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IMPACT OF NITROGEN AND PHOSPHORUS ON SEED YIELD AND YIELD COMPONENTS OF OKRA CULTIVARS

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ABSTRACT

A field experiment was conducted at Horticulture Research Farm Malakandher, Khyber Pakhtunkhwa Agricultural University Peshawar, during summer 2010 to evaluate the impact of nitrogen and phosphorus on seed yield and yield components of Okra cultivars. The experiment was laid out in Randomized Complete Block Design with split plot arrangement having three replications. Cultivars were allotted to the main plots, while various levels of nitrogen and phosphorus were kept in the subplots. Urea and single superphosphate (SSP) were used as source of nitrogen and phosphorus, respectively. Germination percentage (%) and seed yield (kg ha^{-1}) were significantly different with respect to cultivars. Maximum germination percentage (89 %) was observed in variety Arka Anamika, and maximum seed yield (1311 kg ha^{-1}) was recorded in variety Green Star. Significant response of various levels of nitrogen and phosphorus were observed in number of pods $plant^{-1}$ and seed yield (kg ha^{-1}). Maximum number of pods $plant^{-1}$ (10.69) and maximum seed yield (1374.9 kg ha^{-1}) were reported in plots having received both 150 kg N/ha and 90 kg P/ha. A non significant difference was observed in parameters i.e. number of seeds pod^{-1} and 1000 seed weight (g). It is concluded that Okra variety Green Star and application of N and P (at rates of 100 kg N ha^{-1} + 60 kg P ha^{-1}) in combination resulted in higher seed yield of Okra.

Key words: Nitrogen, Phosphorus, Okra and Seed yield.

INTRODUCTION

Okra (*Hibiscus esculentus* L.) belonging to family Malvaceae is very sensitive to frost and grows best in hot summer with minimum and maximum mean temperature of 18°C (65°F) and 35°C (95°F), respectively. If planted in late spring may remain vegetative until late summer or early fall (Pandita *et al*., 2010). The total area in growing season 2008-09 under Okra cultivation in Pakistan was 15.081 thousand ha with total production of 114.657 thousand ton in which KP contributes an area of 2.126 thousand hectare with total production of 18.156 thousand ton (MINFA, 2009).The nutrient requirements of crops depend upon soil texture, types of previous vegetation cover, cropping intensity and soil moisture (Denton and Swarup, 1990). Nitrogen, phosphorus and potassium are among the common major nutrients, which are essential for the growth and development of all plant species. Nitrogen is the important part of plant parts such as chlorophyll, amino acid, proteins and pigments. Nitrogen makes leafy vegetables and fodder more succulent. It also increases the protein content of food and feed.Therefore proper attention must be given to these nutrients while planning a project on plant nutrition (Khalil, 2006). Phosphorus is a key element in the formation of high energy compounds, such as AMP, ADP and ATP, which play essential role in photosynthesis and respiration. It is a vital component of nucleic acids and phospholipids. Plants take up phosphorus in the inorganic form, mainly as the orthophosphate H_2PO_4 ion. Phosphorus supports early phase of crop development, synchronizes the germination process and leading to enhance the final yield, especially in P deficient soil (Asgedom and Becker, 2001; Arif *et al*., 2005). It increases crop resistance to diseases. In contrast to N, deficiency symptoms of P most often, occur in seedlings and young plants. Since P is mobile within the plant, symptoms appear on the lower leaves/parts of the plants (Khalil, 2006). Vegetable seed production is unique from most agronomic crops as they must develop sufficient vegetative growth prior to cool temperature exposure in order that vernalization may successfully induce flower formation in the following season such as that in Okra. Its seed production is affected by climatic factors and various agronomic practices including fertilizer application and planting density (Asgedom and Becker, 2001). Among macronutrients, Phosphorus (P) is an essential macronutrient that can limit plant growth if not provided in sufficient quantities by the soil or external sources. For soils low in available P, the nutrient must be applied in either organic or inorganic P sources to obtain optimal crop yield. However, excessive use of applied P sources can cause eutrophication in water bodies from surface runoff of sediments carrying P or leaching of P in sandy soils (Chien *et al*., 2011). Many researchers

