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Effect of Different NPK Levels and Chlorophyll Content on Growth and Development of Sweet Orange (*Citrus sinesis* Osbeck)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The current study, which was conducted at the Agricultural Research Farm of Rama University in Mandhana, Kanpur, India, was titled Effect of varying amounts of Nitrogen (N), Phosphorus (P2O5), and Potassium (K2O) on growth and development of Sweet Orange (Citrus sinesis Osbeck) plants. In terms of maximum plant height (83.57 cm), maximum number of leaves (421.04), maximum number of branches (26.36), maximum stem diameter (3.04 cm), maximum spread of canopy (42.36 cm), maximum length of inter-nodes (9.68 cm), and maximum chlorophyll content (4.58 mg/g), the results showed that treatment T2 (850 g / plant Nitrogen, 600 g / plant Phosphorus, and 850 g / plant Potash) achieved the best results followed by treatment T_9 (800 g / plant Nitrogen, 400 g / plant Phosphorus and500 g / plant Potash) and the minimum was recorded in T_4(700g / plant Nitrogen, 400g / plant Phosphorus and 400g / plant Potash).

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1. INTRODUCTION

"After mangos and bananas, citrus fruits are the most popular and widely farmed tropical and subtropical fruits in India. Mandarin (*Citrus sinesis* Osbeck) is grown commercially in several specific regions of the country, such as Sweet Orange in Central India, and is regarded as one of the most important cultivated species among citrus" [1]. "In terms of area and productivity, the crop is the most popular citrus variety in India. Manures and fertilizers are applied on the basis of soil, climate, age of plant and location etc. In Uttar Pradesh, N, P_2O_5 and K_2O are applied @ 850: 600 and 850 g/tree for the crops at the age of 10 years or above old [2]. Nutrition constitutes an important component in the cultivation of all the crops" [3,4]. "Citrus groves require 17 essential nutrients for its growth and development. Among these, carbon, oxygen, hydrogen and part of nitrogen are provided by rain water or air; the remaining nitrogen and rest of the essential nutrients are replenished by soil, irrigation water, organic or synthetic fertilizers" [5,6].

"It has stood the test of time and is still very popular among the poor and marginal farmers. Majority of farmer are still growing local cultivar. There is lack of suitable cultivars in Allahabad agro-climatic condition" [7]. Therefore, there is need to evaluate grafted plants of Sweet Orangefortheir performance in Allahabad agro-climatic conditions so the suitable dose of fertilizer can be identified for the region for growth, development and higher productivity" [8].

2. MATERIALS AND METHODS

In the experimental field of the Agricultural Research Farm, Rama University, Mandhana, Kanpur, Uttar Pradesh, the study was conducted in the years 2020–2021 utilizing Sweet Orange plants on various levels of Nitrogen (N), Phosphorus (P2O5), and Potassium (K2O) on growth and development in the Kanpur agro climatic conditions. The experimental design was complete randomized block with twelve treatments of the following as inadequate levels of Nitrogen (N) Phosphorus (P_2O_5) and Potassium (K_2O) was applied for all the treatments. After weeding, the initial fertilizer doses were sprayed [9]. Weeding, watering, pruning, disease and insect control, and other intercultural activities were carried out as needed. Characters' growth and development data were collected correctly. Data were statistically examined with the MSTATC computer application.

3. RESULTS AND DISCUSSION

T2{83.57 cm (850 g/plant Nitrogen, 400 g/plant Phosphorus, and 400 g/plant Potash)} was the highest plant height measured, and T9{79.45 cm (800 g/plant Nitrogen, 400 g/plant Phosphorus, and 500 g/plant Potash)} was the next highest. Nonetheless, T4 recorded the lowest plant height of 62.34 cm (700 g/plant nitrogen, 400 g/plant phosphorus, and 400 g/plant potash). A comparable outcome was discovered by Bihari et al. in 2009 [5].

T2 {421.04 (850 g/plant Nitrogen, 400 g/plant Phosphorus, and 400 g/plant Potash)} had the most leaves, followed by T9 {418.05 (800 g/plant Nitrogen, 400 g/plant Phosphorus, and 500 g/plant Potash)}. Nonetheless, T4~352.08(700 g/plant Nitrogen, 400 g/plant Phosphorus, and 400 g/plant Potash)} had the bare minimum of leaves reported.

