Journal of Plant Production

Journal homepage & Available online at: www.jpp.journals.ekb.eg

Response of Seashore Paspalum Turfgrass Grown in Two Different Soil Types to Spraying with Plant Growth Regulators

Sharaf El-Din, M. N.[1]; M. Y. A. Abdalla[1]; A. A. Helaly[1] and O. A. Quawasha[2*]

[1]Vegetable and Ornamental Dept., Fac. of Agric., Mansoura Univ., Egypt
[2]El- Delta Company for Fertilizers and Chemical Industries

ABSTRACT

Seashore paspalum (*Paspalum vaginatum*, Swarts) is often used as a recreational turf. To achieve quality turf, special maintenance such as frequent mowing is required. This investigation studied the effectiveness of two growth-regulating chemicals at different rates in retarding paspalum vertical growth and thus reducing the mowing frequency, as well as evaluating their impact on paspalum visual quality with a special focus on photosynthetic pigments to determine the optimum concentrations of the used retardants. Two plant growth regulators, paclobutrazol at the rates of 50, 100, 150 mg/l, and cycocel at the rates of 1000, 2000, and 3000 mg/l were applied to seashore paspalum turf grown in alluvial or sandy soil during the two successive seasons of 2020 and 2021. The obtained results showed that spraying paspalum turf grown in alluvial or sandy soil with either paclobutrazol or cycocel led to a significant decrease in clipping fresh and dry weights, where spraying the plants with cycocel caused more suppression than spraying the plants with paclobutrazol. Also, the plants untreated possessed the highest values of clipping fresh and dry weights, while the lowest values were recorded from plants sprayed with cycocel at a rate of 3000 mg/l followed by those sprayed with 2000 mg/l and those sprayed with 1000 mg/l then those sprayed with paclobutrazol at the rate of 150,100 and 50 mg/l, respectively. Furthermore, the untreated plants possessed the highest contents of photosynthetic pigments. Also, plants treated with cycocel gave lower values of photosynthetic pigments than those treated with paclobutrazol.

***Keywords*:** Paspalum; paclobutrazol, cycocel.

INTRODUCTION

Seashore paspalum (*Paspalum vaginatum*, *Swartz*) is used as a turfgrass, where is adapted to tropical and warm subtropical climates. It forms a dense, fine-textured turf of dark green. It can be used as utility lawns and sport turfs, including golf course greens. Seashore paspalum has considerable interspecific diversity against various environmental stresses including salinity, drought, wear, pests and soil acidity (Duncan, 1999; Trenholm *et al.*, 1999 and Lee *et al.*, 2004). However, adequate management practices and their economic implications for paspalum grasses are largely unknown and undocumented (Sharaf El-Din *et al*., 2018).

Plant growth regulators represent one of the smallest sectors in the agricultural chemicals market. They are compounds that regulate the growth and metabolism of plants beneficially and include a diverse series of chemical structures, which may be synthetic or naturally occurring (Bhalla and Shehata, 2017). The usage of plant growth regulators or inhibitors has become an accepted practice in some turfgrass management systems. To maintain high- quality athletic turf, such as on golf courses, frequent mowing is required. However, frequent mowing is costly and time-consuming. Therefore, turfgrass managers have often used plant growth regulators to suppress both vegetative growth and seed head emergence, and thus reducing mowing frequency and costs. Many commonly used plant growth regulators act by interfering with gibberellin biosynthesis, thus reducing cell elongation (Abdel-Kader and Abdalla, 2003). A reduction in growth can, therefore, significantly decrease mowing frequency.

Paclobutrazol is a compound in the triazole group and belongs to the PGR class B (McElroy and Martins, 2013). It reduces plant growth by blocking the action of ent-kaurene, an oxidase enzyme that inhibits the conversion of ent-kaurene into ent-kaurenol, which prevents the formation of any type of gibberellin (Miller, 2016). Paclobutrazol also inhibits sterol biosynthesis and reduces the amount of abscisic acid, ethylene, and indole-3-acetic acid, while augmenting the number of cytokinins (Melero *et al.*, 2020). Golf green keepers also apply paclobutrazol to inhibit the growth of weeds. As well as its application along with a fungicide reduces the severity of diseases, such as dollar spot or brown patch, more effectively than when the fungicide is used alone (Głąb *et al.*, 2020).

Cycocel (2-chloroethyltrimethyl-ammonium chloride), commonly called CCC, was first reported by Tolbert (1960) to be effective in reducing plant size and in imparting to plants a darker green. Cycocel reduces fresh and dry weight of grass and apparently, CCC exhibits its effect by lowering the auxin level of the plant (Luo *et al.*, 2011).

