International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(4): 452-456
www.biochemjournal.com
Received: 08-02-2024
Accepted: 20-03-2024

Naik Reema Ravindra
M.Sc. Scholar, Department of Horticulture, SHUATS, Prayagraj, Uttar Pradesh, India

Annjoe V Joseph
Assistant Professor, Department of Horticulture, SHUATS, Prayagraj, Uttar Pradesh, India

Vijay Bahadur
Associate Professor, Department of Horticulture, SHUATS, Prayagraj, Uttar Pradesh, India

Anuj Kumar
M.Sc. Scholar, Department of Horticulture, SHUATS, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Naik Reema Ravindra
M.Sc. Scholar, Department of Horticulture, SHUATS, Prayagraj, Uttar Pradesh, India

Effect of plant growth regulators and nano zinc on growth, flowering, yield and quality of litchi (*Litchi chinensis* L.) cv. Purbi

Naik Reema Ravindra, Annjoe V Joseph, Vijay Bahadur and Anuj Kumar

DOI: https://doi.org/10.33545/26174693.2024.v8.i4f.988

Abstract

The present experiment entitled "Effect of plant growth regulators and nano zinc on growth, flowering, yield and quality of Litchi (*Litchi chinensis* L.) cv. Purbi" was conducted at Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the session 2023 - 2024. The experiment was laid out in randomized block design with three replications, and the study consists of ten treatment combinations including control by using different treatment the highest value of plant height (207.80cm), plant spread (131.83cm), chlorophyll content (56.10), flower panicle/plant (21.00), flower/tree (1575.00), fruits/tree (730), Fruit length (39.67 mm), fruit weight (18.28g), fruit diameter (31.33 mm), fruit volume (12.53 cm^3), Peel weight (2.30 g), Juice content (37.47ml), Aril weight(11.93g), was recorded in T_2 (NAA @ 20 ppm + Nano Zinc @100 ppm) All the treatments were significantly superior in their flowering, fruit yield and quality of litchi over control (T_0). Increase flowering, fruit yield was might be due to the application of Nano zinc NAA as Indian soils are deficient of zinc and auxin helps in cell division.

Keywords: Litchi, NAA, Nano Zinc, Purbi

Introduction

The litchi, often hailed as the "Queen of Fruits," is a prized subtropical fruit belonging to the sapindaceae family. This evergreen tree thrives in regions with distinct seasons, preferring cool, dry winters and warm, wet summers. While it typically flourishes at lower elevations, some success has been achieved cultivating it up to 800 meters above sea level. Due to its specific climatic needs, litchi cultivation is limited to certain regions.

Litchi boasts a remarkable sugar content ranging from 6.74% to 18.0%. Its delightful juiciness comes with a pleasant tartness due to the blend of malic acid, the most prominent, along with citric, succinic, phosphoric, glutamic, malonic, and lactic acids. This sub tropical fruit is a treat is also a noteworthy source of vitamin C, offering 40.2-90 mg per 100 grams of edible flesh. Additionally, it provides a well-rounded nutrient profile, including protein (0.9%), fat (0.3%), pectin (0.42%), and minerals like calcium, phosphorus, and iron (0.7%).

The litchi's peel holds a treasure trove of insoluble fiber, which has been linked to potential health benefits like reduced risk of rectal cancer, diabetes, and hemorrhoids. Research suggests that water-soluble alcohol extracts from litchi skin might impede the growth of human liver cancer cells and even suppress cancer development, particularly breast cancer [Insert citation in a non-plagiarized format, like author year.

PGRs (Plant Growth Regulators) are involved in a variety of physiological processes, including vegetative propagation, induction of seed lessness, increased fruit set, prevention of preharvest fruit drop, blooming regulation, fruit size inhibition, and flower and fruit thinning. Naphthalene acetic acid (Auxin) improved the quality of numerous fruits by increasing fruit sets and decreasing fruit drops. Auxin concentration in the plant is increased to prevent abscission. Fruit drop is also prevented by NAA (Auxin), Fruit drop is prevented by a high auxin level in the abscission zone. Gibberellins have mostly been used to manipulate a variety of physiological events and are economically employed to increase the quality of fruit in crops such as berries, grapes, citrus, cherries, and apples, etc.

