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ORIGINAL ARTICLE **OPEN ACCESS**

Effect of Paclobutrazol on hermaphrodite flowers, leaf chlorophyll contents and soil micro organisms

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ABSTRACT
The side effects of paclobutrazol on soil microbial community were assessed in soil samples from Amarachinta village, Mahaboobnagar district of Andhra Pradesh during 2013-14 and 2014-15. Mango Trees were subjected to different concentrations of paclobutrazol, among the different concentrations, more per cent hermaphrodite flowers (3.49% and 3.20%) and less days to full bloom (96 and 100.17) was noticed with the treatment P_3 (PBZ @ 4 ml m^2) followed by P_2 (PBZ @ 3 ml m^2). The highest chlorophyll contents were found with P_3 over control. However, it had negative effect on soil microbial count. The more microbial count was found in untreated soil samples over treated soil samples after 30 days and 60 days of application of paclobutrazol. Therefore the conclusion from these results is that even though Paclobutrazol had positive effect on Hermaphrodite flowers percentage, less days to full bloom and chlorophyll concentration, but it had negative effect on soil micro organisms. Hence, continuous application paclobutrzole to soil is not advisable.
***Key words**: Paclobutrazol, Hermaphrodite flowers percentage, Chlorophyll contents, Micro organisms*

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INTRODUCTION

Mango occupied a pre-eminent place amongst the fruit crops grown in India because of its great utility. Mango exhibits wide variations in flowering and fruiting due to its strong dependency on environment for flowering, particularly on cool winter temperatures and the age of the flowering shoots [15, 14]. There are several reasons that can be attributed for low productivity, but among them, the major cause is the dominance of vegetative phase over the reproductive phase, especially under tropical conditions. The improvement in productivity in modern agriculture system is increasingly dependent on manipulation of the physiological activities of the crop by chemical means. Though several remedial measures have been suggested, none of these was successful until the advent of the plant growth retardant Paclobutrazol. In commercial mango plantations, it is desirable to control the vegetative growth. Paclobutrazol [(2RS, 3RS)-1-(4-chlorophenyl)-4,4- dimethyl-2-(1H-1,2,4-triazol-1-yl) pentan-3-ol] is a plant growth regulator largely utilized in mango cultivation for growth control, to reduce pruning, to get uniform and regular flowering and improves fruit quality. It is usually applied directly into the soil, where it may remain active, and can severely affect the growth and development of subsequent crops or even interact in a harmful way with soil microorganisms [8]. It also has some fungicidal activity against mildew and rusts [6, 8]. Little information is available at present, regarding the effects of this growth regulator on the soil microbial community. Keeping these points in view, the present investigation was planned to study the effect of Paclobutrazol on hermaphrodite flowers percentage, leaf chlorophyll contents and soil micro organisms.

MATERIAL AND METHODS

The investigation on the effect of Paclobutrazol effect on hermaphrodite flowers percentage, leaf chlorophyll contents and soil micro organisms was carried out as on farm research trials of CRIDA, Hyderabad at Amarachinta village, Mahaboobnagar district of Andhra Pradesh during 2013-14 and 2014-15. It lies at 16° 22' 0" North latitude, 77° 47' 0" East longitude at an altitude of 311m from mean sea

level. Rainfall 1053.2 mm and 658.9 mm rainfall was received during 2013-14 and 2014-15 out of which >93 per cent is during South West monsoon. The minimum temperature was 17.29^{0}C and 16.3^{0}C and maximum temperature was 30.63 and 30.72 ^{0}C. The soil of the orchard selected is a red soils with a pH of 6.7 and electrical conductivity of 0.6 d S m^{-1}. It had 131.63 Kg, 16.7 Kg and 179.84 Kg per hectare of available nitrogen, phosphorus and potassium contents respectively. The orchard has a uniform topography. Paclobutrazol concentration was calculated based on the diameter of the tree, and applied @ 2ml m$^{-1,}$ 3ml m^{-1} and 4ml m^{-1} of canopy diameter. The required paclobutrazol was dissolved in 10 litre of water and poured in the holes (10-15cm depth) which were made in the soil around the collar region of the tree on September 1st of 2013 and 2014.

The number of days taken from the date of paclobutrazol application to full bloom was recorded. Ten shoots were randomly tagged (from North, South, East and West directions) and the Days taken from the date of paclobutrazol application to full bloom were recorded. The mean number of days taken for Days taken from the date of paclobutrazol application to full bloom was computed.

