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Effect of paclobutrazol and post flowering foliar sprays of nutrients for accelerating harvesting of jackfruit

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ABSTRACT

An investigation was undertaken to find out the effect of paclobutrazol and post flowering foliar nutrient sprays on harvesting, yield and fruit quality of jackfruit. Fourteen treatments consisted of soil application of paclobutrazol (PBZ @ 3 ml/m canopy diameter), and combinations of urea (1%), potassium nitrate (3%) and monopotassium phosphate (0.5%) were studied in randomized block design. Use of post-flowering foliar nutrient application of monopotassium phosphate (0.5%) and potassium nitrate with or without paclobutrazol accelerated harvesting in jackfruit. Post flowering foliar application of urea, with and without potassium nitrate and paclobutrazol delayed harvesting. All foliar sprays improved yield and quality of jackfruit. The treatment T_{12} (0.5% monopotassium phosphate at fruit set and 20 days after fruit set) was the best where 98.80 per cent of total fruits were harvested before rains and the highest B:C ratio of 2.40.

Key words: Jackfruit, nutrient sprays, paclobutrazol, early harvesting, physico-chemical composition.

INTRODUCTION

Jackfruit (*Artocerpus heterophyllus*) is one of the important but neglected fruit crop in Konkan region. It is an evergreen, monoecious, small to medium tree of height 10-15 m. Mainly two types, *viz*., firm flesh and soft flesh are observed in jackfruit. Both tender and ripe fruit as well as seed are rich source of carbohydrate, vitamin 'A' and 'C'. When unripe, jackfruit is utilized as vegetable and when ripe, it is consumed as a table fruit. Jackfruit also posses enormous processing potential and the value-added products such as chips, *phanas poli* are known for its delicacy. Flowering of jackfruit in Konkan region commences from December to January and most of the fruits are ready for harvesting on the verge of rainy season during May to June. As such 70% fruits of jackfruit are caught in rain and become unfit for fresh consumption as well as processing. According to a baseline survey this loss is estimated to be 8,400 MT valued ₹ 168 lakh (Anon,1). Vulnerability of jackfruit for such major natural loss is one of the prime hurdle in expansion of area and increase in productivity of this valuable fruit crop. An experiment was therefore undertaken to study the utility of soil application of paclobutrazol and post flowering sprays of nutrients to hasten the harvesting period and improve the economical yield of jackfruit.

MATERIALS AND METHODS

The trial was conducted at the Central Experiment Station, Rukhi for three consecutive years during 2008-09, 2009-10 and 2010-11. Twenty-year-old bearing jackfruit trees planted at distance of 10 m × 10 m under uniform recommended management practices were selected. The experiment was conducted in randomized block design with 14 treatments and 2 replications. The treatment details are presented in Table 1.

Paclobutrazol was applied as per respective treatment in the month of August and foliar nutrient sprays were applied at fruit set and 20 days after fruit set. The observations, *viz*., days required for harvesting, advancement / delay in harvesting, total yield, yield before rain, yield after rain and immature fruits remains after rains were recorded. Two fruits per treatment per replication were randomly selected for physico-chemical analysis, *viz*., fruit weight, bulb weight, acidity, TSS and total sugars. The economics of pooled data of three years was worked out. The B:C ratio calculated by using following formula.

$$BCR = \sum_{t=0}^{T} \frac{R / (1 + r)^t}{C / (1 + r)^t}$$

Where R = Returns from period, C = Cost of project, r = discount rate (11%) t = Period of project (3 years). The statistical analysis was done as per the method suggested by Panse and Sukhatme (10).

RESULTS AND DISCUSSION

During 2009, the days required for harvesting were minimum in treatment T_{11} and T_{13} (111 days) (Table 2). These treatments were at par with T_{10},

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Table 1. Treatment details of paclobutrazol and post flowering foliar sprays of nutrients on jackfruit.

