Journal of Agriculture and Ecology, 2016, Vol.2, 17-24
http://saaer.org.in

Research Article **Open Access**

Response of Nitrogen, Phosphorous and Potassium Levels on Growth and Yield of Okra [*Abelmoschus esculentus* (L.) Moench.]

NK Meena* & Akshaya Bhati[1]

*Department of Horticulture, MJRPU, Jaipur

Corresponding Author: Akshaya , Email : akshaya.horti@gmail.com

[1]Current Address: Assistant Prof. (Horticulture), Jayoti Vidhyapeeth Women University, Jaipur

Preferred citation for this article: Meena NK & Bhati A. 2016. Response of Nitrogen, Phosphorous and Potassium Levels on Growth and Yield of Okra [*Abelmoschus esculentus* (L.) Moench.]. *Journal of Agriculture and Ecology*, 2: 17-24; http://doi.org/10.53911/JAE.2016.2203.

Abstract

A field experiment was conducted during *summer (Zaid)* 2015 at Instructional Farm Department of Horticulture, MJRP College of Agriculture & Research, MJRP University Jaipur (Rajasthan). Results of field experiment revealed that the minimum days required to opening flower from sowing were recorded under application of 90 kg N + 60 kg P_2O_5 + 60 K_2O ha^{-1} whereas the maximum days were noted under absolute control. Plant height and seed germination were recorded maximum under application of 90 kg N + 60 kg P_2O_5 + 60 K_2O ha^{-1}, after 40 days, 60 days and 80 days. Amongst fruit characters, the maximum length and diameter of fruits, fruit yield $plant^{-1}$and number of fruits $plant^{-1}$were recorded under application of 90 kg N + 60 kg P_2O_5 + 60 kg K_2O ha^{-1} The maximum yield was obtained under application of 90 kg N + 60 kg P_2O_5 + 60 K_2O ha^{-1}. Application of 90 kg N + 60 kg P_2O_5 + 60 K_2O ha^{-1} recorded significantly higher net returns and B C ratio which was found statistically superior.

Key words: Okra, Growth, Yield, Nitrogen, Phosphorus, Potassium

Introduction

The okra [*Abelmoschus esculentus* (L.) Meonch.] is an annual vegetable crop grown in the tropical and sub tropical region of the world. It had originated from Abyssinian center. It belongs to family Malvaceae. Okra is known by many local names in different parts of the world. In the northern plains of India, the Okra is grown mainly in two seasons *i.e.* rainy and summer. During raining season, plants grow tall, vigorous and bear a large number of fruits, which contributes to the higher yield per unit area over the crop production of the summer season. In Rajasthan, okra group occupies 3.7 thousand hectares area having an annual

production of 12.3 thousand tonnes with an average productivity of 3.3 t ha^{-1} (Anonymous 2013, Samadia 2016).

Okra is a vegetable, that contains various nutrients e.g. potassium, calcium, magnesium, phosphorus, vitamin 'A' and 'C'. The edible fruit of okra (100 g) contains water (89.6 %), Vitamin A (88.01 I.U.), vitamin C (0.07 mg), riboflavin (0.1 mg) with a little amount of iron (1.5 mg) and other nutrients (Choudhary 1969). Apart from its high quantity of vitamin B and folic acid contents, it is said to be very useful against genitor-urinary disorders, spermatorrhoeae and chronic dysentery. It is also used in curing ulcers and hemorrhoids (Olaniyan & Omoleyomi 2013).

The cultivation of this crop in arid and semi-arid regions is mainly done during rainy season. Okra plant requires to grow at high temperatures (warm) and unable to tolerate the conditions of low temperature for long time. The optimum temperature range of 21-30^{0}c with minimum of 18^{0}c and maximum of 35^{0}c. High temperature prevailing during spring and summer season leads to mortality of a large number of plant and less fruiting. But, due to one or another reason, farmers do not harness the desired production potential of the crop. The potent reason for lesser productivity is due to poor management and improper selection of varieties.