The percentage of hermaphrodite flowers was calculated from the randomly selected ten panicles tree^{-1} using the following formula and expressed in percentage.

$$\text{Percentage of hermaphrodite flower} = \frac{\text{Number of hermaphrodite flowers}}{\text{Total number of flowers}} \text{X100}$$

RESULTS AND DISCUSSION

Among different paclobutrazol concentrations significantly more hermaphrodite flowers was noticed with the treatment P_3 (3.49, 3.20) followed by P_2 (3.26, 2.99) in the year 2013-14, 2014-15 respectively. Significantly the lowest hermaphrodite flowers was recorded with the treatment P_4 (2.13, 1.98) in the year 2013-14, 2014-15 respectively. The development of complete (hermaphrodite) flowers probably needs more reserves from the tree than unisexual flowers due to the additional structures. Assuming there are 100,000 flowers and each flower consumes 10 micro gram of nitrogen, then each time a tree flowers, it loses one kilogram of nitrogen. The tree will, therefore, need to have adequate reserves for flower and subsequent fruit formation. The higher reserve in the shoots due to PBZ soil drenching increased the percentages of hermaphrodite flowers (Fig 1). These results are similar to the observations made by Vijayalakshmi and Srinivasan [20], Hoda *et al*. [7].

Among different paclobutrazol concentrations significantly less days to full bloom was noticed with the treatment P_3 (96, 100.17) followed by P_2 (103.5, 107.42) in the year 2013-14, 2014-15 respectively. Significantly the more days to full bloom was recorded with the treatment P_4 (126.33, 130.5) in the year 2013-14, 2014-15 respectively. It means flowering occurred about 30 days earlier than those of the control plants (Fig. 2), it may be due to PBZ, owing to its anti-gibberellins activity and intensify flowering by early reduction of endogenous gibberellins levels within the shoots by blocks the conversion of ent kaurene to ent kaurenol in the terpenoid pathway. One of the major roles of gibberellins is the stimulation of cell elongation. When gibberellins biosynthesis is inhibited, cell division occurs, but new cells do not elongate resulting on suppression of vegetative growth [5], Quinlan and Richardson [12], Webester and Quinlan [22], Voon *et al.* [21]. Similar results were also reported in different important mango cultivars from Australia Winston, [23], Indonesia [21], Thailand [19] and India [10].

These chlorophyll fractions a, b and total were higher in Paclobutrazol 4 ml m^{-2} canopy followed by 3ml m^{-2} and 2ml m^{-2} canopy (Fig. 3 and Fig. 4). It clearly says that the chlorophyll fractions were increased with the increased concentration of paclobutrazol and also suggested that more photosynthetic efficiency and promote regularity and more yield. Chlorophyll content increases with PBZ application. PBZ blocks the production of gibberellins results in shunting of the intermediate compounds to the production of phytol, an essential part of chlorophyll molecule [17]. The increment of chlorophyll content is due to enhanced chlorophyll biosynthesis or is simply a "concentrating effect" due to the decrease leaf expansion or the increase of leaf thickness [2]. The triazole compounds retard shoot growth, reduce leaf extension and increase chlorophyll content Jaggard *et al.* [9], Buchenauer *et al.* [3], Coston [4]. PBZ also found to increase chlorophyll content, checks the transpirational losses and helps in maintaining better plant water balance [13].

Microbial count (Bacteria (10^{-5}), Fungi (10^{-2}) and Actinomycetes (10^{-4}) (cfu g^{-1} soil)

The data on microbial count in soil as influenced by different concentrations of paclobutrazol during 2013-14, 2014-15 are presented in Table 1. Each microbe count in soil recorded two times at 30days intervals after application of paclobutrazol and studied the effect of paclobutrazol on soil microorganisms.

Thirty days after application of paclobutrazol, more bacterial count was observed with control (78.4, 64.2) followed by 2 ml PBZ m^{-2} diameter (32.6, 28.4) in 2013-14, 2014-15 respectively. The lowest bacterial count was noticed with 4 ml PBZ m^{-2} diameter (21.6, 19.4) in 2013-14, 2014-15 respectively.

After 60day application of paclobutrazol more bacterial count was observed with control (67.2, 56.4) followed by 2ml PBZ m^{-2} diameter (43.2, 39.7) in 2013-14, 2014-15 respectively. The lowest bacterial count was noticed with 4ml PBZ m^{-2} diameter (23.4, 21.6) in 2013-14, 2014-15 respectively.

