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Response of nutrients on fruit cracking in different cultivars of Bael (*Aegle marmelos* L.) under sodic soil

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Abstract
The present investigation aimed to find out the "Response of nutrients on fruit cracking in different cultivars of bael (*Aegle marmelos* L.) under sodic soil" was conducted at Main Experiment Station, Department of Horticulture, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) during the year 2017-18 and 2018-19. The experiment was laid out in randomized block design with factorial concept, replicated thrice with 12 treatment combinations, comprising with 4 varieties V_1 (NB-4), V_2(NB-5), V_3 (NB-7) and V_4 (NB-9) and N_1 Borax 200g + Zinc Sulphate200g + Calcium Nitrate 200g, N_2 Borax 400g + Zinc Sulphate 400g + Calcium Nitrate 400g are applied in the soil. In the point of view of nutrients, the minimum fruit cracking of bael was found with N_2 (Borax400g + ZincSulphate400g +CalciumNitrate400g) and in the point of view varieties, the minimum fruit cracking of bael was found with V_2 (NB-5) is founded superior over all treatments for eastern Uttar Pradesh area.

Keywords: bael, cracking, nb-5, nb-4, nb-7, nb-9, soil application, borax, zinc sulphate

Introduction

Bael [*Aegle marmelos* (L.) Correa] is one of the most important minor fruit in India having tremendous commercial potentialities. Bael, which is known in India from pre-historic time, belongs to Rutaceae family and it's an important indigenous fruit of India. It is also known as 'Bengal quince', Indian quince', 'Golden apple', 'Holy fruit', 'Stone apple', 'Bel; Bela; 'Sriphal', 'Belgeri', 'Baelpatra,' Bilva' 'Maredoo' and finds mention in Ramayana, Yajurveda, Buddhist and Jain literature. The bael tree has its origin from Eastern Ghats and Central India and mainly found in tropical and subtropical regions. It is grown throughout India as well as in Sri Lanka, Pakistan, Bangladesh, Burma, Thailand and most of the Southeast Asian countries and Florida. In India, it is found growing along foothills of Himalayas, Uttar Pradesh, Bihar, Chhattisgarh, Uttarakhand, Jharkhand, Madhya Pradesh, The Deccan Plateau and along the East Coast but its exact statistical data on area and production of bael fruit is not available in the literature so for. In India it is cultivated in 25491.77 thousand hac. and produce 313850.66 mt/hac. and productivity is 12.31 mt. (2018-19 third estimation N.H.B.).

Bael plant is also used in traditional medicine for the treatments of fever, intestinal ailments, fertility control and treatment after childbirth and fish poison (Bsu and Sen, 1974) and the fruit is reported to be very effective for the cure of diarrhoea and dysentery in Britain. The fine powder of unripe fruits showed significant effect on intestinal parasites. The leaf extract has been used in Ayurvedic system of medicine in diabetes which is a common metabolic disease around the world. The leaves are also used as a poultice for the treatment of eye disorders. The ripe fruit of bael is used in diarrhea, dysentery and as a tonic for the heart & brain while the roots and bark of the tree are used in the treatment of fever by making a decoction of them. The roots mainly have been reported to be used as an ingredient of the Ayurvedic medicine, 'Dasmool'. The oil obtained from soaking unripe fruits into gingelly (til) oil is useful in removing the peculiar burning sensations in the soles. The mucilage of the seed is cementing material and yellow dye is obtained from the unripe fruit.

Integrated nutrient management refers to the maintenance of soil fertility and plant nutrients supply to an optimal level for sustaining the desired level crop productivity through optimization of the benefits from all possible sources of plant nutrients in integrated manner.

Boron is an essential microelement for higher plants, and its deficiency is widespread around the world and constrains the productivity of both agriculture and forestry. In the last two decades, numerous studies on model or herbaceous plants have contributed greatly to our understanding of the complex network of B-deficiency responses and mechanisms for tolerance. In woody plants, however, fewer studies have been conducted and they have not well been recently synthesized or related to the findings on model species on B transporters.

