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HORTICULTURE

Influence of combined use of organic, inorganic and biological sources of nutrients on fruit quality in lemon

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Abstract

The use of high analysis chemical fertilizers results in the deficiency of nutrients other than the applied. Chemical fertilizers besides being costly are also injurious to plants, ground water and environment. However, in recent years organic sources have emerged as promising components of nutrient supply system. These organic sources when used along with inorganic sources under the concept of integrated nutrient management are known to improve nutrient status of plants either by way of fixation or by making fixed nutrients available to plants. To obtain superior quality of fruit, thus it is a pre-requisite to study the integrated nutrient management in lemon. An experiment was conducted at "Punjab Government Progeny Orchard & Nursery, Attari, Amritsar" during the fruiting years 2005 and 2006 with a view to harvest good quality lemon fruit. The experiment was laid out in Randomized Block Design with five treatments replicated four times. Different treatments involved application of FYM, inorganic fertilizer and biofertilizer (*Azotobacter*) in various combinations. The present experiment shows that the substantial improvement in fruit quality could be achieved with the combined application of these three classes of nutrient sources.

Highlights

- INM is the only solution for nutrient balancing in fruit plants.
- INM plays an important role in enhancing fruit quality.
- Consortium of nutrient sources proves far better to their sole application.

Keywords: Lemon, FYM, inorganic fertilizer, *Azotobacter*, quality

Lemon is a medium sized little thick skinned abundantly juicy acid fruit. It forms an integral part of citrus fruits for their utilization as refreshing cool drinks in summer. It has characterization of bearing fruits in many flushes making it available throughout the year, but simultaneously, lemon is confronted with problem of poor fruit quality in summers which causes considerable reduction in the marketable fruit, thus leading to heavy financial losses to the lemon growers every year. This is mainly due to inadequate uptake of nutrients by plants which occur due to unselective fertilization. The conventinal methods utilizes only inorganic fertilizers of which nitrogenous fertilizers are commonly used by most of the farmers because of quick availability of nitrogen to the plants. However, their continuous use lead to damage the ecosystem and soil health. Thus, there is need to give emphasis on management of natural resourses like biofertilizers and organic manures. Though these are not the substitutes, but a supplement to the chemical fertilizers for improving fruit quality and maintain balance in the ecosystem. The adequate fertilization, regular application of nutrients or alternatively use of nutrient enriched organic manures and biofertilizers in integrated nutrient management results in quality citrus production (Srivastava, 2012). The best fruit quality can be obtained only

if tree is nourished properly (Morgan, 2009). The effects of nutrition on fruit quality are important to understand and taken into consideration by citrus growers to increase profitability and enhance sustainability and worldwide competitiveness (Zekri, 2009). In the present experimentation, poor fruit quality was noticed when one or another source of fertilizer was missing. This may be due to the reason that when one or another source was absent, it caused unbalancing in the nutrient uptake by the plants, hindering proper development of fruits. It is preferable to use FYM and slow release fertilizers or bio-fertilizers along chemical fertilizers to feed the trees as they replenish the nutrients, as time released fertilizers offer the convenience of supplying the nutrients at an even rate for a longer period for consistent growth and improving the quality. Thus, attractive fruit quality, acceptable to consumer appeal can be obtained only by following the concept of integrated nutrient management in lemon. Thus, the optimized standards of fertilizer application are of great importance to enhance fruit quality.

Materials and methods

The present studies were conducted at "Punjab Government Progeny Orchard & Nursery, Attari, Amritsar" during the year 2005 & 2006. In the trial, eight year old, uniform and disease free trees of lemon were selected to study the influence of combined use of organic, inorganic and biological sources of nutrients on fruit quality in lemon (*Citrus limon* (L.) Burm.) cv. Baramasi. The experiment was conducted in Randomized Block Design. There were five treatments as per following treatment details.

T_1 – Control (standard dose *viz.* 75 Kg/tree FYM and 350g/tree N).

T_2 – FYM (75 Kg/tree) + *Azotobacter* (18g/tree)

T_3 – Inorganic fertilizer (350g/tree N) + *Azotobacter* (18g/tree)

T_4 – FYM (75 Kg/tree) + inorganic fertilizer (350g/tree N) + *Azotobacter* (18g/tree)

T_5 – FYM (2 times the standard dose *viz*. 150 Kg/tree) + inorganic fertilizer (1.5 times the standard dose *viz*. 525g/tree N) + *Azotobacter* (18g/tree)

