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Micronutrient and growth regulator enhanced the quality of litchi under the foot hills of Arunachal Pradesh

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Abstract
The experiment was conducted with the objective to observe the effect of $ZnSO_4$, Borax, NAA and GA_3 on the quality of litchi fruit cv. Muzaffarpur. The application of micronutrient and growth regulator significantly influences the quality of litchi. The foliar application of borax @ 0.4%, exhibited improved TSS (18.02 °Brix), total sugar (20.92%), reducing sugar (12.19%), and ascorbic acid (36.75 mg/100 ml). However, there was no effect of applied treatment on titratable acidity, non- reducing sugar and malic acid. Therefore application of boax @ 4% may be recommended for enhancing quality of litchi.

Keywords: ascorbic acid, litchi, Arunachal Pradesh, micronutrients, growth regulators

Introduction
Litchi is important fruit crop grown in northeast India which provide good returns to farmer. However, Northeast India receives heavy rainfall which results in leaching of nutrient from the soil. The leached soils are deficient in macro as well as micronutrients. The requirement of macronutrients is completed through the use of fertilizers but the application of micronutrient is neglected. Micronutrients are required in small amount but plays significant role in improving the quality of litchi. The optimum amount of micronutrients is necessary for healthier plant growth resulting in higher yield due to increased growth, better flowering and higher fruit set [1]. It has been found that a substantial percentage of the total requirements of certain plant nutrients can be fed by foliar application of micronutrient [2]. The improvement in quality of fruit might be due to the catalytic action of micronutrients particularly at higher concentrations. Hence, the foliar application of micronutrients quickly increased the uptake of macronutrients in the tissues and organs and improves fruit quality [3].

Zinc is essentially required for growth, development and also involved in diverse range of enzyme system in litchi. The functional role of zinc includes auxin metabolism, influence of activating enzyme synthesis and stability of ribosomal fractions [4]. It plays a vital role in the metabolic activities of plant. The principle functions of zinc in plant are as a metal activator of enzymes like dehydrogenase (Pyridine nucleotide, glucose - 6 phosphodiesterase, carbonic anhydrase etc.). It is involved in the synthesis of tryptophan, a precursor of IAA, it is associated with water uptake and water retention in plant bodies [2]. Zinc deficiency caused bronzing of leaflets and smaller fruits with reduced flesh recovery and sugar content.

Micronutrient boron is required by plants in relatively small quantities for number of growth processes such as new development in meristematic tissue, translocation of sugars, starch, nitrogen and phosphorus and synthesis of amino acids and protein. Application of boron increases the fruit yield and quality [5]. (Ruby and Brahmachari, 2001). Boron is 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 least and more sterile, fruits are deformed and render themselves commercially useless [6] (Yawalkar *et al*., 1992). Deficiency of zinc and boron result in growth inhibition, reduced flower induction and fruit set as well as decreased fruit quality [7].

Plant Growth Regulators are known to have positive impact on flowering, fruiting and retention of fruit. Shedding of flowers before fertilization and even fruit drop in their initial growth stages are the greatest problems in maintaining yield of fruiting trees. The main reason for shedding of flowers and fruits are formation of abscission layer at the point of attachment

of the fruit stalk with the panicle. With the formation of abscission layer, the supply of cell sap to fruit is gradually cut off and thin cork cells separate and fruit is dislodge easily [8]. Gibberellins control fruit development in various ways and at different developmental stages. Fruit development is a complex and tightly regulated process. Growing fruits are very active metabolically and act as strong sinks for nutrients with hormones possibly modulating the process [9]. The development of a fruit can be separated with phases that include pre-pollination, pollination, fertilization and fruit set, post fruit set, ripening in the growth of the fruit. Gibberellins are known to influence both cell division and cell enlargement [10]. GA_3 has been found to offer suitable means of controlling ripening process in litchi and improving fruit quality [11] and other fruit crops [12]. Keeping the above point in view the experiment was conducted with objective of improving quality of litchi with the help of micronutrients and phyto-hormone.

