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Effect of Potassium and Spacing on Growth and Yield of Baby Corn (*Zea mays* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

During the summer of 2021, the current study was conducted at the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh (Zaid). The experiment used a Randomized Block Design with three repetitions. A total of nine treatments were created, each with a distinct level of spacing and amount of potassium applied. The agricultural field was uniformly composed of sa0ndy loam soil with a pH of neutral, low in organic carbon (0.72 percent), accessible nitrogen (278.48 kg/ha), and medium in available phosphorus and potassium (27.80 kg/ha and 233.24 kg/ha, respectively. Amongst all the treatments, T9 with 50 x 15 cm spacing and 50 kg/ha K_2O exhibited the highest plant productivity and its features such as plant height, number of leaves per plant, dry plant mass, and cob's qualities among all treatments. Furthermore, the maximum crop growth rate, yield, and yield qualities such as cob yield and green fodder yield were discussed. It may be inferred that greater potassium treatment and wider spacing have a good influence on plant production and growth parameters.

Keywords: Potassium; spacing; growth; yield; baby corn.

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1. INTRODUCTION

Maize is amongst one of the leading staple crops as it can easily grow in different temperature and sunlight, thus, having wider adaptability. Maize provides maximum yield in a targeted environment due to genetics as well as environment and hence called the "Queen of Cereals". An improved dry matter accumulation specifically up to 30˚N and 30˚S is another reason for better yield of maize. At present, it is cultivated over an area of 184 MT spread over 160 countries; the major players being USA, China, Brazil, Mexico, Argentina, South Africa and India [1]. After wheat and rice, maize is the third prominent crop on rise and covers and area of 9.60 million hectares with 27.15 MT yield; the mean yield being 2.8 t/ha.

Out of the eight groups of maize based on endosperm, baby corn is the unfertilized, immature ear or cob of maize plant harvested when the stalk is still underdeveloped. In the market, yellow-coloured cobs with regular row array maintaining 10-12 cm spacing and 1-1.5 cm broadness are favourable. Thailand, Taiwan, Sri Lanka, South Africa, Zimbabwe and Myanmar are among the few countries that grow baby corn. Maharashtra, Karnataka, Andhra Pradesh, Rajasthan, and Meghalaya are the few states in India producing baby corn. It is farmed on 8.49 million hectares in India, with production and yield rate of 21.28 million tonnes and 2507 kg per hectare, respectively. Baby corn is a successful crop that provides for production diversity, value accumulation, and revenue growth [2].

Among different minerals, potassium is one of the most vital cations to maintain optimum crop growth, quality and production. The plant tissues require potassium in greater quantities than phosphorus, and the typical proportion of proportion is around 8 to 10 times that of phosphorous. The hay or dry materials contains quadruple of potassium than phosphorus. During the vegetative development cycle, it accumulates in large quantities. This macronutrient is a major activator of numerable enzymes and promotes physiological processes such as photosynthesis, stomatal regulation, nutrient transportation, synthesis of protein, starch and osmoregulation of water and salts in plant [3]. Potassium increases plant immunity to climate fluctuations, infections, and pests as well as maintain cation and anion balance.

Besides the role of potassium, plant density and spacing is the other prominent factor affecting cob growth and yield. The form and area of leaf are controlled by the spatial organization of the plant, which in turn determines the productive interference of solar energy as well as the expansion and maturation of shoots and their activity. Highest yield may be predicted only if plant populace permits each plant to reach their full natural potential [4]. For improved yield, optimal plant population is a crucial component since it allows for more effective use of subterranean resources as well as maximum sunlight, which results in enhanced photosynthesis [5]. All crop species have an ideal plant population for best economic output, varying based on cultivar and climate [6]. Under certain combination of environment and management criteria, particular corn genotype, the crop production improves with increasing plant density, then drops when plant density is raised further [7]. The goal of the study is by taking the potassium and plant spacing can increase the production, plant growth and productivity when compare to other factors.

