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Effect of different levels of paclobutrazol on vegetative growth of olive *(Olea europaea* L.) tree under subtropical climates

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Abstract
The objective of this study was to examine the effect of Paclobutrazol on vegetative growth of olive tree. Paclobutrazol (PBZ) as potent specific inhibitor of GA_3 biosynthesis. Paclobutrazol slightly decreased the length of the plant height. Leaf area reduction by paclobutrazol was also reported and suppressed plant spread also. PBZ with 4ml a.i plant^{-1} was found to be the most effective in suppressing the vegetative growth of the plant. Paclobutrazol has been reported to increase yield of fruit trees. Found no PBZ influence on flowering of olive tree during my research work which may due to immaturity of the plant and unsuitability of the climatic condition.

Keywords: Olive, paclobutrazol, plant spread, leaf area, plant height

1. Introduction
The olive (*Olea europaea* L.) is an evergreen tree requires chilling for fruiting. In India, olive cultivation is restricted to the states of Jammu & Kashmir, Himachal Pradesh and Uttrakhand. Soil and foliar application of growth retardants have successfully been tried elsewhere to increase productivity of olive trees by enhancing their flowering and fruiting and by ensuring optimum use of available water in the plant system. Use of growth retardants like triazol compound such as paclobutrazol has also been advocated in drought prone areas to increase the degree of fruitfulness in olive. Paclobutrazol application at 500-4000 mg/litre reduced shoot growth,

Fig 1: Olive plant

internodal length, leaf area, and at the higher concentration increased shoot number and fruit set in olive (Porlingis and Voyiatzis, 1986) [4]. Olive trees treated with paclobutrazol showed increased water potential but decreased stomatal resistance (Frakulli and Voyiatzis, 1999) [2]. Paclobutrazol has been reported to reduce vegetative flush and increase proportion of flower bearing shoots (Tukey, 1983) [6]. Paclobutrazol application at 500-4000 mg/litre reduced shoot growth, number of nodes, and inter node length, total leaf area, and at the higher concentration

caused bending of the main shoots but increased shoot number and fruit set in olive. Increased in fruit set of Ascolana trees after paclobutrazol application at petal fall was observed by Antognozzi and Catalano (1985) [1]. Paclobutrazol application in mid-December at 2, 4and 6 g/tree increased crop yield, fruit oil per cent, average fruit weight, fruit diameter, fruit volume, fruit length and fruit pulp in olive cv. Picual (Rawash *et al*., 2002) [7]. Olive trees treated with paclobutrazol showed increased water potential but decreased stomatal resistance. However, Paclobutrazol significantly increased the accumulation of osmolytes such as amino acids and soluble sugars compared with untreated plants which enable plants to sustain under stressful conditions (Thakur *et al*., 1998) [5].

2. Material and Method

The plants growth and treatments were conducted in experimental farm of Dept. of Horticulture, located in eastern part of Uttar Pradesh State, India25.7^{0}N latitude and 81.5^{0}E latitude and about 98m from above sea level. The soil is classified as Sandy loam. The climate is exothermal, with an average temperature of 17 °C. During the experimental period, from November to April, the variations of maximum (12 °C to 40 °C) and minimum (10.8 °C to 18.8 °C) temperatures were recorded. The olive tree were four year old, were planted using a spacing of 5x5 m.

Fig 2: Olive leaf

The plants were cultivated in accordance with the culture recommendations in relation to cultural practices, fertilization and pest control. The treatments were organized in Randomize Block Design (RBD), respective to four PBZ concentrations tested: 1, 2, 3 and 4 ml a.i plant^{-1} in randomized block with three replications under three different varieties of olive tree v*iz.*V_1: Arbequina (Spain), V_2: Coratina(Italy), V_3: Koroneiki (Greece).PBZ was applied on soil only once, in December 4th 2017. Before the treatments application, FYM was applied. The plants response to PBZ was evaluated by determination of the height growth, leaf area and plant spread at 60 and 120 days after the PBZ application. Plant height was determined from soil surface to highest shoot apex, leaf area was measured with the help of graph paper.