Material and Methods

The experiment was carried out at fruit research farm of College of Horticulture and Forestry, Central Agricultural University, Pasighat - 791102, Arunachal Pradesh in the year 2019-2020. The geographical location of the research farm is having an altitude of 153 m above mean sea level, latitude of 28°04`N and longitude of 95°22`E. The experiment conducted has twelve treatments and three replications with three plants in each replication. The details are given below:

Table 1: Detailed information of treatments

Treatments	Details
T_1	GA_3 foliar spray @ 5 ppm
T_2	GA_3 foliar spray @ 10 ppm
T_3	GA_3 foliar spray @ 15 ppm
T_4	NAA foliar spray @ 2.5 ppm
T_5	NAA foliar spray @ 5.0 ppm
T_6	NAA foliar spray @ 7.5 ppm
T_7	Borax foliar spray @ 0.2%
T_8	Borax foliar spray @ 0.4%
T_9	Borax foliar spray @ 0.6%
T_{10}	$ZnSO_4$ foliar spray @ 0.2%
T_{11}	$ZnSO_4$ foliar spray @ 0.4%
T_{12}	$ZnSO_4$ foliar spray @ 0.6%

Fruits were harvested at fully ripe stage and following parameters were recorded

Total soluble solids (° Brix)

TSS of the fruit was determined by hand held refractometer (0-32 ° Brix). A small drop of fruit juice was placed over the prism surface (previously calibrated) and the reading was observed and expressed in ° Brix (° B).

Titratable acidity (%)

Titratable acidity of the fruit was determined by titrating the fruit juice against 0.1 N NaOH solution using phenolphthalein as an indicator (light pink end point) and expressed as percentage in terms of malic acid [13].

$$\text{Acidity (\%)} = \frac{\text{Titre reading} \times \text{Normality of alkali} \times \text{Equivalent weight of acid} \times 100}{\text{Volume of sample taken}}$$

Total sugars (%)

Total sugar content was estimated by Anthrone method as described by Hodge and Hofreiter (1962) [14]. In this method, a known sample weight of the fruit was taken and hydrolysed by dilute hydrochloric acid by keeping it in a boiling water bath for three hours. It was cooled, neutralized with solid sodium carbonate until effervescence ceased and centrifuged. The supernatant was then mixed with Anthrone reagent (as indicator). The absorbance of the green colour product was read at 630 nm in spectrophotometer and the total sugar content was calculated by using the formulae:

$$\text{Amount of sugar present in 100 mg of the sample} = \frac{\text{mg of glucose}}{\text{Volume of the sample taken}} \times 100$$

Reducing sugar (%)

The reducing sugar content was estimated by spectrophotometric method as described by Somogyi (1952) [15]. One gram of the ripe fruit was weighed and macerated with 5 ml of hot 80% ethanol and supernatant was collected. Then it was evaporated in water bath at 80°C. Added 1 ml of alkaline copper tartrate reagent to each tube and the tubes were placed in boiling water for 10 minutes. After that cool the tubes and add 1 ml of arsenomolybolic acid reagent to all tubes. The volume was made up to 10 ml and the absorbance was recorded at 620 nm after 10 minutes in spectrophotometer and compared against standard.

Non- reducing sugar (%)

Non- reducing sugar was estimated by subtracting reducing sugar from the total carbohydrate and then multiplying it with 0.95.

Ascorbic acid (mg/100 ml)

Ascorbic acid content was estimated by spectrophotometric method as described by Jagota and Dani (1982) [16]. A known fruit weight was taken and grinded properly with small amount of 6% metaphosphoric acid in a clean mortar and pestle. After proper maceration the volume was made upto 10 ml with 3% metaphosphoric acid. The solution was centrifuged and filtered, through Whatman No.1filter paper. To this, Folin's reagent was added to the aliquot which gave a blue colour and the absorbance was measured at 760 nm.

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{Total volume of sample} \times \text{Conc.of Vitamin C} \times 100}{\text{Weight of the sample} \times \text{Amount of aliquot} \times 1000}$$

Malic acid (%)

Malic acid was estimated by using the standard method of A.O.A.C. (2002) [17] and expressed in percentage.

Result

The data presented below revealed the mean values of the effect of the treatments on the bio-chemical parameters of litchi crop which were subjected to analysis to test the significance of the treatments.

