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Evaluation of growth, yield and some quality characteristics of sweet corn under effect of different nutrient sources

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Abstract

In order to investigate the effect of organic and chemical nutrients on the growth and yield and yield quality of two varieties of sweet corn, two different field experiments were conducted in spring and autumn seasons in 2017, the experimental design was laid out as a split-plot design with three replications. Two sweet corn varieties Goldrash and Chocleta putted in the main plots while three different nutrient sources were fixed in sub-plots. Several vegetative and reproductive growth criteria were studied as well as the rate of accumulated dry matter that allocated to the leaves and stem in two different growth stages pre and post silking were measured. The quality related criteria M%, TS, TSS, and NSS was evaluated. Results of both seasons demonstrated the effectively of organic nutrient sources in exceeding chemical fertilization in a number of criteria or approaching its level in another, The interaction between second organic nutrient and Goldrash showed a maximum yield in the spring season, while the yield in autumn season was non significantly resulted.

Introduction

Sweet corn is a type of maize (*Zea mays ssp. Saccharata*) with an increase in sugar or polysaccharide content in the kernels. Unlike other corn species, which are harvested at or post physiological maturity, sweet corn, is cut off when immature and fresh at the milk stage, marketed as a delicious vegetable, as well as other diverse end uses. Sweet Corn is a good source of the phenolic flavonoid antioxidant, Ferulic acid. Several research studies suggest that Ferulic acid plays a vital role in preventing cancers, aging, and inflammation in humans. The quality traits of sweet corn such as sweetness, flavour, and tenderness are the preferable characteristics for marketing [1].

Organic farming describes systems with the fundamental basis for minimizing chemicals and optimizes natural processes for the production of crops [2 and 3]. In organic farming a wide range of agricultural processes and natural products will use instead of pollutant chemicals, organic fertilizers as a source nutrient for plants can directly reduce the environmental problems associated with the use of inorganic fertilizers[4], while the performance of different genotypes will vary with different environmental and climatic conditions[5]. Juntharathep *et al.,* 2007[6]Found that fermented chicken manure was an efficient fertilizer produced the highest yields of fresh yield of sweet corn. Response of sweet corn varieties to different organic fertilization vary with different genotypes, the concentration of liquid organic fertilizer did not increase growth and yields of organically grown sweet corn. Sweet corn of Asian Honey had the best responses to locally-based liquid organic fertilizer, followed by Muktamar *et al.,* 2016[7].The organic fertilizer gave a significantly higher marketable yield than chemicalfertilizersthe use of organicmineralfertilizers reduces nitrate losses due to leaching and improves soil structure[8]. Nitrogen fertilization sourced from processing of plants is important for sustainability and maintaining organic farming [9].Large quantity of nitrogen residual remains in soil post crop harvesting, especially seasonal vegetables [10 and 11]. Application of the recommended rates for field vegetables may take into account amounts ofresidual soil Nmin [12],especially if crops/vegetables are harvested before maturity, as is the case of sweet corn[9].

The environmental risks have been generated from the continuous application of chemical fertilizers which increased because of the accumulated residuals. Fertilization from organic sources for crops can effectively mitigate the environmental problems, as well as producing healthy products of different vegetables and field crops. Recently the different organic nutrients were used such as crop rotation, growing a diversity of crops, planting cover crops, and adding organic matter to the soil. The organ system increases an income adequate to maintain a good standard of living by producing an abundance of high-quality food, while at the same time nurturing the soil, protecting the environment, and ensuring that the land will be healthy and productive for generations to come. The objective of the present study is investigating the response of two different sweet varieties to effect of organic and chemical nutrients.