The current research studied the effect of spraying with two different growth retarder, paclobutrazol and cycocel, at different rates on suppressing shoot growth of paspalum turf grown in two different soil types and thus reducing mowing frequency, furthermore, to evaluate their impact on paspalum turf visual quality with a special focus on photosynthetic pigments.

MATERIALS AND METHODS

1. Experimental Site and Climate Conditions: The current study was conducted at the Experimental Site of El- Delta Company for Fertilizers and Chemical Industries and the

* **Corresponding author.**
E-mail address: osama.quawasha19@gmail.com
DOI: 10.21608/jpp.2022.152894.1149

Laboratory of Vegetable and Ornamental Dept, Fac. Agric., Mans. Univ., Egypt during the two successive seasons of 2020 and 2021 (from 6th of April to 2nd of October in every season), where the temperature average according to Agriculture Extension services was 30°C and 14°C in summer and winter, respectively.

2. **Analyses of used soils:** Some physical and chemical properties of the initial soils used (alluvial and sandy soils) are shown in Table (1), where their analyses were performed as routine work according to Sparks *et al.* (2020) and Dane and Topp (2020). Alluvial soil was obtained from a private farm in Talkha District, Dakahlia Governorate, while the sandy soil was collected from Kalapshoo Village, Belqas District, Dakahlia Governorate.

Table 1. Some physical and chemical properties of the initial soils used

Characteristic	Alluvial soil	Sandy soil
Sand %	16.00	90.8
Silt %	34.80	5.20
Clay %	49.20	4.00
Texture class	Clayey	Sandy
Available Water (AW) %	19.50	5.50
Wilting Point (WP) %	19.50	5.50
Field Capacity (FC) %	39.00	11.0
EC_w dS/m	1.95	0.95
pH (1:2.5 soil suspension)	8.15	7.92
Bulk Density Mg/m^3	1.20	1.65
Total Porosity %	57.4	40.0
CEC cmol/kg	49.2	7.50
$CaCO_3$ %	1.95	0.95
Organic matter %	1.10	0.20
Available N mg/kg	52.39	25.0
Available P mg/kg	9.550	3.20
Available K mg/kg	215.5	99.2

3. **Examined Grass:** The examined grass was (*Paspalum vaginatum*, Swartz) which belongs to the family Poaceae. Sods of seashore paspalum were obtained from a private turf nursery (named Sheashaa), then divided into pieces (ca. 10 x 10 cm) and planted in the prepared beds (plots).
4. **Studied Plant Growth Retardants:** Two plant growth retardants under study *i.e.*, paclobutrazol and cycocel, were purchased from Teckno Green Company, Egypt. Paclobutrazol was dissolved before spraying in an absolute ethanol solvent obtained from El Nasr Pharmaceutical Chemicals Company, Egypt. Cycocel was dissolved before spraying in distilled water.
5. **Experimental Setup:** A factorial experiment was performed in a randomized complete block design with three replicates (plots) aiming to assess the effect of foliar application of two types of plant growth regulators *i.e.*, paclobutrazol and cycocel at different rates (50, 100, 150 mg/l for the 1st substance and 1000, 2000, 3000 mg/l for the 2nd substance) as alone applications for both of them in addition to control treatment (without foliar application) on the performance of seashore paspalum turf (Cv. Salam) grown in alluvial and sandy soils. Therefore, there were 42 plots: 7 "foliar application treatments" ×3 "replicates" × 2 "soil type"

To perform the trial, the experimental area was divided into 42 square plots (1×1 m) with 50 cm distance between plots. A metal cylinder was used to compact the sod pieces after planting. Coverage percentages had not been changed along with the experiment. The initial establishment was continued for 3 weeks after planting. On April 27th, all grasses were slightly mowed when it turned yellow (all grasses were cut to 4 cm above the soil level) then all turf grasses received, one day after mowing, the tested plant growth regulators as the first application, where the spraying was done early in the morning and the irrigation process was done immediately after foliar application. The exogenous application was repeated twice with one month interval among all application times for both paclobutrazol and cycocel. Each plot was sprayed individually either with 1 litter of absolute ethanol solvent containing the designated amount of paclobutrazol or distilled water containing the designated amount of cycocel using a one litter semi-automated hand sprinkler. Additionally, the corresponding plants continued without foliar application as a control treatment.

