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Study of Dual-purpose Herbicides Efficacy on Weed control in Turfgrass of Landscape

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ABSTRACT: Weed control in lawn is major problem management in urban green space. In order to study the possibility of weed control using dual-purpose herbicides in lawn, an experiment was conducted as Randomized complete block design with three replication at Eram park, Sabzevar in 2013. Treatment were Sulfosulfuron (Apyrous trade name) as 15, 25 and 30 g.ha^{-1}, idosulfuron plus mesosulfuron plus Surfactant (Atlantis OD trade name) as 1, 1.5 and 2 lit.ha-1 with weed control and weedy treatment. Sprayed with herbicides was evaluated at 30 and 60 days after turf emergence. The results showed that Atlantis had undesirable effect on turf. The use of Atlantis herbicides at all concentrations caused the disappearance of grass and one sprayed couldn't a good control of weeds. High control performance was in a single spraying of herbicides Apyrous dose of 30 g.ha^{-1} and a minimum efficiency of herbicides to control the rate of 1 liter per hectare Atlantis.

Key words: dual-propose herbicide, Injury, weed control efficacy, lawn,

INTRODUCTION

The lawn is the most important and essential part of the design of greenbelt which has the most important role in reduction of air pollution in urban environments. One of the most difficult of maintenance of lawn is weed control. The presence of weeds in a turfgrass community disrupts the uniformity due to the variability in leaf width, color, and growth habit (Uddin, *et al.*, 2014). Both broadleaf and grassy weeds were founded in lawn area. Weeds in addition to disrupting the smooth texture and a beautiful lawn can cause problems in the pruning (Hephner, *et al.*, 2012). It was reported that weed competition during seeded bermudagrass establishment could cause total failure of turfgrass establishment (Wang, *et al.*, 2003). In lawns the major weeds are*: Cynodon dactylon, Digitaria adscendens [Digitaria ciliaris], Eleusine indica, Cyperus rotundus, Kyllinga brevifolia, Kyllinga brevifolia Rottb var., Ageratum conyzoides, Artemisia argyi, Hydrocotyle sibthopioides [Hydrocotyle sibthorpioides], Centella asiatica, Conyza canadensis, Eclipta prostrata, Gnaphlium affine [Gnaphalium affine], Gnaphilium hypoleucum [Gnaphalium hypoleucum], Alternanthear philoxeroides [Alternanthera philoxeroides], Alternanthear sessilis [Alternanthera sessilis], Mazus japonicus, Capsella bursa-postoris, Oxalis corymbosa, Oxalis corniculata, Solanum photeinocarpum, Euphorbia hirta* and *Soliva anthemifolia* (Ma, *et al.*, (2002); Martinson, *et al.*, 2014).

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). Nowadays dual-propose herbicide is used for weed control in some plant but there is not registered dual-propose herbicide for Lawn (Zabihollahi, *et al.*, 2009). mesosulfuron-methyl + iodosulfuron-methyl-sodium + Mephen payer (Atlantis OD trade name) is a new herbicide from mesosulfuron-methyl and iodosulfuron-methyl-sodium, two active substances which belong to the Group of sulphonylureas. The two active ingredients in the formulation are mainly absorbed by the leaves and then translocated to the meristems of plants, which act by inhibiting the Acetolactate Synthase (ALS). Sulfosulfuron (Apyros trade name) acts by inhibiting biosynthesis of the essential amino acids valine and isoleucine, hence stopping cell division and plant growth.

