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Research Article

Effect of Organic and Inorganic Sources of Nitrogen on Growth, Quality Parameters, Yield and Yield Attributes of Sweet Corn (*Zea mays* L. *sachharata*) in Typic Haplusteps

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ABSTRACT

An experiment was carried out during kharif, 2019 at the Instructional Farm of the Rajasthan College of Agriculture, Udaipur. Experiment laid out in randomized block design with three replications comprising twelve treatments i.e. 100% RDN through urea, 75% RDN through urea + 25% N – FYM, 50% RDN through urea + 50% N – FYM, 75% RDN through urea + 25% N – VC, 50% RDN through urea + 50% N – VC, 50% RDN through urea + 25% N – FYM + 25% N – VC, 125% RDN through urea, 100% RDN through urea + 25% N – FYM, 75% RDN through urea + 50% N – FYM, 100% RDN through urea + 25% N – VC, 75% RDN through urea + 50% N – VC, 75% RDN through urea + 25% N – FYM + 25% N – VC. Plant growth and yield attributes as well as yield were recorded. Sweet corn variety (Sugar 75) was taken as test crop. Application of 125% RDN through urea significantly improved the growth, quality parameters, yield and yield attributes of sweet corn which was at par with combined organic and inorganic sources of 125% RDN. Treatment receiving 125% RDN through urea gave higher numerical values compared to organic and inorganic combinations.

Keywords: *Integrated nutrient management, Growth, Yield attributes, Yield, Sweet corn, Sugar 75.*

INTRODUCTION

Maize (*Zea mays* L.) is a miracle crop emerging as the third most valuable cereal crop next to rice and wheat in the world. It is grown for food, feed and as a source of various industrial products, grown under complex climatic conditions on an area of approximately 140 m ha. At present, maize is cultivated over 8.80 m ha area with an output of 22.56 million tonnes and an average productivity of 2563 kg ha^{-1}.

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Sweet corn (*Zea mays* L. *saccharata*) is a hybrid maize variety (*Zea mays* L.) specially bred to augment the sugar content and provides green ears in about 75 to 90 days after sowing. Sweet corn contains 10-11% starch, 5-6% soluble sugar, 3% water soluble polysaccharides and 70% water, in addition to moderate levels of protein and vitamin (yellow varieties) and potassium.

The demand of sweet corn industry is expanding day by day because of raising domestic consumption, import replacement and export development. Added advantage of sweet corn is that the crop remains at green stage even after the harvest of green ears and it is fit for feeding cattle as green fodder. Being of its short duration, it has valuable place in different cropping systems. But in our country, cultivation of sweet corn is confined to limited area by both private sectors and farmers to fulfill the demand of industries. Insubstantial knowledge in its usage, economic importance and inadequacy of suitable production technology are the chief constraints for its dissemination amongst Indian farmers. The net income obtained from sweet corn is quite higher in contrast to grain maize.

Keeping in mind the production potential of maize in the state and high economic returns from sweet corn in contrast to grain maize, there is immense scope of cultivating maize as sweet corn to enhance economic status of poor farmers, especially maize growers. High cost accompanied with inadequacy of requisite amount of fertilizer is the serious problem for small and marginal farmers to raise sweet corn in these areas. As a substitute, development of cost effective integrated nutrient management systems constituting fertilizers and organic sources may prove better for cultivation. Integrating organic and inorganic sources also help in maintaining soil health and to accomplish the sustained yield levels besides maintaining the environment pollution free.

Low fertility of the soil is principle obstacle in maintaining sustainable agricultural production and productivity. Application of chemical fertilizers continuously over many years has been found to degrade soil health. Sustainable yield levels could be accomplished by applying suitable integration of chemical fertilizers and organic sources. Integrated use of organic and inorganic sources of nutrients is an option to mitigate soil fertility problem as it exploits available organic and inorganic nutrient sources for sustainable agricultural production and productivity. As the production technology for sweet corn is inadequate in relation to higher cob yields and nutrient management, prime objective of the experiment was to judge the suitable effect of different organic and inorganic sources of nitrogen on soil properties and productivity of sweet corn on a sustainable basis.

