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Yield and yield attributes of sweet corn (*Zea mays* L. *saccharate*) as influenced by split application of nitrogen and potassium during *kharif* under protective irrigation

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Abstract
A field experiment was conducted during *kharif* season of 2018 at WALMI farm, UAS, Dharwad to study the response of sweet corn (*Zea mays* L. *saccharata*) to split application of nitrogen and potassium with protective irrigation. The experiment was laid out in factorial RCBD with three replications. There were two factors *Viz*., fertilizer levels (L_1:100:50:25, L_2:125:60:25 and L_3:150:65:65) and split application of nitrogen and potassium (S_1: Two equal split as basal and 30 DAS, S_2: Three equal splits as basal, 30 and 45 DAS and S_3: P and K as basal and N in three equal splits as basal, 30 and 45 DAS). Among the fertilizer levels, application of 150:65:65 $N:P_2O_5:K_2O$ kg ha^{-1} recorded significantly higher fresh cob yield (150 q ha^{-1}) and fresh fodder yield (245 q ha^{-1}) compared to application of 100:50:25 $N:P_2O_5:K_2O$ kg ha^{-1}. However, it was on par with 125:60:25 $N:P_2O_5:K_2O$ kg ha^{-1}. Among split application, three split application of N and K as basal, 30 and 45 DAS recorded significantly higher fresh cob yield (153 q ha^{-1}) and fresh fodder yield (247 q ha^{-1}) as compared to application of P and K as basal and N was applied in 3 equal split doses (as basal, 30 and 45 DAS). However, it was on par with split application of N and K in two equal splits (as basal and 30 DAS).

Keywords: Sweet corn, split application of nitrogen and potassium

Introduction

Maize is one of the important cereal crop in the world agricultural economy and important crop next to rice and wheat in the world. Maize is a multifaceted crop used as a food, feed and industrial crop globally. It has a very predominant role to carryout in Indian economy. About 85 per cent is consumed as human food. It has got a very high yield potential due to its genetic constituent in contrast to other crops hence it is called “queen of cereals”.

Sweet corn was introduced to India from U.S.A. Sweet corn and common corn both belong to same botanical species but the only variant is that the endosperm of sweet corn in milky stage has greater polysaccharides contents. It has sugary rather that astarchy endosperm. The low starch level makes the grains of sweet corn wrinkled. Sweetcorn is not the same as conventional maize fundamentally for genes that is characteristic of starch synthesis in seed endosperm wherein at least one or more simple recessive alleles adjust the sugars content of the endosperm and elevate the level of water dissolvable polysaccharides and subsequently decrease the levels of starch, consequently the essence of sweet corn is a lot better than ordinary corn. It can't be viewed as staple crop but instead consumed as a confection.

The increased market value of sweet corn at commercial level has led to augment the income of the farmers. It is gaining immense trade potential in domestic and international market. These tends open up vistas of opportunity for India’s maize sector.

Sweet corn consumption takes in wide variety of forms *ie*vegetable, green, frozen, canned or boiled form and is gaining wider popularity amid the urbanites. It has special niche in preparation of native beer. Besides the sweet kernels the fodder is very succulent, highly palatable and digestible hence preferred by the milch animals. The crop is highly remunerative as it possesses high total biomass. “Productivity potential of sweet corn is more than wheat and nutritive status is superior than rice on account of which it will no longer be a ‘course grain’, but a nutritive grain" (Batra, 2002) [3].

Nitrogen is a fundamental key component in crop growth and development and furthermore most restricting supplement in the soil.

Sweet corn yield has been positively related to doses of nitrogen (Bar Yosef *et al.* 1989) [2]. It is positively corelated in improving level of protein, succulency, palatability and the quality of produce, it has important role in synthesis of chlorophyll and other several amino acids. It is also an essential constituent of proteins and many physiological compounds relating to plant metabolism, such as alkaloids, nucleotides, vitamins, phosphatides, hormones, enzymes. Sweet corn is a heavy feeder of the plant nutrients (Bar Yosef *et al.* 1989) [2]. Corn being an exhaustive crop requires higher fertilizer inputs mainly that of nitrogen.

The importance of potassium is quite obvious from the fact that it is involved in more than 80 enzymatic systems in plant (Kasana and Khan, 1976) [17]. It is required by the plants for various processes like synthesis of protein, vitamins, starch and cellulose. Potassium assumes a crucial role in maintaining water balance and water use efficiency by controlling the stomatal movement and helps plant growth under drought condition (Hsiao, 1973) [5]. Potassium is credited to yield increment and influence produce quality and hence called ‘quality element’. It enhances the ability to resist both biotic (pests, diseases, insects) and abiotic (cold and drought) stress potassium has an exceptional significance attributable to its essential job in development and translocation of starch and sugar. Most of potassium is chemically bound in insoluble mineral form and is unavailable or slowly available to plants. Maize absorbs about 70-80 per cent potassium by the time of silking and 100 per cent by the time of 3-4 weeks after silking.

