



## Review Paper

# A review on impact of preharvest foliar sprays of macronutrients on yield and quality improvement of fruit crops

Anjali Tripathi<sup>1\*</sup>, Shweta Uniyal<sup>2</sup>, Paramjeet Sajwan<sup>3</sup> and Sanjay Singh Negi<sup>3</sup>

<sup>1</sup>Department of Horticulture, Chaudhary Charan Singh Haryana Agricultural University, Hisar-125004, India

<sup>2</sup>Department of Horticulture, College of Agriculture, GBPUAT, Pantnagar - 263145, Uttarakhand, India

<sup>3</sup>Dept. of Horticulture, Uttarakhand University of Horticulture and Forestry, College of Forestry Ranichauri, Tehri Garhwal, Uttarakhand, India  
anjalihorti@gmail.com

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## Abstract

*The aim of this paper is to review the current knowledge on the responses of preharvest foliar sprays of macronutrients on yield and quality improvement of fruit crops. Foliar application of nutrients gives more effective and extravagant result to enhance the production, productivity and quality of fruits than soil application. The application nutrients on fruits has received a substantial attention in current years because of their role in enhancing the yield and producing high quality of fruits. The major nutrients like nitrogen, phosphorus, potassium and calcium can be uniformly applied either through foliar applications or fertigation and have major effect on fruit quality. Nutrition has play a very important role to reduce the physiological disorders like reduced respiration, delayed ripening and increasing fruit firmness, thereby enhancing the storage and shelf-life of fruits.*

**Keywords:** Foliar Spray, Macronutrients, Yield, Quality, Fruit Crops.

## Introduction

Fruits cultivation is the most important branch of horticulture, which has been practiced in India since time. Fruit cultivation is an art and science has now developed into one of the most conceive, proficient and accelerate form of land utilization. The standard of living of the people of countries is judged by the production and per capita consumption of fruits. Cultivation of fruits has various profitable benefits. Nutrition plays a crucial role in increasing the yield and quality of fruits. Therefore, balanced application of nutrients and manures on fruit crop is quite necessary for enhancing the quantity as well as quality of fruit crops. Foliar application of nitrogen provides more nitrogen use efficiency than soil application of nitrogen for fruit trees<sup>1</sup>. Nitrogen is a major primary macronutrient. It is essential for proper plant growth, development, leaf development, flower formation, increase in fruit set and fruit size and other characters which combine to determine crop yield<sup>2</sup>. Nitrogen is required for the initial growth of almond trees in the spring during cell division and improves the performance of tree with low nitrogen reserve<sup>3</sup>.

Nitrogen is a basic element of many compounds including nucleic acid, chlorophyll, enzymes and proteins which are essential for plant growth and development. It is also illustrated that nitrogen is essential for the use of carbohydrate within the plant and stimulates growth and development. It plays an important role in the uptake of other nutrients. Phosphorus is the second major nutrient which is essential for plant healthy

growth, development, and greater resistance to diseases. Potassium is the third macronutrient, it is necessary for the development of strong plants. It is helpful for the plant to show resistance against diseases and protects them from low temperature, also helpful in preventing excessive water loss during the dry period<sup>4</sup>. Foliar sprays of phosphorus improve yield and reduce the water core and browning. Potassium fertilization helps in improving the quality and enhancing fruit colour and decreases the bitter pit problem. Calcium sprays diminishes bitter pit while nitrogen application enhances production but decreases the fruit quality and colour. Calcium play very important role to maintain the cell membranes and also helpful to prevent the physiological disorders which occur due to Ca deficiency<sup>5</sup>.

## Effect of calcium spray on fruit crops

Mineral elements affect growth, yield and quality of fruits directly. In most of the soils calcium is present in large amount as carbonates and phosphate. Calcium plays an important role as an activator for phosphatase enzyme and work as a pH regulator by forming salts with plasma protein. Calcium is involved in plant cell wall integrity and play a very important role to increase the shelf life of fruits. Calcium deficiency in plants leads and show less resistance against pathogens and increases the chances of occurrence of diseases in plants, so calcium nutrition has been suggested for disease management<sup>6</sup>. Ca deficiency shows physiological disorder in fruit crops like cork spot, which occurs mainly the early part of the growing

season, bitter pit, which develops during the latter part of the growing season, and senescent breakdown, which occurs during and after storage. Ca may affect disease sensitivity during the growing season, and may affect the development of scald and decay during storage<sup>7</sup>.

