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Effect of Nutrient Management on Productivity and Quality of Acid Lime (*Citrus aurantifolia swingle*)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Acid lime (*Citrus aurantifolia Swingle*) is one of the commercial fruit crops which occupies an important place in the fruit industry, but yield levels of citrus orchards are still very low. An alternate nutrient management system could help in achieving a high yield and quality of acid lime. Thus, an investigation was undertaken on the "Effect of nutrient management on productivity and quality of acid lime (*Citrus aurantifolia Swingle*)" during 2016 – 2018. The experiment was laid out in randomized block design with twelve treatments, various organic manures, biofertilizers along with inorganic fertilizers including recommended dose of fertilization @ 100%, 75%, 50%, farm yard manure @ 100%, 50%, Vermicompost @ 100%, 50%, Biofertilizers (25 g Azotobacter + 25 g phosphate solubilising bacteria + 150 g vesicular arbuscular mycorrhizal) were applied. The yield and quality characters of acid lime were studied at vegetative and reproductive stages. The observations recorded viz., fruit setting (%), fruit diameter (cm), number of fruits per plant, fruit weight (g), yield per tree (kg) and yield per hectare (tonnes). The results revealed that plants treated with T_{12} (50% RDF+ 75% Vermicompost + Biofertilizers (25 g Azotobacter +25 g PSB +150 g VAM) was observed maximum fruit setting (%), fruit diameter (cm), number of fruits per plant, fruit weight (g), yield per tree (kg), yield per hectare (tonnes). The maximum net income (Rs. 281511.5 / ha) and benefit:

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cost ratio (4.72: 1) was observed in the treatment T_{12}-50% RDF + 75% FYM + 75% Vermicompost + Biofertilizers (25 g Azotobacter + 25 g PSB + 150 g VAM) which was superior to other treatments.

Keywords: Citrus; recommended dose of fertilization; farm yard manure; vermicompost; biofertilizers.

1. INTRODUCTION

Acid lime (*Citrus aurantifolia Swingle*) is one of the most commercially grown fruit crops which is widely grown in the tropical and sub-tropical regions of India. It belongs to the Rutaceae family, with chromosome number 2n=18. It is a profusely branched thorny shrub or small tree. The fruits are more or less round or oval, smooth and have thin rind (papery) attached tightly. The immature fruits are dark green in colour, which changes to light yellow when ripe. The colour of the pulp is light greenish-yellow; the taste is acidic, aromatic, and the cells are fine and shiny. It is mainly cultivated for its multi - fold nutritional and medicinal values. Being a rich source of vitamin C and acidic in nature, acid lime fruits have great medicinal value. Its attractive appearance, penetrating aroma of peel and excellent taste gives a remarkable position to acid lime which is grown widely throughout the world [1]. Among the various factors which contribute towards the growth and yield of acid lime, nutrition is an important aspect of crop production [2]. In current days, organically produced fruits have lot of demand because of their high shelf life quality traits which necessitates increasing the use of organic manures in combination with inorganic fertilizers which includes farm yard manure and vermicompost produced by farmers themselves using farm wastes resulting in reducing the cost of cultivation and also reducing environmental pollution to the maximum extent [3]. Apart from this, the use of biofertilizers like Azotobacter, Phosphate Solubilising Bacteria (PSB) and Vesicular Arbuscular Mycorrhizae (VAM) are being sought to maintain and improve soil quality and productivity levels at low input costs. Use of bio-organic sources of nutrients helps to conserve soil health by maintaining the equilibrium of organic matter and soil microflora, which ultimately helps to improve the physical, chemical and biological properties of the soil [4]. Hence, the integration of organic manures and biofertilizers with inorganic fertilizers has been found to be quite promising not only in maintaining higher productivity but also in providing greater stability in crop production. There is an urgent need for a nutritional package in the Cauvery delta regions of Tamil Nadu to attain long term sustainability for quality fruit production as well as to maintain soil productivity under the alternate nutrient management system of fruit crops. Keeping all the above facts in view, an experiment was conducted to study the effect of nutrient management through bio-organic manures on productivity and quality of acid lime (*Citrus aurantifolia Swingle*) in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar with the following objectives:

1. To study the effect of organic manures and biofertilizers with inorganic fertilizers on yield and quality attributes of acid lime.

