The Pharma Innovation Journal 2021; 10(10): 1347-1350

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(10): 1347-1350

www.thepharmajournal.com
Received: 25-08-2021
Accepted: 27-09-2021

Sourabh Sankadiya
M.Sc Scholar, Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh, India

Lalit Sanodiya
Research Scholar, Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Sourabh Sankadiya
M.Sc Scholar, Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh, India

Effect of phosphorus and potassium levels on growth and yield of maize (*Zea mays* L.)

Sourabh Sankadiya and Lalit Sanodiya

Abstract
A field experiment was conducted during *Zaid* season of 2021 at SHUATS Department of Agronomy, SHUATS, Prayagraj (U.P). The soil was sandy loam in texture, neutral in reaction (pH 7.0), low in available N (168.75 kg/ha), medium in available phosphorus (17.40 kg/ha), medium in available potassium (231.7 kg/ha), The experiment was laid out in Randomized block design and having ten treatment. The result showed that growth parameters *viz,* plant height (187.06 cm), no. of leaves/plant (9.4), leaf area index (7.45),plant dry matter accumulation (3008 g/m2), CGR (29.8), RGR (0.0787)yield attributes like effective Cob/Plant (1.53), Cob/length (16.75 cm), Row/cob (14.89) Grains/row (26.94) Grains/cob (396.5 g), Grain yield t/ha (4.5 t/ha), stover yield t/ha (9.5 t/ha), Seed index weight (28.2 g), Harvest index (32.5) were found to be significantly highest with T9 i.e.,70 Kg/ha (P) + 60 Kg/ha (K). Similarly highest gross return (INR 103455 /ha), net return (INR 74095 /ha) and benefit: cost ratio (2.52) were recorded superior with application T9 i.e., 70 Kg/ha (P) + 60 Kg/ha (K).

Keywords: maize, phosphorus, potassium, yield

Introduction
Maize is the most important cereal crops in the world but maize is the most popular due to its high yielding, ease of processing, readily digested and costs less than other cereals (Jaliya *et al.,* 2008). Maize is a major source of carbohydrate which is used for food, in livestock diet and in alcohol production. Maize has immense potential in the tropics and yield of up to 7500 kg/ha can be obtained if the crop is properly managed. Unfortunately, yields are still generally below 5000 kg/ha (FAO, 2007) and this had caused inadequacy of maize for its numerous usages. Yield differences between temperate and tropical areas have been attributed to low nutrient status of tropical soils especially nitrogen, phosphorus and potassium resulting from the practice of slash and burn farming system with excessive leaching of the soil nutrients In India, maize is grown in an area of 9.43million hectares with production of 24.35 m t and productivity of 2583 kg/ha (Government of India, 2020). In UP, maize is grown in area of 0.83 m/ha with production 1.56 m t and productivity of 2376 kg/ha (State wise 2020).
Maize is an exhaustive crop having higher potential than other cereals and absorbs large quantity of nutrients from the soil during different growth stages. Among the essential nutrients, phosphorus is one of the most important nutrients for higher yield in larger quantity (Chen *et al.* 1994) which controls reproductive growth of plant (Wojnowska *et al.* 1995). Generally, P is the second most crop-limiting nutrient in most of the soils. Plant growth behavior is influenced by the application of phosphorus (Hajabbasi and Schumacher, 1994; Gill *et al.* 1995; Kaya *et al.* 2001). It is needed for growth, utilization of sugar and starch, photosynthesis, nucleus formation and cell division, fat and albumen formation. Energy from photosynthesis and the metabolism of carbohydrates is stored in phosphate compounds for later use in growth and reproduction (Ayub *et al.* 2002). It is readily translocated within the plants, moving from older to younger tissues as the plant forms cells and develops roots, stems and leaves (Ali *et al.* 2002). Adequate P results in rapid growth and earlier maturity and improves the quality of vegetative growth. Phosphorus deficiency is responsible for crooked and missing rows as kernel twist and produce small ears nubbies in maize. Phosphorus is the second important key element after nitrogen as a mineral nutrient in terms of quantitative plant requirement. Although abundant in soils, in both organic and inorganic forms, its availability is restricted as it occurs mostly insoluble forms. The P content in an average soil is about 0.05% (w/w) but only 0.1% of the total P is available to plant because of poor solubility and its fixation in soil. An adequate supply of phosphorus during early phases of plant development is important for laying down the primordial of plant reproductive parts. It plays significant role in

