HortFlora Research Spectrum, 1(1): 29-33 (2012) ISSN : 2250-2823

EFFECT OF GROWTH RETARDANTS ON VEGETATIVE GROWTH, FLOWERING AND FRUITING OF LITCHI CV. CALCUTTIA

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ABSTRACT : Present investigation was carriedout during 2009-10 to standardize levels of growth retardants (CCC and PBZ) for proper vegetative growth, flowering and fruiting in litchi cv. Calcuttia, Results revealed that PBZ 7.5 ml proved to be the most effective treatment for suppressing shoot growth, panicle size, male flower percentage, fruit drop and sex ratio. Same treatment resulted in increased hermaphrodite flower percentage, fruit set and fruit retention. PBZ 2.5 ml proved to be the most effective in increasing fruit size and PBZ 5.0 ml in fruit breadth and weight. CCC 2000 ppm resulted in maximum pulp weight, pulp/stone ratio, total soluble solids and minimum acidity whereas CCC 500 ppm found helpful in decreasing seed and peel weight. PBZ 7.5 ml was the most effective treatment in producing maximum sugars (total and reducing) and fruit yield/tree.

Keywords: *Licthi, growth retardant, CCC, PBZ, bearing.*

The litchi (*Litchi chinensis* Sonn.), is the most important sub-tropical evergreen fruit tree, belongs to family Sapindaceae. Botanically it is a nut type of fruit. It is indigenous to south eastern China from where it is considered to have reached eastern India through Myanmar by the end of 17th century or shortly thereafter (Hayes, 7).

In India litchi is grown mainly in the states of Bihar, West Bengal and Uttar Pradesh. It is also grown in limited scale in Tripura, Orissa, Punjab, Himachal Pradesh, Assam and the Nilgiri hills in the south. Current production of litchi is about 4,83,000 MT tonnes from an area of about 74,000 hectares with productivity of 6.5. In Punjab, litchi cultivation is mainly confined to sub-mountainous tracts of Gurdaspur, Hoshiarpur, Nawanshahr, Ropar and union territory of Chandigarh. The problems responsible for low economic potential of litchi cultivation in various litchi growing regions include poor fruit set (Sarkar *et al*., 15), heavy fruit drop (Singh and Phogat, 17), fruit cracking (Bhat *et al*., 2) and inferior fruit quality (Brahmachari and Rani, 3).

Besides these problems irregularity in bearing has remained one of the serious handicaps in the development of litchi industry in many parts of the world including India, Israel, South Africa, Hawaii, Australia and Florida. Litchi bears heavy crop in one year and light or no crop in the adjoining year (Pandey and Sharma, 12). The flushing habit of litchi varieties was intimately connected with irregular bearing. Problem is generally due to failure of flower initiation which puts forth vegetative growth prior to panicle emergence and flowering eliminating the crop completely. Observations on young as well as old 'Calcuttia' trees showed that vegetative growth after September was at the expense of fruiting in the following year (Mustard and Lynch, 10). Several research workers advocated the use of various growth retardants as an alternate approach in litchi to restrict vegetative growth before panicle emergence (Chapman *et al*., 10). Calcuttia litchi was found to be more prone to irregular bearing than other cultivars hence a study was planned to observe the effect of growth retardants on various characteristics of Calcuttia litchi.

Received : 24.12.2011 *Accepted : 03.1.2012*

MATERIALS AND METHODS

The present investigations were carried out in a well managed litchi orchard growing at Government Orchard and Nursery, Gurdaspur during 2009-10. The experimental filed is situated in the sub-mountainous region of Punjab at 32º-02′ N latitude and 75º-24′ E longitude with an elevation of 260-300 m above mean sea level. Gurdaspur is situated in the sub-tropical humid zone of Punjab state with an average rain fall of 900 mm. Soil of the experimental orchard was well drained, fertile, sandy loam, with pH of 8.0 and electrical conductivity of 0.15 mmhos/cm.

Selection of trees

Twenty one 15 year old uniform sized litchi cv. Calcuttia trees were randomly selected for the experiment. Each treatment was replicated thrice with a single tree as a treatment unit. All the experimental trees were applied with uniform cultural practices as recommended by PAU, Ludhiana.

Spray schedule

Growth retardant CCC (500, 1000 and 2000 ppm) was applied as foliar application and PBZ (2.5, 5.0 and 7.5 ml/tree) as soil drench in mid-September to selected trees and sub-sequently treatment was repeated in mid-November as superimposed application to same previously treated trees. Trees under control were sprayed with tap water only. The growth retardants were dissolved in desired quantity of water.