reported the effect of phosphorus application on green pod yield of okra, which also improves root growth, hastens seed maturity and increases fruit yield especially when applied in combination with nitrogen (Sadat, 2000). There are various ways for improving yield and seed production of Okra but the best way is to provide appropriate amount of fertilizers and to select high yielding cultivars. In this connection, a research project was conducted to study the effect of various levels of N and P on Okra cultivars with the objectives to find out the most suitable and high seed yielding variety for the growers of Peshawar region and to determine the optimum level of N and P for better seed production.

MATERIALS AND METHODS

A field experiment on impact of nitrogen and phosphorus on seed yield and yield components of Okra cultivars was conducted at Horticulture Research Farm Malakandher, Khyber Pakhtunkhwa (KP) Agricultural University Peshawar, during the year 2010. A subplot size 9 m^2 was used having four ridges at a distance of 50 cm and on each ridge, Okra plants were kept at a distance of 25 cm. Urea and single superphosphate (SSP) were used as a source of nitrogen and phosphorus respectively. SPP was applied as a whole at the time of sowing while urea was applied in split doses. Subsequent irrigation was applied as required by the crop. Hoeing and weeding were done regularly. The experiment was laid out in Randomized Complete Block (RCB) design with split plot arrangement having two factors i.e. Factor A (Okra Cultivars) including Sabz Pari, Arka Anamika and Green Star and Factor B (Combination of N and P) including 0-0, 100-60, 100-90, 100-120, 150-60, 150-90, and 150 kg N-120 kg P ha^{-1}. Factor A was assigned to main plots and B to the sub plots. A composite soil sample 15-20 cm deep was collected from experimental plot before fertilizer application and was analyzed in Soil Science laboratory, KP Agricultural University Peshawar. Which contain electric conductivity (0.1 dS m^{-1}), organic matter (0.75 %), nitrogen (1.00 mg kg^{-1}), P_2O_5 (0.085 %), K_2O (69.26 mg kg^{-1}), pH (8.2), iron (5.61 mg kg^{-1}), copper (3.46 mg kg^{-1}), zinc (2.39 mg kg^{-1}) and manganese (6.22 mg kg^{-1}). The data was recorded on:

Germination percentage (%): The seed from each variety was tested for germination in Pots and germination percentage was calculated with the help of formula:-

$$\text{Germination percentage} = \frac{\text{Total number of germinated seeds}}{\text{Total number of seeds sown}} \times 100$$

Plant survival percentage (%): The data regarding plant survival was recorded one month after germination in each plot with the following formula:-

$$\text{Plant survival percentage} = \frac{\text{Number of plant survived}}{\text{Total number of plants}} \times 100$$

Number of pods $plant^{-1}$: The number of pods $plant^{-1}$ of the selected plants were recorded and average number of pods $plant^{-1}$ were calculated.

Number of seeds pod^{-1}: The number of seeds per pod of the selected plants was recorded and average number of seeds per pod was calculated.

1000 seeds weight (g): The weight of 1000 seeds was taken with the help of balance in each plot.

Seed yield (kg) ha^{-1} : The seed yield $plot^{-1}$ was recorded and the seed yield (kg) ha^{-1} was computed using the following formula:

$$\text{Seed yield (kg) ha}^{-1} = \frac{\text{Seed yield plot}^{-1}\text{ (kg)}}{\text{Area of plot (m}^2\text{)}} \times 10000\ \text{m}^2$$