Zinc (Zn) is an essential microelement for plant growth in all kinds of soils. It influences many biological processes, including carbohydrate metabolism, cell proliferation and phosphorus-Zn interactions. Zn also serves as an integral component of some enzyme structures, such as CA, alcohol dehydrogenase, and glutamate dehydrogenase. Therefore, Zn deficiency causes the rapid inhibition of plant growth and development, which results in increased reactive oxygen species (ROS) due to photo-oxidative damage and consequently decreased net photosynthesis and photosynthetic electron transport.

Calcium plays a very important role in plant growth and nutrition, as well as in cell wall deposition. As a soil amendment, calcium helps to maintain chemical balance in the soil, reduces soil salinity, and improves water penetration. Calcium plays a critical metabolic role in carbohydrate removal. Calcium neutralizes cell acids. Calcium is found in many minerals in soil, but is relatively insoluble in this state. Calcium is not considered a leachable nutrient. Many soils will contain high levels of insoluble calcium such as calcium carbonate, but crops grown in these soils will often show a calcium deficiency. High levels of other cations such as magnesium, ammonium, iron, aluminum and especially potassium, will reduce the calcium uptake in some crops. A common misconception is that if the pH is high, adequate calcium is present. This is not always true.

A sodic soil is defined as a soil with exchangeable sodium of greater than 6% of the cation exchange capacity. Non-saline sodic soils are usually dispersive in the presence of fresh water. Saline-sodic clays are less dispersive than non-saline-sodic soils and have higher infiltration rates. Many sodic clays may still produce wheat yields near their rainfall-limited yield potential, where the salt levels in the soil solution are higher than the critical flocculation concentration, but are not toxic to plants. The high potential of bael fruits attracts the research scientists and organizations subsequently cultivars, agro-techniques and orchard management practices have been developed for the fruit. The post-harvest management is an important aspect that plays role in expansion of area of a fruit.

Materials and Methods

The experiment was carried out on 25-year-old Bael orchard planted under sodic soil condition and site is located at Main Experiment Station, Horticulture, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya on the Raebareli road at the distance of 42 km away from Ayodhya district headquarter. Geographically it is situated at 26^0-47^0 N latitude, 82.12^0 E longitude of 113 meter away from mean sea level. This site is in typical saline-alkaline belt of indigenous plains of eastern Uttar Pradesh. 25 years old bael plants planted at a distance of 8m × 8m were used as experimental material in the present investigation. All the schedule based cultural practices were followed as per recommendations. The Experiment was conducted at Main Experiment Station, Department of Horticulture, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) during the year 2017-18 and 2018-19. The experiment was laid out in randomized block design with factorial concept, replicated thrice with 12 treatment combinations, comprising with 4 varieties V_1 (NB-4), V_2(NB-5), V_3 (NB-7) and V_4 (NB-9) and N_1 Borax 200g + Zinc Sulphate200g + Calcium Nitrate 200g, N_2 Borax 400g + Zinc Sulphate 400g + Calcium Nitrate 400g are applied in the soil.

