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Studies on the approaches of different organic and biofertilizers with NPK on vegetative growth, yield and fruit quality of seedless lime (*Citrus aurantifolia* Swingle) under Raipur condition

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Abstract

An The present experiment entitled Studies on the approaches of different organic and biofertilizers with NPK on vegetative growth, yield and fruit quality of seedless lime (*Citrus aurantifolia* Swingle) under Raipur condition. Was carried out during the year of August, 2022-23 at Research Farm of Precision Farming Development Centre (PFDC), Department of Fruit Science, College of Agriculture, IGKV, Raipur (C.G.). The results indicate that the morphological and physical parameters of plants were significantly influenced by the organic and biofertilizers with NPK. The results were showed that morphological parameters viz. the maximum plant height (3.94 m), stem girth (29.97 cm), canopy volume (49.34 m³), number of leaves per shoot (135.31), number of branches (38.93) and number of flowers per tree (310.54) and the physical parameters viz. the maximum fruit length (4.92 cm), fruit diameter (4.71 cm), specific gravity (1.06), fruit volume (181.56 ml), fruit weight (192.72 g) and juice content (74.57 ml) were recorded at harvest with the application of (T₈) (90% of RDF + Vermiwash (600 ml) + VAM (5 ml/plant)). While the minimum morphological and physical parameters were recorded under T₀.

Keywords: Seedless lime, *Azotobacter*, PSB, VAM, physical parameters

Introduction

The third-most significant fruit in India is citrus (*Citrus aurantifolia* Swingle). With chromosomal number 2n=18, it belongs to the Rutaceae family. It is one of the oldest crops in the world, and a treatise on citrus that was discovered in 1178 A.D. provides evidence of its cultivation as far back as 2200 B.C. Due to its high adaptability, it is one of the most promising crops for the global market. From the humid tropical regions of North East India to the drylands of Rajasthan, Punjab, and Haryana, various varieties of citrus are produced there (Singh *et al.*, 2004) [16]. Several citrus species are found naturally in the North Eastern Himalayan region, which also benefits from ideal agro-climatic conditions (Singh and Naqvi, 2001) [15]. Their significance as commercial crops are explained by their nutritious quality and numerous nutritional and therapeutic benefits (Rajput and Haribabu, 1995) [14]. Citrus farming faces a variety of obstacles, including biotic stress, which poses a substantial threat, especially in light of climate change. The principal biotic stresses are fungal, bacterial, viral, and nematode diseases, and as a result, management approaches have undergone significant modification. It was discovered that nutrients supplied to citrus fruit development without organic matters were less effective, even at large concentrations, and were more successful when applied with organic matters (Ghosh and Bersa, 1997) [6]. In order to achieve the best growth, yield, and quality of crop in a particular agroecological situation, the concept of integrated nutrient management (INM), which places emphasis on continuous improvement in soil fertility on a long-term basis through appropriate use of fertilizer, bio-fertilizer, and green manures and their scientific management, came into being.

Materials and Methods

The experiment was carried out during 2022-23 at Precision Farming Development Centre, Department of Fruit Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (CG). The experiment was laid out in randomized block design (RBD). The factors of experimentation comprising of fifteen treatments combinations with three replications to

Studies on the approaches of different organic and biofertilizers with NPK on vegetative growth, yield and fruit quality of seedless lime (*Citrus aurantifolia* Swingle) under Raipur condition. Plantations of ninety seedless lime plants were selected. The seedless was planted at a distance of 3 x 3 m. The experimental site is situated in sub-tropical weather and has an elevation of 298.56 metres above mean sea level. It is situated at 21°16' N latitude and 81°31' E longitude. Temperature, relative humidity, annual rainfall, evaporation, wind velocity and sunshine hours these are the meteorological data recorded from the Department of Agricultural Meteorology, Indira Gandhi Agricultural University, Raipur (C.G.).

