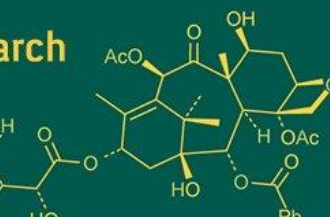
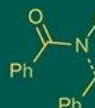


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Effect of different levels of NPK in combination with FYM on growth, mortality and establishment of kinnow (*Citrus reticulata* Blanco) under Kanpur agro-climatic region

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Abstract

The present investigation was under taken at Horticulture Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur, India during 2025-26. The experiment was laid out in randomized block design with three replications and ten treatments, separately. The aim of the study was to find out the "Effect on Different Levels of NPK with Combination of FYM on Growth, Mortality, and Establishment of Kinnow (*Citrus reticulata* Blanco)". The study revealed that the treatments comprised combinations of Nitrogen (N), Phosphorus (P), and Potassium (K) with Farm Yard Manure (FYM). The result indicated that T10 (4 kg/plant Farm Yard Manure, 35g/plant Nitrogen, 40g/plant Phosphorus, and 40g/plant Potash) is found to be the most effective for growth and development of plant viz., (Plant height 95.37 cm), number of leaves per plant at 120 DAP (73.87), Number of branches per plant (33.43), stem diameter (mm) at 120 DAP (4.56 cm), Spread of canopy at 120 DAP (674.09cm²), and survival percentage (97.33). And the T7 (4 kg/plant Farm Yard Manure, 55g/plant Nitrogen, 20g/plant Phosphorus, and 25g/plant Potash) is found to be superior in Leaf area (cm²) at 120 DAP (44.59), Length of internode (cm) at 120 DAP (2.92). Therefore, the (4 kg/plant Farm Yard Manure, 35g/plant Nitrogen, 40g/plant Phosphorus, and 40g/plant Potash) was found most suitable for better growth and development of kinnow fruit plant.

Keywords: Nitrogen, Phosphorus, and Potassium, Growth, Survival percent, kinnow fruit plant

Introduction

Citrus reticulata blanco is the scientific name for kinnow. According to botany, kinnow is a member of the Rutaceae family. According to W. Ahmed *et al.* (2007) [12], kinnow is a well-known citrus fruit that is favored for its pleasant flavor, appearance, color, taste, good yield, high processing value, therapeutic applications, delicious juice, smoothing character, vitamin C source, wider adaptability to various agroclimatic conditions, and high nutritive value. Kinnow is a cross between the citrus cultivars "willow leaf" (*Citrus deliciosa*) and "king" (*Citrus nobilis*). H.B. Frost created it in 1915 at the University of California Citrus Experimentation Station in the United States. In 1935, the hybrid was made available for commercial production (Y. H. Hui *et al.* 2006) [4]. Dr. J.C. Bakshi brought kinnow to India in 1954 at the Punjab Agriculture University Regional Research Station in Abohar (HAG 2017). Kinnow is a highly productive plant with a hot climate. The tree grows quickly and can grow up to 35 feet tall. The broad, shallow roots of the kinnow plant can reach a depth of seven to twelve feet, depending on the state of the soil. The shoot system has a columnar trunk with many long, thin, ascending branches that are almost entirely free of thorns. Branchlets have dense foliage made up of broadly lanceolate, medium-to-large leaves. www.justagriculture.in the leaves have unicostate reticulate venation, are simple, alternating, petiolate, and have a complete edge. Smooth essential oil glands in the lamina of leaves provide a pleasant scent. Off-white hermaphrodite solitary pentaerous flowers are produced by kinnow. The hue of the anthers is yellow. Hesperidium fruit has between 0 and 9 seeds. The shape of kinnow fruit ranges from spherical to oblate. Kinnow has become the King of Fruits in Punjab due to farmers' passion for it (Rajesh Kumar 2020) [6]. One of the most significant fruit crops, citrus is grown on more than 109.6 million hectares of land and

