Evaluating the Efficacy of Vermiwash Foliar Spray on Yield and Nutrient Dynamics in Okra Cultivation

Abstract

A field experiment was conducted to evaluate the efficacy of vermiwash foliar spray on yield and nutrient dynamics in okra cultivation was conducted during *Kharif* 2023-24 atDivision of soil science, Dr. Sharadchandra Pawar College of Agriculture, Baramati. Eight treatments (T_1-T_8) with combinations of GRDF and vermiwash sprays after 30, 38 and 46 DAS was arranged in a Randomized Block Design (RBD) with three replications and were evaluated for yield, and macronutrient (N, P and K) and micronutrient (Fe, Mn, Zn and Cu) uptake.The application of vermiwash foliar sprays significantly enhanced the nutrient uptake of N, P and K in okra. The highest yield (26.66 ton ha^{-1}) and nutrient uptake, including N (76.83 kg ha^{-1}), P (21.60 kg ha^{-1}), K (49.06 kg ha^{-1}), Fe (819.1 g ha^{-1}), Mn (479.12 g ha^{-1}), Zn (153.63 g ha^{-1}) and Cu (203.45 g ha^{-1}) were observed in T8 (100% GRDF + 30% vermiwash) followed by T7, T6 and T5. Lower uptake values were observed in treatments with lesser vermiwash concentrations. Statistical analysis showed significant differences among treatments. It was concluded that combining higher concentrations of vermiwash with GRDF significantly improves okra yield and nutrient uptake.

Keywords: Vermiwash, foliar spray, GRDF, nutrient uptake and okra yield

Introduction

Okra (*Abelmoschus esculentus L.*) is commonly known as lady's finger, is a widely cultivated vegetable crop, particularly in tropical and subtropical regions.(Akanbi *et al.*, 2010). It is valued for its rich nutritional profile, including essential vitamins, minerals, and dietary fibre, making it a crucial component of traditional diets (Farinde*et al.*, 2007). Okra plays an important role in food security, especially in developing countries, due to its ability to thrive in various soil types and climates (Akanbi *et al.*, 2010). However, achieving optimal yield and fruit quality often depends on effective nutrient management strategies (Rao and Rao, 2015). As a result, okra is frequently examined in research on sustainable agricultural practices, such as the application of organic amendments and bio-enhancers like vermiwash, which have been shown to enhance nutrient uptake and improve plant growth (Ansari and Sukhraj, 2010). Investigating these sustainable practices is essential for boosting okra productivity while maintaining environmental sustainability (Singh *et al.*, 2020).

2 Material and methods

2.1 Experimental site and Location

The experiment was carried out during *kharif* *of* 2023-24 at Research Farm of Division of Soil Science, Dr. Sharadchandra Pawar College of Agriculture, Baramati, Maharashtra (India). The location of the experimental farm lies between 18.14^0 latitude and 74.54^0longitude.The experimental site's initial soil sample had a slightly alkaline pH of 8.4 and normal electrical conductivity (0.44 dS/m). Organic carbon content was medium (0.47%), while the soil was somewhat calcareous (5.84%). The soil was low in accessible nitrogen, moderate in phosphate, and relatively high in potassium, with adequate quantities of micronutrients.

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2.2 Experimental design and crop management

The experiment was laid out in a randomized block design with eight treatments and three replications. The unit plot size for each treatment was 5.50 m x 1.2 m. The hybrid variety of okra, Radhika, was sown at a spacing of 60 cm × 30 cm during the Kharif season of 2023-2024. Different concentrations of vermiwash, in combination with the General Recommended Dose of Fertilizers (GRDF), were applied in eight different treatment combinations (T_1-T_8). The treatments were as follows: T_1: GRDF + Water spray; T_2: 100% GRDF (150:100:100 N: P_2O_5: K_2O kg ha^{-1}); T_3: 75% GRDF + 10% Vermiwash spray; T_4: 75% GRDF + 20% Vermiwash spray; T_5: 75% GRDF + 30% Vermiwash spray; T_6: 100% GRDF + 10% Vermiwash spray; T_7: 100% GRDF + 20% Vermiwash spray; and T_8: 100% GRDF + 30% Vermiwash spray.