Fertilization was executed according to the Ministry of Agriculture and Land Reclamation (MALR), where all plots received nitrogen at a rate of 125 g N/plot using ammonium nitrate (33.5%N), while phosphorus and potassium were applied at a rate of 66 g P/plot and 22 g K/plot using potassium sulfate (39.84% K_2O) and calcium super phosphate (15 % P_2O_5), respectively. Other normal agricultural practices were done according to MALR. Irrigation was performed every 2 days at a rate of 10 l/m^2 for alluvial soil, while the irrigation of plants grown on sandy soil was done every day at a rate of 7 l/m^2 until the end of the experiment.

6. **Cut Practices:** After the first foliar application of plant growth regulators, the mowing was performed when the grasses reached 6 cm above the soil level, where the grasses were cut using scissors to a height of 4 cm. The first three cuts were taken throughout each season from each plot to determine the effect of examined growth regulators on the performance of seashore paspalum turf.
7. **Measurement Traits***:* At the three cuts times, the following parameters were determined;

- **Growth parameters:** Clipping fresh weight (g/m^2) was recorded then the clippings were dried at 70°c until constant weight to determine the clipping dry weight (g/m^2).
- **Photosynthetic Pigments:** In fresh clipping samples, chlorophyll *a* and *b* and carotene pigments were determined according to the method described by Bao and Leng (2005).

8. **Statistical Analysis:** Data were statistically analyzed according to Gomez and Gomez (1984) using CoStat (Version 6.303, CoHort, USA, 1998–2004).

RESULTS AND DISCUSSION

Vegetative Growth Parameters and Photosynthetic Pigments: Data presented in Tables from (2) to (7) show the effect of foliar application of paclobutrazol and cycocel at different rates in clipping fresh and dry weights (g/m^2), day number from mowing date to reaching a height of 6 cm (D. N) and photosynthetic pigments *i.e.*, chlorophyll *a* and *b* and carotene of seashore paspalum turf grown in alluvial and sandy soils during both seasons of 2020 and 2021.

Data from the same Tables illustrate that foliar application of both paclobutrazol and cycocel at all rates being studied significantly suppressed the performance of seashore paspalum turf compared to corresponding plants without foliar application (control treatment) under both alluvial and sandy conditions in all cuts during both study seasons.

A. Clipping fresh and dry weights (g/m^2)

Spraying seashore paspalum turf grown in alluvial soil (Tables 2, 3, and 4) or sandy soil (Tables 5, 6, and 7) with either paclobutrazol or cycocel led to a significant decrease in

clipping fresh and dry weights, where spraying plants with cycocel caused suppression more than spraying plants with paclobutrazol. However, the plants untreated possessed the highest values, while the lowest values were recorded with plants sprayed with cycocel at a rate of 3000 mg/l followed by those sprayed with 2000 mg/l followed by those sprayed with 1000 mg/l then those sprayed with paclobutrazol at a rate of 150,100 and 50 mg/l, respectively. The pronounced suppressing effect of cycocel may be due to a result of its ability in lowering the auxin level of the plant, as mentioned by Luo *et al.* (2011), while the pronounced suppressing effect of paclobutrazol could be attributed to its ability in blocking the action of ent-kaurene, inhibiting sterol biosynthesis and reducing the amount of abscisic acid, ethylene, and indole-3-acetic acid by augmenting the number of cytokinins, as reported by Hussein *et al.* (2012), Głąb *et al.* (2020) and Melero *et al.* (2020). Also, the obtained findings confirmed that the effect of both paclobutrazol and cycocel in clipping fresh and dry weights was consistent in the three times cuts. The same trend was found concerning plants grown in both soils under study taking on considering that the performance and growth of paspalum under sandy conditions were better than that under alluvial conditions and this may be attributed to macropores of sandy soil, which are responsible for aeration and fast drainage compared to alluvial soil that possesses micropores causing water holding (El-Agrodi *et al.*, 2016). Our findings are in accordance with those of Sharaf El-Din *et al.* (2018) who recognized the importance of aeration to seashore paspalum turf. Also, Abdel-Kader and Abdalla (2003) studied the suppressing effect of paclobutrazol on bermudagrass plant.