Chart 1. Treatment Combination

Treatment	Nitrogen (g)	Phosphorus (g)	Potassium (g)
T_1	900	400	400
T_2	850	400	400
T_3	750	400	400
T_4	700	400	400
T_5	800	350	400
T_6	800	400	400
T_7	800	450	400
T_8	800	500	400
T_9	800	400	500
T_{10}	800	400	450
T_{11}	800	400	400
T_{12}	800	400	350

Table 1. Effect of differentNPK levels and Chlorophyll content on growth and development of Sweet Orange (*Citrus sinesis* Osbeck)

	Plant Height (cm)	No. of Leave	No. of Branches	Stem Diameter (cm)	Spread of Canopy (cm)	Length of Internode (cm)	Chlorophyll Content (mg/g)
Treatments							
T1	75.70	367.50	17.45	2.47	29.90	7.90	3.47
T2	83.57	421.04	26.36	3.04	42.36	9.68	4.58
T3	64.45	400.91	18.63	1.98	27.98	8.10	2.52
T4	62.34	352.08	16.45	1.21	27.74	7.68	1.75
T5	70.50	386.87	20.28	2.80	28.54	9.47	3.91
T6	74.32	357.98	19.57	1.60	28.00	8.86	2.15
T7	72.62	410.90	18.56	1.98	29.50	9.23	3.21
T8	66.57	374.69	17.1	2.12	28.34	7.80	2.81
T9	79.45	418.05	22.54	2.70	30.06	9.50	4.20
T10	68.89	394.63	21.07	2.36	29.40	7.98	2.95
T11	67.90	378.59	18.5	1.58	29.86	8.12	3.80
T12	65.09	405.80	19.43	1.86	28.76	9.30	2.30

