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Influence of Growth Retardant on Vegetative Growth and Leaf Chlorophyll Content of Jackfruit (*Artocarpus heterophyllus*)

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ABSTRACT

An experiment was carried out during the year 2010-11 and 2011-12 to study the response of growth retardant on the vegetative growth and leaf chlorophyll content of Jackfruit. The experiment was conducted on eleven years old jackfruit trees cv Pant Garima by using variable concentrations of paclobutrazol. Paclobutrazol was applied as soil drench @ 5, 10, 15, 20 and 25 ml with 5 litre of water in each treatment/tree and as foliar spray @ 2.5, 5, 7.5, 10 and 12.5 ml with 5 litre of water in each treatment/tree in the month of September. Findings revealed that tree height, tree spread, shoot length as well as leaf area were reduced by paclobutrazol treatment, especially with soil drench method. The maximum reduction in vegetative growth parameters as well as maximum chlorophyll content of leaves (chlorophyll a, chlorophyll b and total chlorophyll) was recorded with treatment T_5 (soil drench @ 25 ml paclobutrazol/tree).

Key words: *Jackfruit, growth retardant, paclobutrazol, vegetative growth, chlorophyll*

INTRODUCTION

The genus *Artocarpus* consists of about 50 species, out of which only two are of horticultural importance viz., Jackfruit (*Artocarpus heterophyllus*) and bread fruit (*A. altilis*). The jackfruit is a native to India and is now widely cultivated throughout the tropical region. Jackfruit plant comes in bearing in about 10-12 years after transplanting due to its more juvenile phase[5]. Paclobutrazol, a chemical growth retardant which retards the endogenous synthesis of gibberellins, has proved to be promising for flower initiation in shoot bud and giving early and profuse flowering. The paclobutrazol reduces vegetative growth and stem elongation in many fruit trees by interrupting gibberellic acid synthesis at kaurene biosynthesis stage. Usually it is applied to the soil due to its low solubility in water and mobility, but poses a long residual effect[12]. The objective of this experiment was to study the effect of paclobutrazol on vegetative growth and leaf chlorophyll content in Jackfruit.

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MATERIALS AND METHODS

The present experiment was conducted during the year 2010-11 and 2011-12 at Horticulture Research Center, Patharchatta, Department of Horticulture, GB Pant University of Agriculture & Technology, Pantnagar, Distt. Udham Singh Nagar, Uttarakhand. The experimental material consisted of eleven years old Jackfruit trees cv Pant Garima with spacing 10m x 10 m. All the trees selected for experiment to be almost uniform in growth and vigour. All the trees were given uniform cultural operations and the treatments were imposed in September 2010 and September 2011. The experiment was laid out in Randomized Block Design (RBD) with 11 treatments and 4 replications. Paclobutrazol was applied as soil drench @ 5, 10, 15, 20 and 25 ml with 5 litre of water in each treatment/tree and as foliar spray @ 2.5, 5, 7.5, 10 and 12.5 ml with 5 litre of water in each treatment/tree. The tree height was measured with the help of a bamboo pole, which was marked with an appropriate scale and expressed in meter and data was presented as annual increase in tree height. The tree spread was measured with the help of measuring tape and data was presented as annual increase in tree spread. Ten shoots of each tree from all the directions of tree were selected randomly and tagged. The tagged shoots were measured with the help of metre scale and data was presented as annual increase in shoot length. Numbers of leaves were counted in all the tagged shoots of tree. Leaf area was measured by leaf area meter. Concentration of chlorophyll *a* (*Chla*), chlorophyll *b* (*Chlb*) and total chlorophyll will be analyzed by the method given by Hiscox and Israelstam[6] (1979). The *Chla*, *Chlb* and total chlorophyll (mg g^{-1} FW) concentrations in the leaf tissues will be calculated according to the following equations:

Chl a = $[(12.7 \times A_{663}) - (2.63 \times A_{645})]$ / (wt. in gms x 1000)

Chl b = $[(22.9 \times A_{645}) - (4.48 \times A_{663})]$ / (wt. in gms x 1000)

Total Chlorophyll = $[(20.2 \times A_{645}) + (8.02 \times A_{663})]$ / (wt. in gms x 1000)

