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EFFECT OF PACLOBUTRAZOL (PP333) ON GROWTH, FRUIT QUALITY AND STORAGE POTENTIAL OF MANGO CVS. DASHEHARI, LANGRA, CHAUSA AND FAZRI.

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ABSTRACT: *The treatment consisted of different doses of Paclobutrazol (PP333) namely 1.0 gram and 0.5g/canopy diameter along with control. Paclobutrazol was applied once in a year 15 October 1997 and 15 September 1998 in soil around the tree canopy spread. Paclobutrazol did not affect on sugar, color, glucose-fructose ratio reduced sugar concentration and did not affect TSS and firmness of Mango, increased TSS, ascorbic acid, chlorophyll, Carotene, amylase, peroxides activity for 12 days in Dashehari Mango in storage at ambient temperature (30-33°C), Applying paclobutrazol at 1.0 gram on 15 October produced the highest number of fruits as well as yield per plant and the heaviest fruit compared with the lowest yield in control. Paclobutrazol at 1.0 gram applied on 15 October also resulted in higher edible portion, lower stone pulp ratio and peel pulp ratio, longer shelf life, higher TSS, increased vitamin C, lower titratable acidity, higher dry matter, reducing, non-reducing and total sugar contents as compared lower doses 0.5 gram with control plants. The present results suggest that the application of paclobutrazol at 1.0 gram in October enhances yield and quality in mango. chemical used Paclobutrazol [(2RS, 3RS)-1-1(4-Chlorophenyl)-4, 4-dimethyl-2- (1, 2, 4-trizol)-1-yl)] Pentan-3-ethanol.*

KEYWORDS: Paclobutrazol (PBZ), Auxins (IAA), Gibberellins, Cytokinins and Plant growth regulator, Yield and quality of mango, soil drench application of Paclobutrazol.

INTRODUCTION

Paclobutrazol is a **triazols** derivative (2RS, 3RS)-1-1(4-Chlorophenyl)-4, 4-dimethyl-2-(1, 2, 4-4trizol)-1-yl)] Pentan-3-ethanol. Paclobutrazol did not affect on sugar, pH, color, and K or glucose-fructose ratio in grape (Zoecklein et al, 1991). Amino-cyclo-propane, Carboxylic Acid, Ethylene, Respiration, Sorbitol, Fructose, Glucose, Sucrose and Malic Acid in apple (Wang and Steffens, 1987). Paclobutrazol reduced sugar concentration in apple (Greene and 1991), TSS in Cherry (Looney and Mc Killar, 1987), acidity in Apricot (Mehta et al. 1990) and Grape (Shaltout et al., 1988; Zoecklein et al., 1991; Reynolds et al., 1992). Paclobutrazol did not affect TSS and firmness of apple (Steffens et al, 1985; Curry and William, 1986, 1986; Elfving et al., 1987, 1989), Apricot (Subhadrabandhi et al., 1990), Banana (El-Otmani et al., 1992), Cherry (Fateau and Chestnut, 1991), Mango (Kulkanri,1988), peach (Choi et al, 1988, Chun et al., 1990; Chun and Lee, 1989,

1990), Pear (Embree, 1987; Huang and Shen, 1987, Noma et al, 1989) and Plum (Straydom and Honey borne, 1987). It could not affect acidity in Peach (Choi et al, 1988, Chun et al, 1990).

Paclobutrazol also increased fruit TSS in apple (Visai et al., 1989), Grape (Reynolds 1988, 1989, Reynolds et al., 1991, plum (Chandel and Jindal, 1991), Anthocyanin in Citrus Gilfillan and Lowe, 1985) and Strawberry (Thakur et al., 1991), sugar concentration in Apricot (Mehta et al., 1990) and peach (Zhang, 1990), maturation and fruit ripening was retarded by Paclobutrazol in Apple (Green and Murray, 1983, Greene, 1986, Elfving et al.,1987), Citrus (Fucik and Swietlik, 1990), Peach (Erez, 1984, Tonutti et al, 1986) and Strawberry (Mc Arthur and Eaton, 1988). Soil application of paclobutrazol induced precocious flowering in young trees and promoted early flowering in bearing trees (Kulkanni, 1988). Inflorescence becomes visible within 2.5 to 4 months after the application of paclobutrazol depending on cultivar (Junthasri et al., 2000). Improvement in fruit set and fruit retention in mango cv. Gulab Khas as well as the highest yields were recorded under soil application of paclobutrazol (Singh and Singh, 2006). Applying 10 ml paclobutrazol had the greatest effect increasing all the parameters (ascorbic acid, total sugar, reducing sugar and TSS, except for acidity) in harvested fruits from 10 year-old trees of Alphonso mangoes at Coimbatore, India (Vijayalakshmi and Srinivasan, 2000). Compared with the control, trees treated with paclobutrazol had higher results for number of panicles produced, yield as well as quality of the fruit (Yeshitela et al., 2004).