Sulfosulfuron is a selective herbicide for control of annual and perennial grass and broadleaf weeds in highly managed turf sites (Watschke, *et al.,* 2013). There is a little information about chemical weed control in lawn. It was reported that Trifloxysulfuron-sodium application at 23 g a.i. ha^{-1}, foramsulfuron at 30 g a.i. ha^{-1}, or sulfosulfuron at 75 g a.i. ha^{-1} can control over 90% of the *P. annua* population within 28 days of treatment. Optimum control is achieved between 30 and 60 DAT. Sulfosulfuron has also been shown to be very effective in controlling *P. annua* when applied at 75 g a.i. ha^{-1}. Optimum control is achieved between 21 and 45 DAT with a single application of sulfosulfuron In tropical lawns (Pessarakli, 2007). Saudi (2013) reported that 2,4-D+MCPA 1 lit. ha^{-1} and mecoprop-p-dichlroprop-p + MCPA at 2.5 lit.ha^{-1} decreased Plantago lanceolata's biomass and density more effective than other treatments. These herbicides, also, did not cause any damage to lawns. The important averages of green- fields is suitable for sow lawn. The same result was reported by Ashrafi, *et al.,* (2013) who showed that 2,4-D + MCPA (1 L.ha^{-1}) had minimum damages to lawn, and the lowest weed biomass and highest lawn biomass among different herbicide treatment. Zabih Elahi, *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 a.i. ha^{-1} is the best herbicide for Bermudagrass control. Diclofop methyl and Clodinafop methyl had negative effect on Turfgrass growth. It was reported that Among dual-purpose herbicides, sulfusulfuron (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). In 2-year-old lawn Muzafarova (2008) showed that fluroxypyr and florasulam + flumetsulam gave 92-96.6% weed control. Higher doses of the herbicides had a negative effect on quality of the lawn grasses. In bentgrass and most other cool- and warm-season turfgrasses Methiozolin was introduce as a new PRE and POST herbicide for annual bluegrass control. Problematic turfgrass weeds control with herbicide was studied by Perry *et al.,* (2011) who reported that Indaziflam applied at 60 g ai/ha in November provided the most consistent control across weed species. Indaziflam controlled annual bluegrass >90% 20 weeks after treatment (WAT) and large crabgrass >90% 29 WAT. 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) were 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.

As mentioned above, there is little information about the precise dose of different dual-propose herbicide for lawns. The objective of this experiment was to study the efficacy of two double - purpose herbicides on weed control on lawns and injury effect of these herbicide on weed and lawns.

MATERIAL AND METHOD

The experiment was conducted in 2012 at the Eram park, Sabzevar in Razavi Khorasan Province, Iran (latitude of 36° 13', longitude 57° 39' and altitude of 980 m above sea level). This region is semi-arid and the soil is clay-loam with Ph = 7.8, EC = 1.45 ds/m and 0.78% of organic ere matter (Table 1). The avarge of raining and temperature of 30 year in this site are 184.5 mm and 17.64°C.

The experimental design was Randomized complete block with three replication. Treatment were Sulfosulfuron (Apyrous) as 15, 25 and 30 g.ha^{-1} , idosulfuron plus mesosulfuron plus Surfactant (Sabzevar) as 1, 1.5 and 2 lit.ha^{-1} with weed control and weedy treatment. Sprayed with herbicides was evaluated at 30 and 60 days after turf emergence. The experimental filed was under fallow for 5 years. In order to soil preparation the land was plowed in mid of autumn. Fertilizers application was included 10 t.ha^{-1} composted manure.

Table 1: Physico-chemical properties of soil.

Organic matter	Mg	Ca	Na	B	K	Available P	Total N	EC	pH	Sand	Silt	Clay
(%)	mg kg^{-1}							ds.m^{-1}		(%)		
0.78	5.09	8.27	35	0.34	175	3.35	0.014	1.45	7.8	40	40	30

The experimental units were 2*2 m. turfgrass seeds (mixture of four turf seeds (*Lolium perenne* 20%, Poa pratensis. 20%, *Festuca arundinacea* 20% and *Festuca rubra* commutate 40%) were broadcast by hand at density of 50 p. m^{-2} (equivalent 35 $g.m^{-2}$). The seeds were treated with 40% thiram (tetramethylthiuram disulfide) and incorporated to a depth of 1 to 3 cm with hand. Mixture of sand and manner were broadcast on seed by hand The first irrigation was done after planting as sprinkler method. All herbicides were applied using a necking sprayer equipped with Teejet 8001 nozzles delivering 300 L ha^{-1} at 300 kPa. The herbicide effect on weed and lawn was evaluated at two 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 to 100% was used, where 0 = no injury, > 70%= acceptable control and 100 = completely killed (Table 2, (Uddin, 2014). Weed count using 0.25 m^2 quadrate at two places was taken randomly at before spray. All plants and weed were harvested 30 days after second herbicide application. Fresh weight of turf grass and weeds were determined and dry weight was recorded by oven-dried at 70°C for 72 h at first and second herbicide application.