Total soluble solids (°Brix)
The effect of the treatments on total soluble solids was found to be significant and is presented in Table 2. The pooled value of the year 2018 and 2019 ranged from 15.64°Brix to 18.02°Brix. The maximum TSS content (18.02°B) was observed in T_8 (borax @ 0.4%) which was followed by T_9 (17.90°B) while lowest TSS content (15.64°B) was found in T_5 (NAA @ 5.0 ppm). The treatments T_{12} (17.62°B), T_{11} (17.83°B) and T_9 (17.90°B) was statistically at par with T_8 (18.02°B).

Titratable acidity (%)
The values of titratable acidity were found to be non-significant and are presented in Table 2. However, the observed value varied from 0.19% to 0.37% which was recorded in T_8 and T_1 respectively.

Total sugars (%)
Total sugars content recorded in different treatments was found to be significant and is presented in Table 2. The observed value varied from 18.23% to 20.92%. The highest total sugar (20.92%) was found in T_8 (borax @ 0.4%) followed by T_{11} (20.61%) while lowest was found in T_4 (18.23%). The treatments T_{12} (20.03%), T_9 (20.28%) and T_{11} (20.61%) were statistically at par with T_8 (20.92%).

Reducing sugars (%)
The recorded data on reducing sugar showed significant difference among the treatments and is presented in Table 2. The observed value ranged from 10.75% to 12.19%.The highest value was recorded in treatment T_8 (12.19%) followed by T_{11} (12.08%) while lowest was found in T_4 (10.75%). The treatments T_2 (11.56%), T_{10} (11.67%), T_7 (11.76%), T_3 (11.78%), T_{12} (11.92%), T_9 (11.98%) and T_{11} (12.08%) were statistically at par with T_8 (12.19%).

Non-reducing sugars (%)
The calculated data on non-reducing sugars showed non-significant results and is presented in Table 2. However, the highest non-reducing sugars were found in T_{11} (8.40%) while lowest in T_4 (7.11%).

Ascorbic acid (mg/100ml)
The analysed data on ascorbic acid was found to be significant and is presented in Table 3. The observed data ranged from 34.81mg/100ml to 36.75 mg/100ml. The highest ascorbic acid content (36.75 mg/100ml) was noticed in T_8 (borax @ 0.4%) while lowest in T_4 (34.81mg/100ml).The treatments T_{12} (36.20 mg/100 ml), T_9 (36.23 mg/100 ml) and T_{11} (36.51mg/100ml) were statistically at par with T_8 (36.75 mg/100ml).

Malic acid (%)
The analysed data on malic acid was found to be non-significant and is presented in Table 3. The data varied from 0.120 (T_7) to 0.161(T_{12}).

Table 2: Effect of PGRs and micronutrients on total soluble solids, titratable acidity and total sugars of litchi (pooled 2019-20)

Treatments	Total soluble solids (°Brix)	Titratable acidity (%)	Total sugars (%)	Reducing sugar (%)	Non-reducing sugar (%)
T_1	15.74	0.37	18.42	10.88	7.68
T_2	15.85	0.33	19.24	11.56	7.90
T_3	17.09	0.25	19.71	11.78	8.01
T_4	15.82	0.35	18.23	10.75	7.11
T_5	15.64	0.31	18.34	10.83	7.14
T_6	16.98	0.26	19.07	11.43	7.26
T_7	16.97	0.29	19.52	11.76	7.38
T_8	18.02	0.19	20.92	12.19	8.30
T_9	17.90	0.23	20.28	11.98	7.87
T_{10}	16.19	0.31	19.41	11.67	7.81
T_{11}	17.83	0.21	20.61	12.08	8.40
T_{12}	17.62	0.24	20.03	11.92	8.13
Mean (s)	16.80	0.28	19.48	11.57	7.75
C.D. (5%)	0.78	NS	0.97	0.68	NS
S.E. (m) ±	0.27	0.04	0.33	0.23	0.30

Ns-non significant

Table 3: Effect of PGRs and micronutrients on ascorbic acid and malic acid of litchi

Treatments	Ascorbic acid (mg/100ml)	Malic acid (%)
	Pooled data	Pooled data
T_1	34.97	0.127
T_2	35.28	0.138
T_3	35.91	0.129
T_4	34.81	0.124
T_5	35.35	0.130
T_6	35.72	0.132
T_7	35.29	0.120
T_8	36.75	0.135
T_9	36.23	0.148
T_{10}	35.15	0.140
T_{11}	36.51	0.144
T_{12}	36.20	0.161
Mean (s)	35.68	0.136
C.D. (5%)	0.63	NS
S.E. (m) ±	0.21	0.01