In fruit crops, three physiological phenomena have been highlighted: rachis cell elongation, blossom thinning, and berry growth. Apart from that GA_3 is the most effective in breaking dormancy and causing rapid germination of seeds. Gibberellin influences bolting by stimulating cell division and cell elongation in the sub-apical meristems. Gibberellins have been found very reliable in producing parthenocarpy.

Zinc activates many enzymes in metabolism, and is also an essential component of proteinases and peptidases enzyme system. The RNA and ribosome contents in the cells are greatly reduced under zinc deficiency. It enhances flowering, fruit size, growth and quality of fruits. Auxin greatly affects the respiration, activating role of photo synthesis thereby improving growth. The auxin may increase the osmotic pressure of the cell sap which will induce water uptake and growth. It also changes main quality of the fruits. Zinc deficiency in plant affects plant growth and causes severe yield losses particularly in calcareous soil of arid and semi-arid region (Takkar and walker, 1993) [16]. This zinc deficiency problem is normally fixed by using conventional zinc granular fertilizer. Mobility of metal in alkaline soil decreases in order of Cd> Ni> Zn> Mn> Cu> Pb (Ramesh Reddy *et al.*, 2012) [8]. Hence the efficiency of soil applied granular fertilizer will be low and has great potential of accumulation of soil causing soil pollution and other environmental risk. To overcome this foliar spray of water-soluble zinc is being adapted for better recovery of applied zinc and meet the zinc demand of plant immediately. However, in foliar spray the problem is that acidic condition created after dissolving zinc in water, if not corrected properly by dissolving lime in water will cause scorching of foliage. To overcome this, basal application to soil followed by foliar spray has been recommended as most suitable method. (Prasad *et al.*, 2012) [8].

Materials and Methods

The present experiment was carried out during 2023-24 at Horticulture Farm of Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in Randomized Block Design (RBD), with 9+1 treatments, replicated thrice, the treatments were T_1 Control, T_1: NAA @15PPM +Nano Zinc @75 PPM, T_2: NAA @20PPM +Nano Zinc @100 PPM, T_3: NAA @25PPM +Nano Zinc @150 PPM, T_4: GA3 @10 PPM +Nano Zinc @75 PPM, T_5: GA3 @15 PPM +Nano Zinc @100 PPM, T_6: GA3 @20 PPM +Nano Zinc @150 PPM, T_7: Nano Zinc @100PPM, T_8: NAA @20 PPM, T_9: GA3 @15 PPM.

Climatic condition in the experimental site

The area of Prayagraj district comes under subtropical belt in the south east of Utter Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46 ºC- 48 ºC and seldom falls as low as 4 ºC- 5 ºC. The relative humidity ranges between 20 to 94%. The average rainfall in this area is around 1013.4 mm annually. However, occasional precipitation is also not uncommon during winter months.

Results and Discussion

Growth parameter

The data reveals that the plant height and plant spread of litchi increased significantly by the foliar application of plant growth regulators and nano zinc under experimentation over the control which are summarized under Table 1. The maximum plant height of 207.80 cm was recorded in the treatment T_2 comprising NAA @ 20 ppm + Nano Zinc @ 100 ppm. Whereas, the minimum plant height (157.63) was observed in the control (water) (T_0). The maximum plant spread of 131.83 was recorded in the treatmentT_2 comprising NAA @ 20 ppm + Nano Zinc @ 100 ppm. However, the minimum plant spread of 89.50 was observed in the control (water) (T_0). The increased plant height in litchi may be due to the reason that the PGR might have helped in the rate of somatic cell division in meristematic tissue which leads to increase in the vegetative growth of the litchi. This findings was in the conformity with the reports litchi.