Produces 14.25 million tons year (FAO 2023). With 13% of the global orange production, India comes in third. According to the National Horticulture Board database, Kinnow and Mandarin plantations covered 4,29,290 hectares in India, with a total yield of 47,53,830 MT. Punjab, Rajasthan, Madhya Pradesh, Haryana, Maharashtra, and Uttarakhand are among the Indian states where Kinnow, Mandarin, or orange is grown. With a great potential for production, kinnow farming is growing in Western Uttar Pradesh (Agra, Gorakhpur, etc.), with an average of 294 quintals/hectare (q/ha) in Agra. The flavedo/exocarp, a pigmented skin with glands that secrete essential oils, protects the inside, juicy part of kinnow fruit. White, spongy tissues called albedo, which vary in thickness and have a complex network of vascular bundles, are another significant component located immediately adjacent to flavedo (Lado *et al.*, 2016) [7]. The edible portion of kinnow fruit consists of tiny, closely spaced sacs that hold seeds and fluid. Kinnow is well-known around the world for the flavor and nutritional value of its juice. Customer preference is another factor contributing to kinnow fruit's appeal. Customers want to purchase fruit that is easy to eat, dust-free, has few seeds, and has the most liquid possible. Kinnow fruit may be able to satisfy growing customer demands. The abundance of volatile chemicals in kinnow gives it its distinctive flavor. Before harvesting the fruits from the tree, the maturity level must be determined in order to market kinnow on a commercial basis. The amount of total soluble solids (TSS) in kinnow fruit pulp ranges from 9.5 to 16%. The amount of sugar in fruit's juicy sacs is greatly influenced by environmental factors, including temperature, light irradiance, and farming practices. Amino acids, vitamins (ascorbic acid, provitamin-A, and folate), and bioactive chemicals (limonoids, flavones, phenolics, and flavonoids) as well as carotenoids are all abundant in kinnow juice. The temperature and humidity of the storage chamber determine how much amino acid is in kinnow juice. Asparagine (3.5 $\mu\text{mol/g}$) is the main amino acid found in kinnow juice, followed by arginine (2.4 $\mu\text{mol/g}$), aspartic acid (2.0 $\mu\text{mol/g}$), proline (1.5 $\mu\text{mol/g}$), and glutamine (1.0 $\mu\text{mol/g}$) (Matsumoto 2012) [9]. A significant source of osmotic stabilizer and blood pressure-regulating minerals (potassium and salt) is kinnow juice. Kinnow juice's potassium content ranged from 1.6 to 2.5 mg/g, while its sodium content varied from 0.01 to 0.03 mg/g. According to the mineral profile of kinnow juice, calcium is present in the range of 0.14-0.47 mg/g, followed by magnesium (0.11-0.12 mg/g), phosphorus (0.10-0.30 mg/g), iron (0.0015-0.0060 mg/g), zinc (0.0007-0.005 mg/g), copper (6-8 mg/100 ml), and manganese (0.0005 mg/g) (Barros *et al.*, 2012) [1]. The most crucial element for promoting plant growth is thought to be nitrogen. Despite being a naturally occurring element, nitrogen cannot be absorbed by plants. The environment's nitrogen is converted into nutrients that plants can easily access. Thick, green, and sustainable orchards are encouraged by the appropriate use of balanced fertilizer. In addition to being a necessary component of protein and chlorophyll, nitrogen is also found in numerous other substances that are physiologically significant to plant metabolism, including nucleotides, phosphatides, alkaloids, enzymes, hormones, vitamins, and more (Yawalkar *et al.* 1992) [13]. Adequate quantities of phosphorus support general growth and are necessary for root development and nutrient uptake. Numerous functions, including

photosynthesis, the synthesis and breakdown of carbohydrates, and the transport of energy within the plant, depend on phosphorus (Obreza 2001) [10]. Applying optimal P levels greatly increases vegetative parameters, while insufficient P restricts growth, highlighting P's role in energy transfer (ATP) and biochemical processes. Phosphorus (P) is essential for Kinnow growth, promoting robust root and shoot development, increasing leaf count, plant spread, and overall vigor. Deficiency causes stunted growth, dull leaves, and poor energy use.

Higher K can occasionally reduce P absorption while increasing others. Potassium is essential for nutrient balance (affecting Mg, Zn, and Fe) and general tree vigor. Potassium is required for vital physiological processes like development, protein synthesis, and the production of sugars and starches (Abbas 2008). It improves fruit size, flavor, and color and is essential to fruit formation. By improving nutrient uptake (N, K, Mg, Fe, and Cu), increasing canopy volume (plant spread, vigor) for more fruits, and improving physiological processes, potassium (K) greatly increases Kinnow mandarin vegetative growth. Deficits result in yellowing and poor development.

The most popular organic manure utilized by fruit growers is farm yard waste. It supplies the plant rhizosphere with organic matter and other vital nutrients, including 0.5% N, 0.25% P₂O₅, and 0.5% K₂O. Additionally, FYM increases soil porosity and water-holding capacity while reducing leaching losses and preserving the soils balanced nutritional status. As a result, it keeps plants and soil healthy (Prem Chand Garhwal 2010) [3].

