Biological Forum – An International Journal **13(4): 60-65(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Varying Nitrogen and Phosphorus Levels on Growth and Yield of Maize (*Zea mays* L.) Cv. K-64

Tarun Kumar[1], Narendra Swaroop[2] Tarence Thomas[3], Akshita Barthwal[1*], Raghu Nandan Singh Khatana[1] and Dalavi Vishal Monahar[1]

[1]Ph.D. Scholar, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj-211007, (Uttar Pradesh), India.
[2]Associate Professor, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj-211007, (Uttar Pradesh), India.
[3]Professor, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj-211007, (Uttar Pradesh), India.

(Corresponding author: Akshita Barthwal)*
(Received 07 August 2021, Accepted 05 October, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: During the Kharif season of 2018, a field study was conducted at the Soil Science & Agricultural Chemistry Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The soil in the trial region is classified as *Inceptisol*, the result showed that in treatment T_8 (120 kg N ha^{-1} and 60 kg P ha^{-1}), maximum plant height 180.66 (cm), number of leaves 12.43, stem diameter 2.81(cm), cob length 14.56 (cm), weight of 100 seed 28.33 (g), grain yield 45.67 (q ha^{-1}) and highest net profit of ₹53504.50 with cost benefit ratio is 1: 2.19 however, the minimum net profit of ₹1000.00 with cost benefit ratio is 1:1.02 in treatment T_0 (control).

Keywords: Maize, Plant height, Number of leaves, Cob length and Grain yield.

INTRODUCTION

Maize is an important cereal crop that ranks third in the world behind wheat and rice. Maize is widely grown in many countries across the world (Onasanya *et al*., 2009). Maize, botanically known as (*Zea mays* L), is a member of the Gramineae family. Maize is one of the world's most important crops, farmed across an area of 139 million hectares and producing over 600 million tonnes of grain. The United States has the biggest land area, followed by Brazil, China, Mexico, and India. It is grown in practically all Indian states, covering an area of 6.3 million hectares and producing 11.3 million tonnes and 1.9 million tonnes per hectare, respectively (Kumar *et al*., 2007). Maize grain comprises roughly 70% carbohydrate, 10% protein, 4% oil, 2.3 percent crude fibre, 10.4% albuminoids, and 1.4 percent ash (Choudhary *et al*., 1993). It is also higher in phosphorus than rice and sorghum and higher in vitamin A, vitamin E, nicotinic acid, and riboflavin. Its fodder and hay contain 7-10% protein, 15-36% fibre, 2.09-2.62 percent ether extract, 0.42-0.70 percent calcium, 0.28-0.29% phosphorus, 0.45 percent magnesium, 1.34 percent potassium, and 56% carbohydrate, making it exceptionally nutritious fodder and hay. Aside from food grain, fodder, and feed, it is critical in the textile, starch, and large industries (Rai, 2006). Maize, commonly known as the "Queen of Cereals," is a type of fodder maize that has traditionally been considered a poor man's crop but is now assuming a position in wealthy societies due to its diverse uses as both food and feed crop (Suke *et al*., 2011). The higher yield potentiality of maize cannot be manifested up to the brim due to several biotic and a biotic factor among which poor nutritional management is the prime one. Being an exhaustive crop especially the improved and hybrids, respond positive significance to applied nutrients. Application of nitrogen up to 120 kg ha^{-1} was found to be most beneficial for grain and total biomass production of maize as well as the monetary returns (Maurya *et al*., 2004). Greater plant to plant variability in modern maize production systems is frequently caused by increased competition among individual plants at ever larger plant densities for restricted resources like as N, incident photo synthetically active radiation (IPAR), and soil moisture. Previous research has frequently emphasised the importance of stand uniformity for high productivity levels, and that increased plant to plant variability (determined and expressed using a variety of maize growth and developmental parameters) reduces per unit area maize grain yields (GYA) due to decreased stress tolerance. As a result, at greater plant densities, resource availability must be sufficient to aid in the maintenance of consistent growth, development, and grain output of nearby plants under a maize canopy (Rao *et al*., 2014). The notion of balanced fertilisation provides the path for optimal plant nutrient supply in order to fulfil the crop's full yield potential. Continuous application of unbalanced fertiliser, on the other hand, causes a drop in soil fertility and a reduction in production. With these considerations in mind, the current study was undertaken to explore the effect of balanced fertilisation on maize yield and soil fertility (Paramasivan *et al*., 2012). Fertilizer plays a vital role in improving maize production and has a significant economic impact. A well-balanced and optimal use of nitrogen, phosphorous, potassium, and sulphur fertiliser, as well as sulphur fertiliser, is critical to enhancing cereal yields.

