

Effect of some Pre-and Post-emergence Herbicides on Weed Control in Bermudagrass Turf.

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ABSTRACT

In recent years, Golf Turfgrass played an important role in national economic source which gained from tourism sector. Two field experiments were carried out in Katameya Heights Golf and tennis Resort, New Cairo City, Cairo, Egypt, during 2014 and 2015 summer seasons, to evaluate the efficacy of some pre- and post- emergence herbicides in controlling weeds associated with bermudagrass turf as well as to measure the tolerance degree of the bermudagrass turf to the tested herbicidal treatments. Fourteen herbicidal treatments, i.e., Barricade 65% WG (at 440 and 600g/ fed), Stomp extra 45.5% CS (at 1.2 and 1.7L/fed), Roustar 25% EC (at 1.5 and 2.0 L/ fed) Kerb 50% wp (at 1.25 and 1.5kg/ fed), Sencor 70% wp at 300 kg/ fed, Granstar 75% DF at 8g/fed, Starane 20% EC at 200 cm³/fed, Panther 55% SC at 800 cm³/fed, combined tank mixture of Granstar 75% DF at 8g/fed + 2, 4 - D 72% EC at 1.0L/ fed + Starane 20% EC at 200cm³/fed, Envoke 75% WG at 8g/fed + mineral oil at 1.0L/ fed and hand weeding twice were evaluated comparing to the untreated check. The presented annual broadleaf weed species were *Portulacaceae*, *Amaranthusretroflexus* and *Euphorbia prostrata* whereas *Bidenspilosa*, *Euphorbia hirta*, *Conyzaegyptiaca*, *Sonchusoleraceus* and *Ammimajus*, were rarely encountered. Moreover, *Dactylocteniumaegyptium*, *Cenchrusbiflorus*, *Digitariasanguinalis* and *Setariaviridis* were the prevailed annual narrowleaf weeds, whereas *Cyperusrotundus* was the only existed perennial narrowleaf weed. The results indicated that in the 1st season, the tested weed control treatments caused significant reduction percentage for total weeds through 30, 60 and 90 days after planting. Such reduction rates ranged from 41.2% for Sencor at 300g/ fed to 99.3% for Stomp extra at 1.7L/ fed at 30 days, from 42.5% for Granstar at 8.0g/fed to 96.5% for Ronstar at 2.0L/fed at 60 days and from 45.2% for tank mixture of Granstar at 8.0g + 2, 4-D at 1.0 L + Starane at 200 cm³/fed to 99.2% for Stomp extra at 1.7L/ fed at 90 days. In the 2nd season, such reductionpercentage ranged from 74.7% for Kerb at 1.5kg/fed to 89% for Envoke at 8.0g + mineral oil at 1.0L/fed at 30 days, from 64.1% for Panther at 800g/fed to 82.5% for hand weeding twice at 60 days and from 66.0% for Kerb at 1.5 kg/fed to 82.0% for hand weeding twice at 90 days. Bermudagrass turf exhibited adequate tolerance (T) to all used herbicidal treatments at all growth stages during 2014 season and at 90 days only with, marginal tolerance (MT) in bermudagrass dry weight was observed at 30 and 60 days after planting in the 2nd season. Therefore, Barricade (at 600g), Stomp extra (at 2.0L) and Ronstar (at 2.0 L) may be used as selective pre-emergence herbicides to control annual weeds, Granstar and Starane as selective post-emergence herbicides to control the annual broadleaf weeds and Envoke as a selective post - emergence herbicide to control *Cyperusrotundus* without any adverse effects on bermudagrass turf under sprinkler irrigation in sandy soil.

INTRODUCTION

Recently in Egypt, bermudagrass (*Cynodon dactylon L. pers*) turf had been adopted by most of sport clubs for recreation activities as Golf courses, Tennis and football playgrounds. Weeds infested these plantations endanger golf players. Beard (1982) cited that the specific weeds associated with green tee and fairways of turf of grassy weeds include bluegrass (*Poaannua*), large crabgrass (*Digitaria sanguinalis*), smooth crabgrass (*Digitaria ischaemum*), green foxtail (*Setariaviridis*), goose grass (*Eleusineindica*), yellow nustedge (*Cyperus esculentus*), field sandbur (*Cenchrus pousiflorus*) and broadleaf weeds as common chick weed (*Stellaria media*), white clover (*Trifoliumrepens*), curly dock (*Rumexcrispus*), common purslane (*Portulacaceae*) and common mallow (*Malvaneglecta*). Also he added that such weeds disrupt turfgrass major quality components in golf course, i.e., uniformity, density, smoothness, texture and colour.

Many researchers applied certain selective pre- and post-emergence herbicides as good managing tool for weed control in golf courses. Such herbicides had many advantages as reasonable costs, high and rapid efficiency and no phytotoxic effects against the main plantation, bermudagrass turf. For example, Nishimoto and Murdoch (1999) used metribuzin, at 0.28 and/or 0.56 kg/ha, for controlling annual weeds in bermudagrass. (Toler *et al.*, 2007) stated that Pronamide gave controlling rate of 87% or greater against the annual bluegrass (*Poaannua*) in dormant non overseeded bermudagrass turf regardless of application timing and prevent weed flushes during summer season. McCurdy *et al.* (2008). They illustrated that the effectively

controlled smooth crabgrass (*Digitariaischaemum*) in bermudagrass turf by using pendimethalin (at 3.36 kg/ha) and proflaminate (at 1.2 kg/ha) with controlling Percentage of 95 and 91%, respectively.

Moreover, pronamide at 1.68 kg/ha (Rodriguez *et al.*, 2001) or at 1.1 kg/ha (Patton *et al.*, 2007) can be used effectively for weed control in bermudagrass turf without adverse effect including delaying bermudagrass greenup in spring. Wehtje *et al.* (2010) applied proflaminate as pre-emergence herbicide to control weeds in the nursery production and landscape maintenance industries in South Eastern United States.

Therefore, the objective of the present work was to evaluate some pre - and post - emergence herbicides in controlling different broadleaf and narrowleaf weeds associated with bermudagrass turf as well as studied their phytotoxic effects against the bermudagrass turf under sprinkler irrigation in sandy soils.

MATERIALS AND METHODS

Experimental location description:

Two field experiments were carried out during 2014 and 2015 summer seasons in bermudagrass (*Cyndondactylon*) turf, in Katameya Heights Golf and Tennis Resort, New Cairo City, Cairo, Egypt, to evaluate some pre-and post - emergence herbicides in controlling weeds associated with bermudagrass turf under sprinkler irrigation in sandy soils. The soil of the experimental field was mechanically and chemically analyzed according to Dewis and Freitas (1970) and Hess (1971), respectively as shown in Table 1.

Table 1. Mechanical and chemical characteristics of experimental soil from Katameya Heights golf.

Mechanical analysis			Texture	pH at 1:2.5	EC (ds/m)	Milliequivalent/ liter							CaCO ₃ %
Sand %	Clay %	Silt %				Cations				Anions			
						Ca ⁺⁺	Mg ⁺⁺	Na ⁺⁺	K ⁺	Cl ⁻	CO ₃ ⁻	HCO ₃ ⁻	
97.49	0.34	2.17	sandy soil	7.33	0.96	4.15	2.10	2.55	1.11	1.80	ND	3.95	ND

ND = non-detected.

Soil preparation:

Fallow land was prepared by plowing twice by rotary cultivator and mixed by super phosphate fertilizer 15.5% P₂O₅ at 150 kg/fed, sulfur powder S⁺⁺ at 400 kg/fed and peatmoss at 1.5 ton/fed. Then, the soil was compacted and irrigated by using sprinkler.

Each experiment was divided into 64 plots and planted by plugs 5cm × 5cm of bermudagrass in hills which contain from 10-15 plants at 5 cm height and 15cm distance. Pre-emergence herbicides were sprayed immediately by knapsack sprayer with 200L/feddan, meanwhile post-emergence herbicides were sprayed after 15 days from planting. Irrigation was done at 3 days regular intervals. Planting date was in 26th May, 2014 and 1st of June, 2015. Each experiment included sixteen treatments in a complete randomized block design with four replicates of 2m × 3m for each plot as follows:

- 1 and 2 – prodiamine [N, N- Di – N – Propyl – 2,4 – dinitro – 6 (trifluoromethyl) – m – phenylinediamine], known commercially as Barricade 65% WG, applied after sowing immediately (pre – emergence) and used to two rates 440g and 660g/ fed.
- 3 and 4 – pendimethalin [N – (1 – ethylpropyl) 3, 4 – dimethyl – 2,6 – dinitrobenzenamine], known commercially as Stomp extra extraextra 45.5% CS, applied after sowing immediately (pre – emergence) and used at two rates 1.2L and 1.7L/fed.
- 5 and 6 – Oxadiazole [2 – tert – butyl – 4 – (2, 4 – dichloro – 5 – isopropoxyphenyl) – 1, 3, 4 – oxadiazole – 5 – one], known commercially as Ronstar 25% EC, applied after sowing immediately (pre – emergence) and used at two rates 1.5L and 2.0L/fed.
- 7 and 8 – pronamide [3, 5 – dichloro – N – (1, 1 – dimethyl – 2 – propyl) – benzamide], known commercially as Kerb

50% WP, applied after sowing immediately and used at two rates 1.25kg and 1.50kg/fed.