Results and Discussion

The Table No. 1 indicate that the minimum fruit cracking (%) of bael was found with N_2 (Borax400g + ZincSulphate400g + CalciumNitrate400g) 7.02% and 7.15% during 2017-18 and 2018-19, followed by N_1 (Borax 200g+Zinc Sulphate 200g+Calcium Nitrate 200g) 8.50% and 8.27%, respectively. However, the maximum fruit cracking of bael was found with N_0 (Control) 9.81% and 10.01% during 2017-18 and 2018-19 in the both year of investigation. In the point of view varieties, the minimum fruit cracking of bael was found with V_2 (NB-5) 4.56% and 4.83%, followed by V_4 5.35% and 5.45% during 2017-18 and 2018-19, respectively. However, the maximum fruit cracking (%) of bael was found with V_3 (NB-7) 12.50% and 13.00% during 2017-18 and 2018-19 in the both year of investigation. The interaction effect of nutrients and varieties of bael was found significant during both the year of investigation (2017-18 and 2018-19). Minimum fruit cracking (%) of bael was recorded in V_2N_2 (NB-5 with Borax 400g + Zinc Sulphate 400g + Calcium Nitrate 400g) 4.03 in 2017-18 and V_1N_2 (NB-4 with Borax 400g + Zinc Sulphate 400g + Calcium Nitrate 400g) 4.30% in 2018-19 followed by V_1N_2 (NB-4 with Borax 400g + ZincSulphate400g + CalciumNitrate400g) 4.64% and 4.30%. The maximum fruit cracking of bael was recorded in V_3N_0 (NB-7 with control) 14.78% in 2017-18 and V_3N_0 (NB-7 with control) 14.94% in 2018-19 during both the years of investigation.

Data recorded on intensity of fruit cracking (%) due to basal dose of nutrients is depicted that the intensity of fruit cracking percent due to basal dose of nutrients significantly affects the fruit cracking of bael in the month of 15-30 January. The minimum fruit cracking (%) of bael was found with N_2 (Borax400g+ZincSulphate400g + CalciumNitrate400g) 5.08% and 4.32% during 2017-18 and 2018-19, respectively. However, followed by N_1 (Borax 200g+ZincSulphate 200g+CalciumNitrate 200g) 6.50% and 5.91%. The maximum fruit cracking of bael was found with N_0 (Control) 7.68 and 7.39% during 2017-18 and 2018-19 in the both year of investigation. In the point of view varieties, the minimum fruit cracking (%) of bael was found with V_2 (NB-5) 3.81% and 4.05% and followed by V_1 NB-4 4.36% and 4.37% during 2017-18 and 2018-19, respectively. However, the maximum fruit cracking of bael was found with V_4 (NB-9) 9.92% and 9.27% during 2017-18 and 2018-19 in the both year of investigation. The interaction effect of nutrients and varieties of bael was found significant during both the year of investigation (2017-18 and 2018-19). Minimum fruit cracking (%) of bael was recorded in V_2N_2 (NB-5 with Borax 400g + Zinc Sulphate 400g + Calcium Nitrate 400g) 3.40% in 2017-18 and V_3N_2 (NB-7 with

Borax 400g + Zinc Sulphate 400g + Calcium Nitrate 400g) 3.19% in 2018-19. Followed by the V_2N_1 (3.50% and 3.76%). The maximum fruit cracking of bael was recorded in V_4N_0 (NB-9 with control) 12.61% in 2017-18 and V_4N_0 (NB-7 with control) 11.65% in 2018-19 during both the years of investigation.

Data recorded on intensity of fruit cracking (%) due to basal dose of nutrients is depicted in Table No. 1 that the intensity of fruit cracking percent due to basal dose of nutrients significantly affects the fruit cracking of bael in the month of 1-15 February. The minimum fruit cracking of bael was found with N_2 (Borax 400g + Zinc Sulphate 400g + Calcium Nitrate 400g) 2.49% and 2.60% during 2017-18 and 2018-19, respectively. Followed by N_1 (Borax 200g+Zinc Sulphate 200g + Calcium Nitrate 200g) 3.81% and 4.56% during the both of years. However, the maximum fruit cracking of bael was found with N_0 (Control) 5.35% and 5.63% during 2017-18 and 2018-19 in the both year of investigation. In the point of view varieties, the minimum fruit cracking of bael was found with V_3 (NB-7) 2.38% and 3.25% in V_2 (NB-5) during 2017-18 and 2018-19, respectively. Followed by the V_2 NB-5 3.27% and 3.25% during the both of years. However, the maximum fruit cracking of bael was found with V_4 (NB-9) 5.88% and 6.07% during 2017-18 and 2018-19 in the both year of investigation. The interaction effect of nutrients and varieties of bael was found significant during both the year of investigation (2017-18 and 2018-19). Minimum fruit cracking of bael was recorded in V_3N_2 (NB-7 with Borax400g + ZincSulphate400g + CalciumNitrate400g) 1.15% in 2017-18 and 1.11% in 2018-19 followed by the V_2N_1 (2.43% and 2.10%). The maximum fruit cracking of bael was recorded in V_4N_0 (NB-9 with control) 8.96% in 2017-18 and V_4N_0 (NB-7 with control) 7.46% in 2018-19 during both the years of investigation.