MATERIALS AND METHODS

The current study consists of a field experiment conducted at the Soil Science & Agricultural Chemistry Research Farm, Sam Higginbottom University of Agriculture Technology and Sciences Prayagraj during the Kharif season 2018, which is located at 25°24′30″N latitude, 81°51′10″E longitude. This chapter describes the experimental site, soil, and climate in depth, as well as the experimental design, layout plan, cultural practise, and procedures used for the parameters. Prayagraj district is located in the subtropical zone of South East Uttar Pradesh, which has extremely hot summers and mild winters. The highest temperature in the area can reach 46°C-48°C and rarely falls below 4°C – 5°C. The relative humidity ranged from 20% to 94%. The average yearly rainfall in this area is roughly 1100 mm. It has a subtropical climate and receives about 1100 mm of rain per year on average, with the most of the rain falling between July and the end of September. However, precipitation was not uncommon during the winter. The winter months were extremely frigid, while the summer months were extremely hot and dry. During the crop season, the minimum temperature is expected to be 27.1°C and the maximum temperature is expected to be 39.94°C. The minimum humidity was 57.70% and the maximum humidity was 75.37%.

The experiment will be set up in randomised block design with three levels of Nitrogen and Phosphorus, with plot sizes of 2 × 2 m^2 for crop seed rate of 18-20 kg ha^{-1} (*Zea mays* L.) Cv. K-64. Maize was sown on July 12^{th}, 2018, with Urea and SSP as nitrogen and phosphorus sources, respectively. A base dose of fertiliser was administered in each plot based on treatment allocation, with uniform furrows expanded by roughly 5 cm. To raise the crop, all agronomic practises were carried out evenly. In November of 2018, the crop was harvested.

Table 1: The treatments consisted of nine combinations of N and P source of fertilizer.

	Treatment	Rate of fertilizers application	Symbol
T_0	**Control**	**No fertilizer doses**	**(L_0F_0)**
T_1	0 % N + 50 % P	N@0 kg ha^{-1} + P@30 kg ha^{-1}	**(L0F_1)**
T_2	0 % N + 100 % P	N@0 kg ha^{-1} + P@60 kg ha^{-1}	**(L_0F_2)**
T_3	50 % N + 0 % P	N@60 kg ha^{-1} + P@0 kg ha^{-1}	**(L_1 F_0)**
T_4	50 % N + 50 % P	N@60 kg ha^{-1} + P@30 kg ha^{-1}	**(L_1F_1)**
T_5	50 % N + 100 % P	N@60 kg ha^{-1} + P@60 kg ha^{-1}	**(L_1F_2)**
T_6	100% N + 0% P	N@120 kg ha^{-1} + P@0 kg ha^{-1}	**(L_2F_0)**
T_7	100% N + 50% P	N@120 kg ha^{-1} + P@30 kg ha^{-1}	**(L_2F_1)**
T_8	100% N + 100% P	N@120 kg ha^{-1} + P@60 kg ha^{-1}	**(L_2F_2)**

RESULTS AND DISCUSSION

Plant height (cm): The data clearly indicates the response of maize plant height recorded at 30 DAS, 60 DAS, 90 DAS, and 120 DAS as influenced by varying N and P levels. The plant height of maize was shown to grow dramatically as N and P levels rose. The maximum plant height in T_8 (120 kg N ha^{-1} and 60 kg P ha^{-1}) was 39.26 cm, 83.96 cm, 160.33 cm, and 180.66 cm at 30 DAS, 60 DAS, 90 DAS, and 120 DAS, respectively, whereas the minimum plant height in T_0 (control) was 26.67 cm, 48.86 cm, 103.67 cm, and 120.06 cm at 30 DAS, 60 DAS, 90 DAS, and 120 DAS. Increased plant height owing to increased N and P fertilisers may be due to appropriate nutrient availability, which in turn helps in robust vegetative growth of plants and subsequently increases the plant through cell elongation, cell division, photosynthesis, and turbidity of plant cell. Khan *et al*., (2014); Reddy *et al*., (2018)

Number of leaves: As depicted in the maximum number of leaves of maize at different days after sowing (DAS) at 30, 60, 90 and 120 were found in treatment T_8 (120 kg N ha^{-1} and 60 kg P ha^{-1}) was 6.53, 9.2, 11.93 and 12.43 respectively. While the minimum values of the result were found in treatment T_0 (control) 4.4, 5.6, 8.56 and 9.23 respectively.