RESULTS AND DISCUSSION

Data pertaining to effect of paclobutrazol on the vegetative parameters and leaf chlorophyll content are presented in table 1 and 2, respectively. Paclobutrazol had significant effect on annual increase in tree height, and tree spread during both the years. The minimum annual increase in tree height was recorded with treatment T_5 (soil drenching of 25 ml paclobutrazol/tree) while maximum annual increase in tree height was recorded with control (T_{11}) during both the years. The minimum annual increase in the plant spread was recorded with treatment T_5 (soil drenching of 25 ml paclobutrazol/tree) and T_2 (soil drenching of 10 ml paclobutrazol/tree) while maximum annual increase in tree spread was recorded with T_6 (foliar application of 2.5 ml paclobutrazol/tree) followed by treatment T_{11} (control) and T_8 (foliar application of 7.5 ml paclobutrazol/tree), during first year i.e. 2010-11. However, during second year (2011-12) minimum annual increase in the tree spread was recorded with treatment T_4 (soil drenching of 20 ml paclobutrazol/tree) followed by treatment T_5 (soil drenching of 25 ml paclobutrazol/tree) and maximum annual increase in plant spread was recorded with treatment T_8 (foliar application of 7.5 ml paclobutrazol/tree) followed by treatment T_{11} (control). Paclobutrazol responds significantly on shoot length, number of leaves per shoot and leaf area. The minimum shoot length was observed in treatment T_5 (soil drenching of 25 ml paclobutrazol) followed by treatment T_4, while maximum shoot length was recorded with control (T_{11}). The maximum number of leaves per shoot was recorded with treatment T_5 and minimum number of leaves per shoot was recorded with treatment T_6 (foliar application of 2.5 ml paclobutrazol/tree) during both the years. However, minimum leaf area was recorded with treatment T_5 (soil drenching of 25 ml paclobutrazol/tree) and maximum leaf area was recorded with control (T_{11}). All paclobutrazol treated trees had significantly less leaf area in comparison to control during both the years. Paclobutrazol is one of the growth retardant which inhibits kaurene oxidase and thus blocks the oxidative reactions from ent-kaurene to ent-kaurenoic acid in the pathway leading to gibberellic acid synthesis[4,10]. The mode of action of paclobutrazol has been associated with decrease in transpiration, tree

height, biomass and leaf area and increase in stomatal resistance[2]. Wood[13] and Khader[7] reported that paclobutrazol significantly reduced the tree height, tree girth and tree spread in mango. Sarkar *et al*[12]., observed maximum reduction in tree height i.e. 87.95% by paclobutrazol (6.0g a.i./tree) than the control trees, while tree girth and spread were non-significant. These results are in conformity with the findings of Kurian and Iyer[8]. Ram *et al*[11]., observed reduction in tree height, shoot length, shoot girth and internodal length when paclobutrazol (12 and 16 ml/tree) applied as soil drench after pruning of mango cv Dashehari tree.

Presented data revealed that the effect of paclobutrazol on chlorophyll content of leaves was significantly affected by various treatments of paclobutrazol during both the years. Maximum chlorophyll a, chlorophyll b and total chlorophyll was recorded with the treatment T_5 (soil drenching of 25 ml paclobutrazol/tree) as compare to other treatments of paclobutrazol, while, minimum chlorophyll a, chlorophyll b and total chlorophyll was recorded with the treatmentT_{11} (control) during both the years. Dalziel and Lawrence[3] found that sugar beet treated with paclobutrazol, together with GA increase in chlorophyll per unit leaf area, indicates that paclobutrazol increased the chlorophyll content per chloroplast. Mona *et al*[9]., reported that foliar application of paclobutrazol significantly increased chlorophyll a and chlorophyll b at 100 mg/l. Soil treatment (1 mg/l) and foliar treatment(25 mg/l) with paclobutrazol improves the photosynthetic activity and water balance of tomato cv Precador[1].

