Original Research Article

Effect of phosphorus levels and micronutrients on Growth and Yield of Babycorn

Abstract

A field experiment was conducted during kharif season (2022) at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P.). The treatments consisted of 3 levels of Phosphorous (30, 40, 50 kg ha^{-1}) and 3 levels of micronutrients (Zn-0.5%), (B-0.5%) (Fe-0.5%). The experiment was laid out in Randomized Block Design with 10 treatments and replicated thrice. The results reported that the application of 50kg ha^{-1} Phosphorous + 0.5% Zinc (treatment -7) recorded maximum plant height (160.7 cm), Maximum plant dry weight (74.60 g plant^{-1}), No. of corns per plant (1.77), corn length (19.3 cm), corn yield (10.06 t ha^{-1}), green fodder yield (28.43 t ha^{-1}). Maximum gross return (1,20501.00 INR ha^{-1}), net return (77,444.00 INR ha^{-1}) and B:C ratio (1.80) were recorded in (treatment -7) that is with 50 kg ha^{-1} Phosphorous + 0.5% Zinc

Key words: - Babycorn, *Boron, Iron, Kharif, Phosphorus, Zinc.*

Introduction:

Babycorn maize (Zea mays L.) is a highly profitable alternative to farmers due to its short crop duration, being harvested at the juvenile stage. It induces rapid demands for a lot of nutrients. Any sort of corn can be used to make babycorn; it is not a distinct variety of corn like popcorn or sweet corn. It is the dehusked maize ear that has been harvested young, particularly when the silk has either not emerged or is just beginning to emerge and there has been no fertilisation, or the shank with unpollinated silk, which is Babycorn. Due to its fresh and secure product, babycorn growing promises to play a significant role in crop production in the future. (Chamroy et al. 2017). It was a unique choice for cultivation in non-traditional maize growing locations due to its short duration, adaptability to various cropping methods, and appropriateness for cultivation in all seasons. Another benefit of cultivating Babycorn is the biomass (green fodder) that remains after harvest. (Kar 2014).

India is the fifth-largest producer of corn in the world, contributing 3% of global production across an area of about 9.18 million hectares with a production of 27.23 million tonnes and an average productivity of 2.96 t ha-1. Uttar Pradesh contributes an area of about 0.73 M ha with a 7.98% to the entire country of India, which has a production of about 1.53 M t. (Agriculture at glance 2019). One hundred grams of Babycorn contains about 89.1% Moisture, 1.9 g Protein, 0.2 g Fat, 0.06 g Ash, 8.2 mg Carbohydrate, 28 mg Calcium, 86 mg Phosphorus and 11 mg Ascorbic Acid (Thavaprakash et al., 2005). Babycorn offers the essential elements that are typically missing from people's diets. It contains significant amounts of potassium, folic acid, vitamins A, B, and E, as well as numerous other minerals. Additionally, it is a fantastic replacement because it is incredibly low in fat and has a lower Glycemic index than conventional maize. As a result, it will help you lose weight by reducing the overall amount of carbohydrates in your diet.

In terms of the quantitative requirements for plants, phosphorus is the second crucial essential element after nitrogen as a mineral nutrient. Although both organic and inorganic forms of it are plentiful in soils, their availability is limited since they primarily exist in insoluble forms. Growth, the utilisation of starch and sugar, photosynthesis, the development of cell division and nuclei, as well as the formation of albumen and fat, all depend on it. Phosphate molecules store energy from photosynthesis and the metabolism of carbohydrates for later use in growth and reproduction. (Arya and Singh 2000). As the plant creates cells and grows roots, stems, and leaves, it is easily translocated throughout the plant, migrating from older to younger tissues. A sufficient amount of P promotes rapid growth, earlier maturity, and higher-quality vegetative development. Insufficient phosphorus causes the twisting and production of tiny ears in maize, which results in crooked and missing rows.