The influence of varied quantities of N and P fertilisers on the number of maize leaves was also found to be substantial. It is generally too favourable to root and shoot growth of plants, enhancing cell permeability and providing plant nutrients and micronutrients. Nitrogen promotes vegetative growth by cell elongation, as opposed to cell division and expansion. It is an important component of proteins and is found in a variety of other chemicals with significant physiological impact in plant metabolism. Phosphorus is essential for energy storage and transfer. It improves the quality of various fruit, pasture, vegetative, and grain crops while also increasing crop disease resistance. Asghar *et al*., (2010); Reddy *et al*., (2018)

Stem diameter (cm): Perusal of the maximum stem diameter of maize at different days after sowing (DAS) at 30, 60, 90 and 120 were found in treatment T_8 (120 kg N ha^{-1} and 60 kg P ha^{-1}) which was 1.45 cm, 2.24 cm, 2.46 cm and 2.81 cm while the minimum values of the result were found in treatment T_0 (control) which were 1.04 cm, 1.47 cm, 1.6cm and 1.74 cm respectively. Fertilizer applications of N and P greatly boost plant height, stem girth, leaf number, and yield Law-Ogbomo, (2009).

Cob length (cm): The result of data depicted the maximum cob length of maize at were found in treatment T_8 (120 kg N ha^{-1} and 60 kg P ha^{-1}) which was 14.56 cm while the minimum values of the result were found in treatment T_0 (control) which was 8.91 cm respectively. Cob length, cob diameter, 100 grain weight, and grain yield all rose significantly (P =.05) with N and P fertiliser applications, with 90 kg N ha^{-1} and 30 kg P ha^{-1} providing the maximum value. As a result, more research is needed to determine the veracity of this rate of maximum output. Olusegun (2014); Djaman and Irmak (2018).

Weight of 100 seed (g): The result of data depicted the maximum weight of 100 seed of maize at were found in treatment T_8 (120 kg N ha^{-1} and 60 kg P ha^{-1}) which was 28.33 g while the minimum values of the result were found in treatment T_0 (control) which was 19.43 g respectively. The statistical analysis of weight of 100 seeds data indicates that there was a significant difference in weight of 100 seed (g) interaction between nitrogen and phosphorus. Same result also found by Ali (2010).

Grain yield (q ha^{-1}): The result of data the maximum grain yield of maize at were found in treatment T_8 (120 kg N ha^{-1} and 60 kg P ha^{-1}) which was 45.67q ha^{-1} while the minimum values of the result were found in treatment T_0 (control) which was 17.42q ha^{-1} respectively. Grain yield interaction between nitrogen and phosphorus was found to be statistically significant, according to grain yield data analysis. Mahesh (2010) discovered the same result.

Selling price of Maize (Seed yield) = 2150₹/ q

According to following table: - The economy of different treatment concerned, the treatment T_8 (L_2R_2) provides highest net profit of ₹53504.50 with cost benefit ratio is 1: 2.19 however, the minimum net profit of ₹1000.00 was recorded in the treatment T_0 (L_0R_0) with cost benefit ratio is 1:1.02.

Table 2: The effect of varying N and P levels on maize plant height (cm) at different day intervals.

Treatments	30 DAS	60 DAS	90 DAS	120 DAS
T_0	26.67	48.86	103.67	120.06
T_1	27.76	53.33	113.33	126.66
T_2	28.17	55.2	118.16	130.00
T_3	29.67	61.00	125.23	145.67
T_4	31.53	64.23	134.26	157.33
T_5	33.13	66.13	138.67	163.34
T_6	35.16	72.26	149.93	170.34
T_7	37.66	79.4	155.66	173.33
T_8	39.26	83.96	160.33	180.66
F- test	**NS**	**S**	**S**	**S**
S. Em ±	4.079	7.248	7.580	11.272
C.D. (P= 0.05)	11.966	21.261	22.233	33.064