Thirty days after application of paclobutrazol, more fungi count was observed with control (90.1, 86.4) followed by 2ml PBZ m^{-2} diameter (71.3, 68.1) in 2013-14, 2014-15 respectively. The lowest fungi count was noticed with 4ml PBZ m^{-2} diameter (54.4, 42.3) in 2013-14, 2014-15 respectively. After 60days application of paclobutrazol, more fungi count was observed with control (85.1, 83.2) followed by 2ml PBZ m^{-2} diameter (69.4, 57.5) in 2013-14, 2014-15 respectively. The lowest fungi count was noticed with 4ml PBZ m^{-2} diameter (42.4, 56.3) in 2013-14, 2014-15 respectively.

Thirty days after application of paclobutrazol, more actinomycetes count was observed with control (61.4, 58.3) followed by 2ml PBZ m^{-2} diameter (42.3, 37.4) in 2013-14, 2014-15 respectively. The lowest actinomycetes count was noticed with 4 ml PBZ m^{-2} diameter (32.2, 28.6) in 2013-14, 2014-15 respectively. After 60 days application of paclobutrazol, more actinomycetes count was observed with control (54.3, 51.5) followed by 2ml PBZ m^{-2} diameter (36.4, 34.2) in 2013-14, 2014-15 respectively. The lowest actinomycetes count was noticed with 4ml PBZ m^{-2} diameter (28.4, 24.5) in 2013-14, 2014-15 respectively. These results shown that more inhibition action was found on bacteria followed by actinomycetes and fungi. This may be due to toxic action of paclobutrazol on soil micro flora. These findings agreed with the findings of Atlas *et al.,* [1] and he found that the introduction of organic pollutants, which can potentially act as toxic substances and nutrient sources, has been shown to preferentially stimulate specific populations. The differential effect of paclobutrazol on specific groups of microorganisms may alter the microbial population balance, affecting negatively the soil fertility [11, 16, 18].

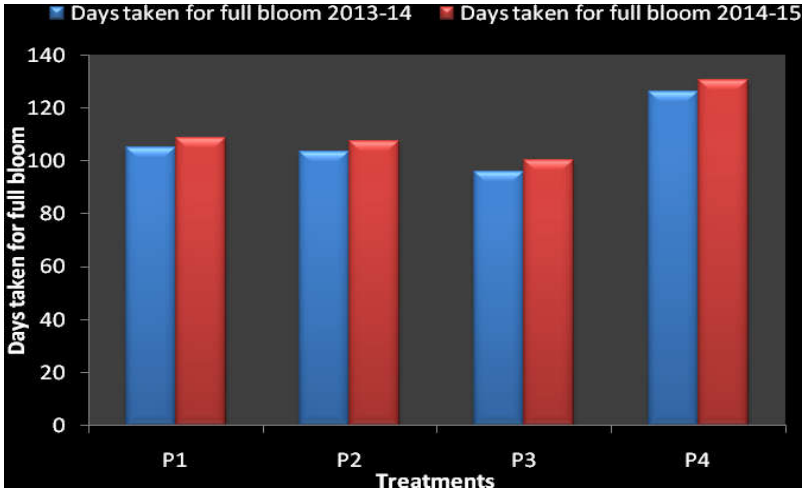

Fig 1: Effect of paclobutrazol on Hermaphrodite flowers (%) of Mango flower cv. Banganpalli

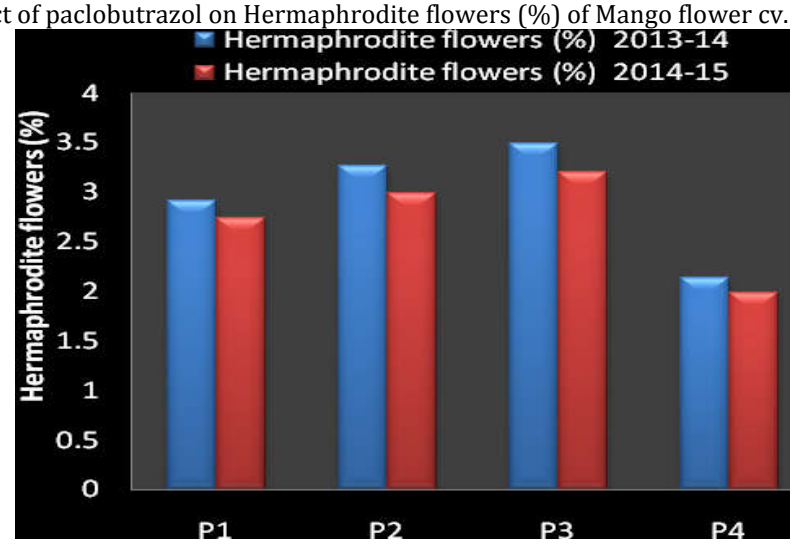

Fig 2: Effect of paclobutrazol on days taken for Full bloom of Mango cv. paclobutrazol Banganpalli