MATERIALS AND METHODS

The present investigation entitled **"Effect of organic and inorganic sources of nitrogen on soil properties and productivity of sweet corn (*Zea mays* L. *saccharata*) in typic haplusteps"** was carried out at Agronomy Farm Rajasthan College of Agriculture, Udaipur during *kharif* season of the year 2019-20. The experimental farm is situated in southern part of Rajasthan at 24°35 N latitude and 73°42 E longitude and this area falls under agro-climate zone IV a (Sub-humid Southern Plain and Aravalli Hills) of Rajasthan. The climate of Udaipur is sub-tropical with mean annual rainfall of 658 mm. The weekly mean maximum temperature during the crop period ranged from 27.6°C to 33.6°C and minimum from 21.0°C to 26.2°C with the average of 30.89°C and 22.57°C, respectively. The weekly mean relative humidity ranged from 55 to 94.3 per cent with an average of 78.3 per cent. A total rainfall of 799.8 mm was received during the period of experimentation.

The experiment was laid out in randomized block design (RBD) with three replications and twelve treatments viz., 100% RDN through urea, 75% RDN through urea + 25% N – FYM, 50% RDN through urea + 50% N – FYM, 75% RDN through urea + 25% N – VC, 50% RDN through urea + 50% N – VC, 50% RDN through urea + 25% N – FYM + 25% N – VC, 125% RDN through urea, 100%

RDN through urea + 25% N – FYM, 75% RDN through urea + 50% N – FYM, 100% RDN through urea + 25% N – VC, 75% RDN through urea + 50% N – VC, 75% RDN through urea + 25% N – FYM + 25% N – VC.

Details of observations recorded:

Plant height: The plant height of sweet corn was measured at three stages i.e., 30 DAS, 50 DAS and at harvest time from the ground level of the plant to the peak point of the top most leaf with the help of wooden scale of 100 cm length.

Dry matter accumulation: The amount of dry matter accumulated in plants was recorded by cutting down tagged plants from the base level and shade drying was done. Thereafter, shade dried plants were subjected to oven drying and weight was recorded.

Cob yield per plant: When 70% moisture was present in the grains, the cobs from the five individual plants were harvested manually and weighed separately to get the cob yield per plant.

Green cob yield: When 70% moisture was present in the grains, the cobs from the plants present in the net plot were harvested manually and weighed to get the cob yield.

Green fodder yield: The plants which were left behind after harvesting of cobs were subsequently cut down to the base of the plant and their fresh weights were taken.

Stover yield: The plants which were left behind after harvesting of cobs were subsequently cut down to the base of the plant and their dry weights were taken.

Protein content: For the determination of protein content of grain, the percentage of nitrogen which is present in the grain was multiplied with a factor of 6.25 given by A.O.A.C. (1960).

Statistical analysis: Statistical analysis was done for the recorded data to test whether the data is significant or not by using analysis of variance technique for randomized block design framed by Panse and Sukhatme (1985).

RESULTS

Plant height

The plant height of sweet corn was recorded at 30, 50 DAS and at harvest and the data was statistically analyzed and provided in Table 1 and Fig. 1. The data revealed that there was a significant effect of different treatments at all three stages of crop growth was observed. It was also found that there was a progressive increase in plant height with the advancement of the crop growth up to harvest. The treatment with 125% RDN through urea recorded maximum plant height of 97.82, 195.64 and 213.87 cm at 30, 50 DAS and at harvest respectively which was statistically on par with 100% RDN through urea + 25% N – FYM, 75% RDN through urea + 50% N – FYM, 100% RDN through urea + 25% N – VC, 75% RDN through urea + 50% N – VC, 75% RDN through urea + 25% N – FYM + 25% N - VC. These were followed by 100% RDN through urea (89.92, 177.14 and 196.07 cm at 30, 50 DAS and at harvest respectively) which was found statistically at par with 75% RDN through urea + 25% N – FYM, 50% RDN through urea + 50% N – FYM, 75% RDN through urea + 25% N – VC, 50% RDN through urea +5 0% N – VC, 50% RDN through urea + 25% N – FYM + 25% N – VC.