**Yield parameter:** Foliar application of calcium increases the production of fruits it was observed that preharvest foliar sprays of  $\text{CaCl}_2$  on pear tree increases 36% yield compared to untreated trees<sup>8</sup>. Pre harvest foliar application of calcium nitrate showed a positive relation with quality characteristics in peach<sup>9</sup>.

**Physico-chemical characters of fruits:** Pre harvest calcium treatments increased the post harvest quality of apple cultivars and observed that the contents of fruit viz., soluble solids, acidity and dry matter after harvest were significantly reduced by calcium treatments<sup>10</sup>. Preharvest calcium sprays (7 weekly application at 1.6% (w/v) 81-123 days after full bloom) applied to 'Fuji kiku-8' apples improved cell to cell adhesion as indicated by higher contents of ionically bound pectins in treated fruit, leading to higher fruit firmness level at commercial harvest<sup>11</sup>. Preharvest foliar application of  $\text{CaCl}_2$  (0.5%) in apple showed the significant effect on fruit yield, fruit firmness, total soluble solid and acidity<sup>7</sup>.

**Shelf life of fruits:** Preharvest application of  $\text{CaCl}_2$  @ 0.3%-0.5% or  $\text{CaNO}_3$  @ 1.0-2.5% enhanced the storage life of apple fruits and also observed that calcium treated fruits had the lowest decay percentage and the longest storage life as compared with untreated ones (Control)<sup>12</sup>. Calcium treatment of apple fruit significantly reduced the number of infected fruit<sup>13</sup>. Preharvest foliar application of calcium nitrate in guava with 1% effectively reduced spoilage, maintained higher firmness total soluble solid and ascorbic acid up to 2 days under ambient condition after 30 days of cold storage and remained moderately acceptable up to 40 days of storage<sup>14</sup>.

### Effect of potassium spray on fruit crops

Potassium (K) is the second most important nutrient for fruit trees. Being very mobile within the plant, K is not directly involved in the structural growth of the tree but it also plays a major role in a number of physiological processes. K is the key nutrient in osmo-regulation and the maintenance of cell turgor and therefore closely related to firmness and crispness of the fruit. Fruits rich in K are more resistant to sunscald<sup>15</sup>. Potassium is known for helping in sugar translocation in plants, thus its application increases total soluble solid contents<sup>16</sup>. Potassium is often referred as the quality element for crop production<sup>17</sup>.

**Yield parameter:** An experiment was carried out at Akola, Maharashtra where flowering was earliest (approximately 27-28 days earlier than the control) in mango trees cv. Pairy when sprayed with 1.5%  $\text{KNO}_3$  solutions and resulted in higher total fruit yield<sup>18</sup>. Mango cv. Tommy Atkins yield was increased when sprayed with three applications of  $\text{KNO}_3$  @ 3% at

different time intervals. It was observed that  $\text{KNO}_3$  treatment promoted higher production per tree and a better relationship between cost and benefit ratio<sup>19</sup>.

**Physico-Chemical characters of fruits:** Pre harvest spray of  $\text{KNO}_3$  and  $\text{K}_2\text{SO}_4$  @ 1.0%, 1.5% and 2% on pear cv. Patharnakh and observed that three foliar application of  $\text{K}_2\text{SO}_4$  @ 2% were highly effective in improving fruit size, fruit length, fruit breath, colour, firmness, TSS and total sugar of fruits<sup>20</sup>. P and K showed significant effect on quality of pear cv. Williams. Fruits weight, volume, and total soluble solid reported highest when P @ 20% and K @ 0.1% applied as preharvest spray in fruiting trees<sup>21</sup>.

**Shelf life of fruits:** Foliar application of  $\text{K}_2\text{SO}_4$  @ 2.0 % on mango cv. Himsagar resulted in lowest physiological weight loss and number of days to fruit ripening<sup>22</sup>. Preharvest application of  $\text{KH}_2\text{PO}_4$  @ 2.0 % to the pomegranate fruit gave highest total and reducing sugars and improved the storage life of fruits<sup>23</sup>. The fruit of pineapple cv. Mauritius were treated with 5 %  $\text{K}_2\text{SO}_4$  followed by spraying with 5%  $\text{Ca}(\text{OH})_2$  and observed significant changes in fruit firmness, taste, flavour and shelf life of fruit<sup>24</sup>.

