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Response of *Kharif* Sweet Corn (*Zea mays* L. *var. Saccharata*) to Micronutrient Management

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ABSTRACT: A field investigation entitled "Response of *kharif* sweet corn (*Zea mays* L. var. *saccharata*) to micronutrient management" was conducted in *Kharif* season of 2022-2023 at the Instructional farm, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra). The soil of experimental field was low in available nitrogen (192.67 kg ha^{-1}), medium in available phosphorus (17.87 kg ha^{-1}) and moderately high in potassium (432.51 kg ha^{-1}). The field experiment was laid out in randomized block design (RBD) with three replications. There were eight treatments *viz.*, T_1: Absolute control, T_2: RDF (120: 60: 40 N: P_2O_5: K_2O kg ha^{-1}), T_3: GRDF (120: 60: 40 N: P_2O_5: K_2O kg ha^{-1} + FYM 10 t ha^{-1}), T_4: GRDF + Soil application of Multi- micronutrient Grade I @ 25 kg ha^{-1}, T_5: GRDF + Soil application of $ZnSO_4$ @ 25 kg ha^{-1}, T_6: GRDF + Two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS, T_7: GRDF + Soil application of Multi- micronutrient Grade I @ 25 kg ha^{-1} + Two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS and T_8: GRDF + Soil application of $ZnSO_4$ @ 25 kg ha^{-1} + Two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS. The yield contributing characters of sweet corn such as weight of cob with husk (237.26 g), and without husk (197.20 g), diameter of cob with husk (21.84 cm) and without husk (18.69 cm) and green cob yield (192.10 q ha^{-1}) were significantly higher under application of GRDF in association with soil application of Multi-micronutrient Grade I @ 25 kg ha^{-1} along with two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS. However, it was at par with GRDF in association with soil application of $ZnSO_4$ @ 25 kg ha^{-1} + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS. The sweet corn crop fertilized with GRDF in association with soil application of Multi-micronutrient Grade I @ 25 kg ha^{-1} along with two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS, recorded significantly higher gross monetary returns (₹ 253369 ha^{-1}), net monetary returns (₹ 169125 ha^{-1}) and B: C ratio (3.01) as compared to rest of the treatments during investigation. However, it was at par with treatment GRDF + soil application of $ZnSO_4$ @ 25 kg ha^{-1} + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS.

Keywords: Sweet corn, Yield, Economics, Micronutrient Grade I, Phule liquid micro grade II.

INTRODUCTION

Agriculture is the key sector of the Indian economy and allied sector contributes nearly 18.8% of GDP (Anonymous, 2022) and about around 58% of the population dependent on agriculture and allied sectors such as livestock, poultry and fishery etc. for their livelihood. Cereals are grass like crop plants in the poaceae family that are produced for their edible starchy seeds that have a global impact. The principal cereals are cultivated on almost half of the world's ploughed land. 50% of the protein consumed worldwide and 56% of the dietary calories comes from wheat, rice, corn, barley, oats, rye, sorghum and millets. In general, wheat, rice, and corn account for three quarters of global grain production. Sorghum, barley, millets, rye and oats account for the world's remaining cereal grain production.

The maize crop is cultivated throughout the year in all states of the India for various purposes including grain, fodder, sweet corn, baby corn, pop-corn in peri-urban areas. Among the speciality corns, sweet corn has gaining popularity both in urban and rural areas because of it's high sugar and low starch content. It is important in urban areas due to it's taste and other uses for human consumption. Thus the increase in production and productivity of sweet corn will be a desirable attribute in facilitating diversified utilization through human consumption of fresh kernels as well as processed food.

Micronutrients are vital plant nutrients consumed in minute amounts by plants. Because it contributes to essential physiological processes, a micronutrient

shortage can have a major influence on crop productivity. Fe serves as an essential micronutrient for almost all living organisms because of it plays critical role in metabolic processes such as DNA synthesis, respiration, and photosynthesis. Copper involved in lignin synthesis and enzyme systems. It required in photosynthesis and intensify flavor and colour in vegetables. Manganese plays role in oxidation and reduction reaction, photosynthesis, fixation of atmospheric nitrogen and synthesis of pigments. Boron assists sugar and nutrient transfer, improve pollination and development of seed. Mo is used by selected enzymes to carry out redox reactions. Alvarez and Rico (2003) noticed that increasing Zn rate in the soil significantly increased dry matter yield of maize as compared with the control treatment without Zn addition.

