Title:

Effect of Phosphorus and Potassium on Growth and Yield of Baby corn *(Zea mays* L.)

Article type: *Original Research Article*

ABSTRACT

Field experiment was conducted during Rabi 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil in the experimental plot was sandy loam texture, almost neutral in soil reaction (pH 7.1), low in organic carbon (0.36%), available N (171.48 kg/ha), available P (15.2 kg/ ha) and available K (232.5 kg/ha). The experiment was arranged in a Randomized Block Design with nine treatments each replicated three times based on a one-year experiment with different levels of Phosphorous and Potassium. The results showed that application of 70 kg/ha Phosphorous + 25 kg/ha Potassium was recorded significantly Plant height (162.73 cm), No. of leaves/plant (13.26), Plant dry weight (108.06 g/plant), Cobs/Plant (1.34), Length of Cob/plant (19.29 cm), Girth of Cob/plant (7.64 cm), Cob weight with husk (65.09 g), cob weight without husk (23.63 g), cob yield with husk (15.14 t/ha), Cob yield without husk (5.16 t/ha) as compared to other treatments.

Key words: *Baby corn, Growth, Phosphorous, Potassium, yield*.

INTRODUCTION

"Baby corn is a young ear of corn peeled to finger length from the female inflorescence, harvested within 2-3 days after silk emergence but before fertilization, and is crunchy and sweet. We can say that a stalk with unpollinated silk is baby corn. Baby corn cobs of light yellow color with a regular row arrangement, 10-12 cm long and 1.0-1.2 cm in diameter are preferred on the market. Baby corn is a vegetable crop that can potentially improve the economic status of farmers. It is a profitable crop that enables production diversification, value aggregation and income enhancement" [1]. It is highly profitable and farmers can get high returns in a short period of 45-60 days. Its short duration, adaptability in different cropping systems, suitability for cultivation in all seasons and ecological cultivation practices have made it a special choice for cultivation in non-traditional maize growing areas. Another advantage of growing baby corn is its residual biomass (green fodder) after harvest [2].

"These green products can be used as feed for animal husbandry and aquaculture" [3]. "High-quality, juicy green fodder contributes enormously to total returns for farmers, resulting in higher profit per unit area per unit time compared to grain maize. Another advantage of baby corn is the use of the husk, silk and Stover as a green herb for feeding ruminants and pigs; only 13 to 20% of fresh ear weight is intended for human consumption" [4]. Corn is highly nutritious and its nutritional value is comparable to several expensive vegetables such as cauliflower, cabbage, beans, spinach, tomatoes, radishes, etc. It is a low-calorie, low-cholesterol, high-fiber product that is free from residual effects of pesticides because they are harvested as young ears tightly wrapped in the husk and well protected from disease and insect pests. Another nutritious green feed is the most valuable by-product of baby corn.

"After nitrogen, phosphorus is the second most important key element as a mineral nutrient in terms of the quantitative needs of plants. Although it is abundant in soil, in both organic and inorganic forms, its availability is limited because it occurs mostly in insoluble forms. It is needed for growth, utilization of sugar and starch, photosynthesis, formation of the nucleus and cell division, formation of fat and protein. Energy from photosynthesis and carbohydrate metabolism is stored in phosphate compounds for later use in growth and reproduction" [5]. It translocates easily in plants, moving from older to younger tissues as the plant forms cells and develops roots, stems and leaves. An adequate amount of 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 the kernel curls and produces small ears in corn.

"Basically, potassium (K) is an important nutrient for plant growth and has the ability to maximize plant growth and also influence soil-plant interactions. As an essential nutrient for plant production and development; it acts as a cofactor for more than 40 enzymes that are directly involved in metabolic pathways. Potassium application activates a number of enzymes, including those involved in carbohydrate synthesis and resistance to disease, adverse environmental conditions, and also increases the utilization of N and P. It is the most abundant cation found in the cytoplasm and regulates osmotic potential. Cells and tissues of glycophytic plant species” [6], Potassium nutrition in maize positively affected dry matter production and plant height.