The vegetative growth of Kinnow plants is greatly enhanced by applying varying amounts of farm yard manure (FYM). When paired with balanced nitrogen fertilization, higher FYM levels typically improve plant height, canopy spread, leaf count, and general vigor. Excessive FYM over ideal levels, however, may result in decreasing returns and may not proportionately boost growth.

The plant rhizosphere receives vital nutrients and organic materials from farm yard manure (FYM). Additionally, FYM increases the soil's porosity and water-holding capacity. Additionally, it keeps the soil's nutritional status balanced and reduces leaching losses. Nitrogen, on the other hand, is the most crucial nutrient for plants and is crucial for boosting vegetative growth and fruit production. Early, robust vegetative growth and green color are caused by nitrogen, which sets off the plant's physiological processes. According to Sharma and Chopra (2000) [11], nitrogen was crucial for boosting sweet orange growth and output.

Materials and Methods

The experiment was conducted during the Kharif season of 2025-2026 at the Horticulture Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur, using 1-year-old Kinnow plants to examine the effects of varying levels of NPK with a combination of FYM on Growth, Mortality, and Establishment of Kinnow (*Citrus reticulata* Blanco) under the Kanpur Agro-Climate Region.

The experimental area had sandy loam soil with pH of 7.2, the soil was moderately fertile. The plant of kinnow was planted at beginning of rainy season with (5mX5m spacing) of commercial variety of Citrus viz. Kinnow Orange. The plants were planted in Randomized Block Design putting 4 plants per treatment per replication. The planting method

used in kinnow is square method. Data were recorded on different growth parameters.

Result and discussion

The present investigation was under taken at Horticulture Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur, India during 2025-26. The result indicated that T10 (4 kg/plant Farm Yard Manure, 35g/plant Nitrogen, 40g/plant Phosphorus, and 40g/plant Potash) is found to be the most effective for growth and development of plant viz., (Plant height 95.37 cm), number of leaves per plant at 120 DAP (73.87), Number of branches per plant (33.43), stem diameter (mm) at 120 DAP (4.56 cm), Spread of canopy at 120 DAP (674.09cm²), and survival percentage (97.33). And the T7 (4 kg/plant Farm Yard Manure, 55g/plant Nitrogen,

20g/plant Phosphorus, and 25g/plant Potash) is found to be superior in Leaf area (cm²) at 120 DAP (44.59), Length of internode (cm) at 120 DAP (2.92).

Table 1: Treatment Combination

Treatments	FYM (kg)	N (gm)	P (gm)	K (gm)
T ₁	4	Control	Control	Control
T ₂	4	40	25	25
T ₃	4	30	20	20
T ₄	4	50	30	20
T ₅	4	40	25	30
T ₆	4	30	35	20
T ₇	4	55	20	25
T ₈	4	45	15	35
T ₉	4	25	20	15
T ₁₀	4	35	40	40

Table 2: Effect on different levels of npk with combination of fym on growth, mortality, and establishment of kinnow (*Citrus reticulata* blanco) under the kanpur agro-climate region

Treatments	Plant height (cm) 120 DAT	No. of leaves 120 DAT	No. of branches / plant 120 DAT	Stem diameters (cm) 120 DAT	Spread of canopy (cm ²) 120 DAT	Leaf area (cm ²) 120 DAT	Length of inter node (cm) 120 DAT	Survival % 120 DAT
T ₁	93.69	71.06	31.60	4.45	628.03	40.79	1.91	90.00
T ₂	92.93	70.84	30.67	4.52	662.44	39.51	2.09	84.00
T ₃	94.90	73.36	31.33	4.47	631.03	38.52	1.89	90.33
T ₄	94.76	70.85	31.37	4.43	646.57	36.09	2.04	94.00
T ₅	93.07	70.96	31.20	4.52	655.73	40.15	1.79	86.67
T ₆	92.95	73.03	32.13	4.51	652.07	41.64	2.14	84.00
T ₇	94.28	71.13	31.83	4.28	668.23	44.59	2.92	95.00
T ₈	94.68	72.14	30.93	4.42	664.15	36.67	1.93	74.00
T ₉	94.17	71.65	30.13	4.46	639.01	40.59	2.08	81.00
T ₁₀	95.37	73.87	33.43	4.56	674.09	42.57	2.00	97.33
SEm±	0.49	0.37	0.42	0.02	9.86	0.36	0.13	0.71
F. TEST	S	S	S	S	S	S	S	S
CD or LSD	1.45	1.10	1.24	0.05	29.29	1.08	0.39	2.12

