J. BIOL. ENVIRON. SCI.,
2012, 6(17), 195-198

Growth and Development of *Lolium perenne* L. 'Barbal'in Response to Different Concentrations of Paclobutrazol

Farzad Nazari[*] and Taimoor Javadi
Department of Horticultural Science, College of Agriculture, University of Kurdistan, Sanandaj, IRAN

Received: 09.01.2012; Accepted: 29.05.2012; Available Online: 11.07.2012

ABSTRACT

It is nowadays possible to use chemical substances to retard lawns growth and it is called chemical mowing. This research was carried out to investigate this issue at College of Agriculture, University of Kurdistan. The experiment was conducted as a completely randomized design with 4 treatments along with control and 4 replications. The seeds of *Lolium perenne* L. were first scarified by soaking them in 50 % sulfuric acid at half an hour and then after rinsing in water and finally the seeds were put in 20, 40, 60, and 80 mg.L^{-1}paclobutrazol solution and shacked for 24 h. In the control treatment seeds soaked in distillated water. The seeds were then sown in pots containing soil mixture. After seed emergence and several mowing, data recording was made. The results of this study indicated that with increasing in paclobutrazol concentration, clipping fresh and dry weight, verdure and root and also seed germination were reduced and visual quality was relatively increased. Thus, due to the adverse effects of high concentration the optimal concentration (20-40 mg.L^{-1}) of paclobutrazol may be recommended used as a growth retardant in lawn management.

Key Words: Paclobutrazol, *Lolium perenne*, Clipping, Verdure, Visual quality

INTRODUCTION

Chemical regulators are commonly used to retard growth of potted flowering plants, bulbous plants, vegetable transplants, bedding plants, ornamental tree and shrubs, some fruit crops, and turfgrass. Turgeon (1996) reported plant growth regulators (PGR's) were introduced over forty years ago to reduce mowing requirements by inhibiting turfgrass shoot growth. PGR's have become important tools for turf managers to inhibit uneven shoot growth (McCullough et al., 2005). PGR's were originally categorized as Type I or Type II compounds from early work performed by Kaufmann and Watschke (Watschke *et al*., 1992). The use of the PGR's as ''chemical mowing agents'' was envisioned many years ago because of the tremendous economic benefits (Davis and Curry, 1991) and additional potential benefits including: improved color, fewer clipping, deeper roots, fewer seedheads, less time spent in trimming (Johnson, 1992). The potential disadvantages are leaf burn, reduced turf recuperative ability, increased weeds, and increased disease incidence (Feltcher *et al.*, 2000). Paclobutrazol is a Class II PGR's and registered for use on turfgrass in this category. Paclobutrazol (PBZ) interferes with gibberellin biosyntheses by inhibiting the oxidation of *ent*-kaurene to *ent*-kaurenoic acid through inactivating cytochrome P450-dependent oxygenases (Graebe, 1987). Soaking seeds in 50 to 100 mg.l^{-1} paclobutrazol solutions controlled the overgrowth of rice seedling (Choi et al., 1988). Soaking the seeds of *Lolium perenne* L. 'Barbal' with paclobutrazol at concentration of 15 mg/L produced the highest turf quality (Shahrokhi *et al*., 2008). Soaking maize kernels in 80 or 160 mg.l^{-1}paclobutrazol for 16 h resulted in a temporary growth reduction of seedlings without decreasing seedling emergence (Dale and Drennan, 1977). Flurprimidol and paclobutrazol are effective PGR's for common and hybrid bermudagrass (*Cynodondactylon* × *C. transvaalensis*) maintained at golf course fairway mowing heights (Johnson, 1992). The objective of this study was to investigate growth and development of *Lolium perenne* L. 'Barbal' in response to different concentrations of paclobutrazol.