increasing root ramification and strength thereby imparting vitality and disease resistance capacity to plant. It also helps in seed formation and early maturation of crop like cereals and legumes. Potassium activates many enzymes and plays an important role in the maintenance of potential gradients across cell membranes and the generation of turgor pressure in plants. It regulates photosynthesis, protein synthesis and starch synthesis (Mengel and Kirkby, 1996). It is also the major cation for the maintenance of cation anion balances. Potassium aids plant in resisting disease, insect, cold weather and drought. Potassium is one of the principal plant nutrient under pinning crop yield and quality determination. It is an important major element for plant growth. It is needed to larger amount than phosphorus within the live plant tissue and average percentage of K is approximately 8 to 10 times more than phosphorus. It also found that hay or dry matter contains up to four times as much potassium as phosphorus. It is accumulated in abundant amount during the vegetative growth period.

Potassium (K) is substantially an important nutrient for plant growth, and has the capability to maximize plant growth and it influences soil plant interactions as well **(**Xie *et al*., 2011**).** As, for acting as an essential nutrient for crop production and its development; it acts as a co-factor for more than 40 enzymes that are involved in metabolic pathways directly (Clarkson and Hanson, 1980). Keeping in view of the above facts, a field experiment was carried out with objection to find out the Effect of Phosphorus and Potassium Levels on growth and Yield of Maize (*Zea mays* L) is planned undertaken to find out the specific objectives given as below.

Materials and Methods

Experiment Site

The experiment was conducted during the Zaid season 2021, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.) which is located at geographical coordinates 25° 24' 42" N latitude, 81° 50' 56" Elongitude and 98 m altitude above the mean sea level. Situation of the area is to the right side of the river Yamuna by the side of Prayagraj Rewa Road about 7 km away from Prayagraj city. The treatment comprised of two different factors first factor Phosphorus and second factor Potassium. The experiment was laid out in Randomized block design, replicated thrice, details of possible treatment combination given in Table 1.

Climate

The mean maximum temperature on weekly basis ranged from 31.710C to 42.600C during *zaid* season of 2021. It was lower during at the time of sowing of the crop in the month of last April and first week of May, which gradually increased with the advancement of the crop period. The mean minimum temperature ranged between 20.880C to 23.0380C. The min temperature also increased while advancement of crop growth which help for crop growth. As per the observations of the meteorological observatory during the crop period, weekly mean relative humidity throughout the crop season varied between 29.81 to 47.33. The maximum relative humidity for different weeks varied from 73.56to 84.086 while, weekly minimum relative humidity varied between 29.81 to 47.33 per cent during *zaid* season 2021.The total rainfall receive o in the month of April to July were 4.96 mm, respectively.

Soil Chemical Status

The field was uniformly irrigated one day before sowing on each of the treatment combinations. The soil of experimental plot was sandy loam in texture, neutral in soil reaction (pH 7.0), low organic carbon (0.37%), low available N (168.75 kg/ha), low available P (17.40 kg/ha) and medium available K (231.7 kg/ha).

Observations

The Experiment was laid out in Randomized Block Design, with ten treatments which are replicated thrice (Table 1). Observations on growth parameters *viz.* plant height (cm), Number of leaves/plant, leaf area index, Dry matter accumulation (g/m2) CGR, RGR and yield attributes *viz.* Cobs/plants, Cobs length (cm), Row/cob, Grains/row, Grains/cob and yield of Maize *viz.* Grains yield (t/ha) and Stover yield (t/ha), Seed index weight (g), Harvest index, was recorded and their significance was tested by the variance ratio and the level of significance used in F-test was P=0.05. Critical difference values were calculated wherever F-test was found significant (Gomez and Gomez, 1984).

