

INFLUENCE OF NUTRIENT MANAGEMENT THROUGH BIO-ORGANIC MANURES ON FRUIT YIELD AND ITS ATTRIBUTES OF ACID LIME

(*CITRUS AURANTIFOLIA* SWINGLE)

T.R. BARATHKUMAR, G.PRADEEPKUMAR, R.SENDHILNATHAN, R.SURESHKUMAR,
M.RAJKUMAR, C.MURUGANANDAN AND S.MULLAIMARAN

Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar

ABSTRACT

An investigation was undertaken on the “Effect of nutrient management through bio-organic manures on fruit yield and its attributes of acid lime (*Citrus aurantifolia* Swingle)” in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu, India during 2016 - 2018. The experiment was conducted with organic manures and biofertilizers along with inorganic fertilizers which were applied with different treatment combinations viz., T₁ – Control, T₂- 100% RDF (400:200:220 g/ plant), T₃-75% RDF, T₄-50% RDF, T₅- 75% RDF + 100% FYM (20 kg/plant), T₆- 75% RDF + 100% Vermicompost (10 kg/plant), T₇- 75% RDF + 50% FYM + 50% Vermicompost, T₈-75% RDF + 50% FYM + 50% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM), T₉- 50% RDF + 100% FYM, T₁₀- 50% RDF + 100% Vermicompost, T₁₁- 50% RDF + 75% FYM + 75% Vermicompost, T₁₂- 50% RDF + 75% FYM + 75% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM). There were twelve treatments replicated thrice in Randomized block design (RBD). The yield characters of plant were significantly influenced by inorganic fertilizers along with organic manures and biofertilizers. The maximum number of fruits per plant (992.49), fruit weight (49.63 g), yield per tree (49.26 kg) and yield per hectare (13.64 tonnes) were recorded under T₁₂ - 50% RDF + 75% FYM + 75 % Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM). The lowest values were obtained under control.

INTRODUCTION

Acid lime (*Citrus aurantifolia* Swingle) is an important fruit crop in citrus group which belongs to the family Rutaceae. It occupies a vital place in the fruit industry, but yield level of citrus orchards are still very low. There are several factors responsible for low yield in acid lime and among these the inadequate supply of inorganic fertilizers and organic manures are the major one. Being a high yielding perennial crop, the nutritional requirements of lime is quite high (Banker *et al.*, 2009) but the prices of inorganic fertilizers are ever increasing which forced the farmers to look for the alternative low cost input

technology. It was observed that nutrients applied at higher doses without organic manures were less effective in improving the fruit production but more effective when applied with organic manures. Apart from this, the use of biofertilizers to maintain and improve the soil quality and productivity levels are at low input costs. Hence, the concept of alternate nutrient management system came into picture which lays emphasis on continuous improvement in soil productivity on long term basis through appropriate use of organic manures and biofertilizers with inorganic fertilizers for optimum growth and development of acid lime fruits in reference to particular agro ecological situations. The present investigation was carried out to assess the efficacy of organic manure (Farm yard manure and vermicompost) and biofertilizers (Azotobacter, Phosphate Solubilizing Bacteria and Vesicular Arbuscular Mycorrhizae) with inorganic fertilizers on fruit yield characters of acid lime

MATERIALS AND METHODS

The experiment was conducted in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu, India during 2016 - 2018. The treatment consisted with organic manures and biofertilizers along with inorganic fertilizers which were applied with different treatment combinations viz., T₁ – Control, T₂-100% RDF (400:200:220 g/ plant), T₃-75% RDF, T₄-50% RDF, T₅- 75% RDF + 100% FYM (20 kg/plant), T₆- 75% RDF + 100% Vermicompost (10 kg/plant), T₇- 75% RDF + 50% FYM + 50% Vermicompost, T₈-75% RDF + 50% FYM + 50%Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM), T₉- 50% RDF + 100% FYM, T₁₀- 50% RDF + 100% Vermicompost, T₁₁- 50% RDF + 75% FYM + 75% Vermicompost, T₁₂- 50% RDF + 75% FYM + 75% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB +150g VAM). There were twelve treatments replicated thrice in Randomized block design (RBD). The observations were recorded on yield parameters viz., number of fruits per plant (No), fruit weight (g), yield per tree (kg) and yield per hectare (tonnes). The data generated through this investigation was analyzed by the statistical method of Panse and Sukhatme (1961)

RESULTS AND DISCUSSION

The yield characters of plant were significantly influenced by inorganic fertilizers along with organic manures and biofertilizers. The maximum number of fruits per plant (992.49), fruit weight (49.63 g), yield per tree (49.26 kg) and yield per hectare (13.64 tonnes).

