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Effect of micronutrients and plant growth regulators on fruiting of litchi

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ABSTRACT

The present investigation was conducted in the litchi orchard of the Horticulture Garden of Bihar Agricultural College, Sabour in the year 2006 to assess the effect of micronutrients and plant growth regulators on fruiting in litchi cv. PURBI. The application of borax 0.4 per cent resulted in maximum fruit set (42.50 per cent), fruit retention (22.60 per cent), size of fruit (3.72 cm x 2.90 cm), number of fruit per tree (5422), weight of individual fruit (20.91 gm) and fruit yield per tree (111.05 Kg). GA_3 20 ppm also was found effective treatment to increase fruit set, fruit retention and size of fruit being maximum of 42.18 per cent, 21.81 per cent and 3.64 cm x 2.84 cm, respectively. GA_3 20 ppm produced maximum number of fruits/tree (5327), weight of individual fruit (20.66gm) and fruit yield per tree (104.55 Kg). Interaction between borax 0.4 per cent and GA_3 20 ppm exhibited in maximum retention of fruit (24.64 per cent) and fruit yield of 123.10 Kg/tree. Aril percentage was high in borax 0.2 per cent and 2,4-D 10 ppm. Minimum fruit crack of 10.91 per cent was observed in borax 0.4 per cent.

Key words : Litchi, Micronutrient, Plant growth regulator, Yield, GA_3, Borax

INTRODUCTION

Indian agriculture as such in its present era is shedding off its traditional costumes acquiring a format which is expected to form the back bone of Indian economy. Once referred to as a begging bowl, Indian agriculture today is bubbling with rejuvinated vigour excelling in all walk of economic front. It has not only gained self sufficiency in food production, but today it is strengthening Indian economy through export of various agricultural products. Horticultural products in general and fruits in particular are premier commodities of export. Amongst fruit crops, litchi (*Litchi chinensis* Sonn.) occupies prime place of importance. So far as export of agricultural products is concerned, by virtue of its delicious taste, excellent flavour, pleasant fragrance, attractive appearance and high nutritional values, it has gained popularity in many parts of the world opening up new vistas for accelerated export opportunity. However, to stay in global market, which is turning more and more competitive day by day, it is of paramount importance to maintain high standard in the qualities of fruits produced, besides imparting fascinating appearance to them and providing longer shelf life. From economic point of view, it is equally important to get a good harvest, besides having improvement in quality aspect.

Zinc plays a vital role in the metabolic activities of plants. The principal functions of zinc in plant is as a metal activator of enzymes like dehydrogenase (pyridine nucleotide, glucose-6 phosphodiesterase, carbonic anhydrase etc.). It is involved in the synthesis of tryptophane, a precursor of IAA. It is associated with water uptake and water retention in plant bodies (Noggle and Fritz, 1989). Boron, on the other hand, is considered to be necessary for hormone metabolism, photosynthetic activities, cellular differentiation and water absorption in plant parts. It is also involved in reproduction, germination of pollen tube and fertilization. In case of boron deficiency, flowers are produced in less number and are mostly sterile, fruits are deformed and renders themselves commercially useless (Yawalkar *et al.,* 1992).

The effect of micronutrients in augmenting litchi yield and quality is a foregone conclusion, but the beneficial effect of micronutrients in combination with plant growth substances was yet to be fully explored especially in the Indo-Gangetic plains of Bihar to which litchi tracts of Bihar belongs. This paves the path for the current experimentation.