MATERIALS AND METHODS

A field experiment was conducted during *Rabi* season of 2021, at Crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj which is located at 25^{o} 24' 42" N latitude, 81^{o} 50' 56" E longitude and 98 m altitude above the mean sea level (MSL). To assess the effect of Phosphorous and Potassium on growth and yield of Baby Corn. The experiment was laid out in Randomized Block Design comprising of 9 treatments which are replicated thrice. Each treatment net plot size is 3m × 3m. The treatment are categorized as with recommended dose of nitrogen through urea in addition with Phosphorous through DAP and potash through Muriate of Potash, where applied in combinations as follows, T_1: 50 kg/ha Phosphorous + 15 kg/ha Potassium, T_2: 50 kg/ha Phosphorous + 20 kg/ha Potassium, T_3: 50 kg/ha Phosphorous + 25 kg/ha Potassium, T_4: 60 kg/ha Phosphorous + 15 kg/ha Potassium, T_5: 60 kg/ha Phosphorous + 20 kg/ha Potassium, T_6: 60 kg/ha Phosphorous + 25 kg/ha Potassium, T_7: 70 kg/ha Phosphorous + 15 kg/ha Potassium, T_8: 70 kg/ha Phosphorous + 20 kg/ha Potassium, T_9: 70 kg/ha Phosphorous + 25 kg/ha Potassium. The crop was harvested treatment wise at harvesting maturity stage. Growth parameters viz. plant height (cm), no of leaves/plant and dry weight (g/plant) were recorded manually on five randomly selected representative plants from each plot of each replication separately and after harvesting, Length of Cob/plant, Girth of Cob/plant, Cob weight with husk, cob weight without husk, cob yield with husk andCob yield without husk were calculated from each net plot and was computed and expressed in tonnes per hectare. The data was computed and analysed by following statistical method of Gomez and Gomez statistical approach [7].

RESULTS AND DISCUSSION

Plant height (cm)

It is clear from Table 1 that the significantly highest plant height (162.73 cm) was observed in the 70 kg/ha phosphorus + 25 kg/ha potassium treatment compared to all other treatments. However, treatments with the application of 60 kg/ha phosphorus + 25 kg/ha potassium (159.64 cm) and 70 kg/ha phosphorus + 20 kg/ha potassium (161.88 cm) which were statistically identical to the 70 kg/ha treatment Phosphorus + 25 kg/ha Potassium. Phosphorus promotes new cell formation, supports plant vigor and accelerates leaf development, which helps harvest more solar energy and better nitrogen utilization, which aids higher growth attributes, Noonari et al., [8]. The increase in plant height may be due to the fact that potassium in this application plays a key role in meristematic growth through its effect on phytohormone synthesis. Among various plant hormones, cytokinin plays an important role in plant growth. The beneficial effect of K on growth is reported by Kumar and Bohra [9].

No. of Leaves/plant

"Treatment with 70 kg/ha Phosphorous + 25 kg/ha Potassium was recorded with significantly maximum No. of Leaves/plant (13.26) over all the treatments. However, the treatments with 60 kg/ha Phosphorous + 25 kg/ha Potassium (12.90) and 70 kg/ha Phosphorous + 20 kg/ha Potassium (13.13) which were found to be statistically at par with 70 kg/ha Phosphorous + 25 kg/ha Potassium. The increase in number of leaves due to the application of Potassium 25 kg/ha might be that potassium application plays a crucial role photosynthetic process and formation of chlorophyll in the leaf. Similar, results observed by Patil and Basvaraju" [10].

Dry matter accumulation

Treatment with 70 kg/ha Phosphorous + 25 kg/ha Potassium was recorded with significantly maximum dry weight (108.06 g/plant) over all the treatments. However, the treatments with 60 kg/ha Phosphorous + 25 kg/ha Potassium (104.73 g/plant) and 70 kg/ha. Phosphorous + 20 kg/ha Potassium (106.44 g/plant) which were found to be statistically at par with 70 kg/ha Phosphorous + 25 kg/ha Potassium. The plants attained more vigour with phosphorus, due to adequate supply and availability of nitrogen, phosphorus, potassium and spacing in balanced combination, resulting in increased dry weight of the plant.The application of Phosphorus 70 kg/ha to baby corn significantly increased dry matter production. The results were in accordance with Hirpara et al. [11**].** Potassium plays a crucial role in meristemtic growth through its effect on the synthesis of phyto hormones. Similar results were reported by Kumar et al. [12**].**

Table 1. Effect of Potassium and Phosphorous on growth parameters of Baby corn.