2.3 Crop yield

2.3.1 Fruit yield per plant

The weight of fruits per plant harvested from randomly tagged five plants from each treatment was determined and each replication was noted down at each picking. Tthe total weight of fruits harvested in each picking was computed, averaged and expressed in weight per plant in grams.

2.3.2 Fruit yield per plot

The weight of fruits harvested from each picking was recorded from each plot (including the tagged plants) and total yield per plot estimated by adding the yield of all the harvest expressed in kilograms per plot.

2.3.3 Fruit yield per hectare

Every week marketable fruits were picked from each plot and total yield was noted and calculated on ha^{-1} basis by using formulae given below.

$$\text{Fruit yield (ton ha}^{-1}\text{)} = \frac{\text{Fruit yield (Kg plot}^{-1}\text{)}}{\text{Net plot area (m}^2\text{)}} * 10$$

2.4 Nutrient uptake

Plant samples were collected from each plot after the final harvest and were washed first with ordinary water and then with distilled water. The samples were dried in an oven at 60 ± 5°C for 72 hours. Once dried, the samples were ground in a steel grinder to ensure thorough mixing of the plant material and stored in butter paper bags for further nutrient content analysis, including nitrogen (N), phosphorus (P), potassium (K), iron (Fe), manganese (Mn), zinc (Zn) and copper (Cu). Nitrogen estimation involved separate digestion using concentrated H_2SO_4 and a digestion mixture, as determined by the micro-Kjeldahl method outlined in AOAC (1970). For P, K, Fe, Mn, Znand Cu.The prepared plant samples were digested using a di-acid mixture of HNO_3 and $HClO_4$ (3:1), following the procedure described by Jackson (1973). Phosphorus in the digest was measured using the vanado-molybdate yellow colour method (Jackson, 1973), while potassium was analyzed on a flame photometer based on the methods of Chapman and Pratt (1961). The micro-nutrient cations (Fe, Mn, Zn and Cu) were determined using an atomic absorption spectrophotometer (Zoroski and Burau, 1977). The uptake of N, P, K, Fe, Mn, Zn and Cu by the okra fruits, stover stover and roots at harvest was calculated using the following formula.

$$\textbf{Nutrient uptake (kg ha}^{-1}\textbf{)} = \frac{\text{Nutrient content (\%)} \times \text{Dry matter yield (kg ha}^{-1})}{100}$$

The total nutrient uptake was calculated as the sum of nutrient uptake by fruits, stover, and roots. The uptake of macronutrients (N, P and K) was expressed in kgha^{-1} micronutrients viz., (Fe, Cu, Zn and Mn) were expressed in g ha^{-1}.

3.5 Statistical Analysis

The data generated after the chemical and physical observations recorded form soil and plant as per the scheduled programme mentioned above was statistically analysed by adopting Randomized Block Design (RBD) as suggested by Panse and Sukhatme (1985).

3. Results and discussion

3.1 Yield

A substantial variation existed across the treatments regarding the fruit production of okra (Table 1, Fig.1).Among all the treatments the highest fruit yield of okra 26.66ton ha^{-1}was recorded inT_8(mention treatment) followed by T_7 (25.33 ton ha^{-1}), T_6 (25.02 ton ha^{-1}) and (75% GRDF + 30% Vermiwash Spray) (mention set up number) (23.18 ton ha^{-1}) which were at par with each other. However, T_4 (22.40 ton ha^{-1}) followed by T_3 (21.25 ton ha^{-1}) was at par with T_2 (19.83 ton ha^{-1}) and T_1 (18.54ton ha^{-1}) recorded the lowest yield. Similar results were aligned by Dwivedi *et al.* (2018) who

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found a significant increase in fruit yield per plant with the application of vermicompost, NPK and vermiwash.