Table 2. Suppression effect of paclobutrazol and cycocel at different rates on growth criteria and photosynthetic pigments of seashore paspalum turf grown in alluvial soil in the first cut during the successive seasons of 2020 and 2021

Characteristics	Clipping fresh weight (g/m^2)		Clipping dry weight (g/m^2)		Chlorophyll a (mg/g)		Chlorophyll b (mg/g)		Carotene (mg/g)		D. N.	
Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control (without foliar application)	931.52a	966.23a	112.67a	116.39a	0.599a	0.615a	0.368a	0.376a	0.397a	0.406a	12.00e	11.67e
Cycocel (at a rate of 1000 mg/l)	636.48e	662.49e	82.55e	85.28e	0.536b	0.549bc	0.322d	0.330d	0.326d	0.339d	16.67bcd	16.67bcd
Cycocel (at a rate of 2000 mg/l)	565.13f	589.31f	77.91f	80.95f	0.538b	0.546c	0.322d	0.328d	0.299e	0.308e	20.67ab	20.33ab
Cycocel (at a rate of 3000 mg/l)	506.13g	526.53g	67.01g	69.75g	0.508c	0.518d	0.304e	0.309e	0.287f	0.292f	22.67a	22.67a
Paclobutrazol (at a rate of 50 mg/l)	875.28b	908.78b	107.52b	111.21b	0.596a	0.607a	0.349b	0.356b	0.385b	0.394b	12.67de	12.67de
Paclobutrazol (at a rate of 100 mg/l)	789.13c	820.46c	100.19c	103.47c	0.545b	0.560b	0.338c	0.348bc	0.341c	0.349c	15.33cde	14.67cde
Paclobutrazol (at a rate of 150 mg/l)	713.58d	738.64d	90.82d	94.34d	0.544b	0.556bc	0.333c	0.339c	0.329d	0.340d	17.67bc	18.00bc
LSD at 5%	17.48	17.59	0.60	0.62	0.013	0.014	0.008	0.009	0.008	0.008	4.28	4.18

D. N.: Day number from the mowing onset to reaching a height of 6 cm starting from the first foliar application

Table 3. Suppression effect of paclobutrazol and cycocel at different rates on growth criteria and photosynthetic pigments of seashore paspalum turf grown in alluvial soil in the second cut during the successive seasons of 2020 and 2021

Characteristics	Clipping fresh weight (g/m^2)		Clipping dry weight (g/m^2)		Chlorophyll a (mg/g)		Chlorophyll b (mg/g)		Carotene (mg/g)		D. N.	
Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control (without foliar application)	749.30a	775.74a	91.91a	95.22a	0.529a	0.542a	0.323a	0.329a	0.311a	0.331a	10.33e	11.00c
Cycocel (at a rate of 1000 mg/l)	540.70d	558.05e	67.13f	69.87f	0.486c	0.496c	0.279d	0.284d	0.254d	0.285e	19.67ab	16.33b
Cycocel (at a rate of 2000 mg/l)	500.72e	520.22f	69.31e	72.28e	0.474c	0.482d	0.269e	0.276e	0.234e	0.274f	22.67a	22.33a
Cycocel (at a rate of 3000 mg/l)	439.30f	457.72g	60.95g	63.41g	0.429d	0.438e	0.265e	0.271e	0.232e	0.270f	22.33a	22.67a
Paclobutrazol (at a rate of 50 mg/l)	656.17b	678.21b	83.54b	86.75b	0.510b	0.519b	0.318a	0.326a	0.292b	0.324b	12.67de	14.67bc
Paclobutrazol (at a rate of 100 mg/l)	624.17c	644.02c	75.76c	78.70c	0.501b	0.514b	0.303b	0.310b	0.268c	0.311c	15.33cd	16.00b
Paclobutrazol (at a rate of 150 mg/l)	551.14d	572.30d	74.39d	77.02d	0.510b	0.517b	0.290c	0.300c	0.264c	0.296d	17.00bc	18.33b
LSD at 5%	13.81	13.94	0.49	0.54	0.011	0.012	0.007	0.007	0.006	0.006	3.85	3.95

D. N.: Day number from the mowing onset to reaching a height of 6 cm starting from the first foliar application

Table 4. Suppression effect of paclobutrazol and cycocel at different rates on growth criteria and photosynthetic pigments of seashore paspalum turf grown in alluvial soil in the third cut during the successive seasons of 2020 and 2021