The research regarding regulation of flowering and harvesting time, increasing yield and quality of mango by using paclobutrazol is almost absent in Bangladesh. Considering the above facts, the present study was carried out to find out the effects of paclobutrazol on the manipulation of harvest time and improving yield as well as quality of mango cv. BARI Aam -3 (Amrapali).In contrast Paclobutrazol induced early maturity and ripening in Grape (Reynolds 1989, Reynolds et al., 1992), Peach (Loreti, 1987, Martin et al., 1987, Zhang, 1990, George and Nissan, 1992, Alan et al., 1993), foliar spray of 2000 and 3000 mg/1 PBZ at fruit bud differentiation, increased TSS, Ascorbic Acid, Chlorophyll, Carotenoid, Amylase, Peroxides activity for 12 days in Dashehari Mango, storage at ambient temperature (Khader, 1990).

MATERIAL AND METHODS

The present investigation was carried out at laboratory of department of Horticulture, College of Agriculture and Horticulture Research Center, Patharchata of G.B. Pant University of Agriculture and Technology, Pant Nagar, India

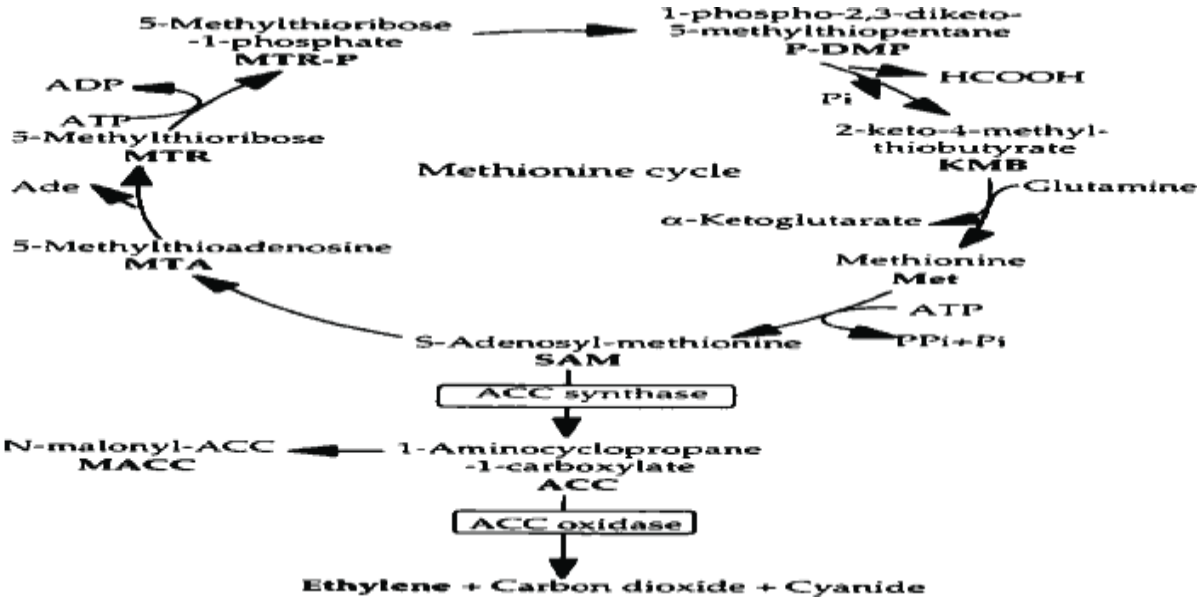
Treatment and Layout: -The experiment was carried out on uniform trees (21-22 years) of Mango Cvs. Dahshehari, Langra, Chausa and Fazri during 1997-99. The treatment consisted of different doses of Paclobutrazol (PP333, PBZ) namely 1.0g and 0.5y/canopy diameter along with control. Paclobutrazol was applied once in years, 15 October 1997 and 15 September 1998 in soil around the tree canopy spread.The uniform size fruits were harvested along with 5 cm stalk length with the help of hand secateurs, harvested fruits were washed and kept in Corrugated Fiber Board (CFB) boxes in single layer under ambient temperature (30-33°C) for shelf life study of Mango Cvs.Dashehari, Langra, Chausa and Fazri.