In this experiment, the effect of FYM, inorganic fertilizer and biofertilizer on the physico-chemical characters of the fruit in lemon was studied. The standard fertilizer dose as recommended by PAU, Ludhiana for 8 years old citrus trees is 75 Kg/tree FYM and 350 g/tree nitrogen. The whole quantity of farm yard manure was applied in December. Nitrogen dose was given in two split doses, the first part was given in February and the second in April after fruit set. The plants received standard irrigation at interval of 10-15 days. The biofertilizer (*Azotobacter*) was procured from PAU, Ludhiana. The dose of biofertilizer used was 18 g/tree and it was applied by mixing in 1.8 litre water and then drenched near the root zone of the tree (Indiamart, 2007). The observations on fruit length and breadth were measured with Vernier's Calliper. The weight of lemon fruits was determined by electronic balance and fruit volume was worked out by water displacement method. The percentage of the juice was calculated on fresh weight basis. The moisture content was expressed as the percent of fresh weight of the peel and pulp of fruit respectively. The chemical characters like TSS, acidity and ascorbic acid were measured as per standard procedures of A.O.A.C (1990).

Results and discussion

A glance over the data in Table 1 & 2 divulged that T_5 proved to be the most effective treatment in maximizing the fruit size in terms of length (5.46 cm and 5.53 cm) and breadth (4.96 cm and 5.00 cm), fruit weight (62.83 g and 63.90 g) and volume (67.06 cc and 68.23 cc) of the lemon fruits during both the years of research study. The minimum fruit size, weight and volume were evidenced in control treatment. The maximum level of these parameters was encountered when all the three sources of nutrients were applied together during the two fruiting years. The maximum moisture content of peel (75.79 per cent and 76.85 per cent) and pulp (85.18 per cent and 86.47 per cent) was observed in the fruits harvested from the trees treated with optimum nutrient sources consisting of T_5 while its lowest level was recorded under control during both the years of study. The application under treatment T_5 helped to retain the highest level of juice content (43.74 per cent and 44.15 per cent) whereas the minimum level was found in the fruits

obtained from the trees under control. The highest level of ascorbic acid (48.50 mg/100 g fresh wt. and 48.33 mg/100 g fresh wt.) was also attained with T_5 while the lowest level was evidenced in control. The minimum TSS and acidity, in the two study years was observed under control treatment while the fruits harvested from the trees under T_5 retained maximum TSS (7.85 per cent and 7.80 per cent) and acidity (5.68 per cent and 5.61 per cent) in comparison to other treatments.

Table 1: Effect of of combined use of organic, inorganic and biological sources of nutrients on fruit quality in lemon during 2005

Treatments	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (g)	Fruit volume (cc)	Moisture content of peel (%)	Moisture content of pulp (%)	Juice (%)	TSS (%)	Acidity (%)	Ascorbic acid (mg/100 ml of juice)
T_1	5.03	4.53	60.60	63.13	73.53	83.70	40.20	7.58	5.40	45.09
T_2	5.10	4.56	60.80	63.56	73.96	83.80	40.50	7.61	5.46	45.30
T_3	5.20	4.63	61.03	64.23	74.12	83.92	40.76	7.65	5.48	45.60
T_4	5.40	4.90	62.60	66.83	75.37	85.07	43.25	7.82	5.61	48.10
T_5	5.46	4.96	62.83	67.06	75.79	85.18	43.74	7.85	5.68	48.50
CD (p=0.05)	0.17	0.14	0.28	0.75	0.69	0.18	0.61	0.10	0.12	0.58

Table 2: Effect of of combined use of organic, inorganic and biological sources of nutrients on fruit quality in lemon during 2006

Treatments	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (g)	Fruit volume (cc)	Moisture content of peel (%)	Moisture content of pulp (%)	Juice (%)	TSS (%)	Acidity (%)	Ascorbic acid (mg/100 ml of juice)
T_1	5.10	4.56	62.06	64.60	74.66	84.03	41.00	7.52	5.33	46.00
T_2	5.16	4.60	62.20	64.70	75.01	84.35	41.06	7.55	5.39	46.13
T_3	5.26	4.66	62.40	65.36	75.29	84.59	41.26	7.59	5.41	46.40
T_4	5.46	4.93	63.70	67.73	76.51	86.20	43.75	7.76	5.54	47.96
T_5	5.53	5.00	63.90	68.23	76.85	86.47	44.15	7.80	5.61	48.33
CD (p=0.05)	0.12	0.17	0.41	0.94	0.98	0.61	1.13	0.13	0.12	0.59

The better fruit size and weight may probably be due to better growth and development of plants with the optimization of nutrients. The biofertilizer enhanced the cell division and cell enlargement as a resultant of induced growth hormones (Narashma and Haripriya, 2001) which helped in increasing the fruit size and weight. When inorganic N was added in combination with FYM and biofertilizer, it resulted in slow release of nitrogen for better nutrition throughout the growth of fruit resulting in increase in size, as nitrogen is an important constituent of nucleo protein and amino acids. The present findings are in agreement with previous results of Bhobia *et al*. (2005). Increased fruit weight ultimately resulted in increased fruit volume. Higher level of moisture content of peel and pulp may be attributed to higher retention of moisture content in soil by organic matter and higher uptake of moisture and nutrients like K by the plant tissue due to biofertilization. This ample availability of water in plant tissue might have resulted in higher moisture content in peel and pulp of lemon.