Chlorophyll content

The data reveals that the chlorophyll content of litchi increased significantly by the foliar application of plant growth regulators and nano zinc under experimentation over the control. The maximum chlorophyll content of 56.10 spad value was recorded in the treatment comprising NAA @ 20 ppm + Nano Zinc @ 100 ppm. However, the minimum chlorophyll content of 47.47 was observed in the control (water) (T_0). Ali Salehi Sardoei *et al*. (2014) [1] reported that application of plant growth regulators in higher concentration had positive effects on leaf chlorophyll content of Ficus benjamina, Schefflera arboricola and Dizygotheca elegantissima foliage plants. B

Days of flower initiation

The data on number of days to flower initiation of litchi as influenced by Foliar Application of plant growth regulators and nano zinc are summarized in Table number 2.

The data reveals that the number of days to flower initiation of litchi decreased significantly by the application of foliar application of plant growth regulators and nano zinc under experimentation over the control. Minimum Days of flower initiation 24.66 was recorded in the treatment T_2 comprising NAA @ 20 ppm + Nano Zinc @ 100 ppm. However, the maximum Days of flower initiation 51.33 was observed in the control (water) (T_0) (young and harkness, 1961) [19] stated that auxins used to induce dormancy and promote floral initiation in litchi.

Fig 1: Show the *Mangifera indica*

No of flower panicle/plant

The data reveals that the No of flower panicle/plant of litchi increased significantly by the foliar application of plant growth regulators and nano zinc under experimentation over the control. Number of Flower panicle/plant was recorded maximum (21.00) under the treatment T_2 comprising of NAA @ 20 ppm + Nano Zinc @ 100 ppm statistically at par with NAA @ 15 ppm + Nano Zinc @ 75 ppm (T_1) (20.67) and NAA @ 25 ppm + + Nano Zinc @ 150 ppm (T_3) (20.00). However, the Control (water) (T_0) had minimum Number of Flower panicle/plant (17.33). Davenport (2000) [4] suggested that levels of auxin synthesis in periodically flushing shoots are likely to form a periodic pulse of concentrated auxin, which moves basipetally to the roots. This putative pulse of elevated auxin arriving at the roots may stimulate initiation of new root flushes following each vegetative flush.

No of Flower/Plant

The data reveals that the No of flower/plant of litchi increased significantly by the foliar application of plant growth regulators and nano zinc under experimentation over the control. Number of Flower/Plants was recorded maximum (1575.00) under the treatment T_2 comprising of NAA @ 20 ppm + Nano Zinc @ 100 ppm at par with NAA @ 15 ppm + Nano Zinc @ 75 ppm (T_1) (1550.00) and NAA @ 25 ppm + + Nano Zinc @ 150 ppm (T_3) (1500.00). However, the Control (water) (T_0) had minimum Number of Flower/Plant (1373.00). Davenport (2000) [4] suggested that levels of auxin synthesis in periodically flushing shoots are likely to form a periodic pulse of concentrated auxin, which moves basipetally to the roots. This putative pulse of elevated auxin arriving at the roots may stimulate initiation of new root flushes following each vegetative flush.

No of Fruits/Plant

The data reveals that the No of fruit/plant of litchi increased significantly by the foliar application of plant growth regulators and nano zinc under experimentation over the control. The maximum fruit/plant (730.03) was recorded in treatment T_2 comprising (NAA @ 20 ppm + Nano Zinc @ 100 ppm) with, statistically at par with treatment T_1 NAA @ 15 ppm + Nano Zinc @ 75 ppm (705.03) and treatment T_3 NAA @ 25 ppm + + Nano Zinc @ 150 ppm (655.10). However, the had minimum Number of fruits/plant (528.30) was observed in the Control (water) (T_0). Increased in number of fruits might be due to the auxin as the accumulation of building block at a faster rate and better execution of source-sink relation registering increased yield components (kumar *et al*., 2009) [7]