- 9- Metribuzin [4- Amino- 6 (1,1 – dimethylethyl) – 3 – (methylthio) – 1, 2, 4- triazin- 5-(4H)-one] known commercially as Sencor 70% WG, applied at 15 days from sowing (post-emergence) and used at rate 300g/fed.
- 10- tribenuron – methyl [Methyl 2 – [3 – (4 – methoxy – 6 – methyl – 1, 3, 5 – triazin – 2 – yl) – n – methylamino] carbonyl] amino] sulfonyl] benzoate], known commercially as Granstar 75% DF, applied at 15 days from sowing, (post- emergence) and used at 8.0g/ fed.
- 11- Fluroxypyr [4 – amino – 3, 5 – dichloro – 6 – fluoro – 2 – pyridyloxyacetic acid], known commercially as Starane 20% EC, applied at 15 days from sowing (Post – emergence), and used at rate 200 cm³/fed.
- 12- Isoproturon 50% + Diflufenican 5% [3- (4- isopropylphenyl) – 1,1 – dimethylurea] + [N- (2, 4 – difluorophenyl) – 2 – (3 – trifluoromethylphenoxy) pyridine – 3 – carboxamide], known commercially as Panther 55% SC, applied at 15 days from sowing (Post – emergence), and used at rate 800cm³/fed.
- 13- Tankmixture of Tribenuron – methyl (Granstar 75% DF) + 2, 4 – D (2, 4 – Dichlorophenoxy acetic acid), known commercially Amine salt of 2, 4 – D + Fluroxypyr (Starane 20% EC), applied at 15 days from sowing (post – emergence) and used at rates 8g + 1.0L + 200 cm³/fed, respectively.
- 14- Tank mixture of trifloxysulfuron sodium [1 – 4, 6 – dimethoxyypyrimidin – z – Yl) – 3) - 3 – (2, 2, 2 – trifluoroethoxy) – 2 – pyridylsulfonyl] urea – sodium salt], known commercially as Envoke 75% WG + Mineral oil, applied at 15 days from sowing (post – emergence) and used at rates 8g + 1.0L/ fed, respectively.
- 15- Hand weeding twice at 10 and 20 days from sowing.
- 16- Untreated control.

Table 2. Weed flora species existed in the experimental field during summer season of 2014 and 2015

Broadleaf weeds				Narrowleafweeds			
Scientific name	English name	Arabic name	Life cycle	Scientific name	English name	Arabic name	Life cycle
<i>Portulacaoleracea</i>	Common purslane	الرجلة	annual	<i>Cyperusrotundus</i>	Purple nutsedge	السعد	perennial
<i>Amaranthusretroflexus</i>	Common amaromth	عرف الديك	annual	<i>Digitariasanguinalis</i>	Large crabgrass	دفيرة	annual
<i>Euphorbia prostrate</i>	Sun spurge	أم اللبن	annual	<i>Setariaviridis</i>	Foxtail, Green	الصيفية	annual
<i>Bidenspilosa</i>	Black Jacke	البدنس ابرة العجوز	annual	<i>Cenchrusbiflorus</i>	Sandbur	ساندبار	annual
<i>Euphoribahirta</i>	Sun spurge	لبين	annual	<i>Dactylocteniumaegyptium</i>	Crow footgrass	رجل الحربية	annual
<i>Ammimajus</i>	Bishops weed	خلة	annual				
<i>Oxalis corniculata</i>	Sorrel yellow	الحامض	annual				
<i>Sonchusoleraceus</i>	Sow – thistle	الجعضيض	annual				
<i>Conyzaaegyptiaca</i>	Fleabane	حشيشة الجبل	annual				

Weeds and bermudagrass assessments:

Weeds and bermudagrass were hand pulled from one square meter (0.50× 0.50m× 4 times) that randomly chosen from each plot at 30, 60 and 90 days from bermudagrass sowing. The gathered weeds were identified according to ViviTöckholm (1974) as shown in Table 2.

Weed species susceptibility to herbicides used:

The susceptibility of the dominant weed species to the used herbicides was measured at 30, 60 and 90 days from planting depending on the reduction percentage of the fresh weight of each species in treatment compared to those of unweeded check according to the scale mentioned by Frans and Talbert (1977) as follows:

- 1- Susceptible (S) = > 90% reduction
- 2- Moderately susceptible (MS)=80–89% reduction
- 3- Moderately tolerant (MT)=60–79% reduction
- 4- Tolerant (T) = < 60% reduction

Bermudagrass turf plants were air dried for 10 days and then oven deriedat 70⁰C for 96H to estimate their dry weight and each survey.

Statistical Analysis:

The obtained data were subjected to proper statistical analysis of variance, according to (Steel and Jour, 1980) and the least significant differences (LSD) at the 5% level of probability were calculated.

RESULTS AND DISCUSSION

The effect of pre- and post-emergence herbicides on weeds and bermudagrass turf at 30, 60, 90 days from turf planting during 2014 and 2015 summer seasons was shown in Tables 3-10

A- Effect of pre- and post-emergence herbicides on weeds in bermudagrass turf (2014 summer season):

1-At 30 days from bermudagrass planting

In Table 3the dominant annual broadleaf weeds species were *Portulaca oleraceae*, *Amaranthus retroflexus* and *Euphorbia prostrata* with infestation rates 657.0, 415.2 and 13.7g fresh weight/ m², respectively.Howover, otherweed species (broad or narrow) observed in the experimental field were very rare, whereas the perennial narrowleaf weed (*Cyperusrotundus*) was presented with infestation rate of 12.5g/m². Such flora list arein agreement with that mentioned by Beard (1982) for golf course.

Results shown in Table 3 indicate that Barricade (at 600g), Stomp extra extra(at 1.2 and 1.7L), Ronstar (at 1.5L) and Kerb (at 1.25 kg) treatments completely depressed the fresh weight of both *P. oleraceae* and *A. retroflexus*. Meanwhile, Stomp extra at the highest rate of application gave the same effect on *E. porstrata* weed. (100% reduction) the reduction of the rest treatments on *P. oleraceae* ranged from 98.6% by hand weeding twice to 68.1 by Sencor at 300g/fed; on *A. retroflexus* ranged from 99.9% by Ronstar at 2.0L/fed to 87.5% by Sencor at 300g/fed; and on *E. Prostrate*

ranged from 98.6% by Kerb at 1.25kg/ fed to 25.5% by Stomp Extra at 1.2L/ fed

On the other side, all weed control treatments were not significantly effective in controlling annual grassy weeds. This result can not be attributed to less activity of such treatments but due to the very low population of these weeds which masked treatments efficiency. However, the use of Barricade (at 440g), Stomp extra (at 1.7L), Ronstar(at 1.5L) and Kerb(at 1.5 kg)

Again, the effectiveness of the treatments on controlling *C. rotundus* was not satisfactorily, because its distribution was not even in all plots. Concerning the effect of weed control treatments on total broadleaf weeds, results in table 4 show that all herbicidal treatments gave controlling rates or hand weeding > 90%.(exceptSencor) The high efficacy of such herbicides, may be owing to the high susceptibility of *P. oleraceae*, *A. retroflexus* and *E. prostrata*, whereas the lowest efficacy of Sencor may be attributed to the high solubility and movement of metribuzin under sandy soil conditions. El-Sharawy et al. (2007) and Mohamed, Ghada (2008) mentioned that the failure of metribuzin against weed species namely pigweed and jungle vice, in sandy soil is attributed to the mobility of metribuzin and its weak adsorption than other soil types.

As for the total weeds, all weed control treatments gave significant effect on the fresh weight of these weeds, and the highest reduction rates were obtained with Stomp extra (at 1.7L), Kerb(at 1.5kg), Ronstar(at 1.5L) and Barricade (at 600g) by 99.8, 99.5, 99.3 and 99.1%,respectively, as compared to the untreated check. However, the lowest reduction rate (73.2%) was recorded with Sencorat 300g/fed.

2- At 60 days from bermudagrass planting:

It is clear from table 4 that *Portulaca oleraceae* and *Amaranthus retroflexus* were the dominated annual broadleaf weed species with infestation ratesof 96.8 and 120.4 gram of fresh weight/m², respectively,meanwhile *Euphorbia prostrata* was presented in very low infestation rate (1.4 g/m²). On the other hand, *Cyperus rotundus* was the only narrowleaf weed presented in this survey with infestation rate of 26.89/m². Concerning of *P.oleraceae* and *A. retroflexus* weeds, most herbicidal treatments as well as hand weeding significantly controlled both weeds with reduction percentages ranged from 87 to 100% for *P. oleraceae* and from 83.8 to 100% for *A. retroflexus*. However, both Sencor and Panther treatments exhibited no effect against *P. oleraceae* whereas Granstar caused only58.8%reduction in the fresh weight of this weed. In addition, Kerb, Starane, Granstar and Envoke + mineral oil treatments resulted in moderate effects against *A. retroflexus* with reduction percentage in its fresh weight by 74.8, 70.7, 67.8 and 54.0% respectively.

Table 3. Effect of weed control treatments as reduction % of weed fresh weight (g/m²) at 30 days from planting in bermudagrasssturf experimental field during 2014 summer season comparing to the untreated check.

