DOI: https://doi.org/10.5281/zenodo.7892150

GU JOURNAL OF PHYTOSCIENCES

GU. J. Phytosci. 3(2): 130-134 (2023)

Demonstration and Evaluation of Impact of Nitrogen Fertilizer on Growth and Yield Attributes of Okra (*Abelmoschus esculentus* L.) in Local Field Conditions of Dera Ghazi Khan

Abdur Rauf[1]*, Iftikhar Ahmad[2], Muhammad Awais Piracha[1], Faiz Karim[3], Zafar Abbas[1], Rehmat Ullah[1], Muhammad Bilal[1], Javed Iqbal[1], Muhammad Sharif Uddin[4], Muhammad Tahir Akbar[5], Sehrish Jamil[6], Ahmad Nadeem[7] and Akram Qadzi[7]

[1]*Soil and Water Testing Laboratory, Dera Ghazi Khan, Pakistan*
[2]*Soil Fertility Research Wing, Multan*
[3]*Adaptive Research Farm, Dera Ghazi Khan*
[4]*Soil Conservation, Agriculture Complex, Dera Ghazi Khan*
[5]*Soil and Water Testing Laboratory, Layyah, Pakistan*
[6]*Soil and Water Testing Laboratory, Bahawalnagar, Pakistan*
[7]*Soil Fertility Research Institute, Lahore, Punjab*

Abstract

A research trial was conducted at farmer's field Mouza Kotla Shafi near Dera Ghazi Khan during kharif season 2020. Urea as a source of N applied at different doses (0, 40, 80, 120 and 160 kg ha^{-1}) using okra (*Abelmoschus esculentus* L.) as a test crop. The experiment was laid out in Randomized Completely Block Design (RCBD) with three replications under local field conditions. Urea was applied in split doses along with basal dose. Growth and yield were tributes such as plant height, number of fruits per plant, fruits fresh weight and fruit yield were determined. Application of N @ 160 Kg ha^{-1} showed maximum improvement in growth and yield attributes compared to all other levels of N. Okra fruit fresh weight, yield and plant height showed maximum values of 15.31 g, 5915.4 Kg ha^{-1} and 79.25 cm under N application @ 160 Kg ha^{-1}, respectively.

Keywords: Kharif; Yield; RCBD; Okra

1. Introduction:

A research trial was conducted at farmer's field Mouza Kotla shafi near Dera Ghazi Khan during kharif season 2020. Urea as a source of N applied at different doses (0, 40, 80, 120 and 160 kg ha^{-1}) using okra (*Ablmoschus esculentus* L.) as a test crop. The experiment was laid out in randomized completely block design (RCBD) with three replications under local field conditions. Urea was applied in split doses along with basal dose. Growth and yield attributes such as plant height, number of fruits per plant, fruits fresh weight and fruit yield were determined. Application of N @ 160 Kg ha^{-1} showed maximum improvement in growth and yield attributes compared to all other levels of N. Okra fruit fresh weight, yield and plant height showed maximum values of 15.31 g,

*Corresponding author Tel.: +92 03346719571
E-mail address: abdulraufy79@gmail.com

© 2023 (Accepted for publication in Feburary 2023)
Published by Department of Botany, Selection and/or peer-review under supervision of Executive Committee, Ghazi University, DG Khan, 32200 Pakistan

5915.4 Kg ha^{-1} and 79.25 cm under N application @ 160 Kg ha^{-1} respectively.

1.1. Objectives:

- To access the efficacy of N application on growth and fruit yield of okra.

2. Materials and Methods:

2.1. Experimental Layout:

During kharif season-2020, current study trial conducted at a farmer's field in Mouza Kotla Shafi, close to Dera Ghazi Khan. The research trial was set up in a Randomized Complete Block Design (RCBD) with five various N (0-160 kg ha^{-1}) treatments and three repeats having a total (5 × 3) of 15 plots each with an area of 2 m × 2 m. Soil was prepared by use one chisel plow with 3-4 cultivation followed by laser level and planking. Ridges are made via cotton ridge. All the agronomic practices were kept as standard. Soil physical and chemical properties including soil texture, electrical conductivity (EC), soil reaction (pH), organic matter content and available K and P determined by using standard protocol and procedures (Table 1).

