

Effects of Calcium, Potassium and Nitrogen on *Punica Granatum* L.- A Review

Pooja Mesurani¹, Vijay R. Ram², Pankaj Ram³

¹Department of Chemistry, R R Mehta College of Science &
C L Parikh College of Commerce, Palanpur, Gujarat, India

^{2,3}Department of Chemistry, KSKV Kachchh University, Bhuj, Gujarat, India

ABSTRACT

Punica granatum L. also known as pomegranate, belonging to family of punicaceae is nutritious fruit with several therapeutic beneficial effects. As the need of food is increasing linearly by the day, measures to increase fruit production are highly demanding. Therefore application of nutrients like Potassium, Calcium and nitrogen can help to increase fruit yield and quality of pomegranate. Results of experiments conducted by several authors concluded that calcium is very useful in reducing cracking problem of pomegranate. Potassium increased vegetative growth, leaf nutrient content and ascorbic acid content. Lastly, Nitrogen increased number of fruits per plant, fruit weight, juice percentage, total soluble solids, total sugar concentration, ascorbic acid content, fruit length and lowest seed percentage, So the present review article aims at providing an up-to-date overview the effects of Calcium, Potassium and nitrogen on pomegranate.

KEYWORDS: *Punica granatum* L., Calcium, Potassium, Nitrogen

INTRODUCTION

The pomegranate (*Punica granatum* L.) belongs to the punicaceae family. It is important crop of arid and semi arid regions, basically of native Iran. Its all parts like roots, bark, leaves, flower and seeds are useful as medicine from early time. Due to its multipurpose medicinal uses it is also known by the name “Super fruit” in the global functional food industry. From market point of view, quality of pomegranate contingent upon peel color, lack of physical defects, juice total soluble solids (TSS), titratable acidity (TA) and taste. Pomegranate is a good source of protein, carbohydrate, minerals, antioxidants, vitamin A, B and C, it is also used in controlling diarrhea, hyperacidity, tuberculosis, leprosy, abdominal pain and fever. .

Minerals affect production and fruit quality, directly or indirectly. To increase crop yield, systematic use of fertilizers is the more important in all agricultural practices but to coordinate nutrient application to plant need is hard. Foliar application of plant nutrients have several benefits on pomegranate,

therefore foliar spray in proper quantity at appropriate time should be applied as to increase growth, fruit quality and reduce fruit cracking, moreover foliar spray has advantage of uniform distribution.

The effect of macronutrients on pomegranate growth and yield has been studied extensively. Macronutrients such as nitrogen, phosphorus, and potassium play vital roles in various physiological processes of pomegranate trees, including growth, flowering, fruit set, and fruit development.

Potassium is an essential element for plants. It is engaged in many physiological processes, triggering of several enzymes and maintain cation and anion balance. Nitrogen plays vital roles in plant growth and development, many parameters like fruit yield and fruit quality are affected by nitrogen. It is required for chlorophyll and enzyme synthesis and it is major component of proteins, metabolites, and nucleic acids. Calcium plays important role in formation of cell wall membrane and its plasticity,

How to cite this paper: Pooja Mesurani | Vijay R. Ram | Pankaj Ram "Effects of Calcium, Potassium and Nitrogen on *Punica Granatum* L.- A Review" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-8 | Issue-2, April 2024, pp.259-262, URL: www.ijtsrd.com/papers/ijtsrd64627.pdf



Copyright © 2024 by author (s) and International Journal of Trend in Scientific Research and Development Journal. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0) (<http://creativecommons.org/licenses/by/4.0>)



influencing normal cell division by sustaining cell integrity and membrane permeability, also it is triggerer of various enzyme in protein synthesis and carbohydrate transfer.

Calcium

Calcium (Ca^{2+}) is considerably an essential element and inspected as playing important role in maintaining postharvest standard of fruit and vegetable crops by contributing to the linkages between pectic substances inside the cell-wall. Calcium(Ca) plays various roles in plants, including structural functions in cell walls, balancing of cell membranes, sustenance of cell turgor pressure, and as a counter-ion for inorganic and organic anions in vacuoles and also as cytoplasmic second messenger.

