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Studding the Influence of Some Growth Retardants as a Chemical Mower on Ryegrass (*Lolium perenne* L.)

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Abstract: This investigation was carried out at Experimental Farm and laboratory of the Vegetable and Ornamental Plants Dept., Faculty of Agriculture, Mansoura Univ., Egypt to examine influence of CCC and PBZ as chemical mowers on *Lolium perenne L* turf grass under different concentrations individually or in combinations. Results cleared that CCC or PBZ reduced ryegrass tillers length comparing with the control one especially with the higher concentrations. Also, the highest fresh and dry weight of ryegrass tillers recorded when 200 mg/L CCC was foliar sprayed. In addition, the highest total sugar and proline % was tabulated for the interaction between 300 mg/L CCC + 50 mg/L PBZ treatment. Generally, all the plant growth retardants (CCC or PBZ individually and in combinations) increased the pigments content (total chlorophyll and carotenoids) than the control.

Keywords: Plant Growth Retardants, CCC, PBZ, *Lolium perenne* L

1. Introduction

Plant growth retardants are synthetic compounds which applied to control plant size without obvious phytotoxicity (Davis and curry, 1991), and have an additional positive effect on improving resistance to drought stress, darker green leaves (Sebastian *et al.,* 2002) and enhance development of roots. Foliar sprays or media drenches are the typical application methods for plant growth retardants. Drenches are more labor intensive than sprays, but produce longer-lasting and more uniform results. Chlormequat chloride (CCC) inhibits gibberellins production and internodes elongation. CCC is highly water soluble and passively absorbed by all plant tissues, allowing it to be effectively applied as a spray. In addition PBZ is available for uptake by the roots (Barrett, 1982), especially from the upper levels of the soil above the root zone.

English ryegrass (*Lolium perenne L.)*, belongs to family Poaceae and extensively used in Egypt for over seeding winter lawns. As the warm season turf grass (Bermuda grass and Paspalum) enter in a dormancy period during the cooler winter months. But, ryegrass has a high vegetative growth, so it must be mowing relentlessly and finally these lead to increase the maintenance program costs.

This investigation was carried out in a trial to reduce *Lolium perenne* tillers growth height and minimizing mowing numbers during the growth season since it has a fast growth habit. So, the aim of this research was to evaluate the ability of CCC and PBZ individually or in combinations under different concentrations as chemical mowers on *Lolium perenne*, L., turf grass. Some authors studied the effect of these chemical substances by soaking the seeds of this turf grass in it (Nazari and Javadi, 2012) but no studies were established for evaluating these growth retardants as a foliar spray on the growing ryegrass turf.

2. Materials and Methods

This investigation carried out in the Experimental Farm and laboratory of the Vegetable and Ornamental Plants Dept., Faculty of Agriculture, Mansoura Univ., Egypt, during the two successive seasons of 2012/2013 and 2013/2014. Perennial ryegrass (*Lolium perenne* L.) seeds (approximately 2 g per pot) were soaked in distilled water for 24 h, then it sown in 35 cm^2 pots filled with 15kg from a mixture of sand and clay (1:2) at 15 November during the both seasons. Then, seeds were covered with a small portion of the culture media. After twenty one days from the culture date, all the growing turf in the pots was moved to 5cm above the soil surface. Two growth retardants were evaluated for their ability as chemical mowing agents. Since, CCC was used as foliar

spray at 0,100,200 and 300 mg/L. In addition, PBZ also was drenched to the culture media at concentrations of 0, 50 and 100 mg/L. Both of the growth retardants were used individually or in combinations. Twenty one days after treating, turf tillers were mowed to determinate some vegetative characteristics such as fresh, dry weights (g), tillers increase in height (cm) and chemical constitutes such as total chlorophyll and carotenoids which determined in fresh leaves according to Mackinney (1941), total sugar % in dried leaves according to Dubois *et al* (1956), Starch % according to Thayumanavan and Sadasivam (1984) and proline mcg/g according to the modified ninhydrine method of Troll and Lindsley (1955) omitting phosphoric acid to avoid interference with concentrated sugar Magne and Larher (1992). Data were subjected to analysis of variance (ANOVA) by the general linear models (GLMs) procedure using (SAS) SAS Institute (1994). Mean comparisons were performed using the least significant difference (LSD) method according to Gomez and Gomez (1984). A significant level of 0.05 was adapted for all statistical analysis and since there were insignificant differences between the two seasons a combined analysis was done.