The application of optimum dose of inorganic fertilizers along with organic manures like farmyard manure and vermicompost which might have increased the activity of beneficial microbial population helped to initiate various growth promoting processes resulting in vigorous growth of plants. Besides promoting growth, these manures imparted beneficial effects on soil environment, especially on soil physical properties, thus making rhizosphere most congenial for growth and development resulting in

increased availability of nutrient status of NPK in both soil and leaf of acid lime which lead to higher yield and yield attributing traits. These results are in conformity with findings of Alexandresca *et al.* (1978) in mandarin, Marathe and Bharambe (2007) in sweet orange and Rajendra *et al.* (2013) in acid lime.

The increased on number basis and weight basis might be attributed due to the fact that, increasing levels of nutrients in assimilating area of crop due to which the rate of dry matter production was enhanced. Similarly, due to rational partitioning of dry matter to economic sink, the yield attributes were improved. The above results are in conformity with the findings of Dalal *et al.* (2004) and Baviskar *et al.* (2011) in sapota.

The enhancement in yield by these treatments was mainly due to proper supply of nutrients and induction of growth hormones, which stimulated cell division, cell elongation leads to increase in number and weight of the fruits, better root development, and better translocation of water and deposition of nutrients. These findings are in accordance with the Singh *et al.* (2012) in aonla and Bohane *et al.* (2016) in ber.

Higher yield response owing to application of organics ascribed to improved physical, chemical and biological properties of soil resulting in better supply of plant nutrients, which in turn led to good crop growth and yield. Humus substance present in organic product could have mobilized the reserve food materials to the sink through increased activity of hydrolyzing and oxidizing enzymes. These products would help the better availability and utilization of nutrients. All these positive effect might have facilitated quick mobilization and availability of nutrients that would aid in increased plant height, number of leaves, leaf area and photosynthetic rate. This in turn would have assisted for the increased yield in the plants. This is in confirmation with the findings of Patel *et al.* (2010) in sapota, Aba *et al.* (2011) and Kuttimani *et al.* (2013) in banana.

The reason behind, the increase in number of fruits and average fruit weight may be due to increased nutrient availability from FYM, the organic phosphorus through phosphobacteria and IAA from Azospirillum which may have increased various endogenous hormonal levels in plant tissue which might be responsible for enhancing flowering, pollen germination and pollen tube which might have ultimately increased fruit set (Dheware and Waghmare, 2009) in sweet orange.

The increase in yield due to vermicompost treatment may be attributed to increase in level of readily converted available form of essential micro and macro nutrient in the presence of either dead or live worms and offered growth mechanism in plants, resulting in increased yield parameters. Vermicompost has also beneficial effects on physical and chemical soil structure and water up take,

resulting in improving plant growth and productivity. The present findings are in accordance with the results reported by Korwar *et al.* (2006) in aonla, Rubee Lata *et al.* (2011) in guava and Ghosh *et al.* (2012) in pomegranate.

The increase in the yield and quality may be due to the content of plant growth hormones, enzymes along with macro and micronutrients in the vermicompost. Vermicompost could reduce requirement of chemical fertilizers by 25-50 percent in addition to its role in improving soil condition (Lee, 1985). These results are agreement with Dutta *et al.* (2003) in sweet orange, Musmade *et al.* (2009) in acid lime and Pawar *et al.* (2014) in acid lime.

The increased yield due to biofertilizers application may be due to the increased nutrient status as well as their uptake by the plants in association with PSB, which also has defined role in plant metabolism such as cell division, development, photosynthesis and regulation of metabolic pathway. Higher leaf chlorophyll content caused by Azotobacter inoculation, which increased meristematic activities, photosynthesis rate and carbohydrates metabolism in turn increasing yield contributing characters. Trivedi *et al.* (2012) and Dwivedi *et al.* (2012) in guava, have also reported similar findings.

