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Subir Gain
Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad Uttar Pradesh, India

VM Prasad
Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad Uttar Pradesh, India

Sandeep Singh
Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad Uttar Pradesh, India

Ashish Kumar Pal
Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad Uttar Pradesh, India

Rahul Kumar
Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad Uttar Pradesh, India

Correspondence
Rahul Kumar
Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad Uttar Pradesh, India

Effect of NPK along with FYM and Poultry manures on growth, flowering and fruiting of four year old sweet orange (*Citrus sinensis* L.)

Subir Gain, VM Prasad, Sandeep Singh, Ashish Kumar Pal and Rahul Kumar

Abstract
The experiment entitle "Effect of N. P. K. along with FYM and Poultry manures on growth, flowering and fruiting of four year old sweet orange (*Citrus sinensis* L.)" was carried out at the fruit research farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (U.P.) - 211007. The observations were recorded on growth parameters *viz*, plant height (cm), number of leaves/plant, number of branches/plant, stem diameter (cm), plant spread (cm^2), leaf area (cm^2), length of inter-nodes (cm), no. of flower/plant, no. of fruit/plant and incidence of disease percentage. The experiment was laid out with 13 treatments having different combination of N. P. K. along with FYM and Poultry manures in Randomized block design with three replications. The observations recorded during the course of investigation were subjected to statistical analysis as per method of 'Analysis of variance' (Fisher, 1950). Considering the present investigation it is concluded that the treatment (T_{12}) RDF (25%) + FYM (25%) + Poultry Manure (50%) was found the best in terms of maximum plant height (380 cm), number of branches (22), number of leaves/plant (597.67), stem diameter (2.59 cm), plant spread (177 cm), leaf area (46.33 cm^2), length of inter-nodes (13.33 cm), number of flowers/plant (243), number of fruits/plant (86.67), with minimum incidence of disease percentage (0.33%).

Keywords: Farm yard manure, poultry manure, sweet orange, NPK, flowering

Introduction
The sweet orange (*Citrus sinensis* L.), is a succulent fruit. The orange fruit is a hesperidium. It is a type of berry that ranges widely in size, color, shape, and juice quality. Locules of the fruits contain juicy sacs develop from placental hair of endocarp (Basic Horticulture, Jitendra Singh). *Citrus sinensis* is a small, shallow-rooted evergreen shrub or tree about 6-13 m high with an enclosed conical top and mostly spiny branch. Hooker considered not less than 78 species of family Rutaceae with a basic chromosome number of X= 9 as natives of India. The flowers are small, pure white and are borne in clusters. The fruits are more or less round or oval, smooth having thin rind (papery) attached tightly. China, Brazil, U.S.A., India, Mexico, and Spain are the world's leading citrus fruit-producing countries, representing close to two-thirds of global production. In the United States, a total of 10.9 million metric tons of citrus production was reported for 2016-17 with Florida constituting 65% as the leading state, California 31%, followed by Texas and Arizona (FAO, 2017) [3]. Sweet orange is found in most parts of the tropics. In India, it is cultivated in Telangana, Andhra Pradesh, Gujarat, Maharashtra, Karnataka, Bihar, Madhya Pradesh, Assam, and Chhattisgarh. Area and Production of Citrus in India is about 191 thousands ha, 3305 thousands MT respectively. Sweet orange Area and Production is about 334.94 thousands ha, 3886.20 thousands MT respectively. Telangana is the largest producer of Sweet orange (1843.87 thousand MT) Followed by Andhra Pradesh (654.54thousand MT). (NHB 2017-18) [6]. The common people of India generally suffer from different malnutrition problems, not only from the deficiency of proteins and calories, but also from the deficiency of different vitamins like vitamin A and vitamin C and minerals like calcium and iron. All such malnutrition problems could have been reduced considerably if the people of India would have adequate access of fruits, especially citrus fruits which are generally known to be rich in these vitamins chemical and minerals. Citrus has also some medicinal value (Reuther *et al*., 1968). Composition of sweet orange shows that it contains water (86-92%), sugar (5-8%), pectin (1-2%), glycosides (0.1-1.5%), pentosans (0.8-1.2%), citric acid (0.4 to 1.5%), fiber (0.6-0.9%), proteins (0.6-0.8%), fat (0.2-0.5%), minerals (0.5-0.9%) and essential oils (0.2-0.5%) (Syed *et al.*, 2012) [8]. The production of fruits can be increased by proper supply of nutrients in the form of fertilizer.