Physio-Chemical Analysis: -The observation on various physio-chemical characters was recorded from 22 June 1998 and 22 July 1999 and harvested fruits recorded on 10 days of storage in all replication according to the experiments. The physio-chemical parameters viz. TSS (Total Soluble Solids) were determined with help of hand refractometer, acidity was estimated by titrating pulp extract with 0.1 N NaOH using phenolphthalein indicators. Total sugar, β-carotene content was determined according to method suggested by Raganna (1992).

Statistical Design -The observation recorded were subjected to statistical analysis by using CRD (Completely Randomized Design) for lab experiments valid conclusions were drawn only on significant differences between the treatment mean at 5 % level of probability (Conchran and Cox, 1959). In order to compare treatment means, critical difference were calculated.

RESULT AND DISCUSSION

The fruits were kept in Corrugated Fibber Board (CFB) boxes in single layer under ambient temperature (30-33^{o}C). The time taken for ripening of fruits of cultivars Dashehari, Langra, Chausa and Fazri were 1-2 days earlier in both the year. However, a lowest dose of Paclobutrazol 0.5 g Paclobutrazol / meter canopy diameter was ineffective on early ripening. Similar was the effect of Paclobutrazol on fruit quality in terms of fruit weight, fruit volume fruits length and width after ripening without any effect on percent weight loss and specific gravity of ripe fruits. Dashehari mango kept in Corrugated Fibber Board (CFB) boxes in ambient temperature (30-33°C). The time taken for ripening in general 11.5 days. Higher doses of PBZ (1.0 g Paclobutrazol/meter canopy diameter) were effective on early ripening; Dashehari Mango is 1-2 days early ripe with lightly significant effect on TSS, Acidity and reducing and non-reducing sugar. Table IA, 1B is shows that Paclobutrazol treated Dashehari mango is slightly increase TSS (23.40%), Acidity (0.22%), and Total Sugar (15.33%) Reducing Sugar (3.89%) Non-reducing sugar (11.46%), ß-carotene (1.42%) and Ascorbic Acid (36.79 mg). However, this treatment is better in higher doses of Paclobutrazol (1.0g/meter canopy diameter) compare to lower doses (0.5 g/meter canopy diameter)



[Fig: The formation of S-AdoMet (S-adenosyl methionine) from methionine is catalysed by SAM synthetase at the expense of one molecule of ATP per molecule of S-AdoMet synthesized (i). A rate-limiting step of ethylene synthesis is the conversion of S-AdoMet to ACC by ACC synthase (ii). MTA (methylthioadenosine) is the by-product generated, along with ACC, by ACC synthase antagonist by Paclobutrazol.]

The fruit of Langra mango is greenish yellow with medium is big dark green dots, ovals-oblong, 8.10.5 cm long by 6.5-7.5 cm broad by 6-7 cm thick weighting 235-735 g. The skin is medium smooth thick. The flesh firm to soft, fibreless lemon yellow, very sweet with strong pleasant aroma, juice moderately abundant, mono embryonic seed in medium sized, flattened stone covered with dense, soft and short fibber, quality is very good. The prepared solutions of paclobutrazol as per treatment uniformly drenched into the wholes and the soil was reworked after application of paclobutrazol. Only water was applied in the control plants. The data of the following parameters were recorded: length of terminal shoot, number of leaves per terminal shoot, leaf area, length of panicle, number of secondary branches per panicle, date of first panicle emergence, total number of panicles, fruit set per panicle, number of fruits retained per panicle at 10 day intervals starting from pea stage up to harvest, date of harvest, number of fruits per plant, fruit weight, yield, edible portion, stone pulp ratio, peel pulp ratio, shelf-life, TSS, titratable acidity, vitamin C, dry matter, reducing sugar, non reducing sugar and total sugar content.

The length and number leaves of ten randomly selected terminal shoots at flowering stage were measured and the average was worked out. Leaf area was measured for all the 50 leaves taking 5 from each of ten above selected shoots by a leaf area meter and expressed as square centimeter. The length and number of secondary branches per panicle of 10 randomly tagged panicles covering the whole tree was recorded and the average was worked out. Ten panicles were randomly selected from each treatment. The initial number of fruits of each panicle and the fruits to be retained per panicle at 10 day intervals starting from pea stage up to harvest was recorded and the average was

worked out. After harvest, ten randomly selected fruits were allowed to ripen at room temperature and fruit quality was determined using 10 fruits per tree.

