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Effect of different levels of NPK and poultry manure on growth and yield of okra (*Abelmoschus esculentus* L.) Var. Syndicate Spl

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Abstract
The research work was conducted during *kharif* season 2021 at Research Farm of Department Soil Science and Agricultural Chemistry, Naini Agricultural Institute, SHUATS, Prayagraj. To examine the effect of different levels of NPK and Poultry manure on growth and yield of Okra (*Abelmoschus esculentus* L.) Var. Syndicate Spl. There were 9 treatments combinations replicated thrice in 3^2 Factorial Randomized Block design (RBD) with three levels of NPK @ 0,50 and 100% ha^{-1} and three levels of Poultry manure @0,50 and 100% ha^{-1} respectively. The results showed that treatment T_9 [100% NPK + 100% Poultry manure] has greater effects on growth and yield of okra. The observed results were Plant height of okra (88.9 cm), No. of leaves $plant^{-1}$ (34.4), No. of branches $plant^{-1}$ (5.8), No. of fruits $plant^{-1}$ (21.8), Length of fruits $plot^{-1}$ (18.8 cm), and Yield (63.98) t ha^{-1} compared to other treatments. Maximum Gross return (95,970 INR/ha), Net return (25,430 INR/ha) and B: C ratio (1.36) were recorded in treatment with the application of T_9 [100% NPK + 100% Poultry manure] as well. Based on the above results obtained during present research work that that the application of 100% NPK fertilizers along with 100% Poultry manures gives the significant effects on growth and yield of okra.

Keywords: Okra, NPK, poultry manure, organic manures, chemical fertilizers, growth and yield etc.

Introduction
Okra (*Abelmoschus esculentus* L.) is a popular vegetable which is cultivated in the tropical and sub-tropical region of the world. Okra belongs to the Malvaceae family and semi pollinated in nature which plays an important role to the demand of vegetables in the country where they are scanty in the market. India ranks first in the world with 5,784.00 thousand tons (72% of the total world production) of lady finger/okra. It is also cultivated in Nigeria, Sudan, Pakistan, Ghana, Egypt, Benin, Saudi Arabia, Mexico and Cameroon. Okra is mainly cultivated for its pods which are cooked and eaten in African countries like Nigeria, Egypt and Sudan. Most okra is eaten in cooked or processed form. Young fruits may be eaten raw, the oil could be as high as in poultry eggs and soyabean. (Adesida *et al.*, 2019) [1]. Okra is a multipurpose crop due to its various uses of the fresh leaves, bud, flowers, pods, stems, and seeds (Minhretu *et al.* 2014) [16]. Okra seeds are used as a non-caffeinated substitute for coffee and also as a source of seed oil. (Atijegbe *et al.*, 2014) [6]. The nutritional constituents of lady's finger include carbohydrate, protein, phosphorus, calcium, magnesium, iron, vitamin A and C with traces of vitamin B. (Gopalan, 2007) [12]. Ladies finger pod contains 8.20% carbohydrates, 2.10% protein and a significant amount of riboflavin. (Benchasri, 2012) [7]. The mature stem contains crude fibre which is used in paper industries and for making ropes (Ojo *et al.*, 2012) [10]. The mucilage has medical importance as it is used as a plasma replacement or blood volume expander and binds cholesterol and bile acid carrying toxins dumped into it by the liver (Gemede, 2015) [11].

Chemical fertilizers are inorganic fertilizers which are most important to increase growth and yield of Okra. Nitrogen promotes leaf growth and forms proteins and chlorophyll. Phosphorous contributes to root, flower and fruit development. Potassium contributes to stem and root growth and synthesis of proteins. (Khetran *et al.*, 2016) [13]. The application of fertilizer is necessary for enhancing the soil nutrient status and increasing crop yield (Olaniyi *et al.*, 2010) [18]. Okra response very well to fertilizer application and an effective fertilizer use is the key to its higher growth and yield (Kumar, 2019) [15]. Inorganic fertilizers are synthetic, chemical, artificial material added to the soil that supplies one or more required materials for

plants. Use of inorganic fertilizer changes physical, chemical and biological properties of soil as well as reduces the fertility status of soil. Chemical fertilizers are costly too and are not always affordable to poor farmers. The scarcity and high cost of inorganic fertilizer in the world call for concerted efforts by all stakeholders to encourage the production and usage of the organic fertilizer (Adewole and Adeoye, 2008) [2]. Their continuous application has been found to deplete soil organic matter and consequently leading to reduction in crop yield and serious degradation and decline in soil productivity. (Nnah *et al.*, 2016) [17].