Vegetative and floral characters

Shoot length, panicle length, male flower, hermaphrodite flower percentage and sex ratio on the basis of male and hermaphrodite flower percentage was calculated from the selected plants.

Collection and analysis of fruit sample

Fruit sample was collected in last week of June (June 26). At each sampling fruits per treatment and replication were collected randomly from all sides of the trees from previously tagged branches at shoulder height to record various physico-chemical characteristics of fruits. These fruits were analyzed for their physico-chemical characteristics in the laboratory of Department of Horticulture, Khalsa College, Amritsar.

TSS were recorded with hand refractometer and acidity was calculated by titrating the fruit juice with N/10 NaOH solution. Sugars were calculated by the standard procedure given by AOAC

Statistical analysis

There were altogether seven treatments replicated thrice in a Randomized Block design (RBD). The data was analysed as per standard procedures.

RESULTS AND DISCUSSION

Application of Cultar and cycocel reduced the length of terminal shoot and caused more flowering in litchi cv. Calcuttia. All the vegetative and floral parameters were affected more by paclobutrazol than cycocel (Table 1). Minimum length (11.5 cm) of terminal shoots was recorded in soil application of Cultar @ 7.5 ml which was closely followed by Cultar @ 5ml this has been due to antagonism of gibberellin bio-synthesis for which Cultar is known (Desai and Chundawat, 6). There is considerable evidence which showed that Cultar reduced vegetative growth and stem elongation in many fruits by interrupting gibberellic acid synthesis (Burondkar and Gunzate, 4). Cultar was resulted in early physiological maturity and reduced vegetative growth causing higher flower bud initiation. Minimum panicle length/breadth 21.7/9.67 cm was recorded in PBZ 7.5 ml treated plants. Reduction in panicle length in Cultar

treated trees was due to more number of panicles/tree. Cycocel also reduced the panicle size than control but to a lesser extent than PBZ. Lower percentage of male flowers was recorded in PBZ 7.5 ml treatment (74.53 %) than control (81.31 %). Highest percentage of hermaphrodite gibberellins were powerful modifiers of sex expression, thus the reduced endogenous GA levels with the application of PBZ and CCC might be possible factor for the higher proportion of hermaphrodite flowers observed (Table 1). Lower sex ratio was observed in 7.5 ml cultar treatment. Lower sex ratio means lower number of male flowers and higher number of hermaphrodite flowers is due to maintenance of physiological concentration of auxins in plant tissues by the PBZ and cycocel which resulted in increase flowering in general and femaleness in particular. This was precisely the reason of improved sex ratio in present studies confirming the earlier findings of Kulkarni (8), Kurian and Iyer (9) and Singh (16) in mango. Highest fruit set, lower fruit drop, maximum fruit retention was noticed in PBZ 7.5 ml treatment. Minimum fruit retention was found in cycocel 500 ppm.

Longest fruits and highest fruit breadth were noticed under Cultar, smallest fruits and minimum breadth was noticed in cycocel 500 ppm (Table 2). Maximum fruit weight was registered with PBZ 5.0 ml and minimum in fruits harvested from PBZ 2.5 ml treated plants. The highest value of pulp weight was noticed in cycocel 2000 ppm lowest was found in PBZ 2.5 ml while lowest pulp weight seed weight was recorded in cycocel 500 ppm and highest seed weight was registered in PBZ 5 ml. The lowest peel weight was produced in fruits harvested from PBZ 5 ml. Growth retardants affect the peel weight to some extent directly or indirectly via their effect on cell division and cell expansion. Results of present study were corroborated by the findings of Rani and Brahmachari (14) in litchi. Highest total soluble solids were observed with cycocel 2000 ppm. All the treatments helped in producing more TSS than in fruits under control (Table 3). The increase in total soluble solids were might be due to the metabolizing effect of growth retardants and their effect on osmotic pressure of the cells tends to increase and solutes like ions and sugars accumulates and thus the TSS level was increased in treated fruits (Singh, 16). Other reason may be increased efficiency of photosynthetic apparatus (leaves) of PBZ treated plants resulting in increase content of TSS in litchi fruits (Ahmad *et al*., 1).

Lowest acidity was detected in the fruits which were treated with cycocel 2000 ppm than control. PBZ produced high acidity due to the accumulation of organic acids in the fruit sac (Rani and Brahmachari, 14). Maximum TSS/acid ratio was noticed in 2000 ppm cycocel and minimum in control.