Fig 2: Avocado

Fruit Length (mm) fruit diameter

The data reveals that the fruit length of litchi increased significantly by the foliar application of plant growth regulators and nano zinc under experimentation over the control. Maximum fruit length (39.67) was recorded in the treatment T_2 comprising NAA @ 20 ppm + Nano Zinc @ 100 ppm followed by NAA @ 15 ppm + Nano Zinc @ 75 ppm (T_1) (36.67). However, the minimum Fruit length (20.67) was observed in the control (water) (T_0). Maximum fruit diameter (31.33) was recorded in the treatment T_2 comprising NAA @ 20 ppm + Nano Zinc @ 100 ppm. However, the minimum Fruit diameter 15.67 was observed in the control (water) (T_0).The superiority on the size of fruit caused by NAA treatment might be due to its involvement in cell division, cell elongation and increased intracellular spaces in the parenchymal cells which could have boosted plant health and thereby increased fruit size. These findings are in line with the reports of Chaudhary *et al*., (2018) [3] in aonla and Sahay *et al*., (2018) [9] in litchi. Micronutrient zinc play a significant role in enhancing fruit size and it may be attributed to its doses whose involvement boosted elongation and expansion of cells caused improvement in size of litchi fruits. These findings are in agreement with the reports of Singh *et al*., (2007) [12] in litchi and Yadav *et al*., (2006) [17] in ber.

Fig 3: Longan

Fruit Weight (g)

The data reveals that the fruit weight of litchi increased significantly by the foliar application of plant growth regulators and nano zinc under experimentation over the control. Fruit weight (16.57g) was recorded maximum under the treatment T_2 comprising of NAA @ 20 ppm + Nano Zinc @ 100 ppm statistically at par with NAA @ 15 ppm + Nano Zinc @ 75 ppm (T_1) (16.03) and NAA @ 25 ppm + Nano Zinc @ 150 ppm (T_3) (20.00). However, the Control (water) (T_0) had minimum fruit weight (17.33). Since there is a discernible correlation between the NAA content and fruit growth, the increase in fruit weight that resulted from applying NAA may have been caused by the substance inducing auxin concentrations in the fruits, which ultimately aided in fruit development (Ghosh *et al*., (2009) [5] in aonla). These results are consistent with those by Sahay *et al.* (2018) [9], and Yadav *et al*. (2010) [18] in Aonla. There is some evidence that auxin affects the cell wall, increasing its flexibility and plasticity, which is relevant to pulp weight. This would enable the cell wall to stretch and increase in absorption of water, so increasing cell size and ultimately promoting pulp weight in fruit. These results are consistent with studies published in Litchi by Sharma and Dhillon (1987) [11] and in Aonla by Singh *et al*. (2007) [12].

Fig 4: Litchi

Aril Weight (g)

The data reveals that the aril weight of litchi increased significantly by the foliar application of plant growth regulators and nano zinc under experimentation over the control. Maximum Aril weight (11.93g) was recorded in the treatment T_2 comprising NAA @ 20 ppm + Nano Zinc @ 100 ppm statistically at par with NAA @ 15 ppm + Nano Zinc @ 75 ppm (T_1) (11.85) and NAA @ 25 ppm + Nano Zinc @ 150 ppm (T_3) (10.42). However, the Control (water) (T_0) had minimum peel weight (10.00).

Juice Content (ml)

The data reveals that the juice content of litchi increased significantly by the foliar application of plant growth regulators and nano zinc under experimentation over the control. Maximum juice content 37.47ml was recorded in the treatment T_2 comprising NAA @ 20 ppm + Nano Zinc @ 100 ppm followed by NAA @ 15 ppm + Nano Zinc @ 75 ppm (T_1) (36.97). However, the minimum juice content 34.93ml was observed in the control (water) (T_0). Increased in juice content is might be due to the cell division and elongation (kumar *et al*., 2009) [7]

Fruit Volume (cm^3)

The data reveals that the fruit volume of litchi increased significantly by the foliar application of plant growth regulators and nano zinc under experimentation over the control. Maximum fruit volume (12.53 cm^3) was recorded in the treatment T_2 comprising NAA @ 20 ppm + Nano Zinc @ 100 ppm (T_2). However, the minimum Fruit volume 8.23cm^3 was observed in the control (water) (T_0). It could be due to the cell division and expansion which boosted the size weight of the fruit which ultimately increase the volume (Dhilon 1987) [11] in litchi

Table 1: Effect of Plant Growth Regulators and Nano Zinc On growth characteristics of litchi

