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Priyanka Katara
College of Horticulture and Forestry, Agriculture University Kota campus Jhalrapatan, Jhalawar, Rajasthan, India

Prerak Bhatnagar
College of Horticulture and Forestry, Agriculture University Kota campus Jhalrapatan, Jhalawar, Rajasthan, India

J Singh
College of Horticulture and Forestry, Agriculture University Kota campus Jhalrapatan, Jhalawar, Rajasthan, India

CK Arya
College of Horticulture and Forestry, Agriculture University Kota campus Jhalrapatan, Jhalawar, Rajasthan, India

Rahul Chopra
College of Horticulture and Forestry, Agriculture University Kota campus Jhalrapatan, Jhalawar, Rajasthan, India

IB Maurya
College of Horticulture and Forestry, Agriculture University Kota campus Jhalrapatan, Jhalawar, Rajasthan, India

Corresponding Author:
Priyanka Katara
College of Horticulture and Forestry, Agriculture University Kota campus Jhalrapatan, Jhalawar, Rajasthan, India

Effect of integrated nutrient management on yield and quality of acid lime (*Citrus aurantifolia* Swingle.) cv. Kagzi

Priyanka Katara, Prerak Bhatnagar, J Singh, CK Arya, Rahul Chopra and IB Maurya

Abstract
A field experiment entitled "Effect of Integrated Nutrient Management on yield and quality of Acid lime (*Citrus aurantifolia* Swingle.) cv. "Kagzi" was conducted using 21 treatments in Randomized Block Design with four replications covering 88 plants in all during July 2019 to December 2020 at the Instructional Farm, Department of Fruit Science, College of Horticulture and Forestry, Jhalawar, Rajasthan.

The result harnessed that application of T_{19} treatment (75% RDF + Vermicompost 10kg+ 75g VAM/plant) was found significantly superior over all other treatments with respect to biometric improvement in yield and quality parameters *viz*. fruit length (4.66cm), fruit retention (30.79%), fruit breadth (4.25cm), average fruit weight (59.24g), fruit volume (68.93), specific gravity (1.07), number of seeds/fruit (7.88), peel thickness (1.33mm), number of fruits per plant (560.75) and bio-chemical quality attributes like relative water content (77.56%), total soluble solids (9.80^0brix), acidity (6.34%), TSS/acidity ratio (1.51), reducing sugars (0.88%), non-reducing sugars (0.77%), total sugars (2.02%), ascorbic acid (63.56mg/100g), juice (51.98%), chlorophyll a (1.11mg g^{-1}), chlorophyll b (0.70 mg g^{-1}), total chlorophyll (1.88 mg g^{-1}) and estimated yield (33.01kg $plant^{-1}$).

Keywords: V.C=Vermicompost, PSB=Phosphorous solubilizing bacteria, AZB=Azotobacter, VAM=Vesicular arbuscular mycorrhiza, Analytical Procedures, Compost, Horticulture Crops, Fruit Crops, Fruit Crops, General Plant Nutrition

1. Introduction

India holds unique position as number one producer of acid lime in the world. The nutritional need of acid lime is unique and differs from other fruit crops as it has continuous flowering and heavy fruiting habit. Acid lime (*Citrus aurantifolia* Swingle.) popular cultivar with thin peel is known as Kagzi lime or Neebu and belongs to the family Rutaceae. The word Kagzi being derived from the word Kagaj meaning paper as the rind of the fruit is very thin. Acid lime has gained popularity among the commercially important citrus fruits grown in India besides mandarin, sweet oranges and grape fruit. The four prominent lime species are namely; *Citrus aurantifolia* (Acid lime), *Citrus latifolia* (Tahiti lime), *Citrus limonia* (Rangpur lime) and *Citrus limettioides* (Sweet lime). Kagzi lime is considered to be a native of India. Citrus fruits represent significant place as regard to fruit industry in India. By nature the Kagzi lime trees bears more profusely in Ambe Bahar, Mrig Bahar conditions and somewhat lesser during Hasthabahar conditions in Northern India.