Materials and Methods

Two different field experiments were conducted in spring season on April 24, 2017 and autumn season on Aug. 01, 2017 in Kanipanka Agricultural Research Centre in order to investigate the effect of chemical and organic fertilization on the growth, yield and yield quality of two different varieties of sweet corn which were (Goldrash (V_1) and Chocleta(V_2)). The experiments were laid out as a split-plot design with three /replications, the nutrient sources include organic fertilizers were treated as the main factor while the two varieties were located in sub- plots. The nutrient sources involved in the study were organic and chemical fertilization, the organic fertilizations were coming from two different organic sources which were Liquid Organic fertilizer Majesto, (T_1), and local poultry manure (T_2), while recommended chemical Nitrogen and phosphorous fertilization, (170 Kg ha^{-1}N and 75 Kg ha^{-1}P2O5) used as (T_3). The Majesto organic fertilization was used according to the company's instructions, (3 lt. ha^{-1}) 14cc/16 Lt. Water every 10 days in May 23, Jun, 04, and Jun 14. The Poultry manure was applied before planting at the base of 850 Kg ha^{-1}, the nitrogen fertilizer was applied in two split doses, and the first was applied with cultivation and the second dose at seedling stage. The area of main experimental units were 2.50 m ×8.00 m, which was planted with V_1 or V_2, and divided into 3 sub plots for T_1,T_2 and T_3, there were four rows in each subplot, the space between two rows was 75 cm, and 25 cm for each two plants within rows. All agricultural processes were carried out as required. For determining rate of varieties growth through dry matter accumulation, destructive samples were taken pre-silking and after 21 days at post-silking. The fresh samples were oven dried at 70°C till stable weight, and then calculated according to the following equation:

Dry Weight (g) = DW_1×(FW_t\ FW_2)

Where:

DW1 = Dry weight of fresh sample taken from the leaf or stem

FWs = Fresh weight of the sample taken from the leaf or stem

FWt = Fresh weight of the plant leaves(all leaves) or stem

The studied criteria include criteria related to the growth and performance of the two sweet corn varieties under effect of organic and chemical fertilization in both spring and autumn seasons and their interactions, include no. of leaves, leaf area /plant (cm²) conducted at silking, and also growth stage periods, no. of days required to 50% tasseling and no. of days required to 50% silking, as well as the rate of dry matter accumulation that partitioned to the leaves and stem carried in two different stages pre-silking and post-silking, and also fresh yield per plants (Kg pl^{-1}). The quality of the two varieties of sweet corn was evaluated through different criteria related to the quality as moisture content%, TS, TSS, and NSS as well as the Ear diameters. The fresh, immature ears of two intermediate rows in the sub plots were harvested when the silks on the husk of the ears dry and change color to dark brown at 20 days post silking.

Quality evaluations

The fruit quality parameters were evaluated after harvest

1-The moisture content (M %) was determined according to standard methods [13].

2-Total solids (TS %): Total solids have been determined according to [14], calculated by the following formula: TS%= 100 - % moisture content (M %).

3-Total Soluble Solids (TSS %): Hand Refractometer (LCD digital model) was used to determine TSS%. A drop of the fruit extract was placed on the prism of digital Refractometer and the total soluble solid values were read in °Brix [14].
4-Non soluble solids (NSS %) = Total solids (TS %) - Total Soluble Solids (TSS %).
5-Ear length (cm) calculated by digital Vernier calipers.
The obtained Data were analysed statistically by using analysis of variance techniques with (XLSTAT). The Least significant differences test was used to compare the differences among the data means at significant level of 5%.

Results and Discussion

Growth Performance

The growth performance of the two sweet corn varieties in spring season were varied in their responses to the effect of different nutrient sources, table (1) reveals studied criteria related to vegetative growing and growth periods to tasseling and silking in both seasons, although almost of differences among studied characters was not extended to a significant level, but the results confirm affectivity of organic sources which approaching chemical fertilizers[5 and 7].
Figs. 1, and 2, demonstrate variation in the rate of dry matter accumulation that partitioned to the leaves and stem under effect of three different nutrient sources T_1,T_2 and T_3, pre and post silking in both seasons, there were generally increasing in the accumulated dry matter to both leaves and stems in both growth stages in spring growing season, the maximum value of both components were achieved with T_3, while in Autumn season the liquid organic fertilizerT_1 exceeded significantly other nutrient sources in the quantity of accumulated dry matter to stem presilking with (11.722)g,while T_2 was with lowest quantity of dry matter accumulation(7.823)g, as well as higher value of the T_1 for leaf and stem post silking. Fig.3, show performance of both varieties V_1 and V_2 in accumulating dry matter that allocated to leaf and stem in the two seasons. There were higher values of the potentials of both varieties in dry matter accumulation in spring season comparing with the autumn growing season, the Chocleta variety was with higher rates of dry matter accumulated in the leaves stems post silking in spring, results with agreement of previous research [7 and 15].