The absence of information about the utilization and economic significance of sweet corn and its non-accessibility of suitable appropriate production technology are the major constraints for its popularization amid Indian sweet corn growers, with a view of higher monetary returns from sweet corn, growing of sweet corn instead of maize to improve the economic condition of the grower is picking up significance.

Material and Methods

The experimental site was located at 15^0 31’ 01” N latitude, 74^0 55’ 32” E longitudes an altitude of 711 m above mean sea level. The research plot is located in Northern Transition Zone (Zone-8) of Karnataka. The soil type of experimental site was clay loam soil. The pH of soil (7.64), electrical conductivity (0.28 dS m^{-1}), organic matter content (0.56 %), available nitrogen (255.9 kgha^{-1}), available phosphorus (34.9 kg ha^{-1}) and available potassium (370.6 kg ha^{-1}). The experiment was laid out in RCBD with factorial concept with three replications. The first factor consisted of levels of fertilizers (L_1: 100 : 50 : 25, L_2: 125 : 60 : 25, L_3: 150 : 65 : 65 N, P_2O_5, K_2O kg ha^{-1}) and second consisted of split application of nitrogen and potassium (S_1: Two splits, one at basal and another at 30 DAS, S_2: Three splits, one at basal, another one at 30 DAS and rest at 45 DAS, S_3: P and K basal and N was applied in 3 equal split doses at sowing, 30 DAS and at 45 DAS). There were nine treatment combinations. The experiment was replicated three times. Sweet corn genotype Sugar 75 was used in the present field experiment. The hybrid was released by Syngenta seeds Ltd. The seeds were dibbled at 60 cm apart with intra row spacing of 20 cm on 19 June 2018. Two seeds were dibbled to a depth of 4-5 cm in the furrows.

Observations on yield and yieldattributes viz., fresh cob yield (q ha^{-1}), fresh cob yield (q ha^{-1}), cob length (cm), cob girth (cm), number of grains per cob and number of rows per cob were recorded after the harvest of the crop.

Results and Discussion

Performance of fertilizer levels on yield

In the present study, significantly higher fresh cob yield (150.0 q ha^{-1}) and fresh fodder yield (244.2 q ha^{-1}) was recorded with higher fertilizer level (150: 65: 65 N:P_2O_5: K_2O kg ha^{-1}) (L_3) and which was on par with fertilizer level of 125 : 60 : 25 N:P_2O_5:K_2O kg ha^{-1}. Whereas, significantly lower fresh cob yield (143.5 q ha^{-1}) and fresh fodder yield (236.5 q ha^{-1}) was recorded with lower fertilizer level of 100:50: 25 N:P_2O_5: K_2O kg ha^{-1} (L_1) (Table 1). Similar results were observed by Singh and Yadav (2007) [13]. The native available soil nitrogen was low (255.6 kg ha^{-1}) and hence the application of higher level of fertilizer resulted in higher nutrient availability. The balanced application of nutrients has favoured the growth and development of better root system, which helped in better uptake of nutrients. Further, it improves the rate of photosynthesis, dry matter accumulation and translocation to reproductive parts as indicated by higher values of growth and yield components that resulted in higher fresh cob yield with husk of sweet corn.

Effect of split application of N and K on yield

Among the split application of N and K, significantly higher fresh cob yield (152.9 q ha^{-1}) and fresh fodder yield (247.4 q ha^{-1}) was recorded with three split application of N and K (one at basal, another one at 30 DAS and rest at 45 DAS) (S_2). However, significantly lower fresh cob and fodder yield was observed with P and K basal and N was applied in 3 equal split doses (1/3rd at sowing, 1/3rd at 30 DAS and 1/3rd at 45 DAS) (S_3) (Table 1). The similar results are obtained by Muthukumar *et al.* (2005) [12]. The higher fresh cob yield was due to continuous availability of nutrients throughout the crop growth period without any interruption for nutrient requirements, because split application of N and K (one at basal, another one at 30 DAS and rest at 45 DAS to sweet corn crop might fulfil the needs of plants. The higher availability of source under split application of nutrient which created more sink which ultimately higher productivity of sweet corn and also split application of potassium regulates the biosynthesis, conversion, and allocation of metabolites that ultimately increases the yield. Islam and Muttaleb (2016) [6] experimented on rice with various doses of K fertilizer. They reported that K helps to increase the N uptake as well as N use efficiency that help in increasing the yield of rice. As a result, rice yield increased to 6.86 t ha^{-1} year^{-1} with optimum doses of K, whereas without K the yield was 5.19 t ha^{-1} year^{-1}.

Treatment effect of fertilizer levels and split application of N and K was found non-significant with respect to yield of sweet corn.