Data recorded on intensity of fruit cracking percent due to basal dose of nutrients is depicted in Table No. 1 that the intensity of fruit cracking percent due to basal dose of nutrients significantly affects the fruit cracking of bael in the month of 15-28 February. The minimum fruit cracking (%) of bael was found with N_2 (Borax 400g + Zinc Sulphate 400g + Calcium Nitrate 400g) 1.56% and 1.51% during 2017-18 and 2018-19, respectively. Followed by N_1 (Borax 200g + Zinc Sulphate 200g + Calcium Nitrate 200g) 2.99% and 2.54% during the both of years. However, the maximum fruit cracking of bael was found with N_0 (Control) 4.65% and 4.28% during 2017-18 and 2018-19 in the both year of investigation. In the point of view varieties, the minimum fruit cracking (%) of bael was found with V_3 (NB-7) 2.03% and 1.52% followed by V_1 2.78% and 2.71% during 2017-18 and 2018-19, respectively. However, the maximum fruit cracking of bael was found with V_4 (NB-9) 4.46% and 3.94% during 2017-18 and 2018-19 in the both year of investigation. The interaction effect of nutrients and varieties of bael was found significant during both the year of investigation (2017-18 and 2018-19). Minimum fruit cracking (%) of bael was recorded in V_3N_2 (NB-7 with Borax400g + ZincSulphate400g + CalciumNitrate400g) 0.00% followed by V_3N_1 1.39% in 2017-18 and 0.00% in 2018-19. The maximum fruit cracking of bael was recorded in V_4N_0 (NB-9 with control) 5.99% in 2017-18 and V_4N_0 (NB-7 with control) 5.07% in 2018-19 during both the years of investigation.

Data recorded on intensity of fruit cracking (%) the intensity of fruit cracking percent due to basal dose of nutrients significantly affects the fruit cracking of bael in the month of 1-15 March. The minimum fruit cracking of bael was found with N_2 (Borax400g + ZincSulphate400g + CalciumNitrate400g) 0.69% and 0.67% during 2017-18 and 2018-19, respectively. Followed by N_1 (Borax 200g + ZincSulphate200g + CalciumNitrate200g) 1.30% and 1.16%. However, the maximum fruit cracking of bael was found with N_0 (Control) 2.10% and 1.59% during 2017-18 and 2018-19 in the both year of investigation. In the point of view varieties, the minimum fruit cracking of bael was found with V_3 (NB-7) 0.58% and 0.00% followed by V_1 (NB-4) 1.48% and 1.45% during 2017-18 and 2018-19, respectively. However, the maximum fruit cracking of bael was found with V_4 (NB-9) 1.84% and 1.59% during 2017-18 and 2018-19 in the both year of investigation. The interaction effect of nutrients and varieties of bael was found significant during both the year of investigation (2017-18 and 2018-19). Minimum fruit cracking of bael was recorded in V_3N_2 (NB-7 with Borax400g + ZincSulphate400g + CalciumNitrate400g) 0.00% in 2017-18 and 0.00% in 2018-19 followed by the V_3N_1. The maximum fruit cracking of bael was recorded in V_4N_0 (NB-9 with control) 2.39% in 2017-18 and V_2N_0 (NB-5 with control) 2.19% in 2018-19 during both the years of investigation.