Table-1: Effect of nutrient sources on the vegetative and growth criteria in both seasons

Seasons	*Treatments*	*Plant Height (cm)*	*Plant Leaf Area(cm^2)*	*Stem thickness (cm)*	*No. of days to 50% Tasseling*	*No. of days to 50% Silking*
Spring	T_1	165.250	419.563	1.766	45.000	56.833
	T_2	168.500	420.637	2.066	44.833	56.333
	T_3	179.083	484.301	1.933	45.166	56.166
	$LSD_{(P\leq0.05)}$	24.901	122.346	0.363	2.698	2.476
Autumn	T_1	122.583	2231.563	1.316	42.333	55.333
	T_2	100.333	1377.025	1.283	43.000	57.500
	T_3	112.583	1751.900	1.250	42.833	56.666
	$LSD_{(P\leq0.05)}$	21.247	627.182	0.269	1.363	1.848

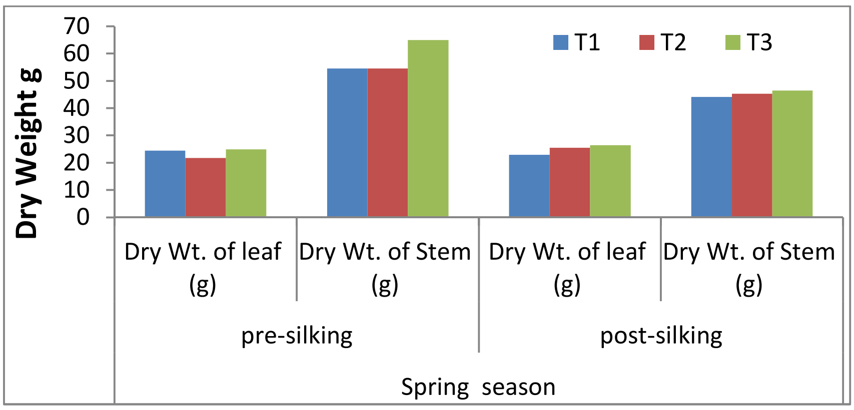


Fig.1: Dry matter accumulation in leaf and stem under effect of nutrient sources in spring season

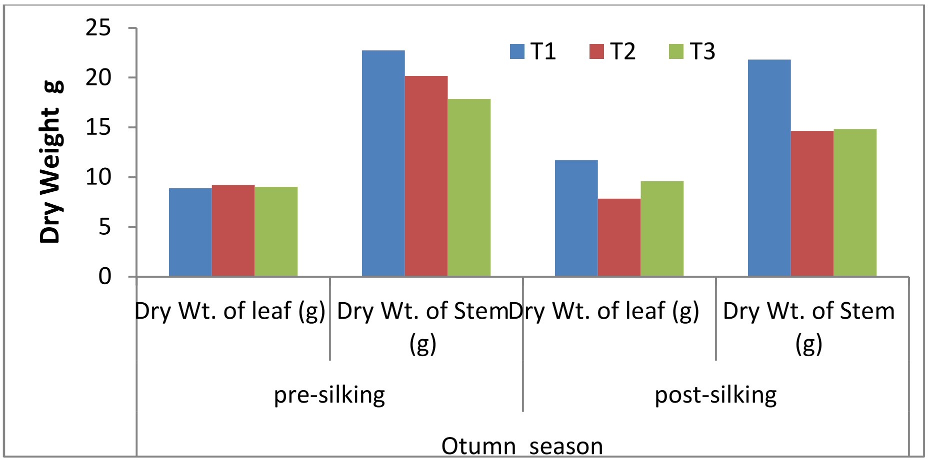


Fig.2: Dry matter accumulation in leaf and stem under the effect of nutrient sources in autumn season