Total Soluble Solid (TSS) of 10 fully ripened fruits for each treatment was estimated by a hand refractometer and the average was worked out. The titratable acidity (Ranganna, 1979), vitamin C (Plummer, 1971), reducing sugar (Miller, 1972) and total sugar content (Jayaraman, 1981) in mango pulp were determined. The recorded data on different parameters of the experiment were tabulated and analyzed and the treatment means were separated by Least Significant Difference (LSD) test at 5 % level of significance. Data 1A, 1B is show that higher doses of PBZ (1.0g/meter canopy diameter) is slightly increased TSS (21.07%), Acidity (0.18%), Total Sugar (17.35%), Reducing Sugar (5.82%), Non-Reducing Sugar (21.83%), ß-Carotene (1.38%), Total Sugar (17.39%), Reducing (5 85%). Non-Reducing (11.56%), β-Carotene (1.39), Ascorbic Acid (132.43mg) as well as lower doses (0.5 g/m canopy diameter). Chausa is late maturing cultivars of Mango.

Table 1A: Effects Paclobutrazol on post harvest life of Mango cvs. Dasheri, Langra, Chausa and Fazri (1998-99).

Treatment	TSS (%)	Acidity (%)	Total Sugar (%)	Reducing Sugar (%)	Non reducing Sugar (%)	β-carotene	Ascorbic acid (mg)
Dashehari							
Control	23.31	0.23	15.35	3.88	11.44	1.13	37.75
0.5g PBZ m tree canopy diam.	23.65	0.20	15.42	3.88	11.48	1.14	37.12
Langra							
Control	21.11	0.18	17.37	5.81	11.54	1.37	132.32
0.5g PBZ/ m tree canopy diam.	21.78	0.17	17.41	5.83	11.54	1.38	132.37
Chausa							
Control	21.64	0.26	17.48	5.33	12.13	1.11	38.97
0.5g PBZ/ m tree canopy diam.	21.81	0.25	17.54	5.36	13.15	1.13	39.33
Fazri							
Control	17.54	0.31	13.64	5.67	8.46	1.14	22.89
0.5g PBZ/ m tree canopy diam.	17.75	0.29	13.73	5.65	8.04	1.16	13.17
CD at 5%							
Cultivar	0.60	0.84	0.11	0.43	0.37	0.56	0.44
Treatment	0.43	0.59	0.79	0.30	0.26	0.40	0.31
Interction	0.86	NS	NS	0.61	NS	NS	0.63

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Table 1B: Effects Paclobutrazol on post harvest life of mango cvs Dasheri, Langra, Chausa and Fazri (1997-98)

Treatment	TSS (%)	Acidity (%)	Total Sugar (%)	Reducing Sugar (%)	Non reducing Sugar (%)	βcarotene	Ascorbic acid (mg)
Dashehari							
Control	23.40	0.22	15.33	3.89	11.46	1.42	36.79
1.0g PBZ m tree canopy diam.	23.73	0.20	15.39	3.90	11.51	1.14	37.16
Langra							
Control	21.07	0.18	17.35	5.82	11.54	1.38	132.34
1.0g PBZ m tree canopy diam.	21.83	0.17	17.39	5.85	11.56	1.39	132.43
Chausa							
Control	21.66	0.26	17.47	5.34	12.14	1.12	38.86
1.0g PBZ m tree canopy diam.	21.71	0.25	17.51	5.36	13.23	1.13	39.35
Fazri							
Control	17.57	0.31	13.64	5.66	7.98	1.15	12.91
1.0g PBZ m tree canopy diam.	17.81	0.29	13.69	5.67	8.05	1.16	13.21
CD at 5%							
Cultivar	0.20	0.84	0.19	0.12	0.40	0.76	0.51
Treatment	0.14	0.59	0.13	0.86	0.28	0.54	0.36
Interction	0.28	NS	NS	NS	NS	NS	0.72

