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Integrated Nutrient Management in Ppomegranate: A Review

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Abstract

Alleviation of poverty and achievement of zero hunger target and food security are significant challenges faced by agricultural planners worldwide. Indiscriminate use of chemical fertilizers for yield maximization is needed to report this aim which has drastic effects on crop growth and yield. Integrated Nutrient Management (INM) is a sustainable approach to managing soil fertility and plant nutrition that emphasizes the use of organic and inorganic fertilizers, along with cultural practices, to enhance soil health, promote plant growth, and increase crop yields. Integrated nutrient management is a recognized tool for maintenance or adjustment of soil fertility and plant nutrient supply at an optimum level to sustain the desired crop productivity through all possible sources of plant nutrients in an integrated manner through a balanced use of fertilizers combined with organic sources. In the case of pomegranate cultivation, INM practices have been found to be highly effective in improving soil fertility, nutrient availability, and overall plant health.

Key words : Pomegranate, yield, fruit, quality and growth.

Pomegranates (*Punica granatum* L.) are tropical and subtropical fruit crops belonging to the Punicaceae family and native of Iran. Due to the fruit's ability to grow in arid and semi-arid regions of India, it is one of the most important pomegranate producing countries with higher return. Phule Bhagwa, Dholka, Kabul, Alandi, G-137, Ganesh, Khandari, Mridula and Jyoti are important cultivars grown in India (Wasker and Sushanta, 2004). It contains 12-16 percent sugar and 1.5-2 percent acid. It is rich in sugars, ascorbic acid, pantothenic folate, and vitamins A, E, and K (Yadav *et al*., 2006).It has some medicinal properties and is considered useful for treating leprosy, dysentery, and diarrhea. Fruit rinds contain about 30 percent tannin that can be used to make leather. Pomegranates being a non-climacteric fruit have great potential for modified atmosphere packaging (MAP) using polymeric films, during refrigerated transport or storage; this will preserve fruit quality as well as prevent chilling injury. Pomegranate production is affected by several factors, such as soil, climate, irrigation, variety, pest and disease situation, and nutrition of the soil and plant. Pomegranate production, yield and quality are drastically reduced when pomegranate nutrients are deficient. There is a horticultural solution for every nutritional problem. Nutrition is vital for productivity, quality, and profitability. Chemical fertilizers are not only causing significant deterioration of soil health and productivity, but are also affecting soil micro flora, reducing pH. Organic matter increases root growth and proliferation by improving soil aeration. To maintain and improve soil quality and productivity levels at low input costs, bio fertilizers are being explored (Singh *et al*., 2010). Using bio-fertilizers like Phosphorous Solubilizing Bacteria (Mia *et al*., 2005) and *Trichoderma harzianum* (Balakrishna *et al*., 2005) in conjunction with vermicompost

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(Sabarad *et al*., 2004) results in increased yield, especially in reclaimed soils due to overcoming drought, salt and pathogens stresses, reducing fertilizer applications, and increasing availability of macro and micro elements. By combining chemical fertilizers with biofertilizers, efficiency of fertilizer use has been improved and losses and leakage minimized (Dutta *et al*., 2010). The nation's greatest challenge in recent years has been to provide food to a growing population using less chemical fertilizers and pesticides and more bio-agents that are pollution free. In view of these, there is an urgent requirement of integrated nutrient management system which takes the holistic approach of the maintenance of soil fertility and of plant nutrients supply to an optimum level for sustaining crop productivity through optimization of benefits from all possible sources of plant nutrients in an integrated manner. Based on this background, the present review was compiled to study the effects of integrated nutrient management in fruit crops.