Seeds of a hybrid variety of okra (Sabz Pari) collected from the local market and dipped in water to check the viability of seeds by floating method. Seed (4-5) sown in ridges at the distance of 15 cm (P × P) and 45 cm (R × R) respectively with seed rate of 13 kg acre 1. After 15 days of sowing, thinning of unhealthy plants was done and two healthy plants per slot maintained all over the trial area. Irrigation of field done after 10-15 days. The application of N is done in three equal splits while the recommended dose of P and K applied as approved by Government of Punjab, soil Fertility and Research Institute, at the time of soil bed preparation.

The experiment was laid out in RCBD with five treatments and three replicas as under.

T_1: Nitrogen= 0, Phosphorus= 90, Potash= 60 (0 bag)
T_2: Nitrogen= 40, Phosphorus= 90, Potash= 60 (0.64 bag)
T_3: Nitrogen= 80, Phosphorus= 90, Potash= 60 (1.29 bag)
T_4: Nitrogen= 120, Phosphorus= 90, Potash= 60 (1.93 bag)
T_5: Nitrogen= 160, Phosphorus= 90, Potash= 60 (2.58 bag)

All recommended DAP, Potash was applied at the time of seed bed preparation, while urea was used as per treatments. The crop was harvested by 08 pickings of fruits up to 09 September 2020. About 6 irrigations were applied with rainfall 04 times. Urea was applied in 03 split doses at sowing time, one month after sowing and 45 days after sowing. Data regarding plant height, fruit fresh weight, number of fruits and branches per plant, length of branch, fruit length, was recorded by selecting 10 plants and average was counted. The number of plants and yield was counted on m^2 basis.

2.2. Soil Analysis:

Soil chemical and physical characters investigated by standard procedures and details as under.

2.2.1. Aqueous Extraction:

Soil textural class determined by taking 50 g of each soil sample was taken in a 500 mL beaker and 50 mL of 1% sodium hexametaphosphate solution and 250 mL of distilled water were added and kept it overnight. Soil solution stirred (10 minutes) via mechanical stirrer and transferred in 1000 mL graduated cylinder and the volume was made up to the mark by distilled water. Reading was noted by Bouyoucous hydrometer after 4 second and after 2 hours (Gee & Bauder, 1986). Soil textural class was determined by using the International Textural Triangle.

2.2.2. Electrical Conductivity and pH:

Electrical conductivity of soil measured with a soil water ratio of 1:2 by using EC meter calibrated with 0.01 N KCl solution. Cell constant of EC meter was calculated as.

K = 1.413/EC of 0.01 N KCl

While pH of soil access by taking soil water ratio of 1:2 overnight and using pH meter calibrated with buffer of pH 7.01 and 10.01 (Bigham, 1996).

2.2.3. Organic Matter Content:

Soil OM content determined according to the standard method described by Nelson & Sommers (1982). For this, 1.0 g of soil sample was mixed thoroughly with 10 mL of 1N $K_2Cr_2O_7$ solution and 20 mL of concentrated H_2SO_4. Then 150 mL of distilled water and 25 mL of 0.5 N FeSO4 solutions was added, and the excess was treated with 0.1 N $KMnO_4$ solutions to sharp green end point.

Organic matter content (%) = me of $K_2Cr_2O_7$ reduced / weight of sample (g) x 0.698

2.2.4. Available Phosphorus and Potassium:

Available P was estimated by taking soil (5 g) and extracted with 0.5 M $NaHCO_3$ solution adjusted to pH 8.5. Filtrate (5 mL) was taken into 50 mL volumetric flask and then added 5 mL colour

developing reagent (ascorbic acid) and volume was made up to the mark. Reading was taken on spectrophotometer at 880 nm and available P was calculated with standard curve (Olsen *et al.,* 1954). For available K, 2.5 g soil sample taken into a 250ml conical flask, add 50 ml 1 N NH_4OAC solution adjusted at pH 7.0 and finally shake on a reciprocal shaker for 30 minutes and filter the extract via Whatman filter paper no. 40. Determine K by flame photometer in ppm using standard graph readings.

2.3. Statistical Analysis:

Data analysed for the comparison among treatments by using software Statistix 8.1. Means compared using least significance difference (LSD) test at significance level of 0.05 (Steel *et al.,* 1997).