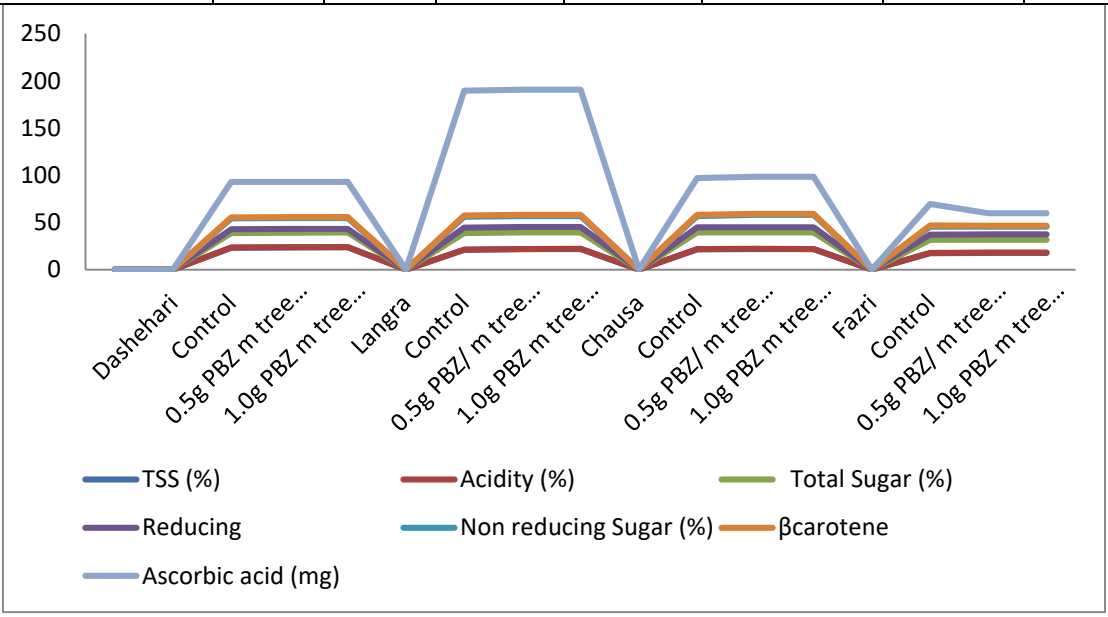

Fig 1A: Paclobutrazol treatment (0.5 and 1.0 g/canopy diameter) affects on post harvest physiology of Mango cvs Dasheri, Langra, Chausa and Fazri (1997-99)

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Table 2A: Effect of Paclobutrazol on fruit set, fruit growth and yield of Mango Cvs. Dashehari, Langra, Causa and Fazri (1998-99).

Treatment	Fruit set at mustard stage	Fruit set at pea stage	Mature Fruits/pnicle	No. of fruits/ Tree	Fruit yield tree(kg)	Per fruit weight (gm)	Per fruit volume	Length of fruit(cm)	Width of fruit(cm)
Dashehari									
Control	47.60	13.15	3.79	375.75	98.37	245.45	241.25	10.31	6.80
0.5g PBZ m tree canopy diam.	56.12	15.41	5.16	577.75	136.38	200.65	195.00	10.00	6.70
Langra									
Control	21.11	13.92	3.23	273.75	73.49	270.25	261.12	9.43	7.40
0.5g PBZ/ m tree canopy diam.	21.78	17.11	4.14	405.25	107.62	265.57	235.16	9.00	4.29
Chausa									
Control	21.64	13.65	2.80	252.45	73.31	290.50	282.35	11.71	6.56
0.5g PBZ/ m tree canopy diam.	21.81	15.03	3.58	392.50	112.16	285.75	265.82	11.33	6.50
Fazri									
Control	39.76	10.10	1.95	212.50	91.50	430.75	422.50	12.42	7.90
0.5g PBZ/ m tree canopy diam.	47.10	12.11	2.28	390.00	166.32	426.50	426.50	12.10	7.75
CD at 5%	0.72	0.64	0.28	28.28	10.94	2.98	3.42	0.22	0.14
Cultivar	0.51	0.45	0.20	40.00	7.73	2.10	2.42	0.16	0.10
Treatment	1.02	NS	0.40	NS	15.47	NS	NS	NS	1.00
Interction									

(Means followed by different letters within columns significantly differ by Fisher's LSD at p = 0.05)

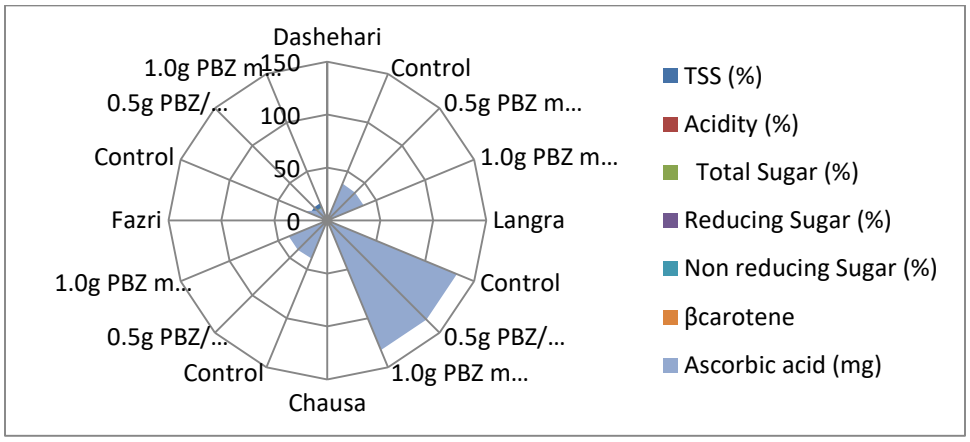


Fig: 1B: Paclobutrazol (0.5 and 1.0 g/canopy diameter) affects on post harvest physiology of Mango cvs Dasheri, Langra, Chausa and Fazri (1997-99)