2. MATERIALS AND METHODS

The current experiment was conducted at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh (25˚39'42"N, 81˚67"56"E, 98 m) during the 2021 summer season (*Zaid)* The experiment was set up in a Randomized Block Design with nine treatments and three replicates to study the effect of different levels of spacing and quantity of potassium application - T_1: 30 kg/ha K_2O + 30cm x 15 cm, T_2: 30 Hiokg/ha K_2O + 40cm x 15 cm, T_3: 30 kg/ha K_2O + 50cm x 15 cm, T_4: 40 kg/ha K_2O + 30cm x 15 cm, T_5: 40 kg/ha K_2O + 40cm x 15 cm, T_6: 40 kg/ha K_2O + 50cm x 15 cm, T_7: 50 kg/ha K_2O + 30cm x 15 cm, T_8: 50 kg/ha K_2O + 40cm x 15 cm, T_9: 50 kg/ha K_2O + 50cm x 15 cm. The cultivated land had a sandy loam soil with virtually neutral pH, low in organic carbon (0.72 percent), accessible nitrogen (278.48 kg/ha), and medium in available phosphorus and potassium (27.80 kg/ha and 233.24 kg/ha, respectively). To meet the nitrogen, phosphorous, and potassium requirements, the study plot employed urea, DAP, and MoP as fertilizer sources. A suggested dosage of 120 kg N and 60 kg P2O5 was employed. According to the treatment specifics, 30 kg/ha, 40 kg/ha, and 50 kg/ha of potassium were administered by Muirate of Potash (MOP). Various plant growth metrics were measured at equal intervals from germination through harvest, and several yield characteristics were measured after harvest. Plant Height (cm), Number of

Leaves per Plant, and Dry Mass (g/plant) were measured in growth parameters, and yield parameters such as Cobs per plant, Cob Length per Plant (cm), Cob Weight (g) with and without husk, Cob Yield (t/ha), and Green Fodder Yield (t/ha) were measured and statistically analyzed using analysis of variance (ANOVA) (Gomez, K. A. and Gomez, A. A. 1984).

3. RESULTS AND DISCUSSIONS

3.1 Growth Parameters

3.1.1 Plant Height

The treatment (T9) with spacing 50 x 15 cm and potassium application of 50 kg/ha K_2O had the maximum plant height (161.43 cm) in comparison to other treatments. Two treatments with 50kg/ha K_2O and 40cm x 15cm (T_8) (161.10 cm) and 40kg/ha K_2O and 50cm x 15cm spacing (T6) (159.93 cm) had comparable results to T_9. The rise in plant height might be attributable to potassium, which plays an important role in meristematic development via its influence on the production of phytohormones. Cytokinin is a plant hormone that plays a key function in plant growth. Similar findings have been published by Kumar and Bohra [8]. Reduced row spacing led to lower plant height, owing to greater contest within the plants in narrower spacings vs broader spacings. The battle for space, light, nutrients, and moisture within intra-row plants was at its peak with low to moderate row spacing, which may explain the decrease in stem girth thickness. The considerable drop in growth of plants with reduced row spacing appears to be the consequence of natural shade caused by plant overcrowding, which may have restricted the accessibility of light inside the crop canopy and impeded extension of lower internodes. The present findings were akin to those of Neupane et al. [9].

3.1.2 Number of leaves per plant

The treatment with spacing 50 x 15 cm and potassium application of 50 kg/ha K_2O (T_9) had the maximum number of leaves per plant (12.60) in comparison to other treatments. Two treatments 50kg/ha K_2O and 40cm x 15cm (T_8) (12.43) and 40kg/ha K_2O and 50cm x 15cm spacing T_6 (12.33) had comparable results to T_9. Potassium treatment may result in an increase in the number of leaves since potassium plays an important part in the photosynthetic process and the production of photosynthetic pigments in the leaf. Parallel results have been published by Patil et al. [10].