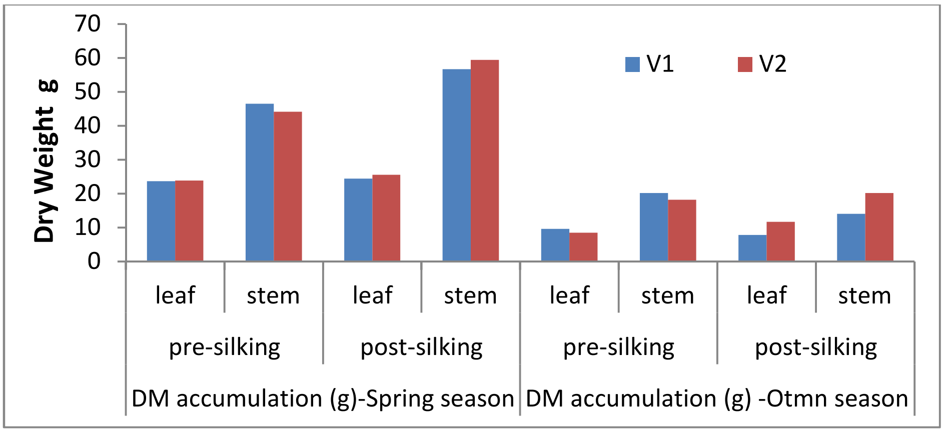
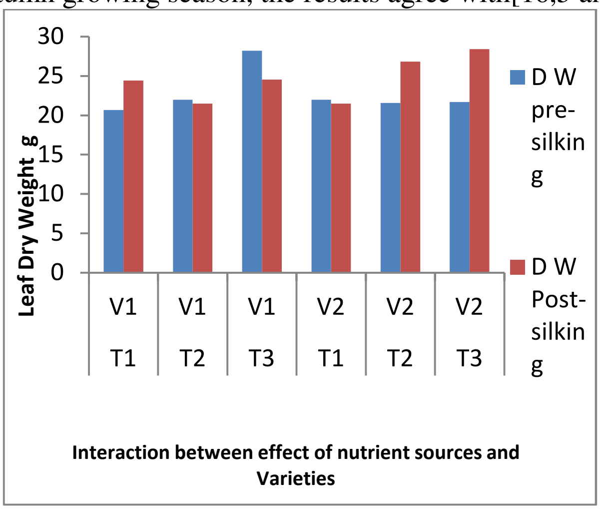


Fig.3: Dry matter accumulation in leaf and stem of both varieties in both seasons

Interactions:

Fig.4, indicate to interactions between the influence of the nutrient sources (T_1, T_2, and T_3), and two sweet varieties (V_1 and V_2), showing various responses in both growing seasons. The highest value obtained from the (variety x nutrients) interactions, was for the liquid organic fertilizer T_1 and Chocleta variety V_2 in the quantity of dry matter accumulated in the leaves and stems with 13.393 g and 26.246 g post silking in autumn growing season, the results agree with[16,5 and 9].



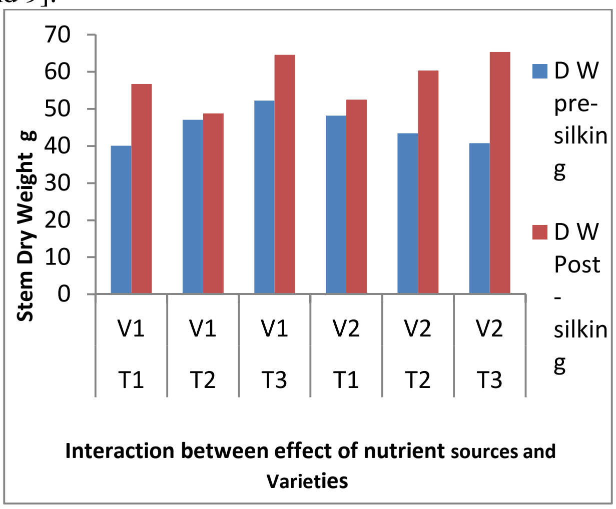


Fig.4: Effect of the interaction between the effect of nutrient sources and both varieties on dry matter accumulation

Quality related criteria:

Tables 2 and 3 indicate to quality related criteria in both seasons, which include ear diameters and chemical tests and yield under the influence of three nutrient sources. At spring season, there wasa similar effect of the nutrient sources with higher value of organic sources in all studied criteria except TSS in which the superiority was to chemical fertilization with 18,533. The highest yield of fresh sweet kernel yield /plant was to liquid organic source. At autumn season, while all of the studied criteria were not significantly differentiated, the highest fresh yield was to chemical fertilization with 9.123 gplant^{-1}, but it was with a no significant excess of organic sources T_1 and T_2. Evaluating of influence of nutrient sources on the quality related criteria indicate to the affectivity of organic sources to approaching the effect of chemical fertilization source, the results are with agreement with previous work of [6 and 4].

