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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 3 (12): 2101-2104, 2000

Effect of Different Levels of Nitrogen Alone and in Combination with Constant Doses of Phospohorus and Potassium on Grwoth and Yield of Okra (*Abelmoschus esculentus* L.) Cv. T-13 under the Agro-climatic Conditions of Mingora, Swat

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Abstract: Investigation were undertaken to study the effect of different levels of nitrogen (0, 100, 120, 140 kg ha^{-1}) alone and in combination with constant doses of phosphorus (90 kg ha^{-1}) on growth and yield of Okra (*Abelmoschus esculentus* L.) Cv.T-13 at Agriculture Research Station (North) Mingora, Swat during 1997. Maximum plant height (185 cm), number of pods per plant (24.59), pod length (12.63 cm), and the highest pod yield per hectare (16950.79 kg) was recorded in plots fertilized with 120:90:60 kg ha^{-1}. No significant differences were observed in days to emergence, flowering, and first picking respectively.

Key words: Okra (*Abelmoschus esculentus* L.) NPK levels 0:100:120:140: kg ha^{-1}, cultivar.T-13, Yield, Agro-climatic condition of Swat

Introduction

Okra (*Abelmoschus esculentus* L.) belongs to Malvaceae family. Okra originated in tropical Africa, was grown in Mediterranean region, and its wild forms were also found in India. It is grown in all parts of the tropics and during the summer in the warmer parts of the temperate regions (Baloch, 1994).

The total area under Okra cultivation in N.W.F.P was 2151 hectares with total production of 19098 tones in which Malakand division contributed an area of 466 hectares witfi a total production of 4788 tones during 1998-99 (Anonymous,1999). Okra thrives in all kinds of soil, but it grows best in moderately deep, well-manured, friable medium loam soil with good drainage.

Plants require food for growth *and* development. Okra crop responds well to the application of proper doses of N, P and K. Adequate supply of nitrogen favors the transformation of carbohydrate into proteins. Nitrogen is a part of chlorophyll molecule, amino acid, proteins, nucleic acid and pigments. Adequate supply of nitrogen favors the transformation of carbohydrate in to proteins while inadequate supply of N induces their deposition in the vegetative cells. Nitrogen promotes the formation of protoplasm, and since protoplasm is highly hydrated, the plant becomes more succulent. In all plants, N considerably influences the utilization of P and K and other plant nutrients. Nitrogen mobilizes the process of flower opening, fruit setting and fruit development. Normal metabolic activities can continue only in the presence of nitrogen, leaves being metabolically most active, contain the highest level of N, followed by root, stem and fruits. The addition of nitrogen enhances vegetative growth and its deficiency leads to low production, stunted growth, and small yellow leaves. Nitrogen is mobile in plants and deficiency symptoms appears in the older leaves first (Haque and Jakhro, 1996).

Potassium is considered essential in photosynthesis, sugar translocation, nitrogen metabolism, enzyme activation, stomata, opening, water relation and promotion of growth and inenstematic tissues. It act as a chemical traffic policeman, stalk strengthener, protein builder, breathing regulator, disease retarder and increase the plumpness and boldness of seeds but it is not effective without its co-nutrients as N and P (Chandra,1989).

The agro-climatic conditions of NWFP are highly suitable for the production of Okra, but the yield per hectare is very low. One way to increase the yield is to apply appropriate amount of fertilizers with suitable combinations. The present project was therefore, under taken to study the effect of different levels of nitrogen alone and in combination with constant doses of phosphorus and potassium on growth and yield of Okra under the agro-climatic condition of Mingora, Swat.

Materials and Methods

To find out the effect of different levels of nitrogen alone and in combination with constant doses of phosphorus and potassium on growth and yield of Okra cultivar T-13, an experiment was conducted at Agriculture Research Station (N) Mingora Swat in the year 1996-97.

Before fertilizer application soil samples up to 25 cm depth were taken randomly from different parts of the field and were analyzed in Soil Science and Water Testing Laboratory at ARS Mingora Swat, both for physical and chemical characters, which are given as under in Table 1:

Table 1: Physico-chemical characteristics of experimental field

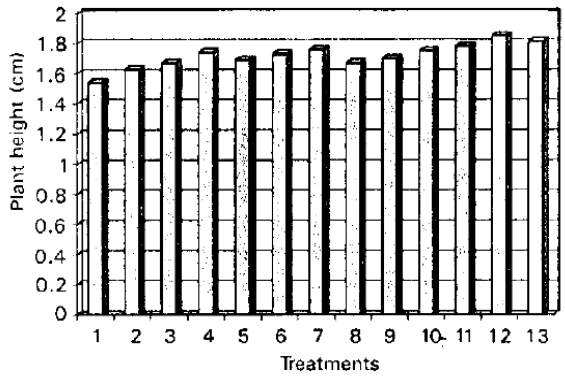
Textural Class	Silty clay loam
$CaCO_3$	4.92%
Organic matter	1.50%
Nitrogen	0.08%
P_2O_5	10.8 ppm
K_2	104.6 ppm
pH	7.1

The experiment was laid out in Randomized Complete Block (RCB) design with thirteen treatments each replicated thrice. Total number of plots were thirty-nine. Plot size was 6.75 m^2. Row to row and plant to plant distances were 75 and 30 cm, respectively.