The intensity of fruit cracking percent due to basal dose of nutrients significantly affects the fruit cracking of bael in the month of 15-30 March. The minimum fruit cracking of bael was found with N_2 (Borax400g + ZincSulphate400g + CalciumNitrate400g) 0.00% followed by N_1 (Borax 200g + ZincSulphate200g + CalciumNitrate200g) during 2017-18 and N_1 (Borax200g + Zinc Sulphate 200g+ Calcium Nitrate 200g) 0.00% in 2018-19, respectively followed by N_1 (control). However, the maximum fruit cracking of bael was found with N_0 (Control) 0.33% and 0.31% during 2017-18 and 2018-19 in the both year of investigation. In the point of view varieties, the minimum fruit cracking of bael was found with V_3 (NB-7) 0.00% and 0.00% followed by V_2 (NB-5) during 2017-18 and 2018-19, respectively. However, the maximum fruit cracking of bael was found with V_1 (NB-4) 0.24% and 0.32% during 2017-18 and 2018-19 in the both year of investigation. The interaction effect of nutrients and varieties of bael was found significant during both the year of investigation (2017-18 and 2018-19). Minimum fruit cracking of bael was recorded in V_3N_2 (NB-7 with Borax400g + ZincSulphate400g + CalciumNitrate400g) 0.00% in 2017-18 and 0.00% in 2018-19. The maximum fruit cracking of bael was recorded in V_1N_0 (NB-4 with control) 0.72% in 2017-18 and 0.71% in 2018-19 during both the years of investigation.

Data recorded on intensity of fruit cracking percent due to basal dose of nutrients is depicted in Table No. 1 that the intensity of fruit cracking percent due to basal dose of nutrients significantly affects the fruit cracking of bael in the month of bael 1 December to 31 March. The minimum fruit cracking of bael was found with N_2 (Borax400g + ZincSulphate400g +CalciumNitrate400g) 16.83% and 16.31%, followed by N_1 (Borax 200g + Zinc Sulphate 200g+CalciumNitrate 200g) 23.10% and 22.45% during 2017-18 and 2018-19, respectively. However, the maximum fruit cracking of bael was found with N_0 (Control) 29.92% and 29.45% during 2017-18 and 2018-19 in the both year of investigation. In the point of view varieties, the minimum fruit cracking of bael was found with V_2 (NB-5) 16.17% and 15.84% followed by V_1 (NB-4) 18.21% and 17.92% during 2017-18 and 2018-19, respectively. However, the maximum fruit cracking of bael was found with V_4 (NB-9) 33.66% and 31.66% during 2017-18 and 2018-19 in the both year of investigation. The interaction effect of nutrients and varieties of bael was found significant during both the year of investigation (2017-18 and 2018-19). Minimum fruit cracking of bael was recorded in V_2N_2 (NB-5 with Borax400g + ZincSulphate400g + CalciumNitrate400g) 13.49% followed by V_1N_2 (14.47%) in 2017-18 and 14.04% followed by V_1N_2 (14.08%) in 2018-19. The maximum fruit cracking of bael was recorded in V_4N_0 (NB-9 with control) 44.04% in 2017-18 and 39.84% in 2018-19 during both the years of investigation. Highest intensity of cracking in cv NB-9 of bael fruit was recorded under control and lowest under the combined treatment of V_2N_2 (NB-5 with Borax 400g + Zinc Sulphate 400g + Calcium Nitrate 400g) which might be due to the optimum level of boron, zinc and calcium nitrate as they increase the rate of photosynthesis and leaf area. The outer wall of cracked fruits was hard, so at maturity stage when the internal tissues expanded the skin breaks up due to poor elasticity of the shell. NB-5 bael shell is very thin and having much more elasticity of shell and compare to NB-9, NB-7 and NB-4. The possible reason for cracking could be quick depletion of soil moisture when fruit is young during its rapid phase of development. Effect of different nutrients on varieties had shown significant reduction in fruit cracking. The reduction in intensity of fruit cracking was due to positive effect of boron in boric acid treatment, boron content was higher than in the untreated trees. So was the case with the content of phosphorus and manganese.