2. MATERIALS AND METHODS

The studies on " Effect of nutrient management through bio organic manures on productivity and quality of acid lime (*Citrus aurantifolia*)'' was carried out in the orchard, Department of Horticulture, Annamalai University, Annamalainagar, Tamil Nadu during 2018. Five years old uniform trees of acid lime (*Citrus aurantifolia Swingle*) were selected for the study. Using randomized block design with twelve treatments and three replications. The yield and quality parameters. Viz.,. fruit setting (%), fruit diameter (cm), number of fruits per plant, fruit weight (g), yield per tree (kg) and yield per hectare (tonnes). There are twelve treatment solutions which are used to increase growth and yield, and the treatment details are given below.

3. RESULTS AND DISCUSSION

3.1 Fruit Setting (%)

A significant difference was observed among the treatments for the fruit setting percent when compared with control (Table 1). The treatment T_{12}-50% RDF + 75% FYM + 75% Vermicompost + Biofertilizers (25 g Azotobacter + 25 g PSB + 150 g VAM) recorded maximum fruit setting percentage (72.73%). It was followed by T_8- 75% RDF + 50% FYM + 50% Vermicompost + Biofertilizers (25 g Azotobacter + 25g PSB + 150g VAM) (68.56%) whereas ,control exerted the minimum fruit setting percentage (35.06%).

List 1. Treatment Details

T_1	Control
T_2	100% RDF (400:200:220 NPK g/plant)
T_3	75% RDF
T_4	50% RDF
T_5	75% RDF + 100% FYM (20 kg/plant)
T_6	75% RDF + 100% Vermicompost (10 kg/plant)
T_7	75% RDF + 50%FYM + 50% Vermicompost
T_8	75% RDF + 50% FYM + 50%Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM)
T_9	50% RDF + 100% FYM
T_{10}	50% RDF + 100% Vermicompost
T_{11}	50% RDF + 75%FYM + 75% Vermicompost
T_{12}	50% RDF +75% FYM +75% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB +150g vesicular arbuscular mycorrhizal)

Binepal *et al.* [5] expressed that the maximum increase in plant height (0.65 m), canopy spread N-S direction (0.92 m) and E-W direction (1.00 m), maximum fruit length (7.52 cm) and fruit diameter (7.91 cm) at harvest, fruit volume (217.41 ml), maximum fruit setting (79.56%), minimum fruit drop (20.41%), maximum fruit retention (79.59%), average fruit weight (220.37 g), number of fruits per tree (384 fruits/plant), TSS (11.67 ^{o}Brix), total sugar (8.06%), reducing sugar (4.17%), non-reducing sugar (3.89%), pectin (0.81%), ascorbic acid (207.90 mg/100 g pulp) and lowest acidity (0.20%) were obtained with treatment T9-(100% N+100 % P_2O_5 +Azospirillum + PSB + 10kg vermicompost) in guava cv. L-49.

3.2 Fruit Diameter (cm)

Significant differences among the treatments are indicated for the fruit diameter (Table 1). The application of T_{12}-50% RDF + 75% FYM + 75% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM) obtained a maximum fruit diameter of (4.93 cm). It was followed by T_8-75% RDF + 50% FYM + 50% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM) (4.76 cm), whereas, control reported the minimum fruit diameter (3.56cm). Bohane *et al*. [6] exhibited that the application of 50% recommended dose of fertilizer through Vermicompost + 50% RDF through NPK + 50 g Azotobacter + 50 g PSB (T_7) significantly increased the plant height (2.43 m), canopy volume (9.56), number of primary (16.93) and secondary branches (24.92) per shoot, fruit set (7.30%) and fruit retention (40.95%), fruit length (3.58 cm) and diameter (3.31 cm), fruit volume (22.25 ml), pulp weight (20.06 g), stone weight (1.91 g), average fruit weight (21.97 g), yield (34.14 kg/tree), TSS (20.85°Brix), ascorbic acid (74.04 mg/100 g pulp), reducing sugar (5.15%), non-reducing sugars (4.74%), total sugars (9.89%), TSS: acid ratio (160.38) and chlorophyll content in leaves spad value (71.00) in ber cv. Umran.