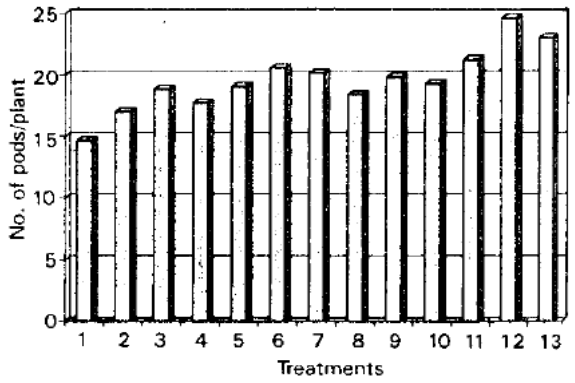
The plots were properly leveled for even and efficient distribution of fertilizers. The fertilizers used as sources of nitrogen, phosphorus and potassium were urea, single superphosphate, and potassium sulfate respectively. Fertilizers were applied by placement method. Nitrogen was applied in two split doses. First dose of N along with full doses of phosphorus and potassium was applied at the time of sowing, while the remaining half of the nitrogen was applied at flowering stage. Cultural practices such as weeding, hoeing, earthing up, irrigation and sprays against insects pests and

Table 2: Showing mean data on various aspect on effect of different levels of nitrogen alone and in combination with constant doses of phosphorus potassium on growth and yield of okra (*Abelmoschus esculentus* L.) CV.T-13

Treatment	Days to emerge	Days to flower	Days to 1st pick	Pl. heig. (cm)	Pods/plant	pods leng. (cm)	Yield (kg ha^{-1})
0:0:0	10.33	53.07	61.27	154F	14.66 F	9.61G	9047.613
100:0:0	9.66	53.67	61.87	163EF	17.04 EF	9.88 FG	11069.671
120:0:0	10.33	54.07	62.27	167DE	18.87 CDE	10.32 DEFG	12430.32 FG
140:0:0	11.00	55.93	64.53	174BCD	17.76 DE	10.25 EFG	11415.36H1
100:90:0	10.00	52.00	60.07	169 CDE	19.08 CDE	10.80 CDEFG	12817.15 EF
120:90:0	9.66	52.33	60.47	173 BCDE	20.58 BCD	11.59 ABCD	14096.78 C
140:90:0	10.00	53.73	62.13	176 ABCD	20.18 BCD	11.28 BCDE	13883.50 CD
100:0:60	10.00	52.67	60.73	167 DE	18.43 CDE	10.30 DEFG	11967.76 GH
120:0:60	10.33	53.80	61.80	170 CDE	19.84 CDE	11.02 BCDEF	13358.99 DE
140:0:60	10.66	54.73	63.13	175 ABCD	19.29 CDE.	10.86 CDEFG	13097.40 EF
100:90:60	9.33	51.07	59.07	178 ABC	21.24 BC	11.84 ABC	14425.57 C
120:90:60	9.66	52.27	60.40	185 A	24.59 A	12.63 A	16950.79 A
140:90:50	10.00	53.87	62.00	181 AB	23.01 AB	12.17 AB	15634.11 B
LSD at 5%.	N.S	N.S	N.S	0.1066	2.931	1.306	685.7



1 = N_0 8 = N_1K_1
2 = N_1 9 = N_2K_1
3 = N_2 10 = N_3K_1
4 = N_3 11 = $N_1P_1K_1$
5 = N_1P_1 12 = $N_2P_1K_1$
6 = N_2P_1 13 = $N_3P_1K_1$
7 = N_3P_1
N_0 = Control N_3 = 140 kg N/ha
N_1 = 100 kg N/ha P_1 = 90 kg P_2O_5/ha
N_2 = 120 kg N/ha K_1 = 60 kg K_2O/ha



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6 = N_2P_1 13 = $N_3P_1K_1$
7 = N_3P_1
N_0 = Control N_3 = 140 kg N/ha
N_1 = 100 kg N/ha P_1 = 90 kg P_2O_5/ha
N_2 = 120 kg N/ha K_1 = 60 kg K_2O/ha

diseases were done uniformly in all treatments of each replication.