Maximum reducing and total sugars was found in PBZ 7.5 ml treatment. All other treatments yielded more total sugars than control. Highest level of total sugars in the fruits treated with growth retardants were due to their action on -amylase synthesis converting starch to reducing sugar. The improvement in first quality with the application of growth regulators might be due to diversion of photosynthesis towards the fruits (Rai and Bist, 13). Similar observations were made by Rani and Brahmachari (14) with CCC in litchi and Singh and Singh (18) with PBZ in mango.

Higher fruit yield (Table 3) was estimated in 7.5 ml PBZ treatment and lowest in control. PBZ and cycocel significantly affect the crop yield, profuse flowering, higher sex ratio, lesser fruit drop and higher fruit retention. PBZ applied contributed to higher fruit yields in litchi as has also been supported by Oosthuizen *et al.* (11). Increase in yield with the soil application of Cultar may have been due to its effect on shifting of assimilates, mineral elements and soluble proteins in leaves, stems and roots (Wang *et al*., 19).

Table 1: Effect of growth retardants on vegetative growth and flowering of litchi cv. Calcuttia.

Treatment	Concentration	Shoot growth (cm)	Panicle length (cm)	Panicle breadth (cm)	Male flower (%)	Hermaphrodite flower (%)	Sex ratio	Fruit set (%)
T1	CCC 500 ppm	17.40	29.47	12.23	77.8	22.2	3.52	45.25
T2	CCC 1000 ppm	15.98	29.35	12.70	77.31	22.69	3.43	49.12
T3	CCC 2000 ppm	15.83	27.03	11.87	76.54	23.46	3.30	54.20
T4	PBZ 2.5 ml	15.66	24.6	11.25	75.97	24.03	3.16	57.15
T5	PBZ 5 ml	13.69	23.8	9.97	75.79	24.21	3.15	62.17
T6	PBZ 7.5 ml	11.57	21.7	9.67	74.53	25.13	2.97	64.10
T7	Control	23.53	30.6	15.06	81.31	18.69	4.44	41.18
	C.D. (P = 0.05)	2.23	3.05	2.69	3.28	3.05	0.68	4.12

Table 2: Effect of growth retardants on fruiting parameters of litchi cv. Calcuttia.

Treatment	Concentration	Fruit drop (%)	Fruit retention (%)	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (g)	Pulp weight (g)	Seed weight (g)
T1	CCC 500 ppm	78.15	10.92	3.23	2.14	17.3	13.96	3.13
T2	CCC 1000 ppm	73.33	14.20	3.37	3.09	21.08	16.37	3.56
T3	CCC 2000 ppm	71.72	18.82	3.43	3.17	20.68	17.06	3.15
T4	PBZ 2.5 ml	69.28	12.40	3.73	2.76	16.28	11.39	3.48
T5	PBZ 5 ml	65.09	23.27	3.47	3.37	21.30	16.18	3.68
T6	PBZ 7.5 ml	63.14	28.26	3.23	2.68	17.95	13.21	3.33
T7	Control	83.28	12.93	3.43	3.05	16.03	12.00	3.37
	C.D. (P = 0.05)	5.17	5.72	0.20	0.39	1.40	1.55	NS

Table 3: Effect of growth retardants on various physico-chemical characteristics of litchi cv. Calcuttia.

Treatment	Concentration	Pulp/ Seed ratio	Peel weight (g)	Fruit TSS (%)	Acidity (%)	TSS/ acid ratio	Total sugars (%)	Reducing sugars (%)	Fruit yield (kg)
T_1	CCC 500 ppm	4.46	1.20	18.95	0.60	31.60	16.36	6.35	101.43
T_2	CCC 1000 ppm	4.64	1.37	19.30	0.57	34.00	16.74	7.09	98.27
T_3	CCC 2000 ppm	5.42	1.46	19.96	0.52	38.18	16.30	5.55	98.00
T_4	PBZ 2.5 ml	3.31	1.41	19.43	0.62	31.38	16.60	6.13	100.37
T_5	PBZ 5 ml	4.40	1.49	19.12	0.72	26.57	15.77	5.96	110.38
T_6	PBZ 7.5 ml	3.97	1.41	18.76	0.56	33.90	17.65	7.29	113.95
T_7	Control	3.56	1.42	18.15	0.93	19.60	14.26	7.25	85.18
	C.D. (P = 0.05)	0.82	NS	0.69	NS	3.01	1.86	1.09	2.97

Acknowledgements

The help rendered by Dr. B.S. Dhillon, Deputy Director (Trg.), KVK, Amritsar and Dr. NP Singh, Assistant Horticulturist, Department of Horticulture, PAU, Ludhiana during the course of this study is duly acknowledged.

