Effect of different levels of Fertilizer doses and vermicompost application on growth and yield of okra [*Abelmoschus esculentus* L.] var. Kashi Kranti

Abstract

The present research was carried out to investigate the effect of different levels of NPK and vermicompost on growth and yield of okra [*Abelmoschus esculentus* L.] var. Khasi Kranti. The field experiment was conducted during kharif season of 2021 at central research farm, department of soil science and agricultural chemistry, shuats, prayagraj. The soil of experimental area falls in order inceptisol and soil texture was sandy loam (sand 61.20%, silt 23.20%, clay 15.6%). There were 9 treatments combination replicated three times in RBD. The result shows that application of treatment 100:60:50 kg ha^{-1} NPK + 6t ha^{-1} vermicompost has greater effects on growth and yield of okra. The treatment 100:60:50 kg ha^{-1} NPK + 6t ha^{-1} vermicompost observed highest plant height of okra (77.47 cm), No. of leaves $plant^{-1}$ (33.62), No. of branches $plant^{-1}$ (38.01), No. of fruits $plant^{-1}$ (19.87), and Yield (135.59) q ha^{-1} compared to other treatments. Maximum Gross return (222885 ha), Net return (182494 ha) and B: C ratio (1:2.10) were recorded in treatment with the application of 100:60:50kg ha^{-1} NPK + 6t ha^{-1} vermicompost as well. Based on the above results obtained during present research work that that the application of 100:60:50 kg ha^{-1} NPK + 6t ha^{-1} vermicompost gave the significant effects on growth and yield of okra.

Introduction

The okra, scientifically known as *Abelmoschus esculentus*, is native to the African continent. The organism has a somatic chromosome count of 2n=130 and is an amphidiploid resulting from the combination of *Abelmoschus tuberculatus* with 2n=58 and an unidentified species with 2n=72. Okra, also known as Bhindi or lady finger, is a member of the Malvaceae family. It is a perennial vegetable crop that is grown on a yearly basis in tropical and subtropical regions of the globe. The vegetable has a brief duration (Oyelade *et al*., 2003). The okra plant need warm temperatures and is incapable of enduring prolonged exposure to cold temperatures or tolerating any risk of frost. The ideal temperature is between the range of 21 to 30 degrees Celsius. Okra is a significant vegetable crop that provides abundant nourishment. The green pod of okra, in a 100g edible portion, contains 89.6g of moisture, 6.6g of carbohydrates, 1.9 g of protein, 0.2 g of fat, 1.2 g of fibre, 0.7 g of minerals, 66 mg of calcium, 43 mg of magnesium, 56 mg of phosphorus, 103 mg of potassium, 88 IU of vitamin

A, 0.07 mg of thiamine, 0.1 mg of riboflavin, 0.6 mg of nicotinic acid, 13 mg of vitamin C, and 8 mg of oxalic acid (Choudhary *et al*., 2015). Okra fruit is mostly eaten either fresh or cooked and is a significant provider of vitamins A, B, C, minerals such as iron and iodine, and serves as an essential vegetable source of viscous fibre. However, it is believed to have low levels of salt, saturated fats, and cholesterol (Singh *et al*., 2014).

India's primary objective is to enhance the sustainable production of high-quality food, while simultaneously addressing the problem of feeding its vast population and improving the income of farmers. The fertilisation needs for okra play a crucial role in promoting early development and maximising overall fruit output. The use of both organic and inorganic fertilisers has the potential to enhance the production of crops, as shown by Mal et al. (2013). Organic fertiliser releases a wide range of micro and macro nutrients that promote plant elongation. Organic fertilisers enhance soil physical qualities and provide important plant nutrients, promoting increased plant development. They also safeguard the soil from erosion, contribute to the creation of ideal soil aggregates by supplying cementing substances, and improve soil looseness (Yadav *et al*., 2020).

Nitrogen is a crucial macronutrient that plays a significant role in the growth and development of agricultural plants. Nitrogen is essential for the creation of chlorophyll, proteins, nucleic acids, hormones, and vitamins. Nitrogen has a crucial role in cell proliferation, cell elongation, and the overall increase in green pod yields of okra (Das *et al*., 2014). Phosphorus is a crucial ingredient in the manufacture of potent chemicals, such as AMP, ADP, and ATP, that have a vital function in the processes of photosynthesis and respiration. It is an essential constituent of nucleic acids and phospholipids. Plants absorb phosphorus in its inorganic state, mostly as the orthophosphate H2PO4 ion. Phosphorus facilitates the first stages of crop growth, coordinates the process of seed germination, and ultimately improves the overall yield, particularly in soils that lack sufficient phosphorus (Meena *et al*., 2017). Several studies have shown the impact of phosphorus administration on the production of green pods in okra. This application also enhances root development, accelerates seed maturation, and boosts fruit output, particularly when combined with nitrogen (Lakra *et al*., 2017). Potassium is a vital macronutrient for plants, along with nitrogen (N) and phosphorus (P). Potassium enhances the plant's vitality and ability to withstand diseases, hence significantly contributing to agricultural yield. Potassium has a crucial role in promoting stem development, root growth, and protein synthesis.Vermicomposting is a bio-oxidative process in which earthworms and decomposer microorganisms work together to break down organic waste in a controlled manner. This process also helps to enhance the physical, chemical, and biological qualities of the soil.