MATERIALS AND METHODS

This study was conducted at the department of horticultural science, University of Kurdistan, Sanandaj, Iran. Perennial ryegrass (*Lolium perenne* L. 'Barbal') seeds (1.5 g per pot) were soaked in water (control treatment) or water solutions of paclobutrazol at concentrations of 20, 40, 60, and 80 mg.L^{-1} for 24 h in a flask shaking on a shaker device (model 75, Burrell Co., Pittsburgh, PA, USA. Before treatments of seeds, the seeds were treated with 50 % sulfuric acid at half an hour (Salehi and Khosh-Khui, 2005). Treated seeds were kept under running tap water for 24 h, then seeds were sown in 250 cm^2 pots containing soil mixture (field soil, sand and animal manure, 1:1:1). After sowing, seeds were covered with a small portion of animal manure. Pots were transferred to the greenhouse, under natural light (>800 µmol m^{-2} s^{-1}) at a day temperature of 23±2 ^{o}C and night temperature of 13±2 ^{o}C and a RH of about 55±5%. In all pots, clipping, verdure and root were weighed for fresh weight, then

[*] Corresponding author: fnazari56@yahoo.com

dried at 70 ^{o}C for 48 h and weighed as dry weight. After seed emergence and several mowing, data recording was made. For visual quality, a ranking scale of 0 to 9, 0=no live turf; 9=ideal texture (Salehi and Khosh-Khui, 2004), color and density was used. The experiment was conducted as a completely randomized design with 4 treatments along with control and 4 replications. Statistical analysis was done with MSTATC software. Means compared with Duncan's multiple range tests (DNMRT) at 5 % level. To determine of germination percentage (GP), laboratory germination was conducted on four replication of 100 seeds each per treatments and placed on a filter paper in a Petri dish wetted with 5ml distillated water. The Petri dishes were covered with a transparent polyethylene sheet to reduce the evaporation to a minimum, and then GP was investigated.

RESULTS AND DISCUSSION

When seeds were soaked in paclobutrazol, reduction in clipping and verdure fresh and dry weights significantly were observed. The lowest clipping and verdure fresh and dry weights were obtained with 80 mg.L^{-1} significantly different in comparison with control. Paclobutrazol is one of the most important groups of PGR's that inhibits the oxidation of *ent*-kaurene to *ent*-kaurenoic acid, an early reaction in GA biosynthesis (Fletcher *et al*., 2000: Rademacher, 2000). Inhibition of GA biosynthesis leads to reduction of clipping and verdure growth. Soaking the seeds of marigold, pelargonium and tomato in paclobutrazol solution decreased height of seedlings (Pasian and Bennett, 2001). Deyton *et al.* (1991) found that total and shoot dry weights of strawberry 'Cardinal' were decreased by foliar application of paclobutrazol in concentrations of 75-1200 mg L^{-1}. Cucumber (*Cucumis sativus* L.) seeds soaked in 250, 500, 1000 or 2000 mg L^{-1} paclobutrazol solution for 6, 12 or 24 hr produced seedlings with reduced stem elongation and hypocotyl length (Cho *et al.,* 2002). Probably secondary activities of paclobutrazol are associated with changes in the endogenous levels of abscisic acid, cytokinin (Fletcher *et al*., 2000; Rademacher, 2000). Therefore high concentration of paclobutrazol resulted to reduction of shoot and root growth (Table 1 and Fig. 1). Paclobutrazol treatments had significant effects on root fresh and dry weights. The lowest amounts of root fresh and dry weights were obtained with paclobutrazol at 80 mg.L^{-1} (Table 1). Photosynthesis is the process that plants use to produce carbohydrate needed for plant growth. Because high concentration of paclobutrazol leads to reduction of clipping and verdure growth, so carbohydrate production is decreased for root growth (Christians, 2004). Paclobutrazol significantly influenced turf visual quality. Highest visual quality was observed in concentration 20, 40 and 60 mg L^{-1}paclobutrazol whereas lowest quality was in control (Table 1). Several studies demonstrated increase in chlorophyll content in triazole-treated plants (Berova and Zlatev, 2003; Fletcher *et al*., 2000). Paclobutrazol treatments had significant effects on seed germination. Increasing paclobutrazol concentrations reduced laboratory germination in all treatments. The highest germination percentage was observed in the control (Fig. 2). Reduction of seed germination can be undesirable side effects from treating seed with paclobutrazol (Pasian and Bennett, 2001). In this study, because the seeds were treated with 50 % sulfuric acid for better and faster germination, might paclobutrazol penetration into seed in amount sufficient to reduce endogenous GA levels below those required for induction of α-amylase expression in aleurone cells (Taiz and Zeiger, 2002). Thus, due to the adverse effects of high concentration the optimal concentration (20-40 mg.L^{-1}) of paclobutrazol may be recommended used as a growth retardant in lawn management.