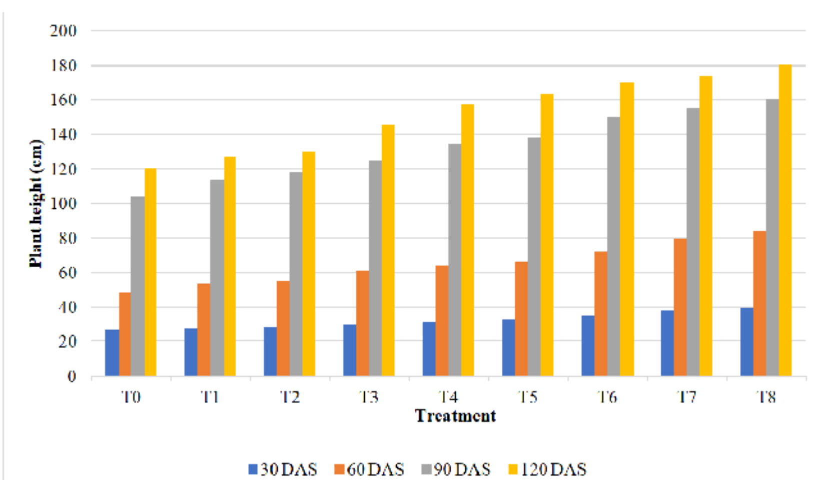

Fig. 1. The effect of varying N and P levels on maize plant height (cm) at different day intervals.

Table 3: The effect of varying levels of N and P on the number of leaves per maize plant at different time intervals.

Treatments	30 DAS	60 DAS	90 DAS	120 DAS
T_0	4.4	5.6	8.56	9.23
T_1	4.76	5.76	8.6	9.6
T_2	4.8	6.26	8.33	9.8
T_3	5.16	6.3	8.66	10.2
T_4	5.23	6.63	8.7	11.13
T_5	5.73	7.1	9.03	11.3
T_6	6.13	8.23	9.67	10.46
T_7	6.3	8.7	11.06	12.03
T_8	6.53	9.2	11.93	12.43
F- test	**NS**	**S**	**S**	**S**
S. Em ±	0.495	0.337	0.444	0.420
C.D. (P= 0.05)	1.453	0.989	1.304	1.233

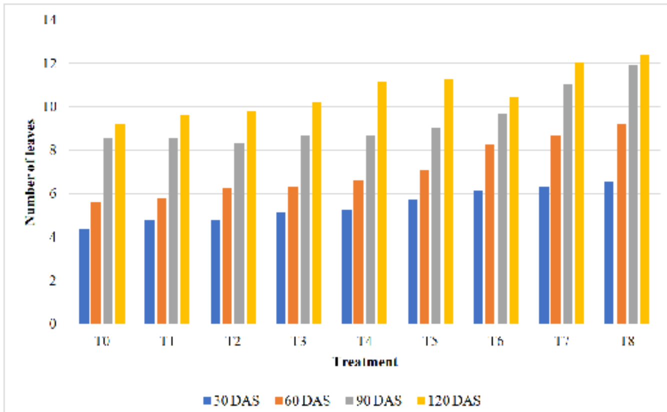

Fig. 2. The effect of varying levels of N and P on the number of leaves per maize plant at different time intervals.

Table 4: The effect of varying levels of N and P on maize stem diameter (cm) at different time intervals.

Treatments	30 DAS	60 DAS	90 DAS	120 DAS
T_0	1.04	1.47	1.6	1.74
T_1	1.1	1.58	1.76	1.8
T_2	1.12	1.64	1.82	2.01
T_3	1.18	1.76	1.86	2.21
T_4	1.22	1.82	1.95	2.33
T_5	1.24	1.92	1.98	2.45
T_6	1.35	2.01	2.21	2.57
T_7	1.39	2.16	2.37	2.7
T_8	1.45	2.24	2.46	2.81
F- test	**NS**	**S**	**S**	**S**
S. Em ±	0.120	0.078	0.067	0.062
C.D. (P= 0.05)	0.352	0.230	0.199	0.183

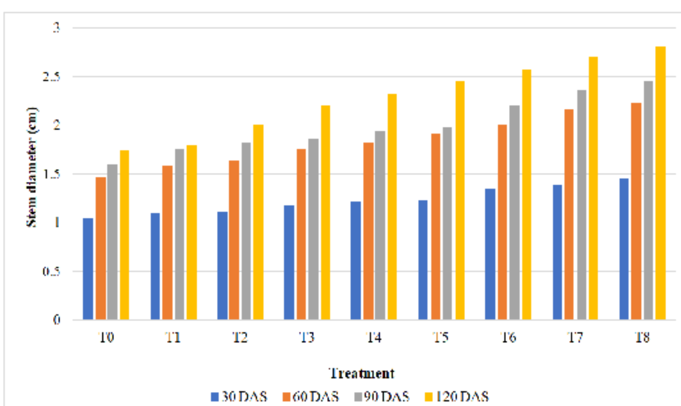

Fig. 3. The effect of varying levels of N and P on maize stem diameter (cm) at different time intervals.

