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Effect of Pre-Harvest Mineral Nutrient and Growth Regulator Sprays on Yield and Yield Related Parameters of Litchi cv Rose Scented

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Abstract Litchi is one of the delicious fruit and is appreciated for its refreshing taste and aroma. Litchi is highly specific to sub-tropical climate and available in the market for only limited period. Fruit drop being one of the major problems along with fruit cracking in litchi. Hence, a field experiment was conducted during 2013-14 and 2014-15 for improving fruit retention and yield related parameters. Various treatments viz. $CaCl_2$ @0.5%, K_2SO_4 @ 0.5%borax @1%, putrescine@ 40ppm,salicylic acid @ 100ppm and ascorbic acid @ 0.2% and combinations of these treatments were applied thrice before 45 days of harvest at 15 days interval. The experiment was laid out in randomized block design with 11 treatments, replicated thrice. Analytical study of the data obtained revelated that the treatment T_{10} with a combination of $CaCl_2$ + K_2SO_5 + Borax @ 0.5% + 0.5% + 1.0% had better effect on fruit retention per panicle (13.30 and 12.83), fruit weight (23.51 g and 23.34 g), pulp weight (16.59g and 16.41 g), peel weight (4.28 g and 3.99 g) stone weight (2.65g and 2.94g), fruit volume (21.35 g and 21.23 g), yield per hectare (8.34 q/ha and 8.05 q/ha) respectively for 2013-14 and 2014-15. Therefore, T_{10} treatment can be recommended to farmers for better yield in litchi cv Rose Scented.

Keywords Fruit retention, Litchi, Nutrient spray, Pre-harvest, Yield.

Introduction

Litchi (*Litchi chinensis* Sonn.) is an evergreen, subtropical fruit tree native to southern China. It belongs to family sapindaceae with a chromosome number 2n = 30. Rambutan and pulsan are other members of sapindaceae family. Litchi is being grown in limited area in India as it flourishes only in subtropical climate. India is the second largest producer of litchi in the world after China. Presently in India litchi is cultivated in an area of about 90 thousand hectares with a total production of 564 thousand metric tonnes [1]. In India, Bihar has the first rank in both area and production. Tarai region of uttarakhand contributes to great extent to the litchi production in the country. Fruit drop and fruit cracking before harvesting are considered as major obstacles in getting higher

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yields. This fruit drop mostly occurs when fruits are at pea size stage which is due to weaker pedicel attachment and only 2-18% of fruit set that is retained until maturity. This fruit drop can be reduced to a great extent by the application mineral nutrients and growth regulators. Reduction in fruit drop leads to higher fruit retention, ultimately contributing to increase in yield. Foliar fertilization of nutrients has advantage of lower application rates, uniform distribution of nutrients and quick response to applied nutrients. Application through foliage can be 10 to 20 times more effective than soil application [2]. Hence, with an intention to increase yield by way of minimizing fruit drop and affecting yield related parameters, different mineral nutrients and growth regulators were applied to get fruitful results.

Materials and Methods

The present experiment was conducted at the Horticultural Research Center, Patharchatta and the Department of Horticulture of GB Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand during the years 2013-14 and 2014-15. Twenty five years old bearing litchi trees of cv Rose Scented of uniform vigor and size were selected for study. There were 11 treatments i.e. T_0 : Control (water spray), T_1 : $CaCl_2$ (0.5%), T_2 : K_2SO_4 (0.5%) , T_3 : Borax (1%), T_4 : Putrescine (40 ppm), T_5 : Salicylic acid (100 ppm), T_6 : Ascorbic acid (0.2%), T_7 : $CaCl_2$ (0.5%) + K_2SO_4 (0.5%) T_8 : $CaCl_2$ (0.5%) + Borax (1%), T_9 : Borax (1%) + K_2SO_4 (0.5%) and T_{10} : $CaCl_2$ (0.5%) + Borax (1%) + K_2SO_4 (0.5%). All the litchi trees were maintained under uniform cultural practices during the course of investigation. The experiment was laid out in a randomized block design (RBD) with 10 treatments + 10 treatments + 1 control. All the treatments, including control were replicated three times and one tree served as a unit of treatment in each replication. The spray of each chemical was done three times 45 days before harvesting at 15 days interval, for spraying each one of 33 trees, 15 liters solution each of different chemicals was used. Prepared chemical solutions were sprayed using foot sprayer in order to cover whole tree foliage as well as fruit panicles during daytime on specified date. The stock solution of different chemicals was prepared on the spot by dissolving them in appropriate volume of solvents i. e. distilled water or ethanol and final volume for spraying was prepared by adding 15 liters of simple water. The pH of solution was adjusted to neutral by adding 0.1 N NaOH and 0.1 N HCl. Surfactant tween-20 was added in order enhance the effectiveness of sprays. The data were statistically analyzed by method given by Snedecor and Cochran [3].