The maximum temperature during the experimental period in the year of 2022 ranged from 33.90 °C to 28.81 °C, whereas minimum temperature varied between 11.07 °C to 25.73 °C. The total rainfall received was 99.69 mm. Average relative humidity ranged between 75.57 to 92%. The average value of open pan evaporation varied between 2.56 mm/day to 3.97 mm/day. The maximum wind velocity was recorded 6.57 Km/hour, whereas minimum was recorded 0.40 Km/hour. The crop period sunshine ranged from 2.80 to 9.50 hours/day during 2022.

Treatment combinations

1. **T₀ (Control):** 100% of RDF as soil application and irrigation through drip
2. **T₁:** 100% of RDF + Vermiwash (400 ml) + Cow urine (600 ml)
3. **T₂:** 90% of RDF + Vermiwash (600 ml) + Cow urine(400 ml)
4. **T₃:** 100% of RDF + Vermiwash (400 ml) + *Azotobacter* (2 ml/plant)
5. **T₄:** 90% of RDF + Vermiwash (600 ml) + *Azotobacter* (3 ml/plant)
6. **T₅:** 100% of RDF + Vermiwash (400 ml) + *PSB* (2 ml/plant)
7. **T₆:** 90% of RDF + Vermiwash (600 ml) + *PSB* (3 ml/plant)
8. **T₇:** 100% of RDF + Vermiwash (400 ml) + *VAM* (2.5 ml/plant)
9. **T₈:** 90% of RDF + Vermiwash (600 ml) + *VAM* (5 ml/plant)
10. **T₉:** 100% of RDF + Cow urine (400 ml) + *Azotobacter* (2 ml/plant)
11. **T₁₀:** 90% of RDF + Cow urine (600 ml) + *Azotobacter* (3 ml/plant)
12. **T₁₁:** 100% of RDF + Cow urine (400 ml) + *PSB* (2 ml/plant)
13. **T₁₂:** 90% of RDF + Cow urine (600 ml) + *PSB* (3 ml/plant)
14. **T₁₃:** 100% of RDF + Cow urine (400 ml) + *VAM* (2.5 ml/plant)
15. **T₁₄:** 90% of RDF + Cow urine (600 ml) + *VAM* (5 ml/plant)

Observations on morphological and physical parameters were taken during experiment. The height of a plant was measured

by the help of a measuring bamboo having metre marking from the ground level to the tip of the highest shoot of the plant in each replication of the treatment and average was worked out and measurements were made at the end of growing season and it was expressed in metre. Stem girth of the plant was measured by the help of tape at ground level and measurements were made at the end of growing season. It was measured in centimetre. The number of leaves per shoot were counted during harvesting periods of fruits. The length of acid lime fruits was measured from stem end to calyx end in centimetres at harvest with the help of Vernier callipers. The diameter of acid lime fruits was measured from the centre of the fruits in centimetres at harvest with the help of Vernier Calliper. The volume of fruit was recorded by water displacement method with the help of measuring cylinder and expressed in millilitres. Seedless which are four year oldplants, spacing between RxR and PxP were kept 3 meter under square systems of planting, The data generated from these investigation were appropriately computed, tabulated and analysed as described by using MS-Excel and OPSTAT in Randomized Block Design. (RBD).

Results and Discussion

Morphological parameters

The morphological parameters of plant were significantly influenced by the organic and biofertilizers with NPK. The results showed that the maximum plant height (3.94 m), stem girth (9.54 cm), canopy volume (49.34 m³), number of leaves per shoot (135.31), number of branches (38.93) and number of flowers per tree (310.54) were recorded at harvest with the application of (T₈) 90% of RDF + Vermiwash (600 ml) + *VAM* (5 ml/plant). While minimum all above the growth parameters were recorded under T₀ (100% of RDF as soil application and irrigation through drip system).