Table: 1 Physico-Chemical characters of experimental site soil

Soil Properties	Soil Depth	Reading	Rating	Reference
pH	0-15 cm and 16-30 cm	8	High	1:2, soil: water suspense (Bigham, 1996)
EC ($dS\ m^{-1}$)	0-15 cm and 16-30 cm	92	High	1:2, soil: water suspense (Bigham, 1996)
Available OM (%)	0-15 cm and 16-30 cm	0.64 0.52	Low	Walkley & black method (Nelson & Sommers, 1982)
Available K (kg ha^{-1})	0-15 cm and 16-30 cm	144 112	Medium Low	NH_4OAC method
Available P (kg ha^{-1})	0-15 cm and 16-30 cm	8.4 7	Low	0.5 N $NaHCO_3$ extractable P (Olsen *et al.,* 1954)
Texture class	0-15 cm 16-30 M		Clay loam	(Gee & Bauder, 1986)

3. Results:

Growth and yield characters of *Abelmoschus esculentus* including plant height, number of fruits per plant, fruit weight and size and yield estimated by applying various levels of N (0, 40, 80, 120 and 160 kg ha^{-1}) with constant P and K fertilization. All the growth and yield parameters showed significant improvement by changing the N doses at different growth stages.

3.1. Plant Height:

A key to access the growth character of crop plant is plant height that showed a significant ($P \leq 0.05$) increase in its value under different treatments of N compared to control (Table 2). It was observed that with the increase in N level from 40 to 160 kg ha^{-1} plant height also increased. Maximum height of okra plant of 79.25 cm observed at 160 kg ha^{-1} application of N while minimum in control (21.19 cm). The positive effect of N for plant height may be due to higher N utilization and higher photosynthetic rate.

3.2. Number of Branches Per Plant:

Higher number of branches per plant required for maximum fruit yield. Nitrogen application showed significant ($P < 0.05$) effect on number of branches per plant (Table 2) among treatments. Nitrogen application @ 120 resulted 3.07 branches per plant while 160 kg N ha^{-1} treatment resulted maximum of 3.53 branches $plant^{-1}$. Control, 40 and 80 kg ha^{-1} N observed 1.39, 1.96 and 2.48 branches per plant. As a primary essential macronutrient for plant growth, N has a potential to boost growth character of crops.

Table 2: Effect of various level of N fertilizer on growth and yield parameter of Okra

Treatments	Number of plants	Plant height	Number of branches	Branch length	Number of fruits/ plants	Fruit length	Fresh weight of fruit	Yield kg/ acre

T_1: **Nitrogen= 0,** Phosphorus= 90, Potash= 60 (0 bag)	14500	21.19 e	1.39 e	15.19 e	23.08 e	8.24 e	14.29 e	4675.149
T_2: **Nitrogen= 40**, Phosphorus = 90, Potash= 60 (0.64 bag)	14500	33.26 d	1.96 d	20.13 d	24.31 d	10.35 d	14.61 d	5266.641
T_3: **Nitrogen= 80**, Phosphorus = 90, Potash= 60 (1.29 bag)	14500	51.43 c	2.48 c	24.36 c	25.26 c	13.08 c	15.16 c	5520.252
T_4: **Nitrogen= 120**, Phosphorus = 90, Potash= 60 (1.93 bag)	14500	65.48 b	3.07 b	27.96 b	25.59 b	15.13 b	15.24 b	5688.724
T_5: **Nitrogen= 160**, Phosphorus= 90, Potash= 60 (2.58 bag)	14500	79.25 a	3.53 a	32.55 a	26.65 a	17.47 a	15.31 a	5915.4

3.3. Number of Fruits Per Plant:

Okra fruits significantly ($P \leq 0.05$) affected by increasing level of urea compared to control. With the gradual increase in N level from 0 to 160 kg ha^{-1}, the number of okra fruit also increased from 23.08 to 26.65 per plant (Table 2). Control treatment showed minimum number of okra fruit per plant while N application @160 kg ha^{-1} yield maximum number of fruits. Different N applications also showed significant variation in fruits yield and observed 24.31, 25.26 and 25.59 number of fruits per plant under 40, 80 and 120 kg ha^{-1}, respectively.

3.4. Fruit Fresh Weight (g):

Fresh weight of fruit was also significantly ($P \leq 0.05$) affected by varying N levels over control (Table 2). Maximum fruit fresh weight of 15.31 g followed by 15.2 rainfall 4 g attained under N @ 160 and 120 kg ha^{-1} respectively. While minimum fresh weight of 14.29 g attained under control followed by 14.61 and 15.16 g under 40 and 80 kg ha^{-1} treatments, respectively (Figure 1).