Vermicompost aids in decreasing the carbon-to-nitrogen ratio, enhancing the amount of humic acid, increasing the cation exchange capacity, and boosting the concentration of water-soluble carbohydrates. Organic manure enhances soil structure and supplies essential nutrients to promote soil production (Qhureshi, 2007). Organic fertilisers are ecologically sustainable since they enhance the proliferation of advantageous microorganisms and overall enhance soil vitality (Oyewole et al., 2012). Additionally, it includes biologically active substances like plant growth regulators. Vermicompost serves as a rich source of both micro and macro nutrients and functions as a chelating agent. Vermicompost undergoes significant humification as a result of the breakdown of organic components by earthworms and the subsequent colonisation by microorganisms (Singh *et al*., 2013).

Materials and Methods

An experiment was conducted during the kharif season of 2021 at the crop Research farm of the Soil Science and Agricultural Chemistry department, Sam Higginbottom University of Agriculture, Technology and Sciences in Prayagraj, Uttar Pradesh. The farm is situated on the outskirts of Prayagraj city. The region is located to the south of Prayagraj, on the right bank of the Yamuna River, and is about 6 km away from the city, along the Rewa road. The location is positioned at a latitude of 25°24'30" north, a longitude of 81°51'10" east, and an elevation of 98 metres above sea level. The site experiences a maximum temperature ranging from 46 to 48℃, while the minimum temperature goes from 40 to 50 ℃. The range of relative humidity values varied from 20% to 94%. The annual precipitation in this region averages around 1100 mm. Prayagraj has a sub-tropical and semi-arid climate, characterised by rainfall occurring mostly from July to September. The experiment was conducted using a Randomised Block Design (RBD) as proposed by Fisher R. A. in 1958. It consisted of 9 different treatments and each treatment was replicated 3 times. The treatment included various combinations of NPK fertiliser at three levels: 0% (N0:P0:K0 kgha^{-1}), 50% (N50: P30:K25 kgha^{-1}), and 100% (N100:P60:K50 kgha^{-1}). Additionally, three levels of vermicompost were used: 0% (0 t ha-1), 50% (3 t ha^{-1}), and 100% (6 t ha^{-1}). The prescribed dosage of fertilisers, namely nitrogen, phosphorus, and potassium, was administered in a ratio of 100:60:50 kg ha^{-1}. Additionally, a quantity of 6 tonnes per hectare of vermicompost was applied. The nitrogen was derived from urea, which contains 46% nitrogen. Phosphorus was obtained from single super phosphate, which contains 16% P_2O_5. Potassium was sourced from muriate of potash, which contains 60% K_2O. Additionally, vermicompost provided nitrogen (1.67% N_2), phosphorus (1.20% P_2O_5), and potassium (0.89% K_2O). A certain amount of fertiliser was put to each plot based on the treatment allocation. Furrows were opened to a depth of about 5 cm. The space between plants, denoted as R x R, is 30 cm, while the distance between seeds, denoted as P x P, is 45 cm. The recommended seed rate is 8-10 kg per hectare. The agronomic procedures were consistently used to cultivate the crop.

Results and Discussion

The experiment revealed substantial variations in plant height, number of leaves per plant, number of branches per plant, number of fruits per plant, and yield as a result of different treatments. The findings indicate that the administration of a combination of 100:60:50 kg ha^{-1} NPK fertiliser and 6t ha^{-1} vermicompost leads to the greatest average plant height of 77.47 cm. In contrast, the control group, which did not receive any treatment, had a plant height of 68.91 cm (Table 1). The data reveals that the use of a 100:60:50 kg ha^{-1} NPK + 6t ha^{-1} vermicompost results in the greatest average number of leaves per plant (33.62), compared to the control group which had an average of 26.01 leaves per plant (Table 1). The use of a fertiliser combination consisting of 100 kilogrammes per hectare of nitrogen, 60 kilogrammes per hectare of phosphorus, and 50 kilogrammes per hectare of potassium, together with 6 metric tonnes per hectare of vermicompost, resulted in the largest number of branches per plant (38.01), as compared to the control group which had 29.75 branches per plant (Table 1). The use of a combination of 100 kilogrammes per hectare of nitrogen, 60 kilogrammes per hectare of phosphorus, and 50 kilogrammes per hectare of potassium, together with 6 metric tonnes per hectare of vermicompost, resulted in the maximum number of fruits per plant (19.87). In contrast, the control group had the lowest number of fruits per plant (14.21) as shown in Table 2. The application of a combination of 100:60:50 kg ha^{-1} NPK fertiliser and 6t ha^{-1} vermicompost resulted in the maximum production of 135.59 q ha^{-1}. In comparison, the control group only produced a yield of 47.56 q ha-1 (Table 2). The treatment that resulted in the highest gross return (222,885 hectares), net return (182,494 hectares), and B:C ratio (1:2.10) was the application of 100:60:50 kg/ha NPK fertiliser together with 6 tons/ha of vermicompost, as shown in Table 3. The application of a combination of 100:60:50 kg ha^{-1} NPK and 6 tonnes ha^{-1} vermicompost resulted in the most favourable performance of okra compared to other treatments.