The data recorded for each trait were individually subjected to the ANOVA Technique by using MSTATC computer software and means were separated by using Fisher's LSD test (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Germination percentage (%): Statistical analysis of the data showed that cultivars had a significant ($P<0.05$) effect on germination percentage while various levels of nitrogen and phosphorus and their interaction with cultivars had non significant effects on germination percentage of Okra (Table 1). Among the cultivars, maximum germination percentage (88.81%) was recorded in variety Arka Anamika, followed by 88.10% in Green Star as compared to 83.33% noted in Sabz Pari. The N and P fertilizers as well as their interactions had non significant effect on germination percentage of Okra. The germination process is mainly controlled by viability of seed, different seed sources and different ages of seeds, adequate moisture, proper temperature, good aeration and freedom from pathogenic organisms and also the genetic makeup of the cultivars (Amjad *et al*., 2001). The embryo grows at the expense of the food materials which it absorbs from the cotyledons or endosperum when it is present. Therefore the effect of fertilizer was not pronounced in the initial stages of germination.

Plant Survival Percentage (%): Significant variation in percent plant survival was observed in different cultivars of Okra. The maximum plant survival percentage (91.40%) was recorded in cultivar Green star, followed by cultivar Sabz pari with 89.78%, while minimum plant survival percentage (88.57%) recorded in cultivar Arka anamika. Various levels of N and P also significantly affected the percent survival of okra plants. The highest plant survival (94.25%) was recorded in plots that received both 100 kg N ha-1 and 90 kg P ha-1, followed by 93.48% in plots treated with 150 kg N ha-1 and 90 kg

P ha-1, while minimum plant survival (68.92%) was recorded in control plots. Phosphorus priming proved to reduce seed infection. Chaluvaraju *et al*., (2004) reported that the pearl millet downy mildew (PDM) disease was decreased by various phosphorus sources. The chemicals acted as growth stimulants under laboratory conditions by improving seed germination and vigor, hence, leading to better survival of the seedling.

Number of pods plant^{-1}: Statistical analysis of data regarding number of pods plant^{-1} showed that various levels of N and P had a significant (P<0.05) effect while cultivars and the interaction between cultivars and NP levels had a non significant effect on number of pods plant^{-1} (Table 1). Though the differences among the various levels of N and P for numbers of pods plant^{-1} were significant, however maximum number of pods plant^{-1} (10.69) was recorded in plots of 150 kg N and 90 kg P ha^{-1}, followed by 10.33 pods plant^{-1} in 100 kg N and 90 kg P ha^{-1}, while minimum number of pods plant^{-1} (5.33) was recorded in control plots. The highest number of pods plant^{-1} might be due to vigour of plant and more number of leaves by the application of nitrogenous and phosphatic fertilizer together, while less number of pods plant^{-1} might be due to the poor nutritional status of control treatment (Khan *et al*., 2000). These results agree with the finding of Sadat (2000) who concluded that number of pods plant^{-1} was significantly increased with the application of NPK fertilizer. Similar results were also obtained by Sultana (2002) who reported that number of pods plant^{-1} were significantly increased by the application of N and P.

Number of seeds pod^{-1}: The data related to number of seeds pod^{-1} (Table 1) showed that cultivars, various levels of nitrogen and phosphorus and their interaction all had a non significant effect on number of seeds pod^{-1}. However, in the interaction highest number of seeds pod^{-1} was obtained in Sabz Pari variety where 150 kg N and 60 kg P ha^{-1} were applied. The lowest number of seeds pod^{-1} was found in the Green Star variety treated with 150 kg N and 90 kg P ha^{-1}. Our findings are in agreement with Khan *et al*., (2000), who also found a non-significant effect of NPK on number of seeds pod^{-1}.

1000 seeds weight (g): Statistical analysis of data showed that cultivars, various levels of N and P and their interaction had non significant effect on 1000 seeds weight (Table 1). However, in the interaction maximum 1000 seeds weight (65.0 g) was recorded in variety Green Star in plot which received 100 kg N/ha and 120 kg P/ha followed by (63.33 g) 1000 seed weight in variety Arka Anamika in plot which received 100 kg N/ha and 90 kg P/ha while minimum 1000 seeds weight (51.67 g) was recorded in variety Green Star in control plot. These results are in close conformity of Sarnaik *et al*., (1986) who found no significant differences in 100 seeds weight for different nitrogen and K levels.