Dry matter accumulation

The data presented in the Table 1 and Fig. 2 revealed that there was a significant effect of different treatments on the dry matter accumulation of plant at 30, 50 DAS and at harvest. The maximum dry matter accumulation of 36.74, 64.66 and 83.55 g plant^{-1} was obtained with the application of 125% RDN through urea at 30, 50 DAS and at harvest respectively which was statistically on par with 100% RDN through urea + 25% N – FYM, 75% RDN through urea + 50% N – FYM, 100% RDN through urea + 25% N – VC, 75% RDN through urea + 50% N – VC, 75% RDN through urea + 25% N – FYM + 25% N - VC. These were followed by 100% RDN through urea (34.19, 54.63 and 72.86 g plant^{-1} at 30, 50 DAS and at harvest respectively) which was found statistically at par with 75% RDN through urea + 25% N – FYM, 50% RDN through urea + 50% N – FYM, 75% RDN through urea + 25% N – VC, 50% RDN through urea + 50% N – VC, 50% RDN through urea + 25% N – FYM + 25% N – VC.

Protein content

It can be inferred from the data furnished in the Table 1 and Fig. 3 revealed that that the protein content of cob was significantly varied from 10.25 to 11.88 %. The highest protein content was recorded with the application of 125% RDN through urea (11.88 %) which was statistically at par with 100% RDN through urea + 25% N – FYM, 75% RDN through urea + 50% N – FYM, 100% RDN through urea + 25% N – VC, 75% RDN through urea + 50% N – VC, 75% RDN through urea + 25% N – FYM + 25% N – VC. These were followed by 100% RDN through urea (10.84 %) which was found statistically at par with 75% RDN through urea + 25% N – FYM, 50% RDN through urea + 50% N – FYM, 75% RDN through urea + 25% N – VC, 50% RDN through urea + 50% N – VC, 50% RDN through urea + 25% N – FYM + 25% N – VC. The lowest protein content was observed with 50% RDN through urea + 50% N – FYM (10.25 %).

Cob yield (g plant^{-1})

On the basis of data furnished in Table 2 and Fig. 4 it can be inferred that cob yield plant^{-1} varied from 371.63 g to 304.76 g. The different treatments was showed significant effect on cob yield plant^{-1} and the maximum yield 371.63 g of was recorded with the application of 125% RDN through urea which was statistically at par with 100% RDN through urea + 25% N – FYM, 75% RDN through urea + 50% N – FYM, 100% RDN through urea + 25% N – VC, 75% RDN through urea + 50% N – VC, 75% RDN through urea + 25% N – FYM + 25% N – VC. These were followed by 100% RDN through urea (310.15 g) which was found statistically at par with 75% RDN through urea + 25% N – FYM, 50% RDN through urea + 50% N – FYM, 75% RDN through urea + 25% N – VC, 50% RDN through urea + 50% N – VC, 50% RDN through urea + 25% N – FYM + 25% N – VC.

Stover yield

A perusal of data given in Table 2 and Fig. 4 showed that there was significant effect of different treatments on stover yield and the highest yield obtained with the 125% RDN through urea (5514.30 kg ha^{-1}) which was statistically at par with 100% RDN through urea + 25% N – FYM, 75% RDN through urea + 50% N – FYM, 100% RDN through urea + 25% N – VC, 75% RDN through urea + 50% N – VC, 75% RDN through urea + 25% N – FYM + 25% N – VC. These were followed by 100% RDN through urea which recorded 4808.77 kg ha^{-1} and found statistically at par with 75% RDN through urea + 25% N – FYM, 50% RDN through urea + 50% N – FYM, 75% RDN through urea + 25% N – VC, 50% RDN through urea + 50% N – VC, 50% RDN through urea + 25% N – FYM + 25% N – VC. The lowest stover yield was observed with 50% RDN through urea + 50% N – FYM (4297.26 kg ha^{-1}).