The Effect of Integrated Nutrient Management on Growth Parameters, Yield and Yield Attributes : Saraf *et al*. (2001) reported that the application of poultry manure at 5 kg plant^{-1} followed by FYM at 10 kg plant^{-1} (180.00cm), bone meal 1 kg + N: P: K plant^{-1} (178.48g), and FYM 10 kg + N: P: K plant-1is the effective treatments to boost up the growth of pomegranate plants. Pooja *et al*. (2022) reported that the growth parameters such as plant height, stem girth, number of stems per plant, plant spread (N-S and E-W), number of shoots, shoot length, shoot girth, number of leaves per shoot and leaf area were significantly higher in a plants treated with 100 per cent RDF + vermicompost (5 kg plant^{-1}) + neem cake (1 kg plant^{-1}) + trichokawach (100 g plant^{-1}) + darakshak (4 ml litre^{-1}) foliar application + VAM (50 g plant^{-1}) + Penicillium pinophilum (20 g plant^{-1}t) + seaweed extract (20 g plant^{-1}) + chitosan (2 g litre^{-1}) + salicylic acid (300ppm) + phosphoric acid (3 ml litre^{-1}) + micronutrients through soil and foliar application + growth regulators (foliar application). Hence, it indicated that this treatment enhances the growth parameters which indirectly improves the flowering and yielding capacity of pomegranate plants. Sheikh and Manjula (2009) observed the effects of the split application (2 splits at 2-month interval, 3 splits at 1.5-month intervals or 4 splits at one-month intervals) of the recommended NPK rates (400:200:200 g per plant) on the performance of pomegranate cv. Ganesh.The split application of fertilizers did not enhance plant height irrespective of the number of splits. Plant spread was not significantly affected by the treatments. The increase in the number of splits increased the number of shoots per branch. The leaf area was greatest with fertilizer application in 4 splits (8.09 cm^2). Eman *et al*. (2010) found that soil application of 500:250:500 N: P_2O_5:K_2Og plant^{-1} along with 15 kg of FYM plant-1 resulted in maximum fruit set (28.85 and 27.37%) in pomegranate. Dhillon *et al*. (2011) investigate the effect of fertilization on pomegranate 'Kandhari', the plants were fertilized on individual nutrient basis for the period of three years. The treatments consisted of four levels of N (0, 20, 40 and 60 g tree^{-1} year^{-1}), three levels of P2O5 (0, 20, 40 g tree^{-1} year^{-1}) and four levels of K2O (0, 20, 40 and 60 g tree^{-1} year^{-1}). Nitrogen increased the growth of plant in terms of higher girth, height, spread and volume of tree as compared to rest of the treatments. Nandi *et al*. (2013) reported that in pomegranate cv. Ganesh significant improvement in plant height, canopy spread EW and NS by the use of enriched vermicompost with 75 and 100% recommended dose of inorganic fertilizer(i.e. 100 g urea, 250 g single super phosphate and 50 g muriate of potash plant^{-1}). Ray *et al*. (2014) found that increase in production and quality of pomegranate plants treated with 300g

