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Effect of nitrogen and phosphorus levels on growth and yield of *Rabi* baby corn (*Zea mays* L.)

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Abstract
Field experimentation was conducted during *Rabi*, 2020 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.). The soil of experimental plot was sandy loam in texture, Basic in soil reaction (pH 7.4), low in organic carbon (0.49%), available N (219 kg/ha), available P (21.3 kg/ha), available K (235.8 kg/ha). The treatments which are Nitrogen at 80, 100, 120 kg/ha along with it Phosphorus at 40, 50, 60 kg/ha were used. The research was laid out in Randomized Block Design with nine treatments each replicated three times. In the study maximum plant height (173.57 cm), plant dry weight (17.81 g/plant), Cob yield (19.52 t/ha), Green fodder yield (22.08 t/ha), Cost of cultivation (49008.91 Rs./ha), Gross returns (205383.87 Rs./ha), Net returns (156374.96 Rs./ha) and B:C ratio (3.19) was obtained with by application of Nitrogen at 100 kg/ha + Phosphorus at 60 kg/ha.

Keywords: Baby corn, nitrogen, phosphorus, growth, yield and economics

Introduction
Maize (*Zea mays* L.) is the third most widely produced and consumed cereal crop next to rice, and wheat is one of the most versatile emerging crop having wider adaptability under varied agro-climatic conditions. Globally, maize is known as "queen of cereals" and "miracle crop" because it has the highest genetic yield potential among the cereals. The crop is cultivated over 139 million ha of area and around 600 million tons of maize is produced. The United States of America (USA) is the largest producer of maize contributing nearly 35% of the total production in the world, where in India maize has grown in 9.22 million hectares area with a production and productivity of 28.72 million tones and 3,115 kg/ha respectively contributing 2.53% share over worlds production (Directorate of Economics and Statistics 2018) [1] and contributes nearly 9% in the national food basket.

With the rise in standards of living and advancement in science and technology, there is a change in the traditional usage of maize as vegetable and increase in the consumption of green ears as food especially in cities and towns, for that "Baby corn'' is a profitable crop that allows diversification of production, aggregation of value and increased income (Pandey *et al.* 2002) [8]. As the name implies is not genetically dwarf maize but it is the immature ear of normally grown maize harvested within 2-3 days of silking or we can say the shank with unpollinated silk is baby corn. Baby corn is a highly nutritious low caloric vegetable which is rich in fiber content. One Baby corn can be compared with an 'egg' in terms of minerals. it is rich in phosphorus content, 86 mg 100 g per corn edible portion in comparison to 21-57 mg 100g per corn phosphorus content in other common vegetables (Kumar *et al.*, 2006) [4].

Farmers can grow four crops in a year, and the production of baby corn generates employment amongst the rural poor's, from children to the elderly persons. Other sectors of society who are also benefited from the crop are the regional brokers who buy from farmers, canneries, wholesale merchants (for the local market), retail merchants and exporters. It's by products, such as tassels, young husk silk and green stalk provide good cattle food. It may be consumed as raw or used as ingredient in various preparations *viz*. chop- suey (Chinese dish), pickles, corn pakoras, etc. fresh baby corn ears are used as decorative and crispy vegetable and salad. Baby corn is free from insect-pests and diseases and its nutritional value is comparable with other several high-priced vegetables (Pandey *et al*., 2002) [8].

Nitrogen is indispensable for increasing crop production as a constituent of protoplasm and chlorophyll and is associated with the activity of every living cells. It is considered as a primary plant nutrient that plays a major role in achieving the maximum economic yields from production. Nitrogen plays an important role in plant growth and development, photosynthesis, cell multiplication and differentiation. It aids in formation of chlorophyll pigment thereby enhancing the photosynthesis contributing significant role in growth and reproductive phases of crop. The biochemical process in plants is mainly influenced by nitrogen status leading to alteration in physiological process. Higher quantities of nitrogen during the period of efficient utilization, leads to higher productivity. Nitrogen boosts photosynthetic process that aids in translocation of produced assimilates into the different sink parts in Baby corn such. (Singh and Nepalia 2009)

Phosphorus is second essential nutrient required to higher yield of maize. Among nutrient elements, phosphorus plays a vital role besides nitrogen in plant nutrient that influences vigor of plant, root growth and improves the quality of baby corn yield. Phosphorus is an essential factor for cell division because it is a constituent element of nucleoproteins which are involved in the cell reproduction processes. it is important for seed and fruit formation and crop maturation. Phosphorus mainly plays key role in root development which are necessary for the plant to get nutrients from the soil. The roots are also necessary for the support of the plant. When the roots are well developed, they are able to penetrate the ground and gather all the nutrients required by the plant for development.it helps to strengthen the skeletal structure of the plant there by preventing lodging (Rangothama, 1999) [9]. Plants that have access to enough phosphorous have the ability to resist diseases because all their parts are well developed and grow quickly. Plants grown using hydroponics are supplied with enough phosphorous to ensure they grow well consequently, lack of phosphorus is as important as the lack of nitrogen limiting maize performance (Gul *et al*., 2015) [3].