Green cob yield

It was observed from the data presented in Table 2 and Fig. 4 that green cob yield was recorded significantly highest with the application of 125% RDN through urea (9879 kg ha^{-1}) which was statistically at par with 100% RDN through urea + 25% N – FYM, 75% RDN through urea + 50% N – FYM, 100% RDN through urea + 25% N – VC, 75% RDN through urea + 50% N – VC, 75% RDN through urea + 25% N – FYM + 25% N – VC. These were followed by 100% RDN through urea (9087.02 kg ha^{-1}) which was found statistically at par with 75% RDN through urea + 25% N – FYM, 50% RDN through urea + 50% N – FYM, 75% RDN through urea + 25% N – VC, 50% RDN through urea + 50% N – VC, 50% RDN through urea + 25% N – FYM + 25% N – VC. The lowest green cob yield was observed with 50% RDN through urea + 50% N – FYM (8433 kg ha^{-1}).

Green fodder yield

It is concluded from the data presented in Table 2 and Fig. 4 that green fodder yield was recorded significantly highest with the application of 125% RDN through urea (22057.20 kg ha^{-1}) which was statistically at par with 100% RDN through urea + 25% N – FYM, 75% RDN through urea + 50% N – FYM, 100% RDN through urea + 25% N – VC, 75% RDN through urea + 50% N – VC, 75% RDN through urea + 25% N – FYM + 25% N – VC. These were followed by 100% RDN through urea (19235.09 kg ha^{-1}) which was found statistically at par with 75% RDN through urea + 25% N – FYM, 50% RDN through urea + 50% N – FYM, 75% RDN through urea + 25% N – VC, 50% RDN through urea + 50% N – VC, 50% RDN through urea + 25% N – FYM + 25% N – VC. The lowest green fodder yield was observed with 50% RDN through urea + 50% N – FYM (17189.04 kg ha^{-1}).

DISCUSSION

Growth, yield and yield attributes

Data presented in the Table 1 and Table 2 showed that increased levels of nitrogen dose from 100 to 125 kg N ha^{-1} significantly enhanced the growth, yield and yield attributes of sweet corn. The significant enhancement with high dose of nitrogen could be due to higher uptake and utilisation of nitrogen during active cell division to form building blocks for cell elongation at higher level of N application (Kumar & Bohra, 2014). Kumar et al. (2016) also reported that increasing nitrogen levels up to 150 kg N ha^{-1} significantly increased growth and yield attributes of maize. These results are in conformity with Abebe and Feyisa (2017), Sabha et al. (2017), Shrestha et al. (2018).

The highest plant height, dry matter accumulation and cob yield were recorded with 125% RDN through urea significantly over farmyard manure and vermicompost might be due to quick release of nutrients and high availability of nitrogen. Similar results were reported by Sabha et al. (2017), Shakunthala et al. (2018), Verma et al. (2018), Roopashree et al. (2019). Gunjal et al. (2020) reported that application of vermicompost recorded higher yield than farmyard manure which might be due to narrow C: N ratio and higher availability of nutrients to plants. These results are in conformity with Chhetri and Sinha (2019), Dey et al. (2019).

Singh (2011) also reported increase in plant height and dry matter accumulation with increasing nitrogen levels. These results are in conformity with Hassan et al. (2010), Mahdi et al. (2011), Parija (2011), Ullah et al. (2015), Kaur et al. (2016), Ankita et al. (2018).