S.No	Treatments	Plant height (cm)	Leaves/plant	Dry matter (g plant^{-1})
1.	50 kg/ha Phosphorous + 15 kg/ha Potassium	149.24	11.95	94.75
2.	50 kg/ha Phosphorous + 20 kg/ha Potassium	150.79	12.07	96.48
3.	50 kg/ha Phosphorous + 25 kg/ha Potassium	155.39	12.61	100.60
4.	60 kg/ha Phosphorous + 15 kg/ha Potassium	152.46	12.22	97.60
5.	60 kg/ha Phosphorous + 20 kg/ha Potassium	157.48	12.76	102.72
6.	60 kg/ha Phosphorous + 25 kg/ha Potassium	159.64	12.90	104.73
7.	70 kg/ha Phosphorous + 15 kg/ha Potassium	154.34	12.52	99.62
8.	70 kg/ha Phosphorous + 20 kg/ha Potassium	161.88	13.13	106.44
9.	70 kg/ha Phosphorous + 25 kg/ha Potassium	162.73	13.26	108.06
	SEm (±)	1.15	0.14	1.19
	CD (P 0.05)	3.44	0.41	3.57

Yield and Yield Attributes:

Number of Cobs/plant

Significantly Maximum ear/plant (1.34) was recorded with application of 70 kg/ha phosphorus + 25 kg/ha potassium during all treatments. However, the 60 kg/ha phosphorus + 25 kg/ha potassium (1.23) and 70 kg/ha phosphorus + 20 kg/ha potassium (1.28) treatments were found to be statistically at par with 70 kg /ha phosphorus + 25 kg /ha Potassium. The application of P increased the number of spikes per plant, which may be due to increased early vegetative growth in terms of higher leaf area, dry matter accumulation and a robust root system, which subsequently significantly increased the number of spikes. Similar findings were observed by Masood et al., [13].

Spike length/plant (cm)

Significantly maximum spike length/plant (19.29 cm) was recorded at 70 kg/ha phosphorus + 25 kg/ha potassium application during all treatments. However, the 60 kg/ha phosphorus + 25 kg/ha potassium (18.57 cm) and 70 kg/ha phosphorus + 20 kg/ha potassium (18.97 cm) treatments were found to be statistically at par with 70 kg/ha phosphorus + 25 kg/ha Potassium. The application of potassium promotes the development of strong cell walls and improves the germination of pollen in the flowers, which leads to high fertility and ear formation. The results were consistent with Kalpana and Anbumani [14].

Girth of Cob/plant (cm)

Significantly Maximum Girth of Cob/plant (7.64 cm) was recorded with the treatment of application of 70 kg/ha Phosphorous + 25 kg/ha Potassium over all the treatments. However, the treatments 60 kg/ha Phosphorous + 25 kg/ha Potassium (7.35 cm) and 70 kg/ha Phosphorous + 20 kg/ha Potassium (7.50 cm) which were found to be statistically at par with 70 kg/ha Phosphorous + 25 kg/ha Potassium. Potassium might be attributed to better filling of grains and thus, an increase in different yield attributing characters. The results were found to be similar with Singh et al., [15].

Cob weight (g)

a) With husk

Significantly Maximum Cob weight (65.09 g) was recorded with the treatment of application of 70 kg/ha Phosphorous + 25 kg/ha Potassium over all the treatments. However, the treatments 60 kg/ha Phosphorous + 25 kg/ha Potassium (64.42 g) and 70 kg/ha Phosphorous + 20 kg/ha Potassium (64.85 g) which were found to be statistically at par with 70 kg/ha Phosphorous + 25 kg/ha Potassium.

b) Without husk

Significantly Maximum Cob weight (23.63 g) was recorded with the treatment of application of 70 kg/ha Phosphorous + 25 kg/ha Potassium over all the treatments. However, the treatments 60 kg/ha Phosphorous + 25 kg/ha Potassium (23.23 g) and 70 kg/ha Phosphorous + 20 kg/ha Potassium

(23.45 g) which were found to be statistically at par with 70 kg/ha Phosphorous + 25 kg/ha Potassium.