Performance of fertilizer levels on yield attributers

Higher yield attributes of sweet corn might be due to higher fertilizer level of 150:65:65 N:P_2O_5:K_2O kg ha^{-1} as compared to lower level of fertilizer this was due to superior yield characters *viz.*, cob girth, cob length, number of grains per row. The higher yield attributes was observed with higher fertilizer as compared to lower fertilizer it might be due to adequate availability of NPK levels improved nitrogen use efficiency. Higher accumulation of dry matter in plants and effective translocation of photosynthates from source to sink which might have helped in early formation of reproductive structures at higher levels of NPK and increased yield attributes (Table 2). Similar findings were also reported by Arunkumar *et al.* (2007) [1], Kar *et al.* (2006) [7] and Singh *et al.* (2008) [14].

Effect of split application of N and K on yield attributes

Higher yield attributes was observed with three split application of N and K (one at basal, another one at 30 DAS and rest at 45 DAS as compared to other split application of N and K. The higher yield attributes it might be due to higher cob girth, cob length, number of and grains per row (Table 2). The similar results are close conformity with the findings of Tilahun *et al.* (2013) [15]. The higher yield attributes was observed with three split application of N and K as compared to other treatments. It might be due to nitrogen and potassium application cause enhanced the crop growth at maximum level. Timely supply of sufficient nutrients for proper growth and development and also potassium (quality element) enhanced grains numbers and quality of sweet corn (Yang *et al.*, 2014) [16].

Treatment effect of fertilizer levels and split application of N and K was found non-significant with respect to yield attributes of sweet corn.

Table 1: Fresh cob yield and fresh fodder yield of sweet corn as influenced by fertilizer levels and split application of NK during *kharif* under protective irrigation

Treatments	Fresh cob yield (q ha^{-1})	Fresh fodder yield (q ha^{-1})
Factor I: (Levels of N, P_2O_5 and K_2O kg ha^{-1})		
L_1: 100 : 50 : 25	144	236
L_2: 125 : 60 : 25	148	241
L_3: 150 : 65 : 65	150	245
SE.m+	1.92	2.32
C.D at 5 %	5.74	6.97
Factor II: (Split application of nitrogen and potassium)		
S_1: Two (basal, 30 DAS)	147	241
S_2: Three (basal, 30 DAS, 45 DAS)	153	247
S_3: P and K basal and N will be applied in 3 equal split doses (sowing, 30DAS, 45DAS)	141	234
SE.m+	1.92	2.32
C.D at 5 %	5.74	6.97
Interactions		
L_1S_1	144	232
L_1S_2	152	243
L_1S_3	135	232
L_2S_1	147	244
L_2S_2	152	247
L_2S_3	144	233
L_3S_1	151	246
L_3S_2	154	251
L_3S_3	145	237
S.Em+	3.32	4.03
C.D at 5 %	NS	NS

Table 2: Cob length, girth, number of grains per cob and number of rows per cob of sweet corn as influenced by fertilizer levels and split application of NK during *kharif* under protective irrigation

Treatments	Cob length (cm)	Cob girth (cm)	Number of grains per cob	Number of rows per cob
Factor I: (Levels of N, P_2O_5 and K_2O kg ha^{-1})				
L_1: 100 : 50 : 25	15.4	14.4	35.4	15.1
L_2: 125 : 60 : 25	16.6	14.5	36.7	15.3
L_3: 150 : 65 : 65	16.9	15.0	37.6	15.8
SE.m+	0.37	0.21	1.16	0.46
C.D at 5 %	1.11	0.64	NS	NS
Factor II: (Split application of nitrogen and potassium)				
S_1: Two (basal, 30 DAS)	16.3	14.8	36.4	15.8
S_2: Three (basal, 30 DAS, 45 DAS)	17.3	15.3	39.9	16.7
S_3: P and K basal and N will be applied in 3 equal split doses (sowing, 30DAS, 45DAS)	15.2	13.9	33.3	13.8
SE.m+	0.37	0.21	1.16	0.46
C.D at 5 %	1.11	0.64	3.47	1.37
Interactions				
L_1S_1	16.1	14.6	35.0	15.3
L_1S_2	16.8	15.2	39.3	16.7
L_1S_3	13.3	13.5	32.0	13.3
L_2S_1	16.3	14.6	36.7	16.0
L_2S_2	17.4	15.1	39.7	16.7
L_2S_3	16.1	14.0	33.7	13.3

L_3S_1	16.7	15.2	37.7	16.0
L_3S_2	17.8	15.5	40.7	16.7
L_3S_3	16.1	14.3	34.3	14.7
S.Em+	0.64	0.37	2.01	0.79
C.D at 5 %	NS	NS	NS	NS

Conclusion

In the present investigation carried to find the response of Yield and yield attributes of sweet corn (*Zea mays* L. *saccharate*) as influenced by split application of nitrogen and potassium during kharif under protective irrigation, the application of fertilizer level of 150: 65: 65 N, P_2O_5, K_2O kg ha^{-1} significantly recorded higher yield and yield attributes compared to the other fertilizer levels. In case of split application of nitrogen and potassium in three splits, one at basal, another one at 30 DAS and rest at 45 DAS recorded higher yield and yield attributes.

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