Treatments	Rate/faddan	Time of application	Weed Species													Total broad and narrow leaf weed species g/m ² controlling %			
			Broadleaf weed species*						Narrowleaf weed species**										
			<i>Portulaca oleracea</i>		<i>Amaranthus retroflexus</i>		<i>Euphorbia prostrata</i>		(a) Other broad leaf g/m ²	Total broad leaf g/m ²	controlling%	<i>Cyperus rotundus</i>		(b) other grassy weed	Total narrowleaf g/m ²		controlling %		
g/m ²	%	g/m ²	%	g/m ²	%				g/m ²	%									
1	Barricade65% WG	440g	Pre-em	30.2	95.4	16.2	96.0	1.4	89.7	39.0	87.0	92.0	0	100	57.2	57.2	0	144.2	87.0
2	Barricade65% WG	600g	Pre-em	0	100	0	100	1.4	89.7	3.1	4.5	99.5	4.4	64.8	0	4.4	100	8.9	99.1
3	Stomp Extra 45.5% CS	1.2L	Pre-em	0	100	0	100	10.2	25.5	0	10.2	99.0	58.0	0	0	58.0	0	68.2	93.8
4	Stomp Extra 45.5% CS	1.7L	Pre-em	0	100	0	100	0	100	1.8	1.8	99.8	0	100	0	0	100	1.8	99.8
5	Ronstar25% EC	1.5L	Pre-em	0	100	0	100	1.1	92.8	6.1	7.2	99.3	0	100	0	0	100	7.2	99.3
6	Ronstar25% EC	2L	Pre-em	19.5	97.0	0.2	99.9	0.4	97.0	1.5	21.6	98.0	4.8	61.6	0	4.8	61.6	26.4	97.6
7	Kerb 50% wp	1.25kg	Pre-em	0	100	0	100	2.4	82.4	1.7	4.1	99.6	11.5	8.07	19.7	31.2	0	35.3	96.7
8	Kerb 50% wp	1.5kg	Pre-em	0	100	5.3	98.7	0.19	98.6	0	5.5	99.4	0	100	0	0	100	5.5	99.5
9	Sencor 70% wp	300g	Post-em	209.5	68.1	51.7	87.5	3.6	73.7	4.3	269.1	75.3	5.5	56.0	20.0	25.5	0	294.6	73.2
10	Granstar 75% df	8g	Post-em	14.4	97.8	29.7	92.8	0.43	96.8	0.57	45.1	95.8	2.8	77.6	0	2.8	77.6	47.9	95.6
11	Starane 20% Ec	200cm ³	Post-em	33.1	95.0	51.2	87.6	1.2	91.2	0.43	86.0	92.1	14.6	0	0	14.6	0	100.6	90.8
12	Panther 55% Sc Granstar 75% df+	800cm ³ 8g +	Post-em	33.4	95.0	31.5	92.4	0.75	94.5	0	65.6	94.0	13.5	0	0	13.5	0	79.1	92.8
13	2,4-D 72% EC+ Starane 20% EC	IL+ 200cm ³	Post-em	37.5	94.2	31.7	92.3	72.00	0	.77	141.9	87.0	26.8	0	2.7	29.5	0	171.4	84.4
14	Envoke 75% WG+ Mineral oil	8g+ IL	Post-em	52.3	92.0	16.3	96.0	1.8	86.8	0	70.4	93.5	13.3	0	9.51	22.8	0	93.2	91.5
15	Hand weeding	Twice		8.8	98.6	2.5	99.3	2.3	83.2	.50	14.1	98.7	7.3	41.6	0	7.3	41.6	21.4	98.0
16	Untreated check L S D at 0.05			657.0		415.2		13.7		3.8	1089.7		12.51		12.5		1102.2		
				291.64		250.09		51.31		N.S	304.33		48.47		NS	NS		313.11	

(a): Other broadleaf weeds: *Oxalis corniculata*, *Euphorbia hirta*, *Ammimajus*, *Bidens pilosa*, *Conyza aegyptica*, *Sonchus oleracea*.

(b): Other grassy weeds: *Dactyloctenium aegyptium*, *Cenchrus biflorus*, *Setaria viridis*

Notes: *Cyperus rotundus* was the only perennial weed in the experimental field.

The other annual broadleaf weeds including *E. prostrata* were presented in very low population which masking the weed control treatments efficiency. For *C. rotundus* which was not even presented in the experimental plots, the efficacy of the herbicides was not clear or enough satisfactory.

For the total weeds, most tested treatments significantly reduced the fresh weight of these weeds. Ronstar (at 2 and 1.5L/fed), Kerb (at 1.25 kg/fed), Barricade (at 400g/fed) and Stomp extra (at 1.7L/ fed) gave the highest reduction Percentage, on the fresh weight of the total weeds by 99.3, 95.8, 93.8, 93.2 and 89.5% respectively, meanwhile, the rest treatments gave reduction percentage between 16.3% by Sencorat 300g/fed to 87.6% by Stomp extra at 1.2L/ fed.

3- At 90 days from bermudagrass planting:

Results shown in Table 5 that *Portulaca oleracea*,

Amaranthus retroflexus, and *Euphorbia prostrata* were still the major dominate annual broadleaf weed species. All herbicidal and hand weeding treatments decreased significantly the fresh weight of these weeds. As for *P. oleracea*, Barricade at 440 and 600g/fed, Stomp extra at 1.2 and 1.7L/fed, Ronstar at 1.5 and 2.0L/ fed, Kerb at 1.25 kg/fed and Starane at 200g/ fed gave 100% control. The rest treatments, however, gave variable controlling rates which ranged from 36.3% by Sencorat 300g/ fed to 98.3% by [Granstar at 8g + 2,4-D at 1.0L + Starane at 200 cm/fed]. For *A. retroflexus*, Barricade at 600g, Stomp extra at 1.7L, Ronstar at 1.5 and 2 L, Kerbs at 1.5kg, (Granstar at 8g + 2,4-D at 1.0L + Starane at 200 cm/fed), (Envoke at 8g + mineral oil at 1.0L/fed) and hand weeding twice gave 100% control. The rest treatments resulted in controlling percentage ranged between 20.3% by Sencorat at 300g/fed to 99.8% by Barricade at 440g/ fed.

Table 4. Effect of weed control treatments as reduction % of weed fresh weight (g/m²) at 60 days from planting in bermudagrasssturf experimental field during 2014 summer season comparing to the untreated check.

Treatments	Rate/ faddan	Time of application	Weed Species											Total broad and narrowleaf weed species g/m ²	controlling%	
			Broadleaf weed species									Narrowleaf weed species				
			<i>Portulaca oleracea</i>	<i>Amaranthus retroflexus</i>	<i>Euphorbia prostrata</i>	(a) Other broad leaf			Total broad leaf g/m ²	controlling%	<i>Cyperusrotundus</i>					
						g/m ²	%	g/m ²			%	g/m ²	%			g/m ²
1	Barricade65% WG	440g	Pre-em	0	100	0	100	0	0	0	0.00	100	16.5	38.4	16.5	93.2
2	Barricade65% WG	600g	Pre-em	0	100	0	100	0	0	0	0.00	100	45.6	0	45.6	81.4
3	Stomp Extra 45.5% CS	1.2L	Pre-em	0	100	0	100	0	0	0	0.00	100	30.2	0	30.2	87.6
4	Stomp Extra 45.5% CS	1.7L	Pre-em	12.5	87.1	0	100	0.54	0	11.3	24.3	88.8	2.8	89.5	27.1	89.5
5	Ronstar25% EC	1.5L	Pre-em	0	100	5.4	95.5	0.50	0	4.2	10.1	95.3	0	100	10.1	95.8
6	Ronstar 25% EC	2L	Pre-em	0	100	0	100	0	0	1.5	1.5	99.3	0	100	1.5	99.3
7	Kerb 50% wp	1.25kg	Pre-em	0	100	11.9	90.1	0	0	0	11.9	94.5	3.2	88.	15.1	93.8
8	Kerb50% wp	1.5kg	Pre-em	0	100	30.3	74.8	3.2	0	11.8	45.3	79.2	27.1	0	72.2	70.5
9	Sencor 70% wp	300g	Post- em	179.3	0	11.4	90.5	0	0	0	190.8	12.75	14.2	47.0	205.4	16.3
10	Granstar 75% df	8g	Post- em	39.8	58.8	52.6	67.8	0	0	7.1	99.3	54.4	0	100	99.6	59.4
11	Starane 20% Ec	200cm ³	Post- em	0	100	49.7	70.7	2.4	0	28.3	80.5	63.1	40.5	0	121.0	50.7
12	Panther 55% Sc	800cm ³	Post- em	117.3	0	0	100	0	0	0	117.3	46.3	0	100	117.3	52.2
13	Granstar75% df+ 2.4-D 72% EC+ Starane 20% EC	8g + IL + 200cm ³	Post- em	0	100	5.3	95.5	1.1	0	8.5	14.9	93.1	17.6	34.3	32.5	86.7
14	Envoke75% WG+ Mineral oil	8g + IL	Post- em	11.7	87.9	55.3	54.0	0.51	0	.97	68.5	68.6	3.4	87.3	72.6	70.4
15	Hand weeding	Twice		0	100	19.5	83.8	0	0	0	19.5	91.1	90.2	0	109.8	55.2
16	Untreated check			96.8		120.4		0		1.4	218.7		26.8		245.5	
	L S D at 0.05			130.0		56.18		2.72		NS	136.28		47.75		150.00	

(a): Other broadleaf weeds: *Oxalis corniculata*, *Euphorbia hirta*.