Table 2: Injury rating scale of weed and turf.

Rating scale	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

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 = weed biomass in control treatment (weed free) and b = 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).

RESULT AND DISCUTION

Field data showed that dominant weed flora were: flixweed (*Sisymbrium Sophia*), London rocket *(Sisymbrium irio*), shepherd's-purse *(Capsella bursa-postoris*), horseweed (*Conyza canadensis)*, goosegrass (*Eleusine indica*), Dhoob (*Cynodon dactylon*), Redroot Pigweed (*Amaranthus retroflexus*) and Lamb's-quarters (*Chenopodium album*).

A. Weed Control Efficacy

Analysis of variance showed that herbicide type had significant effect on weed control efficacy. 30 $g.ha^{-1}$ Apyrous had the highest weed control efficacy and Atlantis as 1 $lit.ha^{-1}$ had the lowest weed control efficacy. There is no significant difference between 1 and 1.5 $lit.ha^{-1}$ Atlantis dosage (Fig. 1). Differential reports observed about sulfonylurea herbicides family. It was reported Goosegrass (Eleusine indica) can be controlled about 80-89% by foramsulfuron whereas, was reported that foramsulfuron + metribuzin had more effect on Goosegrass (Pessarakli, 2007). These findings have a sufficient support from the previous work of (Zabihollahi, *et al.*, 2009), who concluded in their studies that Illoxan at 2.5 l ha^{-1} had the height weed control efficacy to control of Yellow Foxtail and Common Dandelion on Tall Festuca.

B. Weed and Plant Injury at First Application Time

At first time (30 day after establishment of lawns) spraying with Atlantis as 2 $Lit.ha^{-1}$ controlling 85 percent of weeds that has the most controlling and Apyrous with 15 $g.ha^{-1}$ controlling 30 percent average of weeds at first stage that has minimum weeds controlling (Fig. 2) . At this time there is no significant difference among 1 and 1.5 lit.ha-1 Atlantis and 30 $g.ha^{-1}$ Apyrous. Excellent smooth crabgrass control (greater than 90%) was exhibited by Flazasulfuron and trifloxysulfuron-sodium, whereas these herbicide had high injury effect on young seeded bermudagrass (Willis *et al.*, 2007).

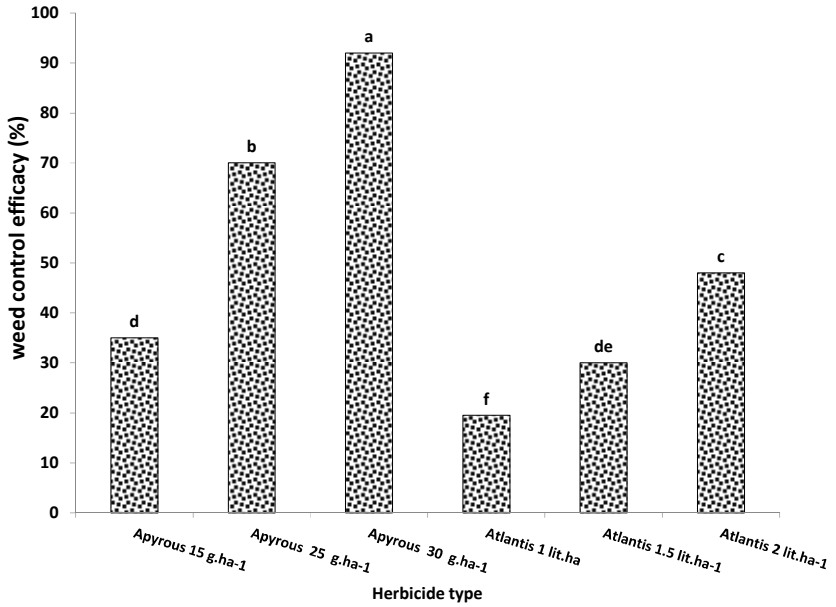

Fig. 1. The effect of herbicide type on weed control efficacy.