Treat. No.	Soil application	At fruit set (foliar spray)	20 days after fruit set (foliar sprays)
T_1	PBZ @ 3 ml /m canopy dia.	-	-
T_2		1% urea	1% urea
T_3	PBZ @ 3 ml /m canopy dia.	1% urea	1% urea
T_4		1% urea	3% potassium nitrate
T_5	PBZ @ 3 ml /m canopy dia.	1% urea	3% potassium nitrate
T_6		1% urea	0.5% monopotassium phosphate
T_7	PBZ @ 3 ml /m canopy dia.	1% urea	0.5% monopotassium phosphate
T_8		3% potassium nitrate	3% potassium nitrate
T_9	PBZ @ 3 ml /m canopy dia.	3% potassium nitrate	3% potassium nitrate
T_{10}		3% potassium nitrate	0.5% monopotassium phosphate
T_{11}	PBZ @ 3 ml /m canopy dia.	3% potassium nitrate	0.5% monopotassium phosphate
T_{12}		0.5% monopotassium phosphate	0.5% monopotassium phosphate
T_{13}	PBZ @ 3 ml /m canopy dia.	0.5% monopotassium phosphate	0.5% monopotassium phosphate
T_{14}	control (no PBZ and no spray)	Control (no spray)	Control (no spray)

T_{12} and T9 (114 days). It was followed by T_8 (116 days) which was at par with T_6 and T_7 (117 days). All these treatments recorded remarkably less days for harvesting than control (156 days). The days required for harvesting in T_5 (158 days), T_4 (155 days) and T_2 (154 days) were at par with that of control, whereas in treatment T_1 it took 137 days for harvesting. During 2010, the days required for harvesting were minimum in T_6 and T_{10} (110 days) and at par with T_7, T_8, T_9, T_{11} and T_{13}. During 2010, the days required for harvesting in control (149 days) were at par with T_2, T_3, T_4, and T_5. During 2011, the days required for harvesting in T_{11} were minimum (119 days), which was at par with treatment T_6, T_{13}, T_9, T_{10} and T_8. In control it took 161 days for harvesting which was at par with T_2, T_3 and T_4. The pooled data of three years indicated that the

Table 2. Effect of paclobutrazol and post flowering foliar nutrient sprays on days required for harvesting and advancement/ delay of harvesting in jackfruit.

Treatment	Days required for harvesting				Advancement/ delay of harvesting (days)			
	2009	2010	2011	Pooled	2009	2010	2011	Pooled
T_1 - PBZ @ 3 ml /m canopy dia.	137	137	140	138	-21	-12	-21	-18
T_2 - 1 % urea twice	154	149	159	154	-4	0	-2	-2
T_3 - T_1 + 1% urea twice	152	149	159	153.33	-6	0	-2	-2.67
T_4 - 1% urea + 3% KNO_3	155	149	159	154.33	-3	0	-2	-1.67
T_5 - T_1 + 1% urea + 3% KNO_3	158	149	151	152.67	0	0	-10	-3.33
T_6 - 1% urea + 0.5% MPP	117	110	120	115.67	-41	-39	-41	-40.33
T_7 - T_1 + 1% urea + 0.5% MPP	117	113	127	119.00	-41	-36	-34	-37.00
T_8 - 3% KNO_3 twice	116	113	124	117.67	-42	-36	-37	-38.33
T_9 - T_1 + 3% KNO_3 twice	114	113	123	116.67	-44	-36	-38	-39.33
T_{10} - 3% KNO_3 + 0.5% MPP	114	110	123	115.67	-44	-39	-38	-40.33
T_{11} - T_1 + 3% KNO_3 + 0.5% MPP	111	113	119	114.33	-47	-36	-42	-41.67
T_{12} - 0.5% MPP twice	114	116	131	120.33	-44	-33	-30	-35.67
T_{13} - T_1 + 0.5% MPP twice	111	113	122	115.33	-47	-36	-39	-40.67
T_{14} - control (no PBZ and no spray)	158	149	161	156	0	0	0	0
CD at 5%	14.50	13.5	16.9	6.52	8.29	13.9	17.4	5.08