MATERIAL AND METHODS

The field experiment was conducted at the Instructional farm, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri Dist. Ahmednagar during *kharif* season of 2022-23.The soil in the experimental field belongs to Inceptisol order and medium deep soil with a depth of more than 60 cm and the topography is uniform and levelled. For the assessment of initial soil fertility status, representative initial soil samples were taken. These soil samples were properly mixed and a composite soil sample was collected and evaluated for physical and chemical soil parameters. The soil texture of experimental field was clay loam, low in available nitrogen (192.67 kg ha^{-1}), medium in available phosphorus (17.87 kg ha^{-1}) and very high in available potassium (432.51 kg ha^{-1}). The soil in the experimental field was slightly alkaline (pH 7.59) with 0.54% org. carbon, soil electrical conductivity was 0.43 dS m^{-1}.Geographically, the Instructional Farm of PGI, MPKV, Rahuri lies on the elevation of 495 to 569 m above sea level. It is situated between 19°48' and 19°57′ North latitude and 74°10′ and 74°32′ East longitude. Agro climatically, this area is located in rain scarcity zone of Maharashtra (drought prone area). Monsoon season usually begins in the third week of June and ends in the last week of September, with yearly rainfall ranging from 307 to 619 mm, with an average rainfall of 520 mm. The climatic conditions were favorable for sweet corn growth and development, according to the meteorological data.

The experiment was laid out in a randomized block design with three replications. Eight different treatment combinations were created. The seeds of sweet corn variety Phule Madhu were obtained from Chief Scientist (Seed), Seed Cell unit, MPKV, Rahuri. Sowing was done on 3rd July 2022 by dibbling two seeds at each hill at recommended spacing 60 cm × 20 cm. Harvesting was done manually at physiological maturity of crop.

RESULTS AND DISCUSSION

A. Yield Characters

(i) Weight of cob with husk and without husk. The data in respect of weight of cob with husk and without husk of sweet corn as influenced by different treatments during *kharif* season, 2022 are presented in Table 1. The mean weight of cob with husk and without husk of sweet corn (207.81 g and 171.84 g, respectively) was obtained during investigation.

The data in respect of cob weight with husk and without husk of sweet corn was influenced significantly due to different nutrient combinations at harvest. The sweet corn crop applied with GRDF along with soil application of Multi-micronutrient Grade I @ 25 kg ha^{-1} + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS produced significantly higher weight of cob with husk and without husk of sweet corn (237.26 g and 197.20 g, respectively) as compared to rest of the nutrient management treatments. However, the treatment GRDF + soil application of $ZnSO_4$@ 25 kg ha^{-1} + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS was found at par with it in weight of cob with husk and without husk(232.46 g and 194.24 g, respectively) at harvest. Whereas the significantly minimum weight of cob with husk and without husk of sweet corn (116.79 g and 85.73 g, respectively) was recorded in the treatment absolute control, where no fertilizers were applied during the experimentation. Adhikary *et al.* (2010); Jayant *et al.* (2018); Bhangare *et al.* (2019) all discovered that the increased fresh weight of the cob could have been attributed to the function of iron and zinc in photosynthesis, as well as the uptake and transfer of photosynthates from leaves to the sink.

(ii) Diameter of cob with husk and without husk. The data in respect of diameter of cob with husk and without husk of sweet corn as influenced by different treatments during *kharif* season, 2022 are presented in Table 1. The mean diameter of cob with husk and without husk of sweet corn (18.62 cm and 15.74 cm, respectively) was obtained during investigation.

The data in respect of diameter of cob with husk and without husk of sweet corn was influenced significantly due to different nutrient combinations at harvest. The sweet corn crop applied with GRDF along with soil application of Multi-micronutrient Grade I @ 25 kg ha^{-1} + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS produced significantly maximum diameter of cob with husk and without husk of sweet corn (21.84 cm and 18.69 cm, respectively) as compared to rest of the nutrient management treatments. However, the treatment GRDF + soil application of $ZnSO_4$ @ 25 kg ha^{-1} + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS was found at par with it in diameter of cob with husk and without husk(20.82 cm and 17.73 cm, respectively) at harvest. Whereas, the significantly minimum diameter of cob with husk and without husk of sweet corn (13.30 cm and 11.97 cm, respectively) was recorded in the treatment absolute control, where no fertilizers were applied during the experimentation. Based on the continuous availability of nutrients to the plant, basal treatments combined with foliar nutrients improve diameter of cob, according to Chandrakanth *et al.* (2017); Drocelle *et al.* (2019).