Notes: *Cyperusrotundus* was the only perennial weed in the experimental field.

As regards *E. prostrata*, Barricade at 440g, Ronstar at 2L, Kerb at 1.5kg, and Panther at 800 cm³/fed gave 100% controlling rates, meanwhile the rest treatments exhibited controlling percentage ranged between 56.1% by Sencorat 300g/fed and 95.2% by Stomp extra at 1.2 L/fed.

On the other hand, the annual grassy weed, *D. sanguinalis* was completely controlled with the treatments No. 1, 2, 3, 4, 5, 6, 7, 8, 13 and 15 that shown in Table 5, whilst the rest treatments (No. 9, 10, 11, 12 and 14) gave controlling percentage ranged from 36.4% by (Envokeat 8g + mineral oil at 1.0L/fed) to 87.7% by Granstar at 8g/fed. The only perennial narrowleaf weed, *C. rotundus* was

not even presented in the experimental plots as mentioned before as the habitat of the different perennial weeds species. However, kerb at 1.25 kg, Stomp extra at 1.7L, Envoke + mineral oil, Granstarat 8g + 2, 4-D at 1.0L + Starane at 200 cm³/fed, hand weeding twice, Ronstar at 2 L, Sencor at 300g, Ronstar at 1.5 L and Panther at 800 cm³/fed significantly reduced the fresh weight of this weed by 100, 99.3, 97.8, 95.4, 91.3, 89.3, 88, 84.6 and 81.7%, respectively. The rest treatments caused reduction percentage ranged from 0.0% by both Barricade at 600g and Stomp extra at 1.2 L to 70.8% by Starane at 200 cm³/fed.

Table 5. Effect of weed control treatments as reduction % of weed fresh weight (g/m²) at 90 days from planting in bermudagrass turf experimental field during 2014 summer season comparing to the untreated check.

Treatments	Rate/ feddan	Time of application	Weed Species																	
			Broadleaf weed species								Narrowleaf weed species									
			<i>Portulaca oleracea</i>		<i>Amaranthus retroflexus</i>		<i>Euphorbia prostrata</i>		(a) Other broad leaf g/m ²	Total broad leaf g/m ²	controlling%	<i>Digitaria songuinatis</i>		<i>Cyperus rotundus</i>		Total narrowleaf g/m ²	controlling%	Total broad and narrowleaf weed species g/m ²	controlling%	
g/m ²	%	g/m ²	%	g/m ²	%				g/m ²	%	g/m ²	%								
1	Barricade65 % WG	440g	Pre-em	0	100	0.53	99.8	0	100	0	0.53	99.8	0	100	37.4	36.9	37.4	65.1	37.9	90.3
2	Barricade65 % WG	600g	Pre-em	0	100	0	100	2.6	89.6	3.6	6.2	97.8	0	100	73.8	0	73.8	31.2	80.0	79.7
3	Stomp Extra 45.5% CS	1.2L	Pre-em	0	100	3.05	94.1	1.2	95.2	0	4.3	98.5	0	100	61.6	0	61.6	42.5	65.9	83.2
4	Stomp Extra 45.5% CS	1.7L	Pre-em	0	100	0	100	2.6	89.6	0	2.6	99.0	0	100	.41	99.3	.41	99.6	3.0	99.2
5	Ronstar25% EC	1.5L	Pre-em	0	100	0	100	2.3	90.8	2.3	4.6	98.3	0	100	9.1	84.6	9.1	91.5	13.7	96.5
6	Ronstar 25% EC	2L	Pre-em	0	100	0	100	0	100	1.2	1.2	99.5	0	100	6.3	89.3	6.3	94.1	7.5	98.0
7	Kerb 50% wp	1.25kg	Pre-em	62.5	69.8	3.2	94.8	4.3	82.8	0	70.0	75.6	0	100	0	100	0	100	70.0	82.2
8	Kerb50% wp	1.5kg	Pre-em	0	100	0	100	0	100	6.2	6.2	97.8	0	100	21.8	63.2	21.8	79.6	28.0	92.8
9	Sencor 70% wp	300g	Post-em	128.3	36.3	41.8	20.3	11.0	56.1	0	181.1	36.8	7.0	85.4	7.1	88.0	14.1	86.8	195.2	50.4
10	Granstar 75% df	8g	Post-em	47.3	76.5	6.8	87.0	2.2	91.2	0	56.4	80.3	5.9	87.7	25.4	57.1	31.3	70.8	87.8	77.7
11	Starane 20% Ec	200cm ³	Post-em	0	100	13.5	74.2	8.7	65.3	0	22.3	92.2	19.5	59.3	17.8	70.8	37.3	65.2	59.7	84.8
12	Panther 55% Sc	800cm ³	Post-em	28.0	86.1	19.4	0	0	100	3.8	123.3	57.0	10.2	78.7	10.8	81.7	21	80.4	142.5	63.8
13	Granstar75% df+ 2.4-D 72% EC+	8g + IL +	Post-em	3.4	98.3	0	100	5.4	78.4	11.4	20.3	93.8	0	100	2.7	95.4	2.7	97.4	23.0	94.1
14	Starane 20% EC	200cm ³	Post-em	37.4	81.4	0	100	2.2	91.2	0	39.6	86.2	30.5	36.4	1.3	97.8	31.8	70.3	71.5	81.8
15	Hand weeding	Twice		68.8	65.8	0	100	3.0	88.0	0	71.0	75.2	0	100	5.1	91.3	5.1	95.2	76.1	80.6
16	Untreated check			201.5		52.5		25.1		7.7	287.0		48.		59.3		107.3		394.3	
	L S D at 0.05			76.94		54.85		10.75		NS	94.02		32.98		60.39		NS		133.66	

(a): Other broadleaf weeds: *Oxalis corniculata*, *Euphorbia hirta*, *Bidens pilosa*.
Notes: *Cyperus rotundus* was the only perennial weed in the experimental field.

As for the total broadleaf weeds, all the weed control treatments except Sencor gave significant effect on the fresh weight of these weeds, with reduction percentage ranged from 99.8% for Barricade at 440g to 57% for Panther. General speaking, all the tested weed control treatments significantly reduced the fresh weight of the total weeds (broad – and narrowleaf weeds) ranged between 99.2% for Stomp extra at 1.7L and 50.4% for Sencor at 300g/fed.

These results suggest that the tested herbicidal treatments can give prolonged weed control season in bermudagrass turf through the summer season which work as acting soil herbicides.

4- Bermudagrass turf tolerance to the tested pre- and post-emergence herbicides during 2014 summer season:

Table 6 show the tolerance degree of bermudagrass turf, to the applied pre- and post-emergence herbicides used in controlling the associated weeds at 30, 60 and 90 days depending on the effect of these herbicides on dry weight (g/m²) of bermudagrass as compared with that of untreated check.

As shown in table 6 there is no significant effects for the tested herbicidal treatments or handweeding on bermudagrass dry weight (g/m²) comparing to the untreated

check at all the three studied growth periods. Therefore and according to Beard (1982), it is clearly that bermudagrass had adequate tolerance to all studied individual or combined herbicidal treatments.

Table 6. Effect of weed control treatments on dry weight (g/m²) of bermudagrass after 30, 60 and 90 days from planting in Katamyia heights during 2014 summer season.

Treatments	Rate / feddan	Time of application	Dry weight of bermudagrass (g/m ²)		
			30 days	60 days	90 days
Barricade65% WG	440g	Pre-em	181.7 T	222.0 T	205.7 T
Barricade65% WG	600g	Pre-em	293.0 T	215.6 T	195.5 T
Stomp extra 45.5% CS	1.2L	Pre-em	211.8 T	219.0 T	190.2 T
Stomp extra 45.5% CS	1.7L	Pre-em	201.2 T	226.5 T	215.8 T
Ronstar25% EC	1.5L	Pre-em	183.0 T	203.2 T	200.7 T
Ronstar 25% EC	2L	Pre-em	240.1 T	228.1 T	250.5 T
Kerb 50% WP	1.25kg	Pre-em	200.6 T	220.4 T	208.1 T
Kerb50% WP	1.5kg	Pre-em	216.1 T	214.2 T	245.1 T
Sencor 70% WP	300g	Post-em	194.5 T	184.5 T	164.3 T
Granstar 75% DF	8g	Post-em	196.1 T	215.0 T	200.0 T
Starane 20% EC	200cm ³	Post-em	180.5 T	228.9 T	187.7 T
Panther 55% SC	800cm ³	Post-em	217.2 T	224.7 T	208.0 T
Granstar 75% DF + 2.4-D 72% EC+ Starane 20% EC	8g 1L 200cm ³	Post-em	192.3 T	198.7 T	194.9 T
Envoke75% WG+ Mineral oil	8g 1L	Post-em	198.4 T	198.3 T	208.4 T
Hand weeding	Twice		203.7 T	246.3 T	212.7 T
Untreated check			172.6 T	215.9 T	212.1 T
L S D at 0.05			NS	NS	NS

Note: According to Beard (1982) T=Adequate tolerance with proper use of the herbicides, M= Marginal tolerance, injury can occur.