Table 1. Effect of N and P fertilizers on germination percentage, plant survival percentage, number of pods plant^{-1}, number of seeds pod^{-1}, 1000 seeds weight (g) and seed yield (kg ha^{-1}) of Okra cultivars

Treatments	Germination percentage (%)	Survival Percentage (%)	Number of pods plant^{-1}	Number of seeds pod^{-1}	1000 seeds weight (g)	Seed yield (kg ha^{-1})
Okra cultivars (V)						
Sabz pari	83.33 b	89.78 ab	9.22	52.24	57.62	1226.4 ab
Arka anamika	88.81 a	88.57 b	8.87	51.86	59.05	1110.1 b
Green star	88.10 a	91.40 a	10.02	47.77	59.05	1311.2 a
LSD	**1.4280**	**2.78**	**NS**	**NS**	**NS**	**147.52**
Fertilizer: Nitrogen+Phosphorus (kg ha^{-1})						
0N+0P	84.17	68.92 b	5.33 c	48.73	53.33	632.5 b
100N+60P	87.50	93.18 a	10.04 ab	49.02	58.33	1221.6 a
100N+90P	87.78	94.52 a	10.33 ab	49.98	61.67	1379.0 a
100N+120P	86.67	93.10 a	10.04 ab	50.27	60.56	1356.0 a
150N+60P	87.22	93.18 a	8.87 b	54.67	58.89	1219.9 a
150N+90P	87.22	93.48 a	10.69 a	48.42	58.33	1374.9 a
150N+120P	86.67	93.06 a	10.27ab	53.27	58.89	1327.3 a
LSD	**NS**	**2.03**	**1.7776**	**NS**	**NS**	**297.99**
Interaction (V x F)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

LSD = Least Significant Difference NS = Non-Significant
* = Significant V x F = Variety x Fertilizers

Seed yield (kg ha^{-1}): The data pertaining seed yield kg ha^{-1} are presented in Table 1. Statistical analysis of data showed that cultivars and various levels of N and P had a significant effect while the interaction between cultivars with various levels of N and P had non significant effect on seed yield kg ha^{-1}. According to the mean values of

the experimental results, maximum seed yield (1311 kg ha^{-1}) was recorded in variety Green Star, followed by 1226 kg ha^{-1} in variety Sabz Pari, while minimum seed yield (1110 kg ha^{-1}) was recorded in variety Arka Anamika. Experimental results of various levels of N and P showed that maximum seed yield (1379 kg ha^{-1}) was recorded in plots that received both 100 kg N ha^{-1} and 90 kg P ha^{-1}, followed by seed yield of 1374.9 kg ha^{-1} in plots treated with 150 kg N ha^{-1} and 90 kg P ha^{-1}, while minimum seed yield (632.5 kg ha^{-1}) was recorded in control plots. The cultivar Green Star showed maximum survival percentage which significantly enhanced the seed yield (kg ha^{-1}), followed by Sabz Pari. The maximum seed yield might be due to more number of survived plants and pods $plant^{-1}$ resulting from balanced fertilization (Khan *et al*., 2000). These results are in close conformity with the findings of Singh *et al*., (2008). The seed yield depends upon the pod number, seed number and average seed weight pod^{-1}. As the cultivars differed for these parameters, therefore, seed yield $plant^{-1}$ also varied among the cultivars. These results are also in accordance with the findings of Sarnaik *et al*., (1986), who obtained highest seed yield with N and P at 120 and 60 kg ha^{-1}, respectively. Lenka *et al*., (1989) obtained satisfactory seed yield with 30 kg P_2O_5 ha^{-1}.