Table 1: Weight of cob with husk and without husk, diameter of cob with husk and without husk and green cob yield of sweet corn as influenced by different treatments.

Sr. No.	Treatment	Weight of cob with husk (g)	Weight of cob without husk (g)	Diameter of cob with husk (cm)	Diameter of cob without husk (cm)	Green cob yield (q ha^{-1})
1.	Absolute control	116.79	85.73	13.30	11.97	90.21
2.	RDF (120: 60: 40 N: P_2O_5: K_2O kg ha^{-1})	198.33	164.08	17.34	14.32	141.76
3.	GRDF (120: 60: 40 N: P_2O_5: K_2O kg ha^{-1} + FYM 10 t ha^{-1})	209.08	174.24	17.86	14.67	165.47
4.	GRDF + Soil application of Multi-micronutrient Grade I@ 25 kg ha^{-1}	227.81	190.59	19.73	16.62	178.17
5.	GRDF + Soil application of $ZnSO_4$@ 25 kg ha^{-1}	223.18	187.17	19.37	16.21	176.54
6.	GRDF + Two foliar sprays of Phule Liquid Micro Grade II @ 1% at30 and 45 DAS	217.57	182.42	18.78	15.74	174.63
7.	GRDF + Soil application of Multi-micronutrient Grade I@ 25 kg ha^{-1} + Two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS	237.26	197.20	21.84	18.69	192.10
8.	GRDF + Soil application of $ZnSO_4$ @ 25 kg ha^{-1} + Two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS	232.46	194.24	20.82	17.73	189.34
	S. Em ±	2.65	1.94	0.66	0.65	3.45
	CD (P= 0.05)	7.97	5.88	2.01	1.98	10.39
	General mean	207.81	171.84	18.62	15.74	163.53

(iii) Green cob yield. The data in respect of green cob yield of sweet corn as influenced by different treatments during *kharif* season, 2022 are presented in Table 1. The mean green cob yield of sweet corn (163.53 q ha^{-1}) was obtained during investigation.

The data in respect of green cob yield of sweet corn was influenced significantly due to different nutrient combinations at harvest. The sweet corn crop applied with GRDF along with soil application of Multi-micronutrient Grade I @ 25 kg ha^{-1}+ two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS produced significantly maximum green cob yield of sweet corn (192.10 qha^{-1}) as compared to rest of the nutrient management treatments. However, the treatment GRDF + soil application of $ZnSO_4$ @ 25 kg ha^{-1} + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS was found at par with it (189.34 q ha^{-1}) in green cob yield. Whereas the minimum green cob yield of sweet corn (90.21 q ha^{-1}) was recorded in the treatment absolute control, where no fertilizers were applied during the experimentation. The sweet corn applied GRDF along with soil application of Multi-micronutrient Grade I or $ZnSO_4$@ 25 kg ha^{-1} + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS offered easy availability for the absorption of micro and macro nutrients in higher amount.

The efficient utilization of zinc helped in the synthesis of IAA and uptake of water. Boron boosts the salt absorption, hormone movement and carbohydrate metabolism. Iron played vital role in synthesis of chlorophyll and act as oxygen carrier. The continuous availability of the micronutrients from soil and foliar spray increases the growth characters and zinc and iron increases the translocation of photosynthates from source to sink ultimately leads to higher green cob yield. The similar findings were reported by Adhikary *et al.* (2010); Karanjikar *et al.* (2020).

B. Economic studies

The economic evaluation of sweet corn crop was assessed in terms of gross monetary returns, cost of cultivation, net monetary returns and benefit cost ratio during *kharif* season of 2022-23 are presented in Table 2.

(i) Gross monetary returns. The mean gross monetary returns of sweet corn crop obtained during *kharif* 2022-23 was (₹219158 ha^{-1}). The gross monetary returns of sweet corn crop were influenced significantly due to different nutrient management treatments. The sweet corn crop fertilized with GRDF along with soil application of Multi-micronutrient Grade I @ 25 kg ha^{-1} and two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS found superior and obtained significantly maximum gross monetary returns ₹ 253369 ha^{-1}than other treatments. However, the treatment GRDF + soil application of $ZnSO_4$ @ 25 kg ha^{-1} + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS was found at par with it in gross monetary returns(₹ 249721 ha^{-1}). Whereas the significantly minimum gross monetary returns (₹ 130191) were recorded in the treatment absolute control, where no fertilizers were applied during the experimentation. Similar findings were recorded by Ashoka *et al.* (2009); Manjanaik *et al.* (2012).