Table1: Response of different concentrations and application methods of paclobutrazol on vegetative parameters of Jackfruit

Treatment	Annual increase in tree height (m)		Annual increase in tree spread (m)		Annual increase in shoot length (cm)		Number of leaves per shoot		Leaf Area (cm^2)	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
Soil Drenching of 5 ml paclobutrazol /tree	0.50	0.40	0.64	0.54	6.25	10.98	10.52	10.697	49.81	48.98
T_2: Soil Drenching of 10 ml paclobutrazol/tree	0.65	0.32	0.54	0.54	5.71	7.22	13.79	16.46	49.79	48.54
Soil Drenching of 15 ml paclobutrazol/tree	0.37	0.27	0.55	0.46	7.22	6.02	14.61	17.78	41.36	40.22
Soil Drenching of 20 ml paclobutrazol/tree	0.42	0.20	0.55	0.35	4.25	3.50	14.98	15.93	35.56	32.93
Soil Drenching of 25 ml paclobutrazol/tree	0.32	0.12	0.54	0.37	3.41	3.30	16.36	18.24	28.77	25.01
Foliar Application of 2.5 ml paclobutrazol/tree	0.67	0.57	1.05	0.65	12.42	10.83	6.71	8.35	75.59	69.35
Foliar Application of 5 ml paclobutrazol/tree	0.75	0.60	0.87	0.55	12.56	9.83	6.84	9.74	67.24	65.07
Foliar Application of 7.5 ml paclobutrazol/tree	0.77	0.45	0.94	0.79	10.63	9.27	6.86	9.77	63.25	59.96
Foliar Application of 10 ml paclobutrazol/tree	0.77	0.37	0.78	0.54	12.08	9.57	8.30	9.38	55.44	52.46
Foliar Application of 12.5 ml paclobutrazol/tree	0.40	0.40	0.82	0.54	7.96	8.21	8.34	11.13	51.32	47.88
T_{11}: Control (water spray)	0.80	0.80	0.94	0.70	16.22	13.36	7.12	9.18	85.14	88.26
C.D. at 5%	0.29	0.24	0.26	0.18	3.29	2.78	2.91	3.68	4.18	6.69

Table 2: Effect of paclobutrazol on chlorophyll a, chlorophyll b and total chlorophyll content of Jackfruit leaves

Treatment	Chlorophyll a (mg/g)		Chlorophyll b (mg/g)		Total Chlorophyll (mg/g)	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
$T_{1:}$ Soil Drenching of 5 ml paclobutrazol /tree	0.118	0.120	0.045	0.048	0.161	0.166
$T_{2:}$ Soil Drenching of 10 ml paclobutrazol/tree	0.140	0.144	0.045	0.048	0.182	0.189
$T_{3:}$ Soil Drenching of 15 ml paclobutrazol/tree	0.154	0.159	0.051	0.055	0.203	0.212
$T_{4:}$ Soil Drenching of 20 ml paclobutrazol/tree	0.165	0.171	0.055	0.057	0.217	0.224
$T_{5:}$ Soil Drenching of 25 ml paclobutrazol/tree	0.171	0.176	0.056	0.058	0.224	0.231
$T_{6:}$ Foliar Application of 2.5 ml paclobutrazol/tree	0.043	0.044	0.031	0.033	0.074	0.076
$T_{7:}$ Foliar Application of 5 ml paclobutrazol/tree	0.092	0.097	0.033	0.035	0.124	0.130
$T_{8:}$ Foliar Application of 7.5 ml paclobutrazol/tree	0.095	0.098	0.035	0.036	0.129	0.133
$T_{9:}$ Foliar Application of 10 ml paclobutrazol/tree	0.108	0.112	0.036	0.040	0.142	0.150
$T_{10:}$ Foliar Application of 12.5 ml paclobutrazol/tree	0.114	0.115	0.041	0.046	0.154	0.158
$T_{11:}$ Control (water spray)	0.042	0.043	0.032	0.034	0.073	0.076
C.D. at 5%	0.005	0.003	0.004	0.003	0.004	0.005

CONCLUSION

On the basis of results summarized above, it can be concluded that application of paclobutrazol @ 20-25 ml/tree as soil drench method gives maximum reduction in tree vigour and increases leaf chlorophyll content per unit area. The long term effects of the paclobutrazol in Jackfruit need to be studied to arrive at valued conclusion.

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