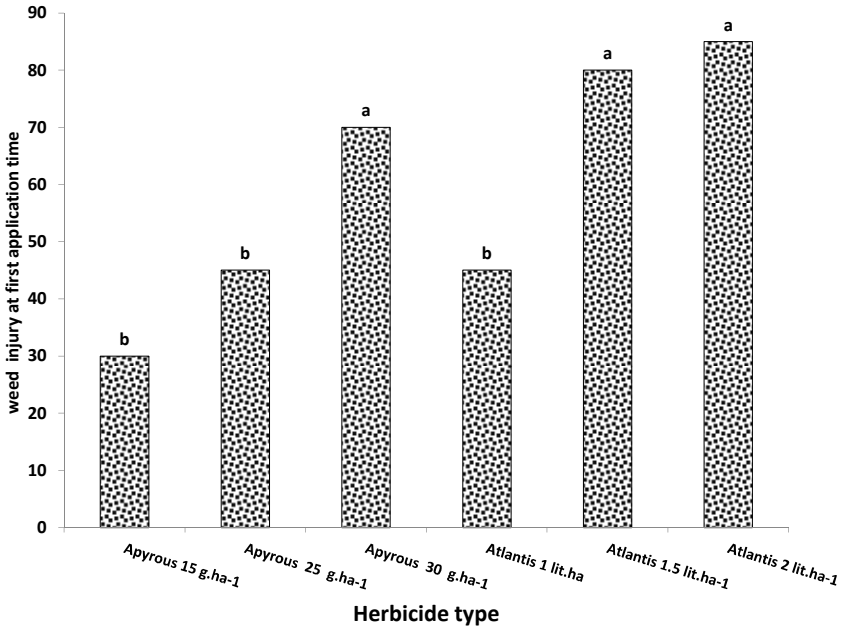

Fig. 2. The effect of herbicide type on Weed injury at first application time.

Unlike weeds, Atlantis as 2 Lit.ha^{-1} had the highest injury on Turfgrass (47%) that had significant difference with other treatment. The lowest Turfgrass injury was observed in Apyrous as 15 g.ha^{-1} (Fig. 3). Novrozi *at al.,* (2013) reported that Poa had high resistance to Acetyl coenzyme A carboxylase (ACCase) inhibitor herbicides. The same result was reported by (Zabih Elahi *et al.,* 2008). McELROY *et al.,* (2005) found that MSMA, clopyralid, and quinclorac did not injure seedling bermudagrass, while diclofop, metsulfuron, 2,4-D, and dicamba injured seedling bermudagrass. The same result was reported that foramsulfuron, rimsulfuron, trifloxysulfuron, metsulfuron, and sulfosulfuron did not significantly injure seedling bermudagrass (Askew, *et al.,* 2004). Willis, *et al.,* (2007) found that trifloxysulfuron at 0.03 kg ai/ha alone or in tank-mixtures with carfentrazone at 0.03 kg ai/ha or quinclorac at 0.84 kg ai/ha significantly injured seeded bermudagrass when applied at 1, 2, and 4 weeks after 80% of seedlings had emerged and had one to three true leaves.