Discussion
The observations on effect of plant growth regulators and micronutrients spray were found to be significant and improved total soluble solids in litchi, though malic acid (0.161%) and titratable acidity (0.19%) was found to be non-significant. The highest TSS (18.02°B) was recorded in T_8 i.e. borax @ 0.4% followed by TSS (17.90°B) in T_9 (borax @ 0.6%). Increase in total soluble solids might be due to boron, helps in Trans-membrane sugar transport, which may be possible cause for improvement in borax sprayed trees [18]. A notable characteristic of borax is that it directly affects photosynthetic activity of plants [19] (Lavon *et al*. (1982) opined that the increase in TSS content with these micro-nutrients may be attributed to the quick metabolic transformation of starch and pectin into soluble compounds and rapid translocation of sugars from leaves to developing fruits. The findings of the present investigation are in agreement with Singh and Kaur (2016) [20] and Kaur (2017)

[18] in litchi, Gaur *et al*. (2014) [21] in guava.

The maximum total sugars (20.92%) content in litchi fruits was recorded with foliar application of 0.4% borax followed by 20.61% with 0.4% $ZnSO_4$. The improvement in the total sugars might be due to better translocation of sugars from leaves to developing fruits. The enhancement in quality of fruit could be due to the catalytic action of micronutrients. Hence, the foliar application of micronutrients quickly increased the uptake of macronutrients in the tissues and organs of the litchi plants, decreased the nutritional deficiencies and improved the fruit quality. These results are in close conformity with the findings of Gaur *et al*. (2014) [21] in guava, Singh and Kaur (2016) [20], Kaur (2017) [18] and Priyadarshi *et al*. (2018) [22] in litchi.

In the present investigations, the maximum reducing sugars (12.19%) were observed with T_8 (borax @ 0.4%). This increase might be due to the more rapid translocation of sugars from leaves to developing fruits. Boron facilitated sugar transport within the plant. It was reported that borate reacted with sugar to form a sugar-borate complex, which is easier to transverse membrane. Boron acted as a switcher in the degradation of glucose either by glycolysis or by pentose sugar pathway. These results also collaborates the findings of Sachindra *et al*. (2012), Haq *et al*. (2013) [23] in litchi, Singh (2009), Kaur (2017) [18] in litchi cv. Dehradun, Priyadarshi *et al*. (2018) [22] in litchi. The data pertaining to the effect of plant growth regulators and micronutrients on non-reducing sugars was found to be non-significant. However, the highest was observed in T_{11} (8.40%) with $ZnSO_4$ @ 0.4%.

The maximum ascorbic acid (36.75 mg/100 ml) was obtained in fruits treated with borax @ 0.4%. This might be due to the higher level of sugars in boron treated fruits which increased the content of ascorbic acid, since ascorbic acid is synthesized from sugar. Similar results were observed by Lal *et al*. (2010) [24] and Singh and Kaur (2016) [20] in litchi crop and Thirkey *et al*. (2018) [25] in guava.

Conclusion

The application of micronutrient and growth regulator significantly influences the quality of litchi. The foliar application of borax @ 0.4%, exhibited improved TSS (18.02 °Brix), total sugar (20.92%), reducing sugar (12.19%), and ascorbic acid (36.75 mg/100 ml). However, there was no effect of applied treatment on titratable acidity, non- reducing sugar and malic acid. Therefore application of boax @ 4% may be recommended for enhancing quality of litchi.