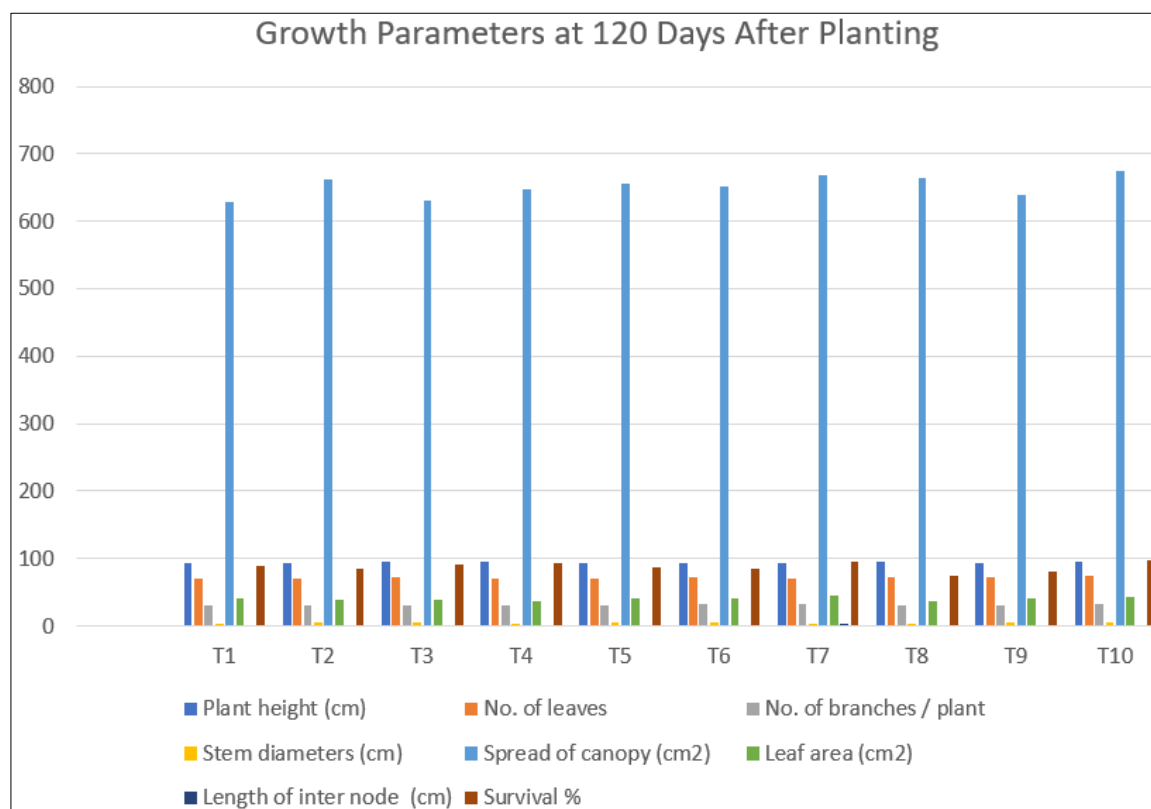


Fig 1: Effect of different treatments on Plant

Conclusion

On the basis of results obtained, It is concluded that the treatment T10 (4 kg/plant Farm Yard Manure, 35g/plant Nitrogen, 40g/plant Phosphorus, and 40g/plant Potash) was found to be the best in terms of maximum plant height (85.93 cm), maximum number of leaves (54.52), maximum number of branches (24.49), maximum stem diameter (3.63 cm), maximum spread of canopy (526.34 cm²), maximum survival percent (97.33 %) and T7 (4 kg/plant farm yard manure, 55g/plant nitrogen, 20g/plant phosphorus, and 25g/plant potash) maximum leaf area (32.28cm²), maximum length of inter-nodes (1.71cm) and followed by treatment T₁₀ (10 kg / plant Farm Yard Manure, 1 kg / plant Vermicompost, 60g / plant Nitrogen, 60g / plant Phosphorus and 65g / plant Potash) and the minimum was recorded in T₄ (10 kg / plant Farm Yard Manure, 1 kg / plant Vermicompost, 50g / plant Nitrogen, 40g / plant Phosphorus and 60g / plant Potash).

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