### Effect of combine NPK Spray on Fruit Crops

The macronutrients (N, P, K and Ca) which can be specifically applied either through foliar sprays or fertigation have major effect on fruit quality. Nitrogen is an integral component of many compounds including proteins, nucleic acid, enzymes and chlorophyll which are necessary for plant growth and development. It is also illustrated that nitrogen is imperative for the use of carbohydrate within the plant and encourages growth and development. It plays an important role in the uptake of other nutrients. Phosphorus is the second major macro nutrients and play a very important role for plant growth, development and protect the plant from various diseases which is occurs due to phosphorous deficiency in main crop field. Potassium is the third primary macronutrient and essential for the strong plant growth and development. It is helpful to show resistant against plant diseases and protect plants from the low temperature and preventing excessive water loss during dry weather<sup>4</sup>.

**Yield parameter:** NPK combinations on fruit yield and quality of apple cv. Red Delicious and observed that soil application of N @ 600g/tree, P @ 300g/tree, K 900g/tree give the highest yield of fruits this may be due to higher NPK application which resulted in higher metabolism and enhanced yield<sup>25</sup>. Combine soil application of NPK in ber cv Umran @ (N 500g,  $\text{P}_2\text{O}_5$  500g,  $\text{K}_2\text{O}$  50g) applied as per tree maximum economic yield were found<sup>26</sup>. Sweet orange cv. Jaffa yield was increased with the combine soil application of NPK @ (N 100 g, P @ 300 g, K 300g)<sup>27</sup>.

**Physico-chemical characters of fruits:** Combine soil application of NPK in apple cv. Red Delicious and highest fruit

firmness was found with the soil application of N @ 300g/tree, P @ 300g/ tree and K @ 900g/tree which could be due to low N and high P and K concentration and highest T.S.S. content were found with the soil application of N @ 600g/tree, P@ 300g/tree and K @ 900 g/tree which may be due to high potassium application to fruit trees<sup>25</sup>. Soil application of N @ 600g N, P<sub>2</sub>O<sub>5</sub> @ 150g, K<sub>2</sub>O @ 300g resulted in higher yield, volume and TSS with low acid content in pear<sup>28</sup>. Soil application of N @ 200g, P<sub>2</sub>O<sub>5</sub> @ 75g and K<sub>2</sub>O @ 200 g in plum resulted in highest pulp stone ratio, largest and heaviest fruit<sup>29</sup>. Foliar application of NPK @ 19:09:19 recorded the maximum yield, fruit weight, fruit length, fruit diameter and TSS<sup>30</sup>.

## Conclusion

The preharvest foliar application of macronutrients is found to be more effective in fruit production and quality improvement because it is required by the plant in greater amount than other nutrients and plays important role in high yield production and enhancing the quality of fruits. Foliar fertilization has proved beneficial under such conditions or areas where nutrient availability in soil was decreased and root activity decreased during the flowering stage. Foliar applications of nutrients are cheap and environmental friendly and gives expeditious result than soil application of nutrients.