3. Results and Discussion

3.1. Turf Tillers Height and Weights

The concerned results in Table (1) and figure (1) indicated that pots which sprayed with the control treatment (distilled water) or drenched with 50 mg/L PBZ significantly tabulated the maximum tillers height of 22.00 and 20.67 cm, respectively followed by 14.00 cm when PBZ was used at the higher concentration of 100 mg/L.

Table 1. *Effect of CCC, PBZ concentrations and their interactions on tillers height, fresh and dry weight of Lolium perenne L.*

Vegetative growth				
Growth retardants mg/L		**Tillers height increase (cm)**	**Fresh weight (g)**	**Dry weight (g)**
CCC	**PBZ**			
----	----	22 a	78.07 bcd	13.03 j
----	50	20.67a	79.5 bcd	16.07 b
----	100	14 b	73.3 cd	13.97 g
100	----	16 b	90.23 abc	17.62 a
100	50	6 c	84.6 bcd	14.17 f
100	100	6.67c	99.97 ab	14.43 e
200	----	6.67c	110.6 a	17.63 a
200	50	6.33c	84.77 bcd	15.5 d
200	100	7.33c	82.87 bcd	13.2 i
300	----	7.67c	89.71 abc	15.67 c
300	50	7.67c	65.07 d	13.6 h
300	100	8.33c	75.2 bcd	12.77 k

Means having the same letter (s) in a column are not significant at 5% level.

In contrast, the maximum effects for growth retardants to retard ryegrass tillers height were shown with using CCC concentrations (100,200 or 300 mg/L) individually or in combinations with PBZ at 50 or 100 mg/L and insignificant difference was found among them. This may be due to the role of Chlormequat chloride (CCC) in inhibition the cyclization of geranylgeranyl pyrophosphate to copallyl pyrophosphate in the gibberellin biosynthesis pathway (Rademacher, 2000 and Wang *et al.,* 2009). Also, Paclobutrazol (PBZ) has a role in regulating the gibberellin biosynthesis and inhibits the oxidation of kaurene to kaurenoic acid. Specifically, it interacts with kaurene oxidase, acytochrome P-450 oxidas, and inhibits the microsomal oxidation of kaurene, Kuarenal and kaurenol (Hadden and Graebe, 1985).

CCC 300 mg/L + PBZ 50 mg/L Control

Figure 1. *Showed effects of CCC and PBZ combination comparing with the control on ryegrass tillers height increase (cm.).*

Generally, it could be noticed from the same table (1) that by using the high dose of growth retardants a decrease on tillers fresh weight were obtained, because of PGRs play as promoters in the low and optimal concentration or retardants and inhibitors with the higher doses. This may be due to the finding of Mackay *et al*. (1990), as they illustrated that PBZ increase cytokinins content and this is a big reason for enhancing tillers production which finally led to increase the fresh weight with the optimal concentrations and on the other side it decrease ethylene concentration. The same result was obtained by Nazari and Javadi (2012). But, it was obvious that pots which sprayed with 300 mg/L CCC + 50 mg/l PBZ tabulated the lowest fresh weight value of 65.07g. On the other side, spraying CCC at concentrations of 100 or 200 mg/L significantly showed a higher dry weight values comparing with the other treatments. Obviously, the lowest

dry weight value of 12.77g was recorded for turf treated with the interaction of maximum concentrations of CCC and PBZ, followed by the control treatment, since it was 13.03g.

3.2. Turf Tillers Chemical Constitutes

As shown in Table (2) all the growth retardants concentrations reduced the starch content in the ryegrass comparing with the control which sprayed with the distilled water. But, it was clear that interaction between CCC and PBZ at 300 and 50 mg/L., respectively tabulated the lowest starch value of 29.11. In contrast, it was evident that the total sugar was increased gradually by increasing CCC and PBZ concentrations individually or in combinations than the control one. But, the highest total sugar content of 4.54 was recorded for pots treated with 300 mg/L CCC+ 50 mg/L PBZ. This may discussed by the mode of action of CCC and PBZ treatments which enhance the sucrose contents in leaves probably due to the increase of chlorophyll contents according to Zheng *et al.* (2012). In correlation the superior treatment in increasing the total sugar content, also increased proline content, as it was 8.21. In addition, the control treatment tabulated significantly the lower proline value of 5.80. The same results were obtained by Hajihashemi *et al.* (2007), as they cleared that PBZ treatment increased free proline content.