3.5. Fruit Yield:

Varying levels of N application significantly ($P \leq 0.05$) affected okra fruit yield over control and also within treatments (Table 2). Highest fruit yield of 5915.4 Kg ha^{-1} recorded where N @ 160 kg/acre applied. Control treatment without N application showed 4675.149 Kg ha^{-1} fruit yield. Nitrogen @ 120 Kg ha^{-1} produced the 2nd highest fruit yield of 5688.72 Kg ha^{-1} followed by 5520.25 and 5266.64 Kg ha^{-1} fruit yield where 80 and 40 Kg ha^{-1} N used over control.

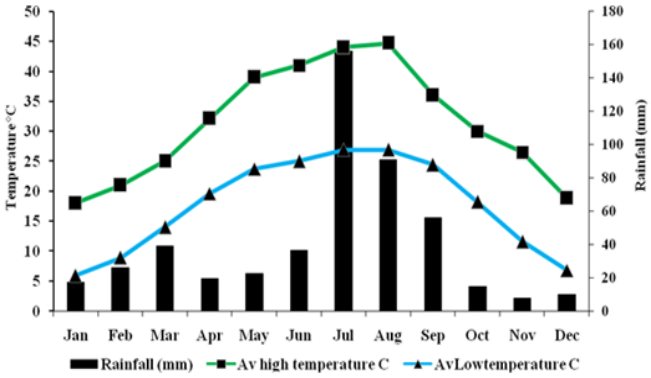

Figure 1: Temperature (°C) and Rainfall (mm) data of Dera Ghazi Khan District

4. Discussion:

Birbal *et al.,* (1995) and Brar & Sing (2016) also reported that with the increase in N application rate plant height of *Abelmoschus esculentus* also improved. Higher number of branches by increased N application may be due to rapid growth and increase leaf area index (Babatola *et al.,* 2002). Similar findings also reported by Babatola *et al.,* (2002) and Omotoso & Shittu (2007) by applying N using Okra as test crop. Abbas *et el.,* 2022 also reported increased number of sympodial branches for cotton crop by N application. Higher photosynthetic rate due to increase N application may result in greater number of okra fruit

per plant. Such findings were also reported by Akintunde *et al*., (2000), Adediran & Banjoko, (2003) and Abbas *et al.,* (2022). Nitrogen application @ 125 kg ha^{-1} yield highest number of fruit (36.7) as reported by Brar & Sing, (2016). A higher rate of N improves the rate of photosynthesis that ultimately boosts accumulation of photosynthate in fruit and causes higher fruit fresh weight. Adediran & Banjoko, (2003) and Abbas *et al.* (2019) both reported increased fruit fresh weight by applying N @ 150 kg ha^{-1} while it was decreased at 300 N kg ha^{-1} application. Brar & Sing, (2016) and Abbas *et al.,* (2019) reported 302 g fruit yield per plant at 100 kg N ha^{-1} combined with three different plants spacing. Similarly, Abbas *et al.,* (2022) also reported the highest seed cotton yield of 1701.6 kg ha^{-1} under198 kg ha^{-1} N application.

5. Conclusion:

It is concluded that application of N fertilizer for okra significantly enhances growth and yield attributes. Current study recommended that N @ 160 kg ha^{-1} can be used at three different growth stages at sowing time, one month after sowing and 45 days after sowing to achieve highest yield attributes. So, this proposal is useful for improving the productivity and profitability of okra growers in Dera Ghazi Khan division of Punjab.

6. References:

Abbas, H., M. A. Wahid, A., Sattar, S. A., Tung, M. F., Saleem, S., Irshad, J., Alkahtani, M. S., Elshikh, M. Cheema, and Y., Li. 2022. Foliar application of mepiquat chloride and nitrogen improves yield and fiber quality traits of cotton (*Gossypium hirsutum* L.). *Plos one*, **17(6).**

Adediran, J. A. and V. A. Banjoko, 2003. Comparative effectiveness of some compost fertilizer formulations for maize in Nigeria. *Nig. J. Soil Sci.,* **13**: 24-49.