Table 1: Response of nutrients on fruit cracking in different cultivars of bael (*Aegle marmelos* L.) under sodic soil

Treatment	Fruit cracking (%) 1-15 January		Fruit cracking (%) 15-30 January.		Fruit cracking (%) 1-15 February		Fruit cracking (%) 15-28 February.		Fruit cracking (%) 1-15 March		Fruit cracking (%) 15-31 March.		Fruit cracking (%) 1 Dec. to 31 March.	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
N_0	9.81	10.01	7.68	7.39	5.35	5.63	4.65	4.28	2.10	1.59	0.33	0.31	29.92	29.45
N_1	8.50	8.27	6.50	5.91	3.81	4.56	2.99	2.54	1.30	1.16	0.00	0.00	23.10	22.45
N_2	7.02	7.15	5.08	4.32	2.49	2.60	1.56	1.51	0.69	0.67	0.00	0.07	16.83	16.31
SEM±	0.292	0.302	0.248	0.131	0.167	0.192	0.118	0.137	0.045	0.059	0.006	0.003	0.379	0.339
C.D.(P=0.05)	0.856	0.886	0.726	0.384	0.490	0.564	0.346	0.400	0.133	0.172	0.016	0.009	1.112	0.993
V_1	5.35	5.45	4.36	4.37	4.00	3.62	2.78	2.71	1.48	1.45	0.24	0.32	18.21	17.92
V_2	4.56	4.83	3.81	4.05	3.27	3.25	2.98	2.94	1.56	1.54	0.00	0.00	16.17	15.84
V_3	12.50	13.00	7.59	5.79	2.38	4.11	2.03	1.52	0.58	0.00	0.00	0.00	25.08	24.75
V_4	11.36	10.62	9.92	9.27	5.88	6.07	4.46	3.94	1.84	1.59	0.19	0.18	33.66	31.66
SEM±	0.337	0.349	0.286	0.151	0.193	0.222	0.136	0.158	0.052	0.068	0.006	0.004	0.438	0.391
C.D.(P=0.05)	0.989	1.023	0.838	0.444	0.566	0.651	0.400	0.462	0.154	0.198	0.019	0.010	1.284	1.147
N_0 V_1	6.00	7.23	4.87	5.11	4.79	4.43	4.01	3.64	2.10	2.07	0.72	0.71	22.49	23.16
N_0 V_2	4.92	4.85	4.52	4.78	4.41	4.69	3.89	3.86	2.21	2.19	0.00	0.00	19.96	20.36
N_0 V_3	14.78	14.94	8.71	8.01	3.25	5.93	4.70	4.55	1.75	0.00	0.00	0.00	33.19	34.43
N_0 V_4	13.54	13.01	12.61	11.65	8.96	7.46	5.99	5.07	2.35	2.12	0.58	0.53	44.04	39.84
N_1 V_1	5.41	4.83	4.37	4.27	4.00	3.34	2.68	2.89	1.23	1.19	0.00	0.00	17.69	16.53
N_1 V_2	4.73	5.20	3.50	3.76	2.43	2.10	2.80	2.76	1.60	1.57	0.00	0.00	15.05	15.40
N_1 V_3	12.16	11.93	7.60	6.17	2.72	5.28	1.39	0.00	0.00	0.00	0.00	0.00	23.87	23.39
N_1 V_4	11.69	11.10	10.53	9.46	6.08	7.52	5.09	4.53	2.39	1.89	0.00	0.00	35.78	34.50
N_2 V_1	4.64	4.30	3.85	3.74	3.20	3.10	1.65	1.60	1.12	1.07	0.00	0.26	14.47	14.08
N_2 V_2	4.03	4.44	3.40	3.62	2.98	2.95	2.26	2.21	0.86	0.85	0.00	0.00	13.49	14.07
N_2 V_3	10.57	12.12	6.46	3.19	1.15	1.11	0.00	0.00	0.00	0.00	0.00	0.00	18.17	16.43
N_2 V_4	8.85	7.74	6.62	6.72	2.61	3.22	2.31	2.21	0.78	0.76	0.00	0.00	21.17	20.66
SEM±	0.584	0.604	0.495	0.262	0.334	0.385	0.236	0.273	0.091	0.117	0.011	0.006	0.759	0.677
C.D.(P=0.05)	1.713	1.772	1.452	0.768	0.980	1.128	0.692	0.801	0.266	0.344	0.032	0.018	2.225	1.987