Characteristics	Clipping fresh weight (g/m^2)		Clipping dry weight (g/m^2)		Chlorophyll a (mg/g)		Chlorophyll b (mg/g)		Carotene (mg/g)		D. N.	
Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control (without foliar application)	732.56a	763.37a	82.94a	85.68a	0.526a	0.538a	0.255a	0.262a	0.244a	0.250a	11.00d	13.33d
Cycocel (at a rate of 1000 mg/l)	517.03d	537.44d	59.32f	61.17f	0.444d	0.455e	0.234c	0.239cd	0.216cd	0.224c	19.67b	20.67b
Cycocel (at a rate of 2000 mg/l)	467.67e	489.25e	60.12e	62.53e	0.441d	0.448e	0.228d	0.233d	0.211de	0.218d	20.67ab	22.67ab
Cycocel (at a rate of 3000 mg/l)	452.27f	468.52f	51.41g	53.59g	0.419e	0.427f	0.217e	0.221e	0.207e	0.210e	24.00a	24.67a
Paclobutrazol (at a rate of 50 mg/l)	660.21b	689.00b	75.12b	77.59b	0.501b	0.511b	0.251a	0.256b	0.241a	0.247a	14.67cd	16.33cd
Paclobutrazol (at a rate of 100 mg/l)	590.37c	612.75c	67.80c	70.04c	0.479c	0.493c	0.245b	0.251b	0.227b	0.232b	17.00bc	19.33bc
Paclobutrazol (at a rate of 150 mg/l)	579.95c	602.05c	66.58d	69.17d	0.469c	0.479d	0.240b	0.242c	0.220c	0.227bc	18.67b	20.33b
LSD at 5%	13.59	13.56	0.44	0.49	0.011	0.011	0.006	0.006	0.006	0.005	3.87	3.98

D. N.: Day number from the mowing onset to reaching a height of 6 cm starting from the first foliar application

B. Photosynthetic pigments

The same Tables illustrate that foliar application of both paclobutrazol and cycocel caused a significant decline in the contents of photosynthetic pigments *i.e.,* chlorophyll a and b and carotene of seashore paspalum turf grown in either alluvial or sandy soil in three cuts. Under alluvial and sandy conditions, the plants untreated with plant growth regulators under study possessed the highest contents of aforementioned photosynthetic pigments, whilst the sequence order of growth regulator treatment from the most suppressing to less was as

follows; Plants sprayed with 3000 mg/l cycocel> 2000 mg/l cycocel > 1000 mg/l cycocel> 150 mg/l paclobutrazol > 100 mg/l paclobutrazol > 50 mg/l paclobutrazol.

It could be said that cycocel at the different under study had a suppression effect more than paclobutrazol at the different study rates. Also, the obtained findings confirmed that the effect of both paclobutrazol and cycocel on the contents of aforementioned photosynthetic pigments was consistent in the three times cuts, where the same trend was found concerning plants grown on both soils under study taking into consideration that the performance of paspalum under sandy conditions was better than that under alluvial conditions and this was discussed above, where aeration in sandy soil is better than alluvial soil and the aeration is beneficial for paspalum grass. Our results are in harmony with those obtained by Abdel-Kader and Abdalla (2003), Luo *et al.* (2011), Hussein *et al.* (2012), Sharaf El-Din *et al.* (2018), Głąb *et al.* (2020) and Melero *et al.* (2020).

Table 5. Suppression effect of paclobutrazol and cycocel at different rates on growth criteria and photosynthetic pigments of seashore paspalum turf grown in sandy soil in the first cut during the successive seasons of 2020 and 2021

Characteristics	Clipping fresh weight (g/m^2)		Clipping dry weight (g/m^2)		Chlorophyll a (mg/g)		Chlorophyll b (mg/g)		Carotene (mg/g)		D. N.	
Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control (without foliar application)	1108.29a	1150.41a	140.71a	145.49a	0.714a	0.732a	0.428a	0.439a	0.490a	0.501a	10.00d	9.00e
Cycocel (at a rate of 1000 mg/l)	786.45e	817.21e	100.76e	103.92e	0.694bcd	0.708bc	0.389d	0.397cd	0.413e	0.429e	16.33b	17.33abc
Cycocel (at a rate of 2000 mg/l)	705.55f	736.52f	91.76f	95.34f	0.687cd	0.708bc	0.378e	0.392d	0.393f	0.405f	17.67ab	19.67ab
Cycocel (at a rate of 3000 mg/l)	616.33g	641.93g	80.67g	84.04g	0.682d	0.695c	0.366f	0.373e	0.373g	0.379g	20.00a	20.67a
Paclobutrazol (at a rate of 50 mg/l)	1029.24b	1068.87b	131.06b	135.47b	0.709ab	0.722ab	0.417b	0.424b	0.469b	0.481b	12.33cd	13.67cd
Paclobutrazol (at a rate of 100 mg/l)	951.08c	990.18c	120.70c	124.70c	0.704ab	0.723ab	0.407c	0.418b	0.454c	0.464c	12.67cd	13.00de
Paclobutrazol (at a rate of 150 mg/l)	870.56d	901.00d	110.81d	115.13d	0.700abc	0.714b	0.397d	0.406c	0.432d	0.448d	14.33bc	16.33bcd
LSD at 5%	21.43	7.48	0.71	0.77	0.017	0.017	0.009	0.010	0.011	0.011	3.66	4.12