Organic manure helps to improve the physical condition of soil and provide adequate amount of necessary nutrients for the soil productivity (Qhureshi, 2007) [20]. Organic fertilizers are environmentally friendly; it promotes population of beneficial microorganisms and generally improves the soil health (Oyewole *et al*., 2012) [19]. Organic fertilizers have been reported to increase crop production similar to inorganic fertilizers (Tonfack, *et al*., 2009) [23] because they contain both micro and macro nutrients in addition to some plant promoting factors and beneficial microorganisms (Sreenivasa *et al*., 2010) [22]. Poultry Manure is relatively resistant to microbial degradation. However, it is essential for establishing and maintaining the optimum soil physical condition for plant growth. It is a good source of N for sustainable crop production, but its availability remains an important issue due to its bulky nature, while inorganic fertilizer is no longer affordable to poor farmers due to its high cost (Rahman *et al.*, 2014) [21]. Poultry manure is a good source of major and minor mineral elements that are capable of enhancing soil fertility. The fertility of soil could be sustained with the addition of poultry manure. Poultry manure contains high percentage of nitrogen and phosphorus for the healthy growth of plants. Poultry manure is widely recognized as soil conditioner for raising soil PH and exchangeable bases levels. Therefore, a combination of organic materials and mineral fertilizers is important for management of these soils for high yield and quality harvest of okra (Akande *et al*., 2010) [4]. Therefore, this study was carried out the effect of different levels of NPK fertilizers and Poultry manure on Growth and Yield of Okra.

Materials and Methods

Study sites

The field experiment was conducted at Research Farm Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, SHUATS, Prayagraj during the year of 2021 in kharif Season. (25.57^0 N, 81.59^0 E and altitude 98 meters above sea level). The average rainfall in this area is around 1013.4 mm annually and externs in temperature of location reaches up to 46^0-48^0 c and seldom falls as low as 3^0-4^0c.The soil of experimental field was sandy loam in texture with Sand 60.60%, Slit 20.30%, Clay 19.10%, pH 7.5, EC 0.28, Organic Carbon 0.21% and Soil containing Available Nitrogen 242.25 kg ha^{-1}, Phosphorous 19.40 kg ha^{-1} and Potassium 169.23 kg ha^{-1} of pre- harvest soil. There were 9 treatments and 3 replications. The experiment was laid out in randomized block design. Okra variety Syndicate spl was sown. The plot size was 2.0 m×2.0 m. Seed of okra variety Syndicate spl were dibbled on ridges at the distance of 15.0 cm plant to plant while row to row distance was 40.0 cm. Proper thinning was done after 15 Days of sowing and healthy plants were maintained for proper development of roots. The doses of inorganic and organic fertilizers were fixed by standard practices. The treatment included T_1 [control]; T_2[@ 0% NPK + @50% Poultry Manure]; T_3 [@ 0% NPK + @100% Poultry Manure]; T_4 [@50% NPK + @0% Poultry Manure]; T_5[@ 50% NPK + @50% Poultry Manure]; T_6 [@50% NPK + @100% Poultry Manure]; T_7[@ 100% NPK + @0% Poultry Manure]; T_8 [@100% NPK + @50% Poultry Manure]; T_9[@ 100%NPK+@100%Poultry Manure]. The field was ploughed by one disc harrow and cultivar cultivator operations before the sowing of crop. Crop were managed according to the recommended agronomic practices including irrigation water management.

Result and Discussion

From the experiment it was observed that Plant height, Number of leaves $plant^{-1}$, Number of branches $plant^{-1}$, Number of fruits $plant^{-1}$, Length of fruits $plant^{-1}$ and Yield differed significantly due to various treatments The results shows that the combine application of NPK fertilizer and Poultry manure has the highest mean of Plant height (88.9 cm), While the control (no application) has a plant height of (61.4 cm).The results indicates that the application of a combination of NPK fertilizer and Poultry manure shows that highest mean number of leaves (34.4), and 24.7 leaves for the control. The application of a combination of NPK fertilizer and Poultry manure gave the highest mean number of branches (5.8), and (3.1) branches for the control. These results corroborate with the findings of (Antoinette *et al.*, 2013) [5] that the combine application of NPK fertilizer and Poultry manure, results in an increases of plant height, number of leaves per plant and number of fruits per plant of okra. Similar studies revealed that combined treatments with NPK fertilizer and Poultry manure produces the highest levels of growth characteristics of some crops as compared to the sole applications of either of the two inputs (Busari *et al.*, 2008) [8]. Such results might be attributed to the complementary effect of the combine application of organic and inorganic fertilizers. (Ajari *et al*., 2003) [3] opined that organic manure, especially Poultry manure could increase plant height of crops when compared with other sources of manures. Significant differences were declared with respect to number of fruits $plant^{-1}$. The combine application of NPK fertilizer and Poultry manure gave the highest number of fruits $plant^{-1}$ (21.8) and the control has the least (16.2). The length of the fruit revealed that significant differences between the treatments exists. Although, combine application of NPK fertilizer and Poultry manure gave (18.8 cm), and control gave (15.7 cm) respectively. The highest yield of (63.98 tons) ha^{-1} was obtained as a result of the combine application of NPK fertilizer and Poultry manure and the control respectively produces (20.24 tons) ha^{-1} respectively. The increase yield of okra due to NPK fertilizer and Poultry manure application corroborates with the findings of (Firoz, 2009) [9]. The combination of organic and inorganic fertilizers does not only improve the physical status of the soil, but also improves crop yield. The combined application rates of 100:60:50 kg ha^{-1} NPK and 3 tons ha^{-1} Poultry manure gave the best okra performance compared to other treatments (Olaniyi *et al.*, 2010) [18].

