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Studies on the effect of Paclobutrazol in *Zoysia japonica* Grass

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ABSTRACT: *Optimizing appropriate mowing frequencies is a major component in a lawn to develop dense, actively growing and attractive grasses. Mowing would become a destructive practice if not appropriate, because it damages the leaf portions. If too much of leaves are removed by frequent mowing, the grasses will lose its aesthetic appearance and resulted in scalping effect. To avoid such damages in lawn by frequent mowing the present study taken up in Botanical Garden, Department of Floriculture and Landscaping, with the objectives to study the effect of growth retardant, paclobutrazol at varied concentrations to optimize the shoot growth and to reduce the mowing frequency in Zoysia japonica (Korean grass). Paclobutrazol under different concentrations are used in zoysia japonica grass for its potential to reduce its vegetative growth and the number of required mowing. From the study it could be inferred that the reduction in plant height, number of leaves per node, number of nodes per 15cm length, internodal distance leaf area and turf quality are observed in Zoysia japonica (T_3 PBZ 500 ppm). Turf injury with scorching symptoms was observed when paclobutrazol was used at 750 and 1000 ppm concentrations. Application of growth retardant, paclobutrazol has effective control in plant height and thereby makes a tremendous change in morphological trait of the grasses used. The findings of paclobutrazol @ 500 ppm for Zoysia japonica grass was found to be effective in reducing the plant height as well as the frequency of mowing.*

Key words: *mowing, paclobutrazol, vegetative growth, Zoysia japonica*

INTRODUCTION

A lawn is an area where grass is grown as a green carpet for a landscape and is the basic feature of any garden. It serves to enhance the beauty of the garden, be it larger or smaller. Healthy, properly maintained lawn positively impacts the quality of our lives and the quality of our environment in ways that almost nothing else can. Grasses are pleasing to the eye in an aesthetic lookout, provide an appropriate surface for play and sport as a utility turf, provide life-giving oxygen. Having a lawn is always bring pleasure when it is been properly maintained. Lawn maintenance is an aspect which requires routine care or maintenance such as mowing, fertilizing, irrigation, top dressing, aerifying, etc.,. Among the maintenance operations, mowing is a necessary operation in turf care to retain its beauty everlasting and purposeful when it is lawn as sports turf. Mowing is a process of cutting the grass periodically at heights to stimulate more prostrate type of growth, without weakening the grass. Only the grasses that are capable of responding to such cuttings are useful for fine turf.

When repeated, excessively close mowing exhaust the food reserves to the point where the plant loses its ability to endure drought, heat, diseases and competitions with aggressive weeds besides the labour cost involved in often mowing is also to be taken into consideration. To overcome the usage of lawn mowers frequently and to reduce the number of mowings or mowing frequency, plant growth retardants like paclobutrazol, flurprimidol, trinexapac-ethyl are being used as a "chemical mowing agents" by the turf managers for cool season grasses especially in the sports grounds. The growth retardants used inhibit the shoot growth or vegetative growth by blocking the enzyme in GA biosynthesis pathway. Reduced height in grasses resulted in reduction number of mowing or mowing frequencies.

MATERIALS AND METHODS

The experiment was conducted at the Botanic Gardens, Department of Floriculture and Landscaping, Horticultural College and Research Institute, Tamil Nadu Agricultural University,

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Coimbatore. The treatments consisted of varied concentrations of paclobutrazol to study the effect of paclobutrazol in warm season grasses under open field condition.

Treatments applied in the experiment are detailed below.

Treatment	*Particulars*
T_1	Control
T_2	250 ppm Paclobutrazol
T_3	500 ppm Paclobutrazol
T_4	750 ppm Paclobutrazol
T_5	1000 ppm Paclobutrazol

Grass planting was taken up by dibbling method and after 6 months of establishment from the date of planting, Paclobutrazol (PBZ) was applied at different concentration to the open field grass during the study period. Three sprays were given at fortnight interval.

