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Foliar Nutrition of Micro-nutrients on Physico-biochemical Characters of Pear cv. Patharnakh

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Abstract

The present investigation was carried out in the orchard, Department of Agriculture, Khalsa College, Amritsar during the year 2022-2023. The experiment was laid out in randomized block design with ten treatments, replicated thrice and results were statistically analyzed at $p \leq 0.05$ level of significance. The pear plants were sprayed with different concentration of micro-nutrients i.e. Borax (0.2 %, 0.4 % and 0.6 %), $ZnSO_4$ (0.2 %, 0.4 % and 0.6 %) and $FeSO_4$ (0.2 %, 0.4 % and 0.6 %). It was concluded from the present study that boron (0.6 percent) proved to be the most effective treatment in enhancing the fruit length, fruit breadth, fruit weight, fruit volume, TSS, TSS/TA, juice pH and minimum titratable acidity of fruit.

Keywords: Pear; Micro-nutrients; Physico-biochemical characters; Foliar; Nutrition

Introduction

Pear is a temperate fruit crop grown in northern India's sub-tropical regions. *Pyrus pyrifolia* (Hard pear or Japanese pear or Asian pear) and *Pyrus communis* (Soft pear or European pear) are the two main species of pear belongs to family Rosaceae are grown in both sub-tropical and temperate regions. The pear (*Pyrus pyrifolia* Burm F.) Nakai originated in China, where its culture dates back to 2500-3000 years. It may have been introduced into India from China during the time of Lord Kanishka, who settled some Chinese hostages around village Harsha Chhina (Amritsar district) by them. Pear has high nutritional value with reasonable amounts of vitamins A, B, B_2, C and minerals like K, P, Ca, Mg, Fe and Na. Due to the presence of grit cells in pear fruits regular consumption of it offers protection against colon cancer. Various micro-nutrients such as boron, zinc and iron are required for improving tree growth, fruit yield and quality (Shoeib and El sayed, 2003) as compared to soil application. Micro-nutrients applied through foliage can be 10 to 20 times more effective. Foliar application of micro-nutrients such as boron, zinc and iron appear to be a useful strategy for both correcting deficiency symptoms and increasing plant production (Jasim et al., 2022; Tariq et al., 2007; Kumari and Thakur, 2024; Jasim and Hariz, 2023; Alryahil and Jasim, 2022). Boron plays important role in flowering, fruit processes nitrogen metabolism, hormone movement and movement of sugars. If boron is deficient, young growing tissues are discoloured, disrupted and die, the plants remain stunted and flowering is suppressed. Zinc is required for photosynthesis and associated enzymes, which results in the accumulation of sugars (Abedy, 2001). Deficient leaves of fruit trees are easily identified by their characteristics interveinal chlorosis, small leaves, the rosette formation which results from insufficient synthesis of IAA and shortening of internodes. Zinc is involved in synthesis of tryptophan, a precursor of IAA. Iron plays an important role in chlorophyll biosynthesis pathway (Abadia, 1992) thus deficiency of this element reduced the net photosynthesis (Molassiotis et al., 2006) which causes huge reduction in fruit yield (Sanz et al., 1997). Iron is involved in the activity of many enzymes such as catalase, cryochrome, ferrodoxin, lematin & cytochrome oxidase. Most of the iron is present in chloroplast, where it has some role in synthesis chlorophyll.

Materials and methods

The present study was conducted during the year 2022-2023. The study was conducted on 7 years old pear trees grafted on Kainth rootstock uniform in size and vigour, free from the attack of diseases and pests were selected on which all the given treatments were applied. For each replication one tree was selected randomly from the interior part of the orchard, all the experiment trees were given uniform cultural practices as recommended by PAU, Ludhiana. On the selected trees, three concentrations of each chemical were sprayed. The concentration of borax (0.2, 0.4 and 0.6%), $ZnSO_4$ (0.2, 0.4 and 0.6%) and $FeSO_4$ (0.2, 0.4 and 0.6%). The control treatment was confined to no spray. The chemicals were dissolved first in one litre quantity of water and then required volume was made by adding distilled water. There were a total 10 treatments which were replicated thrice in a randomized block design. Time of spray first week of March and first week of April.