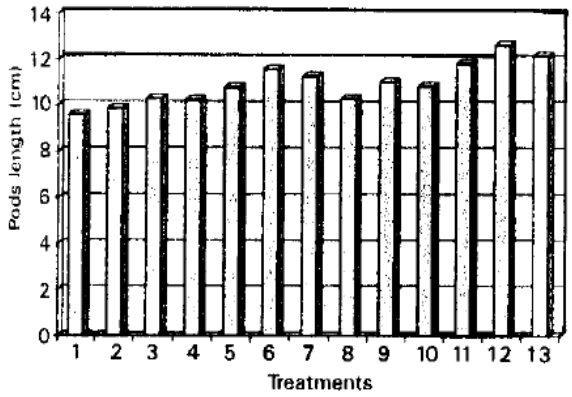
The following parameters were studied during the course of experiment.

1. Days to emergence
2. Days to flowering
3. Days to first picking
4. Plant height (cm)
5. Number of pods per plant
6. Pod length (cm)
7. Fresh Pod yield (kg ha^{-1})

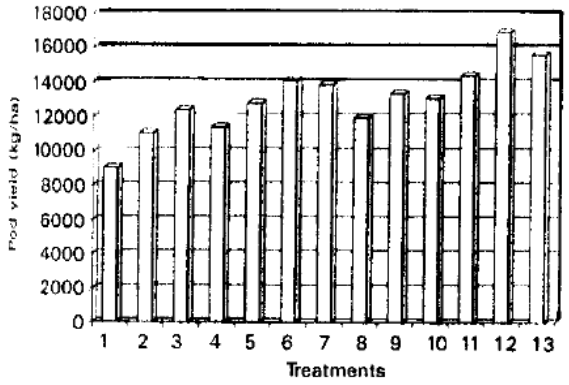
Results and Discussion.

Days to emergence: The data regarding days to emergence are given in Table 2. It is clear from the mean values of experimental results that maximum days (11.00) to emergence were taken in plot that received nitrogen alone at the rate of 140 kg ha^{-1}, whereas minimum days (9.33) to emergence were noted in plot received fertilizer level of 100-90-60 kg NPK/ha. The statistical analysis of data revealed that different levels of nitrogen alone and in combination with constant doses of phosphorus and potassium had no significant effect on days to emergence of okra. The possible reason could be that the germination process is mainly controlled by viability of seed, adequate moisture, proper temperature, good aeration, freedom from pathogenic organisms and toxic amount of salts and least by soil fertility. Therefore the effect of fertilizers was not pronounced in the initial stage of germination.

Days to flowering: Statistical analysis of data revealed that there is no significant effect on days to flowering. Maximum days (55.93) to flowering were taken by plot received only nitrogen at the rate of 140 kg ha^{-1}, whereas minimum days (51.07) were taken at fertilizer level of 100-90-60 kg NPK/ha. As regards the nitrogen fertilizer treatments, the higher doses of nitrogen delayed blooming. This may be due to the fact that excessive supply of nitrogen promotes luxuriant and succulent vegetative growth dominating the reproductive phase. As phosphorus enhances development of reproductive parts,



1	=	N_0	8	=	N_1K_1
2	=	N_1	9	=	N_2K_1
3	=	N_2	10	=	N_3K_1
4	=	N_3	11	=	$N_1P_1K_1$
5	=	N_1P_1	12	=	$N_2P_1K_1$
6	=	N_2P_1	13	=	$N_3P_1K_1$
7	=	N_3P_1			
N_0	=	Control	N_3	=	140 kg N/ha
N_1	=	100 kg N/ha	P_1	=	90 kg P_2O_5/ha
N_2	=	120 kg N/ha	K_1	=	60 kg K_2O/ha



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3	=	N_2	10	=	N_3K_1
4	=	N_3	11	=	$N_1P_1K_1$
5	=	N_1P_1	12	=	$N_2P_1K_1$
6	=	N_2P_1	13	=	$N_3P_1K_1$
7	=	N_3P_1			
N_0	=	Control	N_3	=	140 kg N/ha
N_1	=	100 kg N/ha	P_1	=	90 kg P_2O_5/ha
N_2	=	120 kg N/ha	K_1	=	60 kg K_2O/ha

stimulates blooming and fruit setting, therefore, minimum days to flowering were recorded in plot fertilized with lowest dose of nitrogen (100 kg ha^{-1}) combined with phosphorus and potassium. The results agree with that of Gill *et al*. (1974) who reported that number of days to flowering was reduced by phosphorus and increased by nitrogen in sweet pepper.