Higher vigour and growth attained by the plants due to sufficient absorption of nutrients might have resulted in higher cob weight. The results were found to be similar with Hadiya and Shah [16].

Cob yield (t/ha)

a) With husk

Significantly highest Cob yield (15.14 t/ha) was recorded with the treatment application of 70 kg/ha Phosphorous + 25 kg/ha Potassium over all the treatments. However, the treatments with (14.74 t/ha) in 60 kg/ha Phosphorous + 25 kg/ha Potassium and with (15.00 t/ha) in 70 kg/ha Phosphorous + 20 kg/ha Potassium which were found to be statistically at par with 70 kg/ha Phosphorous + 25 kg/ha Potassium.

b) Without husk

Significantly highest Cob yield (5.16 t/ha) was recorded with the treatment application of 70 kg/ha Phosphorous + 25 kg/ha Potassium over all the treatments. However, the treatments with (4.91 t/ha) in 60 kg/ha Phosphorous + 25 kg/ha Potassium and with (5.06 t/ha) in 70 kg/ha Phosphorous + 20 kg/ha Potassium which were found to be statistically at par with 70 kg/ha Phosphorous + 25 kg/ha Potassium.

The increase in ear yield due to phosphorus application is attributed to the source-sink relationship. It appears that greater translocation of photosynthates from source to sink could increase ear yield. Phosphorus increases yield due to its well-developed root system, increased N fixation and its availability to plants, and a favorable environment in the rhizosphere. Similar results were found by Reddy et al., [17]**.** Potassium application stimulates the cumulative effect of improving yield traits, i.e. spike number per plant, spike length and thickness, and spike weight, as well as increased availability, absorption and translocation of K nutrients Mastoi et al. (2013).

Table 2. Effect of Phosphorous and Potassium on Yield attributes and Yield of Baby corn.

Treatments	No. of Cobs/plant	Length of Cob/plant (cm)	Girth of Cob/plant (cm)	Cob weight (g)		Cob yield (t/ha)	
				With Husk	Without Husk	With Husk	Without Husk
1. 50 kg/ha Phosphorous + 15 kg/ha Potassium	1.06	17.18	6.49	62.94	21.94	13.64	3.54
2. 50 kg/ha Phosphorous + 20 kg/ha Potassium	1.08	17.42	6.62	63.24	22.19	13.82	3.76
3. 50 kg/ha Phosphorous + 25 kg/ha Potassium	1.18	18.13	7.08	63.90	22.74	14.27	4.53
4. 60 kg/ha Phosphorous + 15 kg/ha Potassium	1.11	17.64	6.71	63.43	22.43	13.88	4.01
5. 60 kg/ha Phosphorous + 20 kg/ha Potassium	1.20	18.33	7.24	64.26	23.03	14.57	4.73
6. 60 kg/ha Phosphorous + 25 kg/ha Potassium	1.23	18.57	7.35	64.42	23.23	14.74	4.91
7. 70 kg/ha Phosphorous + 15 kg/ha Potassium	1.15	17.92	6.89	63.70	22.52	14.07	4.26
8. 70 kg/ha Phosphorous + 20 kg/ha Potassium	1.28	18.97	7.50	64.85	23.45	15.00	5.06
9. 70 kg/ha Phosphorous + 25 kg/ha Potassium	1.34	19.29	7.64	65.09	23.63	15.14	5.16
S. EM (±)	0.04	0.28	0.10	0.24	0.14	0.15	0.09
CD (P = 0.05)	0.12	0.84	0.31	0.71	0.41	0.45	0.28

CONCLUSION

Based on the findings of the investigation, it can be concluded that the treatment of 70 kg/ha of phosphorus + 25 kg/ha of potassium was exceptionally effective in all growth and yield parameters and in reaching the maximum yield of sweet corn cobs. Therefore, 70 kg/ha of phosphorus + 25 kg/ha of potassium, which can be recommended to farmers, may be more beneficial.

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