Protein content

The positive correlation between crude protein percentage and increased nitrogen level concentration might be due to nitrogen being an important constituent of protein molecule and a building block of amino acid might have substantially increased the protein content of kernel due to increased uptake of nitrogen under higher nutrient level of 125% RDN through urea. Similar results were observed by Aslam et al. (2011), Ullah et al. (2015), Jaswinder et al. (2019), Gunjal et al. (2020).

Table 1: Effect of organic and inorganic sources of nitrogen on cobs per plant and protein content

Treatments	Plant height (cm.)	Dry matter accumulation (g $plant^{-1}$)	Protein content (%)
T_1 : 100% RDN through urea	196.07	72.86	10.84
T_2 : 75% RDN through urea + 25% N - FYM	191.55	69.03	10.70
T_3 : 50% RDN through urea + 50% N - FYM	183.25	65.11	10.25
T_4 : 75% RDN through urea + 25% N - VC	193.07	70.58	10.74
T_5 : 50% RDN through urea + 50% N - VC	187.13	67.93	10.54
T_6 : 50% RDN through urea + 25% N – FYM + 25% N - VC	185.49	66.78	10.40
T_7 : 125% RDN through urea	213.87	83.55	11.88
T_8 : 100% RDN through urea + 25% N - FYM	208.73	81.62	11.66
T_9 : 75% RDN through urea + 50% N - FYM	200.69	78.73	10.92
T_{10} : 100% RDN through urea + 25% N - VC	210.65	82.65	11.81
T_{11} : 75% RDN through urea + 50% N - VC	205.31	80.28	11.44
T_{12} : 75% RDN through urea + 25% N – FYM + 25% N - VC	202.51	79.37	11.14
SEm±	5.755	1.991	0.333
CD (at 5 %)	16.879	5.840	0.977

Table 2: Effect of organic and inorganic sources of nitrogen on yield of sweet corn

Treatments	Yield (kg ha^{-1})			
	Cob yield (g plant^{-1})	**Stover yield**	**Green cob yield (kg ha^{-1})**	**Green fodder yield (kg ha^{-1})**
T_1 : 100% RDN through urea	310.15	4808.77	9087.02	19235.09
T_2 : 75% RDN through urea + 25% N - FYM	308.11	4555.98	8745.00	18223.92
T_3 : 50% RDN through urea + 50% N - FYM	304.76	4297.26	8433.00	17189.04
T_4 : 75% RDN through urea + 25% N - VC	308.66	4658.28	8874.00	18633.12
T_5 : 50% RDN through urea + 50% N - VC	306.62	4483.38	8639.00	17933.52
T_6 : 50% RDN through urea + 25% N – FYM + 25% N - VC	305.54	4407.48	8541.00	17688.69
T_7 : 125% RDN through urea	371.63	5514.30	9879.00	22057.20
T_8 : 100% RDN through urea + 25% N - FYM	368.66	5287.92	9651.00	21151.68
T_9 : 75% RDN through urea + 50% N - FYM	342.24	5039.18	9347.10	19596.72
T_{10} : 100% RDN through urea + 25% N - VC	369.82	5388.90	9746.02	21555.60
T_{11} : 75% RDN through urea + 50% N - VC	345.73	5152.48	9567.11	20269.92
T_{12} : 75% RDN through urea + 25% N – FYM + 25% N - VC	347.04	5097.42	9479.11	20029.68
SEm±	10.426	163.863	220.736	854.919
CD (at 5 %)	30.577	480.592	647.396	2507.392