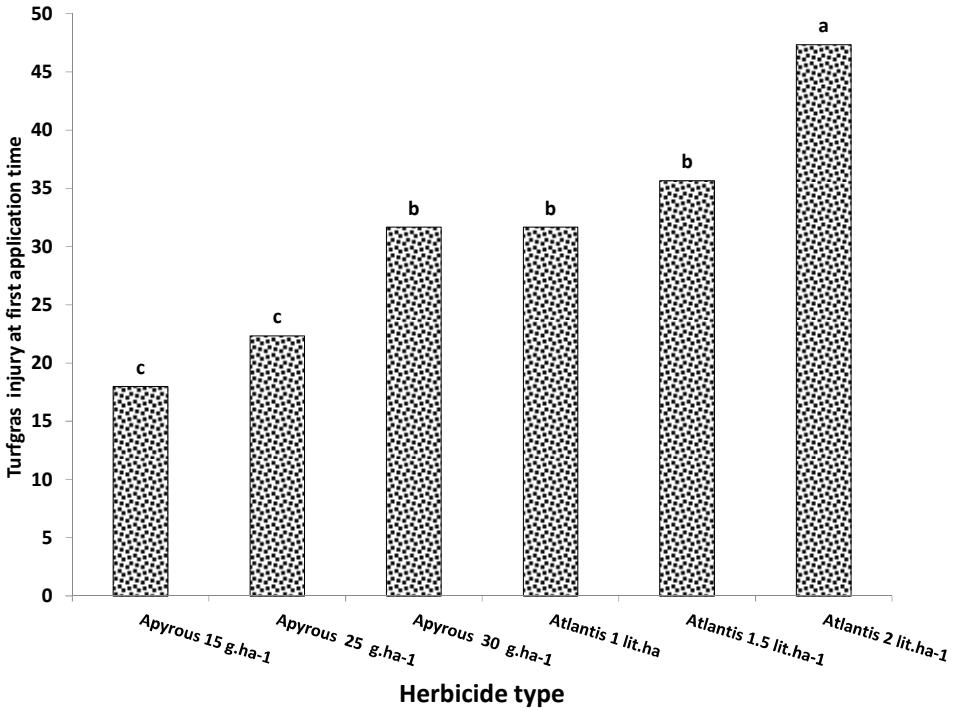

Fig. 3. The effect of herbicide type on plant injury at first application time.

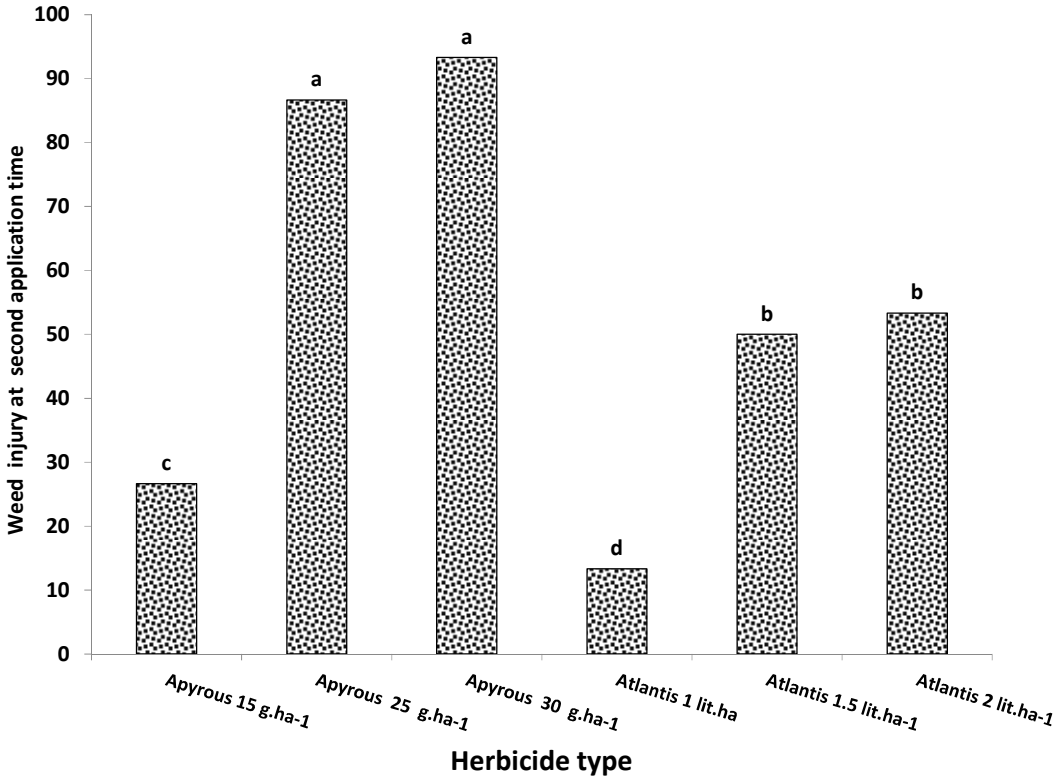

Fig. 4. The effect of herbicide type on weed injury at second application time.