3.3 Number of Fruits Per Plant

The maximum number of fruits (992.49) was recorded in 50% RDF + 75% FYM + 75% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM) T_{12} which was superior to other treatments. It was followed by T_8 -75% RDF + 50% FYM + 50% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM) (940.18) whereas, the minimum number of fruits (570.70) was exerted in control. Hadole *et al*. [7] conducted an experiment on Nagpur mandarin (*Citrus reticulate* Blanco), revealing that the highest fruit yield (112.75 kg/tree) was observed in 100% RDF + VAM (500 g/plant) + PSB (100 g/plant) + Azospirillum (100 g /plant) followed by 100 per cent RDF + VAM + PSB + Azospirillum (100 g/plant) (99.01 kg/tree).

3.4 Fruit Weight (g)

The application of 50% RDF + 75% FYM + 75% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM) T_{12} noted the maximum fruit weight (49.63g) which was superior to other treatments. It was followed by T_8-75% RDF + 50% FYM + 50% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM) (47.35g) whereas, control expressed the minimum fruit weight (29.22g). Shukla *et al*. [8] described that the application of 50 percent dose of recommended NPK + 50kg FYM + 250g Azotobacter significantly increased the canopy

volume (201.42m^3), fruit weight (153.30g), TSS (14^o Brix), ascorbic acid (198.30mg/100g pulp), reducing sugar (4.77%), total sugars (8.10%), leaf nitrogen (1.40%), phosphorus (0.46%), potassium (1.17%) contents and significantly higher fruit yield/plant (28.95kg) with higher B:C ratio (2.53:1).Nitrogen, phosphorus and potassium content of the leaf were positively correlated with fruit yield in eight year old guava trees cv. Sardar.

3.5 Yield Per Tree (kg)

Maximum yield per tree (49.26 kg) was found in 50% RDF + 75% FYM + 75% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM) T_{12} which was superior to other treatments. It was followed by T_8-75% RDF + 50% FYM + 50% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM) (44.51 kg)whereas, the minimum yield per tree (16.68 kg) was exhibited in control. Dwivedi *et al*. [9] expressed that in guava, the application of biofertilizer was more effective than organic manures in enhancing fruit growth parameters in guava. Average fruit yield was 19.03 kg /tree with Azotobacter 250g/tree + FYM 20kg/tree+ Vermicompost (20 kg/tree) having a significantly higher yield over control.

3.6 Yield Per Hectare (Tonnes)

The soil placement of 50% RDF + 75% FYM + 75% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM)T_{12}indicated the maximum yield per hectare (13.64tonnes) which was superior to other treatments. It was followed by T_8 - 75% RDF + 50% FYM + 50% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM) (12.32tonnes) whereas, control observed the minimum yield per hectare (4.62 tonnes). Singh *et al*. [10] recorded the maximum fruit set (59.66%), fruit retention (58.63%) and yield (43.24 kg/plant or 24 t/ha) in guava with vermicompost @ 10kg + 50 % recommended dose of NPK + PSB @ 20 g per plant treatment as compared to control.