Alexandra M. F., A. Suzuki and N. Hongu. 2015. Book let published by Univeristy of Arizona college of Agriculture and life sciences regarding okra nutrients benefits. http://hdl.handle.net/10150/346103

Amjad, A. A., M. A. and S. Hussain. (2001) Effect of different sowing dates and various doses of fertilizer on juvenility and productivity of okra. *Pakistan J. Agril. Sci.,* **38 (1-2)**, 29-32.

Akintunde, A. Y., G. O. Obigbesan, S. K. Kiru and E. A. Akinrinde. 2000. Effects of nitrogen rates on grain yield response of maize varieties in four ecological zones of Nigeria. *Nig. J. Soil Sci*., **12**: 35-44.

Babatola, L. A., D. O. Ojo, and O. B. Adewoyin. 2002. Effect of NPK 20:10:10 fertilizer levels on the yield of okra-sweetcorn intercrop and post harvest quality of okra. *In Proc. Hortic. Soc. Nig. Conf.* (pp. 74-78).

Bigham, J. M., U. Schwertmann, & G.Pfab, 1996. Influence of pH on mineral speciation in a bioreactor simulating acid mine drainage. *Applied Geochemistry*, ***11*(6),** 845-849.

Bk Birbal, N., and Y. S. Malik, 1995. Effect of spacing and nitrogen on fruit yield of okra (*Abelmoschus esculentus* (L) (Moench) cv. *Varasha Uphar. Haryana Agric. Uni. J. Res.*, **25**, 47-51.

Brar, N. S., and D. Singh, 2016. Impact of nitrogen and spacing on the growth and yield of okra [*Abelmoschus esculentus* (L.) Moench]. In: *MATEC Web Conf.* (**57**, pp. 04001). EDP Sciences.

Firoz Z. A. 2009. Impact of nitrogen and phosphorus on the growth and yield of okra (*Abelmoschus esculentus* (L.) Moench.) in hill slope condition. *Bangladesh J. Agri. Res.* **34(4):** 713-722.

Gee, G. W. and J. W. Bauder, 1986. Particle-size analysis 1. *Methods of Soil Analysis: Part*-I, *Physical and mineralogical methods*, 2nd Ed. (pp. 383-411).

Gupta, A., K. Srinivas, and V. Shukla. 1981. Response okra (*Abelmoschus esculentus* L. Moench) to plant spacing and nitrogen, phosphorus fertilization. *Indian J. Horti. Sci.* **38 (3-4):** 218-222.

Katung M. D., J. D. Olanrewaju, U. S. Gupta, and I. Kureh. 1996. Fruit and seed yields of okra as influenced by farmyard manure and nitrogen fertilizer. In: Proc. 14th Hortson Cent; Ago-Iwoye,

Majanbu I. S., V. B. Ogunlela, M. K. Ahmed, and J. D. Olarewarju. 1985. Response of two okra varieties to fertilizers on the yield and yield components as influenced by nitrogen and phosphorus application. *Fert. Res.* **6(3)**:257-267.

Nelson, D. W. and L. E. Sommers, 1996. Total carbon, organic carbon, and organic matter. In: A. L. Page, R. H. Miller, D. R. Keeney, (Eds.), *Methods of soil analysis part 3-chemical methods, Part-II*, 2nd Ed., (pp. 961-1010).

Olsen, S. R., C. V. Cole, F. S. Watanabe and L. A. Dean. 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. In: A. D. Banderis, D. H. Barter & K. Anderson (Eds). U.S. *Department of Agriculture Circular No. 939.* Agricultural and Advisor.

Omotoso, S. O. and O. S. Shittu. 2007. Effect of NPK fertilizer rates and method of application on growth and yield of Okra (*Abelmoschus esculentus* (L.) Moench) at Ado-Ekiti Southwestern, Nigeria. *Int. J. Agri. Res.* **2(7)**, 614-619.

Rahman, M. M., S. k. Roy, and A. Quasem, 1992. Effect of plant population and nitrogen on the yield and yield attributes of okra. *Bangladesh Agro. J.,* **4(1 & 2)**, 7-12.

Satyanarayana, V., P. Prasad, V. Murthy and K. Boote. 2002. Influence of integrated use of farmyard manure and inorganic fertilizers on yield and yield components of irrigated lowland rice. *Indian J. Pl. Nut.*, **25**, 2081-90.

Steel, R. G. D., J. H. Torrie, and D. A. Dichey. 1997. Principles and procedures of statistics: A biometrical approach. 3rd Edition. McGraw Hill co., Inc., New York, USA.