days required for harvesting of jackfruit in treatment T_{11} (114.33 days) were minimum which was at par with T_{13}, T_{10} , T_6, T_9, T_8, T_7 and T_{12}. The average days required for harvesting in control were 156 days which was at par with T_2, T_3, T_4 and T_5. The fruits of T_{11} were harvested 41.67 days earlier than control. The average advancement of harvesting by 18 days was noticed in T_1. Importantly in T_2, T_4 and T_5 slightly delayed the harvesting than that of control. The results indicated that monopotassium phosphate, potassium nitrate and paclobutrazol accelerated harvesting in jackfruit. Wherever urea was used alone or with potassium nitrate and paclobutrazol the harvesting was delayed. An increasing nitrogen supply delays senescence and stimulates growth (Horst Marschner, 7). Higher nitrogen is reported to delay fruit maturity in mango (Samra *et al*., 11). Urea contains 46% nitrogen, whereas potassium nitrate contains 13% nitrogen. Monopotassium phosphate dose not contains nitrogen. Paclobutrazol help in accumulation of carbohydrates and lowers the gibbrellic acid content (Sergent *et al*., 12), which might have helped for hastening maturity than control. Potassium and phosphorus advance maturity and ripening in fruit crops (Bose *et al*., 3) and also increase the capacity to synthesize the starch.

The highest total yield was recorded in treatment T_7 during 2009 (32 fruits /plant), 2010 (34 fruits/plant), 2011 (36 fruits/plant) and pooled (34 fruits/plant) (Table 3), whereas the lowest fruit yield was recorded in control (13.5 fruits/plant). Of the total yield produced by various treatments, maximum number of fruits harvested before rains were found in T_7 (33.40, which were 98.33% of the total yield. It was followed by T_{11} where 26 fruits were harvested before rains and its proportion in total yield was 98.07%. In treatment T_{12}, 98.80% fruits of total yield were harvested before rains, which were 20.27. Importantly in treatments T_6 to T_{13} more than 87% fruits were harvested before rains. In all these treatments monopotassium phosphate, potassium nitrate and paclobutrazol were used. In control 0.93 fruits were harvested before rains which were 6.02% of total yield. In treatments T_2, T_3, T_4, T_5 one to two fruits were harvested before rains, which were 5.53 to 10.20% of total yield. The study indicated that foliar application of higher nitrogen in the initial stage of fruit growth delayed the harvesting where as foliar application of potassium and phosphorus preponed harvesting in jackfruit. Potassium and phosphorus are reported to advance maturity and harvesting in fruit crops (Arzumanov, 2). High nitrogen causes peaches to be late in ripening (Gustafson, 5). Advancement of fruit maturity and quality of *kokum* by use of monopotassium phosphate and potassium nitrate and delayed harvesting by foliar application of urea in *kokum* is reported (Shinde, 13; Haldankar *et al*., 6). In mango cv. Kent, paclobutrazol application

Table 3. Effect of paclobutrazol and post flowering foliar nutrient sprays on total yield and fruits harvested before rains in jackfruit.