Fruit cracking or splitting is serious problem in many fruits including pomegranate. Fruit cracking was notably reduced by application of CaCl_2 foliar spray of concentration 2 and 4% in cultivars 'Manfaloty' and 'Wonderfull'. By , experiment was carried out in orchard of Razavi Khorasan in North Eastern Iran in two seasons to note the effect of Ca fertilization on fruit cracking and their result showed that results show that Ca fertilization reduces fruit cracking upto 26–52% in two different seasons in comparison with the control, with the best effect obtained by nano-Ca fertilizer at 0.50 g Ca L^{-1} . In pomegranate, the rate of cracking was reduced to 5.5 and 5.2%, from 28.4% in comparison with unsprayed trees by application of CaCl_2 spraying of concentration 0.5 and 1%. From the experiment conducted by in two seasons of year 2013 and 2014 it was found that by spraying 2% calcium chloride, fruit cracking reduced to 8.0% and 7.2% from 19.4% and 17.9% in comparison with trees sprayed with water. Reduction in fruit cracking percentage is due to role of Ca in the cohesion of cell walls, since it interacts with pectic acid.

From the experiment conducted by in two seasons of year 2013 and 2014, it was observed that tree height, fruit number, leaf area, leaf total chlorophyll were increased, percentage of sunburn fruits decreased, peel calcium and nitrogen content were increased as compared with control treatment of Manfaloty pomegranate by application of calcium chloride foliar spray. Among various concentration of calcium chloride, 2% calcium chloride treatment showed the best effect. Tree productivity was influenced remarkably by calcium chloride treatments as compared with the control(water spray) treatment. Tree productivity increased to 47.1 and 40.3 kg/tree from 38.9 and 30.4 kg/tree for control treatment in 2013 and 2014 seasons, by application of 2% calcium chloride . High yield, good-fruit quality, and reduction in fruit cracking was noted by spraying

Manfaloty pomegranate trees with calcium chloride at 40 or 80 ml/L. Positive effect were noted in yield, leaf area and chlorophyll content with calcium chloride and manganese sulphate spraying of Salemy cultivar. The remarkable yield was observed by spraying calcium at 100 mg L^{-1} in combination with manganese at 60 mg. L^{-1} .

Potassium

Potassium is an essential element for plants. It is engaged in many physiological processes, triggering of several enzymes and maintain cation and anion balance. An experiment was carried out by in Natural Resources Research Center (ANRRC) of Iran in 2009 to study effects of potassium nitrate on 'Malas Yazdi' pomegranate. The result of the experiment concluded that fruit length, fruit quality and reduction in harmful effect of carob moth were noted by spraying KNO_3 at concentration of 250 mg L^{-1} .

To study combined effect of Potassium, Calcium and boron, a study was conducted by in experimental farm in state of himachal pradesh on eight year old plants of Bhagewa cultivar for two year. It showed that foliar application of 1% KNO_3 , 1% CaCl_2 and 0.4% H_3BO_3 increased vegetative growth, yeild, fruit quality, reduced fruit cracking, increased leaf nutrient content. So combination of these nutrients can be used for over all growth and yeild as per requirements. Foliar spray of KNO_3 at concentration of $10,000 \text{ mg L}^{-1}$ reduced fruit cracking, also highest ascorbic acid concentration was obtained by this treatment in 'Kadru' cultivar. In addition to that KNO_3 at concentration of $15,000 \text{ mg L}^{-1}$ showed lowest fruit length /diameter ratio and highest peel thickness. . It can be attributed that increasing in diameter or decreasing in length of fruit is considered as an betterment (from elongated to spherical) of fruit form (Stander, 2013). It may be due to role of potassium that fruit splitting resistance ability of is due to cell division betterment that leads to formation of thicker fruit peel. .

Nitrogen

Nitrogen plays vital roles in plant growth and development, many parameters like fruit yeild and fruit quality are affected by nitrogen. It is required for chlorophyll and enzyme synthesis and it is major component of proteins, metabolites, and nucleic acids. The growth of all plant organs, including roots, stems, leaves, flowers, and fruits is limited if there is N deficiency.