The effect of paclobutrazol was clearly noticed in all the concentrations used and its direct reflection in morphological, physiological and biochemical characters were documented in *Zoysia japonica*. The observations on the characters *viz.*, plant height, number of leaves per node, number of nodes per 15cm length, internodal length, leaf area and turf quality have been recorded.

Statistical Analysis

The data generated from various experiments were subjected to statistical analysis in a Randomized Block Design (RBD) as given by Panse and Sukhatme (1967). The critical difference was worked for 0.05 % probability and the results were interpreted.

RESULTS AND DISCUSSION

Plant Height

The data on plant height influenced by different concentrations of paclobutrazol at various growth stages for *Zoysia japonica* are presented in Table 1. A significant reduction in plant height was observed in 15 DAS, 30 DAS, 45 DAS and the decrease in plant height is directly proportional to the increased concentration in both the experiment when compare with the control. In general, paclobutrazol under various concentrations recorded significantly lower values for plant height. Effect of paclobutrazol in *zoysia japonica* at 15, 30 and 45 DAS a minimum plant height of (4.84, 4.88 and 5.85cm recorded respectively) in the treatment T_5 (PBZ @ 1000 ppm). The high concentration among the treatments resulted with drying symptoms inspite it produced desirable height. Whereas the treatment T_3 (PBZ @ 500 ppm) had shown almost desirable plant height quality (7.03, 7.71 and 8.62cm recorded respectively) with better leaf quality.

The suppression in shoot growth might be due to the effect of paclobutrazol in blocking the enzyme *ent*-kaurene oxidase which is responsible for the oxidation of *ent*-kaurene, *ent*-kaurenol and *ent*- kaurenal from forming GA_{12}- aldehyde, causing 20 per cent reduction in GA accumulation (Kalil and Rahman, 1995). Inhibition of *ent*- kaurene oxidase might decrease cell number, reduce cortical cells and reduce xylem length. The results are in confirmative with the observations of Sponsel, 1995 and Fletcher *et al.*, 2000.

Table 1
Effect of paclobutrazol on plant height (cm) in *Zoysia japonica*

Treatments	*Plant height at 15 DAS (cm)*	*Plant height at 30 DAS (cm)*	*Plant height at 45 DAS (cm)*
T_1 Control	11.90	14.02	17.52
T_2 PBZ @ 250 ppm	8.63	10.71	12.50
T_3 PBZ @ 500 ppm	7.03	7.71	8.62
T_4 PBZ @ 750 ppm	6.35	7.35	8.41
T_5 PBZ @ 1000 ppm	4.84	4.88	5.85
Mean	**7.75**	**8.94**	**10.58**
SE(d)	0.2888	0.3389	0.3026
CD @ 0.05%	0.6156	0.7383	0.6594

Table 2
Effect of paclobutrazol on number of leaves per node, number of nodes per 15cm and internodal length (cm) in *Zoysia japonica*

Treatments	*Number of leaves / node (nos.)*	*Number of nodes/ 15 cm (nos.)*	*Internodal length (cm)*
T_1 Control	5.14	8.83	2.88
T_2 PBZ @ 250 ppm	6.43	14.24	2.43
T_3 PBZ @ 500 ppm	7.28	14.56	1.89
T_4 PBZ @ 750 ppm	8.21	16.18	1.27
T_5 PBZ @ 1000 ppm	8.85	17.54	1.52
Mean	**7.18**	**14.27**	**2.00**
SE(d)	0.18	0.36	0.06
CD @ 0.05%	0.41	0.83	0.14

Number of leaves per node

The data recorded in table 2 revealed a predominant increase in number of leaves per node was observed in all the treatments of different concentrations of paclobutrazol. Among the treatments T_5 (PBZ @ 1000 ppm) had resulted with more number of leaves per node (8.85) when compared with control (5.14) in *Zoysia japonica.*

Inhibition of GA biosynthesis makes application of growth retardant, paclobutrazol to have effective

control in plant height and thereby makes a tremendous change in morphological trait of the grasses used. When compare with the control almost triple the numbers increase in leaf was noticed as one of the interesting characters in the paclobutrazol applied treatments. This might be due the sudden stress caused to the plant by paclobutrazol application after 6 months during the full establishment of the grass from the date of planting. The stress factor implies a sudden suppression in plant height but not the reserved carbohydrate which should be present in the plant at that time. So increase in leaves might be due to the carbohydrates reserves which would have been utilized for this other than vertical growth.