Table 1: Treatment combination

Treatments	Treatment combination
T1	30 Kg/ha (P) + 0 Kg/ha (K)
T2	30 Kg/ha (P) + 30 Kg/ha (K)
T3	30 Kg/ha (P) + 60 Kg/ha (K)
T4	50 Kg/ha (P) + 0 Kg/ha (K)
T5	50 Kg/ha (P) + 30Kg/ha (K)
T6	50 Kg/ha (P) + 60 Kg/ha (K)
T7	70 kg/ha (P) + 0 Kg/ha (K)
T8	70 kg/ha (P) + 30 Kg/ha (K)
T9	70 kg/ha (P) + 60 Kg/ha (K)
T10	150:60:40 (RDF)

Results and Discussion

Growth parameter

Growth parameters of Maize, viz. plant height (cm), Dry matter accumulation (g/m2), number of leaves/plant and leaf area index varied due to different Phosphorus and Potassium are presented in Table 2. The treatment T9i.e., application of 70 kg/ha (P) + 60 Kg/ha (K) resulted significantly higher plant height (187.06 cm), number of leaves/plant (9.4), leaf area index (7.45), and contribute maximum dry matter accumulation (3008 g/m2) whereas, T6i.e.,application of 50 Kg/ha (P) + 60 Kg/ha (K) was found to be statistically at par and comparatively followed with highest in growth attributes like plant height (175.16 cm), and dry matter accumulation (3002.6 g/m2). Phosphorus and Potassium encourage formation of new cells, promote plant vigoursly and hastens leaf development, which help in harvesting more solar energy and better utilization of nitrogen, which help towards higher growth attributes. Similar results also found by Alias *et al.* (2003) [1] and Naomi *et al*. (2021) [10]. Data was recorded just prior to harvest of crop 5 plants randomly from net plot tagged to record pre harvest observation.

Yield and Yield attributes

Yield attributes such as number of Cob/plants, Cob length/plant and Seed index weight (g) exhibited significant variation during the experimental period varied due to different Phosphorus and Potassium are presented in Table 3. The treatment T9 i.e, application of 70 kg/ha (P) + 60 Kg/ha (K) resulted significantly higher number of Grains/cob

(396.5), number of Cob/plant (1.53), Seed index weight (28.2,) grain yield (4.5 t/ha) and stover yield (9.5 t/ha). The increase in seed yield due to Phosphorus and Potassium application is attributed to source and sink relationship. It appears that greater translocation of photosynthates from source to sink might have increased Grain yield as Reported by Sharma *et al.* (2018) [17].

Economics

Data represented in Table 4. Shows that the economics performance of different treatment combination based on cost of cultivation (INR/ha), gross return (INR/ha), net return (INR/ha) and benefit cost ratio (B:C). Highest cost of cultivation (INR 29359/ha), gross return (INR 103455/ha), net return (INR 74095/ha) and benefit cost ratio (2.52) were found with the application of T9 i.e., 70 kg/ha (P) + 60 Kg/ha (K) Increased in economic performance of Maize was due to the positive effect to Phosphorus and Potassium combination on plants at higher levels which were responsible for higher marketable seed and Stover yield. The application of 70 kg/ha (P) + 60 Kg/ha (K) gave highest gross return (INR103455/ha), net return (INR74095/ha) and also maximum B: C Ratio (2.52). Similar results also reported by Hirpara *et al.* (2017) [12].

Table 1: Effect of Phosphorus and Potassium on the Growth attributes of Maize.

T. No.	Treatment combinations	Plant height (cm)	No. of leaves/ plant	Leaf area index (cm)	Dry matter accumulation (g/m2)	CGR (g/m2/day)	RGR (g/g/day)
T1	30 Kg/ha (P) + 0 Kg/ha (K)	160.98	7.8	5.48	2684.6	26.06	0.0753
T2	30 Kg/ha (P) + 30 Kg/ha (K)	166.10	8.6	6.13	2856.6	27.16	0.0774
T3	30 Kg/ha (P) + 60 Kg/ha (K)	172.61	8.8	6.73	2893.3	27.5	0.0777
T4	50 Kg/ha (P) + 0 Kg/ha (K)	168.71	8.0	5.91	2793.3	26.66	0.0764
T5	50 Kg/ha (P) + 30 Kg/ha (K)	172.18	8.7	6.42	2860	27.23	0.0775
T6	50 Kg/ha (P) + 60 Kg/ha (K)	175.16	9.0	7.11	3002.6	27.63	0.0780
T7	70 kg/ha (P) + 0 Kg/ha (K)	167.52	8.2	6.07	2848	26.86	0.0767
T8	70 kg/ha (P) + 30 Kg/ha (K)	172.26	8.8	6.44	2866.6	27.46	0.0777
T9	70 kg/ha (P) + 60 Kg/ha (K)	187.06	9.4	7.45	3008	29.8	0.0787
T10	150:60:40 (RDF)	173.30	8.9	6.76	2930	27.6	0.0780
	S.E.m(±)	0.44	0.34	0.3	47.8	0.47	0.0009
	CD. (5%)	1.32	---	1.0	142.3	1.41	------