Table-2: Effect of nutrient sources on the quality related criteria in spring season

Treatments	Ear Length cm	Ear Width cm	M%	TS	TSS	NSS	Yield g plant^{-1}
T1	*20.475*	*4.15*	*79.913*	*20.086*	*17.033*	*3.053*	*5.402*
T2	*18.2*	*4.066*	*77.192*	*22.808*	*17.833*	*4.974*	*4.713*
T3	*17.016*	*4.108*	*77.963*	*22.036*	*18.533*	*3.503*	*4.765*
LSD$_{(P\leq0.05)}$	*4.641*	*0.172*	*2.315*	*2.315*	*3.645*	*2.573*	*1.152*

Table-3: Effect of nutrient sources on the quality related criteria in autumn season

Treatments	Ear Length cm	Ear Width cm	M%	TS	TSS	NSS	Yield g plant^{-1}
T1	*21.333*	*3.812*	*76.215*	*23.725*	*16.442*	*7.279*	*7.935*
T2	*20.72*	*3.94*	*77.143*	*23.06*	*16.275*	*6.785*	*8.956*
T3	*20.748*	*4.005*	*76.115*	*23.616*	*16.366*	*7.25*	*9.123*
LSD$_{(P\leq0.05)}$	*1.518*	*0.283*	*1.043*	*1.224*	*1.354*	*2.421*	*2.481*

Sweet corn varieties:

Figs 4,and 5 clarifies significant differences between the two sweet corn varieties, in spring growing season there was exceeding of V_1 in ear width and fresh yield with (4.082cm and 9.611) respectively, while V_2 exceeded V_1 in TSS with 17.95. At autumn season there was not significant, exceeding between both varieties in the fresh yield, while the V_2 was with superiority in ear length and TSS with 19.283 and 19.422 respectively, results are in agreement with[1, 16 and 17].

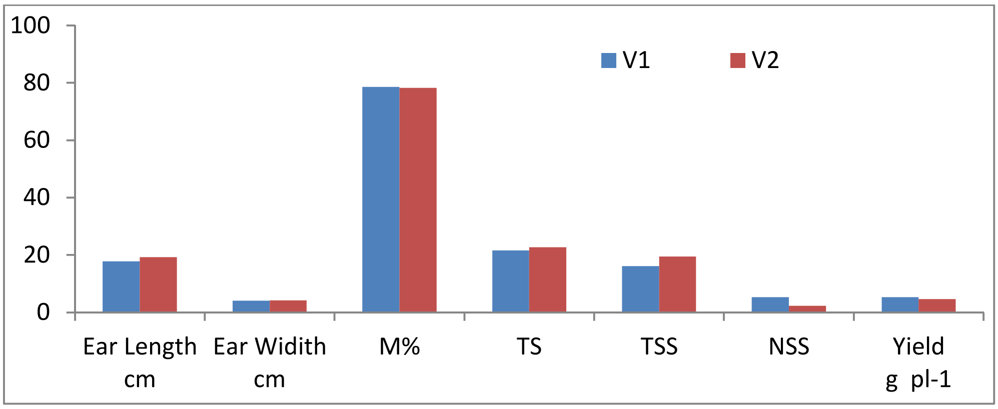


Fig.5: Performance of both varieties in the quality related criteria in spring season