Table 2: Economics of sweet corn as influenced by different treatments.

Tr. No.	Treatment	Gross monetary returns (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Net monetary returns (₹ ha^{-1})	B: C ratio
T_1	Absolute control	130191	61142	69049	2.13
T_2	RDF (120: 60: 40 N: P_2O_5: K_2O kg ha^{-1})	193566	69593	123973	2.78
T_3	GRDF (120: 60: 40 N: P_2O_5: K_2O kgha^{-1} + FYM 10 t ha^{-1})	222971	79593	143378	2.80
T_4	GRDF + Soil application of Multi- micronutrient Grade I @ 25 kg ha^{-1}.	236707	81093	155613	2.92
T_5	GRDF + Soil application of $ZnSO_4$@ 25 kg ha^{-1}	234573	82093	152480	2.86
T_6	GRDF + Two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS	232168	82413	149756	2.82
T_7	GRDF + Soil application of Multi- micronutrient Grade I @ 25 kg ha^{-1} + Two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS	253369	84245	169125	3.01
T_8	GRDF + Soil application of $ZnSO_4$ @ 25 kg ha^{-1} + Two foliar sprays of Phule Liquid Micro Grade II @ 1% at30 and 45 DAS	249721	84913	164808	2.94
	S. Em ±	4106.20	-	4106.20	-
	CD (P= 0.05)	12454.72	-	12454.72	-
	General mean	**219158**	**78136**	**141023**	**2.78**

(ii) Net monetary returns. Themean net monetary returns of sweet corn crop obtained during *kharif* 2022-23 were (₹ 141023 ha^{-1}). The net monetary returns of sweet corn crop were influenced significantly due to different nutrient management treatments. The sweet corn crop fertilized with GRDF along with soil application of Multi-micronutrient Grade I @ 25 kg ha^{-1} and two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS found superior and obtained significantly maximum net monetary returns (₹ 169125 ha^{-1}) than other treatments. However, the treatment GRDF + soil application of $ZnSO_4$ @ 25 kg ha^{-1} + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS was found at par with it in net monetary returns(₹ 164808 ha^{-1}). Whereas the significantly minimum gross monetary returns (₹ 69049) were recorded in the treatment absolute control, where no fertilizers were applied during the experimentation. Similar findings were recorded by Ashoka *et al.* (2009); Manjanaik *et al.* (2012).

(iii) Cost of cultivation. Themean cost of cultivation of sweet corn crop obtained during *kharif* 2022-23 was (₹ 78136 ha^{-1}). The sweet corn crop fertilized with GRDF along with soil application of $ZnSO_4$@ 25 kg ha^{-1} and two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS recorded maximum cost of cultivation (₹ 84913 ha^{-1}) than other treatments. However, the minimum cost of cultivation (₹ 61142) was recorded in the treatment absolute control, where no fertilizers were applied during the experimentation.

(iv) Benefit: cost ratio. The mean benefit cost ratio of sweet corn crop obtained during *kharif* 2022-23 was (2.78). The sweet corn crop fertilized with GRDF along with soil application of $ZnSO_4$@ 25 kg ha^{-1} and two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS found superior and obtained maximum benefit cost ratio (3.01) which was followed by GRDF + soil application of $ZnSO_4$ @ 25 kg ha^{-1} + two foliar sprays of Phule Liquid Micro Grade II @ 1% at30 and 45 DAS (2.94). However, the minimum benefit cost ratio (2.13) was recorded in the treatment absolute control, where no fertilizers were applied during the experimentation. Similar findings were recorded by Ashoka *et al.* (2009) ; Manjanaik *et al.* (2012).

CONCLUSIONS

The application of GRDF (120: 60: 40 N: P_2O_5: K_2O Kg ha^{-1} + FYM 10 t ha^{-1}) along with soil application of Multi-micronutrient Grade I or $ZnSO_4$ @ 25 kg ha^{-1} and two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS to sweet corn crop found beneficial for increase of yield attributes, yield and economic returns grown on medium deep soil.

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