Zinc is a crucial component for higher plants, and agriculture is starting to realise its value more and more (Genc et al. 2006). Zinc is essential for the pollination and seed-set processes, so a deficit could result in a decrease in seed production and a consequent loss in yield. In India, zine deficiency has increased from 44% to 48% and is projected to rise even further to 63% by 2025. According to (Vitosh et al. 1997), one of the crops most vulnerable to zinc deficiency is maize (Mattiello et al. 2015). "WHITE BUD" refers to a zinc deficit in maize. Due to its catalytic role in nearly all crops' metabolic processes, zinc is the most important element for plant growth and development (George et al. 2002). According to recent reports, after N and P, zinc is the third most significant nutritional element that limits crop yield.

All crops require boron to thrive and remain healthy. This substance is found in plant reproductive structures and cell walls. Numerous environmental parameters, such as temperature, light, and soil water conditions, have an impact on the requirements of boron to crops (Shorrocks, 1997). The nutrient is susceptible to migration in the soil since it is mobile there. Boron is required in minute quantities, thus it's crucial that it's dispersed equally over the area. It is essential for many processes that occur in plants, including pollination, seed germination, and the creation and stability of cell walls as well as the preservation of the structural and functional integrity of biological membranes. Effective nitrogen fixation and nodulation in legume crops also depend on adequate B levels. More often than any other micronutrient, crops lack boron (Gupta et al. 1985). For maize to tassel and produce silk, particularly during the tasseling phase, an adequate amount of boron is necessary. Boron supplementation improved the stability of heavy membranes, chlorophyll, soluble sugars, soluble proteins, and ammonia acids concentrations in leaf RWC dry mass accumulation. When used topically, boron is more efficient.

Chlorosis is caused by a deficiency of iron (Fe), which also causes major drops in plant quality and output. In numerous physiological and metabolic processes in plants, iron plays a crucial role. It is needed for a variety of biological processes as it is a component of numerous essential enzymes, including cytochromes of the electron transport chain. Iron is a component of chlorophyll production in plants and is necessary for the preservation of chloroplast structure and function. Foliar feeding is a novel and contentious method of feeding plants that involves drenching their leaves in liquid fertiliser (Rout and Sahoo, 2015).

Materials and Methods:

The current study was carried out in the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, during the Kharif season 2022. The experimental field coordinates are 25.4089833, 81.8530037 and it is located approximately 9 kilometers from Prayagraj city, near the Yamuna River, on the left side of the Prayagraj-Rewa Road. Prayagraj is located in the subtropical zone of Uttar Pradesh, with hot summers and pleasant winters. The soil chemistry analysis revealed a sandy loam texture with a pH of 7.6, low amounts of organic carbon (0.870 percent) and potassium (261.12 kg ha^{-1}), and a quantity of accessible phosphorus (41.8 kg ha). The soil was electrically conductive and had a conductivity of 0.511 dS m^{-1}. For each of the ten treatments combinations, three replications were employed. The treatment details and treatment combinations are shown in Tables 1 and 2, respectively. Phosphorus and micronutrients (Zn, B, Fe) were maintained according to the treatment combinations were all successfully measured, and an economic analysis of each treatment was completed to determine the best treatment combination for Babycorn cultivation. The growth parameters reading such as plant height, plant dry weight and also, yield parameters such as number of Corns per plant, corn length, corn yield and green fodder. The statistics were calculated and analysed using statistical approach which is one-way anova table used to compare more than two groups based on one factor with F probability of 0.005%.