D. N.: Day number from the mowing onset to reaching a height of 6 cm starting from the first foliar application

Table 6. Suppression effect of paclobutrazol and cycocel at different rates on growth criteria and photosynthetic pigments of seashore paspalum turf grown in sandy soil in the second cut during the successive seasons of 2020 and 2021

Characteristics	Clipping fresh weight (g/m^2)		Clipping dry weight (g/m^2)		Chlorophyll a (mg/g)		Chlorophyll b (mg/g)		Carotene (mg/g)		D. N.	
Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control (without foliar application)	951.02a	988.37a	105.64a	109.90a	0.689a	0.704a	0.384a	0.398a	0.410a	0.419a	8.00d	8.67d
Cycocel (at a rate of 1000 mg/l)	717.42e	748.35e	81.87e	85.30e	0.638de	0.661c	0.343d	0.352d	0.343e	0.351e	20.00a	21.33a
Cycocel (at a rate of 2000 mg/l)	659.03f	680.54f	76.17f	78.75f	0.626ef	0.638d	0.344d	0.347d	0.329f	0.341f	21.00a	22.67a
Cycocel (at a rate of 3000 mg/l)	595.61g	614.62g	70.87g	74.11g	0.612f	0.622d	0.323e	0.329e	0.313g	0.319g	22.33a	24.00a
Paclobutrazol (at a rate of 50 mg/l)	891.66b	925.82b	99.45b	103.23b	0.670b	0.688ab	0.374ab	0.380b	0.393b	0.401b	11.00cd	11.67cd
Paclobutrazol (at a rate of 100 mg/l)	830.72c	865.15c	93.54c	97.19c	0.657bc	0.672bc	0.364bc	0.375b	0.377c	0.386c	12.67c	13.67c
Paclobutrazol (at a rate of 150 mg/l)	773.41d	803.81d	87.52d	90.70d	0.648cd	0.662c	0.354cd	0.361c	0.361d	0.369d	16.33b	17.33b
LSD at 5%	18.67	19.73	0.59	0.65	0.016	0.016	0.013	0.009	0.009	0.008	3.17	3.43

D. N.: Day number from the mowing onset to reaching a height of 6 cm starting from the first foliar application

Table 7. Suppression effect of paclobutrazol and cycocel at different rates on growth criteria and photosynthetic pigments of seashore paspalum turf grown in sandy soil in the third cut during the successive seasons of 2020 and 2021

Characteristics	Clipping fresh weight (g/m^2)		Clipping dry weight (g/m^2)		Chlorophyll a (mg/g)		Chlorophyll b (mg/g)		Carotene (mg/g)		D. N.	
Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control (without foliar application)	815.22a	846.73a	95.24a	98.97a	0.612a	0.625a	0.305a	0.311a	0.291a	0.297a	9.00e	10.00d
Cycocel (at a rate of 1000 mg/l)	655.90e	625.42e	72.30e	74.91e	0.586cde	0.606c	0.289cd	0.294cde	0.260d	0.265c	17.67bc	22.33ab
Cycocel (at a rate of 2000 mg/l)	549.84f	569.79f	66.13f	68.71f	0.579de	0.591d	0.285de	0.293de	0.254d	0.261c	18.67b	24.67a
Cycocel (at a rate of 3000 mg/l)	600.68g	516.26g	59.80g	61.91g	0.573e	0.583d	0.282e	0.288e	0.247e	0.252d	22.67a	25.67a
Paclobutrazol (at a rate of 50 mg/l)	794.00b	791.53b	89.33b	92.36b	0.604ab	0.621ab	0.299ab	0.306ab	0.283b	0.291a	12.67de	17.00c
Paclobutrazol (at a rate of 100 mg/l)	762.60c	736.26c	83.79c	86.72c	0.599abc	0.613abc	0.295bc	0.301bc	0.274c	0.278b	14.67cd	17.67c
Paclobutrazol (at a rate of 150 mg/l)	708.67d	679.86d	78.32d	81.92d	0.593bcd	0.608bc	0.292bcd	0.298cd	0.268c	0.275b	17.00bc	19.67bc
LSD at 5%	16.32	16.45	0.55	0.57	0.015	0.014	0.007	0.007	0.006	0.006	3.84	4.27

D. N.: Day number from the mowing onset to reaching a height of 6 cm starting from the first foliar application

Data from the same Tables point out that day number from the mowing date to reaching a height of 6 cm (D. N.) significantly affected owing to foliar application treatments, where both paclobutrazol and cycocel led to the lateness of reaching a height of 6 cm compared with the corresponding plants untreated.