Boron (B) is an essential microelement for higher plants, and its deficiency is widespread around the world and constrains the productivity of both agriculture and forestry. In the last two decades, numerous studies on model or herbaceous plants have contributed greatly to our understanding of the complex network of B-deficiency responses and mechanisms for tolerance. In woody plants, however, fewer studies have been conducted and they have not well been recently synthesized or related to the findings on model species on B transporters Ghanbarpour *et al.* (2019) [1], Korkmaz and Askın (2015) [2] in pomegranate, Nutrients like boron, zinc, calcium, copper, molybdenum manganese and potash are involve in physiological processes during fruit growth period, and theirs deficiencies cause cracking in Maurer, M. and Truman, J., (1999) [4]. Zinc (Zn) is an essential microelement for plant growth in all kinds of soils. It influences many biological processes, including carbohydrate metabolism, cell proliferation and phosphorus-Zn interactions. Zn also serves as an integral component of some enzyme structures, such as CA, alcohol dehydrogenase, and glutamate dehydrogenase by Singh *et al.* (2016) [11]. Zinc plays an important role in nucleic acid and protein synthesis and helps in the utilization of phosphorous and nitrogen and calcium may have an effect on fruit cracking due to its important roles in the cell wall, influencing the mechanical properties of plant tissues Sinha *et al.* (1999) [4], Munish *et al.* (2003) [5], Mitra *et al*. (2008) [6], Dhaker *et al*. (2013) [12] in bael.

In litchi fruit and its relation with fruit skin cracking was conducted to evaluate litchi cultivars for fruit quality attributes such as fruit size, fruit weight, pulp weight, TSS, total sugars, fruit cracking, fruit specific gravity, reducing and non-reducing sugars, skin strength and its boron and calcium content. Darjazin, Iran and designed to evaluate the impacts of foliar application of 2 and 5 ml^{-1} humic acid, 6% kaolin, and 3% Calcium-1% Boron (CB) separately or in combination. Pomegranate fruits were examined under two irrigation regimes at three time periods during the growing season. It was found that 14day irrigation periods resulted in significantly more cracking in pomegranate than standard irrigation. Increased temperatures in 2015 contributed to higher percentages of fruit cracking as well Ghanbarpour *et al*. (2019) [1] in pomegranate. Inhibition and recovery of proton release upon boron withdrawal and restitution in plant culture medium demonstrated boron involvement in membrane processes. Rapid boron-induced changes in membrane function could be attributed to boron-complexing membrane constituents. Molecular studies of boron nutrition have been initiated by the discovery of a novel mutant of Arabidopsis thaliana with an altered requirement for boron in citru. Based on the result of trail with calcium chloride and applied growing technologies it seems that 0.35-10% calcium chloride solution is effective in cherry orchards to reduce the cracking of fruits. Studied different metallic salts and their effect on reducing fruit cracking in cherry. Copper salts are used in horticulture for a long time such as Bordeaux mixture with copper sulphate ($CuSO_4$) solution in 0.1% concentration has decreased the fruit cracking. Similar result finding observed also reported that application of boron checks the fruit cracking in apple in boron deficient areas. The findings discussed above are in conformity with reports made by Singh *et al.* (2016) [11] in bael, Haq and Rab. (2012) [7], Singh *et al.* (2016) [11], Marboh (2017) [8] in litchi, Khehra and Bal (2014) [9] in lemon, Lal *et al*. (2011) [10], Khalil and Aly (2013) [12], Khub (2014) [13], in pomegranate.