B- Effect of weed control treatments on weeds and bermudagrass turf at 2015 summer season:

1- At 30 days from bermudagrass planting:

Data in Table 7 indicated that the dominant weeds species in this season were *Portulacaoleracea*, *Amaranthus retroflexus*, *Euphorbia prostrata*, *Bidenspilosa* (as annual broadleaved weeds) and *Digitaria sanguinalis* (as annual narrow leaved weeds) with infestation levels of 1152.3, 818.0, 48.8, 362.4 and 23.5g fresh weight/m², respectively, where as *Cyperus rotundus* still the only recorded perennial narrowleaf weed with level of 726.4 g/m².

In general, all herbicidal and hand weeding treatments were highly effective in controlling the previous weeds species. For *P. oleracea*, both hand weeding and Starane gave the same highest controlling percentage (94.3%) while Sencor gave the lowest percentage (65.8%). Regarding *A. retroflexus*, the corresponding highest and lowest controlling percentage were 96.9 and 75.5% for Ronstar at 1.5L and tank mixture of Granstar + 2, 4-D + Starane, respectively. Respecting *E. prostrata*, Sencor, Granstar, Envoke + mineral oil and Panther gave controlling percentage of 99.1, 97.5, 92.2 and 44.6%, respectively, whereas the rest treatments resulted 100% control.

For *Bidens pilosa*, Granstar, Starane and Barricade at 600g/ fed gave controlling percentage of 89.5, 85.6 and 85.2%, respectively, where as those of the rest of treatments ranged between 63.2% by Barricade at 440g/fed and 84.6% by hand weeding.

On the other hand, the following treatments; Barricade at 440g, Ronstar at 1.5 and 2L, Kerb at 1.5 kg, Granstar, Starane and hand weeding completely controlled *D. sanguinalis*, as annual narrowleaf weed, meanwhile the rest treatments caused controlling percentages ranged from 6.3% for Envoke + mineral oil to 80.8% for Kerb at 1.25 kg. Regarding the perennial grassy weed, *C. rotundus*, Sencor, Panther, Envoke +

mineral, Ronstar at 2L, Kerb at 1.25 kg, hand weeding, Stomp extra at 1.7L and Starane gave controlling rates of 94.4, 91.2, 88.5, 88.4, 87.1, 86.9, 80.5 and 80.5%, respectively, whereas the rest treatments resulted controlling percentages ranged between 66.5% for Kerb at 1.5kg and 79.1% for Stomp extra at 1.2L.

The results indicated that all the tested treatments gave significant effect on the fresh weight of the total narrowleaf weeds, and the highest reduction rates were obtained with Sencor, Ronstar at 2 L, Panther and hand weeding by 92.3, 88.8, 88.7 and 87.3%, respectively, as compared to the untreated control, whilst, the rest treatments gave reduction percentages between 67.5% by kerb at 1.5 to 85.9% by (Envoke + mineral oil).

As for the total weeds, all the examined treatments significantly reduced their fresh weights and the highest reduction percentages were recorded with hand weeding, (Envoke + mineral oil), Barricade at 600g and 400g by 88.7, 88.3, 87.8 and 86.5%, respectively, as compared to the untreated check. The rest of treatments, gave reduction rates between 73.7% by Kerb at 1.5 to 86.4% by Stomp extra at 1.2L.

2- At 60 days from bermudagrass planting:

Data in Table 8 illustrated that the annual broadleaf weeds i.e. *Portulaca oleraceae*, *Amaranthus retroflexus* and *Bidenspilosa* and the perennial narrow leaf weed i.e. *Cyperus rotundus* was the predominated weed species at 60 days.

All weed control treatments satisfactorily reduced the fresh weight of *P. oleracea*, and Stomp extra at 1.2, hand weeding and Barricade at both 600 and 440g gave the highest reduction rates by 87.6, 84.8, 84.6 and 79.8%, respectively, meanwhile, the rest of treatments gave reduction percentages between 56.8% by Stomp extra at 1.7L to 79% by Kerb at 1.5kg/fed.

As for *A. retroflexus*, Ronstar at 1.5L, Barricade at both 600 and 440g gave the highest reduction percentages

by 85.6, 83.0 and 82.4%, respectively, whereas the rest of treatments gave reduction percentages between 57.5% by Kerb at 1.25kg and 79.1% by Stomp extra at 1.2L/fed.

As for *Bidens pilosa*, all the weed control treatments significantly reduced its fresh weight and the highest reduction percentage was obtained by Granstar (89.7%) whereas the lowest percentage was recorded with Kerb at 1.25 kg (63.9%).

As the other annual broadleaf weeds, e.g. *Euphorbia hirta*, rarely exist in experimental field, the herbicidal treatments didn't exhibit any significant effect against such weed.

Moreover, the effects of the tested weed control treatments on the fresh weight of the total annual broadleaf weeds were identical to those observed on the individual dominant weeds.

Table 7. Effect of weed control treatments as reduction % of weed fresh weight (g/m²) at 30 days from planting in bermudagrass turf experimental field during 2015 summer season comparing to the untreated check.

Treatments	Rate/ feddan	Time of application	Weed Species																				
			Broadleaf weed species								Narrowleaf weed species												
			<i>Portulaca oleracea</i>		<i>Amaranthus retroflexus</i>		<i>Euphorbia prostrata</i>		<i>Bidens pilosa</i>		Other broad leaf		Total broad leaf g/m ²		<i>Digitaria songuinilis</i>		<i>Cyperus rotundus</i>		Other grassy weed		Total narrowleaf g/m ²		
			g/m ²	%	g/m ²	%	g/m ²	%	g/m ²	%	(a)	Controlling %	g/m ²	%	g/m ²	%	(b)	controlling %	Total broadleaf + narrowleaf weed species g/m ²	controlling %			
1	Barricade65 % WG	440g	Pre-em	90.6	92.1	32.9	95.9	0.0	100	133.2	63.2	0.0	256.8	89.4	0.0	100	169.4	76.6	0.0	169.4	77.4	426.2	86.5
2	Barricade65 % WG	600g	Pre-em	121.9	89.4	39.3	95.1	0.0	100	53.6	85.2	0.0	214.8	91.1	8.4	64.2	164.1	77.4	0.0	172.6	76.9	387.4	87.8
3	Stomp Extra 45.5% CS	1.2L	Pre-em	99.6	91.3	106.2	87.0	0.0	100	68.0	81.2	1.3	275.1	88.6	5.0	78.7	151.2	79.1	0.0	156.2	79.1	431.3	86.4
4	Stomp Extra 45.5% CS	1.7L	Pre-em	263.0	77.1	153.0	81.2	0.0	100	88.1	75.6	0.0	504.1	79.2	20.4	13.1	141.2	80.5	0.0	161.6	78.4	665.8	79.4
5	Ronstar25% EC	1.5L	Pre-em	343.8	70.1	24.9	96.9	0.0	100	107.7	70.2	7.9	484.3	80.0	0.0	100	238.7	67.1	0.0	238.7	68.1	723.0	77.2
6	Ronstar 25% EC	2L	Pre-em	204.3	82.2	79.6	90.2	0.0	100	69.1	80.9	0.0	353.1	85.4	0.0	100	83.7	88.4	0.0	83.7	88.8	436.8	86.2
7	Kerb 50% wp	1.25kg	Pre-em	216.7	81.1	163.5	80.0	0.0	100	93.4	74.2	0.0	473.6	80.4	4.5	80.8	93.2	87.1	49.9	147.6	80.3	621.2	80.4
8	Kerb50% wp	1.5kg	Pre-em	354.0	69.2	155.6	80.9	0.0	100	83.0	77.0	0.0	592.6	75.5	0.0	100	243.0	66.5	0.0	243.0	67.5	835.6	73.7
9	Sencor 70% wp	300g	Post-em	393.9	65.8	125.5	84.6	0.4	99.1	101.6	71.9	0.0	621.4	74.4	17.1	27.2	40.6	94.4	0.0	57.7	92.3	679.1	78.6
10	Granstar 75% df	8g	Post-em	219.0	81.0	155.5	80.9	1.2	97.5	37.7	89.5	0.0	413.4	82.9	0.0	100	176.3	75.7	0.0	176.3	76.4	589.8	81.4
11	Starane 20% Ec	200cm	Post-em	65.0	94.3	194.6	76.2	0.0	100	52.0	85.6	18.3	329.9	86.4	0.0	100	141.3	80.5	0.0	141.3	81.1	471.2	85.1
12	Panther 55% Sc	800cm	Post-em	156.0	86.4	94.9	88.3	27.0	44.6	93.6	74.1	0.0	371.6	84.6	12.5	46.8	63.3	91.2	8.2	84.0	88.7	455.7	85.6
	Granstar 75% df + 2.4-D 72% EC + Starane 20% EC	8g + 200cm	Post-em	110.1	90.4	200.3	75.5	0.0	100	66.1	81.7	11.7	387.7	84.0	11.7	50.2	171.1	76.4	49.9	232.7	68.9	620.5	80.4
14	Starane 20% EC + Envoke75% WG + Mineral oil	200cm + 8g + IL	Post-em	130.4	88.6	65.6	91.9	3.8	92.2	65.2	81.7	46.3	265.0	89.0	22.0	6.3	83.1	88.5	0.0	105.1	85.9	370.1	88.3
15	Hand weeding	Twice		65.6	94.3	140.7	82.7	0.0	100	55.8	84.6	0.0	262.1	89.2	0.0	100	94.5	86.9	0.0	94.5	87.3	356.6	88.7
16	Untreated check			1152.3		818.0		48.8		362.4		46.32	2427.8		23.5		726.4		0.0	749.9		3177.7	
	L S D at 0.05			256.05		185.1		25.03		67.45		NS	350.5		28.28		188.09		NS	196.02		346.05	

(a) Other broadleaf: *Euphorbia hirta*

(b) Other Grassyweed: *Dactyloctenium aegyptium*.