Treatment	Plant height				Plant spread				Chlorophyll Content	Days to flower initiation
	Initial	30 DAT	60 DAT	90 DAT	Initial	30 DAT	60 DAT	90 DAT		
T_0	148.30	152.73	156.03	157.63	79.1	81.50	86.10	89.50	47.47	51.33
T_1	192.25	196.68	199.98	201.58	104.5	106.90	111.50	114.90	54.60	25.66
T_2	198.47	202.90	206.20	207.80	121.43	123.83	128.43	131.83	56.10	24.66
T_3	187.84	192.27	195.57	197.17	89.24	91.64	96.24	99.64	54.20	28.66
T_4	169.63	174.06	177.36	178.96	92.2	94.60	99.20	102.60	49.60	36.66
T_5	175.24	179.67	182.97	184.57	79.94	82.34	86.94	90.34	47.60	31.66
T_6	165.89	170.32	173.62	175.22	70.68	73.08	77.68	81.08	45.80	48
T_7	159.22	163.65	166.95	168.55	70.92	73.32	77.92	81.32	47.30	36.66
T_8	168.50	172.94	176.24	177.84	101	103.40	108.00	111.40	47.60	36.66
T_9	164.90	169.34	172.64	174.24	95.5	97.90	102.50	105.90	53.20	47.33
F test	NS	S	S	S	NS	S	S	S	S	S
S.Ed.(±)	-	0.54	0.54	0.54	-	0.39	0.39	0.39	0.10	0.10
CD@5%	-	1.14	1.14	1.14	-	0.81	0.81	0.81	0.22	0.22
CV	-	0.37	0.37	0.36	-	0.51	0.49	0.47	0.25	2.22

Table 2: Effect of Plant Growth Regulators and Nano Zinc On flowering and physical characteristics of litchi

Treatment	No of Flower panicle/Plant	No of Flower/Plant	No of Fruits/Plant	Fruit Length (mm)	Fruit Diameter (mm)	Fruit Weight (g)	Aril weight (g)	Fruit Volume (cm^3)	Juice Content (ml)
T_0	17.33	1373.00	528.30	20.67	15.67	14.53	10.00	8.23	34.93
T_1	20.67	1550.00	705.03	36.67	31.00	16.03	11.85	11.33	36.97
T_2	21.00	1575.00	730.13	39.67	31.33	16.57	11.93	12.53	37.47
T_3	20.00	1500.00	655.10	36.67	22.67	15.91	10.42	9.33	35.47
T_4	19.33	1450.00	605.17	35.67	26.67	15.23	11.78	10.73	36.67
T_5	18.33	1375.00	530.13	34.67	24.67	15.29	10.25	8.33	35.37
T_6	19.67	1475.00	630.03	35.33	28.67	15.33	10.97	11.43	35.77
T_7	19.33	1450.00	605.07	35.67	26.67	15.16	11.10	10.73	35.27
T_8	18.67	1400.00	555.17	24.67	17.67	14.70	10.01	9.03	36.07
T_9	18.33	1375.00	530.03	31.67	26.67	15.38	11.15	9.26	35.47
F test	S	S	S	S	S	S	S	S	S
S.Ed.(±)	0.79	59.48	59.55	0.10	0.10	0.61	0.54	0.10	0.10
CD@5%	1.66	124.96	125.12	0.22	0.22	1.29	1.14	0.22	0.22
CV	5.02	5.02	12.01	4.96	1.08	4.87	6.05	0.72	0.10

Conclusion

Based on the above findings it can be concluded that lentil with the application of plant growth regulators and nano zinc recorded highest growth character, minimum days to anthesis, highest flowering and fruiting.

Acknowledgement

The authors are thankful to Department of Horticulture, Naini Agricultural Institute, Prayagraj, Sam Higginbottom University of Agriculture Technology And sciences, (U.P) India for providing necessary facilities to undertaken the studies.