Treatment	Total yield				Harvested before rains				% of total fruits harvested before rains			
	2009	2010	2011	Pooled	2009	2010	2011	Pooled	2009	2010	2011	Pooled
T_1 - PBZ @ 3 ml/m canopy dia.	17.0	15.5	19.0	17.2	6	6	8	6.72	35.2	37.00	43.00	38.41
T_2 - 1% urea twice	18.0	17.0	21.0	18.7	0	0	6	2.00	0	0.00	26.90	8.97
T_3 - T_1 + 1% urea twice	17.0	17.5	16.0	16.8	0	0	3	1.00	0	0.00	16.60	5.53
T_4 - 1% urea + 3% KNO_3	20.0	19.5	19.5	19.7	0	0	5	1.67	0	0.00	28.20	9.40
T_5 - T_1 + 1% urea + 3% KNO_3	20.0	21.5	15.0	18.8	0	4	2	2.00	0	17.30	13.30	10.20
T_6 - 1% urea + 0.5% MPP	17.0	16.5	19.0	17.5	17	16	12	14.97	100	96.50	65.20	87.23
T_7 - T_1 + 1% urea + 0.5% MPP	32.0	34.0	36.0	34.0	32	34	34	33.40	100	100.00	95.00	98.33
T_8 - 3% KNO_3 twice	16.0	15.0	18.0	16.3	16	15	15	15.33	100	100.00	81.80	93.93
T_9 - T_1 + 3% KNO_3 twice	22.0	26.0	19.0	22.3	20	22	18	20.00	89.30	83.33	96.55	89.73
T_{10} - 3% KNO_3 + 0.5% MPP	15.0	16.5	17.0	16.2	15	17	15	15.67	100	100.00	90.00	96.67
T_{11} - T_1 + 3% KNO_3 + 0.5% MPP	26.0	30.0	24.5	26.8	26	29	23	26.00	100	98.30	95.90	98.07
T_{12} - 0.5% MPP twice	17.0	22.0	24.0	21.0	17	22	23	20.71	100	100.00	96.40	98.80
T_{13} - T_1 + 0.5% MPP twice	19.0	20.5	24.0	21.2	19	20	23	20.67	100	97.60	95.80	97.80
T_{14} - control (no PBZ and no spray)	10.0	17.5	13.0	13.5	0	2	1	0.93	0	10.00	8.06	6.02
CD at 5%	6.53	8.64	16.95	8.32	6.65	6.82	8.42	15.48	4.48	2.74	3.74	1.03

resulted in advance harvesting by 25 days than control (Mouco *et al*., 8). Paclobutrazol accelerated harvesting in *karonda* (Mukadam and Haldankar, 9). Urea application showed delayed maturity in mango (Samra *et al*., 11).

The effect of foliar nutrients sprays and paclobutrazol on fruit weight of jackfruit was non-significant (Table 4). However, the bulb weight differed significantly. The minimum bulb weight was observed in control (8.36 g). All other treatments recorded higher bulb weight than control. It was maximum in T_1 (12.82 g) which was at par with T_{12}, T_6, T_{13}, T_9, T_7, T_4 and T_5. The maximum TSS was noticed in treatment T_{10} (29.78ºB) which was at par with T_9 (28.34ºB) and T_7 (28.15ºB). The total sugars were maximum in T_7 (25.07%) which was significantly superior over rest of treatments. It was followed by T_{12} (23.22%) which was at par with T_{10} (22.54%), T_9 (22.43%) and T_{13} (22.35%). The lowest total sugars was recorded in control. The acidity was maximum in T_9 (0.30%) which was at par with T_1 (23.71%) and T_{10} (0.25%). Thus, physico-chemical composition with respect to bulb weight, total sugars and TSS was improved by all treatments over control. The nutrients nitrogen, potassium and phosphorus are essential constituents of several metabolically active compounds and are major structural constituent of cell which increase growth and development of all living tissue. In foliar feeding the nutrients are applied directly to the sight of metabolism which could be attributed to enhance carbohydrates metabolism. Improvement in fruit quality by foliar sprays is reported in peach (Gill *et al*., 4), *karonda* (Mukadam and Haldankar, 9) and mango (Vijayalaxmi and Srinivasan, 14). Paclobutrazol is reported for higher total non structural carbohydrate and improvement of quality in Tommy Atkins mango (Yeshitela *et al*., 15). The input cost was maximum in treatment T_9 followed by T_{11} (Table 5). The input and total cost both were minimum in control. The gross returns were highest in T_7 followed by T_{11}. The B:C ratio of treatment T_{12} (2.40) was the best followed by T_7 (2.35) and T_6. (2.08). The B:C ratio of control was 0.99.