3.1.3 Dry plant mass (g/plant)

The treatment (T_9) with spacing 50 x 15 cm and potassium application of 50 kg/ha K_2O had the highest dry plant mass (88.10 g/plant) in comparison to other treatments. Two treatments 50kg/ha K_2O and 40cm x 15cm (T_8) (87.42 g/plant) and 40kg/ha K_2O and 50cm x 15cm spacing T_6 (87.13 g/plant) had comparable results to T_9. Potassium is essential for meristematic growth because to its influence on phytohormone production. Identical outcomes have been noted by Kumar et al. [11]. Dry matter accumulation rose from 20 to 80 DAS owing to increased sunlight and CO2 availability under with the spacing of 50 x 15 cm, which may have led in greater photosynthetic productivity than with the spacings of 30 x 15 and 40 x 15 cm. This was evidenced by greater dry matter buildup at 50 x 15 cm spacing, followed by 40 x 15, 30 x 15 cm spacing. These results are in line with those of Sumeria et al. [12].

3.2 Effect on Yield and Yield Attributes of Baby Corn

3.2.1 Number of Cobs per Plant

The treatment with spacing 50 x 15 cm and potassium application of 50 kg/ha K_2O (T_9) had the highest number of cobs per plant (2.74) in comparison to other treatments. Two treatments with 50kg/ha K_2O and 40cm x 15cm (T_8) (2.67) and 40kg/ha K_2O and 50cm x 15cm spacing T_6 (2.63) had comparable results to T_9. Potassium treatment promotes the construction of robust cell walls and the sporulation of pollen mostly in florets, coupled with high productivity and cob formation. The current findings are parallel to Kalpana and Anbumani [13].

3.2.2 Length of Cob per Plant (cm)

The treatment (T_9) with spacing 50 x 15 cm and potassium application of 50 kg/ha K_2O had the highest number of cobs per plant (16.28 cm) in comparison to other treatments. Two treatments 50kg/ha K_2O and 40cm x 15cm T_8 (15.70 cm) and 40kg/ha K_2O and 50cm x 15cm spacing T_6 (15.53 cm) had comparable results to T_9. Potassium may be linked to improved grain filling and, as a result, an increase in several yield-related characteristics. The present outcomes are in accordance to those of Singh et al. [14].

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

Treatment Combinations		Plant height (cm)	Number of leaves/plant	Dry weight (g/plant)
1.	30 kg/ha K_2O + 30cm x 15 cm	152.30	11.10	84.29
2.	30 kg/ha K_2O + 40cm x 15 cm	155.00	11.33	85.23
3.	30 kg/ha K_2O + 50cm x 15 cm	156.54	11.63	85.83
4.	40 kg/ha K_2O + 30cm x 15 cm	155.63	11.47	85.38
5.	40 kg/ha K_2O + 40cm x 15 cm	159.20	12.10	86.75
6.	40 kg/ha K_2O + 50cm x 15 cm	159.93	12.33	87.13
7.	50 kg/ha K_2O + 30cm x 15 cm	158.23	11.90	86.21
8.	50 kg/ha K_2O + 40cm x 15 cm	161.10	12.43	87.42
9.	50 kg/ha K_2O + 50cm x 15 cm	161.43	12.60	88.10
S. Em (±)		0.59	0.09	0.34
CD (p=0.05)		1.76	0.27	1.01

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

Treatment Combinations		No. of cobs/plant	Length of cob/plant (cm)	Cob weight (g)		Cob Yield(t/ha)		Green fodder Yield (t/ha)
				With husk	Without husk	With husk	Without husk	
1.	30 kg/ha K_2O + 30cm x 15 cm	2.21	12.81	39.31	13.21	6.26	3.43	29.67
2.	30 kg/ha K_2O + 40cm x 15 cm	2.32	13.24	40.08	13.92	5.96	3.11	26.27
3.	30 kg/ha K_2O + 50cm x 15 cm	2.50	14.12	41.18	14.74	5.85	2.95	25.80
4.	40 kg/ha K_2O + 30cm x 15 cm	2.41	13.63	40.38	14.26	6.36	3.68	32.30
5.	40 kg/ha K_2O + 40cm x 15 cm	2.58	14.95	41.90	15.48	6.32	3.48	30.93
6.	40 kg/ha K_2O + 50cm x 15 cm	2.63	15.53	42.39	16.06	6.07	3.23	27.53
7.	50 kg/ha K_2O + 30cm x 15 cm	2.54	14.43	41.39	15.04	6.52	3.85	34.63
8.	50 kg/ha K_2O + 40cm x 15 cm	2.67	15.70	42.94	16.61	6.47	3.77	33.47
9.	50 kg/ha K_2O + 50cm x 15 cm	2.74	16.28	43.14	16.91	6.23	3.31	28.63
S. Em (±)		0.04	0.30	0.27	0.29	0.05	0.06	0.47
CD (P = 0.05)		0.12	0.91	0.82	0.88	0.16	0.18	1.41