Moreover, K also maintains the water status of cells. The percentage of juice was influenced by various manurial, inorganic and biofertilizer doses as the beneficial effect of manuring and biofertilization seems to have resulted from the increased supply of nitrogen which forms the basis of many physiological reactions in the living cells. The striking increase in case of combination of organic and inorganic sources of nitrogen appears to be due to the added benefits of organic matter which improves the soil structure, penetration, retention of moisture, etc. and root proliferation by biofertilizer. Since water is the chief constituent of fruit juice, its increased availability within certain limits was apt to affect the juice percentage favourably. There is enough evidence in literature to support these findings. Seshadri and Madhavi (2001) also reported similar results in sweet orange. The higher ascorbic acid content with increased N application in form of organic and inorganic nutrient sources under T_5 might be due to the catalytic activity of several enzymes, which participate in biosynthesis of ascorbic acid and its precursor. These results are in line with the findings of Dudi *et al*. (2005) in Kinnow, Ingle *et al*. (2001) in acid lime and Seshadri and Madhavi (2001) in sweet orange. The TSS and acidity showed an increment with increase in nutrient supply. Even absence of single source also influenced the parameters adversely. The improved tree condition, efficient functioning of the leaf area and increased photosynthesis increased the soluble solids. Increase in acidity with enhanced nitrogen application in form of additives like FYM and biofertilizer along inorganic N might be due to the fact that N helps in synthesis of various organic acids. Similar findings were reported by Dudi *et al*. (2005) in kinnow mandarian. The results for total soluble solids and acidity are in full accord with the findings of Ingle *et al*. (2001) in acid lime.

Conclusion

The nutrient requirement in lemon needs to be emphasized as inadequacy of one or other nutrient at critical stage of fruit development adversely affects the quality of lemon. The study concludes that organic or biological sources when used along chemical sources of nutrients fulfill more needs of plant as compared to their sole application. Therefore, routes which are operated through the use of FYM and biofertilizer along inorganic nitrogen form vital component of integrated nutrient management for improving soil fertility and health for optimum crop production.

References

A.O.A.C., 1990. *Official methods of Analysis of Analytical Chemists, 15th Edition (Ed. W. Horowitz)*. Association of the Official Analytical Chemists, Washington, DC, USA

Bhobia, S.K., Godara, R.K., Singh, S., Beniwal, L.S., and Kumar, S. 2005. Effect of organic and inorganic nitrogen on growth, yield and NPK content of guava cv. Hisar Surkha during winter season. *Haryana Journal of Horticulture Science* **34**: 232-233

Dudi, O.P., Singh, S., Baloda, S., and Singh, D. 2005. Effect of nitrogen and FYM on fruit quality and yield of kinnow mandarin. *Haryana Journal of Horticulture Science* **34**: 224-226

Indiamart, 2007. Homepage. < http://www.indiamart.com/jayenterprises/fertilizers. html#bio-fertilizer>. Accessed 2007 Apr, 10

Ingle, H.V., Athawale, R.B., Ghawde, S.M., and Shivankar, S.K. 2001. Integrated nutrient management in acid lime. *South Indian Horticulture* **49**: 126-127

Narashma, R.S., and Haripriya, K. 2001. Integrated nutrient management in crossandra cv. Dingigul Local. *South Indian Horticulture* **49**: 181-184

Morgan, K.T. 2009. Response of Young and Maturing Citrus Trees Grown on a Sandy Soil to Irrigation Scheduling, Nitrogen Fertilizer Rate, and Nitrogen Application Method. *Horticulture Science*. **44**(1): 145–150.

Seshadri, K.V., and Madhavi, M. 2001. Effect of organic and inorganic manuring on twenty years old seedlings of sweet orange (*Citrus sinensis* (L) Osbeck) cv. Sathgudi. *South Indian Horticulture* **49**: 122-125

Srivastava, A.K. 2012. Integrated nutrient management in Citrus. In: *Advances in Citrus nutrition*, Springer, New York, London. pp 369-390.

Zekri, M., Obreza, T.A., and Koo, R. 2009. Irrigation, Nutrition, and Citrus Fruit Quality. University of Florida, IFAS Extension, SL207:1-3