Results and discussion:

Effect on the growth of Babycorn. As can be seen Table 1. Growth parameters are summarized statistically. At 60 DAS. Significantly taller plant height (160.7 cm) was recorded with application of (50Kg ha^{-1} Phosphorus + 0.5% Zinc). However, treatments (t5, t6, t8 and t9) was found to be statistically at par with treatment 7(50 kg ha^{-1} Phosphorus + 0.5% Zinc). At harvest, significantly maximum plant dry weight (74.73g) was recorded with application of (50 kg ha^{-1}Phosphorus + 0.5% Zinc). However, treatments (t8 and t9) was found to be statistically at par with treatment 7 (50 kg ha^{-1} Phosphorus + 0.5% Zinc). The results demonstrated that application of 50kg ha^{-1} phosphorus and 0.5% Zinc resulted in significant improvement in plant height and dry matter in Babycorn. Bose (2009) noted that morphological traits increased with phosphorus levels, which may be ascribed to phosphorus's higher function in cell division, cell expansion, and enlargement, which ultimately led to improved vegetative development and plant height. The beneficial increase in babycorn's dry weight may have resulted from zinc's participation in the synthesis of auxin, which was crucial to the crop's photosynthetic activity (as it is in the case with other C4 plants). Amutham et al., 2019.

Table: 1. Effect of phosphorus and micronutrients on growth of Babycorn.

S.No	Treatment combination	Plant height(cm)	Dry weight(g $plant^{-1}$)
1	Phosphorus 30 kg ha^{-1} + 0.5% Zinc	143.8	71.00
2	Phosphorus 30 kg ha^{-1} + 0.5% Boron	147.7	70.87
3	Phosphorus 30 kg ha^{-1} + 0.5% Iron	147.1	70.97
4	Phosphorus 40 kg ha^{-1} + 0.5% Zinc	148.5	71.87
5	Phosphorus 40 kg ha^{-1} + 0.5% Boron	153.7	72.27
6	Phosphorus 40 kg ha^{-1} + 0.5% Iron	154.6	71.93
7	Phosphorus 50 kg ha^{-1} + 0.5% Zinc	160.7	74.73
8	Phosphorus 50 kg ha^{-1} + 0.5% Boron	159.0	73.97
9	Phosphorus 50 kg ha^{-1} + 0.5% Iron	158.8	74.60
10	Control (90-60-40 NPK kg ha^{-1})	147.3	72.36
	SEm (±)	1.48	0.54
	CD 5%	4.39	1.60

Table:2. Effect of phosphorous levels and micronutrients on yield attributes in Babycorn.

S.no	Treatments	No. of corns per plant	Length of corn (cm)	Corn yield with husk (t ha^{-1})	Corn yield without husk (t ha^{-1})	Green fodder yield (t ha^{-1})
1.	Phosphorus 30 kg ha^{-1} + 0.5% Zinc	1.40	17.3	7.66	2.16	21.85
2.	Phosphorus 30 kg ha^{-1} + 0.5% Boron	1.47	17.3	8.05	2.55	22.83
3.	Phosphorus 30 kg ha^{-1} + 0.5% Iron	1.47	17.6	8.12	2.62	23.54
4.	Phosphorus 40 kg ha^{-1} + 0.5% Zinc	1.60	17.7	8.24	2.74	24.22
5.	Phosphorus 40 kg ha^{-1} + 0.5% Boron	1.53	17.9	8.28	2.78	25.12
6.	Phosphorus 40 kg ha^{-1} + 0.5% Iron	1.63	18.1	8.23	2.73	24.15
7.	Phosphorus 50 kg ha^{-1} + 0.5% Zinc	1.77	19.3	10.06	3.91	28.43
8.	Phosphorus 50 kg ha^{-1} + 0.5% Boron	1.73	19.1	9.79	3.52	27.90
9.	Phosphorus 50 kg ha^{-1} + 0.5% Iron	1.73	17.9	9.55	3.34	26.64
10.	Control (90-60-40 NPK kg ha^{-1})	1.20	16.2	7.42	3.42	21.10
	SEm (±)	0.058	0.545	0.372	0.42	1.07
	CD (5%)	0.174	1.620	1.108	1.20	3.19

Table 3. Effect of phosphorous levels and micronutrients on economics in Babycorn.