Days to first picking: The number of days to first picking was not significantly affected by different levels of nitrogen alone and in combination with constant doses of phosphorus and potassium. Maximum number of days 164.53) to first picking was taken by plot receiving only nitrogen at the rate of 140 kg ha^{-1}, while minimum number of days (59.07) to first picking was taken by plot fertilized with NPK at the rate of 100-90-60 kg ha^{-1}. The number of days to first picking increased with increasing nitrogen levels. It might be due to the fact that high levels of nitrogen prolong the growing period with consequent delay in maturity under certain conditions especially when the supply of other plant nutrients is not adequately balanced (Haque and Jakhro, 1996). These results are not in conformity with those of Sharestha (1983) who reported that nitrogen fertilization advanced the first harvest by 4-6 days compared with control. Although nitrogen tends to delay fruiting but various nitrogen levels when combined with constant doses of phosphorus and potassium gave no significant effect. The reason might be its combination with phosphorus and potassium, because nitrogen increases days to fruiting, whole phosphorus brings early maturity of crops, therefore, the non significant differences are due to their counter balancing effect in various combinations.

Plant height (cm): The mean values of experimental results revealed that plant height was significantly affected by different levels of nitrogen alone in combination with constant doses of phosphorus and potassium. According to the experimental results the maximum plant height (185 cm) was recorded at fertilizer level of 120-90-60 kg NPK/ha, while minimum plant height (154 cm) was noted in control treatment. It might be due to increase in nitrogen level along with constant doses of phosphorus and potassium, which enhanced the vegetative growth. Because normal metabolic process can continue only in the presence of an optimum level of nitrogen and phosphorus while potassium plays its role in promotion of growth and meristmatic tissues. The result resemble with that of Sarnaik *et al*. (1986) who obtained maximum plant height with application of 120 kg N + 60 kg P/ha. Similar results were also obtained by Gondane and Bhatia (1995) who reported that NPK fertilizer significantly increased plant height.

Number of pods per plant: The data pertaining to number of pods per plant presented in Table 2. showed that different levels of nitrogen alone and in combination with constant doses of phosphorus and potassium. significantly affected number of pods per plant. The mean values indicated that plots at fertilizer level of 120-90-60 kg NPK/ha, gave significantly higher number of pods per plant (24.59) than the other treatments with lower and higher doses of nitrogen alone and in various combinations with phosphorus and potassium, while minimum number of pods per plant (14.66) was noted in control treatment. The highest number of pods per plant might be due to vigor of plant and more number of leaves by the application of NPK nutrients. while less number of pods per plant might be due to the poor nutritional status of control treatment. These results agree with the finding of Gondane and Bhatia (1995) who concluded that number of pods per plant was significantly increased with the application of NPK fertilizers. Similar results were also obtained by Mishra and Pandy (1987) and Arora *et al*. (1991) who reported that number of pods per plant were significantly increased by the application of nitrogen and phosphorus.

Pod length (cm): Statistical analysis revealed that different

levels of nitrogen alone and in combination with constant doses of phosphorus and potassium had a significant effect on pod length. The mean values showed that maximum pod length (12.63 cm) was obtained at fertilizer level of 120-90-60 kg NPK/ha, while minimum pod length (9.61 cm) was noted in control treatment. The results resemble to those of Arrora *et al*. (1991) who reported that length was significantly improved by application of nitrogen and phosphorus. Similar results were obtained by Singh (1979) who reported that pod size was increased by application of NPK.

Fresh pod yield (kg ha^{-1}): Fresh pod yield kg ha^{-1} was significantly affected by different levels of nitrogen alone and in combination with constant doses of phosphorus and potassium. It is evident from mean values of experimental results that plants at fertilizer level of 120-90-60 kg NPK/ha, gave maximum pod yield (16950.79 kg ha^{-1}) than the other treatment with lower and higher doses of nitrogen alone and in combinations with phosphorus and potassium, while minimum pods yield (9047.61 kg ha^{-1}) was recorded in control treatment. The maximum yield might be due to more number of fruits and maximum fruit length resulting from balanced fertilization. These results resemble to previous results who obtained the highest yield with 120 kg N combined with 34.58 kg P_2O_5 and 49.8 kg K_2O/ha, while Abusaleha and Shanmugavelu (1988) obtained 18.19 tlha pod yield with application of NPK fertilizers. These results also coincides with the findings of Abdul and Aarf (1986) who got maximum yield 12.23 t/donum with the application of NPK fertilizers.

Conclusion and recommendations

In the light of results recorded in this experiment, the following conclusion and recommendations can be generalized. As the soil was low in nitrogen, available phosphorus and potassium, therefore, the balanced amount of fertilizers resulted in higher yield of the crop.

Maximum plant height (1.85 m), number of pods per plant (24.59), pod length (12.63 cm) and the highest pod yield per hectare (16950.79 kg) was recorded in plot fertilized with 120:90:60 kg ha^{-1}. No significant differences were observed in days to emergence, flowering and first picking respectively. Combination of nitrogen, phosphorus and potassium at the rate of 120-90-60 kg ha^{-1} was found to be the best dose of fertilizer and is recommended for the highest yield of okra under the agro-climatic conditions of Mingora Swat.

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