Citrus fruits are popular in subtropical regions of North India and tropical regions of South India mainly due to their hardy nature and good nutritional values. India produced 3717 MT of lime/lemon fruits annually from 3.17 lakh hectare areas with an annual productivity of 11.72tonnes/hectare (NHB database 2019-20). Rajasthan produce about 994.38 MT of fruits production from an area of 61.58 thousand hectare (NHB, 2019-20).

The integrated nutrient management enriches long term sustainability in the productivity level because of availability of nutrients in soil for next season crop. Incorporation of organic fertilizers is a common practice to improve the yield of many fruit crops. Integrated application of nutrient sources *viz*., organic, inorganic and microbial in consortium holds a good potential to overcome some of adverse soil physical constraints (Bellakki and Badanur, 1997) [3]. The integrated nutrient management (INM) is considered to be viable module with regard to efficient use of manure and fertilizers.

Biofertilizers such as Azospirillum, PSB, and VAM have immense and potential practical utility to increase crop productivity through increased biological nitrogen fixation, enhanced availability through uptake of nutrients and accelerated phosphate solubilisation and increased absorption through proliferation of root volume, stimulation of plant growth occurs by rapid decomposition of organic residues. (Govindrajan and Thangaraju, 1998).

Farmyard manure has potential role on growth, yield and quality of plants and help in improving soil texture, soil aeration, soil structure, humus content, water holding capacity and microbial activities of the soil.

Vermicompost is a stable fine granular organic matter, which when added to the clay soil loosens the soil and provides passage for entry of air. The Vermicompost chiefly the faecal matter of earthworms is rich in plant nutrients, plant growth promoters and beneficial micro flora. Vermicompost augments soil organic matter and nutrient content, improves the soil structure and overall improves physical and chemical indicators of soil. Earth worms utilize organic wastes as food and the undigested material excreted by them has gained the name 'vermicompost'. The vermicompost serves as organic manure, since it is a source of nutrients, emphatically nitrogen, phosphorus, potassium and micronutrients.

Phosphate Solubilizing Bacteria (PSB) is another important biofertilizers which has capacity to solubilize the native phosphorus due to secretion of organic acid. It also produces plant growth promoting substances like vitamin B_{12} and auxin.

Azotobacter, a heterotrophic aerobic bacterium capable of fixing nitrogen as non-symbiotic is of paramount importance in rhizosphere of many plants is most widely used bio-inoculant those days in different horticultural crops. The use of Azotobacter as bio fertilizers has increased in recent years keeping in view its ability to produce biologically active substances was ascertained, its tremendous effect on plants was associated not only with the biological nitrogen fixation and improving nitrogen availability to plants, but also with the translocation of biologically active compounds such as vitamins and gibberellins in lime seedlings (Yadav, 2012) [5].

Vesicular Arbuscular Mycorrhiza (VAM) is roots infected with particular soil fungi which form symbiotic association. It is often assumed that VAM fungi could be used to increase the efficiency of phosphate fertilizer in agriculture to improve the phosphorous as uptake.

Material methods

Experimental Site

The experiment was conducted during the years July 2019 - Dec. 2020 at the experimental orchard of Fruit Research Farm, Department of Fruit Science at College of Horticulture and Forestry, Jhalrapatan, Jhalawar (Agriculture University, Kota). Eleven year old Acid lime plants cv. Kagzi of uniform vigour and size were selected for study. All plants were maintained under uniform cultural practices during the course of investigation. Located at 23º4 to 24º52 North-Latitude and 75º29 to 76º56 East-Longitudes in South Eastern Rajasthan. Agro-climatically, the district falls in zone V, which is known as Humid South-Eastern plain. The average annual rainfall is 950 mm. During summer the temperature touches around 44-47ºC and during winter it goes down up to 2ºC.