Besides nitrogen fixing abilities of the microbial inoculants, the capacity to releasing phytohormones especially gibberellins should be regarded which increases the fruit size. Also the efficient partitioning of photosynthesis towards the sink by Azotobacter inoculation increased the fruit size and weight. The yield attributes or the sink capacity of a crop is determined by its vegetative growth throughout the life cycle of the plant. Vigorous growth is associated with higher sink capacity of a crop. The increase in yield can be resulted from better root proliferation. In addition, increased nutrient elements in the soil enhanced uptake of nutrients and water caused to higher photosynthesis leading to an increase of the assimilation rates. The generation of CO₂ during compost decomposition has also been found responsible for increasing yield. The present findings are in agreed with those workers of Lieten (1996) in strawberry Rubee Lata *et al.* (2011) in guava and Dadashpour and Jouki (2012) in strawberry.

SUMMARY

Thus, it could be seen that the application of organic manures at the rate of 15kg FYM+ 7.5 kg Vermicompost and Biofertilizers at the rate of 25g Azotobacter + 25g PSB + 150g VAM can reduce the inorganic fertilizations to at extent of 50 percent (200g nitrogen,100g phosphorus and 110g potassium per tree) increasing the yield parameters of acid lime. This may be due to proper supply of nutrients and synthesis of growth hormones which induces cell division and cell elongation which in turn increase the number and weight of fruit and better translocation of water uptake and deposition of nutrients.

REFERENCES

- Aba, S.C, P.K. Baiyeri and A. Tenkouano. 2011. Impact of poultry manure on growth behavior, black sigatoka disease response and yield attributes of two plantain (*Musa spp.* AAB) genotypes. **Tropicultura**.**29(1)**: 20-27.
- Alexandrescu, I., C. Popa and M. Baci. 1978. Effect of organic and chemical fertilizer on growth, yield and quality of selected fruits. **Riv. Hort. Vitic.** **4**: 295-307.
- Bankar, S.P., D.V. Indi and M.A. Gud. 2009. Effect of VAM fungi and azospirillum on growth and development of kagzi lime (*Citrus aurantifolia* L.) Seedlings. **J. Maharashtra Agric. Univ.****34(2)**: 183-185.
- Baviskar, M.N., S.G. Bharad, V.N. Dod and V.G. Barne. (2011). Effect of integrated nutrient management on yield and quality of sapota. **Plant Arch.** **11 (2)**: 661-663.
- Bohane, L., R. Tiwari and K.K. Gautam. 2016. Integrated nutrient management in ber (*Zizyphus mauritiana* Lamk.) cv. Gola under Malwa Plateau conditions of Madhya Pradesh. **Indian J. Hort.** **73(1)**: 128-132.
- Dadashpour Ahmad and Jouki Mohammad. 2012. Impact of Integrated Organic Nutrient Handling on Fruit Yields and Quality of Strawberry cv. Kurdistan in Iran. **J. Orna. Horti. Pl.** **2 (4)**: 251-256.
- Dalal, S.R., V.S. Gonge, N.D. Jogdande and A. Moharia. 2004. Response of different levels of nutrients and PSB on fruit yield and economics of sapota. **PKV Res. J.** **28**: 126-128.
- Dheware, R.M. and M.S. Waghmare. 2009. Influence of organic-inorganic and biofertilizers and their interaction on flowering and fruit set of sweet orange (*Citrus sinensis* Osbeck L.). **The Asian journal of Horticulture.** **4 (1)**: 194-197.
- Dutta, P., A.K. Chakroborthy and P.K. Chakroborthy. 2003. **Ann. Agric. Res. Review.** **24 (4)**: 786.
- Dwivedi, D.H., R. Lata, R.B. Ram and M. Babu. 2012. Effect of Bio-Fertilizer and Organic Manures on Yield and Quality of Red Fleshed Guava. **Acta Hort.** : **933**.
- Ghosh, S.N., B. Bera, S. Roy and A. Kundu. 2012. Integrated nutrient management in pomegranate grown in laterite soil. **Ind. J. Hort.** **69 (3)**: 333-337.