C. Weed and Plant Injury at Second Application Time

At second application time, the maximum weed injury was observed at Apyrous as 30 g.ha^{-1} with no significant difference with Apyrous 25 g.ha^{-1}. Atlantis as 1 lit.ha^{-1} had the lowest weed injury. With increasing dosage of both Apyrous and Atlantis weed injury was increased (Fig. 4). It was reported that, as weeds increase in size, they may become less susceptible to herbicides.

Turfgrass injury at second application time significantly affected by herbicide type. Atlantis as 1 and 1.5 lit.ha^{-1} had more than 90% damage on Turfgrass whereas some of Turfgrass completely was died. Apyrous had the less damage than Atlantis to Turfgrass (Fig. 5). Increased frequency of spraying was increased Atlantis damage and reduce Turfgrass biomass so after the second treatment resulted in the loss of grass biomass. Our result consistent with finding of (McELROY *et al.,* 2005) who reported bermudagrass seedling tolerance (13% or less phytotoxicity) to trifloxysulfuron applications at 0.03 kg a.i./ha. whereas no bermudagrass phytotoxicity was reported by (Hephner *et al.,* 2012).

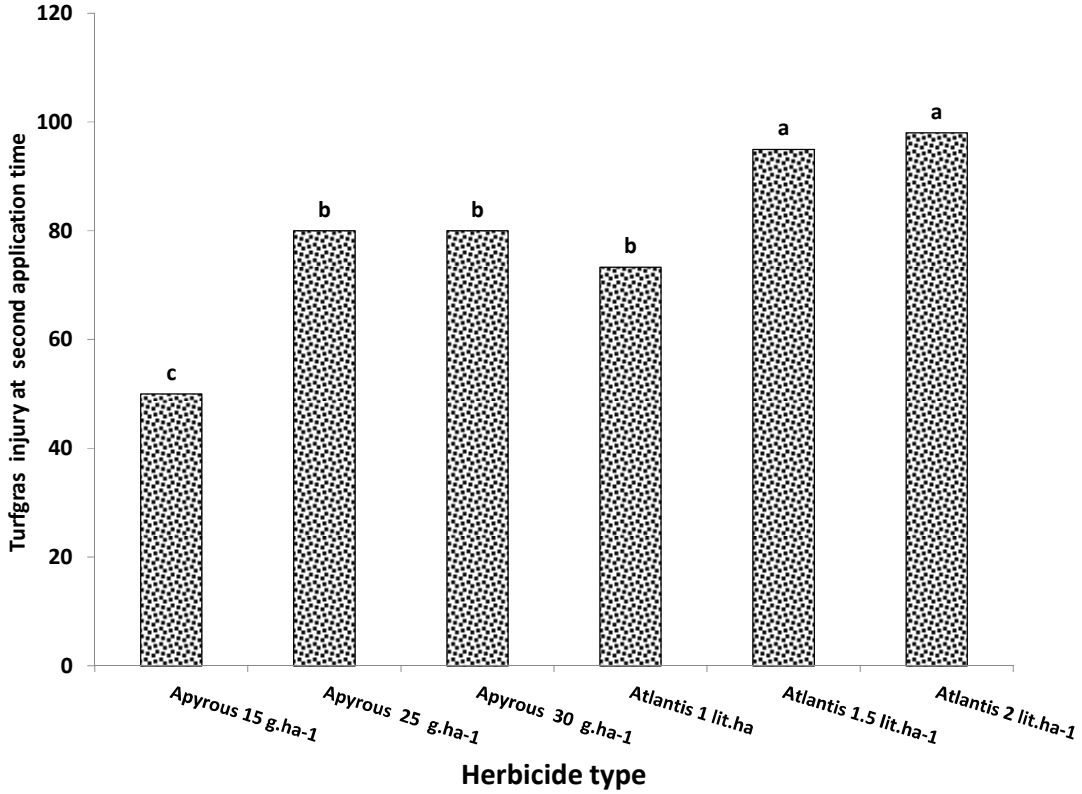

Fig. 5. The effect of herbicide type on plant injury at second application time.