Fruit length and breadth (cm)

The fruit length and breadth were measured with the help of Vernier Caliper by taking a sample of 5 randomly selected fruits for each replication and the average length and breadth were expressed in centimetres.

Fruit weight (g)

The weight of the fruit was determined by electronic balance by taking sample of 5 randomly selected fruits for each replication and average fruit weight was expressed in grams.

Fruit volume (cc)

Volume of the fruit was calculated by water displacement method and expressed in cubic centimetres.

Total soluble solids (°Brix)

The TSS of randomly selected fruits was determined with the help of Erma Hand Refractometer (0-32 °Brix). The values were corrected at 20°C with the help of temperature correction chart (AOAC 1990) and expressed as TSS (%).

Titratable acidity (%)

The titratable acidity was determined by titrating the juice against standard alkali solution (0.1N NaOH). 10 ml of juice was taken by means of pipette and was transferred into 100 ml volumetric flask and distilled water was added to make the volume 100 ml. Ten ml aliquot of diluted juice was pipetted out and transferred in 250 ml beaker. 1-2 drops of phenolphthalein indicator were added to the solution. The juice of conical flask was titrated against 0.1N NaOH solution. The alkali was added drop by drop to the conical flask with constant stirring until the end point was reached with appearance of light pink colour persisting for 30 seconds. Factor used for estimation of titratable acidity was (0.0067) malic acid as under.

$$\text{Titratable acidity (\%)} = \frac{0.0067 \times \text{Volume of NaOH used}}{\text{Volume of juice taken (ml)}} \times 100$$

TSS: acidity

TSS: acidity was calculated mathematically by dividing the value of TSS with that of the corresponding value of titratable acidity.

Juice pH

The juice was extracted from each treatment in each replication then pH was determined by the standard method AOAC by using pH meter.

The juice of selected pear fruits was extracted and filtered through muslin cloth and then the pH of the juice was measured by dipping the pH meter electrode inside the juice (150 ml) for a few seconds and stabilized pH reading was recorded. Before every observation, the bulb of the pH meter was washed with double distilled water to eliminate the residual effect.

Statistical Analysis

The data from experiment were statistically analyzed by Randomised Block Design (RBD). All the data presented were Mean ± S.E. The analysis of variance (ANOVA) followed Tukey's posthoc test were applied to compare the different treatment under each parameter which was represented by different alphabets. All the statistical analysis were done at 5 % significance level by using SPSS statistical software (version 26).

Results and discussion

Fruit length (cm)

The results showed that fruit length significantly improved with the foliar application of micro-nutrients. The maximum fruit length (6.89 cm) was recorded with the foliar application of borax (0.6 %). Whereas, minimum fruit length (5.50 cm) was recorded with control. Increment in fruit length due to multiplication, enlargement of cell and higher accumulation of food material like sugar and water in expanded cells due to foliar application of boron (Dutta and Banik, 2007).

Fruit breadth (cm)

The maximum breadth of pear fruit (6.18 cm) was recorded with the application of borax (0.6 %). Whereas, minimum fruit breadth (5.18 cm) was recorded under control. It might be due to foliar application of micro-nutrients significantly increased breadth of fruits due to accumulation of more dry matter in the fruits by the translocation of carbohydrates from leaf to fruit and rapid synthesis of protein in the developing fruits regulated by boron thus resulting increase in fruit size (Singh et al., 2010).

Fruit weight (g)

It is evident from the perusal of data that micro-nutrients had a marked influence on fruit weight. Among different treatments, borax 0.6 per cent was found most effective in increasing fruit weight to 165.40 g which was at par with borax (0.4 %) and zinc sulphate (0.6 %) recorded fruit weight of 156.14 g and 151.64 g, respectively. The minimum fruit weight (108.43 g) was recorded with control. The increase in fruit weight might be due to borax play a positive role in nucleoprotein, amino acids, amino sugars and many other compounds formation of cell wall. This would allow stretching of cell wall along with greater water uptake and increased cell size which ultimately increase the size of fruits being directly responsible for the increase in weight of fruit also (Gupta et al., 2022).

