Original Research Article

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

Abstract: A field experiment was conducted duing kharif season (2022) at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P.). The soil of experimental plot was sandy loam in texture, pH 7.6, organic carbon (0.870 %), available N (219 kg ha^{-1}), available P (41.8 kg ha^{-1}) and available K (261.2 kg ha^{-1}ha). 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 demands large amounts of nutrients in a short time. Babycorn is not a separate type of corn like sweet corn or popcorn and any corn type can be used as Babycorn. It is the dehusked maize ear, harvested young especially when the silk has either not emerged or just emerging and no fertilization takes place or the shank with unpollinated silk is Babycorn. Babycorn cultivation promises to have an important role in the future of crop production due to its fresh and safe product (Chamroy et al. 2017). Its short duration, adoptability in different cropping systems, suitability to cultivate in all the seasons cultivation practices made it a special choice for cultivation in non-traditional corn growing areas. The other advantage of growing Babycorn is its remaining biomass (green fodder) after harvesting (Kar 2014).

In India, corn is being cultivated in an area of about 9.18 million hectares with a production of 27.23 million tons and an average productivity of 2.96 t ha^{-1} which is fifth largest producer in the world contributing three percent of the global production, Uttar Pradesh contributes an area of about 0.73 M ha with a 7.98% to all over India which has a production of about 1.53 M t (Agriculture at glance 2019). One hundred grams of Babycorn are found to be rich in 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 provides the valuable nutrients that lack in most people’s diets. It is high in potassium, folic acid, and is a rich source of vitamins A, B, E and many other minerals. Furthermore, it is extremely low in fat and has a lower Glycemic index than regular corn making it a great substitute. This means it will contribute fewer carbohydrates to your diet overall and help with weight loss.

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. 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 (Arya and Singh et al. 2000). It is readily translocated within the plants, moving from older to younger tissues as the plant forms cells and develops roots, stems and leaves. 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 in maize.

Zinc is an essential element for higher plants, and its importance in agriculture is increasingly being recognized (Genc et al. 2006). Zinc plays a key role in pollination and seed set processes; so that their deficiency can cause decrease in seed formation and subsequent yield reduction. Zine deficiency has increased from 44% to 48%, and is expected to further increase up to 63% by 2025 in India. (Vitosh et al. 1997) expressed that maize is one of the crops most sensitive to zinc deficiency (Mattiello et al. 2015). Zinc deficiency in maize is known as "WHITE BUD". Zinc is most crucial among the micronutrients that take part in plant growth and development due to its catalytic action in metabolism of almost all crops (George et al. 2002). Zinc is now been reported as the third most important limiting nutrient elements in crop production after N and P.

Boron is essential to the growth and health of all crops. Cell walls and reproductive structures of plants contain this compound. The requirements of boron to crop is affected by several environmental factors like temperature, light and soil water conditions (Shorrocks, 1997). The nutrient is mobile in the soil, which means it is prone to movement. As Boron is needed in small amounts, it is important that it is distributed evenly across the field. It plays a key role in numerous plant functions, including cell wall formation and stability, the maintenance of structural and functional integrity of biological membranes, the movement of sugar into growing parts, and pollination and seed germination. Adequate B is also required for effective nitrogen fixation and nodulation in legume crops. It is more common for crops to lack boron than for any other micronutrient (Gupta et al. 1985). A sufficient quantity of boron is required for corn to tassel and silk, especially during the tasseling process. Application of boron increased the stability of leavy membranes, chlorophyll, soluble sugars, soluble protein, ammonia acids contents leaf RWC dry mass accumulation. Boron is more effective when applied foliarly.

Iron (Fe), the lack of which causes chlorosis and is responsible for significant decreases in yield and quality of plants. Iron plays a significant role in various physiological and biochemical pathways in plants. It serves as a component of many vital enzymes such as cytochromes of the electron transport chain, and it is thus required for a wide range of biological functions. In plants, iron is involved in the synthesis of chlorophyll, and it is essential for the maintenance of chloroplast structure and function. Foliar feeding is a new and controversial technique of feeding plants by applying liquid fertilizer directly to their leaves (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 2021-22, (U.P.). 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% developed by Ronald Fisher in 1918.

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) observed that with increase in the levels of phosphorus morphological characters increased which might be attributed to a stronger role of phosphorus in cell division, cell expansion, and enlargement which ultimately lead to the improved vegetative growth and plant height. The possible reason for this might be due to the fact that the favourable increase in dry weight of Babycorn might be due to Zinc involvement in auxin synthesis which played a major role in photosynthetic activity of the crop (as in 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
	F-test	S	S
	SEm (±)	1.48	0.540
	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
	F- test	S	S	S	S	S
	SEm (±)	0.058	0.545	0.372	0.42	1.07
	CD (5%)	0.174	1.620	1.108	1.20	3.19

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 results demonstrated that no. of corns plant^{-1} and corn length might be due to the favourable influence of the micronutrient on the growth of Babycorn might be due to rapid cell division and cell elongation with balanced nutrient (NPK) supply. in maize helps to increase the no. of corns/plant Rakesh Kumar and Bohra (2014). The increase in corn yield with fertilization might be due to the role of phosphorus and zinc play a vital role in increasing corn yield because zinc and phosphorus takes place in many physiological process of plant such as chlorophyll formation, stomatal regulation, starch utilization which enhance corn yield. The continuous filling of grains due to sufficient photosynthesis might have resulted in increased length and size of the corn. Gnanasundari et al., (2018). Increase in a green fodder yield might be due to the enhanced translocation of photosynthates with applied Zinc, which resulted in a higher production of green fodder in a respective level of nutrient. Similar results of significantly higher fodder yield with Zn application was also reported by Mahdi et al., 2012.

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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