Conclusion

Based on the aforementioned data, it can be inferred that the treatment consisting of 100:60:50 kg ha-1 NPK + 6t ha-1 vermicompost yields superior outcomes compared to other treatment combinations. The maximum profit achieved is 182494.00 ha-1, with the highest benefit-cost ratio of 1.2.10. The growth and yield of Okra were improved by applying NPK and Vermicompost either alone or together.

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Table 1: Growth attributes of Okra influenced by NPK Fertilizer and Vermicompost Application

Treatment	Plant height (cm)	No. of leaves plant^{-1}	No. of branches plant^{-1}
Control	68.91	26.01	29.75
0kg ha^{-1} NPK + 3t ha^{-1} VC	70.10	26.68	31.09
0kg ha^{-1} NPK + 6t ha^{-1} VC	70.66	27.48	33.08
50:30:25 kg ha^{-1} NPK + 0t ha^{-1} VC	72.64	28.5	32.02
50:30:25 kg ha^{-1} NPK + 3t ha^{-1} VC	73.79	29.36	35.04
50:30:25 kg ha^{-1} NPK + 6t ha^{-1} VC	74.75	30.7	35.94
100:60:50kg ha^{-1} NPK + 0t ha^{-1} VC	75.66	31.69	34.03
100:60:50kg ha^{-1} NPK + 3t ha^{-1} VC	76.67	36.69	36.99
100:60:50kg ha^{-1} NPK + 6t ha^{-1} VC	77.47	33.62	28.01
S.Em (±)	0.57	0.69	0.71
C.D.	1.67	2.12	2.01