Results and Duiscussion

Table 1 reveals that there was significant difference among the various treatments on fruits retention per panicle. During the year 2013-14, highest number of fruit retention per panicle (13.20) was recorded in trees under treatment T_{10} ($CaCl_2$ + Borax + K_2SO_4) which was significantly superior over other treatments except T_1 (12.40), T_7 (12.46) and T_8 (12.73) and lowest number of fruits retention per panicle (10.50) was recorded in T_0 (control). During the second year, treatment T_{10} recorded maximum number of fruit retention per panicle (12.83) closely followed by T_8 (12.56) and T_7 (12.23) and control treatment recorded lowest number of fruits per panicle (9.66). In general, the data indicated that the plants sprayed with two or more mineral nutrients in combination retained more number of fruits per panicle in comparison to litchi trees sprayed with a single nutrient or other chemicals viz.salicylic acid, ascorbic acid and putrescine. This higher fruit retention might be because of the fact that both calcium and boron are principal constituents of middle lamella of plant cell in the form of calcium pectate which plays an important role in strengthening of the pedicel attachment and boron also has an indirect role in auxin synthesis that in turn delays the formation of abscission layer at the pedicel during the early stages of fruit development. These findings on number of fruits retained per panicle are in close proximity with the observations of earlier reporters [4—6] in litchi.

The data presented on fruit weight in Table 1 clearly depict that different treatments had significant effect during both the years i.e. 2013-14 and 2014-15. In the first year, maximum fruit weight (23.51g) was found in T_{10} was at par with T_1 (22.82 g), T_7 (23.00 g), T_8 (23.02 g) treatments but signifi-

Table 1. Effect of different pre-harvest treatments on yield and yield related parameters of litchi cv Rose Scented.

Treatments	Fruit retention per panicle		Fruit weight (g)		Pulp weight (g)		Peel weight (g)		Stone weight (g)		Fruit volume (ml)		Fruit yield per hectare (tonnes)	
	2013 -14	2014 -15	2013 -14	2014 -15	2013 -14	2014 -15	2013 -14	2014 -15	2013 -14	2014 -15	2013 -14	2014 -15	2013 -14	2014 -15
T_0 : Control	10.50	9.66	20.51	20.42	14.13	13.81	3.79	4.01	2.58	2.59	19.81	19.93	7.27	7.04
T_1 : $CaCl_2$ (0.5%)	12.40	12.00	22.82	22.54	15.96	15.47	4.30	4.11	2.62	2.95	21.13	20.99	8.09	7.77
T_2 : K_2SO_4 (0.5%)	11.86	11.26	21.54	21.07	14.93	14.50	4.01	3.86	2.58	2.68	20.55	20.20	7.63	7.26
T_3 : Borax (1%)	12.03	11.50	22.03	21.95	15.38	14.93	4.07	4.15	2.57	2.86	20.55	20.51	7.81	7.57
T_4 : Putrescine (40 ppm)	11.43	11.13	21.79	21.33	15.19	14.78	4.00	3.79	2.59	2.76	20.65	20.26	7.73	7.40
T_5 : Salicylic acid (100 ppm)	11.33	10.83	21.41	20.98	14.90	14.47	3.93	3.76	2.57	2.75	20.39	20.12	7.60	7.23
T_6 : Ascorbic acid 0.2%	11.26	10.76	20.80	20.45	14.49	14.20	3.74	3.57	2.57	2.67	20.06	19.74	7.38	7.05
T_7 : $CaCl_2$ (0.5%) + K_2SO_4 (0.5%)	12.46	12.23	23.00	20.87	16.11	15.90	4.20	3.95	2.62	3.01	21.29	21.24	8.16	7.88
T_8 : $CaCl_2$ (0.5%) + Borax (1%)	12.73	12.56	23.02	22.92	16.18	15.93	4.22	3.92	2.61	3.05	21.10	21.11	8.17	8.15
T_9 : Borax (1%) + K_2SO_4 (0.5%)	12.16	11.63	22.35	22.10	15.50	15.21	4.25	4.11	2.59	2.75	20.78	20.64	7.92	7.62
T_{10} : $CaCl_2$ (0.5%) + Borax (1%) + K_2SO_4 (0.5%)	13.20	12.83	23.51	23.34	16.59	16.41	4.28	3.99	2.65	2.94	21.35	21.23	8.34	8.05
SEm	0.22	0.26	0.37	0.39	0.20	0.22	0.18	0.15	0.74	0.13	0.55	0.41	0.11	0.13
CD @ 5%	0.97	1.06	1.12	1.15	0.84	0.90	ns	ns	ns	ns	1.64	1.23	0.46	0.55

cantly superior over other treatments while minimum fruit weight (20.51 g) was recorded in control treatment followed by 7.38 g fruit weight in T_6. In the second year, maximum fruit weight (23.34 g) was obtained in T_{10} which was highly singnificant over other treatments except T_1, T_7 and T_8 treatments while significantly minimum fruit weight (20.42 g) was observed in control. In litchi, fruit size varies fom cultivar to cultivar and it is a cultivar specific trait. But Brahmachari et al. [7] reported an increase in fruit size and weight in litchi when foliar application of micronutrients and calcium was done. The increase in fruit weight under T_{10} treatment was might be due to rapid growth and development of fruits as their initial requirement of nutrients was met with foliar application of nutrients. Similar results were also observed by earlier reporters [8,9] in litchi.