Table 1. Effect of nutrient management on yield and quality of acid lime

Treatment details	Fruit setting (%)	Fruit diameter (cm)	No.of fruits per plant	Fruit weight (g)	Yield per tree (kg)	Yield per hectare (tonnes)
T_1 Control	35.06	3.56	570.70	29.22	16.68	4.62
T_2 100% RDF (400:200:220 NPK g /plant)	45.79	3.97	670.76	34.95	23.44	6.49
T_3 75% RDF	42.11	3.85	631.34	32.97	20.81	5.76
T_4 50% RDF	38.64	3.70	599.35	31.06	18.61	5.15
T_5 75% RDF + 100% FYM (20kg/plant)	52.89	4.26	755.79	38.99	29.46	8.16
T_6 75% RDF + 100% Vermicompost (10kg/plant)	58.83	4.43	821.38	42.17	34.63	9.59
T_7 75% RDF + 50% FYM + 50% Vermicompost	62.35	4.54	871.21	44.24	38.54	10.67
T_8 75% RDF + 50% FYM + 50% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM)	68.56	4.76	940.18	47.35	44.51	12.32
T_9 50% RDF + 100% FYM	49.55	4.10	713.98	37.0	26.41	7.31
T_{10} 50% RDF + 100% Vermicompost	55.42	4.32	776.89	40.13	31.17	8.63
T_{11} 50% RDF + 75% FYM + 75%Vermicompost	66.39	4.72	919.37	46.26	42.53	11.78
T_{12} 50% RDF + 75% FYM + 75% Vermicompost + Biofertilizers (25g Azotobacter + 25g PSB + 150g VAM)	72.73	4.93	992.49	49.63	49.26	13.64
S.Ed	1.55	0.03	10.66	0.63	0.94	0.25
CD(P=0.05)	3.12	0.08	21.37	1.29	1.90	0.52

4. CONCLUSION

In this study T_{12} (50% RDF+ 75%Vermicompost + Biofertilizers (25g Azotobacter +25g PSB +150 g VAM) treatment combination had the highest maximum fruit setting (%), fruit diameter (cm), number of fruits per plant, fruit weight (g), yield per tree (kg) and yield per hectare (tonnes).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Babu R. Lime and lemons. Handbook of Horticulture, ICAR. New Delhi, 2001;212.
2. Umar I, VK, Wali R, Kher A, Sharma. 2008. Impact of Integrated nutrient management on strawberry yield and soil nutrient status. Appl. Biol. Res. 2008;10: 22-25.
3. Bankar SP, DV, Indi MA, Gud. Effect of VAM fungi and azospirillum on growth and development of kagzi lime (*Citrus aurantifolia* L.) Seedlings. J. Maharashtra Agric. Univ. 2009; 34(2):183-185.
4. Walia S, DS Kler. Organic versus chemical farming. J. Res. Punjab Agric. Univ. 2009;46(3&4):114-26.
5. Binepal MN, R, Tiwari, BR, Kumawat. Integrated approach for nutrient management in guava cv. L49 under Malwa Plateau conditions of Madhya Pradesh. Int. J. Agri. Sci. 2013;9(2):467-471.
6. Bohane LR, Tiwari, KK, Gautam. Integrated nutrient management in ber (*Zizyphusmauritiana*Lamk.) cv. Gola under Malwa Plateau conditions of Madhya Pradesh. Indian J. Hort. 2016;73(1):128-132.
7. Hadole SS, S, Waghmare, SD, Jadhao. 2015. Integrated use of organic and inorganic fertilizers with bio-inoculants on yield, soil fertility and quality of Nagpur mandarin (*Citrus reticulate* Blanco). Int. J. Agri. Sci. 2015;11(2):242-247.
8. Shukla AK, DK, Sarolia, B, Kumari, RA, Kaushik LN, Mahawer, HL, Bairwa. Evaluation of substrate dynamics for integrated nutrient management under high density planting of guava cv. Sardar.Ind. J. Hort. 2009;66(4):461-464.
9. Dwivedi H, Deepa, RubeeLata, RB, Ram. Effect of biofertilizer and organic manures on yield and quality of guava cv. Red fleshed. The Scientific Temper. 2010;193(1): 193-198.
10. Singh V, LK, Dashora, RS, Rathore, CL, Meena. Flowering and yield of guava (*Psidiumguajava*L.) cv. Sardar as influenced by various organic and inorganic sources. Curr. Agric. 2007;31(1-2): 67-71.

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