Number of nodes per 15cm length

The effect of paclobutrazol in *Zoysia japonica* exhibits a tillering nature for its establishment and presented in Table 2, recorded increased number of nodes (17.54) in T_5 (PBZ @ 1000 ppm). The data from the result clearly stated that the internodal length is inversely proportional to the number of nodes present in the plant *i.e.*, an increase in number of nodes there was a decrease in internodal length. This might be due to the blocking GA biosynthesis pathway by the application of paclobutrazol in arresting the vertical growth (Mc Cullough *et al.,* 2005; Singh, 2004).

Internodal length

Inspite of more leaves recorded in the treatment T_5 (PBZ @ 1000 ppm) the internodal length of *Zoysia japonica* had show cased a shortest internodal length of (1.52cm) which was found to be an expected output to satisfy the objective of the study. The control and other remaining treatments produced an increased internodal length with the respect to the concentrations used and it was clearly tabulated in Table 2.

Paclobutrazol which was also reduced the internodal length responded in a different manner. When gibberellin production is inhibited, plant cells do not elongate, internodes become shortened and overall plant growth is reduced. In the present study there was decrease in the length of internodes in all the treatments of paclobutrazol. Singh (2004) who observed restricted growth of internode in marigold. Less gibberellins and auxins in the tissue due to the action of growth retardant can account for the shorter internodal length (Tongumpai *et al.*, 1991).

Leaf area (cm^2/leaf)

The effect of paclobutrazol exerted significant influence on leaf area. The results presented in Figure 1 depicted that there was a significant difference noticed in the study with different treatmental combinations. The maximum leaf area of 0.47cm^2/leaf was recorded for *Zoysia japonica* in treatment T_1 (control). Obviously the impact of paclobutrazol resulted in significant reduction in leaf area with respect to the concentration adhered in the experiment.