Table 1. Effects of different concentrations of paclobutrazol on clipping fresh and dry weight, root fresh and dry weight, verdure fresh and dry weight and visual quality of *Lolium perenne* L. 'Barbal' 40 days after sowing seeds in pots (250 cm^2).

Paclobutrazol concentration [mg. L^{-1}]	Control†	20	40	60	80
Clipping fresh weight [g]	12.40a	5.70b	3.96c	2.42d	2.13d
Clipping dry weight [g]	3.94a	1.00b	0.87c	0.50d	0.34e
Verdure fresh weight [g]	23.26a	12.45b	8.50c	6.92c	4.62d
Verdure dry weight [g]	3.22a	1.33b	0.94c	0.75d	0.53e
Root fresh weight [g]	25.20a	7.96b	5.57bc	4.98c	3.77c
Root dry weight [g]	7.70a	0.92b	0.34c	0.28c	0.22c
Visual quality	7.00c	9.00a	9.00a	9.00a	8.00b

† In each row means with the same letter(s) are not significantly different at 5% level of probability using DNMRT.

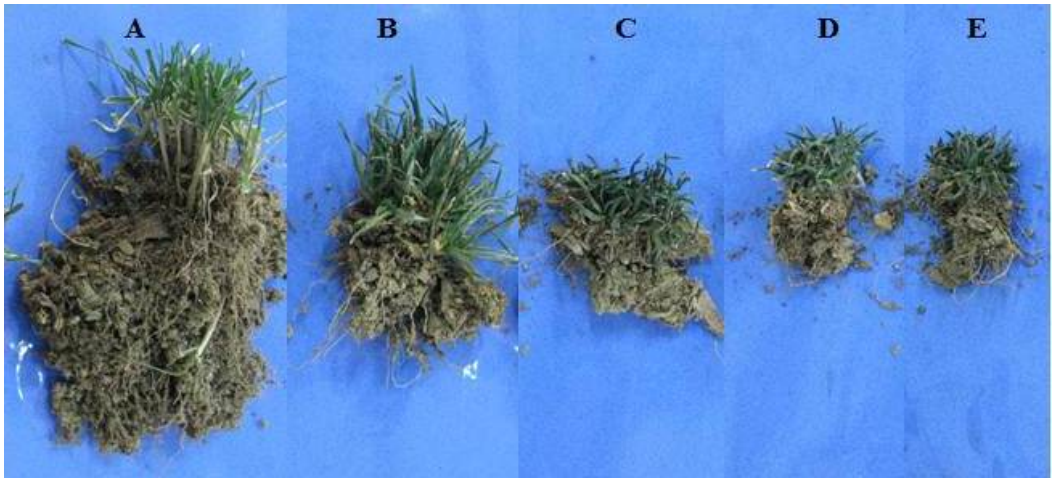

Figure 1. Effects of different concentrations of paclobutrazol on shoot and root growth of *Lolium perenne* L. 'Barbal' (A: Control, B: 20, C: 40, D: 60, and E: 80 $mg.L^{-1}$).