P_1 - PBZ @ 2 ml m^{-2} (soil drenching), P_2 - PBZ @ 3 ml m^{-2} (soil drenching), P_3 - PBZ @ 4 ml m^{-2}(soil drenching), P_4- Control

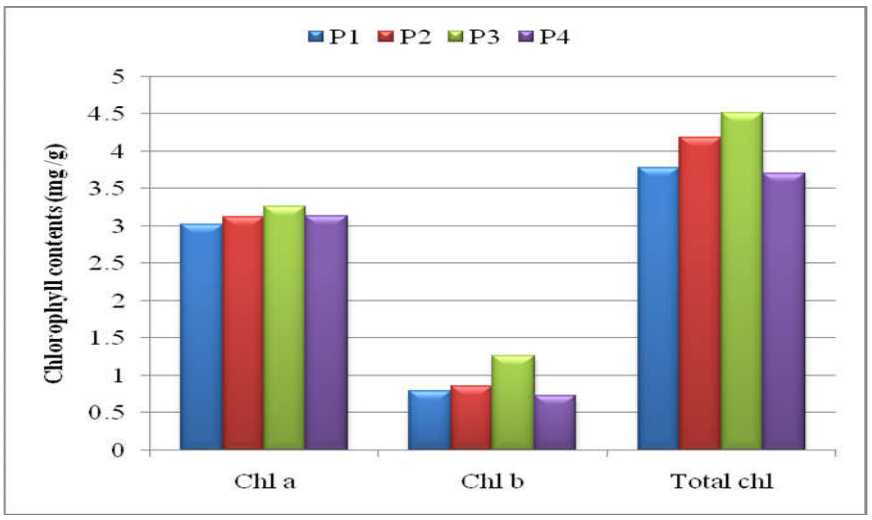

Fig 3: Effect of paclobutrazol on Chlorophyll contents of Mango leaves cv. Banganpalli during 2013-14

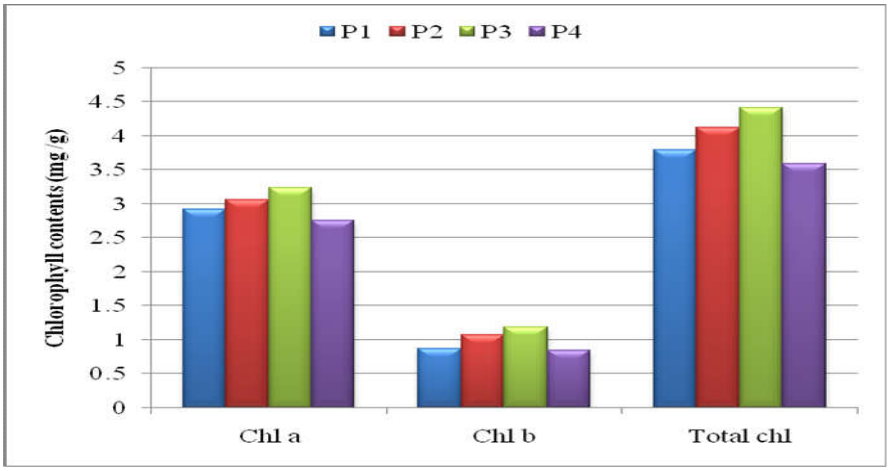

Fig 4: Effect of paclobutrazol on Chlorophyll contents of Mango leaves cv. Banganpalli during 2014-15

P_1 - PBZ @ 2 ml m^{-2} (soil drenching) ; P_2 - PBZ @ 3 ml m^{-2} (soil drenching)

P_3 - PBZ @ 4 ml m^{-2} (soil drenching); P_4- Control;

Table 1: Soil microbial count as influenced by paclobutrazol application

Treatment	Bacteria (10^{-5}) (cfu/g soil)				Fungi (10^{-2}) (cfu/g soil)				Actinnomycetes (10^{-4}) (cfu/g soil)			
	30 days after application		60 days after application		30 days after application		60 days after application		30 days after application		60 days after application	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
2ml/m^{-2} dia	32.6	28.4	43.2	39.7	71.3	68.1	69.4	57.5	42.3	37.4	36.4	34.2
3ml/m^{-2} dia	27.3	24.2	31.1	27.3	62.2	58.4	64.2	52.1	38.3	36.5	31.2	26.4
4ml/m^{-2} dia	21.6	19.4	23.4	21.6	54.4	42.3	42.4	56.3	32.2	28.6	28.4	24.5
control	78.4	64.2	67.2	56.4	90.1	86.4	85.1	83.2	61.4	58.3	54.3	51.5

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