## References

1. Weinbaum S.A. (1988). Foliar nutrition of fruit trees. *Plant growth and leaf applied chemicals*, CRC Press, Inc. Boca Raton, Florida, USA: 81-100.
2. Bright J. (2005). Apple and Pear nutrition. NSW Department of Primary Industries. Primefact 85. 1-12.
3. BI G., Scagel C.F., Cheng L., Dong S. and Fuchigami H. (2003). Spring growth of Almond nursery trees depends upon nitrogen from both plant reserves and spring fertilizer application. *J. Hort. Sci. & Biotech*, 78(6), 853-858.
4. Sah H., Kumar Pratibha R. and Topwal M. (2014). Response of NPK on growth, yield and quality of Oriental pear. *Indian Hort. J.*, 4(1), 01-08.
5. Neilsen D. and Neilsen G.H. (2009). Nutritional effects on fruit quality for apple trees. *New York Fruit Quality*, 17(3), 21-24.
6. Naradisorn M. (2013). Effect of calcium nutrition on fruit quality and post harvest diseases. *Int. J. Sci. Innovations and Discoverie.*, 3(1), 8-13.
7. Asgharzade A., Valizade G.A. and Babaeian M. (2012). Effect of calcium chloride(CaCl<sub>2</sub>) on some quality characteristic of apple fruit in Shrivan region. *African J. Micro. Res.*, 6(9), 2000-2003.
8. Raese J.T. and Drake S.R. (1993). Effect of preharvest calcium sprays on apple and pear quality. *J. Plant Nutri. (USDA)*, 16(9), 1807-1819.
9. Singh S.K., Arora R.L. and Sharma A.K. (2002). Effect of pre harvest spray of calcium nitrate on flowering, yield and quality of peach cv. Floridasun. *Prog. Hort.*, 34(1), 83-87.
10. Moor U., Poldmd P., Karp K., Asafova L. and Pae A. (2005). Influence of pre harvest calcium treatments on post harvest quality of Estonian apple cultivars. *Acta Hort.*, 682(2), 1041-1048.
11. Ortiz A., Graell J. and Lara I. (2011). Preharvest calcium applications inhibit some cell wall modifying enzyme activities and delay cell wall disassembly at commercial harvest of 'Fuji Kiku-8' apples. *Post harvest Bio. Tech.*, 62(2), 161-167.
12. Recasens I., Benavides A., puy J. and Casero T. (2004). Pre-harvest calcium treatments in relation to the respiration rate and ethylene production of 'Golden Smoothee' apples. *J. Sci. Food Agric.*, 84(8), 765-771.
13. Holb Imre J., Barbara B., Vamos A. and Gall J.M. (2012). Influence of preharvest calcium applications, fruit, injury, and storage atmosphere on postharvest brown rot of apple. *Postharvest Biol. Tech.*, 67, 29-36.
14. Goutam M., Dhaliwal H.S. and Mahajan B.V.C. (2010). Effect of preharvest calcium sprays on post harvest life of winter guava (Pisidium guajava). *J. Food Sci.Tech.*, 47(5), 501-506.
15. Ebert G. (2009). Fertilizing for high yield and quality pome and stone fruits of the temperate zone. *K IPI Bulletin*, 19-28.
16. Jauhari O.S. and Singh D.V. (1971). Effect of potassium on fruit quality of fruit crops. *Prog. Hort.*, 2, 81-89.
17. Ushirwood N.R. (1985). Potassium in Agriculture. *Madison*, 489.
18. Dalal R., Gonge V.S., Jadnao B.J. and Jogdande N.D. (2005). Effect of chemical on flowering and fruit yield of Mango. *Int. J. of Agric Sci.*, 1, 24-25.
19. Ataide E. and Jose A. (2000). Effect of different intervals of potassium nitrate spraying on flowering and production of mango trees (*Mangifera indica* L.) cv. Tommy Atkins. *Acta Hort.*, 509, 581-586.
20. Gill P.P.S., Ganaie M.Y., Dhillon W.S. and Singh Nav Prem (2012). Effect of foliar spray of potassium on fruit size and quality of 'Patharnakh' pear. *Indian J. of Hort.*, 69(4), 512-516.
21. Hudina M. and Stampar F. (2002). Effect of phosphorus and potassium foliar fertilization on fruit quality of pears. *Acta Hort.*, 594, 487-493.
22. Dutta P. and Dhua R.S. (2005). Foliar spray of potassium for high yield and quality of Himsagar mango. *Hort. J.*, 18(3), 153-156.
23. Heshi A.B., Garande V.K., Wagh A.N. and Katore H.S. (2001). Effect of pre harvest spray of chemicals on the

- quality of pomegranate (*Punica granatum* L.) cv. G-137. *Agri. Sci. Digest*, 21(1), 25-27.
24. Nanayakkara K.G.P.A., Herath H.M.W. and Senanayake Y.O.A. (2005). Effect of Ethephon + potassium sulphate on the process of ripening and internal browning in pineapple. *Acta Hort.*, 666, 315-319.
25. Singh S.R., Sharma A.K., and Sharma M.K. (2009). Influence of NPK combinations at different altitudes and aspects on fruit yield, quality and leaf nutrients status of apple cv. Red Delicious. *Indian J. Hort.*, 66(2), 175-182.
26. Lal G., Pareek C.S., Sen N. L. and Soni A.K. (2003). Effect of N, P and K on growth, yield and quality of ber (*Zizyphus mauritiana* Lamk.) cv. Umran. *Indian J. Hort.*, 60(2), 158-62.
27. Monga P.K., Kumar Harish, Vij V.K. and Aulakh P.S. (2002). Effect of NPK on yield and fruit quality of sweet orange cv. Jaffa. *Indian J. Hort.*, 59(4), 378-381.
28. Henry V.R, Mani, A.K. and Sampath V. (1984). Studies on effect of NPK on the yield and fruit quality of Country pear. *South Indian Hort.*, 32, 119-121.
29. Dhillon W.S. and Ball J.S. (1991). A note on effect of N,P,K on fruit size, yield and quality of Kataru Chak plum (*Prunus salicina* Lindl.). *Haryana J. Hort. Sci.*, 19(1/2), 143-145.
30. Chaurasia S.N.S., Singh K.P. and Rai M. (2005). Effect of foliar application of water soluble fertilizers on growth, yield and quality of tomato (*Lycopersicon esculentum* L.). *Shri Lanka J. Agric. Sci.*, 42, 66-70.