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Response of Okra (*Abelmoschus esculentus* L. Moench) to Different Levels of N, P and K Fertilizers

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Abstract

The fertilizers were applied @ 50, 75, 100, or 125 kg ha^{-1} N, 60, 80 or 100 kg ha^{-1} P_2O_5 and 60 or 80 kg ha^{-1} K_2O in different combinations to okra cv. Pusa Sawani. Results divulged that seed germination was not affected statistically by the fertilizer application while plant height, number of leaves per plant, number of pods per plant, pod length and green pod yield were affected significantly and were highest at the highest dose of fertilizers.

Introduction

Okra (*Abelmoschus esculentus* L. Moench) is one of the most important summer vegetables of Pakistan and grown throughout the country. The yield of okra is quite low in the country (7.88 tons ha^{-1}) as compared to the advanced countries (12.5 tons ha^{-1}). Among the various agronomic practices, fertilizer application influences the growth and green pod yield in okra. Application of nitrogen to the crop results in increase in plant height, number of branches, leaves and pods per plant (Lenka *et al*., 1989; Arora *et al*., 1991; Ayub *et al*., 1993) and green pod yield (Reddy *et al*., 1984; Lee *et al*., 1990; Ayub *et al*., 1993). Phosphorus application also results in increased plant growth and green pod yield (Hooda *et al*., 1980; Reddy *et al*., 1984; Arora *et al*., 1991; Naik and Srinivas, 1992). While, potassium is only effective when applied in combination with nitrogen and had no significant effect in the absence of nitrogen (Mani and Randhawa, 1980; Ahmad, 1991). Little research has been carried out in Pakistan to study the response of vegetables against fertilizers. Response to fertilizer application also varies from crop to crop and even within cultivars of a same species. Hence, it appears a pressing need to develop rational regarding the fertilizers for okra crop. Therefore, present studies were conducted to observe the effect of varying levels of nitrogen, phosphorus and potassium on growth and green pod yield of okra cv. Pusa Sawani.

Materials and Methods

The present studies were conducted at Vegetable Research Area, Department of Horticulture, University of Agriculture, Faisalabad. The physico-chemical characteristics of the soil used for the experiment are given in Table 1, as determined using the method of U.S. Salinity Laboratory Staff (1954). The materials for the studies consisted of okra cv. Pusa Sawani and various fertilizers. The fertilizers used for the crop were containing nitrogen, phosphorus and potassium elements. These were combined in different proportions and the treatments included were; T_0 = Control, T_1 = 50 kg N ha^{-1}, T_2 = 75 kg N + 60 kg P_2O_5 ha^{-1}, T_3 = 100 kg N + 80 kg P_2O_5 + 60 kg K_2O ha^{-1}, T_4 = 125 kg N + 100 kg P_2O_5 + 80 kg K_2O ha^{-1}.

All the phosphorus, potassium and half amount of the nitrogen were applied at the time of sowing. The rest amount of nitrogen was applied as a top dressing 30 days after sowing the crop in respective plots. The experiment was laid out in a Randomized complete block design with four replications. The crop was sown on May 25, 1996. The soil was prepared well before sowing. Seeds were sown on both sides of beds prepared 60 cm apart keeping plant to plant distance of 30 cm. Field was irrigated immediately after sowing and a total 5 irrigations were given with fortnight interval.

Table 1: Physico-chemical characteristics of the soil used for the experiment

Characteristic	Unit	Quantity
Sand	%	53.1
Silt	%	21.2
Clay	%	25.7
Textural class	-	Sandy clay loam
pH	-	7.9
TSS	%	0.23
Organic matter	%	0.66
Total nitrogen	%	0.041
Available Phosphorus	ppm	5.2
Available potassium	ppm	186

Seed germination was recorded after two weeks of sowing. Later, ten plants were tagged randomly in each plot and data were recorded on; a) plant height, b) number of leaves per plant, c) number of green pods per plant, d) length of green pod e) yield of green pods per plant, and f) yield of green pods per hectare. The data collected were analyzed statistically using the Fisher's analysis of variance technique and the treatment means were compared using Duncan's multiple range test at 5 per cent probability (Peters, 1994). Economic analysis of the fertilizer treatments was worked out on the basis of cost of production using prevailing market prices (CIMMYT, 1988).

Results and Discussion

Data regarding germination percentage revealed non-significant results for fertilizer treatments indicating that seed germination was not affected by the fertilizer treatments applied (Table 2). These results are in agreement with Zanin and Kimoto (1980) who reported that fertilizers have no effect on seed germination of okra cv. Campinas-1. The fertilizer treatments had significant effect on plant height. Mean values indicated that T_4 and T_3 behaved statistically alike and differed significantly from the other treatments. T_4 resulted in maximum plant height while the control (T_0) gave the minimum plant height (Table 2). This indicates that by increasing fertilizer dose, plant height was increased. Therefore, the control plants were dwarf because these did not receive any fertilizer. Similar results have been reported by Zanin and Kimoto (1980), Lenka *et al.* (1989) and Arora *et al.* (1991).