Fig 1. Growth attributes of Okra

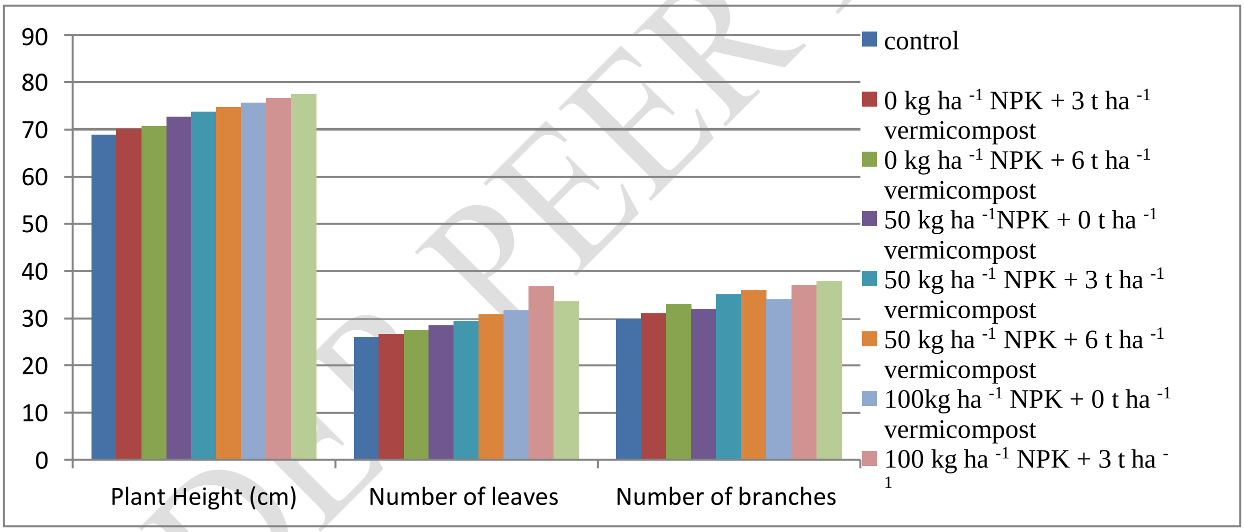

Table 2: Yield attributes of Okra influenced by NPK and Vermicompost

Treatment	No. of Fruit $plant^{-1}$	Yield of Fruits ($q\ ha^{-1}$)
Control	39.13	47.56
0kg ha^{-1} NPK + 3t ha^{-1} VC	40.2	52.06
0kg ha^{-1} NPK + 6t ha^{-1} VC	42.9	73.71
50:30:25 kg ha^{-1} NPK + 0t ha^{-1} VC	41.87	61.46
50:30:25 kg ha^{-1} NPK + 3t ha^{-1} VC	44.4	107.34
50:30:25 kg ha^{-1} NPK + 6t ha^{-1} VC	45.31	115.91
100:60:50kg ha^{-1} NPK + 0t ha^{-1} VC	43.81	87.53
100:60:50kg ha^{-1} NPK + 3t ha^{-1} VC	46.51	118.74
100:60:50kg ha^{-1} NPK + 6t ha^{-1} VC	47.27	135.59
S.Em (±)	1.81	0.91
C.D.	2.69	1.78

Fig 2. Yield attributes of Okra

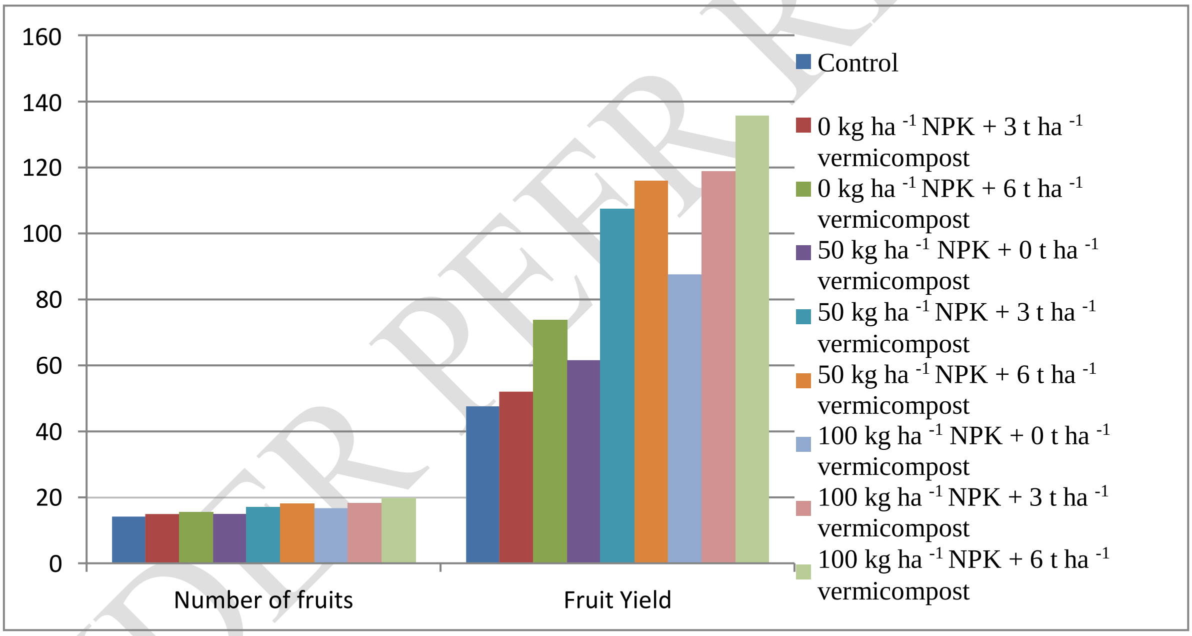

Table 3: Economics of different treatment combinations of okra

Treatment	Gross return (ha^{-1})	Total cost of cultivation (ha^{-1})	Net profit (ha^{-1})	Cost benefit ratio (B:C)
Control	71340	25250	46090	1:1.13
0kg ha^{-1} NPK + 3t ha^{-1} VC	78090	30250	47840	1:1.23
0kg ha^{-1} NPK + 6t ha^{-1} VC	110565	35250	75315	1:1.30
50:30:25 kg ha^{-1} NPK + 0t ha^{-1} VC	92190	27967.76	64222.2	1:1.56
50:30:25 kg ha^{-1} NPK + 3t ha^{-1} VC	161010	28467.76	132542	1:1.72
50:30:25 kg ha^{-1} NPK + 6t ha^{-1} VC	182865	28967.67	153897	1:1.76
100:60:50kg ha^{-1} NPK + 0t ha^{-1} VC	131295	30391	100904	1:1.82
100:60:50kg ha^{-1} NPK + 3t ha^{-1} VC	209610	35391	174219	1:2.00
100:60:50kg ha^{-1} NPK + 6t ha^{-1} VC	222885	40391	182494	1:2.10

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