Fruit volume (cc)

The maximum fruit volume (136.48 cc) was recorded in fruit harvested from plants treated with boron (0.6 %). The minimum fruit volume (123.25 cc) was recorded under control. The increase in fruit volume might be due to increase in volume of intercellular spaces in the mesocarpic cells. It could also be due to higher mobilization of food and minerals from the other parts of the plant towards the developing fruits. Singh (2007) recorded the increased fruit volume in all the treatments as compared to control while investigating the effect of foliar application of nutrients in litchi cv. Calcuttia.

Total soluble solids (%)

The maximum TSS (12.48 %) was noted with borax (0.6 %). The minimum TSS (10.52 %) was recorded under control. The increase in TSS might be due to boron role in the mobilization of food material leading to the accumulation of quality constituents like carbohydrates which ultimately increase in total soluble solids. The findings are in line with the results of Kaur and Sukhjit (2017) in litchi, Singh *et al*. (2017) in mango and Chaturvedi *et al*. (2005) in strawberry.

Titratable acidity (%)

It is clearly indicated from the data that foliar application of micro-nutrients had a marked influence on titratable acidity. Among different treatments, minimum titratable acidity (0.32 %) was recorded with borax (0.6 %) which was followed by borax (0.4 %), borax (0.2 %), zinc sulphate

(0.6 %) and ferrous sulphate (0.6 %) and recorded titratable acidity to 0.36, 0.40, 0.42 and 0.46 per cent, respectively. These treatments stood at par with each other. The maximum titratable acidity (0.66 %) was recorded under control. The acidity of fruits decreases with the foliar application of boron might be due to rapid utilization of organic acid in respiration (Ruffner et al., 1975).

TSS:TA

The results showed that TSS:TA significantly improved with the application of micro-nutrients. The maximum TSS:TA (39.01) was recorded with the foliar application of borax (0.6 %) which was at par with borax (0.4 %), zinc sulphate (0.6 %) and borax (0.2 %) which recorded TSS:TA to 33.63, 29.07 and 28.07, respectively. Whereas, minimum TSS:TA (15.93) was recorded with control.

Juice pH

The maximum juice pH (5.10) was recorded with the foliar application of borax (0.6 %), it was closely followed by zinc sulphate (0.6 %), borax (0.4 %) and ferrous sulphate (0.6 %) which recorded fruit juice pH to 5.05, 5.02 and 4.90, respectively. These treatments stood at par with each other. The minimum juice pH (3.50) was recorded under control. These results are in agreement with the findings of Askin et al., (2015) in pomegranate.

Table 1. Effect of foliar application of micro-nutrients on fruit length (cm), breadth (cm), weight (g) and fruit volume(cc) of pear cv. Patharnakh