Experiment Description

The experiment was laid out in Randomized Block Design. The factors of experimentation comprising of twenty two treatments combinations to study the effect ofintegrated nutrient management on growth yield and quality of Acid lime (*Citrus aurantifolia* Swingle.) cv. "Kagzi". The treatments were applied on Jun end 2019. Plantations of eighty eight acid lime plants were selected at the College of Horticulture & Forestry, Jhalawar under (Agriculture University, Kota) for experimentation. The Acid lime cv. Kagzi was planted at a distance of 6 x 6 m.

Treatment combinations

T0 RDF (625g: 1250g: 400g) (N: P: K)
T1 75% RDF + Vermicompost 10kg
T2 50% RDF +Vermicompost 15kg
T3 25% RDF + Vermicompost 20kg
T4 75% RDF + Vermicompost 10kg+ 50g PSB/plant
T5 50% RDF + Vermicompost 15kg+ 50g PSB/plant
T6 25% RDF + Vermicompost 20kg+ 50g PSB/plant
T7 75% RDF + Vermicompost 10kg+ 50g Azotobacter/plant
T8 50% RDF + Vermicompost 15kg+ 50g Azotobacter/plant
T9 25% RDF + Vermicompost 20kg+ 50g Azotobacter/plant
T10 75% RDF + Vermicompost 10kg+ 75g Azotobacter/plant
T11 50% RDF + Vermicompost15kg+ 75g Azotobacter/plant
T12 25% RDF + Vermicompost20kg+ 75g Azotobacter/plant
T13 75% RDF + Vermicompost 10kg+ 75g PSB/plant
T14 50% RDF + Vermicompost15kg+ 75g PSB/plant
T15 25% RDF + Vermicompost20kg+ 75g PSB/plant
T16 75% RDF + Vermicompost10kg+ 50g VAM/plant
T17 50% RDF + Vermicompost 15kg+ 50g VAM/plant
T18 25% RDF + Vermicompost20kg+ 50g VAM/plant
T19 75% RDF + Vermicompost 10kg+ 75g VAM/plant
T20 50% RDF + Vermicompost 15kg+ 75g VAM/plant
T21 25% RDF + Vermicompost 20kg+ 75g VAM/plant

Results and discussion

Effect of INM on Fruit Quality attributes

Physical Parameters

Data in Table 1 and 2 show clearly that, RDF, Vermicompost and VAM were significantly effects on fruit quality. The highest values of fruit length(cm), fruit retention (%), fruit breadth (cm), Average fruit weight (g), Volume of fruit (cc), Specific gravity (g/cc), Number of seeds/fruit, Peel Thickness (mm), Relative water content (%) and chemical Parameters like TSS (°Brix), Acidity (%), TSS/acidity ratio, Reducing Sugar (%), Non Reducing Sugar (%), Total sugar (%), Ascorbic acid (mg/100 g), Juice (%).

Application of 75% Recommended dose of chemical fertilizers @625:1250:400 NPK g/plant+Vermicompost @10kg+VAM@75g/plant (T19) recorded the highest fruit length (4.61cm), fruit breadth (4.15cm),average fruit weight (60.18g), fruit volume (68.85), specific gravity value (1.03), and minimum fruit length(3.18cm), fruit breadth (3.47cm) and average fruit weight (45.65g) was recorded under T_0 treatment consisting (RDF) and minimum fruit volume of Kagzi lime (4.40) was recorded in T_9 treatment consisting (25%RDF+ Vermicompost 20kg+50g *Azotobacter*/plant),lowest specific gravity value (0.97) was observed in T_3 treatment consisting (25% RDF + Vermicompost 20kg/plant) the could be attributed to improved macro and micro-nutrients availability, increased soil rhizosphere with feeder roots density, enhanced soil organic carbon content as a result of application of both organic and inorganic fertilizers, augmented production of carbohydrates and better source-sink ratio due to more mobilization and translocation of assimilates. The results of

present investigations are in accordance with those reported by Lal and Dayal (2014) [10]; Nurbhanej *et al.* (2016) [12], Prabhu *et al.* (2018) [4] and Barath Kumar *et al.* (2019).