Table 3: Effect of Phosphorus and Potassium levels on yield and yield attributes of Maize

T. No.	Treatment combination	Cobs/plant	Cob length(cm)	Seed index (g)	Grain yield (t/ha)	Stover yield (t/ha)
T1	30 Kg/ha (P) + 0 Kg/ha (K)	1.28	14.54	25.3	2.6	7.5
T2	30 Kg/ha (P) + 30 Kg/ha (K)	1.36	15.41	26.4	3.5	8.4
T3	30 Kg/ha (P) + 60 Kg/ha (K)	1.46	16.23	26.7	3.7	9.2
T4	50 Kg/ha (P) + 0 Kg/ha (K)	1.32	15.10	25.8	3.5	8.3
T5	50 Kg/ha (P) + 30 Kg/ha (K)	1.4	15.96	26.5	3.6	8.7
T6	50 Kg/ha (P) + 60 Kg/ha (K)	1.50	16.51	27.3	4.1	9.5
T7	70 kg/ha (P) + 0 Kg/ha (K)	1.32	15.37	26.4	3.5	8.3
T8	70 kg/ha (P) + 30 Kg/ha (K)	1.45	15.98	26.6	3.7	9.2
T9	70 kg/ha (P) + 60 Kg/ha (K)	1.53	16.75	28.2	4.5	9.5
T10	150:60:40 (RDF)	1.48	16.41	27.1	4.1	9.3
	S.E.m(±)	0.07	1.20	0.27	0.1	0.25
	CD (P = 0.05)	----	0.40	0.81	0.4	0.75

Table 4: Effect of Phosphorus and Potassium on economics return of Maize.

Treatment No.	Treatment details	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C Ratio
T1	30 Kg/ha (P) + 0 Kg/ha (K)	24781.75	64037.50	39255.75	1.58
T2	30 Kg/ha (P) + 30 Kg/ha (K)	25678.15	83877.50	58199.35	2.27
T3	30 Kg/ha (P) + 60 Kg/ha (K)	26574.55	88960.00	62385.45	2.35
T4	50 Kg/ha (P) + 0 Kg/ha (K)	26174.25	83015.00	56840.75	2.17
T5	50 Kg/ha (P) + 30 Kg/ha (K)	27070.65	85000.00	57929.35	2.14
T6	50 Kg/ha (P) + 60 Kg/ha (K)	27967.05	97582.50	69615.45	2.49
T7	70 kg/ha (P) + 0 Kg/ha (K)	27566.75	83055.00	55488.25	2.01
T8	70 kg/ha (P) + 30 Kg/ha (K)	28463.15	88002.50	59539.35	2.09
T9	70 kg/ha (P) + 60 Kg/ha (K)	29359.55	103455.00	74095.45	2.52
T10	150:60:40 (RDF)	28065.70	95722.50	67656.80	2.41

Conclusion

On the basis of one-year experimentation it can be concluded that the that application of 50 kg/ha (P) + 60 Kg/ha (K) (T6) among the other treatments has proved to be a better treatment for getting higher productivity.in Maize and is more productive economically as well.

References

1. Alias A, Usman M, Ullah E, Warraich EA. Effects of Different Phosphorus Levels on the Growth and Yield of Two Cultivars of Maize (*Zea mays* L.) International journal of agriculture & biology. 2003;05(4):632-634.
2. Azeem K, Khan A, Naz F, Ilyas M, Azeem I, Anwar F, *et al*. The Impact of Different P Fertilizer Sources on Growth, Yield and Yield Component of Maize Varieties Agri Res & Tech: Open Access 2018;13(3):2471- 6764.
3. Gnanasundari R, Sellamuthu KM, Malathi P. Effect of Potassium on Growth, Yield and NPK Uptake of Hybrid