Table 5: The effect of varying N and P levels on maize cob length (cm), weight of 100 seed (g), and grain yield (q ha^{-1}).

Treatments	Cob length (cm)	weight of 100 seed (g)	Grain yield (q ha^{-1})
T_0	8.91	19.43	17.42
T_1	9.53	20.4	19.31
T_2	10.16	21.63	22.18
T_3	11.76	23.13	25.22
T_4	12.26	23.96	28.67
T_5	12.63	24.73	34.86
T_6	13.06	25.16	39.20
T_7	13.67	26.83	42.87
T_8	14.56	28.33	45.67
F- test	**S**	**S**	**S**
S. Em±	0.458	0.654	1.297
C.D. (P= 0.05)	1.344	1.918	3.806

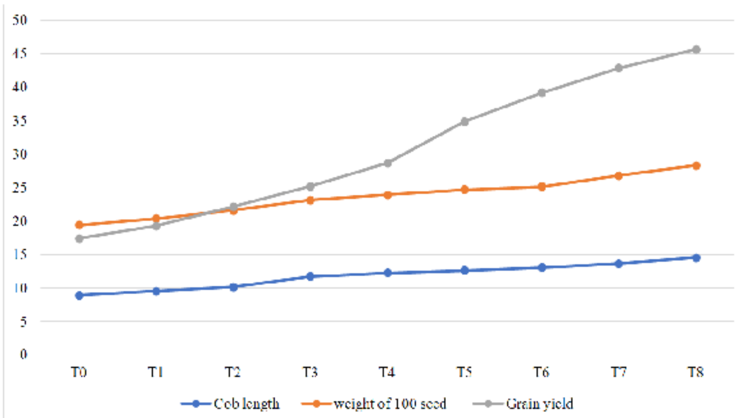

Fig. 4. The effect of varying N and P levels on maize cob length (cm), weight of 100 seed (g), and grain yield (q ha^{-1}).

Table 6: Effect of different cost benefit ratio (C: B) of different treatment combination with maize crop.

Treatment	Yield (q ha^{-1})	Selling rate (₹/ q)	Gross return (₹ ha^{-1})	Total cost of cultivation (₹ ha^{-1})	Net profit (₹ ha^{-1})	Cost benefit ratio (C: B)
T_0	17.42	2150.00	37453.00	36453.00	1000.00	1: 1.02
T_1	19.31	2150.00	41516.50	39265.5	2251.00	1: 1.05
T_2	22.18	2150.00	47687.00	42078	5609.00	1: 1.13
T_3	25.22	2150.00	54223.00	37757	16466.00	1: 1.43
T_4	28.67	2150.00	61640.50	40569.5	21071.00	1: 1.51
T_5	34.86	2150.00	74949.00	43382	31567.00	1: 1.72
T_6	39.20	2150.00	84280.00	39061	45219.00	1: 2.15
T_7	42.87	2150.00	92170.50	41873.5	50317.00	1: 2.20
T_8	45.67	2150.00	98190.50	44686	53504.50	1: 2.19

CONCLUSION

In the present investigation, it was apparent that application of N and P fertilizer in treatment T_8 (120 kg N ha^{-1} and 60 kg P ha^{-1}) was found on maximum plant height, number of leaves, stem diameter, cob length, weight of 100 seed and grain yield than other treatment combinations. Plant height, number of leaves, stem diameter, cob length, weight of 100 seed and grain yield are significant. Thus it can be concluded that different levels of N and P fertilizer improved soil available nutrient, increased plant height, number of leaves, stem diameter, cob length and weight of 100 seeds. However, grain yield increased and also among the treatments T_8 recorded the best treatment which increased the availability of nutrient and influenced on plant parameters of Maize as well as gave the maximum net return ₹53504.50 ha^{-1}.

Acknowledgements. The authors are grateful to the Hon'ble Vice chancellor SHUATS, Department of Soil Science and Agricultural Chemistry, Naini Agriculture Institute, for taking their keen interest and encouragement to carry out the research work.
Conflict of Interest. None.