Notes: *Cyperus rotundus* was the only perennial weed in the experimental field.

Table 8. Effect of weed control treatments as reduction % of weed fresh weight (g/m²) at 60 days from planting in bermudagrass turf experimental field during 2015 summer season comparing to the untreated check.

Treatments	Rate/ feddan	Time of application	Weed Species																
			Broadleaf weed species								Narrowleaf weed species								
			<i>Portulaca oleracea</i>		<i>Amaranthus retroflexus</i>		<i>Bidens bitulsa</i>		(a) Other broad leaf g/m ²	Total broad leaf g/m ²	controlling %	<i>Cyperus rotundus</i>		(b) other grassy weed Total narrowleaf g/m ²	Controlling %	Total broad and narrowleaf weed species g/m ²	Controlling %		
			g/m ²	%	g/m ²	%	g/m ²	%				g/m ²	%						
1	Barricade 65% WG	440g	Pre-em	137.1	79.8	91.2	82.4	120.3	75.5	1.0	349.6	80.0	240.8	71.7	0.0	240.8	71.7	590.5	77.2
2	Barricade 65% WG	600g	Pre-em	104.1	84.7	88.3	83.0	138.1	71.9	0.0	330.5	81.0	264.2	68.9	0.0	264.2	68.9	594.7	77.0
3	StompExtra 45.5% CS	1.2L	Pre-em	84.1	87.6	1083.4	79.1	147.7	70.0	0.0	340.2	80.4	178.8	78.9	0.0	178.8	78.9	519.0	80.0
4	StompExtra 45.5% CS	1.7L	Pre-em	294.3	56.8	142.3	72.6	160.5	67.3	0.0	597.1	65.6	305.4	64.1	0.0	305.4	64.1	902.5	65.1
5	Ronstar 25% EC	1.5L	Pre-em	263.6	61.3	74.5	85.6	175.8	64.2	0.0	514.0	70.4	263.2	69.0	14.6	277.8	67.3	791.8	69.4
6	Ronstar 25% EC	2L	Pre-em	206.2	69.7	152.8	70.6	97.1	80.2	3.4	459.7	73.5	121.5	85.7	6.0	127.5	85.0	587.2	77.3
7	Kerb 50% wp	1.25kg	Pre-em	194.3	71.4	220.5	57.5	177.2	63.9	0.0	592.1	65.9	265.6	68.7	81.8	347.4	59.1	939.6	63.7
8	Kerb 50% wp	1.5kg	Pre-em	142.3	79.0	111.9	78.4	175.2	64.3	0.0	429.7	75.3	228.1	73.1	126.2	354.3	58.3	784.0	69.7
9	Sencor 70% wp	300g	Post-em	213.6	68.6	215.7	58.5	169.3	65.5	39.4	638.1	63.3	396.0	53.4	2.0	398.0	53.2	1036.1	60.0
10	Granstar 75% df	8g	Post-em	236.9	65.2	158.5	69.5	50.5	89.7	110.1	556.2	68.0	161.8	80.9	12.8	174.6	79.4	730.8	71.8
11	Starane 20% Ec	200cm ³	Post-em	200.4	70.5	200.1	61.5	78.3	84.0	28.7	507.5	70.8	234.1	72.4	18.8	252.9	70.2	760.4	70.6
12	Panther 55% Sc	800cm ³	Post-em	282.1	58.5	203.7	60.8	130.6	73.4	25.2	641.7	63.1	179.7	78.8	103.7	283.4	66.6	925.1	64.2
13	Granstar 75% df+ 2.4-D 72% EC+	8g + IL+	Post-em	204.1	70.0	171.1	67.0	162.5	66.9	38.6	576.3	66.8	164.6	80.6	91.7	256.3	69.8	832.7	67.8
14	Starane 20% EC Envoke 75% WG+ Mineral oil	200cm ³ 8g + IL	Post-em	232.7	65.8	194.7	62.5	65.8	86.6	8.7	502.0	71.1	103.1	87.8	0.0	103.1	87.8	605.2	76.6
15	Hand weeding	Twice		103.4	84.8	147.4	71.6	70.2	85.7	72.7	393.7	77.3	90.7	89.3	31.7	122.4	85.6	516.1	80.0
16	Untreated check			681.3		520.0		491.9		46.5	1739.7		851.0		0.0	851.0		2590.7	
	LSD at 0.05			216.92		102.31		96.96		NS	265.3		241.97		NS	261.26		318.41	

(a) Other broadleaf: *Euphorbia hirta*

(b) Other grassyweed: *Dactyloctenium aegyptium*, *Cenchrus biflorus*.

Notes: *Cyperus rotundus* was the only perennial weed in the experimental field.

Concerning the fresh weight of the perennial narrowleaf weed (*Cyperus rotundus*), hand weeding, Envoke + mineral oil and Ronstar at 2.0L gave the highest reduction percentages by 89.3, 87.8 and 85.7%, respectively, meanwhile, the other treatments gave reduction percentages between 53.2% by Sencor and 80.9% by Granstar. Again, the examined weed control treatments did not cause significant effect on the fresh weight of the other annual grassy weeds, due to their low population.

As for the total weeds, all the applied weed control treatments exhibited significant effect on the fresh weight of these weeds. Stomp extra at 1.2L, hand weeding, Ronstar at 2L and Barricade at both 440g and 600g/fed gave the highest reduction percentages were 80.0, 80.0, 77.3, 77.2 and 77.0%, respectively, whereas the rest treatments gave reduction percentages between 60% by Sencor and 76.6% by Envoke + mineral.

3- At 90 days from bermudagrass planting:

Data in Table 9 illustrated that the dominant weeds at 90 days from bermudagrass planting were *Portulacaoleracea*, *Amaranthusretroflexus*, *Euphorbia prostrate*, *Bidenspilosa* and *Ammimajus* (as annual broadleaved), *Digitariasanguinalis* (as annual narrowleaved) and *Cyperus rotundus* (as perennial narrowleaved weed). The results, also, indicated that all the weed control treatments significantly reduced the fresh weigh of such weeds with few exceptions.

Barricade at 440g, Granstar + 2, 4-D + Starane, Stomp extra at 1.2L, Barricade at 600g and hand weeding gave the highest reduction percentages on *P. oleracea* by 84.5%; 83.3%; 81.6%, 77.8% and 77.8%, respectively, as compared to untreated check. Accordingly, such treatments can gave season long weed control in bermudagrass turf. Meanwhile, the rest treatments gave reduction percentages ranged from 65.6% by Ronstar at 2L to 77.6% by both Stomp extra at 1.7L and Ronstar at 2L. As for *A. retroflexus*, Envoke + mineral oil and hand weeding gave the highest reduction percentage by 75.9% and 72.3%, respectively, as compared to untreated check, whilst the rest treatments gave reduction rates ranged between 46.5% by Ronsrar at 1.5 L and 68.9% by Stomp extra at 1.2L/fed.

As for *E. prostrata*, the highest reduction percentages were obtained with hand weeding, Starane, Barricade at 400g and both Barricade at 600g, and Stomp extra at 1.2 L/fed by 91.5; 87.6; 86.7 and 78% respectively, compared to untreated control. Whilst, the rest treatments gave reduction percentages between 48.2% by Panther and 77.5% by Kerb at 1.25L/fed

As for *Bidenspilosa*, the highest reduction percentages were obtained with Envoke + mineral oil, Barricade at 440g and Kerb at 1.25 kg by 86.8, 81.5 and 80.4%, respectively, as compared to untreated control, whilst the rest treatments gave reduction percentages ranged from 52.3% by Ronstar at 2L to 77.5% by Stomp extra at 1.2 L/ fed.

As for *Ammimajus*, the highest reduction rates were obtained with Barricade at 440g, hand weeding, Barricade at 600g and Ronstar at 1.5 L/ fed by 93.9, 91.1, 88.8 and 84.3% respectively, as compared to untreated control, whereas the rest treatments gave reduction percentages ranged between 47.0% by Kerb at 1.5 kg and 77.7% by Granstar.

Regarding the annual grassy weed, *D. sanguinalis*, all the weed control treatments significantly reduced its fresh weight and the highest reduction (100%) was obtained by Barricade 440g, Stomp extra at 1.2L, Ronstar at both 1.5 and 2L, Kerb at 1.5 kg, Starane and Panther. The rest treatments gave reduction rates between zero effect by Envoke + mineral oil and 87.7% by Granstar.