To study combined effect of nitrogen and neem cake, an investigation was carried out by at Horticulture Research Station B. C. K. V. Mondouri, West bengal, India on cultivar Ganesh. From various combination of Nitrogen and Urea, $300 \text{ g plant}^{-1} \text{ year}^{-1} + 1 \text{ Kg neem}$

cake gave best results along with common doses of 100 g P₂O₅ and 100g K₂O. Nitrogen and neem cake influenced many parameters. 300g plant⁻¹year⁻¹ + 1 Kg neem cake increased number of fruits per plant, fruit weight (from 146. 77 g to 239. 83 g), juice percentage, total soluble solids, total sugar concentration, ascorbic acid content (21. 93 mg 100⁻¹ ml juice), fruit length. Along with these lowest seed percentage and least acidic fruits were obtained by thid combination in comparision with trees under control treatment which were supplied with common doses of potassium and phosphorus. Increase in growth can be explained by fact the many compounds that have physiological importance in metabolism like amino acids, proteins, nucleic acids, porphyrins, enzymes, and coenzymes have nitrogen as major constituent.

Conclusion

Plant growth depend on water, soil, irrigation systems, temperature and many more parameter, but Nutrients play major role in plants overall growth, so to increase production and improve quality of fruits, adequate amount of nutrients at proper time interval should be used. Moreover foliar application of nutrients are more beneficial as nutrients are directly absorbed by the leaves and has advantage of uniform distribution. As Potassium, Calcium and nitrogen are essential nutrients required for pomegranate, use of Calcium showed beneficial effect in reducing cracking problem of pomegranate. Potassium increased vegetative growth, leaf nutrient content and ascorbic acid content. Lastly, Nitrogen increased number of fruits per plant, fruit weight, juice percentage, total soluble solids, total sugar concentration, ascorbic acid content, fruit length and lowest seed percentage.

Acknowledgement

The author thank Department of Chemistry, KSKV Kachchh University and Council of Scientific and Industrial Research (CSIR) for their support.

References

[1] Agarwala, S. C., & Sharma, C. P. (2013). Plant nutrients – their functions and uptake. *1976*, 7-64.

[2] Al-Said, F., L. A. O., & Al-Yahyai, R. (2009). Physicochemical and textural quality attributes of pomegranate cultivars (*Punica granatum* L.) grown in the Sultanate of Oman. *Journal of Food Engineering*, *90*(1), 129-134.

[3] Al-Said, F., Opara, L. A., & Al-Yahyai, R. (2009). Physicochemical and textural quality attributes of pomegranate cultivars (*Punica granatum* L.) grown in the Sultanate of Oman. *Journal of Food Engineering*, *90*(1), 129-134.

[4] Arhtar, A., Abbasi, N., & Hussain, A. (2010). Effect of calcium chloride treatments on quality characteristics of loquat fruit during storage. *Pak. J. Bot*, *42*(1), 181-188.

[5] Aseri, G., Jain, N., Panwar, J., Rao, A., & Meghwal, P. (2008). Biofertilizers improve plant growth, fruit yield, nutrition, metabolism and rhizosphere enzyme activities of pomegranate (*punica granatum* L.) in Indian Thar Desert. *Scientia Horticulturae*, *117*(2), 130-135.

[6] Bakeer, S. (2016). Effect of ammonium nitrate fertilizer and calcium chloride foliar spray on fruit cracking and sunburn of Manfalouty pomegranate trees. *Scientia Horticulturae*, *209*, 300-308.

[7] Barker, A. V., & Pilbeam, D. J. (2007). *Handbook of plant nutrition*. CRC Press, Taylor and Francis.

[8] Davarpanah, S., Tehranifar, A., Abadia, J., Val, J., Davarynejad, G., Aran, M., & Khorassani, R. (2018). Foliar calcium fertilization reduces fruit cracking in pomegranate (*Punica granatum* cv. Ardestani). *Scientia Horticulturae*, *230*, 86-91.

[9] Demarty, M., Morvan, C., & Thellier, M. (1984). Calcium and the cell wall. *Plant, Cell and Environment*, *7*(6), 441-448.

[10] Dong, S., Cheng, L., Scagel, C., & Fuchigami, L. (2005). Timing of urea application affects leaf and root N uptake in young Fuji/M. 9 apple trees. *The Journal of Horticultural Science and Biotechnology*, *80*(1), 116-120.

[11] Duttaray, S., Takawale, P., Chatterjee, R., & Hnamte, V. (2014). Yield and quality of pomegranate as influenced by organic and inorganic nutrients. *The Bioscan*, *9*(2), 617-620.