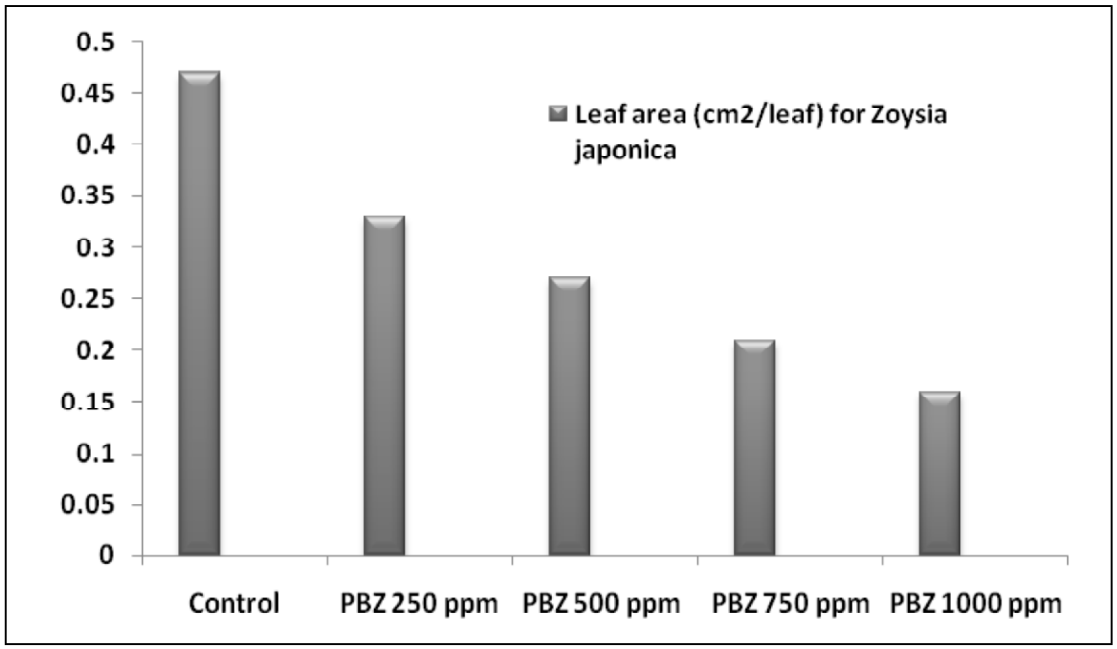

Figure 1: Effect of paclobutrazol on leaf area (cm^2/leaf) in *Zoysia japonica*

The reduction of leaf by changing in the partitioning of assimilates, reduction of transfer of assimilates to leaves and thereby determining the growth of leaves by application of paclobutrazol when compared to control. The range of leaf reduction in leaf area attributed more when the concentration was increased. Overall the cause for decreased leaf area might be due to the inhibition of GA biosynthesis resulted in reduced cell division and elongation. The research findings done by Hans *et al.* (1998) and Symington *et al.* (1986).

Turf quality

Rating was done on the basis of colour, texture and density of grasses. The data on visual scoring indicated significant differences among the varied paclobutrazol concentrations were furnished in Figure 2. Among all the treatments of in this study, T_3 (PBZ @ 500 ppm) scored 8.4 in *Zoysia japonica* exhibited the superiority in turf quality.

Visual quality ratings were made on 1 to 9 scale with 9 = dark green turf and 1 = completely dormant turf. Quality ratings below 7 were considered unacceptable (Patrick *et al.,* 2005).

The rating was done based on the colour, texture, appearance and density of grasses. Several studies reported the visual turf grass quality based on turf injury and turf discolouration (Shahrokhi *et al.,* 2010; Patrick *et al.,* 2005; Taiz and Zeiger, 2002). Paclobutrazol applied at 750 ppm during the study period caused slight moderate turf grass injury but the injury was temporary and the grass had fully recovered by 3 weeks after. However paclobutrazol at 1000 ppm resulted in high turf grass injury (> 20 %) and persistence also prolonged for long period in *Zoysia japonica*.