Similar results for application of organic, inorganic nutrient and biofertilizers were reported by Goramnagar *et al.* (2000)^[4] in Nagpur orange, Pawar (2014)^[17], Bhandari *et al.* (2017)^[18], Jagdish (2021)^[19] and Priyanka *et al.* (2021)^[20] in acid lime.

Physical parameters

The observation regarding the effect of organic and biofertilizers with NPK on seedless lime, including fruit length (cm), fruit diameter (cm), specific gravity, fruit volume (ml), fruit weight (g) and juice content (ml) at harvest were taken under physical parameters during the experiment and significantly influenced by the organic and biofertilizers with NPK. The results were showed that the maximum fruit length(4.92 cm), fruit diameter (4.71 cm), specific gravity (1.06), fruit volume (181.56 ml), fruit weight (192.72 g) and juice content (74.57 ml) were recorded at harvest with the application of (T₈) 90% RDF + Vermiwash (600 ml) + *VAM* (5 ml/plant). While the minimum physical parameters were recorded under control (T₀) (100% of RDF as soil application and irrigation through drip system).

Similar results for application of organic, inorganic nutrient and biofertilizers were reported by Bhandari *et al.* (2017)^[18], Priyanka *et al.* (2021)^[20] in acid lime.

Table 1: Effect of organic and biofertilizers with NPK on morphological parameters

	Treatments	Plant height (m)	Stem girth (cm)	Canopy volume (m ³)	Number of leaves per shoot	Number of branches	Number of flowers per tree
T ₀	100% of RDF as soil application and irrigation through drip	3.31	9.23	32.48	105.62	17.33	274.71
T ₁	100% of RDF + Vermiwash (400 ml) + Cow urine (600 ml)	3.43	9.24	35.91	108.74	19.60	278.02
T ₂	90% of RDF + Vermiwash (600 ml) + Cow urine (400 ml)	3.47	9.24	37.35	110.44	23.20	279.15
T ₃	100% of RDF + Vermiwash (400 ml) + <i>Azotobacter</i> (2 ml/plant)	3.49	9.26	43.00	111.66	26.83	286.63
T ₄	90% of RDF + Vermiwash (600 ml) + <i>Azotobacter</i> (3 ml/plant)	3.72	9.27	44.01	113.37	28.61	290.99
T ₅	100% of RDF + Vermiwash (400 ml) + <i>PSB</i> (2 ml/plant)	3.73	9.29	45.47	119.73	33.57	293.23
T ₆	90% of RDF + Vermiwash (600 ml) + <i>PSB</i> (3 ml/plant)	3.70	9.30	46.22	121.34	34.09	294.09
T ₇	100% of RDF + Vermiwash (400 ml) + <i>VAM</i> (2.5 ml/plant)	3.83	9.35	47.85	132.42	36.72	303.61
T ₈	90% of RDF + Vermiwash (600 ml) + <i>VAM</i> (5 ml/plant)	3.94	9.54	49.34	135.31	38.39	310.54
T ₉	100% of RDF + Cow urine (400 ml) + <i>Azotobacter</i> (2 ml/plant)	3.52	9.25	38.37	105.49	24.27	279.61
T ₁₀	90% of RDF + Cow urine (600 ml) + <i>Azotobacter</i> (3 ml/plant)	3.54	9.26	39.57	109.69	25.63	282.41
T ₁₁	100% of RDF + Cow urine (400 ml) + <i>PSB</i> (2 ml/plant)	3.62	9.27	40.39	114.58	29.91	283.90
T ₁₂	90% of RDF + Cow urine (600 ml) + <i>PSB</i> (3 ml/plant)	3.64	9.28	41.62	116.49	31.76	286.10
T ₁₃	100% of RDF + Cow urine (400 ml) + <i>VAM</i> (2.5 ml/plant)	3.74	9.30	46.70	125.53	34.75	296.42
T ₁₄	90% of RDF + Cow urine (600 ml) + <i>VAM</i> (5 ml/plant)	3.77	9.34	47.15	128.50	35.78	298.71
	SE (m) ±	0.04	0.01	0.61	0.49	1.59	1.44
	C.D. at 5%	0.12	0.03	1.76	1.41	4.61	4.16