nitrogen + 1 kg neem cake plant^{-1} recorded highest total soluble solids (12.29°Brix), total sugar (10.74%), reducing sugar (9.78%), non reducing sugar (1.09%) and ascorbic acid (21.93 mg 100^{-1} mL of juice). The acidity was also recorded lower (0.39%) with this treatment. Gajbhiye *et al*. (2020) evaluated the effect of Integrated Nutrient Management on Disease Resistance of Pomegranate (*Punica granatum* L.).They found that the growth parameter, height of pomegranate plant at flowering and harvesting showed statistical significance with application of FYM @ 15 kg, Azotobacter @ 8 ml per tree, PSB@ 8 ml per tree and Trichoderma @ 100 g per tree, 625:250:250 g N, P2O5 and K2O per tree and 25 kg URHS per tree.The spread of pomegranate tree was not found significant with Integrated Nutrient Management practices (FYM, Solubilizers, RDF, Antibiotics and URHS). Yield attributes viz., number of flowers (204.75), number of fruits (172.88), fruit set (84.39%), fruit weight (244.82 g) and yield (41.21 kg tree^{-1}) of pomegranate were significantly increased due to application of 15 kg FYM + 8 ml Azotobactor + 8 ml PSB +100 g *Trichoderma* + RDF+ Umber (Ficus racemosa). Kashyap *et al* (2012) reported that in pomegranate plants maximum fruit set (28.85 and 27.37 %), fruit yield(14.94 and 14.91 kg),TSS (16.07 and 16%), total sugars (11.46 and 11.44%), non-reducing sugars (2.80 and 2.68%) and reducing sugars (9.56 and 9.58%) were recorded with the treatment N3K4 (N-500 and K-500 g plant^{-1}). Whereas maximum fruit weight (458.3 and 458.1 g) and fruit with high acidity (0.52 and 0.54%) were obtained with N5K4 (N-750:K-500) and N5K5 (N-750:K-600) for both the years. The application of N and K at optimum level of 500 g plant^{-1} year^{-1} of each was found to be superior as compared to other treatments for enhancing fruit, yield and quality. Rao and Subramanyam (2009) reported that in pomegranate maximum number of fruits (45.1) and fruit yield (11.6 kg) per tree were recorded by applying 50% recommended dose of nitrogen at fortnight intervals. Kirankumar *et al*. (2022) reported that application of 100% recommended dose of fertilizers (RDF) along with vermicompost + poultry manure + Azospirillum + PSB + KSBT9 has recorded the maximum fresh weight of leaf (0.28 and 0.38 g), dry weight of leaf (0.17 and 0.27 g), leaf area (9.91 and 12.89 cm2), shoot length (35.22 and 43.33 cm) at 30 and 60 days after first Biofertilizer application respectively in pomegranate. Patil *et al*. (2020) found that the growth parameter, height of pomegranate plant at flowering and harvesting showed statistical significance with application of FYM @ 15 kg, Azotobacter @ 8 ml per tree, PSB@ 8 ml per tree and *Trichoderma* @ 100 g per tree, 625:250:250 g N, P_2O_5 and K_2O per tree and 25 kg URHS per tree.

Impact of Integrated Nutrient Management on Leaf and fruit nutrient : Meena *et al*., 2020 found that combination of vermicompost @ 10 kg + 25 per cent recommended dose of NPK + 5 kg Neem cake+ PSB 20g per plant significantly increased the quality components of pomegranate fruits in terms of TSS (16.95°Brix) , TSS acid ratio (41.62), ascorbic acid (14.39 mg/100 g), total sugar (14.24%) and organoleptic score (8.51) as well as leaf and soil nutrient status as compared to recommended dose of NPK (500g : 200g: 500g). Marathe *et al*. (2017) found that application of FYM had the highest availability of most of the nutrients (P: 64.4 and K: 578.7 kg ha^{-1}; Cu: 15.1, Zn: 2.30 and Mn: 8.4 ppm) in the soil. Highest P (0.182%), K (1.06%) and Fe (176.7 ppm) contents in the leaves were supplied by PM, while N (2.33%) was by FYM. Maximum fruit yield was obtained with the application of PM (3.96 kg tree^{-1}) followed by FYM (3.86 kg tree^{-1}). All of the organic manuring treatments resulted in improved fruit

quality characteristics viz. fruit juice content, juice acidity, TSS and TSS: acid ratio as compared to inorganic fertilizers. Organic manuring with neem recorded the lowest disease index (5.84) on plants. Similarly, increased microbial load in the rhizosphere soil in terms of *P. fluorescence* (20.3 x 10^{-4} cfu g^{-1}) and Azotobacter chroococcum (17.4 x 10^{-3} cfu g^{-1}) population was recorded in FYM.