Conclusions and Recommendations: On the basis of results obtained, it is concluded that Okra variety Green Star can produce higher seed yield (kg ha^{-1}) followed by Sabz Pari. Moreover, the incremental doses of NP in combinations had not significantly influence the seed yield of Okra. Therefore, the variety Green Star with minimum level of NP (100:60 kg ha-1) can be recommended for the grower of Peshawar region (Pakistan).

REFERENCES

Amjad, M., M. A. Anjum and A. Ali (2001). Effect of phosphorus and planting density on seed production in Okra (*Hibiscus esculentus* L. Moench). Inter. J. Agri. and Bio. 3(4): 380-383.

Arif, M., S. Ali, A. Shah, N. Javed and A. Rashid (2005). Seed priming maize for improving emergence and seedling growth. Sarhad J. Agric., 21(4): 539-543.

Asgedom, H. and M. Becker. 2001. Effect of seed priming with nutrient solutions on germination, seedling growth and weed competitiveness of cereals in Eritrea. In: Proc. Deutscher Tropentag 2001, Univ. Bonn and ATSAF, Margraf Publishers Press, Weickersheim. p. 282.

Chaluvaraju, G., P. Basavaraju, N.P. Deepak, K.N. Amruthesh and H.S. Shetty (2004). Effect of some phosphorus based compounds on control of pearl millet downy mildew disease. Crop Prot., 23 (7): 595-600.

Chien, S. H., L. I. Prochnow, S. Tu and C. S. Synder (2011). The agronomic and environmental aspects of phosphate fertilizers varying in source and solubility: an update review. Nutr Cycl Agroecosyst 89:229–255

Denton, L. and V. Swarup (1990). Tomato cultivation and its potential in Nigeria. African symposium on Horticultural crops, Ibadan, pp. 257.

Khalil, I. A. (2006). Crops and Cropping patterns In Pakistan: Crop Nutrition. 6th Chapter. HEC Publisher, Islamabad. pp. 64-65.

Khan, H., M. Khan, K. Rasul, A. Majeed and F. A. Safi (2000). Effect of different levels of nitrogen alone and in combination with constant doses of phosphorus and potassium on growth and yield of Okra (*Hibiscus esculentus* L.) Cv. T-13 under Agro-climatic conditions of Mingora, Swat. Pak. J. Bio. Sci. 3 (12): 2101-2104.

Lenka, P. C., D. K. Das and H. N. Mishra (1989). Effect of nitrogen and phosphorus on seed yield of bhendi cv. Parbhanikranti. Orissa Journal of Agricultural Research 2(2): 125-127.

MINFA. (2009). Government of Pakistan, Ministry of Food, Agriculture and Livestock. Economic Wing, Islamabad.

Pandita, V. K., A. Anand, S. Nagarajan, R. Seth and S. N. Sinha (2010). Solid matrix priming improves seed emergence and crop performance in okra, 38: 665-674.

Sadat, M. S. I. (2000). Studies on the effects of different levels of nitrogen, phosphorous and potassium on the growth yield and seed production of okra *(Abelmoschus esculentus* L.). M S. Thesis, Dept. of Horticulture, Bangladesh Agril. Univ., Mymensingh, Bangladesh.

Sarnaik, D. A., B. S. Bagael and K. Singh (1986). Response of Okra seed crop to major nutrients. Research and Development Reporter. 3(2): 1012.

Singh, J. P., I. N. Shukla, R. K. S. Gautam, B. Singh and K. Srawan (2008). Effect of different levels of nitrogen and phosphorus under varying plant geometry on growth and yield of okra [*Abelmoschus Esculentus*(L.) Moench]. Ind. J. Hort. 8 (1):21-24.

Steel, R.G.D., J. H. Torrie,., and D.A. Dickey (1997). Principles and Procedures of Statistics. A Biometrical Approach. 3rd edition. McGraw-Hill Publishing.

Sultana S. (2002). Effect of nitrogen, phosphorus, potassium, sulphur and boron on okra. M. S Thesis. Department of Soil Science, Banghabandhu Sheikh Muijibur Rahman Agril. Univ. Gazipur.