Generally, in both seasons under study, the highest D. N. was recorded when plants were sprayed with cycocel at a rate of 3000 mg/l, while the lowest D. N. was realized with the plants untreated. This trend was consistent in the three times cuts either under alluvial or sandy conditions. For example, the plants grown in alluvial soil and sprayed with cycocel at a rate of 3000 mg/l reached a height of 6 cm after 22.67, 22.33, 24.0 days in the first season and 22.67, 22.67, 24.67 days in the second season after the 1st, 2nd and 3rd foliar application times cuts, respectively, while the plants untreated (control) reached a height of 6 cm after 12, 10.33, 11.0 days in the first season and 11.67, 11.0, 13.3 days in the second season after the 1st, 2nd and 3rd foliar application times cuts. Also, the lateness of reaching a height of 6 cm resulted from foliar application of cycocel was greater than that of paclobutrazol.

Generally, it could be said that foliar application of both cycocel and paclobutrazol has a suppression effect on paspalum growth, but perhaps the paclobutrazol effect is preferred over the

cycocel even though cycocel inhibits paspalum growth more than paclobutrazol. The findings are in agreement with those obtained by Abdel-Kader and Abdalla (2003), Luo *et al.* (2011), Hussein *et al.* (2012), Sharaf El-Din *et al.* (2018), Głąb *et al.* (2020) and Melero *et al.* (2020).

CONCLUSION

In our opinion, and according to the obtained results in this investigation, it can conclude that both paclobutrazol and cycocel at all rates under study suppressed the paspalum growth and lateness of reaching a height of 6 cm. Economically, it can be concluded that the best treatment is foliar application of paclobutrazol at a rate of 150 mg/l and may be foliar application of cycocel at a rate of 1000 mg/l useful economically.

REFERENCES

Abdel-Kader, H. H. and M. Y. A. Abdalla (2003). Effect of mefluidide and paclobutrazol on the growth and quality of "Tifwat" bermudagrass plants. J. Agri. Sci. Mans Univ., 28(12): 8307-8321.

Bao, W. K. and L. Leng (2005). Determination methods for photosynthetic pigment content of bryophyte with special relation of extracting solvents. Chin. J. Appl. Environ. Biol.,11(2): 235-237.

Bhalla, P and S. M. Shehata (2017). Imidazolinones as plant growth regulators. In The Imidazoline Herbicides (pp. 247-260). CRC Press.

Dane, J. H. and C. G. Topp (Eds.) (2020). "Methods of soil analysis", Part 4: Physical methods (Vol. 20). John Wiley & Sons.

Duncan, R. R. (1999). Environmental compatibility of seashore paspalum for golf course and other recreational uses. II. Management protocols. Int. Turfgrass Soc. Res. J., 8: 1216-1230.

El-Agrodi, M., EL-Shebiny, G., Mosa, A., and El-sherpiny, M. (2016). Maize tolerance to different levels of boron and salinity in irrigation water. Journal of Soil Sciences and Agricultural Engineering, 7(1), 35-44.

Głąb, T.; W. Szewczyk; K. Gondek; J. Knaga; M. Tomasik and K. Kowalik (2020). Effect of plant growth regulators on visual quality of turfgrass. Scientia Horticulturae, 267, 109314.

Gomez, K. A. and A. A. Gomez (1984). "Statistical Procedures for Agricultural Research". John Wiley and Sons, Inc. New York.pp:680.

Hussein, M. M. M.; H. A. Mansour and H. A. Ashour (2012). Response of Paspalum vaginatum turfgrass grown under shade conditions to paclobutrazol and trinexapac-ethyl as plant growth retardants (PGRs). J. Hortic. Sci. Ornament. Plants, 4(2): 134-147.

Lee, G. J.; R. N. Carrow and R. R. Duncan (2004). Photosynthetic responses to salinity stress in halophytic seashore paspalum genotypes. Plant Sci., 166: 1417-1425.

Luo, T. Q.; Z. P. Mo; B. T. Mo; K. J. Wen and J. B. Zhang (2011). Effect of different growth regulators on the lawn quality [J]. Pratacultural Sci., 5.

McElroy, J. S. and D. Martins (2013). Use of herbicides on turfgrass. Planta daninha, 31, 455-467.