Conclusion

The study demonstrates that tailored nutrient application, particularly the combination N2 (Borax 400g + Zinc Sulphate 400g + Calcium Nitrate 400g), significantly reduces bael fruit cracking. Varietal selection also plays a crucial role, with varieties like V2 (NB-5) exhibiting the least cracking percentages. The interaction between nutrients and varieties further influences cracking, highlighting the importance of precision management. Factors such as boron, zinc, and calcium levels significantly impact fruit quality and cracking susceptibility. Additionally, the research underscores the importance of understanding physiological mechanisms behind fruit cracking and the role of nutrients in mitigating this issue. These findings provide valuable insights for optimizing cultivation practices to enhance bael fruit quality and reduce cracking incidence, ultimately benefiting growers and the agricultural sector.

References

1. Ghanbarpour E, Rezaei M, Lawson S, Obstbau E. Reduction of Cracking in Pomegranate Fruit After Foliar Application of Humic. Acid, Calcium-boron and Kaolin During Water Stress. Springer. 2019;61:29–37.
2. Korkmaz, Askın. Effects of calcium and boron foliar application on pomegranate (*Punica granatum* L.) fruit quality, yield, and seasonal changes of leaf mineral nutrition. Acta. Horticulturae. 2015;1089:413-422.
3. Bhatt BB, Rawat SS, Naithani DC, Kumar D, Singh KK. Effect of soil application of bio-regulators and nutrients on growth and yield characters of lemon (*Citrus limon burma*.) cv. pant lemon-1 under subtropical condition of Garhwal region. Plant Archives. 2016;16(2):821-825.
4. Sinha AK, Singh C, Jain BP. Effect of plant-growth substances and micronutrients on fruit set, fruit drop, fruit retention and cracking of litchi cv. Purbi. Indian journal of horticulture. 1999;56(4):309-311.
5. Munish A, Kahlon PS, Mahajan BVC. Effect of exogenous application of growth regulators on fruit drop, cracking and quality of litchi (*Litchi chinensis* Sonn.) cv. Dehradun. Agricultural sciences digest. 2003;28(3):191-194.
6. Mitra SK, Pathak PK, Debnath S, Sarkar A, Mondal D. Elucidation of the factors responsible for cracking and sunburn in litchi and integrated management to minimize the disorders. III International Symposium on Longan, Acta Horticulturae. 2008;863.
7. Haq IU, Rab A. Characterization of physico-chemical attributes of litchi fruit and its relation with fruit skin cracking. The Journal of Animal & Plant Sciences. 2012;22(1):142-147.
8. Marboh ES, Singh SK, Pandey S, Nath S, Gupta AK, Pongener A. Fruit cracking in litchi (*Litchi chinensis*): An overview. Indian Journal of Agricultural Sciences. 2017;87(1):03-11.
9. Khehra S, Bal JS. Influence of foliar sprays on fruit cracking in lemon. International Journal of Plant, Animal and Environmental sciences. 2014;4(4):124-128.
10. Lal S, et al. Effect of different chemicals on fruit cracking in pomegranate under Karewa condition of Kashmir valley. Indian Journal of Plant Physiology. 2011;16(3):326-330.
11. Singh MK, Satya Prakash, Kumar M, Singh KV, Malik S. Effect of micro nutrients and fungicide application on internal fruit necrosis, cracking and fruit drop in bael (*Aegle marmelos* Correa.). Hort. Flora Research Spectrum. 2016;5(3):258-260.
12. Khalil HA, Aly HSH. Cracking and Fruit Quality of Pomegranate (*Punica granatum* L.) As Affected by Pre-Harvest Sprays of Some Growth Regulators and Mineral Nutrients. Journal of Horticultural Science & Ornamental Plants. 2013;5(2):71-76.
13. Khadivi-Khub A. Physiological and genetic factors influencing fruit cracking. Acta. Physiologiae. Plantarum. 2014;3(7):1718.