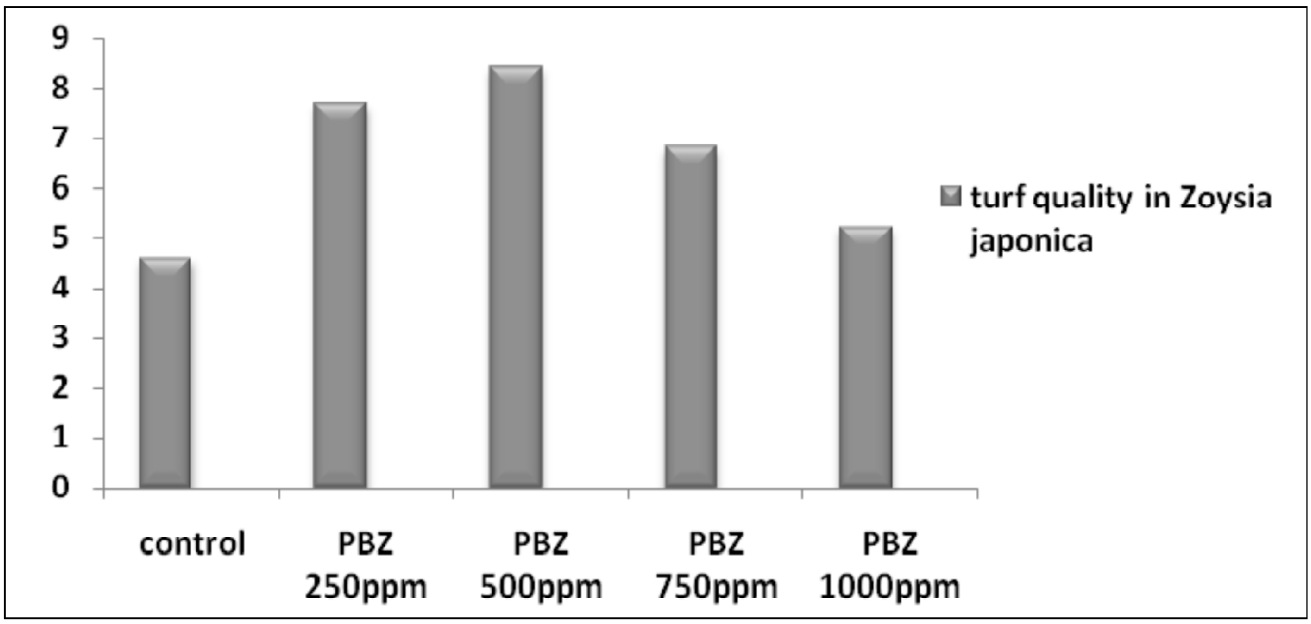

Figure 2: Effect of paclobutrazol on turf quality in Zoysia japonica

CONCLUSION

In the present study, the plant growth retardant palobutrazol was tried in turf grass to reduce the vegetative growth and number of required mowings. Where the usage of Zoysia grass are predominant in lawn establishment. A definite reduction in mowing and in turn reduction in cost input, time and labour saving and eventually the good visual turf quality are the output of the research. Paclobutrazol @ 500 ppm for *Zoysia japonica* grass were found to be effective.

REFERENCES

Fletcher, G. J. O., J. A. Simpson and G. Thomas. (2000), The measurement of perceived relationship quality components: A confirmatory factor analytic study. *Personality and Social Psychology Bulletin,* **26,** 340- 354.

Han, S.W., T.W.Fermanian, J.A. Juvik and L.A. Spomer. (1998), Growth retardant effects on visual quality and non-structural carbohydrate of Creeping Bentgrass. *Hort Sci.,* 33 (7): 1197-1199.

Kalil, I.A., and H. Rahman. (1995), Effects of paclobutrazol on growth, chloroplast pigments and sterol biosynthesis of maize *(Zea mays* L.). *Plant Sci.,* **105:** 15-21.

McCullough, P. E., H. Liu, L. B. McCarty, and T. Whitwell. (2005), Physiological response to TifEagle bermmudagrass to paclobutrazol. *Hort. Sci.,* **40:** 224-226.

Panse, U.G. and P.V. Sukhatme. (1967), Statistical methods for agricultural workers. ICAR, New Delhi, pp: 345-361.

Patrick, E., McCullough, L. Haibo, B. Lamber and T. Whitwell. (2005), Physiological response of TifEagle Bermuda grass to paclobutrazol. *Hort Sci*., 40 (1): 224-226.

Shahrokhi, M., A. Tehranifar, H. Hadizadeh, Y. Selahvarzi. (2010), Turfgrass seedling height and quality in Lolium perenne and Festuca aurandinacea. *J. Biol. Environ,* **4(12).**

Singh, A.K. (2004), Growth and seed yield of African marigold as influenced by growth retarding chemicals**.** *South Indian Hort.* **52 (1/6):** 377-380.

Sponsel, V.M. (1995), the biosynthesis and metabolism of gibberellins in higher plants. *P.J. Davies.,* pp: 66-97.

Symington, A.G., L.E. Craker and K.A. Hurto. (1986), Effect of environmental stress on Kentucky Blue grass to chemical growth retardants. *Appl. Agr. Res.*, **1:** 41-44.

Taiz, L. and E. Zeiger. (2002), Plant physiology. 3rd ed. Sinauer Assoc., Sunderland, Mass.

Tongumpai, P., K. Jutamanee and S. Subhadrabandu. (1991), Effect of paclobutrazol on flowering of mango cv. Khiew Sawoey. *Acta Hort.,* 291: 67-69.