Melero, M. M.; P. L. F. D. Santos; J. C. M. Bezerra; B. H. D. Lima; M. K. Pagliarini and R. M. M. D. Castilho (2020). Paclobutrazol and phenoxaprope-P-ethyl potential as growth regulator in Carpet grass Plus®. Ornamental Horticulture, 26:432-439.

Miller, G. L. (2016). Effect of watered-in demethylation-inhibitor fungicide and paclobutrazol applications on foliar disease severity and turfgrass quality of creeping bentgrass putting greens. Crop Protection, 79:64-69.

Sharaf El-Din, M. N.; M. Y. A. Abdalla; A. A. Helaly and O. A. Quawasha (2018). Response of seashore paspalum (*Paspalum vaginatum Swartz.)* grass to different aeration and fertilization levels. Journal of Plant Production Mans. Univ., 9(7): 579-585.

Sparks, D. L.; A. L. Page; P. A. Helmke and R. H. Loeppert (Eds.) (2020). "Methods of Soil Analysis", part 3: Chemical methods (Vol. 14). John Wiley & Sons.

Tolbert, N. E. (1960). (2-Chloroethyl) trimethylammonium chloride and related compounds as plant growth substances. II. Effect on growth of wheat. J. Biological Chemistry Plant physiology, 235(2): 475-479.

Trenholm, L. E.; R. R. Duncan and R. N. Carrow (1999). Wear tolerance, shoot performance and spectral reflectance of seashore paspalum and bermudagrass. Crop Sci., 39: 1147-1152.

إستجابة نجيل الباسبالم النامى فى نوعين مختلفين من التربة للرش بمنظمات النمو

محمد نزيه شرف الدين[1]، محمد يونس علي عبد الله[1]، أحمد عبد المنعم هلالي[1]وأسامه عبد الرحمن قوشه[2]

[1]قسم الخضر والزينة، كلية الزراعة، جامعة المنصورة

[2]شركة الدلتا للأسمدة والصناعات الكيماوية

الملخص

نجيل الباسبالم يستخدم كمسطحات خضراء فى كثير من مناطق الترفيه. للحصول على مسطح أخضر عالى الجودة يلزم إجراء عمليات الصيانة بصفة مستمرة وخاصة عملية تكرار قص المسطح. الهدف هو دراسة فاعلية مادتين كيميائيتين من منظمات للنمو بمعدلات مختلفة في تأخير نمو حشيشة الباسبالم بهدف تقليل تكرار عملية القص وكذلك تقييم تأثير تلك المادتين على الجودة البصرية للباسبالم مع التركيز بشكل خاص على أصباغ التمثيل الضوئي لتحديد التركيزات المثلى للمثبطات المستخدمة. حيث تم رش نوعين منفصلين من منظمات النمو هما الباكلوبترازول بمعدلات 50، 100 و150 مجم/ لتر والسيكوسيل بمعدلات 1000، 2000 و3000 مجم/ لتر على نجيل الباسبالم النامى مرة في تربة طينيه ومرة اخري في تربة رملية خلال موسمى 2020 و2021. ولقد أظهرت النتائج المتحصل عليها ان رش عشب الباسبالم المزروع على تربة طينية أو رملية إما بالباكلوبترازول أو السيكوسيل قد أدى إلى انخفاض معنوى في الأوزان الطازجة والجافة لناتج عمليات القص، حيث أدى رش النباتات بالسيكوسيل إلى تثبيط نموها أكثر من تلك النباتات المرشوشة بالباكلوبترازول. من ناحية أخرى، أعطت النباتات غير المعالجة (غير المرشوشة) أعلى قيم للقص فى الأوزان الطازجة والجافة، بينما سجلت أقل القيم للنباتات التي تم رشها بالسيكوسيل بمعدل 3000 مجم/ لتر يليها تلك المرشوشة بـ 2000 مجم/ لتر ثم تلك التى تم رشها بـ 1000 مجم/ لتر ثم تلك المرشوشة بمادة الباكلوبترازول بمعدلات 150، 100 و 50 ملجم /لتر على التوالي. علاوة على ذلك ، فإن النباتات غير المعالجة المزروعة في كلا نوعي التربة أعطت أعلى محتويات من صبغات التمثيل الضوئى. أيضا اعطت النباتات المرشوشة بالسيكوسيل قيم أقل لمحتوى صبغات التمثيل الضوئى عن تلك المرشوشة بالباكلوبترازول.

الكلمات الدالة: الباسبالم، الباكلوبترازول والسيكوسيل