The quality attribute number of seeds per fruit in Kagzi lime cultivar was obtained minimum (7.88) in T_{19} treatment comprising (75% RDF + Vermicompost 10kg + VAM@75g/plant) and maximum number of seeds/fruit (9.24) was measured under T_o (RDF) and T_3 treatments. Among different treatments of integrated nutrient management less number of seeds per fruit is a very important character which is directly correlated with more edible mass encompassing juice vesicles of the fruit and less number of seeds per fruit under present study could be attributed to better differential nutritional response of INM treatments and hormonal balance in the physiology of seed development in acid lime cv. Kagzi trees. Similar findings were reported by Kamatyanatti *et al.* (2016) [14] on evaluation of acid lime genotypes at Akola.

Peel thickness of acid lime cv. Kagzi fruits was obtained minimum (1.33mm) in T_{19} treatment consisting (75%RDF+Vermicompost 10kg+VAM@75g/plant).The maximum peel thickness (1.77mm) in acid lime cv. Kagzi fruits was recorded in T_5 treatment consisting (50%RDF+Vermicompost 15kg+50g PSB/Plant). The lesser peel thickness obtained in T_{19} treatment might be due to the progressive development of fruit in which the stored food material ought to have been shifted to the edible mass of fruit. The peel thickness might get reduced and juice content got increased during the course of its development. These results are in consonance with those reported by Prasad (1989) who reported peel thickness range (0.89 mm to 2.13 mm) in acid lime fruits.

The maximum relative water content of Kagzi lime leaves with value (77.56%) was obtained in T_{19} treatment consisting (75%RDF+Vermicompost 10kg+VAM@75g/plant) and minimum relative water content (68.47%) was obtained in T_0 treatment (RDF). The relative water content in fruit trees indicate cellular water deficit expressed in leaves under prevailing soil moisture status under available nutritional inputs. The relatively better relative water content (77.56%) estimated in Kagzi lime leaves under T_{19} treatment might be due to enhanced water uptake capacity of acid lime trees in combination with nutritional inputs supplied to the canopy rhizosphere in Kagzi lime trees.

Chemical Parameters

Application of differential nutritional inputs in canopy rhizosphere of acid lime cv. Kagzi resulted in significant improvement in chemical parameters *viz.* TSS, acidity percentage, TSS: acidity ratio, reducing and non-reducing sugar percentage, total sugar content, ascorbic acid and juice percentage. The maximum total soluble solid content (9.80^0 brix) was obtained in Kagzi lime fruits under T_{19} treatment consisting (75% RDF+ Vermicompost 10kg+ VAM@75g/plant) and was observed significantly superior has compared with other treatments and minimum total soluble solids content (8.82^0brix) was measured in T_3 treatment consisting (25% RDF+ Vermicompost 20kg/plant). The higher TSS content observed in T_{19} treatment might be due to synergistic action of macro nutrients coupled with better translocation of water uptake and nutrients and improved fertilizer use efficiency in consonance with the application of organic source like Vermicompost and VAM. The increase in TSS in Kagzi lime fruits could also be attributed to the regulatory role of nitrogen upon endogenous factors on the quality of acid lime fruits in which carbohydrate reserves synthesized in the roots and stem are translocated in more concentration to the fruits which might have resulted in higher TSS content in fruits. These findings are in accordance with the results reported by Bohane *et al.* (2016) [6] in BER.

The application of various INM sources in acid lime cv. Kagzi lime plants affected the acidity percentage content. The incorporation of differential INM treatments resulted in marked variation in acidity percentage of Kagzi lime fruits. The results exhibited that minimum acidity content (6.29%) was obtained in T_{19} treatment having maximum TSS content and maximum acidity percentage having value (7.13%) was measured in T_0 treatment (RDF) The minimum acidity percentage recorded in T_{19} treatment could be due to sustained supply of nutrients organic manures and enhancement in soil micro-organics which might increase the electrolyte and metabolite concentration with improvement in soil moisture availability, soil pH, organic carbon status of soil and decrease in acidity percentage of Kagzi lime fruits could be attributed to their conversion into sugars along with generation of bye products by chemical reactions involving use in respiration.