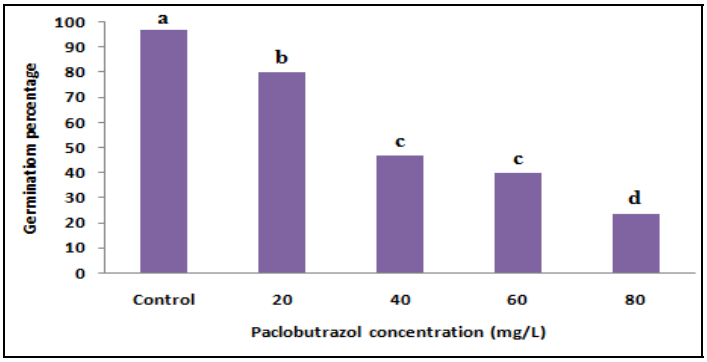

Figure 2. Effects of different concentrations of paclobutrazolon germination percentage of *Loliumperenne* L. 'Barbal' (means with the same letter(s) are not significantly different at 5% level of probability using DNMRT).

REFERENCES

Berova M, and Zlatev Z (2003). Physiological responses of paclobutrazol treated triticale plants to water stress. Biol. Plant. 46:133-136.

Cho KC, Yang WM, Kim WS, and Chung SJ (2002). Growth retardation of cucumber (*Cucumussativus* L.) seedlings by treatment of paclobutrazol and removal of retardation by foliar spray of gibberellin. J. Korean Soc. Hort. Sci. 43:415-420.

Choi CD, Kim SC, and Lee SK (1988). Agricultural use of the plant growth regulator. I. Controlling rice seedling growth by seed soaking treatment. Res. Rpt. Rur. Dev. Admin. 30:24-29.

Christians N (2004). Fundamentals of Turfgrass Management.John Wiley and sons Inc., NJ, U.S.A. 359 p.

Dale AE, and Drennan DSH (1977). Transplanted maize (*Zea mays*) for grain production in southern England. III. Effects of plant growth regulator treatments on maize transplant morphology. J. Agri. Sci. 128:45-50.

Davis TD, and Curry EA (1991).Chemical regulation of vegetative growth. Crit. Rev. Plant Sci. 10:151-188.

Deyton DE, Sams CE, and Cummins JC (1991). Strawberry growth and photosynthetic responses to paclobutrazol. HortScience 26:1178-1180.

Fletcher RA, Angella G, Sankala N, and Tim D (2000). Triazoles as plant growth regulators and stress protectors .Hort. Rev. 24:55-105.

Graebe JE (1987). Gibberellin biosynthesis and control. Annu. Rev. Plant Physiol. 38:419-465.

Johnson BJ (1992). Response of 'Tifway' bermudagrass to rate and frequency of flurprimidol and paclobutrazol application. HortScience 27:230-233.

McCullough PE, Liu H, and McCarty LB (2005). Dwarf bermudagrass responses to flurprimidol and paclubotrazol. HortScience 40:1549-1551.

Million JB, Barrett JE, Nell TA, and Clark DG (1999).Paclobutrazol distribution following application to two media as determined by bioassay. HortScience 34:1099-1102.

Pasian CC, and Bennett MA (2001). Paclobutrazol soaked marigold, geranium, and tomato seeds produce short seedlings. HortScience 36:721-723.

Rademacher W (2000). Growth retardants: effects on gibberellins biosynthesis and other metabolic pathways . Annu. Rev. Plant physiol. Plant Mol. Biol. 51:501-531.

Salehi H, and Khosh-Khui M (2005).Germination rate of four turfgrass genera by acid treatments. J. Agron. Crop Sci. 191:346–350.

Shahrokhi M, Salehi H, Eshghi S, and Abdi Gh (2008). Turf seedling height and quality in paclobutrazol-treated seeds of *Lolium perenne* L. 'Barbal' sown in the soil mixed with zeolite. Hort. Environ. Biotechnol. 49:381-386.
Taiz L, and Zeiger E (2006). Plant Physiology. 4th ed. Sunderland, Massachusetts: Sinauer Associates, Inc. 764 p.
Turgeon AJ (1996). Turfgrass management. 4th ed. Prentice-Hall, Inc., Upper Saddle River, NJ. pp.1-406.
Watschke TL, Prinster MG, and Breuninger JM (1992).Plant growth regulators and turfgrass management. In Waddington DV, Carrow RN, and Shearman RC (eds.) Turfgrass. Agronomy Monograph. 32:557-588.