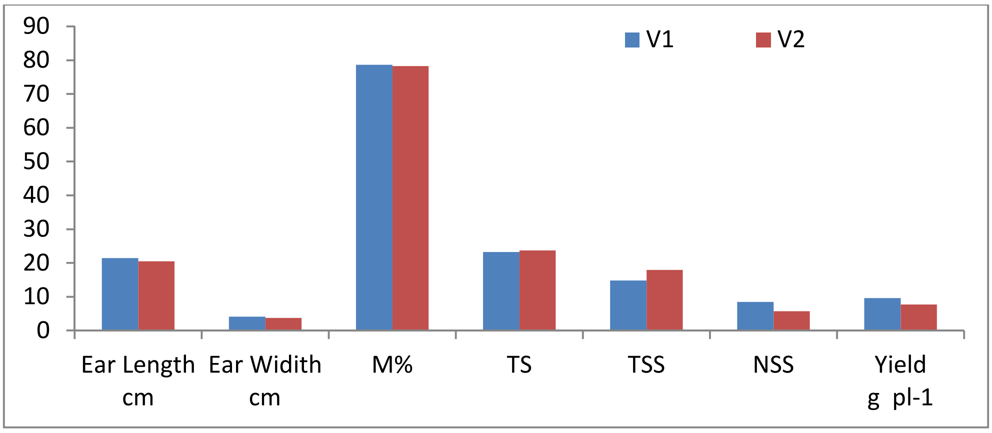


Fig.6: Performance of both varieties in the quality related criteria in autumn season

Interactions:

Table 4 and 5 demonstrate the effect of the interactions between the influence of the nutrient sources and response of both sweet corn varieties(V_1 and V_2), there were significant differences between the interactions of the two components of most of studied criteria in both seasons, at spring season the superiority was to the interactions between organic sources and sweet corn varieties in criteria ear diameters (T_1V_1), and T_1V_1 and T_2 V_1 for criteria NSS%, and Yield, with 9.176, and 10.626 respectively. At autumn season there were significant exceeding of the interaction between organic sources T_1 and T_2 and sweet cornvarieties in ear length,TS, TSS, and NSS, showed in the interactions (T_1V_1, T_2V_2, T_2V_2, and T_2V_1), while the differences between the yield of chemical and organic sources did not reach significant variation[10,2 and 11].

Table-4: Interactions between nutrient sources and responses of both varieties in quality related criteria in spring season

Treatment combinations	*Ear Length cm*	*Ear Width cm*	*M%*	*TS*	*TSS*	*NSS*	*Yield g plant^{-1}*
T_1 V_1	22.333	4.100	73.827	24.171	14.983	9.187	8.176
T_2 V_1	20.776	4.090	77.136	22.864	14.983	7.881	10.626
T_3 V_1	21.163	4.056	77.432	22.699	14.350	8.349	10.030
T_1 V_2	20.333	3.523	76.603	23.281	17.900	5.371	7.693
T_2 V_2	20.663	3.790	77.150	23.255	17.556	5.688	7.286
T_3 V_2	20.333	3.953	74.799	24.534	18.383	6.151	8.216
$LSD_{(P\leq0.05)}$	1.773	0.335	1.450	1.956	4.642	3.243	2.033

Table-5: Interactions between nutrient sources and responses of both varieties in quality related criteria in autumn season

Treatment combinations	*Ear Length cm*	*Ear Width cm*	*M%*	*TS*	*TSS*	*NSS*	*Yield g plant^{-1}*
T_1 V_1	20.566	3.95	79.338	20.661	15.666	4.995	5.95
T_2 V_1	17.65	4.033	77.483	22.516	15.333	7.183	5.293
T_3 V_1	15.316	4.166	78.568	21.432	17.533	3.898	5.716
T_1 V_2	20.383	4.35	80.488	19.512	18.4	1.112	4.853
T_2 V_2	18.75	4.1	76.9	23.1	20.333	2.766	4.133
T_3 V_2	18.716	4.05	77.358	22.642	19.533	3.108	3.813
$LSD_{(P\leq0.05)}$	4.591	0.599	4.982	4.98	4.642	5.317	1.962

Conclusions:

The organic nutrient sources, liquid organic majesto and poultry manure are with available results in comparing with the results of the effect of chemical fertilizer. There were significant, exceeding of T1 and T2 in some studied criteria , while these two organic nutrient effects approached effect of chemical fertilizer source in other studied criteria, so organic sources are considerable nutrient source in sweet corn productivity especially they are with non-harmful influence of the soil and environment as well as produce healthy product to human consumers.

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