REFERENCES

Ali, M. S., Paul, N. K., & Quayyum M. A. (2010). Production potential of different varieties of hybrid maize (*Zea mays* L.) with groundnut (*Arachis hypogaea* L.) under intercropping system. *Bangladesh J. Agri. Res.*, *35*(1): 51-64.

Asghar, A., Ali, A., Syed, W. H., Asif, M., Khaliq, T., & Abid, A. A. (2010). Growth and yield of maize (*Zea mays* L.) cultivars affected by NPK application in different proportion. *Pakistan Journal of Science, 62*, 4.

Choudhary, O. P., Bajwa, M. S., & Josan, A. S. (1993). Effect of frequency of sodic and saline-sodic irrigations and gypsum on the build-up of sodium in soil and crop yields. *Irrig. Sci., 14*: 21-26.

Djaman, K., & Irmak, S. (2018). Evaluation of critical nitrogen and phosphorus models for maize under full and limited irrigation conditions. *Italian Journal of Agronomy*, *3*(958): 80-92.

Khan, F., Khan, S., Fahad, S., Faisal, S., Hussain, S., Ali, S., & Ali, A. (2014) Effect of different levels of Nitrogen and Phosphorus on the Phenology and yield of maize. *American Journal of Plant Sciences, 5*, 2582-2590.

Kumar, M. A. A., Gali, S. K., & Hebsur, N. S. (2007). Effect of different levels of NPK on growth and yield parameters of sweet corn. *Karnataka Journal of Agricultural Sciences 20*, 41-43.

Law-Ogbomo, K., & Law-Ogbomo, J. E. (2009). The performance of (*Zea mays* L.) as influenced by NPK fertilizer application. *Noti. Sci. Biol., 1*(1): 59-62.

Mahesh, M. P., & Desai, B. K. (2010). Effect of micronutrients with or without organic manures on yield of baby corn-chickpea sequence. *Kar. J. Agric. Sci., 21*: 485-487.

Maurya, J. P., Singh, R., Kumar, R. K., Prasad, P., Kumar, Kumari, A., & Prakash, P. (2004). Effect of nitrogen and sulphur levels on yield, economics and quality of QPM hybrids under dryland condition of eastern Uttar Pradesh, India. *Journal of Agricultural Sciences*, *4*(9): 31-38.

Olusegun, S. O. (2014). Nitrogen and Phosphorus fertilizer application on maize (*Zea mays* L.) growth and yield at Ado-Ekiti, South-West, Nigeria. *American Journal of Experimental Agriculture, 6*(1): 22-29.

Onasanya, R. O., Aiyelari, O. P., Nwilene F. E., & Oyelakin, O. O. (2009). Growth and Yield response of maize (*Zea mays* L.) to different rates of nitrogen and phosphorus fertilizers in Southern Nigeria. *World J. of Agri. Sci., 5*(4): 400-407.

Paramasivan, M., Malarvizhi, P., & Thiyageswari, S. (2012). Balanced use of inorganic fertilizer on maize (*Zea mays* L.) yield, nutrient uptake and soil fertility in *alfisols*. *Karnataka J. Agri. Sci., 25*(4): 423-426.

Rai, S. S., Sonani, V. V., & Patil, P. A. (2006). Study of economics of maize as influenced by different levels of nitrogen and phosphorus. *International Journal of Scientific and Research Publications*, *3*, 2250-3153.

Rao, P. V., Subbaiah, G., & Veeraraghavaiah, R. (2014). Agronomic response of maize to plant population and nitrogen availability. *International journal of Plant, Animal and Environmental Science, 4*: 107-116.

Reddy, U. V. B., Reddy, G. P., Reddy, M. S., & Kavitha, P. (2018). Effect of Different Nitrogen and Phosphorus Levels on Growth and Yield of Maize during Kharif Season. *Int. J. Curr. Microbiol. App. Sci., 7*(1): 3548-3555.

Suke, R. K., Rakesh, K., & Anupama, K. (2011). Influence of sulphur, phosphorus and farm yard manure on yield attributes and productivity of maize in humid south eastern plains of Rajasthan. *Agriculture Science and Digest., 33*(1): 9-14.

How to cite this article: Kumar, T.; Swaroop, N.; Thomas, T.; Barthwal, A.; Khatana, R.N.S.; and Monahar, D.V. (2021). Effect of Varying Nitrogen and Phosphorus Levels on Growth and Yield of Maize (*Zea mays* L.) Cv. K-64. *Biological Forum – An International Journal, 13*(4): 60-65.