D. Fresh Weight of Turfgrass

Based on the results of analysis of variance herbicides type were significant effects of on fresh weight of Turfgrass. The maximum fresh weight of Turfgrass was achieved on control treatment (291 g.m^{-2}) and weedy plot had the lost fresh weight (120.30 g.m^{-2}). In this study all doses of Atlantis complete loss of Turfgrass and no Turfgrass was grown in the plots that sprayed two times with Atlantis. Apyrous as 15 g.ha^{-1} couldn't well control of weed but Apyrous as 25 and 30 g.ha^{-1} represents a better fight against weeds which increases the amount of fresh weight of Turfgrass (Fig. 6).

E. Fresh Weight of Weeds

Fresh weight of weeds was significantly inhibited by all treatments. Weedy plot had the heights Fresh weight (302 g.m^{-2}). Among herbicide treatment Apyrous as 25 g.ha^{-1} was the best treatment to reduce fresh weight. There was no significant difference between 25 and 30 g.ha^{-1} Apyrous doses. all doses of Atlantis were destroyed both weed and plant at all plots (Fig. 7).

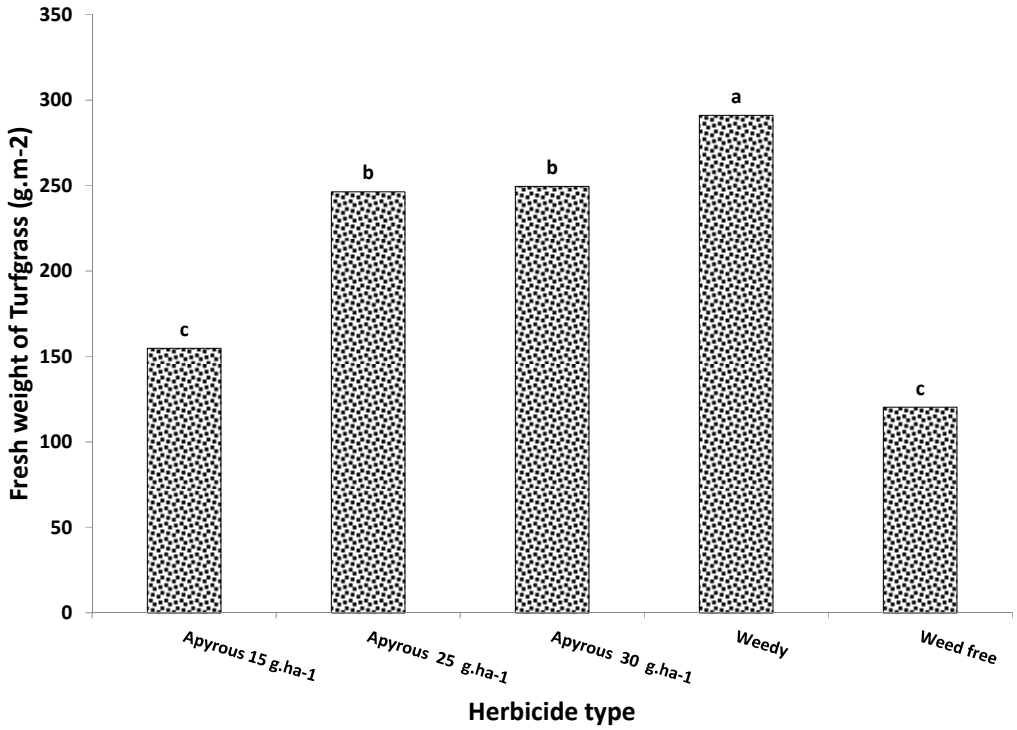

Fig. 6. The effect of herbicide type Fresh weight of Turfgrass.