Table 2: Effect of organic and biofertilizers on physical parameters

	Treatments	Fruit length (cm)	Fruit diameter (cm)	Specific gravity	Fruit volume (ml)	Fruit weight (g)	Juice content (ml)
T ₀	100% of RDF as soil application and irrigation through drip	3.96	3.22	1.00	94.31	95.26	35.83
T ₁	100% of RDF + Vermiwash (400 ml) + Cow urine (600 ml)	4.12	3.26	1.00	96.49	99.80	38.62
T ₂	90% of RDF + Vermiwash (600 ml) + Cow urine (400 ml)	4.15	3.33	1.01	99.65	111.96	41.41
T ₃	100% of RDF + Vermiwash (400 ml) + <i>Azotobacter</i> (2 ml/plant)	4.36	3.57	1.01	114.08	118.73	54.45
T ₄	90% of RDF + Vermiwash (600 ml) + <i>Azotobacter</i> (3 ml/plant)	4.41	3.83	1.00	117.02	122.64	62.30
T ₅	100% of RDF + Vermiwash (400 ml) + <i>PSB</i> (2ml/plant)	4.66	4.39	1.02	131.95	138.49	64.50
T ₆	90% of RDF + Vermiwash (600 ml) + <i>PSB</i> (3 ml/plant)	4.70	4.41	1.04	139.78	145.06	65.73
T ₇	100% of RDF + Vermiwash (400 ml) + <i>VAM</i> (2.5 ml/plant)	4.82	4.67	1.05	180.28	190.25	73.62
T ₈	90% of RDF + Vermiwash (600 ml) + <i>VAM</i> (5 ml/plant)	4.92	4.71	1.06	181.56	192.72	74.57
T ₉	100% of RDF + Cow urine (400 ml) + <i>Azotobacter</i> (2 ml/plant)	4.21	3.32	1.01	108.26	112.45	45.52
T ₁₀	90% of RDF + Cow urine (600 ml) + <i>Azotobacter</i> (3 ml/plant)	4.24	3.72	1.01	112.84	117.35	50.47
T ₁₁	100% of RDF + Cow urine (400 ml) + <i>PSB</i> (2 ml/plant)	4.54	3.84	1.00	124.63	129.16	57.62
T ₁₂	90% of RDF + Cow urine (600 ml) + <i>PSB</i> (3 ml/plant)	4.62	4.11	1.03	126.18	132.07	60.55
T ₁₃	100% of RDF + Cow urine (400 ml) + <i>VAM</i> (2.5 ml/plant)	4.74	4.45	1.03	161.36	162.62	66.42
T ₁₄	90% of RDF + Cow urine (600 ml) + <i>VAM</i> (5 ml/plant)	4.76	4.56	1.04	175.85	177.45	69.62
	SE (m) ±	0.06	0.04	0.01	1.04	0.99	0.14
	C.D. at 5%	0.18	0.13	0.02	3.02	2.87	0.40

Conclusions

The results of present research on the four year old Seedless lime showed that maximum growth *viz.* plant height (3.94 m.), Stem girth (29.97 cm.), Canopy volume (49.34 m³), No. of leaves per shoot (135.31), No. of flower per tree (310.54), No. of branches (38.39). And physical parameters *viz.* fruit length (4.92 cm), fruit diameter (4.71 cm), specific gravity (1.06), fruit volume (181.56 ml), fruit weight (192.72 g) and juice content (74.57 ml) were recorded under T₈. Application of (90% of RDF + Vermiwash (600 ml) + *VAM* (5 aml/plant)) had been most suitable organic and inorganic nutrient dose under agro-climatic conditions of Raipur. Hence, the treatment T₈ is given the best growth performance in terms of all the morphological and physical parameters.

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