Impact of Integrated Nutrient Management on soil Properties : Choudhary *et al*. (2022) found that treatment organic combination Jeevamrut 16.08 L $plant^{-1}$ + Vermicompost 24.79 kg $plant^{-1}$ had a significant effect on the nutritional status (available nitrogen, available phosphorus, and available potassium) and microbial population (fungi, bacterial, and actinomycetes count). In addition Jeevamrut 16.08 L $plant^{-1}$ + Vermicompost 24.79 kg $plant^{-1}$ found a significant effect on fruit yield characteristics like fruit $plant^{-1}$ (122.00), fruit yield (17.38 kg $plant^{-1}$), fruit weight (192.50 g) and fruit quality characteristics such as fruit juice percent (52.92%), and total sugar (11.92%). Mir *et al*. (2013) reported the effects of bio-organics and chemical fertilizers on nutrient availability and biological properties of pomegranate orchard soil. He observed that conjoint application of bio-fertilizers 80 g $tree^{-1}$, vermicompost 20 kg tree-1, FYM 20 kg tree-1, green manure(GM) sunnhemp (*Crotalaria juncea* L.) and recommended dose of fertilizers (400:200:200 $N:P_2O_5:K_2O$ g plant-1) resulted in significantly maximum porosity (60.27%), water holding capacity(WHC) (60.31%), bulk density (0.97%), particle density (2.25%), organic carbon (1.90%), soil pH (6.89), soil N (405.56 kg ha^{-1}), P (22.025 kg ha-1), K (419.00 kg ha^{-1}). Muzaffar *et al* (2013) reported the conjoint efficiency of bio-organics used along with chemical fertilizers on nutrient availability and physico-chemical and biological properties of soil on pomegranate cv.'Kandhari Kabuli'. Conjoint application of bio-fertilizers 80 g $tree^{-1}$, vermicompost 20 kg $tree^{-1}$, FYM 20 kg $tree^{-1}$, green manure (GM) sunnhemp (*Crotalaria juncea* L.) and recommended dose of fertilizers (RDF) of Nitrogen, Phosphorus and Potassium (NPK), resulted in significantly maximum porosity (60.27%), water holding capacity (WHC) (60.31%), bulk density (0.97%), particle density (2.25%), organic carbon (1.90%), soil pH (6.89), soil N (405.56%), P (22.02%), K (419.00%), Iron (Fe) (66.92 ppm), Maganese (Mn) (61.95 ppm), Zinc (Zn) (2.33 ppm) and Cupper (Cu) (3.25 ppm). The microbial biomass pool in terms of Pseudomonas sp, soil fungi, Azotobacter chroococcum, Actinomycetes and Arbuscular mycorrhizal fungi increased by 385.57, 60.26, 134.19, 168.02 and 39.87%, respectively over the control.

The Influence of INM on Microbial population : Aseri *et al*. (2008) found that the combined treatment of Azotobacter chroococcum and Glomus mosseae was most effective in increasing the rhizosphere microbial activity and concentration of various metabolites and nutrients in pomegranate. Marathe *et al*. (2017) reported that application of FYM increased microbial load in the rhizosphere soil in terms of P. fluorescence (20.3 x 10^{-4} cfu g^{-1}) and Azotobacter chroococcum (17.4 x 10^{-3} cfu g^{-1}) population. A. niger (13.6 × 10^{-4} cfu g^{-1}) and PSM (15.6 x 10–5 cfu g^{-1}) activity was higher in GM with Karanj and Sun hemp, respectively. Marathe *et al*. (2011) evaluated the effectiveness of various microbial inoculants in pomegranate saplings prepared from air layers. They demonstrate the beneficial effect of seven microbial inoculants isolated from pomegranate and cotton, as sole inoculants or in combination, on nutrient acquisition and plant growth under semi-arid agro-climatic condition. Inoculation with *T. viride* recorded highest content of

available N, P and DTPA extractable Zn content of the soil. A significant improvement in plant height and shoot biomass was also recorded in this treatment while root biomass was highest with P. striata inoculation. Microbial inoculants under study benefited the growth of saplings by improving the soil properties, fertility status, physiological parameters and nutrient uptake. Hence using these microbial inoculants in potting mixture for air layers may facilitate their better establishment and growth under field condition.

Conclusion

Integrated nutrient management is only effective approach which can offer good options and economic choice to supply plants macro and micronutrients and also reduce the use of chemical fertilizers, create favorable soil physiochemical conditions and healthy environment, safeguard soil nutrient balance in the long run, generate an optimum level for sustaining the desired crop productivity and lastly it is safe methods to get rid of agriculture wastes. Overall, INM provides a sustainable solution for pomegranate cultivation that can help to ensure the long-term health and productivity of the soil and the crop, while also providing numerous benefits for farmers and consumers alike.

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