Reference

1. Ram RA, Bose TK. Effect of foliar application of magnesium and micro-nutrients on growth, yield and fruit quality of mandarin orange (*Citrus reticulata* Blanco). Indian journal of Horticulture 2000;57(3):215-20.
2. Noggle GR, Fritz GT. Introductory Plant Physiology, Prentice Hall of India Private Limited Publication, New Delhi 1989, 4.
3. Anees M, Tahir FM, Shahzad J, Mahmood N. Effect of foliar application of micronutrients on the quality of mango (*Mangifera indica* L.) cv. Dusehri fruit. Mycopathologia 2011;9(1):25-8.
4. Tisdale SL, Nelson WL, Beaton JD. Soil Fertility and Fertilizers. Macmillan Publishing Company, New York, 1985, 754.
5. Ruby R, Brahmachari VS, Rani R. Effect of foliar application of calcium, zinc and boron on cracking and physicochemical composition of litchi. Orissa J. Hort. 2001;29(1):50-4.
6. Yawalkar KS, Agarwal JP, Bokde S. Manures and fertilizers. 7th Edn., Agri-Horticultural Publishing House, 52, Bajaj nagar, Nagpur-440010, India, 1992, 20.
7. Menzel CM, Simpson DR. Lychee nutrition: a review. Scientia Horticulturae. 1987;31(3, 4):195-224.
8. Salisbury FB, Ross C. Plant Physiology (ed.) Wadsworth Publishing Company Inc. Belmont, California 1969, 715-747.
9. Brenner ML, Cheikh N. The role of hormones in photosynthate partitioning and seed filling. In :Davies, P.J. (edn.), Plant Hormones Physiology, Biochemistry and Molecular Biology, Kluwer Academic Publishers, Dordrecht 1995, 649-670
10. Kamijima O. Consideration on the mechanism of expression of dwarf genes in rice plants. II. The actions of dwarf genes on cell division and cell elongation in parenchyma of internodes. Jap. J. Breed 1981;31:302-315.
11. Ray PK, Sharma SB. Delaying litchi harvest by growth regulator or urea spray. Scientia horticulturae 1986;28(1-2):93-6.
12. Lavon R, Bar Akiva A, Shapchisky S, Cohen E, Shalon Y, Brosh P. Prolonging the harvesting season of Minneola tangelo fruits by spraying with nutrients and growth substances. Hassadeh 1982;63:492-7.
13. AOAC. Official methods of analysis of the Association of Official Analytical Chemists, 18th edn., Virginia, U.S.A, 2005
14. Hodge JE, Hofreiter BT. Determination of reducing sugars and carbohydrates. I. Analysis and preparation of sugars. Methods in carbohydrate chemistry. 17th edition. Academic Press, New York 1962.
15. Somogyi N. Estimation of sugars by calorimetric method. J. Biol. Chem 1952, 200-245.
16. Jagota SK, Dani HM. A new colorimetric technique for the estimation of vitamin C using Folin phenol reagent. Analytical biochemistry 1982;127(1):178-82.
17. AOAC. Official methods of analysis. Association of Official Analytical Chemists International, Washington D.C 2002, 1-12.
18. Kaur S. Effect of micronutrients and plant growth regulators on fruit set, fruit retention, yield and quality attributes in litchi cultivar Dehradun. Chemical Science Review and Letters 2017;6(22):982-6.
19. Lal KN, Patil S. Role of boron in crop production. Sci. culture 1981;14:54-62
20. Singh N, Kaur A. Response of quality attributes of litchi cv. Dehradun to foliar application of zinc and boron. International journal of current Research. 2016;4(10):339-42.
21. Gaur B, Beer K, Hada TS, Kanth N, Syamal MM. Studies on the effect of foliar application of nutrients and GA3 on fruit yield and quality of winter season guava. The Ecoscan 2014;6:479-83.
22. Priyadarshi V, Hota D, Karna AK. Effect of growth regulators and micronutrients spray on chemical parameters of litchi (*Litchi chinensis* Sonn.) cv. calcuttia. International journal of economic plants 2018;5(3):99-103.
23. Hag I, Rab A, Sajid M. Foliar application of calcium chloride and borax enhance the fruit quality of litchi

cultivars. J Ani. Plant Sci 2013;23(5):1385-1390.
24. Lal RL, Shukla P, Pandey C. Response of plant growth regulators and mineral nutrients on fruit yield and quality of litchi (*Litchi chinensis* Sonn.) cv. Rose Scented. Progressive Horticulture 2010;42(2):217-9.
25. Thirkey NR, Kanpure RN, Kanchouli BK, Bhandari J, Patidar DK. Effect of foliar nutrition of zinc sulphate, borax and NAA on yield and quality of guava (*Psidium guajava* L.) cv. Allahabad Safeda. Int. J Chem. Stu., 2018;6(4):2295-2298.