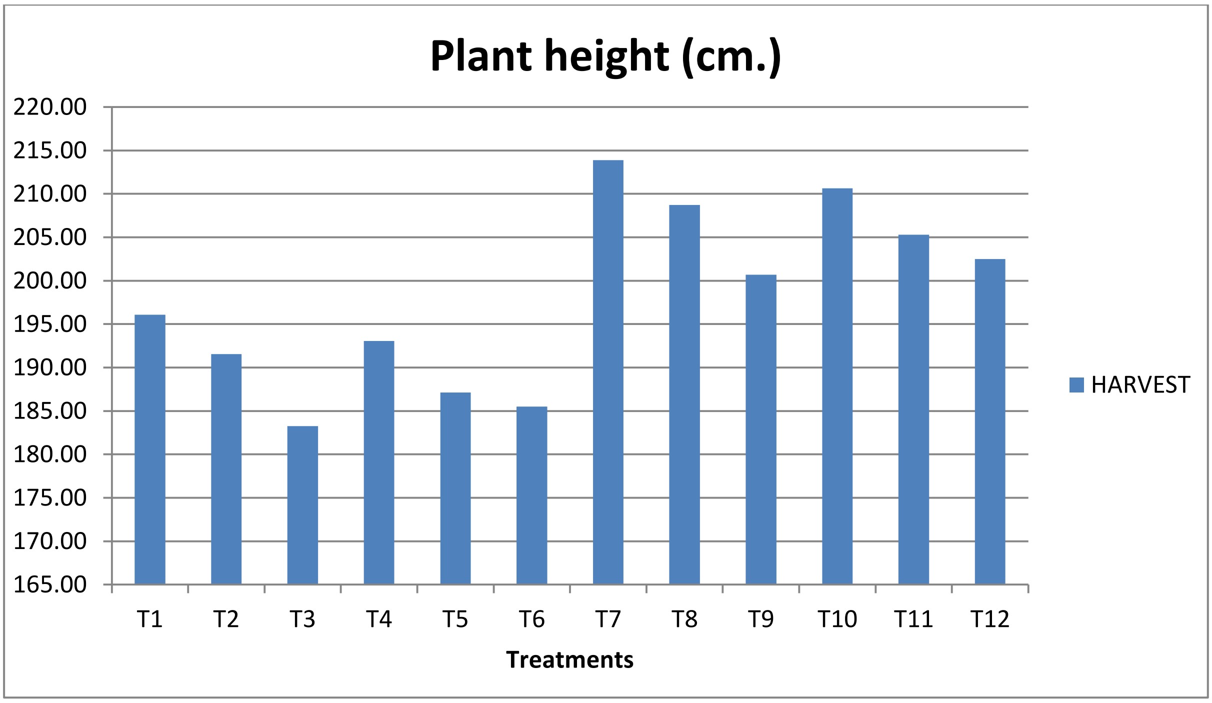

Fig. 1: Effect of organic and inorganic sources of nitrogen on plant height of sweet corn