MATERIALS AND METHODS

The experiment was conducted in the litchi orchard of the Horticulture Garden of the Bihar Agricultural College, Sabour in the year 2006. Two micronutrients ($ZnSO_4$ and borax) and two plant growth regulators (2,4-D and GA_3) each at their two lower and higher levels *i.e.* $ZnSO_4$ at 0.4 per cent (M_1) and 0.8 per cent (M_2); Borax at 0.2 per cent (M_3) and 0.4 per cent (M_4) and 2,4-D at 10 ppm (P_1) and 20 ppm (P_2) and GA_3 also at 10 (P_3) and 20 (P_4) ppm sprays were tested in Randomized Block Design (Factorial) replicated thrice. One control plot was also there in each replication for making effective comparison. Micronutrients were sprayed on new growth flushes before initiation of inflorescence, whereas, PGRs were sprayed after completion of fruit setting. The litchi variety used for experimentation was “Purbi”. The litchi

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trees were 7.62 m apart in both direction *i.e.* between the rows and within the rows having an average height of 7.1 m. The fertility status as envisaged through the status of available N (294.8 Kg), P_2O_5 (23.8 Kg) and K_2O (203.5 Kg) was in the medium range having soil reaction in the neutral range (pH 7.2).

RESULTS AND DISCUSSION

The micronutrients in general were effective in increasing fruit setting significantly in comparison to control (Table 1). Except 0.8% $ZnSO_4$ (M_2) and 20 ppm 2,4-D (P_2) all the concentrations of $ZnSO_4$ and borax significantly increased fruit setting in litchi. Amongst the micronutrients, Borax 0.4% (M_4) exhibited the highest fruit setting (42.5%), but had statistical parity with 0.4% $ZnSO_4$ (M_1) and 0.2% borax (M_3). All the four treatments (M_4) had significantly the maximum fruit retention percentage. However, as per M x P interaction (Table 2), 0.4% borax (M_4) was significantly superior to all other micronutrients and their varying strengths only when 20 ppm GA_3 was in comparison under all other situations of PGR application it had statistical parity with 0.4% $ZnSO_4$ and 0.2% Borax, if 10 ppm 2,4-D was applied. Like wise it was at par with 0.4% $ZnSO_4$, if 20 ppm 2,4-D sprayed. Similarly, when 10 ppm GA_3 was applied 0.4% Borax was comparable with 0.2% borax and 0.4% $ZnSO_4$.

Length and diameter of fruit were the maximum under 0.4% borax application. However, diameter of fruit under 0.4% $ZnSO_4$ was also comparable. Aril percentage was the maximum under 0.2% borax application, which had statistical equality with 0.4% borax. Amongst the PGRs, 10 ppm 2,4-D, 10 ppm GA_3 and 20 ppm GA_3 fared

Table 1 : Effect of micronutrients and PGRs on fruit set, fruit retention, cracking and size of litchi fruit

Treatments	Fruit set (%)	Fruit retention (%)	Cracking of fruit (%)	Length of fruit (cm)	Diameter of fruit (cm)
M_1- $ZnSO_4$ (0.4%)	41.88	21.46	12.70	3.64	2.86
M_2- $ZnSO_4$ (0.8%)	39.72	18.39	12.80	3.33	2.61
M_3- Borax (0.2%)	41.58	21.43	11.96	3.61	2.82
M_4- Borax (0.4%)	42.50	22.60	10.91	3.72	2.90
S.E. ±	0.728	0.332	0.161	0.062	0.051
C.D. (P=0.05)	1.483	0.677	0.328	0.125	0.104
P_1- 2,4-D (10 ppm)	41.70	21.59	12.12	3.63	2.83
P_2- 2,4-D (20 ppm)	40.16	19.04	12.66	3.41	2.68
P_3- GA_3 (10 ppm)	41.64	21.44	12.18	3.62	2.83
P_4- GA_3 (20 ppm)	42.18	21.81	11.40	3.64	2.84
S.E. ±	0.728	0.332	0.161	0.062	0.051
C.D. (P=0.05)	NS	0.677	0.328	0.125	0.104
Control mean	38.11	16.84	14.01	3.16	2.41
Other's mean	41.42	20.97	12.09	3.57	2.79
S.E. ± (control vs. others)	1.061	0.484	0.235	0.090	0.181
C.D. (P=0.05) (control vs. others)	2.162	0.987	0.478	0.183	0.369

pertaining to PGR application showed statistical equality amongst themselves in increasing fruit setting in litchi. Fruit retention also increased due to micronutrients and PGR and fruit cracking reduced significantly as compared to control. Amongst the micronutrients, Borax 0.4% was the most effective in increasing fruit retention and reducing fruit cracking. Amongst the PGR, GA_3 20 ppm had significantly the least fruit cracking. Fruit retention was also the maximum in 20 ppm GA_3, but it was statistically alike to those under 10 ppm 2,4-D and 10 ppm GA_3. It was only 20 ppm 2,4-D, which exhibited significantly lower fruit retention. According to the main effect of micronutrients the plant growth regulators, 0.4% borax