Okra produces fruit for a long time and needs a balanced and sufficient supply of nutrients for higher yield and better quality. Indiscriminate use of inorganic fertilizers has resulted in decreased nutrients uptake, poor quality of vegetables and deterioration of soil health (Agrawal 2003). It is well proved that the growth, yield and quality of plants are greatly influenced by availability of a wide range of nutrients in the soil. Nitrogen is an essential macronutrient which has great significance in growth, development and metabolism of plants. Phosphorus is a constituent of nucleic acid, phospholipids and several enzymes which are of great importance in the transformation of energy within the plant system, metabolism and also in respiration in plants (Yawalker et al. 1962) and has beneficial effect on early root development, plant growth and quality of produce (Brady, 1974). Potassium is one of the three major nutrient elements (N, P and K) required by plants. Potassium imparts vigour and disease resistance to the plant and plays an important role in crop productivity. Therefore, there is need to look for other means in production system management which could help in achieving high yield and productivity.

Material and Methods

The experiment was carried out at the Research Farm, Department of Horticulture, MJRP College of Agriculture & Research, Achrol, Jaipur, MJRP University, Jaipur (Rajasthan) during summer (Zaid) season of 2015. The experiment was laid out in RBD with three replications. The treatments were randomly allotted to different plots using random number table of Fisher & Yates (1963).

Experimental details of layout are as under:

(1)	Name of crop	:	Okra
(2)	Name of variety	:	Arka anamika
(3)	Crop Season	:	Zaid
(4)	Treatment combination	:	8
(5)	Replication	:	3
(6)	Experimental Design	:	RBD
(7)	Total number of plot	:	8 x 3 = 24
(8)	Spacing	:	45 x 30 cm (PxR)
(9)	Plot size	:	3.5 x 3 m^2
(10)	Irrigation channel	:	0.5 m

The growth parameters were taken for record are fruit length, fruit diameter, number of fruit per plant, number of pickings, duration of pickings, weight of fruit, yield etc.

Cultural practices taken during cultivation: The field was thoroughly prepared by tractor drawn plough at required moisture content. It was followed by harrowing and planking. The recommended dose of NPK was applied through Urea, SSP and MOP, respectively. The recommended dose of NPK for okra crop was 90:60:60 kg ha^{-1}, respectively. For each fertilizer treatment combination, the NPK dose was calculated and applied timely. Full dose of phosphorus and potassium and half dose of nitrogen are applied as basal dose just before sowing and rest half dose of nitrogen was applied in two splits i.e. 30 and 45 days after sowing.

The Okra seeds of variety Arka Anamika were obtained from Mahyco seeds were sown in rows by keeping 30 cm. inter-row spacing and 45cm. plant to plant spacing. At each hill two seeds were sown at a depth of 2.5 cm. Before sowing, the seeds were soaked overnight in water to enhance germination. The irrigations were given at an interval of 6 – 10 days, except during the period of intermittent rains. In order to protect the crop from aphids, jassed, shoot and fruit borer and red spider mites, spray of Phosphomedon @ 0.025% and Endosulphan @ 0.05% . The experimental data were statistically analyzed for analysis of variance and test at significance through the procedure described by Fisher (1950).

Results and Discussion

Effect of Nitrogen, Phosphorus and Potassium after sowing on germination percentage, DTFI (days taken to flower initiation) of okra: The data presented in table 1 indicated that maximum (91.24 %) mean germination percentage was recorded in treatment T_7 (N+P+K 90+60+60 kg ha^{-1}), followed by (84.57) treatment T_4 (water soaking for 12 hrs) and

minimum (64.11) in treatment T_0 (control). Among all the treatments, minimum 39.73 days taken to first flowering were recorded under the treatment T_7 (N+P+K 90+60+60 kg. p ha^{-1}) and maximum 44. 21 days taken to first flowering were under the treatment T_0 (control).