Fertilizer is one of the major inputs accounting for nearly one third of the cost of cultivation and its production consumes a lot of energy used in horticulture. The conventional farming system involves enormous use of chemical in horticultural production. Continuous use of chemical fertilizers has degraded the soil health in terms of fertility and has also caused soil pollution. Organic manures have been used for their eco-friendly and beneficial effect on environment and horticultural crops. The era of development in the field of integrated nutrient management will ensure fairly high level of fruit production with sufficiently reduced dose of fertilizers and nutrients. Therefore, increasing need is being felt to integrate nutrient supply with organic sources to restore the health of soil.

Materials and Methods

The experiment was conducted in fruit Research Farm, Department of Horticulture, N.A.I., Sam Higginbottom University of Agriculture, Technology & Science, Allahabad, U.P.- 211007 during the winter season of the year, 2017-18. The experiment was tested in Randomized Block Design (RBD) with three replications and consisted of 13 treatments namely Treatment combination T_0 Control, T_1 RDF (50%) + Poultry Manure (50%), T_2 RDF (50%) + FYM (50%), T_3 FYM (50%) + Poultry Manure (50%), T_4 RDF 25%) + Poultry Manure (75%), T_5 FYM (25%) + Poultry Manure (75%), T_6 RDF (25%) + FYM (75%), T_7 FYM (15 kg), T_8 Poultry Manure (5 kg), T_9 FYM (75%) + Poultry Manure (25%), T_{10} RDF (25%) + FYM (50%) + Poultry Manure (25%), T_{11} RDF (50%) + FYM (25%) + Poultry Manure (25%), T_{12} RDF (25%) + FYM (25%) + Poultry Manure (50%). Observations was recorded on plant height (cm), plant spread (cm), number of branches/ plant, number of leaves/ plant, Stem diameter (cm), leaf area (cm^2), length of internodes (cm), number of flowers per plant, number of fruits per plant, Incidence of disease (%). The required quantity of inorganic fertilizers were applied during October along with FYM and poultry manure by broadcasting under the spread of trees, 30 cm away from the trunk and were mixed with the soil. The nitrogen was applied in split doses, half during spring before flowering and remaining half dose was applied one month after first application.

Results and Discussion

The vegetative growth of sweet orange plant was significantly influenced by N. P. K. along with FYM and Poultry manures. The maximum tree height (380 cm) number of branches (22), number of leaves/plant (597.67), stem diameter (2.59 cm), plant spread (177 cm), leaf area (46.33 cm2), length of inter-nodes (13.33 cm), number of flowers/plant (243), number of fruits/plant (86.67), with minimum incidence of disease percentage (0.33%) were recorded with treatment T_{12} [RDF (25%) + FYM (25%) + Poultry Manure (50%)]. This might be due to improved nutritional status and physical properties of the soil caused by the addition of FYM. This made the plant to uptake water and mineral nutrients better, resulting in its increased growth rate. Similarly, significant growth of kinnow mandarin by the application of FYM has been earlier reported by Dudi *et al.*, (2003) [2]. The data on the effect of nitrogen revealed that the application of organic and inorganic fertilizer increased the plant height, stem diameter and plant spread. Application of nitrogen resulted in vigorous vegetative growth of the plant and gave dark green colour of the foliage. This favoured the photosynthetic activity of the plants and greater synthesis of carbohydrate, which led to the formation of amino acids, nucleo-proteins, chlorophyll, alkaloids and amides. These complex compounds were responsible for building up of new tissues and were associated with a number of metabolic processes, which in turn favoured better development of plants. The increase in growth as a result of nitrogen application is obvious. Similarly, increase in vegetative growth of fruit plants by the application of nitrogen has also been reported earlier by Kaul and Bhatnagar (2006) [5] in Kinnow mandarin. Carranca *et al.*, (1992) [1] reported that the production of sweet oranges and mandarins flower and fruit were high by the application of the highest level of nitrogen but the total yield was maximum by the application of medium level of nitrogen. These results are in accordance with the findings of Hiwale *et al.*, (2010) [4] in citrus.