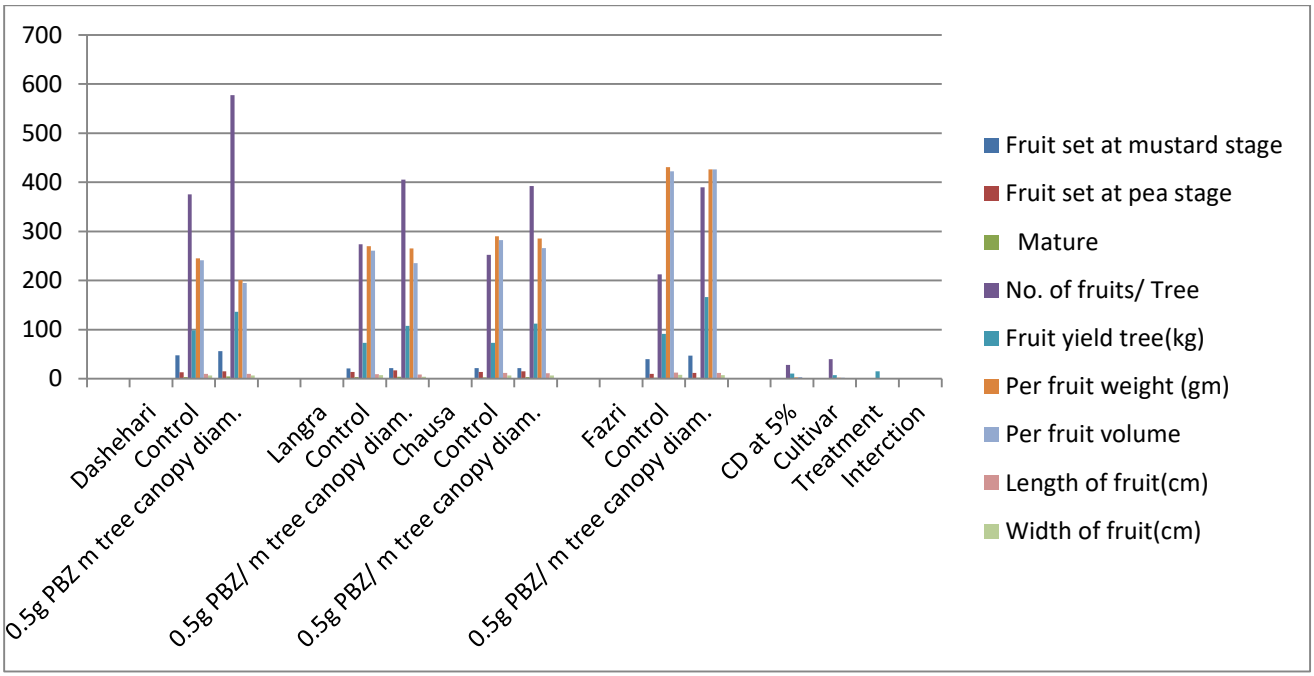
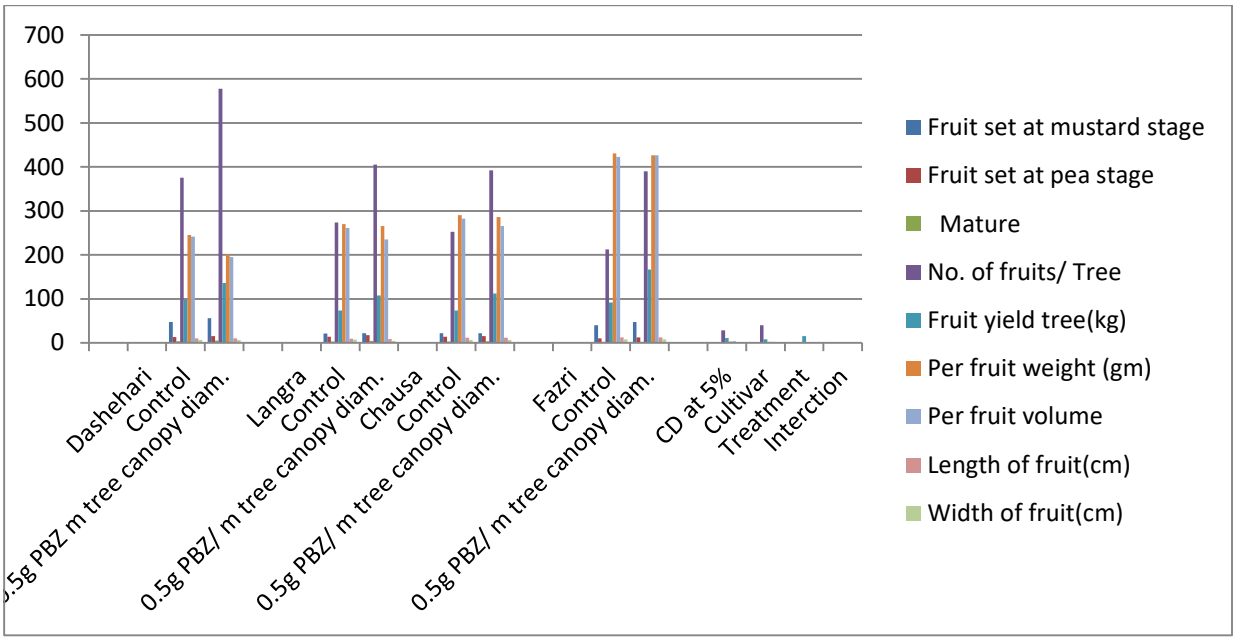