[12] El-Akkad, M., El-Zahraa, F., Gouda, M., & Ibrahim, R. (2016). Effect of GA3, Calcium Chloride and Vapor guard Spraying on Yield and Fruit Quality of Manfalouty Pomegranate Trees. *J. Agric. Sci.*, *47*, 181-190.

[13] Gill, P., & Nandpuri, K. (1970). Comparative resistance to fruit cracking in tomato (*Lycopersicon esculentum* Mill.). *Indian Journal of Agricultural Science*, *40*, 89-98.

[14] Hegazi, A. S. -B. (2014). Improving fruit quality of Manfolty and Wonderful pomegranates by using bagging and some spray treatments with gibberellic acid, calcium

- chloride and kaolin. *Journal of Plant production*, 5(5), 779-792.
- [15] Khayyat, M., Tehranifar, A., Zaree, M., Karimian, Z., Aminifard, M., Vazifeshenas, M., Shakeri, M. (2012). Effect of potassium nitrate spraying on fruit characteristics of 'Malas Yazdi' Pomegranate. *Journal of Plant Nutrition*, 35, 1387-1393.
- [16] Kirkby, E., & Pilbeam, D. (1984). Calcium as a plant nutrient. *Plant, Cell and Environment*, 7(6), 397-405.
- [17] Kumar, G., Sharma, D., Kuchay, M., Kumar, R., Singh, G., & Kaushal, B. (2020). Effect of Foliar Application of Nutrients on growth, Yield and fruit quality of Pomegranate (*Punica granatum L.*) Cv. Bhagwa. *Current Journal of Applied Science and Technology*, 39(20), 50-57.
- [18] Marschner, P. (2012). *Marschner's Mineral Nutrition of Higher Plants* (3rd ed.). London, UK: Academic Press.
- [19] Mastrangelo, M., Rojas, A., Castro, M. A., Gerschenson, L., & Alzamora, S. (2000). Texture and structure of glucose-infused melon. *J. Sci. Food Agric*, 80, 769-776.
- [20] Mokhtarzadeh, Z., & Shahsavar, A. (2020). Effects of gibberellic acid, potassium nitrate and calcium sulfate on pomegranate fruit splitting and fruit characteristics. *Agriculture Conspectus Scientificus*, 85(3), 237-245.
- [21] Picchioni, G., Weinbaum, S., & Brown, P. (1995). Retention and the Kinetics of Uptake and Export of Foliage-applied, Labeled Boron by Apple, Pear, Prune, and Sweet Cherry Leaves. *American Society for Horticultural Science*, 120(1), 28-35.
- [22] Sagimura, Y., Mori, T., Nitta, I., Kotani, E., Furusawa, T., Tatsumi, M., Morita, Y. (1999). Calcium Deposition in Idioblasts of Mulberry Leaves. *Annals of Botany*, 83, 543-550.
- [23] Sheikh, M. M. (2012). Effect of chemicals on control of fruit cracking in pomegranate (*Punica granatum L.*) var. Ganesh. *II International Symposium on the pomegranate*, 133-1, 35.
- [24] Stander, O. (2013). *Fruit split and fruit size studies on Citrus*. University of Stellenbosch, Faculty of Agriculture, , Stellenbosch.
- [25] Talcott, S., Stohlawetz, Rios, J., Hingorani, L., & Derendorf, H. (2006). Absorption, metabolism and antioxidant effect of pomegranate (*Punica granatum L.*) polyphenol after ingestion of a standardized extract in healthy human volunteers. *Journal of Agricultural and Food Chemistry*, 54(23), 8956-8961.
- [26] Titus, J., & Kang, S. (1982). Nitrogen metabolism, translocation and recycling in apple trees. *Horticultural Reviews*, 4, 204-246.
- [27] Waleed, A., Al-Rawi, Jassim, N., & Al-Hadethi, M. (2014). Effect of manganese and calcium foliar application on tree growth, yield and fruit quality of salemy pomegranate cultivar. *Zagazig Journal of Agricultural Research*, 41(5), 977-983.
- [28] White, P. (2001). The pathways of calcium movement to the xylem. *J. Exp. Bot.* 52, 891-899. *J. Exp. Bot.* 52, 891-899.