The data were submitted to variance and regression analysis. The models choice was based on parameters significance tests and regression coefficient, using the t test at 5% probability. The qualitative treatments were compared by mean test.

Table 1: Treatment combinations

Notation	Treatment details
T_0V_1	Control (no Paclobutrazol application) for V_1
T_0V_2	Control (no Paclobutrazol application) for V_2
T_0V_3	Control (no Paclobutrazol application) for V_3
T_1	Paclobutrazol 1ml a.i/plant in V_1
T_2	Paclobutrazol 2 ml a.i/plant in V_1
T_3	Paclobutrazol 3ml a.i/plant in V_1
T_4	Paclobutrazol 4ml a.i/plant in V_1
T_5	Paclobutrazol 1ml a.i/plant in V_2
T_6	Paclobutrazol 2 ml a.i/plant in V_2
T_7	Paclobutrazol 3ml a.i/plant in V_2
T_8	Paclobutrazol 4ml a.i/plant in V_2
T_9	Paclobutrazol 1ml a.i/plant in V_3
T_{10}	Paclobutrazol 2 ml a.i/plant in V_3
T_{11}	Paclobutrazol 3ml a.i/plant in V_3
T_{12}	Paclobutrazol 4ml a.i/plant in V_3

3. Results and Discussion

The effect of PBZ on plant height was evaluated at 60 days after application. There was significant interaction between the PBZ concentrations vegetative shoots development, but no effect was observed on flowering and leaf water potential of PBZ-treated plants. Plant height, assessed at 60 days after PBZ application, decreased by 4.31 % in plants sprayed with 4 ml a.i plant^{-1}PBZcompared to that of control plants. 120 days after the PBZ application no difference was observed in plant growth between the different PBZ concentrations tested.

These features might have place because the PBZ exerted short term effects, likely because it was applied at soil, or as a result of the low concentrations tested, which could not be effective in slowing the olive tree growth for a longer period required to the characteristic non-stop vegetative growth during the winter.

No significant differences was observed for plant spread in plants sprayed with different PBZ concentrations, which showed lowest plant spread of T_8(108.33cm$^{2)}$and highest T_0V_3(119.67 cm$^{2)}$at 60 days whereas lowest plant spread of T_8(109.33cm$^{2)}$and highest T_0V_1(122.00 cm$^{2)}$ 120 days after the PBZ application. Reduction in plant growth does not occur always and should be considered taking into account the concentration applied, the product absorption and plant developmental stage at application time (Goldschmidt *et al*., 1998) [3].

At 60 DAA (Days after application) significant decrease in leaf area was observed following the application of this compound at higher concentration PBZ at 4mla.i. tree^{-1} applied in December T_{12}(315.67 mm^2). After 120 DAA, the maximum leaf area was found still in control T_0V_2 (431.00 mm^2) and minimum was found in T_{12} (321.00 mm^2). But it was found non-significance because the effect of PBZ is short term.

Table 2: Effect of different levels of PZB on plant height, leaf area and plant spread.

	Plant height(cm)		Leaf area(mm^2)		Plant spread(cm^2)	
Treatments	**60 DAA**	**120DAA**	**60 DAA**	**120DAA**	**60 DAA**	**120DAA**
T_0V_1	281.33	287.67	425.00	429.00	118.00	122.00
T_0V_2	281.00	287.00	428.67	431.00	117.33	119.31
T_0V_3	278.00	286.00	414.00	437.67	119.67	120.00
T_1	277.33	285.67	373.00	377.17	116.00	117.33
T_2	276.67	284.33	378.00	383.33	115.33	116.33

