Research Article

The Response Of Row Direction, Sowing Time And Levels Of Zinc On Growth And Yield Of Sweet Corn (*Zea mays saccharata* L.)

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Received: Aug 27, 2020; Accepted: Nov 9, 2020; Published: Dec 30, 2020

CITATION: Singh S, Shukla AK, Shukla MK, Singh R. The Response Of Row Direction, Sowing Time And Levels Of Zinc On Growth And Yield Of Sweet Corn (*Zea mays saccharata* L.). Recent Adv. Biol. Med. 2021; 7(1): 9800012, Pages 1-4.

ABSTRACT

A field experiment was conducted during the *rabi* season of 2013 at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, SHUATS, Prayagraj to evaluate the response of row orientation, sowing time, and levels of zinc on growth and economics of sweet corn (*Zea mays saccharata*). The experiment consisted of twelve treatments comprising of three-row orientations (control, East–West and North-South orientation of sowing), two dates of sowing (22nd October and 06th November) and two zinc levels (20 kg/ha and 30 kg/ha), which were laid out in Randomized Block Design and replicated thrice. The experimental findings reveal the highest plant height, number of leaves/plant, dry weight accumulation, and Crop Growth rate under the treatment T_{11} (East–West orientation of sowing on 22nd October and applied with 30 kg/ha of Zn/ha). Similarly, the highest number of cobs/plant, cob weight (g), number of grains/cob, and stover yield (t/ha) were recorded under the same treatment T_{11}.

KEYWORDS: Sweet Corn; Row Direction; Zinc; Growth; Yield.

1. INTRODUCTION

Maize (*Zea mays* L.) is a cereal crop and it is called as "queen of cereals" and "non-tillering plant". Maize is one of the three major world food crops, is recognized as the "golden food" because of its high grain yield and nutrition value, and plays a very important role in the daily calorie intake of humans. Maize is the third most important crop in India after rice and wheat. In the world, India ranks 5th in acreage and 8th in the production of maize. Globally, the total area of maize was 186.86 m ha, production 1078.56 mt and in India area under maize cultivation is about 9.63 m ha, production 25.90 mt in 2016-17 [14]. Zinc plays a very important role in plant metabolism by influencing the activities of hydrogenase and carbonic anhydrase and stabilization of ribosomal proteins. Amongst crops, maize shows a high sensitivity to Zn deficiency for its physiological requirements. Zinc activates the plant enzymes by carbohydrate metabolism, maintaining the integrity of cellular membranes, protein synthesis, and regulation of auxin synthesis. It is essential for the synthesis of auxin because Zn helps in tryptophan production, which is a precursor of Indole3-acetic acid (IAA). Zinc has a pronounced effect on the important processes of plants like photosynthesis, protection against reactive oxygen species, nitrogen metabolism, carbonic anhydrase activity, chlorophyll synthesis, and resistance to biotic and abiotic stresses [11]. Maize is one of the crops most sensitive to Zn deficiency [12]. Zn is a micronutrient that enhances grain productivity in maize production [12]. The supply of Zn in the crops can be done directly on the soil, as fertilizers, via foliar fertilization or seed treatments [7]. Zinc being an essential nutrient plays a significant role in stomata regulation and reducing the tensions of less water by creating ionic balance in plants [4] and is involved in various physiological processes such as the synthesis of protein and carbohydrates. Application of zinc fertilizers to maize crop not only boost its production but also improve zinc contents in tissues [5]. However, to overcome the zinc shortage for human beings there is a dire need to feed them with zinc increased foods on a sustainable basis. Based on new inquiries connected to reasons for low maize yield, an assumption was framed that the use of Zn as foliar increases processes accountable for the yield and quality of maize [15]. The time that the crop is exposed to climatic factors is different from grain corn and it is known that the *Zea mays* L. species is strongly influenced by environmental factors. On the other hand, temperature, solar radiation, photoperiod, and rainfall vary randomly around seasonal average tendencies, so that the greatest challenge is adjusting the ideal time for sowing [13]. The proper positioning of the sowing time (ST) becomes even more challenging because of the climatic change [6,8,9].

Planting date plays important role in the growth, development, and yield of maize. Optimum planting date has become prime importance for higher crop production. The plant establishment as well as pest and disease incidence are affected by planting dates. Crop varieties respond differently to planting dates. Early or late planting dates on maize causes an array of morpho-anatomical, physiological, and biochemical changes in plants, which affect plant growth and development and such changes may lead to a drastic reduction in yield of Maize [13].