At a glance of data presented in Table 1 clearly indicated that various treatments had significant effect on pulp weight during both the years. In the first year, maximum pulp weight (16.59 g) was recorded in T_{10} which was at par with T_1 (15.96 g), T_7 (16.11 g), T_8 (16.18 g) but statistically significant over others and minimum fruit pulp weight (14.13 g) was recorded in control treatment followed by T_6 (14.49 g). During the second year, similar results were obtained. Pulp weight is closely related to fruit and stone size but it is affected by plant nutrition [10]. Our results are in consonance with the findings of earlier reporters [8, 9].

The data pertaining to the peel and stone weight clearly showed non-significant effect of different treatments on peel and stone weight during years 2013-14 and 2014-15 (Table 1). Although, in 2013-14, highest peel weight (4.28 g) was recorded in T_{10} treatment followed by T_9 treatment (4.25 g) and lowest peel weight (3.74 g) was recorded in T_6 (Ascorbic acid 0.2%) which was followed by control treatment (3.79 g). In the year 2014-15, T_3 (borax) treatment showed highest peel weight (4.15 g) and minimum fruit peel weight (3.57 g) was recorded in T_6 . In the first year, maximum stone weight (2.65 g) was obtained in T_{10} which was followed by T_7 and T_1 treatments which revealed same stone weight (2.62 g) and minimum stone weight was recorded in both T_5 and T_6 treatments (2.57 g). In the second year, treatment T_8 recorded highest stone weight(3.05 g) followed by T_1 (2.95 g) and lowest stone weight (2.59 g) was recorded in control (T_0).

A significant variation in fruit volume was observed among different treatments (Table 1). In

2013-14, treatment T_{10} recorded maximum fruit volume (21.35 ml) which was statistically at par with T_1 (21.13 ml), T_7 (21.29 ml), T_8 (21.10) and T_9 (20.78 ml) treatments but significantly superior over other treatments, while minimum fruit volume was observed in control treatment (19.81 ml). In 2014-15, highest fruit volume (21.24 ml) was recorded in T_7 which was closely followed by T_{10} (21.23 ml) and lowest fruit volume (19.74 ml) was recorded in T_6 treatment. The increase in fruit volume under T_{10} treatment was might be due to rapid growth and development of fruits as their initial requirement of nutrients is met with foliar application of nutrients. similar results were also obtained by Singh et al. [11] in peach, Meena et al. [12] in aonla .

Statistical analysis of data on fruit yield per hectare are presented in Table 1 clearly indicated significant variation between various treatments. In the first year, treatments T_{10} recorded the highest yield per hectare (8.34 tonnes) which was highly significant over other treatments except T_1 (8.08 tonnes), T_7 (8.16 tonnes), T_8 (8.17 tonnes) and T_9 (8.34 tonnes) and lowest yield per hectare (7.27 tonnes) recorded in control. In the second year, same trend followed with highest yield per hectare (8.15 tonnes) in T_8 being significantly superior over T_0 (7.04 tonnes), T_2 (7.26 tonnes), T_4 (7.40 tonnes), T_5 (7.23 tonnes) and T_6 (7.05 tonnes) and lowest yield (7.04 tonnes) was recorded in T_0. Higher fruit retention per panicle per panicle contributed to the yield increase along with lower fruit cracking in T_{10} . Similar increase in yield per hectare was reported by earlier reporters [13—16] in litchi.

Conclusion

On the basis of results summarized above, it can be concluded that fruit retention per panicle and fruit yield can be influenced by the pre-harvest application of different treatments. The maximum fruit retention per panicle and fruit yield were recorded in T_{10} treatment $CaCl_2$ (0.5%) + borax (1%) + K_2SO_4 (0.5%) followed by T_8 treatment $CaCl_2$ (0.5%) + borax (1%). Hence, for obtaining higher yield and good quality litchi fruits by enhancing fruit retention per panicle trees should be sprayed with calcium chloride ($CaCl_2$ @ 0.5%) + potassiuum sulfate (K_2SO_4 @ 0.5%) + borax @ 1% three times at fortnightly interval from forty five days before harvest during day time in litchi cv Rose Scented.

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