The results of present findings are supported by investigations of Dwivedi (2013) [1] and Vadak *et al.* (2014) [11] who reported that VAM enhance availability of unavailable nutrients from different layers of rhizosphere and makes available increased uptake of nutrients thereby favouring chemical quality of fruits, The analysis of results in acid lime v. Kagzi fruits under incorporation of various INM treatments exhibited variation in TSS: Acid ratio. TSS: Acid ratio is an important criterion for determining eating quality and maturity of citrus fruit (Van Rensburg, 1985). The maximum TSS: Acidity ratio (1.51) was observed in T_{19} treatment consisting (75%RDF+Vermicompost 10kg+VAM@75g/plant) and lowest TSS: Acidity ratio (1.24) was estimated in T_3 treatment consisting (25%RDF+Vermicompost 20kg/plant). During development stages of acid lime, TSS content remains low and acidity content remains high but as the fruits matures the TSS increase and the acid level decreases thus bringing about an increase in the ratio. The results of present findings are in agreement with those reported by Van Rensburg (1985).

The application of various treatments of INM in acid lime cv. Kagzi trees resulted in maximum reducing, non-reducing and total sugars content in T_{19} treatment consisting (75% RDF + Vermicompost@10kg+VAM@75g/plant) as compared with other treatments. The T_{19} treatment exhibited maximum values of (0.89%), (0.77%) and (2.02%), minimum content of reducing sugar (0.63%), non-reducing sugars (0.48%) and total sugars (1.69%) content was obtained in T_0 treatment (RDF) of acid lime cv. Kagzi fruits, Respectively in terms of reducing, non-reducing and total sugars content. The higher content of reducing, non-reducing and total sugars in T_{19} treatment could be attributed to active role of N, P and K nutrients through inorganic and organic source *i.e.* Vermicompost and VAM which might favoured increase of metabolites due to formation of more carbohydrates, nucleoproteins, exploration of more volume of soil by mycorrhiza and enhanced uptake of nutrients in plants and fruits formed potent sink of nutrients under regulated source-sink availability. The results of present investigation are in line with the results reported by Dudi *et al.* (2005) in Kinnow and Savreet Khera (2014) [7] in lemon.

The improvement in Vitamin C content of acid lime cv. Kagzi

fruits under application of different treatments of INM revealed that maximum ascorbic acid (63.54 ml/100ml) content was recorded in T_{19} treatment consisting (75% RDF+Vermicompost @10kg+VAM@75g/plant). And minimum content of ascorbic acid with value of (42.45mg/100g) was obtained in T_3 treatment consisting (25%RDF+ Vermicompost@20kg/plant). The better ascorbic acid content obtained in T_{19} treatment might be due to enhanced catalytic activity of multiple enzymes which participate in bio- synthesis of ascorbic acid and its precursor from sugars. The present results are in accordance with the findings of Binepal *et al.* (2013) [2] in guava; Savreet Khera (2014) [7] in lemon and Debbarma and Hazarika (2016) in acid lime.

The application of various INM treatments in acid lime cv. Kagzi trees resulted in marked variation in juice recovery percentage of acid lime fruits. The maximum juice recovery percentage with value (51.98%) was obtained in T_{19} treatments consisting (75%RDF+Vermicompost @10kg+VAM@75g/plant) and minimum juice recovery percentage value of (42.55%) was obtained under T_0 treatment. T_{19} was statistically distinct in juice recovery percentage as compared with rest of the treatments could be attributed to synergistic combination of inorganic, organic and bio fertilizer sources (VAM, PSB and *Azotobacter*) which might resulted in improvement of soil structure, root proliferation, enhanced availability of nutrients, augmentation of favourable soil micro-organism in a holistic manner. Since water is the main component of juice vesicles and juice recovery output, its increased availability in clayey vertisols within some limits was upto increase juice content percentage favorably. The results of present investigations are elaborated by similar results in sweet orange by Singh *et al.* (2000) [8].

