

Original Research Article

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Effect of FYM, NPK and Biofertilizers on Flowering, Fruit Yield and Quality of Kinnow

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ABSTRACT

A study was made on the application of different levels of FYM, NPK along with biofertilizers on Kinnow in order to check its effect on flowering, fruiting and fruit yield. The present study was carried out during February 2019 to December 2019 in Central horticulture research farm of Department of Horticulture, SHUATS, Prayagraj. The study was conducted in Randomized Block Design with 11 treatments replicated thrice. The treatments were T₀ Control (500: 250: 500 g N,P,K / tree/ year) ,T₁ (70% NPK / tree + 27kg FYM / tree), T₂ (70% NPK/ tree + 27kg FYM / tree + *Azotobacter* 10g/ tree) , T₃ (70% NPK / tree +27kg FYM / tree + *Azospirillum* 10g/ tree), T₄ (70% NPK / tree +27kg FYM / tree + PSB 10g/tree), T₅ (70% NPK / tree +27kg FYM / tree + *Azotobacter* 10g/ tree + *Azospirillum* 10g/ tree + PSB 10g/ tree), T₆ (60% NPK/ tree + 30kg FYM / tree), T₇ (60% NPK /tree + 30kg FYM/ tree + *Azotobacter* 15g/ tree), T₈ (60% NPK /tree + 30kg FYM/ tree + *Azospirillum* 15g/ tree), T₉ (60% NPK /tree + 30kg FYM/ tree + PSB 30g/ tree), T₁₀ (60% NPK /tree + 30kg FYM/ tree + *Azotobacter* 15g/ tree + *Azospirillum* 15g/ tree + PSB 15g/ tree). Out of the above treatments, plants which were supplemented according to treatment T₅ (70% NPK / tree +27kg FYM / tree + *Azotobacter* 10g/ tree + *Azospirillum* 10g/ tree + PSB 10g/ tree) showed the superior result in terms of plant height, plant spread, no. of flowers, average fruit weight, fruit yield per plant, weight of pulp, weight of peel, pulp to peel ratio, T.S.S. and Titratable Acidity.

Keywords

Kinnow, FYM,
Azotobacter,
Azospirillum, PSB
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Introduction

Citrus is a widely growing fruit crop of tropical and sub-tropical countries with a global production of 6.3 million MT (USDA report July 2019) and their production is confined between 0-40° N and S of equator. India ranks 6th in citrus fruit production with an area of 1003 ha along with the production of 12546 MT (NHB Database, 2018). The genus Citrus consists of wide variation in its species ranging from sweet orange, lemon, lime, grape fruit, mandarins etc. It is a fruit belongs to the family Rutaceae and subfamily Aurantioideae with a chromosome number of 2n= 18 (Kurg 1943).

Kinnow, a King-willow leaf mandarin was the resultant of an interspecific hybridization between (*Citrus nobilis* Loureiro x *Citrus deliciosa* Tenore) carried out first time by H.B. Frost in 1915, at the University of California Citrus Experiment Station and commercially released in 1935 as a new citrus hybrid. Kinnow as a fruit crop is highly nutrient receptive and requires all major 17 nutrients for a good crop production. Adequate supply of nitrogen, phosphorus and potassium are important for citrus tree growth and productivity (Quaggio *et al.*, 2002). Nitrogen is invoked as “wheel balance” of citrus nutrition, because of the fact that the efficiency of other nutrients based on it. It imparts dark green colour and glossiness to leaves. Sharma and Chopra (2000) observed that nitrogen played an important role in increasing the growth and yield of sweet orange. Potassium is necessary for to carry out physiological functions in plants such as translocation of sugars, synthesis of proteins and cell division and growth. . It also intensifies the competence of plants to fight against disease, insect, pest attacks, cold, drought and other distinct conditions. It rectifies the water economy of trees and generally increases citrus yield, not in the

number, but in fruit size. Phosphorus is indispensable for many processes of life such as photosynthesis, synthesis and breakdown of carbohydrates and the transfer of energy within the plant. Farm yard manure (FYM) provides organic matter and crucial plant nutrients to the plant’s rhizosphere. FYM also enhances soil porosity and water holding capacity of the soil. The application of FYM has been reported to enhance the availability of native as well as applied P. It was also reported that organic matter plays an important role for the retention of urea and greater uptake of P and K.