Conclusion

Considering the present investigation it is concluded that the treatment (T_{12}) RDF (25%) + FYM (25%) + Poultry Manure (50%) was found the best in terms of maximum plant height (380 cm), number of branches (22), number of leaves (597.67), stem diameter (2.59 cm), plant spread (177 cm), leaf area (46.33 cm^2), length of inter-nodes (13.33 cm), number of flowers (243), number of fruits (86.67), with minimum incidence of disease percentage (0.33%).

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Table 1: Effect of N. P. K. along with FYM and Poultry manures on growth, flowering and fruiting of four year old sweet orange

Notation	Treatment	Plant height 150 DAYS (cm)	Plant spread 150 DAYS (cm)	No. of branches 150 DAYS	No. of leaves 150 DAYS	Leaf area (cm^2)	Stem diameter 150 DAYS (cm)	Length of inter-nodes (cm) 150 DAYS	Number of flowers/ plant	Number of fruits/ plant	Incidence of disease %
T_0	(Control)	135.33	60.33	13.67	290.67	25	1.65	8	134.67	32.33	3
T_1	RDF (50%) + Poultry Manure (50%)	220.33	150.17	15.76	481.67	32	2.45	10	165.33	47	1.67
T_2	RDF (50%) + FYM (50%)	214.00	134.17	15.69	474.33	31.66	2.21	9.33	159	46.33	1.67
T_3	FYM (50%) + Poultry Manure (50%)	209.33	115.00	15.67	430.33	28.66	2.43	9.33	147	39	1.67
T_4	RDF (25%) + PoultryManure (75%)	226.33	158.17	16.00	494	33.33	2.52	10	187	60	1.33

T_5	FYM (25%) + Poultry Manure (75%)	224.00	154.00	15.89	482.33	32.33	2.48	9.67	170	58.67	1.33
T_6	RDF (25%) + FYM (75%)	200.67	114.17	15.33	372.23	28	2.39	9.33	144.33	38	2
T_7	FYM (15 kg)	173.17	81.00	14.33	326	26	2.16	9	135.67	35.67	2.67
T_8	Poultry Manure (5 kg)	175.00	95.83	15.00	334.67	27	2.21	9	138	35.67	2.33
T_9	FYM (75%) + Poultry Manure (25%)	195.67	98.33	15.29	371.67	27.33	2.36	9	139.33	37.33	2
T_{10}	RDF (25%) + FYM (50%) + Poultry Manure (25%)	229.33	163.83	16.67	533.33	36	2.52	11	195.33	60.33	1
T_{11}	RDF (50%) + FYM (25%) + Poultry Manure 25%)	290.67	176.67	18.67	580.33	37.67	2.55	11.33	196.67	76.67	0.67
T_{12}	RDF (25%) + FYM (25%) + Poultry Manure (50%)	380.00	177.00	22.00	597.67	46.33	2.59	13.33	243	86.67	0.33
F- test		S	S	S	S	S	S	S	S	S	S
S. Ed. (±)		30.81	31.76	1.52	11.47	4.75	0.15	1.22	17.34	12.57	0.61
C. D. (P = 0.05)		63.58	65.54	3.14	23.67	9.80	0.35	2.52	35.78	25.93	1.26

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