Effect of INM on yield attributes

The yield attributes were significantly influenced by different treatments. Application of 75%RDF+Vermicompost @10kg+VAM@75g/plant (T_{19}) were found to be significantly superior for enhanced fruit yield (33.01 kg/plant) as compared with other treatments. The maximum number of fruits (560.75) in acid lime cv. Kagzi was observed significantly higher and superior as compared with rest of the treatments. The outcome of estimated yield (kg/plant) of Kagzi lime fruits in response to various INM treatments revealed significant variation under different treatments. The maximum estimated yield (33.01kg/plant) was recorded in T_{19} treatment consisting (75%RDF+Vermicompost @10kg+VAM@75g/plant) and minimum estimated yield (20.42 kg) was recorded in T_0 treatment (RDF). The relatively significant higher estimated yield obtained in T_{19} treatment might be due to application of (75%RDF+Vermicompost10kg+ 75g VAM/plant) which favoured optimum supply of plant nutrients, more assimilate production and an increase in endogenous level of growth hormones thereby resulting in more translocation assimilation and thus leading to more accumulation of fruits biomass and thus contributing to overall increase in yield of lime fruits vis a vis other INM treatments. The present results are in conformity with the findings of Dalal (2004) [9] in sapota; Lal and Dayal (2014) [10] in acid lime.

Table 1: Effect of Integrated nutrient management on physical quality parameters of acid lime cv. Kagzi trees during (2019 and 2020)

Treatments	Fruit length(cm)	Fruit retention	Fruit Breadth(cm)	Fruit Weight(g)	Fruit Volume(cc)	Specific gravity(g/cc)	Number of seeds/fruit	Peel Thickness (mm)	RWC %
T_0	3.24	20.98	3.57	45.37	40.61	1.01	9.42	1.74	68.91
T_1	3.70	22.08	3.88	51.31	50.17	1.01	8.26	1.53	70.37
T_2	3.81	23.65	4.01	52.13	56.16	0.99	8.35	1.41	72.29
T_3	3.23	23.33	3.66	52.00	41.34	1.01	9.41	1.63	72.64
T_4	3.52	24.16	3.79	52.29	41.38	1.00	8.84	1.71	72.10
T_5	4.06	25.13	4.09	53.54	63.51	0.99	8.06	1.59	72.17
T_6	3.42	25.26	3.70	52.67	41.90	1.00	9.27	1.63	71.46
T_7	4.24	25.80	4.20	51.56	64.02	1.01	7.96	1.54	73.12
T_8	3.46	25.76	3.75	53.69	45.05	0.99	9.04	1.73	74.19
T_9	3.39	25.86	3.68	49.81	40.49	0.99	9.30	1.67	72.33
T_{10}	4.10	26.42	4.16	52.78	63.39	0.99	7.92	1.47	72.54
T_{11}	3.49	26.09	3.77	54.58	46.24	1.00	8.86	1.72	73.15
T_{12}	3.45	25.83	3.75	50.23	46.37	1.00	9.17	1.71	72.11
T_{13}	3.88	26.00	4.04	53.25	56.82	1.01	8.33	1.45	73.60
T_{14}	3.62	26.06	3.80	53.26	44.56	1.00	8.77	1.63	73.57
T_{15}	4.04	26.58	4.05	49.72	59.14	1.00	8.16	1.43	74.30
T_{16}	3.79	27.79	3.93	50.34	51.70	1.00	8.58	1.59	74.53
T_{17}	3.70	28.81	3.86	53.38	49.00	1.01	8.45	1.63	73.97
T_{18}	3.69	28.87	3.83	51.60	45.50	1.02	8.65	1.56	74.87
T_{19}	4.66	30.79	4.25	59.24	68.93	1.07	7.88	1.33	77.56
T_{20}	3.92	29.00	4.05	55.58	58.40	1.01	8.23	1.64	73.60
T_{21}	3.68	28.62	3.82	50.61	47.91	0.99	8.68	1.59	73.57
SEm (±)	0.11	0.33	0.08	1.12	1.32	0.01	0.06	0.02	0.67
CD (5%)	0.31	0.94	0.22	3.16	3.73	0.05	0.17	0.07	1.90