Treatments	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (g)	Fruit volume(cc)
T_1: Borax (0.2 %)	6.30 ± 0.14^{abc}	5.85 ± 0.13^{ab}	146.52 ± 2.43^{bcd}	130.85 ± 0.96^{bcd}
T_2 : Borax (0.4 %)	6.70 ± 0.16^{ab}	6.15 ± 0.07^{a}	156.14 ± 1.51^{ab}	135.47 ± 0.87^{a}
T_3 : Borax (0.6 %)	6.89 ± 0.17^{a}	6.18 ± 0.14^{a}	165.40 ± 3.91^{a}	136.48 ± 0.66^{a}
T_4 : Zinc Sulphate (0.2 %)	6.20 ± 0.10^{bc}	5.68 ± 0.10^{abc}	141.03 ± 4.79^{cde}	131.50 ± 0.69^{bcd}
T_5: Zinc Sulphate (0.4 %)	6.64 ± 0.09^{ab}	6.12 ± 0.09^{ab}	148.55 ± 1.51^{bcd}	133.33 ± 0.71^{abc}
T_6: Zinc Sulphate (0.6 %)	6.68 ± 0.20^{ab}	6.14 ± 0.10^{a}	151.64 ± 2.02^{abc}	134.60 ± 0.66^{ab}
T_7: Ferrous Sulphate (0.2 %)	5.82 ± 0.06^{cd}	5.60 ± 0.09^{bc}	128.30 ± 1.67^{e}	128.05 ± 0.76^{d}
T_8 : Ferrous Sulphate (0.4 %)	6.28 ± 0.18^{abc}	5.80 ± 0.12^{ab}	134.96 ± 3.75^{de}	129.90 ± 0.74^{cd}
T_9 : Ferrous Sulphate (0.6 %)	6.58 ± 0.07^{ab}	6.05 ± 0.09^{ab}	145.70 ± 2.29^{bcd}	132.75 ± 0.71^{abc}
T_{10} : Control (No spray)	5.50 ± 0.09^{d}	5.18 ± 0.08^{c}	108.43 ± 3.85^{f}	123.25 ± 0.97^{e}

One way ANOVA followed by Tukey's posthoc test was applied for comparing different treatments.
Means in columns followed by different letters shows significant difference at $p \leq 0.05$.

Table 2. Effect of foliar application of micro-nutrients on TSS (%), titratable acidity (%), TSS:TA and juice pH of pear cv. Patharnakh

Treatments	TSS (%)	Titratable acidity (%)	TSS:TA	Juice pH
T_1: Borax (0.2 %)	11.23 ± 0.20^{abc}	0.40 ± 0.01^{cde}	28.07 ± 1.85^{abc}	4.38 ± 0.02^{cd}
T_2 : Borax (0.4 %)	12.11 ± 0.23^{ab}	0.36 ± 0.02^{de}	33.63 ± 1.43^{ab}	5.02 ± 0.16^{a}
T_3 : Borax (0.6 %)	12.48 ± 0.29^{a}	0.32 ± 0.05^{e}	39.01 ± 2.61^{a}	5.10 ± 0.14^{a}
T_4 : Zinc Sulphate (0.2 %)	10.95 ± 0.28^{bc}	0.53 ± 0.02^{abc}	20.66 ± 1.97^{cd}	4.25 ± 0.04^{cd}
T_5: Zinc Sulphate (0.4 %)	11.75 ± 0.25^{abc}	0.49 ± 0.04^{bcd}	23.97 ± 0.39^{bcd}	4.53 ± 0.01^{bc}
T_6: Zinc Sulphate (0.6 %)	12.21 ± 0.25^{ab}	0.42 ± 0.03^{bcde}	29.07 ± 1.46^{abc}	5.05 ± 0.06^{a}
T_7: Ferrous Sulphate (0.2 %)	10.70 ± 0.32^{c}	0.58 ± 0.03^{ab}	18.44 ± 1.02^{d}	3.95 ± 0.05^{dc}
T_8 : Ferrous Sulphate (0.4 %)	11.48 ± 0.30^{abc}	0.50 ± 0.05^{abcd}	22.96 ± 2.59^{bcd}	4.44 ± 0.12^{c}
T_9 : Ferrous Sulphate (0.6 %)	11.80 ± 0.31^{abc}	0.46 ± 0.01^{bcde}	25.65 ± 0.20^{cd}	4.90 ± 0.09^{ab}
T_{10} : Control (No spray)	10.52 ± 0.18^{c}	0.66 ± 0.02^{a}	15.93 ± 1.33^{d}	3.50 ± 0.10^{e}

One way ANOVA followed by Tukey's posthoc test was applied for comparing different treatments.
Means in columns followed by different letters shows significant difference at $p \leq 0.05$.

Conclusion

It was concluded from the present study that borax (0.6 percent) proved to be the most effective treatment in enhancing the fruit size, fruit weight, fruit volume, TSS, TSS: TA, juice pH and minimum titratable acidity of pear fruits.

References

Abadia A (1992) Leaf responses to iron deficiency. Journal of plant Nutrition 15:699-713.