Table 1. Effect of Nitrogen, Phosphorus and Potassium after sowing on germination %, DTFI (days taken to flower initiation) of okra

Treatments	Germination %	DTFI (days taken flower initiation)
T_0	64.11	44.21
T_1	71.82	41.22
T_2	72.94	42.54
T_3	71.18	42.48
T_4	86.89	41.27
T_5	80.82	41.60
T_6	84.30	42.93
T_7	91.24	39.73
S.Em±	3.63	1.26
CD (P=0.05)	11.01	3.81
CV(%)	8.07	5.18

Effect of Nitrogen, Phosphorus and Potassium on plant height (cm) of okra: The application of Nitrogen, Phosphorus and Potassium either alone or in combination brought about perceptible variation in plant height of okra at 40 days after sowing. The maximum plant height (28.10 cm) was obtained with the treatment T_7 (N+P+K at the rate of 90+60+60 kg ha^{-1}) and minimum plant height (18.32 cm) in treatment T_0 (control). A similar trend in plant height was recorded at 60 days after sowing. The maximum plant height (75.40 cm) was obtained with the treatment T_7 (N+P+K 90+60+60 kg. ha^{-1}) and minimum plant height (50.78 cm) was recorded in treatment T_0 (control). It increased the plant height significantly as compared to control of the treatments. At 80 days after sowing, the maximum plant height (106.00 cm) was obtained in T_7 (N+P+K 90+60+60 kg. ha^{-1}) and minimum plant height (67.33 cm) was recorded in treatment T_0 (control). It increased the plant height significantly as compared to control of the treatments (Table 2).

Table 2. Effect of Nitrogen, Phosphorus and Potassium on plant height of okra

Treatments	Plant height (cm)		
	40 DAS	60 DAS	80D AS

T_0	18.32	50.78	67.33
T_1	22.21	57.98	85.97
T_2	19.80	52.73	77.10
T_3	19.91	52.62	77.29
T_4	24.39	66.10	97.57
T_5	25.43	66.76	93.97
T_6	23.82	65.91	92.23
T_7	28.10	75.40	106.00
S.Em±	0.88	2.08	2.02
CD (P=0.05)	2.66	6.30	6.14
CV (%)	6.69	5.90	4.02

Effect of Nitrogen, Phosphorus and Potassium on fruit diameter, length, no. of fruits per plant, number and duration of pickings of okra: It is clear from the data (Table 3) that The maximum fruit diameter (2.61 cm) was recorded with the application of T_7 (N+P+K 90+60+60 kg. ha^{-1}) which was found to be significantly higher of the treatments including control. The mean maximum fruit length (13.93 cm) was obtained T_7 (N+P+K 90+60+60 kg ha^{-1}) that was with T_5, T_3 and T_1 respectively. The treatment T_7 (N+P+K 90+60+60 kg ha^{-1}) represented a significant increase in length of fruits. The mean maximum number of fruits $plant^{-1}$ (30.59) were recorded under the treatment T_7 (N+P+K 90+60+60 kg. ha^{-1}) and minimum number of fruits $plant^{-1}$ (20.31) was obtained in treatment T_0 (control). The mean values of number of pickings under different treatments revealed that maximum number of pickings (18.76) was observed in the treatments T_7 (N+P+K 90+60+60 kg. ha^{-1}) and minimum numbers of pickings (14.23) was found in control. The maximum duration of picking (34.32 days) was found under the treatment T_7 (N+P+K 90+60+60 kg. ha^{-1}), and the minimum duration of picking (23.132) was found under the treatment T_0 (control).