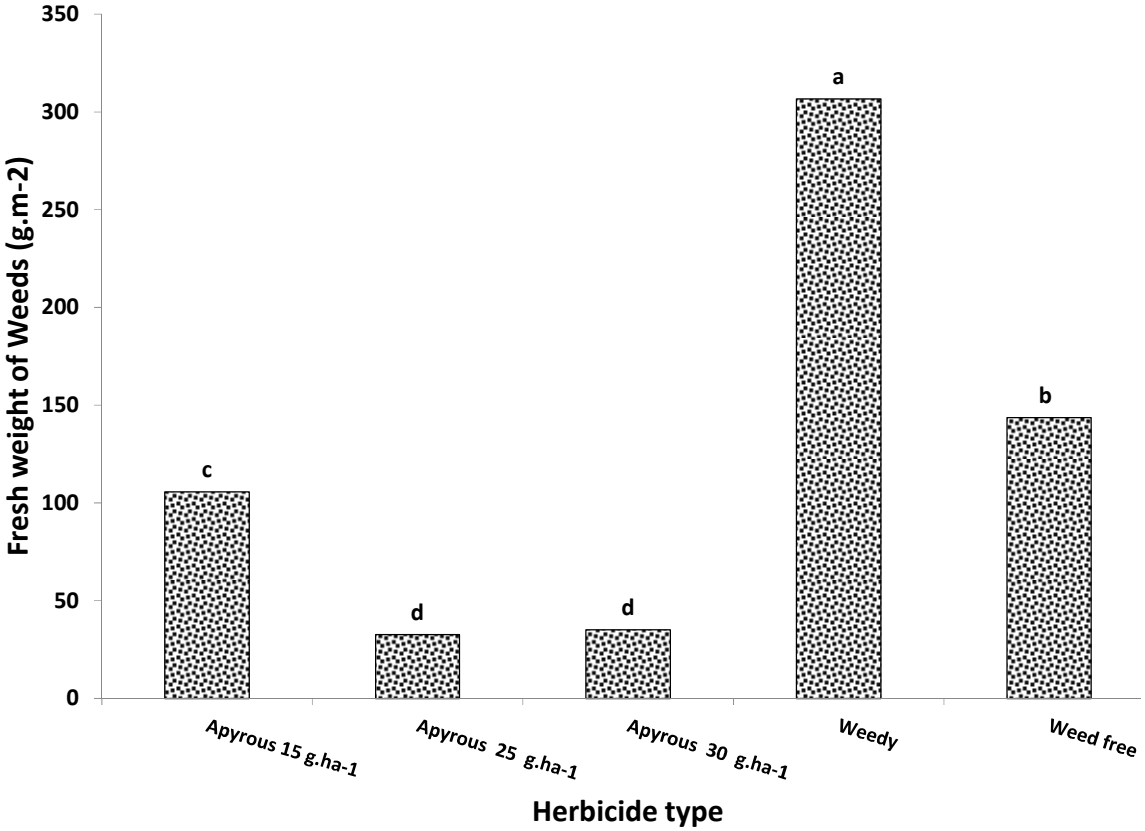

Fig. 7. The effect of herbicide type on Fresh weight of weeds.

CONCLUSION

Sulfosulfuron was the safest herbicide tested, injuring Turfgrass less than 40% at 15 $g.ha^{-1}$ and maintaining high cover ratings relative to other treatments. Examination results showed that spraying at 2 times taking advantage of idosulfuron plus mesosulfuron plus Surfactant herbicide in all examine doses destroyed lawn and spraying at one time could not performed desired controlling of lawn . The most efficiency controlling at one time spraying by Sulfosulfuron herbicide with 30 $g.ha^{-1}$ had least efficiency controlling. Overall, the results showed that taking advantage of Sulfosulfuron herbicide with 30 $g.ha^{-1}$ most suitable attendance for lawn weeds controlling.

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