Use of inorganic fertilizers along with organic manures and bio-fertilizers is a proven technology to build up the fertility status of the soil (Srivastava and Ngullie 2009, Srivastava and Singh 2009).

Bio-fertilizers are the natural fertilizers that are microbial inoculants of bacteria, algae or fungi alone or in combination (kumar *et al.*, 2017). *Azotobacter* and *Azospirillum* these are free-living atmosphere nitrogen fixing bacteria. They fix atmospheric nitrogen in cereal crops and do not need a particular host. *Azotobacter*, a free living microbe, acts as plant growth promoting rhizobacteria (PGPR) in the rhizosphere of almost all crops (Gomare *et al.*, 2013). *Azotobacter* produces many growth regulators such as IAA and GA which positively influence plant growth (Sharma and Kumar 2008). They can fix 15-20kg/ha N per year. *Azotobacter sp.* can also give rise to antifungal substances to prevent against many plant pathogens. *Phosphorus solubilizing bacteria* (PSB) under acidic or calcareous, large amounts of phosphorus can be fixed in the soil but may be unavailable to the plants. Phosphobacterins mainly consists of microbes like bacteria and fungi which can make insoluble forms of phosphorus available to the plants, the solublizing effect of these phosphobacterins are generally due to the

production of organic acids that lower the pH of soil and bring about the disintegration of bound forms of phosphate. It is reported that PSB culture helps to increase yield up to 200-500 kg/ha and thus 30 to 50 kg of superphosphate can be saved (Chen, 2006).

Materials and Methods

The study was conducted in Randomized Block Design with 11 treatments replicated thrice.

The treatments were T₀ Control (500: 250: 500 g N,P,K / tree/ year) ,T₁ (70% NPK / tree + 27kg FYM / tree) , T₂ (70% NPK/ tree + 27kg FYM / tree + *Azotobacter* 10g/ tree) , T₃ (70% NPK / tree +27kg FYM / tree + *Azospirillum* 10g/ tree), T₄ (70% NPK / tree +27kg FYM / tree + PSB 10g/tree), T₅ (70% NPK / tree +27kg FYM / tree + *Azotobacter* 10g/ tree + *Azospirillum* 10g/ tree + PSB 10g/ tree), T₆ (60% NPK/ tree + 30kg FYM / tree), T₇ (60% NPK /tree + 30kg FYM/ tree + *Azotobacter* 15g/ tree), T₈ (60% NPK /tree + 30kg FYM/ tree + *Azospirillum* 15g/ tree), T₉ (60% NPK /tree + 30kg FYM/ tree + PSB 30g/ tree), T₁₀ (60% NPK /tree + 30kg FYM/ tree + *Azotobacter* 15g/ tree + *Azospirillum* 15g/ tree + PSB 15g/ tree).

Climatic condition in the experimental site

The area of Prayagraj district comes under sub-tropical belt in the south east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter.

The maximum temperature of the location reaches up to 46° C-48° C and seldom falls as low as 4° C- 5° C. The relative humidity ranges between 20 to 94 %. The average rainfall in this area is around 1013.4 mm annually. However, occasional precipitation is also not uncommon during winter months.

Results and Discussion

The result of the experiment entitled “Effect of FYM, NPK and biofertilizers on flowering, fruit yield and quality of kinnow” was carried out during February to December in the, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences Prayagraj. The results of the investigation regarding the Growth and yield of 5 yrs old Kinnow trees as influence by different levels of FYM, NPK and bio-fertilizers on growth and yield of Kinnow have been presented in tables and figures, wherever required.

The data in the table 1 showed that the plant height and the plant spread are significantly affected by bio-fertilizer in combination with FYM and NPK.

The highest value plant height and plant spread is recorded in T₅ followed by T₁₀. Same as in case of number of flowers, average fruit weight, pulp weight, pulp to peel ratio and yield, T₅ is recorded to with the highest values followed by T₁₀. The lowest values were recorded with T₀.