Table 3. Effect of Nitrogen, Phosphorus and Potassium on fruit diameter and length, no. of fruits per plant and no. and duration of pickings of okra

Treatments	Fruit diameter (cm)	Fruit length	No. of fruits	No. pickings	Duration pickings

		(cm)	plant^{-1}		(days)
T_0	1.36	12.00	20.31	14.23	23.13
T_1	1.29	13.73	25.86	16.32	27.65
T_2	1.48	13.67	24.29	15.81	25.71
T_3	1.49	13.87	23.44	15.69	26.17
T_4	1.90	13.87	28.44	17.79	30.65
T_5	2.36	13.87	28.67	17.45	30.63
T_6	1.79	13.83	26.53	16.29	29.40
T_7	2.61	13.93	30.59	18.76	34.32
S.Em±	0.07	1.16	0.59	0.54	0.96
CD (P=0.05)	0.21	3.53	1.72	1.63	2.90
CV(%)	6.61	14.81	7.42	5.63	5.81

Effect of Nitrogen, Phosphorus and Potassium on average weight of fruits plant^{-1}, yield plot^{-1}, yield hacters^{-1}, net returns and B:C Ratio of okra: The maximum weight of green fruits per plant (258.18 g) was recorded in T_7 (N+P+K 90+60+60 kg. ha^{-1}) and the minimum (210.80 g) was recorded in control. The treatment T_7 recorded 18.35 % average weight of fruits plant^{-1} higher than the control. The maximum yield plot^{-1} was recorded (18.07 kg) with the treatment T_7 (N+P+K 90+60+60 kg. ha^{-1}) which was followed by T_5 and the minimum yield plot^{-1} was recorded (14.76 kg ha^{-1}) in treatment T_0 (control). Increase in the higher yield in T_7 was by 18.31 % over control. The maximum yield ha^{-1} was recorded (172.12 q ha^{-1}) with the treatment T_7 (N+P+K 90+60+60 kg. ha^{-1}) which was followed by T_4, T_5 and T_6 and the minimum yield of fruit hectare^{-1} was recorded (140.53 q ha^{-1}) in control. A close examination of data (Table 4) shows that all the treatments recorded significant increase in net monetary returns over control. Further, application of increasing doses of N + P + K fertilizers brought about significant increase in net monetary returns. Significantly the highest monetary returns (123084.10 ₹ ha^{-1}) were obtained with application of 90 kg N_2 + 60 kg P_2O_5 and 60 kg K_2O ha^{-1}, which were higher by ₹42769.76 ha^{-1} over control (95588.5 ₹ ha^{-1}).

It is explicitly clear from data (Table 4) that application of increasing doses of N + P fertilizers brought about significant increase in B C ratio. Significantly, the highest B C ratio (2.13) was estimated with application of 90 kg N kg + 60 kg P_2O_5 + 60 kg K_2O ha^{-1} which was higher by 14.08 %, respectively over control (1.83). The results showed that application of Nitrogen, Phosphorus and Potassium (90+60+60) kg ha^{-1} recorded significant increase in the

plant growth characters *viz.* seed germination (91.24 %), plant height after 40 days (28.10 cm), 60 days (75.40 cm) and 80 days (106 cm). While days taken from sowing to the initiation of flowering (39.73 days), were maximum (44.21 days) under absolute control.

Table 4. Effect of Nitrogen, Phosphorus and Potassium on average weight of fruits plant^{-1}, yield plot^{-1}, yield hacters^{-1}, net returns and B:C Ratio of okra

Treatments	Av. wt. of fruits plant^{-1}	Yield plot^{-1} (k	Yield ha^{-} (q)	Net returns (Rs ha^{-1})	B C ratio
T_0	210.80	14.76	140.53	95588.5	1.83
T_1	227.10	15.86	151.39	105817.5	1.99
T_2	221.80	15.40	146.70	99367.0	1.82
T_3	215.91	15.11	143.94	97369.0	1.81
T_4	244.71	17.12	163.12	115434.1	2.06
T_5	242.11	16.95	161.40	114528.1	2.08
T_6	233.57	16.39	156.15	107489.5	1.90
T_7	258.18	18.07	172.12	123084.1	2.13
S.Em ±	7.46	0.52	4.34		
CD (P=0.0	22.63	1.58	13.7		
CV (%)	5.58	5.58	4.87		

Although okra can be cultivated without the application of fertilizer or manures as seen in the control experiment (without manure) but for increase in the vegetative fruit yield, application of organic manure (poultry dung) or inorganic manure (N,P,K and urea) will be very relevant and necessary. This observation also agreed with that of Adepoju (1995). Nitrogen is known to be the most important one among nutrients (Ghose et al. 1958).