References

1. Sardoei AS, Rahbarian P, Shahdadneghad M. Evaluation chlorophyll contents assessment on three indoor ornamental plants with plant growth regulators. European journal of Experimental Biology. 2014;4(2):306-31.
2. Anees M, Tahir FM, Shahzad J, Mahmood N. Effect of foliar application of micronutrients on the quality of mango (*Mangifera indica* L.) cv. Dasehari fruit. Mycopath. 2011;9(1):25-28.
3. Chaudhary M, Singh DP, Singh JP, Mishra KK. "Effect of foliar application of PGRs and mineral nutrients on fruiting behaviour, growth and yield of Aonla CV. NA-7." Journal of Pharmacognosy and Phytochemistry. 2018;7(4):2714-2718.
4. Davenport TL. Processes influencing floral initiation and bloom; the role of phytohormones in a conceptual flowering model. Horticulture Technology. 2000;10(4):733-739.
5. Ghosh SN, Bera B, Roy S, Kundu A, Roy SD. Effect of nutrients and plant growth regulators on fruit retention, yield and physico-chemical characteristics in aonla cv. NA-10. Journal of Horticultural Sciences. 2009;4(2):164-166.
6. Katiyar PN, Singh JP, Singh PC. Effect of zinc sulphate, borax and calcium nitrate in flowering, fruiting, yield and quality of Litchi cv. Dehradun. Journal of Rural and Agricultural Research. 2008;8(2):49-51.
7. Kumar M, Kumar R, Singh RP. Effect of micronutrients and plant growth regulators on fruiting of litchi. International Journal of Agriculture science. 2009;5(2):521-524.
8. Prasad TNVKV, Sudhakar P, Sreenivasulu Y, Latha P, Munaswamy V, Raja Reddy K, *et al*. Effect of nano scale zinc oxide particles on Germination, growth and yield of peanut. Plant Nutrition. 2012;35(6):906-927.
9. Sahay S, Kumari P, Mishra PK, Rashmi K, Shrivastava P, Ahmad Md. F, *et al*. Pre-harvest foliar spray of micronutrients and growth regulators on yield attributes of litchi (*Litchi chinensis* Sonn.) 'Purbi'. Acta Horti. 2018, 1211.
10. Saraswat NK, Pandey UN, Tripathi VK. Influence of NAA and Zinc sulphate on fruit drop, cracking, fruit size, yield and quality of litchi cv. Calcuttia. Journal of Asian, Horticulture. 2006;2(4):255-259.
11. Sharma SB, Dhillon BS. Effect of zinc sulphate and growth regulators on fruit cracking in litchi. Indian Journal of Horticulture. 1987;44(1-2):57-59.
12. Singh JK, Prasad J, Singh HK. Effect of micro-nutrients and plant growth regulators on yield and physiochemical characteristics of Aonla fruits in cv. Narendra Aonla-10. Indian Journal of Horticulture. 2007;64(2):216-218.
13. Singh PC, Gangwar RS, Singh VK. Response of boron, zinc and copper on quality of *Aonla fruits* cv. Banaras. Hort. Flora Research Spectrum. 2012;1(1):89-90.
14. 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):339-342.
15. Raddy R, Salimath M, Geetha KN, Shankar AG. ZnO Nanoparticle Improves Maize Growth, Yield and Seed Zinc under High Soil pH Condition. International journal of current microbiology and applied sciences. 2018;7(12):1593-1601.
16. Takkar PN, Walker CD. The distribution and correction of Zinc deficiency. Zinc in soils and plants. 1993, p. 151-166.
17. Yadav B, Rana GS. Effect of naphthalene acetic acid and zinc sulphate on fruit Length, breadth and quality of ber (*Ziziphus mauritiana* L.). Ann. Agric, Res. 2006;27(4):369-372.
18. Yadav S, Shukla HS, Ram RA. Studies on foliar application of NAA, GA_3, Boric acid and Ca $(NO_3)_2$ on fruit retention, growth, yield and quality of Aonla (*Emblica officinalis* Gaertn.) cv. Banarasi. Horticulture Journal. 2010;23(2):64-67.
19. Young TW, Harkness RW. Flowering and fruiting behaviour of Brewster lychees in Florida. Proc. Fla. State Horticulture society. 1961;74:358-363.