Thus, it may be concluded that foliar nutrient sprays with mono-potassium phosphate, potassium nitrate and paclobutrazol accelerated harvesting in jackfruit, which further helped for producing economical yield. Use of urea either alone or with potassium nitrate and paclobutrazol delayed harvesting in jackfruit.

REFERENCES

1. Anonymous, 2010. *Baseline Survey Report on a Value chain for Kokum, Karonda, Jamun and Jackfruit* submitted by Dr B.S. Konkan Krishi Vidyapeeth, Dapoli.

2. Arzumanov, V.A. 1966. Vinodelie I vinogradarstvo., No. **26**, pp. 39-40.

Table 4. Effect of paclobutrazol and post flowering foliar nutrient sprays on physico-chemical composition of jackfruit (pooled 2008-2011).

Treatment	Fruit weight (kg)	Fruit yield (kg/plant)	Fruit yield (MT/ha)	Acidity (%)	TSS (ºB)	Bulb wt. (g)	Total sugars (%)
T_1 - PBZ @ 3 ml/m canopy dia.	6.57	113.94	11.39	0.26	23.71	12.82	20.10
T_2 - 1% urea twice	5.95	109.78	10.98	0.20	25.53	9.28	19.92
T_3 - T_1 + 1% urea twice	5.75	99.19	9.92	0.22	23.55	8.63	20.26
T_4 - 1% urea + 3% KNO_3	6.04	117.87	11.79	0.21	23.47	10.61	20.24
T_5 - T_1 + 1% urea + 3% KNO_3	5.95	117.29	11.73	0.20	21.55	10.45	18.35
T_6 - 1% urea + 0.5% MPP	6.42	113.42	11.72	0.20	23.37	12.04	18.46
T_7 - T_1 + 1% urea + 0.5% MPP	6.73	227.86	24.94	0.22	28.15	10.72	25.07
T_8 - 3% KNO_3 twice	5.95	95.46	11.45	0.22	24.46	9.37	20.64
T_9 - T_1 + 3% KNO_3 twice	6.19	140.43	16.19	0.30	28.34	11.26	22.43
T_{10} - 3% KNO_3 + 0.5% MPP	6.66	108.55	12.54	0.25	29.78	10.28	22.54
T_{11} - T_1 + 3% KNO_3 + 0.5% MPP	6.08	167.22	19.02	0.22	22.15	9.66	19.23
T_{12} - 0.5% MPP twice	6.40	135.49	14.25	0.21	26.53	12.25	23.22
T_{13} - T_1 + 0.5% MPP twice	6.80	143.70	14.37	0.18	26.43	11.51	22.35
T_{14} - control (no PBZ and no spray)	5.59	76.71	7.67	0.18	20.80	8.36	16.99
CD at 5%	4.86	40.29	3.79	0.05	1.97	2.77	1.35

Table 6. Economics of paclobutrazol and post flowering foliar nutrient sprays on flowering, fruit size and maturity of jackfruit.

Treatment	Input cost (₹)	Total cost (₹)	Gross returns (₹)	Net returns		B:C ratio
				Input cost (₹)	Total cost (₹)	
T_1 - PBZ @ 3 ml /m canopy dia.	20,620	36,421	40,287	19,667	3,866	1.11
T_2 - 1% urea twice	14,384	23,790	26,954	12,570	3,164	1.13
T_3 - T_1 + 1% urea twice	21,224	34,841	21,712	488	-13,129	0.62
T_4 - 1% urea + 3% KNO_3	16,002	29,728	27,397	11,395	-2,331	0.92
T_5 - T_1 + 1% urea + 3% KNO_3	27,522	42,442	27,644	122	-14,798	0.65
T_6 - 1% urea + 0.5% MPP	11,062	29,308	61,093	50,031	31,785	2.08
T_7 - T_1 + 1% urea + 0.5% MPP	24,302	57,680	135,771	1,11,469	78,091	2.35
T_8 - 3% KNO_3 twice	21,580	41,068	55,918	34,338	14,850	1.36
T_9 - T_1 + 3% KNO_3 twice	34,300	59,987	77,994	43,694	18,007	1.30
T_{10} - 3% KNO_3 + 0.5% MPP	16,881	36,614	63,510	46,629	26,896	1.73
T_{11} - T_1 + 3% KNO_3 + 0.5% MPP	28,640	56,394	95,249	66,609	38,855	1.69
T_{12} - 0.5% MPP twice	11,820	33,274	79,898	68,078	46,624	2.40
T_{13} - T_1 + 0.5% MPP twice	23,940	48,825	852,45	61,305	36,420	1.75
T_{14} - control (no PBZ and no spray)	7,300	17,302	170,94	9,794	-208	0.99