700
600
500
400
300
200
100
0
Dashehari
Control
0.5g PBZ m tree canopy diam.
Langra
Control
0.5g PBZ/ m tree canopy diam.
Chausa
Control
0.5g PBZ/ m tree canopy diam.
Fazri
Control
0.5g PBZ/ m tree canopy diam.
CD at 5%
Cultivar
Treatment
Interction
Fruit set at mustard stage
Fruit set at pea stage
Mature
No. of fruits/ Tree
Fruit yield tree(kg)
Per fruit weight (gm)
Per fruit volume
Length of fruit(cm)
Width of fruit(cm)

Table 2B: Effect of Paclobutrazol on fruit set, fruit growth and yield of Mango Cvs. Dashehari, Langra, Causa and Fazri (1997-99).

Treatment	Fruit set at mustard stage	Fruit set at pea stage	Mature Fruits/p nicle	No. of fruits/ Tree	Fruit yield tree(kg)	Per fruit weight (gm)	Per fruit volume	Leng th of fruit(cm)	Widt h of fruit(cm)
Dashehari									
Control	47.60		3.79	375.75	98.37	245.45	241.25	10.31	6.80
0.5g PBZ m tree	56.12	13.15	5.16	577.75	136.38	200.65	195.00	10.00	6.70
canopy diam.		15.41							
Langra									
Control	21.11	13.92	3.23	273.75	73.49	270.25	261.12	9.43	7.40
0.5g PBZ/ m tree	21.78	17.11	4.14	405.25	107.62	265.57	235.16	9.00	4.29
canopy diam.									
Chausa									
Control	21.64		2.80	252.45	73.31	290.50	282.35	11.71	6.56
0.5g PBZ/ m tree	21.81	13.65	3.58	392.50	112.16	285.75	265.82	11.33	6.50
canopy diam.		15.03							
Fazri									
Control	39.76		1.95	212.50	91.50	430.75	422.50	12.42	7.90
0.5g PBZ/ m tree	47.10	10.10	2.28	390.00	166.32	426.50	426.50	12.10	7.75
canopy diam.		12.11							
CD at 5%	0.72	0.64	0.28	28.28	10.94	2.98	3.42	0.22	0.14
Cultivar	0.51	0.45	0.20	40.00	7.73	2.10	2.42	0.16	0.10
Treatment	1.02	NS	0.40	NS	15.47	NS	NS	NS	1.00
Interction									

Fig 2B: Diagrametic reprensntation of effect of Paclobutrazol on fruit set, fruit growth and yield of Mango Cvs. Dashehari, Langra, Causa and Fazri (1997-99).

Treatment	Fruit set at mustard stage	Fruit set at pea stage	Mature Fruits/ pnicle	No. of fruits/ Tree	Fruit yield tree(kg)	Per fruit weight (gm)	Per fruit volume	Length of fruit (cm)	Width of fruit (cm)
Dashehari Control **0.5g PBZ m tree canopy diam.**	47.60 56.12	13.15 15.41	3.79 5.16	375.75 577.75	98.37 136.38	245.45 200.65	241.25 195.00	10.31 10.00	6.80 6.70
Langra Control **0.5g PBZ/ m tree canopy diam.**	21.11 21.78	13.92 17.11	3.23 4.14	273.75 405.25	73.49 107.62	270.25 265.57	261.12 235.16	9.43 9.00	7.40 4.29
Chausa Control **0.5g PBZ/ m tree canopy diam.**	21.64 21.81	13.65 15.03	2.80 3.58	252.45 392.50	73.31 112.16	290.50 285.75	282.35 265.82	11.71 11.33	6.56 6.50
Fazri Control **0.5g PBZ/ m tree canopy diam.**	39.76 47.10	10.10 12.11	1.95 2.28	212.50 390.00	91.50 166.32	430.75 426.50	422.50 426.50	12.42 12.10	7.90 7.75
CD at 5% **Cultivar** **Treatment** **Interction**	0.72 0.51 1.02	0.64 0.45 NS	0.28 0.20 0.40	28.28 40.00 NS	10.94 7.73 15.47	2.98 2.10 NS	3.42 2.42 NS	0.22 0.16 NS	0.14 0.10 1.00