Table 2: Effect of Integrated nutrient management on chemical quality and yield parameters of acid lime cv. Kagzi trees during (2019 and 2020)

Treatments	TSS (ºbrix)	Acidity%	TSS/Acidity ratio	Reducing Sugar%	Non-reducing Sugars%	Total Sugars%	Ascorbic acid(mg/100g)	Juice (%)	No. of fruits per plant	Yield
T_0	9.08	7.13	1.27	0.64	0.50	1.71	48.45	42.76	462.25	20.97
T_1	9.26	6.97	1.32	0.67	0.54	1.76	55.98	46.67	468.50	24.03
T_2	9.21	6.85	1.34	0.73	0.54	1.90	56.42	47.32	471.25	24.56
T_3	8.88	7.12	1.24	0.71	0.53	1.72	43.19	42.87	477.00	24.79
T_4	9.12	7.05	1.29	0.71	0.55	1.82	51.98	44.77	477.75	24.95
T_5	9.25	6.66	1.38	0.75	0.56	1.95	61.61	48.77	485.00	25.96
T_6	9.05	7.11	1.27	0.72	0.56	1.77	49.49	43.27	491.75	25.87
T_7	9.35	6.42	1.46	0.72	0.58	1.89	63.49	51.32	495	25.47
T_8	9.11	7.07	1.28	0.70	0.59	1.79	50.80	43.87	505.75	27.12
T_9	9.01	7.12	1.26	0.71	0.60	1.73	48.48	43.08	506.25	25.20
T_{10}	9.30	6.48	1.44	0.72	0.62	1.91	62.61	49.59	509.75	26.89
T_{11}	9.00	7.05	1.27	0.70	0.66	1.80	51.51	44.46	504.00	27.50
T_{12}	9.06	7.09	1.27	0.72	0.66	1.78	50.09	44.07	513.50	25.77
T_{13}	9.24	6.78	1.36	0.76	0.68	1.89	57.21	47.27	515.75	27.45
T_{14}	9.11	7.03	1.29	0.75	0.69	1.83	52.21	44.64	519.25	27.62
T_{15}	9.27	6.73	1.36	0.78	0.70	1.91	60.35	48.54	527.25	26.21
T_{16}	9.23	6.86	1.36	0.71	0.70	1.87	53.84	45.59	530.50	26.68
T_{17}	9.24	6.86	1.34	0.69	0.71	1.88	54.40	46.15	534.50	28.52
T_{18}	9.18	7.02	1.32	0.72	0.72	1.83	52.77	45.23	534.50	27.56
T_{19}	9.80	6.34	1.51	0.88	0.77	2.02	63.56	51.98	560.75	33.01
T_{20}	9.23	6.84	1.36	0.78	0.70	1.92	58.64	48.02	542.75	29.52
T_{21}	9.11	7.01	1.30	0.70	0.68	1.85	52.53	45.02	527.50	26.69
SEm (±)	0.14	0.05	0.02	0.01	0.01	0.01	1.60	1.39	3.98	0.56
CD (5%)	0.41	0.14	0.06	0.05	0.05	0.04	4.52	3.48	11.27	1.59

Conclusion

The present study on application of INM treatments in acid lime cv. Kagzi plants indicated that use of organics in consortium with inorganic fertilizers in an integrated manner supports the maintenance of sustainable soil fertility and amenable plant nutrient supply at an optimum level for desired productivity. It is apparent from the data in table 1 and 2 that application of 75% RDF + Vermicompost @10kg + 75g VAM/plant significantly affects fruit quality attributes over control during both years (2019-2020) on pooled basis.

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