In regard to the fresh weight of the perennial narrowleaf weed, *Cyperus rotundes*, the highest reduction percentages were obtained with Stomp extra at 1.2L; Starane, Granstar, Kerb at 1.5kg, Barricade at 600g, Panther and Kerb at 1.25kg, by 89.4, 84.9, 83.6, 82.7, 81.9, 80.9 and 80.3%, respectively, compared to untreated control, whilst the rest treatments gave reduction percentages ranged between 59.6 by

Barricade at 440g to 79.1% by hand weeding.

As for the total narrowleaf weeds, Stomp extra at 1.2L, Starane, Granstar, Panther, Barricade at 600g, Kerb at 1.5 kg and Granstar + 2, 4-D + Starane treatments gave the highest controlling rates of 91.4, 87.8, 85.7, 84.6, 82.7, 82.0 and 81.0%, respectively, whereas, the rest treatments gave reduction percentages ranged from 62.7% by Envoke + mineral oil to 77.9% by hand weeding.

Concerning the total weeds, (broad – and grassy weeds), hand weeding, Stomp extra at 1.2 L, Granstar + 2.4-D + Starane and Barricade at both 600g and 400g/fed gave the highest controlling percentages by 80.4, 79.7, 77.7, 77.4 and 77.3%, respectively, as compared to untreated check, whilst the rest treatments gave controlling percentages ranged between 63.1% by Kerb at 1.5 kg and 73.2 by Envoke + mineral oil. In this respect, McCullough *et al.* (2007) stated that pendimethalin and prodiamine are very useful for controlling annual weeds in bermudagrass turf. Brecke *et al.* (2008) reported that trifloxyf sulfuron can be applied effectively in controlling southern crabgrass in bermudagrass turf. Also, Brosnan *et al.* (2014) found that pendimethalin at 3.36 kg/ha, prodiamine at 0.6 kg/ha and oxadiazon at 3.36 kg/ha increased the days required to reach 50% hybrid bermudagrass cover comparing with the untreated control.

The herbicidal treatments didn't cause any significant effect on the other broad – or narrowleaf weeds that surveyed in the experimental field because they were rarely encountered.

4- Bermudagrass turf tolerance to pre- and post-emergence herbicides:

Data shown in Table 10 indicated the tolerance level of bermudagrass to the applied herbicides in 2015 season is relatively varied with that of 2014 season. The results indicated that all the applied herbicides, except Granstar, exhibited significant effect on the dry weight of bermudagrass at 30 days after planting. Therefore and according to Beard (1982), the tested herbicides treatments caused transitory phytotoxic aspects on bermudagrass at 30 days of planting which ranked as marginal tolerance (M). However, such phytotoxic aspects completely disappeared at 60 and 90 days of planting, with two exceptions: i.e. Kerb at 1.25kg and "Granstar + 2, 4-D + Starane" treatments, which ranked as adequate tolerance (T).

These results are in agreement with those obtained by McCullough *et al.* (2007) they determined the response of warm season bermudagrass types to some herbicides. They also reported that oxadiazon at 2.2kg/ha and pendimethalin at 1.7kg/ha reduced root mass of bermudagrass by 2-15% and 28-37%, respectively, comparing with the untreated check. Patton *et al.* (2007) determined that the warm season zoysiagrass turf safety of both oxadiazon (at 3.4kg/ha) and pronamide (at 1.1kg/ha). They also found that these herbicidal treatments did not reduce coverage 7 weeks after emergence and caused only temporary discoloration of seedlings. Brosnan *et al.* (2014) mentioned that the use of oxadiazon at 2.4kg/ha and pronamide at 1.68kg/ha can be used effectively to control weeds without any adverse effects on bermudagrass turf.

Table 9. Effect of weed control treatments as reduction % of weed fresh weight (g/m²) at 90 days from planting in bermudagrass turf experimental field during 2015 summer season comparing to the untreated check.

Treatments	Rate/ faddan	Time of application	Weed Species																									
			Broadleaf weed species										Narrowleaf weed species															
			<i>Portulaca oleracea</i>		<i>Amaranthus retroflexus</i>		<i>Euphorbia prostrata</i>		<i>Bidens bitusa</i>		<i>Ammimajuc</i>		Total broad leaf g/m ²		Controlling %		<i>Digitaria songuinatis</i>		<i>Cyperus rotundus</i>		(b) other grassy weed		Total narrow leaf g/m ²		Controlling %		Total broad and narrowleaf weed species g/m ² controlling %	
			g/m ²	%	g/m ²	%	g/m ²	%	g/m ²	%	g/m ²	%	g/m ²	%	g/m ²	%	g/m ²	%	g/m ²	%	g/m ²	%	g/m ²	%	g/m ²	%	g/m ²	%
1	Barricade65% WG	440g	Pre-em	76.3	84.5	61.7	58.5	26.6	86.7	32.0	81.5	20.8	93.9	10.4	227.9	80.4	0.0	100	118.4	59.6	0.0	118.4	67.3	346.4	77.3			
2	Barricade65% WG	600g	Pre-em	109.8	77.8	49.2	66.9	44.0	78.0	47.0	72.5	14.4	88.8	18.1	283.4	75.7	5.4	82.1	53.0	81.9	4.3	62.7	82.7	346.1	77.4			
3	Stomp Extra 45.5% CS	1.2L	Pre-em	90.6	81.6	46.3	68.9	44.1	78.0	39.0	77.5	29.9	76.8	28.6	278.7	76.1	0.0	100	31.0	89.4	0.0	31.0	91.4	309.8	79.7			
4	Stomp Extra 45.5% CS	1.7L	Pre-em	170.4	65.6	48.5	67.4	52.8	73.7	55.6	67.9	30.8	76.1	0.0	358.3	69.3	27.5	8.9	64.1	78.1	18.7	110.4	69.5	468.7	69.3			
5	Ronstar25% EC	1.5L	Pre-em	110.4	77.6	79.5	46.5	59.9	70.1	56.2	67.5	20.2	84.3	23.6	350.1	70.0	0.0	100	99.4	66.1	0.0	99.4	72.6	449.5	70.6			
6	Ronstar25% EC	2L	Pre-em	170.0	65.6	65.6	55.9	65.5	67.3	82.7	52.3	34.9	73.0	16.7	435.6	62.7	0.0	100	96.0	67.2	0.0	96.0	73.5	531.6	65.2			
7	Kerb50% wp	1.25kg	Pre-em	156.6	68.3	47.3	68.2	45.1	77.5	33.9	80.4	48.9	62.1	0.0	331.9	71.5	8.5	71.8	57.7	80.3	20.3	86.6	76.1	418.5	72.6			
8	Kerb50% wp	1.5kg	Pre-em	162.5	67.1	72.5	51.3	71.9	64.1	67.0	61.3	68.4	47.0	55.8	498.4	57.3	0.0	100	50.6	82.7	14.5	65.1	82.0	563.5	63.1			
9	Sencor70% wp	300g	Post-em	144.7	70.7	52.7	64.6	52.4	73.9	64.6	62.7	58.8	54.5	0.0	373.4	68.0	5.9	80.4	67.8	76.8	21.6	95.5	73.6	468.9	69.3			
10	Granstar75% df	8g	Post-em	165.1	66.6	68.7	53.8	75.4	62.4	63.1	63.6	28.8	77.7	8.7	410.0	64.8	3.7	87.7	47.9	83.6	0.0	51.6	85.7	461.6	69.8			
11	Starane20% Ec	200cm ³	Post-em	145.7	70.5	76.1	48.8	24.7	87.6	71.9	58.5	57.5	55.5	2.3	378.3	67.6	0.0	100	44.1	84.9	0.0	44.1	87.8	422.5	72.4			
12	Panther55% Sc	800cm ³	Post-em	158.3	68.0	63.7	57.2	104.0	48.2	64.0	63.0	40.9	68.3	2.8	433.9	62.8	0.0	100	55.8	80.9	0.0	55.8	84.6	489.7	68.0			
13	Granstar75% df+ 24-D72% EC+ Starane20% EC	8g+ IL+ 200cm ³	Post-em	82.5	83.3	54.5	63.3	56.4	71.9	46.0	73.4	32.5	74.8	0.0	272.0	76.7	3.8	87.4	64.9	77.8	0.0	68.7	81.0	340.7	77.7			
14	Envoke75% WG+ Mineral oil	8g+ IL	Post-em	135.5	72.6	35.8	75.9	48.2	75.9	22.8	86.8	32.1	74.8	0.0	274.6	76.4	36.8	0	98.5	66.4	0.0	135.3	62.7	410.0	73.2			
15	Hand weeding	Twice		109.7	77.8	41.1	72.3	17.0	91.5	40.4	76.7	11.4	91.1	0.0	219.8	81.1	11.2	62.9	61.1	79.1	7.6	79.9	77.9	299.8	80.4			
16	Untreated check			494.9		148.9		200.8		173.4		129.3		20.5	1168.0		30.2		293.3		39.5		363.0		1531.1			
	LSD at 0.05			121.65		17.99		44.94		29.5		27.2		NS	175.8		30.20		63.69		NS		70.6		188.07			

(a) Other broadleaf weeds: *Bidens belusa*, *Conyzaeegyptice*, *Sonchusoleraceos*

(b) Other grassy weeds: *Dactylocteniumaegyptium*-*Cenchrusbiflorus*.