3.2.3 Cob Weight

The treatment (T9) with spacing 50 x 15 cm and potassium application of 50 kg/ha K_2O had the highest number of cob weight with husk (43.14 g) in comparison to other treatments. Two treatments 50kg/ha K_2O and 40cm x 15cm T_8 (42.94 g) and 40kg/ha K_2O and 50cm x 15cm spacing T_6 (42.39 g) had comparable results to T_7.

The treatment with spacing 50 x 15 cm and potassium application of 50 kg/ha K_2O (T_9) had the highest number of cob weight without husk (16.91 g) in comparison to other treatments. Two treatments T_8 (16.61 g) and T_6 (16.06 g) had comparable results to T_7.

3.2.4 Cob Yield

The treatment (T7) with spacing 30 x 15 cm and potassium application of 50 kg/ha K_2O had the maximum cob yield with husk (6.52 t/ha) in comparison to other treatments. Two treatments 40kg/ha K_2O and 50cm x 15cm spacing T_6 (6.47 t/ha) and 40kg/ha K_2O and 30cm x 15cm T_4 (6.36 t/ha) had comparable results to T_7.

The treatment (T7) with spacing 30 x 15 cm and potassium application of 50 kg/ha K_2O (T_7) had the maximum cob yield without husk (3.85 t/ha) in comparison to other treatments. Two treatments T_6 (3.77 t/ha) and T_4 (3.68 t/ha) had comparable results to T_7.

Potassium treatment promotes the cumulative impact of improved yield parameters such as number of cobs per plant, cob length and thickness, and cob weight, as well as enhanced K nutritional availability, absorption, and translocation [15]. Increased cob yield may be partly related to less intra row spacing , which encourages competition in sun energy and ultimately stunts growth of some intra row plants in vegetative phase, preventing them from reaching reproductive phase, attributing factors were high relative to the recommended spacing. Because fewer plants reached the reproductive stage, production was poor. Similar conclusions have been drawn in the study by Sarker et al. [16].

3.2.5 Green Fodder Yield

The treatment with spacing 30 x 15 cm and potassium application of 50 kg/ha K_2O (T_7) had the maximum green fodder yield (34.63 t/ha) in comparison to other treatments. Two treatments $T_6$40kg/ha K_2O and 50cm x 15cm spacing (33.47 t/ha) and 40kg/ha K_2O and 30cm x 15cmT_4 (32.30 t/ha) had comparable results to T_7. Potassium treatment promotes the establishment of thick cell walls and, as a result, stiffer straw, which may result in profuse tillering. The present outcomes are akin to those of Patil and Basavaraja [17]. Reduced spacing resulted in increased plant population, which resulted in increased green fodder output as concluded by Hargilas [18]. The results were in accordance with Hargilas [18].

4. CONCLUSION

Amongst all the treatments, T9 with 30 x 15 cm spacing and 50 kg/ha K_2O exhibited the highest plant productivity and its features such as plant height, number of leaves per plant, dry plant mass, and cob's qualities among all treatments. Furthermore, the maximum crop growth rate, yield, and yield qualities such as cob yield and green fodder yield were discussed. It may be inferred that greater potassium treatment and wider spacing have a good influence on plant production and growth parameters.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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