Keeping the above points in view the present investigation entitled "Effect of Nitrogen and Phosphorus Levels on Growth and Yield of *Rabi* Baby corn (*Zea Mays* L.)" was conducted.

Materials and Methods

The experiment was carried out during *Rabi* season of 2020 at the CRF(Crop Research Farm), Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. The CRF is situated at 25º24‘41.27” N latitude, 81°50‘56” E longitude (Google, 2018) and 98 m altitude above the mean sea level (MSL). This area is situated on the right side of the Yamuna River by the side of Prayagraj - Rewa road about 12 km from the city. The experiment was laid out in Randomized Block Design (RBD) consisting of 9 treatments each replicated thrice. Treatments were randomly arranged in each replication, divided into 27 plots. The soil of the experimental field constituting a part of central Gangetic alluvium is neutral and deep. Pre- sowing soil sample were taken from 5 different places with a depth of 15cm with the help of an auger. The composite samples were used for the chemical and mechanical analysis. The soil was sandy loam in texture, low in organic carbon with (0.49) and medium in available nitrogen (219 kg), Phosphorus (21.3 kg) and low in potassium (235.8 kg), the climate of the region is semi-arid subtropical. Treatment combination of T_1-80 kg/ha Nitrogen + 40 kg/ha phosphorus, T_2-80 kg/ha Nitrogen + 50 kg/ha phosphorus, T_3-80 kg/ha Nitrogen + 60 kg/ha phosphorus, T_4-100 kg/ha Nitrogen + 40 kg/ha phosphorus, T_5-100 kg/ha Nitrogen + 50 kg/ha phosphorus, T_6-100 kg/ha Nitrogen + 60 kg/ha phosphorus, T_7-120 kg/ha Nitrogen + 40 kg/ha phosphorus, T_8-120 kg/ha Nitrogen + 50 kg/ha phosphorus and T_9-120 kg/ha Nitrogen + 60 kg/ha phosphorus were used. The nine treatments were replicated thrice in Randomized Block Design. Data regarding growth parameters *viz*., plant height (cm), No. of dry weight (g), yield and economic were recorded with standard process of observation. The data was statically analysed using analysis of variance (ANOVA) as applicable in Randomized Block Design (RBD) by Gomez and Gomez, 2010 [2].

Result and Discussion

Effect on growth parameters

It is observed from Table 1. The plant height increased with crop growth duration. (At harvest of 167.57 cm.) At harvest T_3 – with Nitrogen at 80 kg/ha+ Phosphorus at 60 kg/ha, T_5- Nitrogen at 100 kg/ha+ Phosphorus at 40 kg/ha, T_8- Nitrogen at 120 kg/ha+ Phosphorus at 50 kg/ha with and T_9 - Nitrogen at 120 kg/ha+ Phosphorus at 60 kg/ha was found statistically at par to T_6 - Nitrogen at 100 kg/ha+ Phosphorus at 60 kg/ha. Abundant nitrogen supply and its availability through source helped the baby corn plants to attain the more vigour in terms of plant height. Higher nitrogen levels significantly increased the plant height because of enough availability of nitrogen at growing stages maximum plant height was observed with 100kg/ha Nitrogen + 60 kg/ha phosphorus this might have been possible due to better photosynthetic activity with better availability of light and abundant supply of nitrogen. The higher plant height under higher nitrogen and phosphorous levels may be due to increase in cell division, assimilation rate and metabolic activities in plant. Similar, results were reported by Thakur *et al*. (2009) and Bindhani *et al*. (2007). Kumar *et al.* (2005) and Saha and Mondal (2006) reported almost similar result. Data regarding number of plant dry weight was recorded at all growth intervals and at harvest (Table.1) in which treatment T_6- Nitrogen at 100 kg/ha+ Phosphorus at 60 kg/ha recorded maximum of plant dry weight (17.81 g), recorded. However, T_3 - Nitrogen at 80 kg/ha+ Phosphorus at 60 kg/ha, T_5- Nitrogen at 100 kg/ha+ Phosphorus at 50 kg/ha and T_7 - Nitrogen at 120 kg/ha+ Phosphorus at 40 kg/ha were found statistically at par to T_6 - Nitrogen at 100 kg/ha+ Phosphorus at 60 kg/ha at harvest. Among the various treatments 100 kg/ha Nitrogen + 60 kg/ha phosphorus was more effective in producing higher dry weight of plant in which might be due to increased availability of nutrients to plants providing more vigour to the plant in becoming the healthier which intern resulted in higher dry weight of plant. The results reported by Saha and Mondal (2006) and Massay (2005) [6] in their experiments are in close conformity with these findings.