3.2 Nutrient uptake by crop

3.2.1 Macronutrient uptake

A review of the mean data in Table 1 indicates that the total uptake of macronutrients (N, P and K) by the okra crop was significantly influenced by the foliar sprays of vermiwash. After harvesting, the uptake of nitrogen (N), phosphorus (P) and potassium (K) in okra was significantly enhanced by the application of different concentrations of vermiwash. The maximum nitrogen uptake was observed in T_8 with 76.83 kg ha^{-1}, followed by T_7 with 75.34 kg ha^{-1} and T_6 with 74.45 kg ha^{-1}, which was at par with T_5 at 73.65 kg ha^{-1}. The lowest N uptake was recorded in T_1 with 69.36 kg ha^{-1}. Similarly, the highest phosphorus uptake was recorded in T_8 with 21.60 kg ha^{-1}, followed by T_7 (19.77 kg ha^{-1}) and T_6 (18.97 kg ha^{-1}), which was at par with T_5 (18.40 kg ha^{-1}). The lowest P uptake was also noted in T_1 with 14.81 kg ha^{-1}. Potassium uptake followed a similar trend, with T_8 recording the highest uptake of 49.06 kg ha^{-1}, followed by T_7 (48.42 kg ha^{-1}) and T_6 (47.75 kg ha^{-1}), which was at par with T_5 (47.34 kg ha^{-1}). The lowest K uptake was recorded in T_1 (43.99 kg ha^{-1})(Figure 2). .

Foliar sprays of vermiwash significantly enhanced the uptake of nitrogen, phosphorus, and potassium in okra, with the highest uptake observed in the treatments with higher vermiwash concentrations. The control treatment consistently showed the lowest nutrient uptake. Similar findings were recorded by Tyagi *et al.* (2013) who reported significantly higher nutrient uptake in Green gram with the application of 100 % RDF + vermicompost 1 t ha^{-1} + Rhizobium. Joshi *et al.* (2023) also observed that uptake of nutrient (kg ha^{-1}) of N, P and K by both seed and straw increased with higher concentrations of foliar spray of vermiwash.

3.2.2 Micronutrients uptake

The specific data on micronutrient uptake by the okra plant is given in table 1. The significant uptake of Fe (819.1 g ha^{-1}), Mn (479.12 g ha^{-1}), Zn (153.63 g ha^{-1}) and Cu (203.45 g ha^{-1}) were recorded in treatment T_8 (100% GRDF + 30% Vermiwash spray) and least micronutrient uptake of Fe (681.4g ha^{-1}), Mn (380.84g ha^{-1}), Zn (117.83 g ha^{-1}) and Cu (138.11 g ha^{-1}) were observed in treatment T_1.(Figure 3)

Conclusion

The study demonstrated that the application of vermiwash foliar sprays significantly improved the growth, yield and nutrient uptake in okra grown in Inceptisol soils. Among the treatments, the highest concentrations of vermiwash combined with GRDF (100% GRDF + 30% Vermiwash) consistently resulted in the highest fruit yield and enhanced uptake of both macronutrients (N, P and K) and micronutrients (Fe, Mn, Zn and Cu). The results suggest that vermiwash is an effective organic supplement that boosts nutrient availability, leading to better crop performance and higher productivity, with the potential to reduce the dependence on synthetic fertilizers.

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Treatments	Yield ton ha^{-1}	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	Fe (g ha^{-1})	Mn (g ha^{-1})	Zn (g ha^{-1})	Cu (g ha^{-1})
T_1	18.54	69.36	14.81	43.99	681.4	380.84	117.83	138.11
T_2	19.83	70.26	15.80	45.52	729.9	402.89	133.19	165.80
T_3	21.25	70.35	16.52	46.15	735.7	411.82	134.26	168.47
T_4	22.40	70.97	16.78	46.42	750.1	413.60	135.21	177.73
T_5	23.18	73.65	18.40	47.34	771.8	445.07	142.98	184.56
T_6	25.02	74.45	18.97	47.75	788.0	452.96	144.32	192.39
T_7	25.33	75.34	19.77	48.42	807.7	462.44	146.59	198.58
T_8	26.66	76.83	21.60	49.06	819.1	479.12	153.63	203.45
SE (m) ±	**1.17**	**1.28**	**1.063**	**0.67**	**21.84**	**19.82**	**4.90**	**6.37**
CD (0.05)	**3.55**	**3.89**	**3.224**	**2.04**	**66.26**	**60.12**	**14.85**	**19.31**