S.no	Treatments	Gross returns (INR/ha)	Net returns (INR/ha)	B: C ratio (B: C)
1.	Phosphorus 30 kg ha^{-1} + 0.5% Zinc	91895.00	49854.00	1.19
2.	Phosphorus 30 kg ha^{-1} + 0.5% Boron	96481.00	54259.00	1.29
3.	Phosphorus 30 kg ha^{-1} + 0.5% Iron	97678.00	55538.00	1.32
4.	Phosphorus 40 kg ha^{-1} + 0.5% Zinc	99354.00	56815.00	1.34
5.	Phosphorus 40 kg ha^{-1} + 0.5% Boron	100384.00	57664.00	1.35
6.	Phosphorus 40 kg ha^{-1} + 0.5% Iron	99205.00	56567.00	1.33
7.	Phosphorus 50 kg ha^{-1} + 0.5% Zinc	120501.00	77444.00	1.80
8.	Phosphorus 50 kg ha^{-1} + 0.5% Boron	117430.00	74192.00	1.72
9.	Phosphorus 50 kg ha^{-1} + 0.5% Iron	114148.00	70992.00	1.65
10.	Control (90-60-40 NPK kg ha^{-1})	88970.00	45464.00	1.05

Effect on the yield of Babycorn:- As can be seen in Table 2. Yield parameters are summarized statistically. At harvest significantly higher number of corns (1.77) $plant^{-1}$ recorded in 50 kg ha^{-1} Phosphorus + 0.5% Zinc. However, treatments (t4, t6, t8 and t9) was found to be statistically at par with the Treatment-7 (50 kg ha^{-1} Phosphorus + 0.5% Zinc). At harvest significantly maximum length of corn $plant^{-1}$ (19.34) recorded in Treatment-7 (50 kg ha^{-1} Phosphorus + 0.5% Zinc). However, treatments (t6, t8 and t9) was found to be statistically at par with the Treatment-7 (50 kg ha^{-1} Phosphorus + 0.5% Zinc). At harvest maximum corn yield with husk (10.06 t ha^{-1}). However, treatments (t8 and t9) was found to be statistically at par with Treatment-7 (50 kg ha^{-1} Phosphorus + 0.5% Zinc). At harvest significantly maximum corn yield without husk (3.91 t ha^{-1}). However, treatments (t4, t5, t6, t8 and t9) was found to be statistically at par with Treatment-7 (50 kg ha^{-1} Phosphorus + 0.5% Zinc). At harvest significantly maximum quantity of green fodder (28.43 t ha^{-1}). However, treatments (t8 and t9) was found to be statistically at par with Treatment-7 (50 kg ha^{-1} Phosphorus + 0.5% Zinc). The findings showed that the number of maize plants per plant and maize length may be related to the beneficial effects of micronutrients on babycorn growth, which may be related to cell division and elongation that occurs quickly with a balanced supply of nutrients (NPK). helps increase the number of corns/plants in maize Bohra and Rakesh Kumar (2014). The role of zinc and phosphorus play a crucial role in increasing maize yield because they are involved in many physiological processes of plants, such as chlorophyll formation, stomatal regulation, and starch utilisation, which increase maize yield. This could explain why fertilisation increases maize yield. A sufficient amount of photosynthesis may have caused the grains to fill continuously, increasing the length and size of the maize. Gnanasundari et al., 2018. The increased production of green fodder at a given amount of nutrient may be attributable to the greater photosynthetic translocation made possible by the application of zinc. Mahdi et al. (2012) observed similar outcomes of noticeably improved fodder yield with Zn application.

CONCLUSION

Based on the study, it can be concluded that in Babycorn crop application of phosphorus 50 kg ha^{-1} along with 0.5% Zinc foliar spray at 30 DAS found desirable for enhancing yield and economic returns under Eastern Uttar Pradesh Agro- Climatic conditions.

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