2. MATERIALS AND METHODS

The field experiment was conducted during the *rabi* season of 2013 at the Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, SHUATS, Prayagraj. The soil was sandy loam in texture, low in organic carbon and medium in available nitrogen, phosphorus, and low in potassium. The experiment was laid out in Randomized Block Design, comprising of 12 treatment combinations each replicated thrice. The treatments comprised of three-row orientations (control, East–West and North-South orientation of sowing), two dates of sowing (22nd October and 06th November), and two zinc levels (20 kg/ha and 30 kg/ha). Sweet corn variety 'US-80' was chosen for the trial. A uniform basal dose of 120 kg N, 80 kg P_2O_5, and 60 kg K_20 was applied at sowing time. Nitrogen was applied in two splits. One part was top-dressed at the knee-high stage and the other part was top-dressed at the tasselling stage. The various observations on plant growth, yield, and economics were calculated as per the treatment details.

3. RESULTS AND DISCUSSION

The observation recorded on 90 DAS clearly show that significantly higher plant height (117.06 cm), number of leaves/ plant (11.46), plant dry weight (76.18 g), Crop Growth Rate (10.93 g/m^2/day), and Relative Growth Rate (0.60 g/g/day) were recorded under the treatment T_{11} (East–West orientation of sowing on 22nd October and applied with 30 kg/ha of Zn/ha). Although the plant height recorded under treatments T_5 (East–West orientation of sowing on 22nd October and applied with 20 kg/ha of Zn/ha), number of leaves/plants recorded under treatment T_5, dry weight recorded under treatment T_6 (North-South+6-11-2013+20 kg/ha Zn), Crop Growth Rate recorded under treatment T_5 and relative growth rate under treatment T_5 were found to be statistically at par with that recorded under treatment T_{11} (East-West+ 22-10-2013+30 kg/ha Zn). East–West orientation of sowing increases the sunlight receptivity of the plants, which might have an influence in the better photosynthetic accumulation in plants and earlier sowing on 22nd October might have led to better growth of maize plants due to higher temperature as compared to 6th November sown crop [5]. The better growth of the plants with zinc application as it is involved in the protein synthesis and biosynthesis of indole 3- acetic acid, required for cell division, cell elongation and increase in growth and yield [2,10].

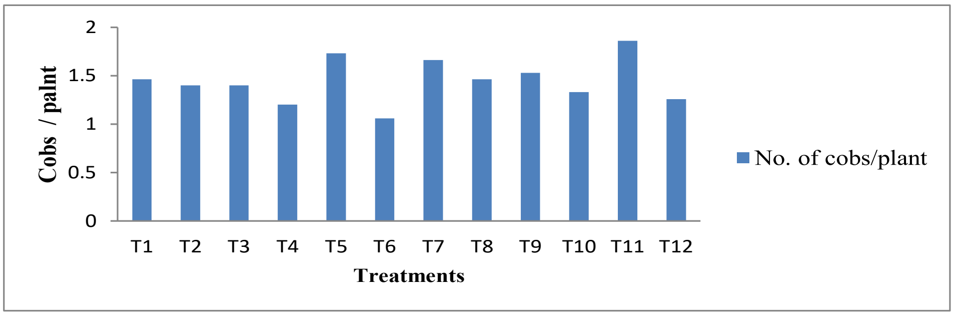
Among the yield contributing characters, the highest number of cobs/plant, cob weight, number of grains/cob, and stover yield (t/ha) were recorded under the treatment T_{11} (East–West orientation of sowing on 22nd October and applied with 30 kg/ha of Zn/ha), although the cobs/plant recorded under treatments T_5 (East–West orientation of sowing on 22nd October and applied with 20 kg/ha of Zn/ha) and T_7 (control sowing on 22nd October and applied with 30 kg/ha of Zn/ha) respectively, cob weight recorded under treatments T_5, cob length recorded under treatments T_5 and T_7 were found to be statistically at par to that recorded under treatment T_{11}.

The highest benefit-cost ratio was recorded under the treatment T_{11}, which can be attributed to the higher yield attributing traits, a greater number of cobs/plant with almost no higher input cost, therefore more net profit than the other treatments [2,3].

Table 1. Effect of different treatments on growth parameters of sweet corn.

S. No.	Treatment	Plant height (cm) 90 DAS	Number of leaves/plants 90 DAS	Dry weight (g) 90DAS	CGR (g/m^2/day) (60-90 DAS)	RGR (g/g/day) (60-90 DAS)
T_1	Control+22-10-2013+20kgha^{-1} Zn	99.50	10.80	72.20	10.41	0.054
T_2	East–West+6-11-2013+20kgha^{-1} Zn	100.62	10.60	69.42	9.89	0.048
T_3	North-South+22-10-2013+20kgha^{-1} Zn	98.57	10.60	71.36	10.39	0.044
T_4	Control+6-11-2013+20kgha^{-1} Zn	95.89	9.53	67.33	10.18	0.056
T_5	East–West+22-10-2013+20kgha^{-1} Zn	111.08	11.13	75.22	10.23	0.045
T_6	North-South+6-11-2013+20kgha^{-1} Zn	94.56	9.40	66.26	10.77	0.058
T_7	Control+22-10-2013+30kgha^{-1} Zn	106.69	11.00	74.34	10.41	0.046
T_8	East–West+6-11-2013+30kgha^{-1} Zn	103.95	10.73	70.58	9.97	0.047
T_9	North-South+22-10-2013+30kgha^{-1} Zn	104.22	10.93	73.70	10.58	0.049
T_{10}	Control+6-11-2013+30kgha^{-1} Zn	98.71	10.33	68.48	9.90	0.050
T_{11}	East-West+ 22-10-2013+30kgha^{-1} Zn	117.06	11.46	76.18	10.93	0.060
T_{12}	North-South+6-11-2013+30kgha^{-1} Zn	97.67	9.86	68.30	10.06	0.052
	F-test	**S**	**S**	**S**	**S**	**S**
	CD (P = 0.05)	**5.31**	**0.33**	**1.42**	**0.32**	**0.002**