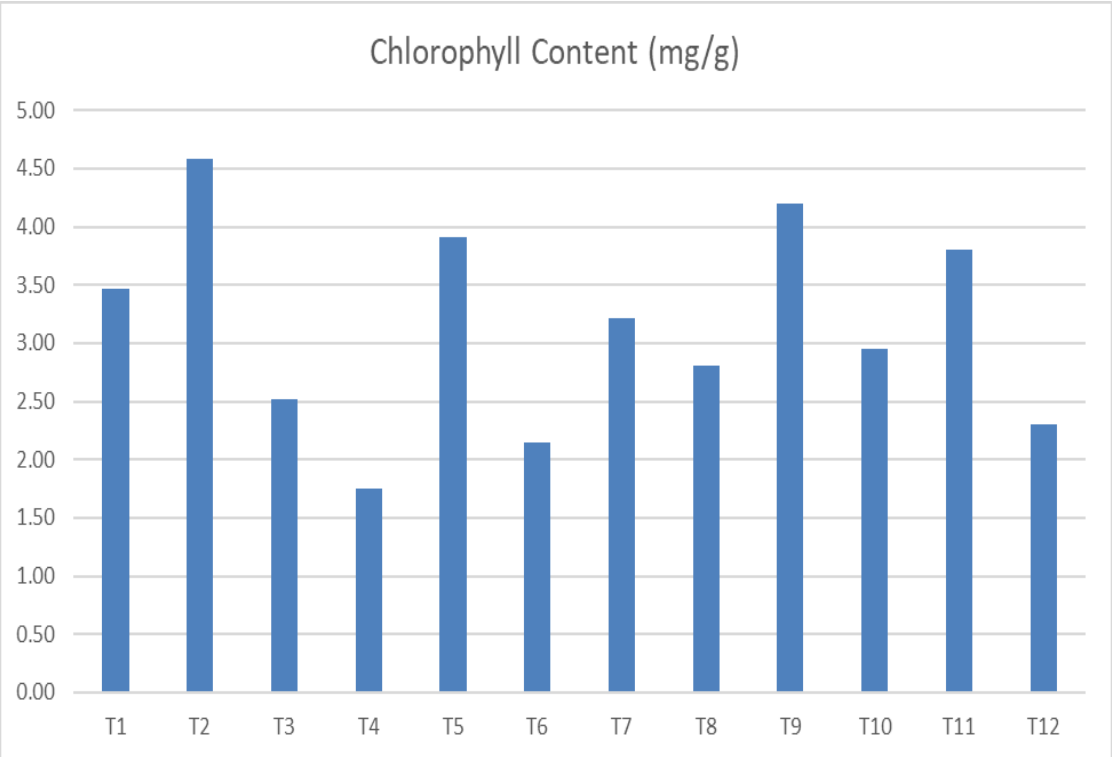

Fig. 1. Effects of different NPK levels and Chlorophyll content on growth and development of Sweet Orange (*Citrus sinesis* Osbeck)

T9{22.54 (800 g / plant Nitrogen, 400 g / plant Phosphorus, and 500 g / plant Potash)} succeeded T2 {26.36 (850 g / plant Nitrogen, 400 g / plant Phosphorus, and 400 g / plant Potash)} as the record for the most branches per plant. But in T4{16.45 (700 g/plant Nitrogen, 400 g/plant Phosphorus, and 400 g/plant Potash), the bare minimum of branches per plant was noted. A similar outcome was discovered in 2009 by Dalal et al [6].

Following T9{2.70 cm (800 g / plant Nitrogen, 400 g / plant Phosphorus, and 500 g / plant Potash)}, T2 had the largest stem diameter (cm) at 3.04 cm (850 g / plant Nitrogen, 400 g / plant Phosphorus, and 400 g / plant Calcium). Nonetheless, T4 reported the lowest

stem diameter at 1.21 cm (700 g/plant nitrogen, 400 g/plant phosphorus, and 400 g/plant potash).

"The maximumspread of canopy(cm) was recorded in T_2 {42.36 cm (850 g / plant Nitrogen, 400 g / plant Phosphorus and400 g / plant Potash)} followed by T_9 {30.06 cm (800 g / plant Nitrogen, 400 g / plant Phosphorus and500 g / plant Potash)}. However minimum spread of canopy(cm) was recorded in T_4 {27.74 cm (700 g / plant Nitrogen, 400 g / plant Phosphorus and400 g / plant Potash)}" [5]. The similar result was found in [10].

The longest distance between nodes (measured in centimeters) was found in T2 at 9.68 cm (850 g/plant Nitrogen, 400 g/plant Phosphorus, and 400 g/plant Potash), and in T9 at 9.50 cm (800 g/plant Nitrogen, 400 g/plant Phosphorus, and 500 g/plant Potash). Nonetheless, T4 reported a minimum inter-node length of 7.68 cm (700 g/plant nitrogen, 400 g/plant phosphorus, and 400 g/plant potash).

"The maximum Chlorophyll content(mg/g) was recorded in T_2 {4.58 mg/g(850 g / plant Nitrogen, 400 g / plant Phosphorus and400 g / plant Potash)} followed by T_9 {4.20 mg/g (800 g / plant Nitrogen, 400 g / plant Phosphorus and500 g / plant Potash)}. However minimum length of inter-nodes (cm)was recorded in T_4 {1.75 mg/g (700 g / plant Nitrogen, 400 g / plant Phosphorus and400 g / plant Potash)}" [1].

4. CONCLUSION

The treatment T2 (850 g/plant nitrogen, 400 g/plant phosphorus, and 400 g/plant potassium) was found to be the most effective in terms of maximum plant height (83.57 cm), maximum number of leaves (421.04), maximum number of branches (26.36), maximum stem diameter (3.04 cm), maximum spread of canopy (42.36 cm), maximum length of inter-nodes (9.68 cm), and minimum incidence of disease percentage (1.51%) for chlorophyll. content (4.59 mg/g)

CONFERENCE DISCLAIMER

Some part of this manuscript was previously presented in the conference: "International Conference on Emerging Trends in Agriculture & Allied Sector for Sustainable Developments" organized by Faculty of Agricultural Sciences & Allied Industries, Rama University, Kanpur Nagar, U.P., India on 8th and 9th December, 2023. Web Link of the proceeding: https://www.ramauniversity.ac.in/news-rama-university-hosts-successful-international-conference-on-emerging-trends-in-agriculture-12-49-5706

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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