Table 1- Variation existed across the treatments regarding the fruit production of okra

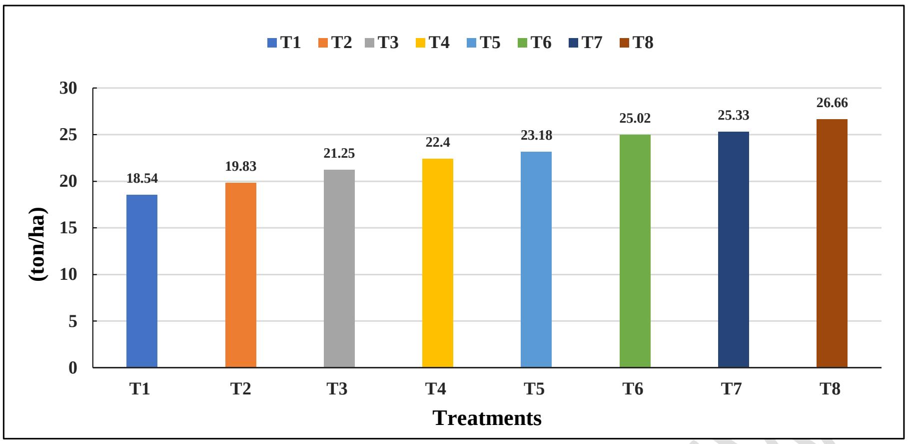

Fig.1 Effect of vermiwash foliar sprays on yield of okra

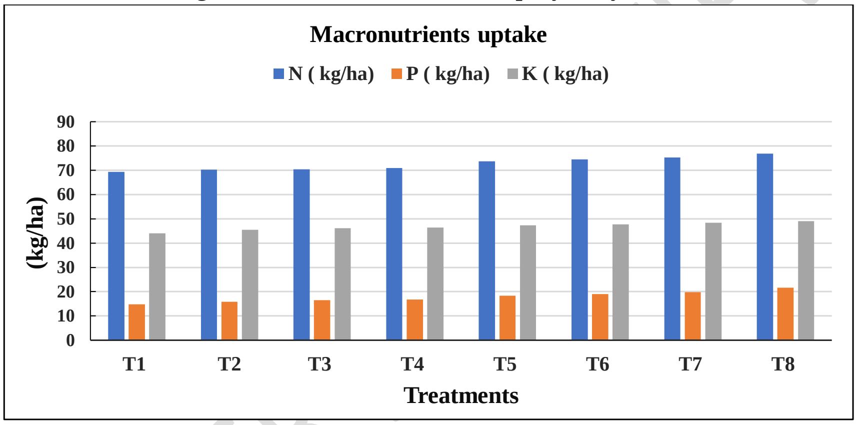

Fig. 2 Effect of vermiwash foliar sprays on macronutrients uptake of okra

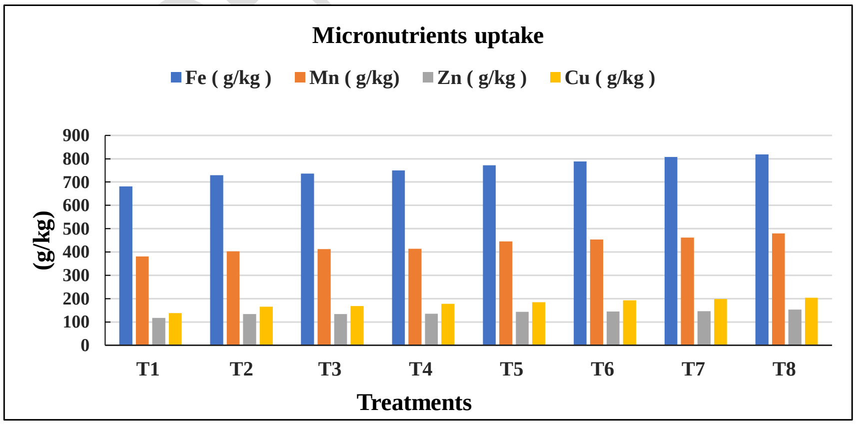

Fig.3 Effect of vermiwash foliar sprays on macronutrients uptake of okra