Figure 1. Effect of row direction, sowing time, and zinc levels on the number of cobs plant^{-1} of sweet corns.



4. CONCLUSION

From the above results, it can be concluded that for obtaining better growth, yield, and profit from sweet corn cultivation, East–West orientation of sowing on 22nd October should be practiced with an application of 30 kg/ha of Zinc, in addition to the recommended doses of nitrogen, phosphorus, and potash.

AUTHOR CONTRIBUTIONS

All authors contributed equally to this study.

CONFLICT OF INTEREST

None.

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Figure 2. Effect of row direction, sowing time, and zinc levels on cob weight (g) of sweet corn.

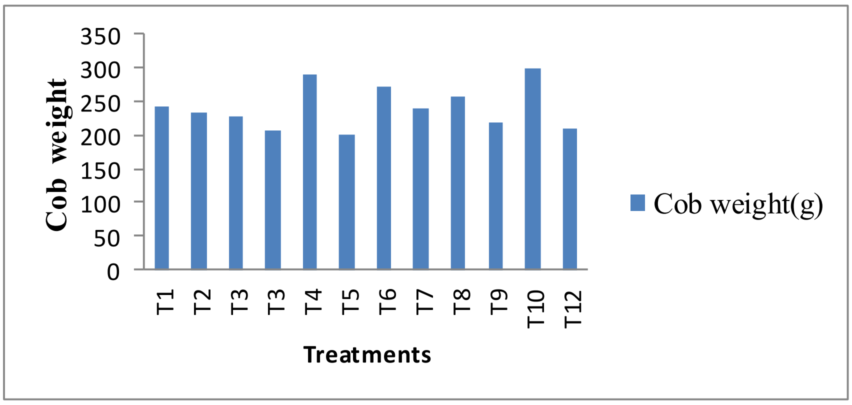

Figure 3. Effect of row direction, sowing time, and zinc levels on the number of grains/cob of sweet corn.

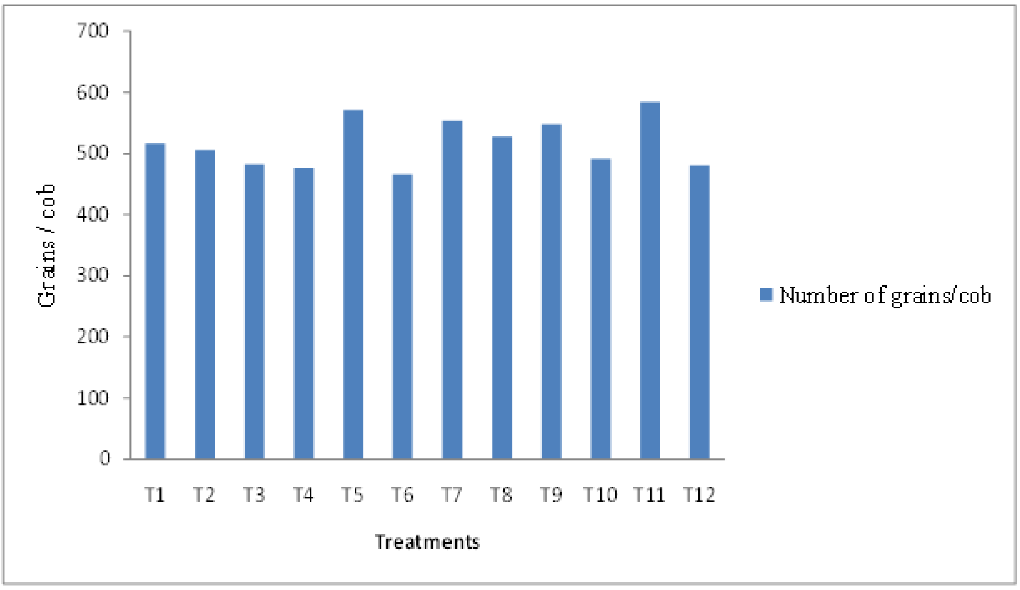

Figure 4. Effect of row direction, sowing time, and zinc levels on the number of stover yield (t/ha) of sweet corn.