Maximum number of leaves were produced in T_4 followed by T_3 and these two treatments behaved statistically alike. Minimum number of leaves were recorded in control (T_0) plants (Table 2). This indicates that the higher dose of fertilizer had resulted in more number of leaves. Thus it could result in increased photosynthesis and higher yield of okra plant.

Data regarding number of green pods per plant gave highly significant results for fertilizer treatments. Mean values indicated that all the treatments differed statistically from each other. T_4 had resulted in maximum number of green pods while T_0 (control) plants gave minimum number of green pods (Table 2). Hence, as the fertilizer dose was increased, number of green pods per plant were also increased. Pod number depends upon intensity of growth of the plant. Higher dose should ordinarily be instrumental in enhancing plant growth and affect consequently the pod number. In the same way, higher doses of fertilizers expressed superiority over low doses in the present study. Zanin and Kimoto (1980) Arora *et al.* (1991) and Naik and Srinivas (1992) also reported similar results in this respect. Pod length was also significantly affected by the fertilizer treatments. T_4 resulted in maximum pod length followed by T_3 and T_2, which behaved statistically alike. These two treatments significantly differed from T_1 and T_0, which also behaved alike (Table 2). This reflects that more the fertilizer dose, better will be the pod length. Arora *et al.* (1991) and Naik and Srinivas (1992) have also reported that pod length in okra increased by increasing the rate of fertilizer application.

Data depicted that the fertilizer treatments had significant effect on green pod yield. Mean values indicate that T_4 resulted in maximum green pod yield followed by T_3 and both these treatments behaved statistically alike. These two treatments differed significantly from other treatments. Minimum green pod yield was obtained from T_0 (control) plants (Table 2). It was observed that green pod yield per plant increased with the increase in fertilizer dose. As the yield per hectare was calculated on the basis of yield per plant and per plot, it presented the similar situation (Table 2). It is an established fact that N promotes vegetative growth consequently resulting in more yields. P and K are also responsible for better growth, maturity, yield and quality of the produce. All these three nutrients affected positively on the performance of plants when their rate of application was increased. Similar results were observed by Mani and Randhawa (1980), Reddy *et al.* (1984), Arora *et al.* (1991) and Ayub *et al.* (1993).

Table 2: Effect of different fertilizer doses on growth and yield of okra cv. Pusa Sawani

Parameters	T_0	T_1	T_2	T_3	T_4
Germination %age	84.75 ± 2.94a*	78.62 ± 2.41a	80.52 ± 4.53 a	80.65 ± 2.56a	82.80 ± 3.00a
Plant height (cm)	71.03 ± 3.22d	76.00 ± 1.64c	81.63 ± 2.02b	86.15 ± 1.65a	86.53 ± 2.95a
No. of leaves/plant	26.60 ± 1.59d	31.20 ± 1.27c	32.90 ± 1.48bc	33.72 ± 1.11ab	35.35 ± 1.76a
No. of green pods/plant	9.85 ± 0.21e	10.48 ± 0.26d	11.25 ± 0.37c	11.98 ± 0.28b	12.52 ± 0.46a
Green pod length (cm)	9.18 ± 0.17c	9.35 ± 0.13c	9.82 ± 0.17b	9.93 ± 0.25b	10.68 ± 0.28a
Pod yield plant $^{-1}$ (gm)	189.76 ± 4.86d	201.94 ± 6.79c	223.20 ± 4.85b	254.80 ± 5.27a	262.40 ± 9.25a
Pod yield ha $^{-1}$ (tons)	10.12 ± 0.26d	10.77 ± 0.37c	11.90 ± 0.26b	13.59 ± 0.28a	13.99 ± 0.49a

*Means ± SD with different letters in a row are statistically significant at 5% probability.

Table 3. Economic analysis of various fertilizer treatments

Fertilizer treatments	Costs that vary (Rs./ha)	Marginal costs (Rs./ha)	Net benefits (Rs./ha)	Marginal net benefits	Marginal rate of return (%)
T_0	-	-	80960.00	-	-
T_1	832.61	832.61	86160.00	5200.00	624.54
T_2	2374.36	1541.75	95232.00	9072.00	588.42
T_3	4493.13	5715.93	2118.77	1222.80	108712.00
T_4	111952.00	13480.00	3240.00	636.22	264.96

Urea @ Rs. 340, TSP @ Rs. 421 and SOP @ Rs. 540 per bag of 50 kg; Transportation, loading and unloading of fertilizer = Rs. 20 per bag; Spreading of fertilizer = Rs. 25 per hectare; Value of the okra green pods @ Rs. 8,000 per ton; Marginal rate of return = Marginal net benefit x 100/Marginal cost.

Economic analysis of the fertilizer treatments indicated that the treatment T_3 was the most economical with maximum marginal rate of return (636.22%) followed by the treatment T_1 (624.54%). Although the treatment T_4 gave the maximum net benefit but marginal rate of return was lower because of higher costs that vary (Table 3).

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