Table 2 : Fruit retention percentage as influenced by micronutrients x PGRs interaction

Micronutrients \ Plant growth regulators	2, 4-D 10 ppm P_1	2, 4-D 20 ppm P_2	GA_3 10 ppm P_3	GA_3 20 ppm P_4	Mean
M_1- $ZnSO_4$ (0.4%)	22.54	19.54	21.13	22.62	21.46
M_2- $ZnSO_4$ (0.8%)	18.43	17.55	19.63	17.94	18.39
M_3- Borax (0.2%)	22.54	18.52	22.62	22.05	21.43
M_4- Borax (0.4%)	22.86	20.52	22.37	24.64	22.60
Mean	21.59	19.04	21.44	21.81	-

ANOVA

Comparison between means of	S.E. ±	C.D. (P=0.05)
Micronutrients x PGR (MxP)	0.665	1.354

equally well. It was only 20 ppm 2,4-D which showed lower length and diameter. Aril percentage did not vary significantly due to PGR. The beneficial effect of micronutrients and PGR can be explained on the basis of their role in plant physiology and plant metabolism. The mechanism of action of zinc may be through auxin stimulation. Zinc is involved in synthesis of tryptophan, a precursor of NAA. A number of workers have reported that heavy drop at early stage was due to the formation of abscission layer. The cell at or near the abscission zone gets reduced and either disintegrates or dissolves resulting in separation of fruit from the stock. The formation of abscission layer is associated with presence of weak auxin gradients in fruit. The increase in fruit set and fruit retention due to Borax application may be ascribed to its beneficial effect on reproduction, germination of pollen tube and fertilization process. 2,4-D itself functions as an auxin former in its lower concentration. Thus, all these chemicals ultimately help in cell division, cell elongation, cell enlargement and in reduction of abscission layer (Salisbury and Ross, 1969). Comparatively less effectiveness of higher concentration of zinc may be attributed to its scorching effect on the juvenile inflorescence. Similarly, subdued impact of higher concentration of 2,4-D (20 ppm) may be due to showing up of inherent herbicidal effect of the chemical for which it is primarily known (Yawalkar *et al.*, 1992). Uptake of water and solutes are governed by the presence of zinc and other micronutrients. In case of enhanced water uptake, solutes accumulate in the fruits and minimize the pressure on the skin resulting in less cracking. Auxin stimulation both due to 2,4-D and GA_3 might be the reason for accumulation of building block at a faster rate and better execution of source-sink relation registering higher fruit setting, retention and less cracking.

Application of borax 0.4% (M_4) was instrumental in formation of maximum fruit per tree, maximum weight of individual fruit and fruit weight per tree (Table 3). However, it had statistical equality with 0.4% $ZnSO_4$ application. 0.2% borax (M_3) was also comparable in case of weight of individual fruit. 0.8% $ZnSO_4$ was the least effective. Amongst the PGRs, 10 ppm 2,4-D, 10 ppm GA_3 and 20 ppm GA_3 fared equally well so far as number of fruit per tree, weight of individual fruit and weight of fruit per tree was concerned. 20 ppm 2,4-D appeared to be the least effective. The micronutrients and PGRs as such were significantly superior to the control. However, according to M x P interaction, the result was more complex. If 0.4% borax or 0.4% $ZnSO_4$ were sprayed, the maximum fruit yield was under 20 ppm GA_3. If 0.2% borax was sprayed, the highest fruit yield was under 10 ppm GA_3 and if 0.8% $ZnSO_4$ was sprayed, the maximum fruit yield was under 10 ppm GA_3. The results of the present investigation get support in the works of Brahmachari and Kumar (1997), Raina *et al.* (2001) and Sharma *et al.* (2005).