Notes: *Cyperusrotundus* was the only perennial weed in the experimental field.

Thus, such herbicides can be used effectively for controlling weeds in bermudagrass turf with adequate tolerance in sandy soil under sprinkler irrigation system. Therefore, Barricade at 600g, Stomp extra at 1.2L, pendimethalin at 2.0L and Ronstar at 2.0L/fed (as pre-emergence herbicides) and Granstar, and Starane (as post-emergence herbicides) can be used selectively to control annual weeds with adequate bermudagrass

tolerance.

Moreover, Envoke + mineral oil can be used selectively to control the perennial grassy weed, *Cyperusrotundus* without any adverse effect on bermudagrass turf under sprinkler irrigation in sandy soil and depending on the dominant weed species in the experimental field.

Table 10. Effect of weed control treatments on dry weight (g/m^2) of bermudagrass after 30, 60 and 90 days from planting in Katameya heights, Cairo, 2015 summer season

No.	Weed Control Treatments	Herbicide rate / faddan	Time of application	Dry weight of bermudagrass (g/m^2) during 2015		
				30 days	60 days	90 days
1	Barricade65% WG	440g	Pre-em	174.9 M	240.1 T	188.9 T
2	Barricade65% WG	600g	Pre-em	183.3 M	259.3 T	213.3 T
3	Stomp45.5% CS	1.2L	Pre-em	178.7 M	263.0 T	184.1 T
4	Stomp45.5% CS	1.7L	Pre-em	169.4 M	235.6 T	203.1 T
5	Ronstar25% EC	1.5L	Pre-em	177.2 M	240.0 T	213.0 T
6	Ronstar 25% EC	2L	Pre-em	179.5 M	257.8 T	199.0 T
7	Kerb 50% WP	1.25kg	Pre-em	186.8 M	199.1 M	214.9 T
8	Kerb50% WP	1.5kg	Pre-em	184.2 M	260.7 T	217.7 T
9	Sencor 70% WP	300g	Post-em	173.1 T	216.5 T	212.8 T
10	Granstar 75% DF	8g	Post-em	209.1 T	244.4 T	223.6 T
11	Starane 20% EC	200cm ³	Post-em	167.6 M	227.5 T	224.6 T
12	Panther 55% SC	800cm ³	Post-em	182.1 M	222.0 T	189.4 T
13	Granstar 75% DF+	8g+	Post-em	162.6 M	208.7 M	199.0 T
	2, 4-D 72% EC+ Starane 20% EC	IL+ 200cm ³				
14	Envoke75% WG+	8g+	Post-em	174.2 M	219.9 T	235.6 T
	Mineral oil	IL				
15	Hand weeding	Twice		206.2 T	243.9 T	201.4 T
16	Untrented check			229.7	258.0	193.1
	L S D at 0.05			23.47	41.4	NS

Note: According to Beard (1982) T=Adequate tolerance with proper use of the herbicides, M= Marginal tolerance, injury can occur.

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تأثير مبيدات الحشائش قبل وبعد الإنبات على مكافحة الحشائش المصاحبة لمسطح نجيل البرمودا الأخضر
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^٢ قسم وقاية النبات، كلية الزراعة، جامعة الأزهر – القاهرة، مصر.
^٣ المعمل المركزي لبحوث الحشائش، مركز البحوث الزراعية، الجيزة، مصر.

في السنوات الأخيرة لعبت المسطحات الخضراء دوراً هاماً في الاقتصاد القومي في قطاع السياحة لذلك زاد الاهتمام بزراعتها والعناية بها ومن ثم كان من الضروري معرفة الآفات التي تنتشر بها وإدارة هذه الآفات – خاصة الحشائش – بشكل علمي لتجنب الأضرار الناجمة عن تلك الآفات والتي بالضرورة تؤثر على كثافتها وجودتها وجاذبيتها. لذلك فقد أجريت هذه الدراسة بملاعب الجولف بمرتفعات القطامية بالقاهرة الجديدة، خلال تجربتين حقليتين في الموسم الصيفي لعامي ٢٠١٤ و ٢٠١٥ في أرض رملية وتحت نظام الري بالرش بهدف تقييم فاعلية أربعة عشر مستحضراً لمبيدات الحشائش الاختيارية قبل وبعد الإنبات على الحشائش المصاحبة لمسطحات البرمودا الخضراء إلى جانب تقييم درجة تحمل نباتات البرمودا للمبيدات المختبرة باعتبارها هي المحصول الرئيسي المستهدف حمايته وذلك مقارنة بمعاملتي النقاوة البيدوية والمقارنة. وقد تضمنت التجربة ١٦ معاملة [٨ معاملات طبقت بعد الزراعة وقبل الري، ٦ معاملات طبقت بعد الإنبات، بجانب معاملتي النقاوة البيدوية والمقارنة]. وقد أوضحت النتائج ما يأتي: الحشائش الحولية عريضة الأوراق السائدة بأرض التجربة خلال موسم الدراسة هي: الرجل، عرف الديك، أم اللين في حين وجدت حشائش إبرة العجوز، نشاش الدبان (حشيشة الجبل)، الجزر البري، الجعبيض، الحامض، لبين ولكن بصورة نادرة. الحشائش الحولية رفيعة الأوراق السائدة بأرض التجربة خلال موسم الدراسة هي: الدفيرة، الصيفية، نعيم الصليب (رجل الحريابة)، الساندار. في حين كانت حشيشة السعد هي الحشيشة الوحيدة المعمرة التي تم رصدها خلال الموسم. في الموسم الأول أحدثت المعاملات المتخصصة في مكافحة الحشائش العريضة والنجيلية معدلات مكافحة للحشائش الكلية عند الفحص الأول (بعد ٣٠ يوماً من الزراعة) في الموسم الأول تراوحت بين ٩٩% لمبيد الاستومب بمعدل ١.٧ لتر/ الفدان ثم ٩٨.٩% لمبيد الكيرب بمعدل ١.٥ كجم/ الفدان ثم ٩٥% لمبيد الرونستار بمعدل ٢ لتر/ الفدان ثم ٩٦% لمبيد الباركيدي بمعدل ٦٠٠ جرام/ الفدان وأخيراً كان مبيد السنكور (٤٢.٢%) وعند الفحص الثاني (بعد ٦٠ يوم من الزراعة) تراوحت نسب المكافحة بين ٤٢.٥% لمبيد الجرانستار بمعدل ٨ جم/ الفدان و ٩٦.٥% لمبيد الرونستار بمعدل ٢ لتر/ الفدان. وعند الفحص الثالث (بعد ٩٠ يوم من الزراعة) تراوحت هذه النسبة بين ٤٥.٢% لمخلوط التنك المكون من جرانستار (٨ جم) + 4-D, 2 (١ لتر) + استارين (٢٠٠ سم^٣/ الفدان) و ٩٢.٢% لمبيد الاستومب بمعدل ١.٧ لتر/ الفدان. أما في الموسم الثاني فقد تراوحت معدلات مكافحة الحشائش الكلية من ٧٤.٧% لمبيد الكيرب بمعدل ١.٥ كجم/ الفدان إلى ٨٩.٩% لمبيد الأنفوك ٨ جرام مخلوطاً بالزيت المعدني بمعدل ١ لتر/ الفدان في الحصر الأول (٣٠ يوماً) ومن ٦٤.١% لمبيد البانتر بمعدل ٨٠٠ سم^٣/ الفدان إلى ٨٢.٥% للنقاوة البيدوية في الحصر الثاني (٦٠ يوماً) ومن ٦٦% لمبيد الكيرب إلى ٨٢.٥% للنقاوة البيدوية في الحصر الثالث (٩٠ يوماً). أظهرت نباتات البرمودا كمسطح أخضر يمثل المحصول الرئيسي مستوى تحمل كامل لجميع المبيدات المستخدمة عند جميع مراحل النمو في الموسم الأول، أما في الموسم الثاني فلقد تأثرت هذه النباتات تأثراً مؤقتاً عند ٣٠ يوم في حين أظهرت تحملاً كاملاً عند ٦٠ و ٩٠ يوم من الزراعة. وعليه فإنه يمكن التوصية للمشتغلين بزراعة مسطحات البرمودا الخضراء في ملاعب الجولف المنتشرة بمصر في الأراضي الرملية وتحت ظروف الري بالرش باستخدام مبيد الباركيدي بمعدل ٦٠٠ جم/ الفدان أو الاستومب ١.٧ لتر/ الفدان أو الرونستار بمعدل ٢ لتر/ الفدان كمبيدات أرضية لمكافحة الحشائش العريضة وضيقة الأوراق بعد الزراعة وقبل الري على امتداد موسم النمو الصيفي لمسطح البرمودا خلال الأشهر الثلاثة (يونيو – يوليو – أغسطس)، أو استخدام مبيد الاستارين أو الجرانستار كمبيدات بعد الإنبات لمكافحة الحشائش العريضة الأوراق كمبيدات اختيارية تستخدم بأمان في مسطح البرمودا الأخضر.