Yield

Data related to cob yield and green fodder yield were evaluated and tabulated in Table 1. in which treatment T_6- Nitrogen at 100 kg/ha+ Phosphorus at 60 kg/ha recorded maximum Cob yield (19.52 t/ha) and Green fodder yield (22.08 t/ha). However, T_2 - Nitrogen at 80 kg/ha+ Phosphorus at 50 kg/ha, T_4- Nitrogen and 100 kg/ha+ Phosphorus at 40 kg/ha, T_5- Nitrogen at 100 kg/ha+ Phosphorus at 50 kg/ha, and T_9- Nitrogen at 120 kg/ha+ Phosphorus at 60 kg/ha in both parameters cob yield (19.52 t/ha) and green fodder yield (22.08 t/ha) were found statistically at par with T_6- Nitrogen at 100 kg/ha+ Phosphorus at 60 kg/ha at harvest. Among the various treatments 100kg/ha Nitrogen + 60 kg/ha phosphorus was more effective in respective yield attributes, The higher nitrogen and phosphorous levels increased nutrients availability to plants, which resulted into higher values of yield attributes like green fodder yield and yield under higher levels of NPK. The results corroborated with those reported by Rao *et al*. (2009) [10], Kunjir *et al*. (2009) [5], Muthukumar *et al*. (2005) [7] and Sobhana *et al*. (2012).

Economics

From Table 1. Nitrogen and Phosphorus sources increased economic stability and returns, the cost of cultivation of baby corn crop recorded numerically higher (₹205383.87/ha) value for the treatment of application Nitrogen at 100 kg/ha+ Phosphorus at 60 kg/ha and numerically average cost of cultivation was recorded with application of Nitrogen at 100 kg/ha+ Phosphorus at 60 kg/ha (₹49008.91/ha). Numerically highest gross return (₹205383.87/ha), net return (₹ 156374.96/ha) and B:C ratio (3.19) were obtained with application of Nitrogen at 100 kg/ha+ Phosphorus at 60 kg/ha among all the treatments.

Table 1: Effect of Nitrogen and Phosphorus levels on Growth, Yield and Economics of Baby corn

Treatments	Plant height (cm/plant)	Plant dry weight (g)	Cob yield (t/ha)	Green fodder yield (t/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
1. 80 kg/ha N + 40kg/ha P	170.31	14.96	15.10	18.66	46699.13	178901.10	132201.97	2.83
2. 80 kg/ha N + 50kg/ha P	172.83	15.29	15.18	20.66	47636.63	169327.20	121690.57	2.55
3. 80 kg/ha N + 60kg/ha P	171.68	17.51	16.22	21.29	48574.13	194320.00	145745.87	3.00
4. 100 kg/ha N + 40kg/ha P	173.30	15.03	18.52	21.74	47133.91	177716.70	130582.79	2.77
5. 100 kg/ha N + 50kg/ha P	172.21	14.40	18.11	21.32	48071.41	200815.63	152744.22	3.17
6. 100 kg/ha N + 60kg/ha P	175.37	17.81	19.52	22.08	49008.91	205383.87	156374.96	3.19
7. 120 kg/ha N + 40kg/ha P	172.41	15.27	17.65	20.20	47568.69	170215.50	122646.81	2.57
8. 120 kg/ha N + 50kg/ha P	171.78	15.05	17.77	20.71	48506.19	168833.70	120327.51	2.48
9. 120 kg/ha N + 60kg/ha P	172.99	15.32	18.09	21.26	49443.69	163698.47	114254.78	2.31
F test	S	S	S	S				
S.Em(+)	0.80	0.17	0.54	0.58				
CD (5%)	2.39	0.52	1.63	1.73				

Conclusion

It is concluded from the study that Maximum Cob yield (19.52 t/ha), net returns (Rs 156374.96/ha) and B:C ratio (3.19) were obtained with application of Nitrogen at 100 kg/ha+ Phosphorus at 60 kg/ha which was significantly superior over rest of the treatments.

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