The different levels of nitrogen, phosphorus and potassium had significant effect on number of fruits, length of fruit, diameter of fruits, no. of seeds fruit^{-1}, yield plot^{-1} and yield hact^{-1}. The increased growth by the use of nitrogen, phosphorus and potassium may be explained on the basis of some of the established facts that the phosphorous is known to play an important role in photosynthesis. It is a constituent of nucleo-protein which is responsible for growth, thus the fact that phosphorus promotes the growth is understandable. Okra responds well to fertilizer application (Babatola 2006). Significant increase in the growth and yield of okra was observed after the application of N and or NPK (Katung et al. 1996). Firoz (2009) reported that the highest yield (16.73 t/ha) was obtained after the application of 100 kg

N/ha which was statistically identical to 120 kg N/ha. He also obtained the highest yield (15.77 t/ha) from 120 kg P_2O_5/ha. Philip et al. (2010) reported that spacing application of NPK fertilizers 150 kg/ha (22.5 kg N, 22.5 kg P_2O_5 and 22.5 kg K_2O_5) gave the highest yield of okra. It has been well emphasized that nitrogen, phosphorus and potassium fertilization to the tune of NPK (90+60+60) kg ha^{-1} play vital role in improving three major aspects of yield determination i.e. formation of vegetative structure for nutrient absorption, photosynthesis and source sink length through development of reproductive structure and production of assimimilates to fill economically improved sink (source strength). The results in preceding chapter showed that application of nitrogen, phosphorus and potassium (90+60+60) kg ha^{-1} recorded significantly higher net returns (333430.52 Rs ha^{-1}) and B C ratio (11.69). This was probably due to higher benefits obtained with selection of appropriate nutrient responsive variety.

References

Agrawal AK. 2003. Role of organic enriches in management of soil salinity. *Agrobios*, 2: 21-23.

Anonymous 2013. Indian Horticulture data base-2013, National Horticulture Board, Gurgaon (Haryana).

Babatola LA. 2006. Effect of NPK 15:15:15 on the performance and storage life of okra (*Abelmoschus esculentus*). *Proceedings of the Horticultural Society of Nigeria Conference*, pp: 125-128.

Choudhary B. 1969. Vegetable. *National Book Trust*, New Delhi. P. 184.

Firoz ZA. 2009. Impact of nitrogen and phosphorus on the growth and yield of okra (*Abelmoschus esculentus* (L.) Moench.) in hill slope condition. *Bangladesh Journal of Agriculture Research*, 34(4): 713-722.

Fishers RA & Yates F. 1963. Statistical tables, Oliver and Boyd. Edinburgh Tweeddate Court, London.

Katung MD. 2007. Productivity of okra varieties as influenced by seasonal changes in Northern Nigeria. *Agrobot*, 35 (1): 65–71.

Olaniyan AM & Omoleyomi BD. 2013. Characteristics of okra under different process pretreatments and different drying conditions. *Journal of Food Processing and Technology*, 4: 237.

Samadia DK. 2016. Horticulture based crop production site management approach (HBCPSMA) –an innovative concept for doubling farm income under dry-lands. *Journal of Agriculture and Ecology*, 1: 1-9

Yawalakar KS, Agarwal JP & Bokde S. 1962. Manures and fertilizer. Agri-Horticultural publishing house, Nagpur, 40010, India.