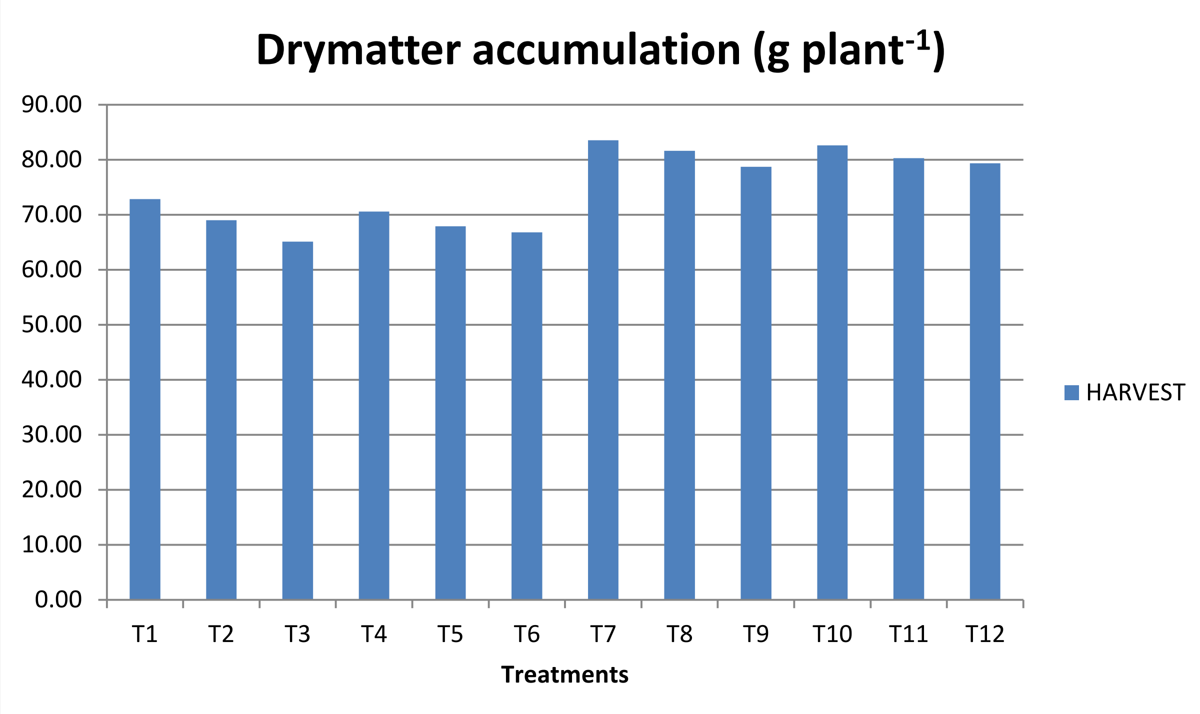

Fig. 2: Effect of organic and inorganic sources of nitrogen on drymatter accumulation of sweet corn