From the previously mentioned results, it was clear the main role of FYM and bio-fertilizers along with different doses of NPK on Kinnow trees, for supply nutrients in order to bring renovation in growth and quality. As the treatment T₅ (70% NPK / tree +27kg FYM / tree + *Azotobacter* 10g/ tree + *Azospirillum* 10g/ tree + PSB 10g/ tree) showed the best result with respect to yield an quality of fruits. Therefore, this treatment is recommended T₅ (70% NPK / tree +27kg FYM / tree + *Azotobacter* 10g/ tree + *Azospirillum* 10g/ tree + PSB 10g/ tree).

Table.1 Effect of different treatments on plant height and plant spread of Kinnow

S.No.	Treatments	Plant height					Plant spread				
		45 days	90 days	135 days	180 days	225 days	45 days	90 days	135 days	180 days	225 days
1.	T ₀	216.000	218.667	221.667	224.333	227.667	150.47	156.15	163.27	167.913	172.413
2.	T ₁	237.333	240.333	243.333	246.333	249.333	162.08	167.093	171.563	175.51	179.76
3.	T ₂	261.000	264.333	267.667	270.667	273.333	172.067	180.627	185.15	189.65	195.35
4.	T ₃	266.667	269.000	271.667	274.667	277.333	178.46	186.057	193.12	196.213	201.177
5.	T ₄	275.000	277.333	279.667	282.667	285.333	173.783	178.373	182.953	187.783	192.04
6.	T ₅	307.667	311.000	313.333	316.333	319.333	230.667	239.847	246.667	250.623	256.127
7.	T ₆	286.667	289.333	291.667	294.333	297	158.3	164.21	168.193	174.537	179.63
8.	T ₇	248.667	251.333	254.000	257	259.667	173.813	177.923	183.137	186.783	190.82
9.	T ₈	281.667	283.667	286.333	289.333	295.667	169.953	174.54	179.433	183.867	189.107
10.	T ₉	264.000	266.667	269.667	272.333	275	171.55	175.4	180.643	188.61	194.443
11.	T ₁₀	294.667	297.333	303.667	306.667	309.333	204.8	209.547	216.547	220.213	225.347
	F-ratio	S	S	S	S	S	S	S	S	S	S
	C.D.	6.499	6.909	7.161	6.722	6.066	15.916	15.048	15.196	16.073	15.819
	S.E(d)	3.094	3.289	3.409	3.2	2.888	7.577	7.163	7.234	7.652	7.531
	C.V	1.418	1.492	1.529	1.421	1.268	5.245	4.802	4.706	4.859	4.662

Table.2 Effect of different treatments on no. of flowers, no. of fruits per plant, yield of fruit/ tree, fruit weight, pulp weight, peel weight, pulp to peel ratio, T.S.S and titratable acidity of kinnow

S.No.	Treatments	No. of flowers	Yield of fruits /tree	Fruit weight	Pulp weight	Peel weight	Pulp to peel ratio	T.S.S	Titrtable acidity
1.	T ₀	58.333	3,759.267	95.000	62.033	30.533	2	5.7	0.95
2.	T ₁	98.333	7,067.000	123.367	99.367	25.633	3.833	6.8	0.54
3.	T ₂	121	8,183.966	134.900	103.767	28.6	3.6	8.467	0.713
4.	T ₃	94.667	8,641.233	138.800	109.967	29.3	3.733	8.067	0.807
5.	T ₄	113.333	9,111.866	145.400	118.6	21.567	5.467	8.6	0.78
6.	T ₅	149	17,536.630	154.633	160.92	15.9	10.167	10.833	0.287
7.	T ₆	140.667	11,075.000	193.567	123.867	27.2	4.4	7.867	0.7
8.	T ₇	133.667	9,982.800	135.533	105.067	26.233	3.933	6.633	0.813
9.	T ₈	141.667	10,832.870	164.800	132.633	28.7	4.6	8.067	0.607
10.	T ₉	144	10,977.600	144.600	112.967	28	4	8.4	0.67
11.	T ₁₀	147.333	14,061.000	173.700	142.967	18.533	7.7	9.9	0.403
	C.D	17.053	2,030.427	5.5	5.333	3.033	0.704	0.771	0.069
	S.E(d)	8.118	969.525	2.618	2.539	1.444	0.335	0.367	0.033
	F-ratio	S	S	S	S	S	S	S	S
	C.V	8.149	11.707	2.199	2.688	6.492	8.445	5.536	6.045

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