrass Pests. CRC Press, Boca Raton, FL.

Wills, G.D., 1987. Description of purple and yellow nutsedge (*Cyperus rotundus* and *C. esculentus*). Weed Technol., 1: 2-9.

Willis, J.B., D.B. Ricker and S.D. Askew, 2007. Sulfonylurea herbicides applied during early establishment of seeded bermudagrass. Weed Technol., 21: 1035-1038.

Yelverton, F., 1996. Know your sedges. Golf Course Management, USA., pp: 56-60.

Yelverton, F.H., T.W. Gannon, J.D. Hinton and L.S. Warren, 2003. Weed control and turfgrass tolerance to flazasulfuron. Proc. Southern Weed Sci. Soc., 56: 101-101.

Zabihollahi, V., F. Meighani, M.A.B. Mibadi and M.J. Mirhadi, 2008. Study of postemergence herbicides efficacy on bermudagrass (*Cynodon dactylon*) control in turf mixture of landscape. J. Plant Prot., 22: 197-209.