Maize in Black Calcareous Soil. Madras Agric. J 2018;106(1):32-37.
4. Hussain N, Khan AZ, Akbar H. Response of maize varieties to phosphorus and potassium levels. Sarhad J. Agric 2007;23(4):882-888.
5. Hussain MZ, Kumar M, Singh D, Yadav S. Effect of Different Levels of Potassium on Yield and Yield Attributes of Kharif Maize (*Zea mays* L.) Int. J. Curr. Microbiol. App. Sci 2019;8(1):2054-2060.
6. Kumar S, Dhar S, Barthakur S, Chandrakala M, Kochewad SA, Meena LR *et al*. Effect of Integrated Potassium Management on Soil Biological Properties and Yields of Corn under Corn-Wheat Cropping System. Int. J Curr. Microbiol. App. Sci 2018;7(12):1855-1866.
7. Liaqat W, Jan MF, Ahmad H, Rehan WR, Khan EH, Khan N. Impact of Mineral Potassium on Phenology, Growth and Yield of Maize Hybrid. Int J Environ Sci Nat Res 2018;8(5):2572-1119.
8. Masood T, Gul R, Munsif F, Jalal F, Hussain Z, Noreen NM, *et al*. Effect of different phosphorus levels on the yield and yield components of maize. Sarhad J Agric 2011;27(2):168-170.
9. Mulyati, Baharuddin AB, Tejowulan RS. Improving Maize (*Zea mays* L.) growth and yield by the application of inorganic and organic fertilizers plus. IOP Conf. Series: Earth and Environmental Science. 2021;712(1):1755-1315.
10. Naomi MR, Supriyono, Nurmalasari IA, Pardono. Role of phosphate fertilizer on growth and yield of hybrid maize (*Zea mays* L.) IOP Conf. Series: Earth and Environmental Science 2021;637(1088):1755-1315.
11. Ogunsola KE, Adetunji MT. Effect of phosphorus and sulphur on dry matter yield of maize (*Zea mays*) in some soils at *Abeokuta*, *ogunstate*, nigeri. Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension 2016;15(2):1-8.
12. Pal B, Hirpara DS, Vora VD, Vekaria PD, Sutaria GS, Akbari KN, *et al*. Effect of Nitrogen and Phosphorus on Yield and Yield Attributes of Maize in South Saurashtra, India. Int. J Curr. Microbiol. App. Sci 2017;6(3):1945-1949.
13. Parashar A, Jain M. Response of nitrogen and phosphorus levels on the yield of maize (*Zea mays* L.) Journal of Pharmacognosy and Phytochemistry 2020;9(5):2589-2592.
14. Rashid M, Iqbal M. Effect of phosphorus fertilizer on the yield and quality of maize (*Zea mays* L) Fodder on clay loam soil. The Journal of Animal & Plant Sciences 2012;22(1):1018-708.
15. Reddy PVD, Dawson J, Ramya BJNS. Effect of Potassium and Iron on Growth and Yield of Summer Baby corn (*Zea mays* L.) Int. J Curr. Microbiol. App. Sci. 2020;9(11):1871-1876.
16. Reddy UVB, Reddy GP, Reddy MS, Kavitha P. Effect of Different Nitrogen and Phosphorus Levels on Growth and Yield of Maize during Kharif Season. Int. J Curr. Microbiol. App. Sci 2018;7(1):3548-3555.
17. Sharma PP, Pandey G, Jawahar S, Kalaiyarasan C, Suseendran K. Effect of different levels of nitrogen and phosphorus on yield and economics of hybrid maize (*Zea mays* L.). International Journal of Research and Analytical Review 2018;5(4):2349-5138.
18. Shehzad M, Hira A, Khalid M, Muhammad J, Majid MT, Mehdi M *et al*. Influence of various mineral phosphorus sources on growth and yield of Maize (*Zea mays* L.) in rainfed conditions of Rawalakot, Azad Jammu and Kashmir. International Journal of Agricultural Technology 2020;16(6):1505- 1514.
19. Sravan AS, Reddy D, Ganesh P, Dawson J. Effect of Potassium and Zinc on Growth and Yield of Baby Corn (*Zea mays* L.) Int. J Curr. Microbiol. App. Sci 2021;10(01):1723-1729.