Table 1: Growth attributes of Okra influenced by NPK and Poultry manure

Treatments	Plant Height (cm)	Number of leaves	Number of Branches
Control	61.4	24.7	3.1
0 kg ha^{-1} NPK + 1.5 t ha^{-1} P.M	64.8	25.8	3.4
0 kg ha^{-1} NPK + 3.0 t ha^{-1} P.M	72.3	27.3	4.2
50:30:25 kg ha^{-1} NPK + 0 t ha^{-1} P.M	73.9	28.9	3.2
50:30:25 kg ha^{-1} NPK+ 1.5 t ha^{-1} P.M	74.7	30.9	3.9
50:30:25 kg ha^{-1} NPK+ 3.0 t ha^{-1} P.M	76.1	31.8	4.8
100:60:50 kg ha^{-1} NPK+ 0 t ha^{-1} P.M	81.5	32.9	4.9
100:60:50 kg ha^{-1} NPK + 1.5 t ha^{-1} P.M	83.6	33.5	5.5
100:60:50 kg ha^{-1} NPK + 3.0 t ha^{-1} P.M	88.9	34.4	5.8
S.Em. (±)	4.95	3.3	0.12
C.D. @ 5%	1.65	1.31	0.03

Table 2: Yield attributes of Okra influenced by NPK and Poultry manure

Treatments	Number of fruits	Length of fruits (cm)	Fruit Yield (t/ha)
Control	16.2	15.7	20.24
0 kg ha^{-1} NPK + 1.5 t ha^{-1} P.M	16.6	15.8	33.58
0 kg ha^{-1} NPK + 3.0 t ha^{-1} P.M	16.9	16.5	47.46
50:30:25 kg ha^{-1} NPK + 0 t ha^{-1} P.M	16.9	17.9	23.82
50:30:25 kg ha^{-1} NPK+ 1.5 t ha^{-1} P.M	18.7	16.2	38.55
50:30:25 kg ha^{-1} NPK+ 3.0 t ha^{-1} P.M	19.5	17.7	49.74
100:60:50 kg ha^{-1} NPK+ 0 t ha^{-1} P.M	18.7	16.7	30.17
100:60:50 kg ha^{-1} NPK + 1.5 t ha^{-1} P.M	20.3	17.7	46.29
100:60:50 kg ha^{-1} NPK + 3.0 t ha^{-1} P.M	21.8	18.8	63.98
S.Em. (±)	0.33	0.87	1.31
C.D. @ 5%	1.01	2.63	2.74

Table 3: Economics of different treatment combinations of okra

Treatments	Total cost of cultivation	Gross return (Rs ha^{-1})	Net return	Benefit cost ratio
Control	26,810.00	30,360	3,550.00	1.13
0 kg ha^{-1} NPK + 1.5 t ha^{-1} P.M	44,180.00	50,370	6,190.00	1.14
0 kg ha^{-1} NPK + 3.0 t ha^{-1} P.M	62,180.00	71,190	9,010.00	1.14
50:30:25 kg ha^{-1} NPK + 0 t ha^{-1} P.M	30,045.00	35,730	5,685.00	1.19
50:30:25 kg ha^{-1} NPK+ 1.5 t ha^{-1} P.M	48,045.00	57,825	9,780.00	1.20
50:30:25 kg ha^{-1} NPK+ 3.0 t ha^{-1} P.M	66,045.00	74,610	8,565.00	1.13
100:60:50 kg ha^{-1} NPK+ 0 t ha^{-1} P.M	34,540.00	45,255	10,715.00	1.31
100:60:50 kg ha^{-1} NPK + 1.5 t ha^{-1} P.M	52,540.00	69,435	16,895.00	1.32
100:60:50 kg ha^{-1} NPK + 3.0 t ha^{-1} P.M	70,540.00	95,970	25,430.00	1.36

Conclusion

On the basis of above findings, it may be concluded that the treatment combinations of T_9 (100% NPK + 100% Poultry Manure) shows best results with respect to in comparison to other treatment combinations. It gives highest profit of 25,430.00 ha^{-1} with highest benefit cost ratio is 1.36. Application of NPK and poultry manure alone or in combination enhanced growth and yield of Okra.

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