T_3	275.33	283.33	325.33	339.33	115.00	116.00
T_4	273.00	283.00	323.00	325.00	113.67	114.00
T_5	274.67	284.00	379.67	381.67	111.33	113.00
T_6	275.67	283.67	338.33	340.33	113.00	114.00
T_7	273.00	283.33	331.67	333.67	117.00	118.00
T_8	271.33	282.00	316.00	325.33	108.33	109.33
T_9	273.00	283.67	350.67	355.67	113.00	120.67
T_{10}	272.33	281.00	328.67	334.33	118.33	118.11
T_{11}	271.33	278.33	317.33	326.33	117.67	111.67
T_{12}	269.33	277.67	315.67	321.00	110.63	111.00
F-Test	S	NS	S	NS	S	NS
SE.d(+)	3.38	5.26	7.06	42.59	8.04	21.59
CD	6.92	-	14.47	-	11.24	-

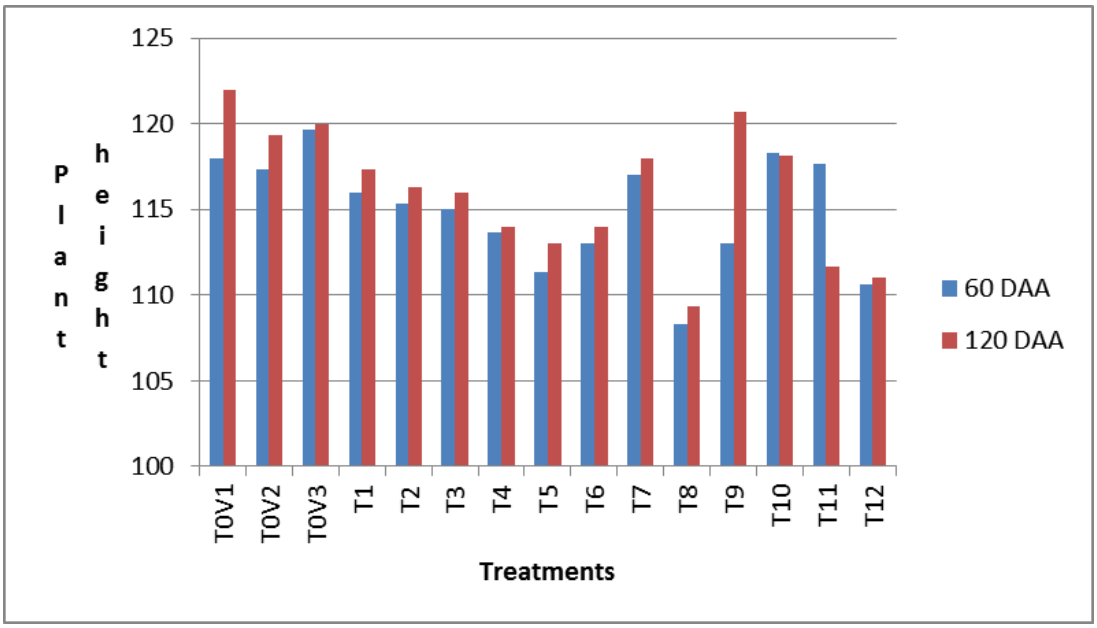

Fig 3: Effect of different levels of PZB on plant height

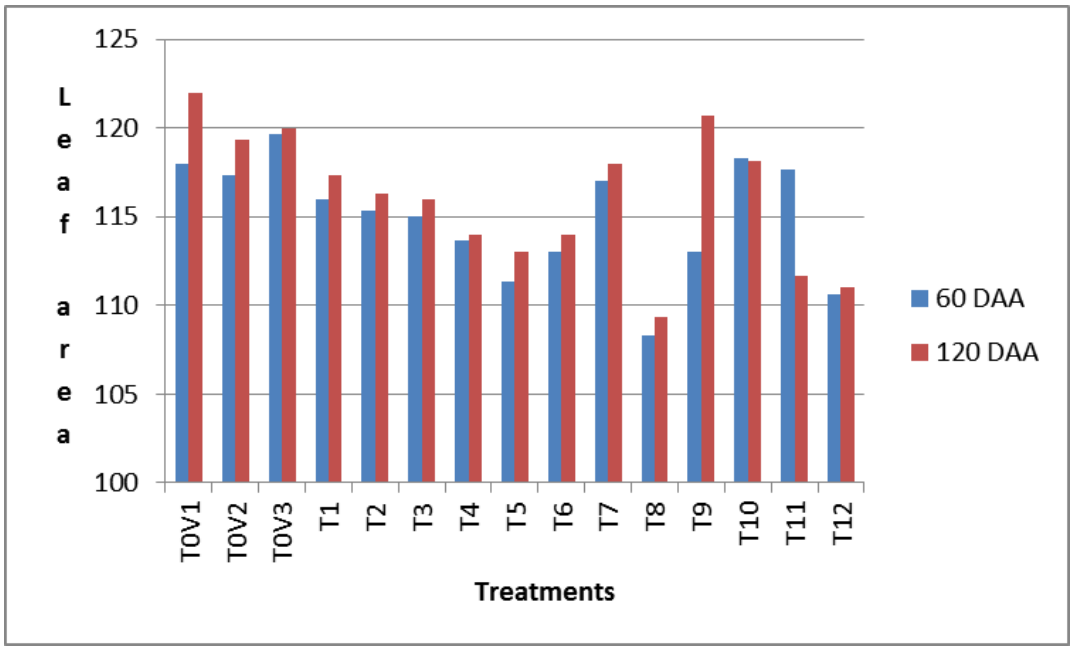

Fig4: Effect of different levels of PZB on leaf area

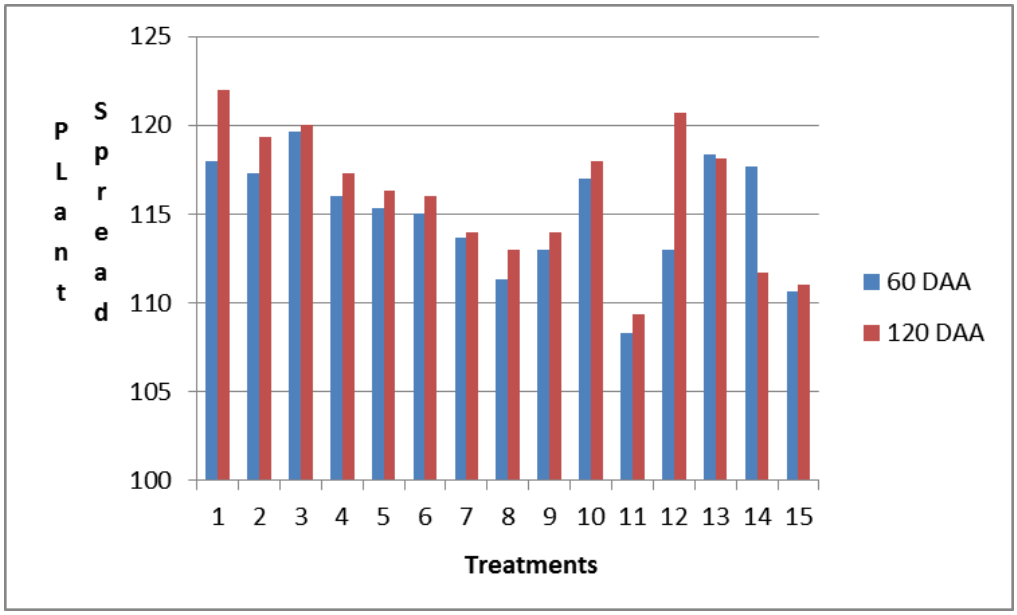

Fig 5: Effect of different levels of PZB on Plant Spread

4. Conclusion

It can be concluded from the field investigation that growth retardants have a great potential in controlling plant height, leaf area and plant spread under irrigate conditions. Specifically when PBZ at 4mla.i tree^{-1} applied in the month of December as a soil drench, decreased plant height, leaf area and plant spread under irrigate condition. So, the recommendation dose of PBZ to suppress the vegetative growth of the tree was at 4mla.i tree^{-1}. This research was conducted so that we can know the effect of PBZ on vegetative growth of olive trees based on Allahabad agro-climatic conditions. Found no PBZ influence on flowering of olive tree during research work which may due to immaturity of the plant and unsuitability of the climatic condition.

5. Reference

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