3. Bose, T.K., Mitra, S.K. and Sadhu, M.K. 1988. *Mineral Nutrition of Fruit Crops*, Naya Prokash Publication, Calcutta, 245 p.

4. Gill, P.P.S., Ganaie, M.Y., Dhillon, W.S. and Singh, Nav Prem. 2012. Effect of foliar sprays of potassium on fruit size and quality of Patharnakh pear. *Indian J. Hort.* **69**: 512-16.

5. Gustafson, A.F. 2000. *Handbook of Fertilizers*, Agrobios (India), New Delhi, pp. 22-26.

6. Haldankar, P.M., Somvanshi, A.V., Rangwala, A.D., Khandekar, R.G. and Buronkar, M.M. 2012. Effect of post flowering foliar nutrient sprays of nutrients for accelerating harvesting of *kokum* (*Garcinia indica* Choisy). *Indian J. Hort.* **69**: 55-59.

7. Horst Marschner. 1988. *Mineral Nutrition of Higher Plants* (2nd Edn.), Academic Press. London, pp. 229-99.

8. Mouco, M.A. do C., Ono, E.O. and Rodrigues J.D. 2010. Mango flower induction in the Brazilian Northeast semi-arid with gibbrellin synthesis inhibitors. *ISHS Acta Hort.* **884**: 591-96.

9. Mukadam, S.J. and Haldankar, P.M. 2013. Effect of paclobutrazol and post flowering foliar sprays of nutrients for accelerating harvesting of *karonda*. *J. Plant Studies*, **2**:145-51.

10. Panse, V.G. and Sukhatme, P.V. 1997. *Statistical Methods for Agricultural Workers*, Published by ICAR, New Delhi, pp. 97-156.

11. Samra, J.S., Thakur, R.S. and Chadha, K.L. 1977. Effect of foliar application of urea on yield and yield parameters of mango. *Indian J. Hort.* **3**: 26-29.

12. Sergent, E.D., Ferrari and Leal, F. 1996. Effect of potassium nitrate and paclobutrazol on flowering induction and yield of mango (*Mangifera indica* L.) cv. Haden. *Proc. Abst. Book. VIth International Mango Symposium*, Pattaya City, Thailand.

13. Shinde, S.R. 2007. Studies on effect of post-flowering foliar sprays of nutrients on maturity and quality of kokum (*Garcinia indica* Choisy). M.Sc. (Agri.) thesis submitted to Konkan Krishi Vidyapeeth, Dapoli. Dist- Ratnagiri. Maharashtra state.

14. Vijayalaxmi, D. and Srinivasan, P.S. 1998. Improving the quality attribute of 'off' year Alphonso mango through chemicals and growth regulators. *Orissa J. Hort.* **28**: 31-33.

15. Yeshitela, Teferi, Robbertse, P.J. and Stassen, P.J.C. 2004. Paclobutrazol suppressed vegetative growth and improved yield as well as fruit quality of Tommy Atkins mango (*Mangifera indica*) in Ethiopia. *New Zeland J. Crop Hort. Sci.* **32**: 281-93.

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