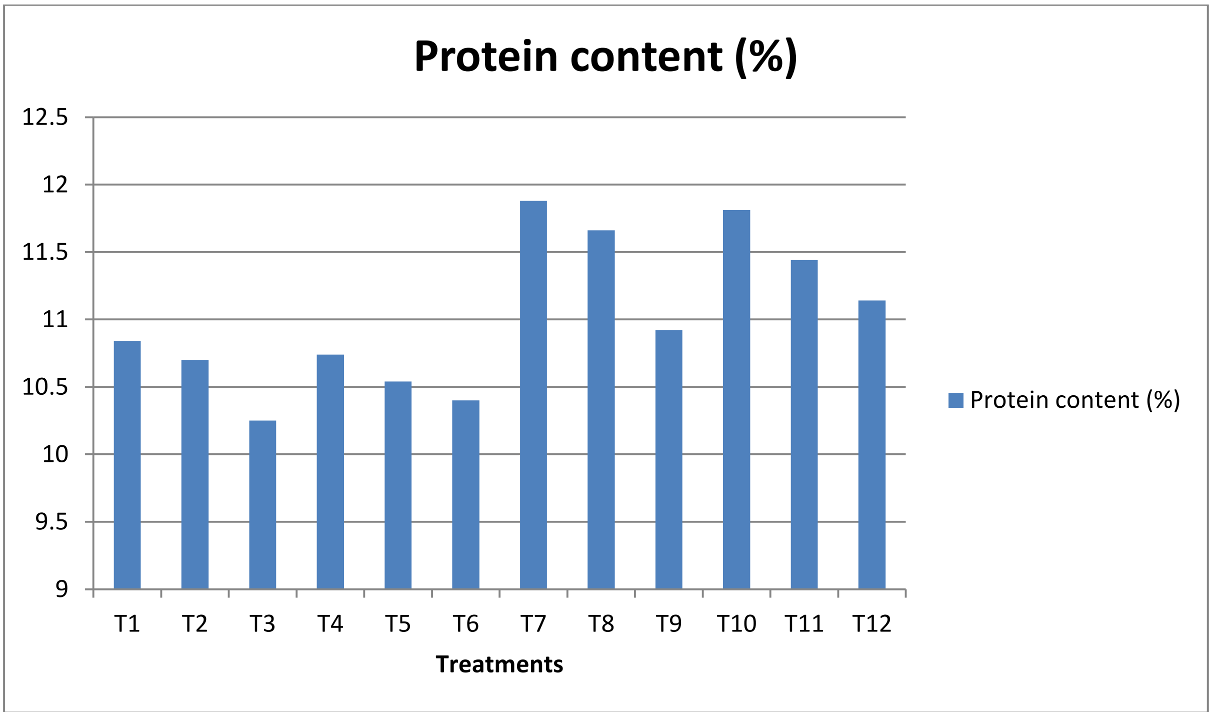

Fig. 3: Effect of organic and inorganic sources of nitrogen on protein content of sweet corn

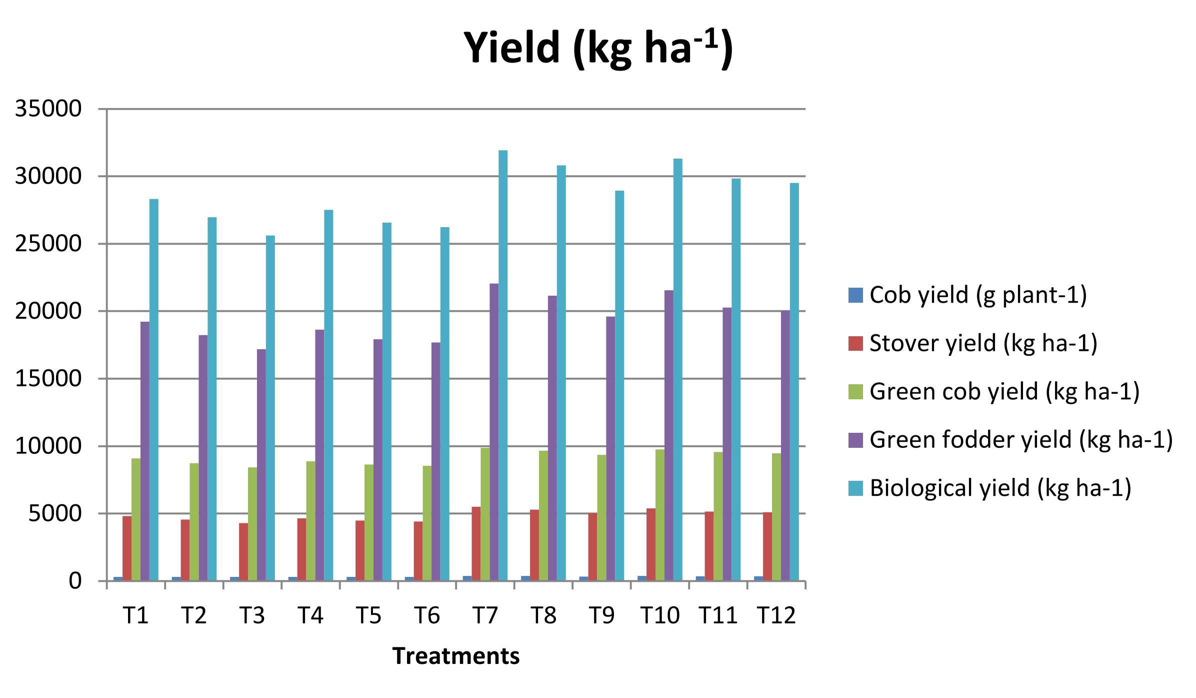

Fig. 4: Effect of organic and inorganic sources of nitrogen on yield and yield attributes of sweet corn

CONCLUSION

From this study it may be concluded that, application of 125% RDN through urea alone gave higher numerical values compared to other combined sources of organic and inorganic nitrogen. But 125% RDN either through vermicompost or farmyard manure along with nitrogen through urea was found to be as effective as 125% RDN through urea only and to enhance the growth, yield, yield attributes and quality parameters of sweet corn.

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