- Korwar, G.R., G. Pratibha, V. Ravi and D. Palanikumar. 2006. Influence of organics and inorganics on growth, yield of aonla (*Emblica officinalis*) and soil quality in semi-arid tropics. **Ind. J. Agric. Sci.** **76(8)**: 457-461.
- Kuttimani, R., K. Velayudham, E. Somasundaram and P. Muthukrishnan. 2013. Effect of integrated nutrient management on yield and economics of banana. **Global Journal of Biology, Agriculture and Health Sciences.** **2(4)**: 191-195.
- Lee, K.E. (1985). Earthworms their ecology and their relation with soil and landuse. **Academic prees, Sydeney, Australia**, pp184-194.
- Lieten, F. (1996). Effect of CO₂ enrichment on greenhouse grow strawberry. **Acta Hort.** **439(2)**: 583-587.
- Marathe, R.A. and P.R. Bharambe. (2007). Correlation of Integrated Nutrient Management Induced Changes in Soil Properties with Yield and Quality of Sweet Orange (*Citrus sinensis*) on Udic Haplustert. **Journal of the Indian Society of Soil Science.** **55 (3)**: 270-275.
- Musmade, A.M., D.D. Jagtap, C.C. Pujari and S.S. Hiray. (2009). Integrated nutrient management in acid lime. **The Asian J. Hort.** **4(2)**: 305-308.
- Panse, M. and K. Sukhathme. (1985). Statistical methods for agriculture workers. **Indian Council of Agriculture Research Publications.** 48-67.
- Patel, D.R. and A.G. Naik. (2010). Effect of pre-harvest treatment of organic manures and inorganic fertilizers on post harvest shelf life of sapota cv. Kalipatti. **Indian J. Hort.** **67(3)**: 381-386.
- Pawar, N. S., S.G. Bharad, R.B. Bhusari and P.H. Ulemale. (2014). Effect of integrated nutrient management on growth, yield and quality of acid lime. **BIOINFOLET 11 (4A)**: 995 – 1000.
- Rajendra, B.N., A.R. Kurubar, G.H. Anasubai and K.M. Swamy. (2013). Influence of organic manures and inorganic fertilizers on vegetative development, yield, self-life traits and sensory evaluation score of acid lime (*Citrus aurantifolia*) cv. Kagzi. **Asian J. Hort.** **8(1)**: 183-187.
- Rubee Lata, D., H. Deepa, R.B. Ram and M.L. Meena. (2011). Response of organic substrates on growth, yield and physiochemical characteristics of guava cv. Red fleshed. **Indian J. Ecol.** **38 (1)**: 81-84.
- Singh, A.K., S. Singh and V.V. Appa Rao. (2012). Influence of organic and inorganic nutrient sources on soil properties and quality of aonla in hot semi-arid ecosystem. **Indian J. Hort.** **69**: 50-54.

Trivedi, Y.V., N.L. Patel, T.R. Ahlawat, S.S. Gaikwad and P.P. Bhalerao. (2012). Impact of organic manures and inorganic fertilizers on growth, yield, nutrient uptake and soil nutrient status in guava. **Ind. J. Hort.** **69** (4): 501-506.

Table 1. Effect of nutrient management through bio-organic manures on fruit yield and its attributes of Acid lime (*Citrus aurantifolia* Swingle)

Tr. No	No. of fruits per plant (Nos)	Fruit weight (g)	Yield per tree (Kg)	Yield per hectare (tonnes)
T ₁	570.70	29.22	16.68	4.62
T ₂	670.76	34.95	23.44	6.49
T ₃	631.34	32.97	20.81	5.76
T ₄	599.35	31.06	18.61	5.15
T ₅	755.79	38.99	29.46	8.16
T ₆	821.38	42.17	34.63	9.59
T ₇	871.21	44.24	38.54	10.67
T ₈	940.18	47.35	44.51	12.32
T ₉	713.98	37.0	26.41	7.31
T ₁₀	776.89	40.13	31.17	8.63
T ₁₁	919.37	46.26	42.53	11.78
T ₁₂	992.49	49.63	49.26	13.64
S.Ed	10.66	0.63	0.94	0.25
CD(P=0.05)	21.37	1.29	1.90	0.52

Treatment Details: T₁ – Control, T₂-100% RDF (400:200:220 g/ plant), T₃-75% RDF, T₄-50% RDF, T₅- 75% RDF + 100% FYM (20 kg/plant), T₆- 75% RDF + 100% Vermicompost (10 kg/plant), T₇- 75% RDF + 50% FYM + 50% Vermicompost, T₈-75% RDF + 50% FYM + 50% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM), T₉- 50% RDF + 100% FYM, T₁₀- 50% RDF + 100% Vermicompost, T₁₁- 50% RDF + 75% FYM + 75% Vermicompost, T₁₂- 50% RDF + 75% FYM + 75% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB +150g VAM).