Table 3 : Effect of micronutrients and PGRs on yield and aril (%) of litchi fruit

Treatments	No. of fruits per tree	Weight of individual fruit (g)	Fruit yield (Kg/tree)	Aril (%)
M_1- $ZnSO_4$ (0.4%)	5286	20.57	106.78	68.68
M_2- $ZnSO_4$ (0.8%)	4688	18.45	84.48	68.18
M_3- Borax (0.2%)	5116	20.85	104.43	71.55
M_4- Borax (0.4%)	5422	20.91	111.05	70.38
S.E. $\pm$	133.7	0.429	2.716	1.242
C.D. (P=0.05)	272.3	0.874	5.532	2.530
P_1- 2,4-D (10 ppm)	5166	20.65	104.75	70.32
P_2- 2,4-D (20 ppm)	4942	19.01	90.55	68.58
P_3- GA_3 (10 ppm)	5177	20.66	104.55	69.33
P_4- GA_3 (20 ppm)	5327	20.47	106.88	70.53
S.E. $\pm$	133.7	0.429	2.716	1.242
C.D. (P=0.05)	272.3	0.874	5.532	NS
Control mean	4156	17.21	69.43	65.20
Other's mean	5128	20.97	101.68	69.69
S.E. $\pm$	194.9	0.626	3.959	1.811
C.D. (P=0.05)	396.9	1.275	8.064	3.689

Table 4 : Fruit yield per tree as influenced by micronutrients x PGRs interaction

Plant growth regulators / Micronutrients	2, 4-D 10 ppm P_1	2, 4-D 20 ppm P_2	GA_3 10 ppm P_3	GA_3 20 ppm P_4	Mean
M_1- $ZnSO_4$ (0.4%)	110.40	96.30	105.60	114.80	106.78
M_2- $ZnSO_4$ (0.8%)	83.70	78.40	94.10	81.70	84.48
M_3- Borax (0.2%)	111.40	88.60	109.80	107.90	104.43
M_4- Borax (0.4%)	113.50	98.90	108.70	123.10	111.05
Mean	104.75	90.95	104.55	106.88	-

ANOVA

Comparison between means of	S.E.$\pm$	C.D. (P=0.05)
Micronutrients x PGR (MxP)	5.432	11.064

REFERENCES

Brahmachari, V.S. and Kumar, Rajesh (1997). Effect of foliar spray of mineral nutrients on fruit set retention and cracking of litchi (*Litchi chinensis* Sonn.) fruit. *Haryana J. Hort. Sci.,* **26** (3-4): 177-180.

Noggle, G.R. and Fritz, G.T. (1980). *Introductory Plant Physiology*, Prentice Hall of India Pvt. Ltd. Publication, New Delhi.

Raina, B.L., Bhatt, S.K. and Muthoo, A.K. (2001). Effect of foliar of NAA and 2, 4-D on yield and quality of litchi (*Litchi chinensis* Sonn.) cv. DEHRADUN. *Advances in Plant Sci.,* **14** (2): 385-389.

Salisburry, F.D. and Ross, C. (1969). *Plant Physiology* (ed.) 1969 Wardworth Publishing Company Inc. Belmont, California.

Sharma, P., Sharma, R.M., Singh, A.K. and Tiku, A.K. (2005). Effect of plant bioregulators and micronutrients on tree productivity, fruit cracking and aril proportion of litchi (*Litchi chinensis* Sonn.) cv. DEHRADUN. *Haryana J. Hort. Sci.,* **34** (3-4): 220-221.

Yawalkar, K.S., Agarwal, J.P. and Bokde, S. (1992). *Manures and fertilizers, seventh edition*. Agri. Horticultural Publishing House, 52, Bajaj nagar, Nagpur.

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