Table 2. *Effect of CCC, PBZ concentrations and their interactions on some chemicals constitutes of Lolium perenne L.*

Chemical constitutes				
Growth retardants mg/L		Starch %	Total sugar %	Proline mcg/g
CCC	PBZ			
----	----	31.93 a	2.40 l	5.80 l
----	50	31.69 b	2.63 k	6.03 k
----	100	31.48 c	2.81 j	6.27 j
100	----	31.04 e	3.24 h	6.60 h
100	50	31.28 d	3.05 i	6.42 i
100	100	30.77 f	3.48 g	6.80 h
200	----	29.74 j	4.27 c	7.74 c
200	50	30.51 g	3.7 f	7.00 f
200	100	29.34 k	4.36 b	7.97 b
300	----	30.29 h	3.89 e	7.27 e
300	50	29.11 l	4.54 a	8.21 a
300	100	29.99 i	4.08 d	7.52 d

Means having the same letter (s) in a column are not significant at 5% level.

3.3. Turf Tillers Pigments Content (mg \ g F.W.)

It was clear from data in Table (3) that total chlorophyll and carotenoid contents increased by using all the growth retardants, when compared with the control treatment. In the same trend, Gliozeris *et al.* (2007) revealed that plant growth retardants such as CCC or PBZ significantly reduced viola Fresh weight and leaves area, but in contrast it increased chlorophyll and carotenoids contents. This may be due to the finding of Wang and Xiao (2009) that foliar spraying of CCC could noticeably decrease GA content which in turn increased chlorophyll level and stimulate photosynthetic rate (Sharma *et al.,* 1998). Also, PBZ improve photosynthetic capacity and water balance in leaves (Abdul Jaleel *et al*., 2007). In addition, the control gave 27.27 and 9.42 mg \ g for total chlorophyll and carotene, respectively. On the other hand, turf which treated with 100 mg/l CCC +100 PBZ and 100 mg/l PBZ recorded -- the highest total chlorophyll and carotene content, respectively. This was in agreement with Miller and Armitage (2002) who stated that plant treated with plant growth retardants had a higher content of chlorophyll and / or reduction of leaf expansion. It could be back to the act of plant growth retardants mode of action as Kirillova *et al.* (2003) suggested that effects of CCC could largely depend on the physiological state of the plants and the concentration of CCC applied.

Table 3. *Effect of CCC, PBZ concentrations and their interactions on total chlorophyll and carotene of Lolium perenne L.*

Pigments content (mg \ g F.W.)			
Growth retardants mg/L		Total chlorophyll	Carotenoids
CCC	PBZ		
----	----	27.27 c	9.42 ab
----	50	30.82 bc	10.14 ab
----	100	42.45 ab	11.02 a
100	----	39.30 abc	10.35 ab
100	50	42.14 ab	9.64 b
100	100	44.53 a	9.83 b
200	----	43.74 a	10.47 ab
200	50	33.86 abc	9.44 b
200	100	34.27 abc	10.58 ab
300	----	33.98 abc	10.07 ab
300	50	30.06 bc	10.54 ab
300	100	36.79 abc	9.71 ab

Means having the same letter (s) in a column are not significant at 5% level

4. Conclusions

Our results cleared that CCC had the upper hand in minimizing *Lolium perenne* tillers height, as a result for inhibition of GA production when comparing with PBZ one especially with the higher concentrations. Also, this effect was obvious in the combination treatments of them. In the same trend the highest fresh and dry weight of ryegrass tillers recorded when 200 mg/L CCC was foliar sprayed. In addition, the highest total sugar and proline % was tabulated for 300 mg/L CCC + 50 mg/L PBZ treatment. Generally, all the plant growth retardants (CCC or PBZ individually and in combinations) increased the pigments content (total chlorophyll and carotenoids) than the control. Finally, we recommend using the combination between CCC and PBZ at 300 and 50 mg/L., respectively.

Abbreviation

CCC Chlormequat chloride,
PBZ Paclobutrazol

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