The fruit is canary yellow raw sienna when fully ripe with numerous obscure medium sized dotes with minute specks inside them along.with prominent, beak obtuse to rounded medium sized. The skin is thin and same what adhering pulp raw sienna soft and fucy with canty fine long fibber near the skin. The fruit is very sweet with luscious, delightful aroma of excellent quality. Seeds are mono embryonic in a thick, medium sized oblong stone with five, short fibbers all over the surface and a tuft of long fibbers on the ventral edge and a light bearer.

The fruits of Chausa is harvested on 24th July were kept at ambient temperature (30-33°C) for ripening and data on their weight, TSS, Acidity percent, total sugars, β- carotene and change of peal and pulp color during ripening. Data further show that Chausa fruit take 6-8 days to ripen when harvested on 24th July. Data of table 1A, 1B show that Paclobutrazol forces the fruit to ripen early (1-2 days) without any significant on percent fruit weight loss, stone ratio width of fruit and stone. Data further show that Paclobutrazol reduced fruit weight, fruit volume, width of fruit, and length of fruit. The various cultivars responded effectively to reduction of fruit size and stone.

Data again shows that higher doses of PBZ (1.0 g/meter canopy diameter) were more effective than lower doses of PBZ (0.5 g/meter canopy diameter) and slightly increased the fruit quality in term of TSS, acidity percent, reducing and non-reducing sugar, β-carotene and ascorbic acid. The fruits kept in ventilated room and ripened at ambient temperature (30-33°C). The fruit of Fazri is light chrome yellow with small, dark colored fairly sparse dots, oblique oval with base slightly rounded and beak distinct to slightly prominent, large, average 14.3 cm long by 9.8 cm board, weighting 500 g on average with a medium thick skin that is smooth with some inclination to be warty and firm to soft fibreless flesh of a light cadmium yellow with a pleasant aroma and a sweet taste, having juice that may be scanty to moderately abundant seed mono embryonic in large, oblong stone that is covered with sparse short and soft fibber, mid to late varieties.

Fazri took 11.5 days for ripening at ambient temperature. Data 2A, 2B show that Paclobutrazol higher doses of 1.0 g/m tree canopy diameter treatments had slightly increase acidity percent; total sugar percent and ascorbic acid than control (expect TSS, reducing and non-reducing sugar percent and ß-carotene). The interaction between Paclobutrazol and cultivars were non-significant except TSS, fruit quality was differed in different cultivars without any interaction effect between PBZ and Cultivars. Data IA, 1B further shows on fruit quality that Paclobutrazol forces the fruit to ripen early 1-2 days.

DISCUSSION

The effect of Paclobutrazol in early treatment was more pronounced than those applied later and PBZ and higher doses conferring the fact the Paclobutrazol with capable of increasing TSS, Acidity %, Ascorbic Acid (mg), reducing and non-reducing sugar and ß-carotene in Mango Cvs. Dashebari, Langra, Chausa and Fazri. In the present investigation Paclobutrazol induced early fruiting in treated trees take lesser time to ripen after than those harvest than those control. (Table 1A, 1B)

Data further shows that fruits of Paclobutrazol treated trees posses, higher TSS%. Acidity %, Ascorbic Acid, reducing and non-reducing sugar and ß-carotene in all the Cvs. of Mango (1A to 2B). Similar works have been reported by some workers in Mango (Khader 1991, Kurian and lyer, 1993) and other crops viz. Apple (Visai et al., 1989), Grape (Reynold, 1988, 1989, Reynold et al., 1991), Plum (Chandel and Jindal, 1991).

CONCLUSSION

Paclobutrazol (PP333), an effective anti-gibberellins, has been proved to have profound effect in inducing flowering and fruiting in many fruit crops. The study revealed that soil application of 1.0 and 0.5 g was found effective in improving economic traits viz., plant, fruit and quality traits, besides yield and quality. The highest dose of 1.0 g was increased total carotenoids, TSS, sugars, ascorbic acid and sugar-acid ratio as compared to control, the response being linear with the increasing concentrations.

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