Abedy A (2001) Effect of zinc sulphate and citric acid spray on fruit characteristics of tomato cv. Urban. International Journal of Scientific & Engineering Research 10:935-41.

AOAC (1990) Official methods of analysis 15th Edition. Association of Official Analytical Chemists Washington DC USA.

Alryahii IA and Jasim AH (2022) Responses of Okra (Abelmoschus esculentus Moench) to Low Levels of Cadmium Compared to Ascorbic Acid, Biomin and Potassium Sulfate. Environ Sci Arch 1(2): 60-63.

Askin MA and Korkmaz N (2015) Effects of calcium and boron foliar application on pomegranate fruit quality, yield and seasonal changes of leaf mineral nutrition. Acta Horticulturae 1089:413-22.

Chaturvedi OP, Singh AK, Tripathi VK and Dixit AK (2005) Effect of zinc and iron on growth, yield and quality of strawberry cv. Chandler. Acta Horticulturae 696:237-40.

Dutta P and Banik AK (2007) Effect of foliar feeding of nutrients and plant growth regulators on physico-chemical quality of Sardar guava grown in red and lateritic tract of West Bengal. Acta Horticulturae 735:407-11.

Gupta A, Tripathi VK and Shukla JK (2022) Influence of GA3, zinc and boron on fruit drop, yield and quality of litchi. Biological Forum-An International Journal 14:1079-83.

Jasim AH, El-Balla MMA and Al-Nabhani HMA (2022) Effect of Chemical NPK, Organic and Foliar (high potash) Fertilizers on Potato Growth and Tuber Yield. Environ Sci Arch 1(2): 81-87.

Jasim AH and Hariz MR (2023) Response of Sweet Corn Growth to Soil Fertilization with Sulfur, NPK Levels and Spraying of Ascorbic Acid. Environ Sci Arch 2(2):114-121.

Kaur and Sukhjit (2017) Effect of micro-nutrients and plant growth regulators on fruit set, fruit retention, yield and quality attributes in litchi cv. Dehradun. Journal of Chemical Sciences 6(22):982-86.

Kumari S and Thakur A (2024) Brassinosteroid a Potential Plant Growth Regulator to Alleviate Drought Stress in Apple Cultivars. Environ Sci Arch 3(STI-1): 37-48.

Molassiotis A, Tanou G, Diamantidis G, Patakas A and Therios I (2006) Effects of 4-month Fe deficiency exposure on Fe reduction mechanism, photosynthetic gas exchange chlorophyll fluorescence and antioxidant defense in two peach rootstocks differing in Fe deficiency tolerance. Journal of Plant Physiology 163:176-85.

Ruffner HP, Hoblet W and Rast D (1975) Gluconeogenesis in the ripening berries of Vitis vinifera. Viticulture 13:314-28.

Sanz M, Pascual J and Machin J (1997) Prognosis and correction of iron chlorosis in peach trees influence of fruit quality. Journal of Plant Nutrition 20:1567-72.

Shoeib MM and El Sayed A (2003) Response of Thompson Seedless grape vines to the spray of some nutrients and citric acid. Journal of Agricultural Research and Development 23:681–98.

Singh P (2007) Effect of foliar application of mineral nutrients on yield and quality of litchi cv. Calcuttia. M.Sc. Thesis GNDU Amritsar.

Singh DK, Ghosh SK, Paul PK and Suresh CP (2010) Effect of different micronutrients on growth, yield and fruit quality of papaya (Carica papaya L.) Ranchi. Acta Horticulturae 851:351-358

Singh T, Tripathi VK and Tiwari P (2017). Influence of pre-harvest application of plant bio-regulators and micronutrients on fruit retention, yield and quality attributes of mango. Progressive Research An International Journal 12(4):2640-44.

Tariq M, Sharif M, Shah Z and Khan R (2007) Effect of foliar application of micronutrients on the yield and quality of sweet orange (Citrus sinensis L.). Journal of Biological Sciences 10:1823-28.

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