REFERENCES

1. Ahmad, F., Mohammad, A. and Kumar, G. (2000). Effect of paclobutrazol on growth, yield and quality of litchi (*Litchi chinensis* Sonn.). *Indian J. Hort.,* **57**(4): 291-94.
2. Bhat, S.K., Raina, B.L., Chogtu, S.K. and Muthoo, A.K. (1997). Effect of exogenous auxin application on fruit drop and cracking in litchi (*Litchi chinensis* Sonn.) cv. Dehradun. *Advances in Plant Sci.,* **10** (1):83-86.
3. Brahmachari, V.S. and Rani, Ruby (2001). Effect of growth substances on productivity, cracking, ripening and quality of fruits of litchi. *The Orissa J. Hort.,* **29** (1): 44-45.
4. Burondkar, M.M. and Gunjate, R.T. (1991). Regulation of shoot growth and flowering in 'Alphonso' mango with paclobutrazol. *Acta Hort.,* **291:** 79-82.
5. Chapman, K.R., Paxton, B. and Cull, B.W. (1980). Litchi cultivar evaluation (Project 1) Bienn. *Rep. Maroochy Hortic. Res. Sta.,* **2**: 32-33.
6. Desai, M.M. and Chundawat, B.S. (1994). Regulation of flowering in mango by Paclobutrazol. *Indian J. Hort.,* **51** (1): 9-15.
7. Hayes, W.B. (1957). *Fruit growing in India*. Kitabistan, Allahabad.
8. Kulkarni, V.J. (1988). Chemical control of free vigour and promotion of flowering in mango using paclobutrazol. *J. Hort. Sci.,* **63** (3): 557-66.
9. Kurian, R.M. and Iyer, C.P.A. (1993). Chemical control of tree size in mango (*Mangifera indica* L). cv. Alphonso. I. effects of growth retardants on vegetative growth and tree vigour. *J. Hort. Sci.,* **68** (3): 349-54.
10. Mustard, M.J. and Lynch, S.J. (1959). Notes on Lychee panicle development. *Proc. Fla. St. Hort., Soc.,* **72:** 324-27.
11. Oosthuizen, H.H., Froneman, I.J. and Roe, D.J. (1995). Long term effect of growth retardants and pruning on growth, yield and fruit quality of litchi trees. I. *South African Soc. Hort. Sci.,* **5** (2): 61-63.
12. Pandey, R.M. and Sharma, H.C. (1989). *The Litchi* pp. 54-61 ICAR, New Delhi.
13. Rai, N. and Bist, L.D. (1992). Effect of soil and foliar applied paclobutrazol on vegetative growth, flowering, fruit set and yield on oriental pear. *Scientia Hort.*, **50:** 153-158.
14. Rani, Ruby and Brahmachari, V.S. (2000). Effect of growth substances on fruit drop, yield and physico-chemical composition of Litchi fruits. *Prog. Hort.,* **32** (1): 50-55.
15. Sarkar, S.K., Sinha, M.M. and Misra, R.S. (1984). Effect of NAA on fruit set, fruit drop, cracking, fruit size and quality in litchi cv. Rose Scented. *Prog. Hort.,* **16** (3-4): 301-04.
16. Singh, D.K. (1996). Effect of paclobutrazol on growth and bearing mango cultivars. *Ph.D. thesis,* GBPUAT, Pantnagar, U.P.
17. Singh, O.P. and Phogat, K.P.S. (1984). Effect of growth regulators on fruit drop, size and quality of Litchi cv. Culcuttia. *Punjab Hort.* J., **24** (1-4): 83-88.
18. Singh, S. and Singh, A.K. (2006). Regulation of shoot growth and flowering in mango cv. Gulab Khas by paclobutrazol. *Ann. Agricul. Res.,* **27** (1): 4-5.
19. Wang, S.Y., Sun, T., Ji, Z.L. and Faust, M. (1995). Effect of paclobutrazol and water stress induced bio-synthesis and polyamine accumulation in apple seedling leaves. *Phytochem.*, **24**:2185-90.