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Effect of sowing date and some organic extracts on organic production of sweet corn

Saad ABOUL-EL-HASSAN[1, 2], Mohamed S.A. EMAM [3], Manal M.H. GAD EL-MOULA [3]

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Abstract: Field experiment was conducted at the experimental farm of the Central Laboratory for Agricultural Climate, Agricultural Research Center, Giza, Egypt, during two successive seasons of 2017 and 2018. This experiment aims to improve the organic production of sweet corn via some organic extracts under different sowing dates. The seeds of sweet corn (Misthi F1 Hybrid) were planted on three different dates on 15 April, 10 May and 5 June in both seasons. Extracts of compost, vermicompost and chicken manure with applying half dose of compost were compared to full dose of compost. Results showed that early sowing had positive effect on growth, yield and ear properties of sweet corn. Applying half dose of compost with adding vermicompost extract gave the highest growth, yield and ear properties of sweet corn without significant differences compared to 50 % compost + chicken manure extract treatment in plant height and leaves number per plant. The treatments of the half dose of compost with adding any organic extracts were superior to the full dose of compost in all studied traits. This study revealed that early planting (April 15) with applying a half dose of compost + vermicompost extract produced the highest yield and quality of sweet corn ears.

Key words: sweet corn; sowing date; compost extract; vermicompost extract; manure extracts

Učinki datuma setve in izvlečkov nekaterih organskih gnojil na pridelek sladke koruze

Izvleček: Poljski poskus je bil izveden na poskusni postaji Central Laboratory for Agricultural Climate, Agricultural Research Center, Giza, Egypt, v rastnih sezonah 2017 in 2018. Namen poskusa je bil izboljšati ekološko pridelavo sladke koruze z izvlečki nekaterih organskih gnojil in različnimi datumi setve. Semena sladke koruze so bila v obeh rastnih sezonah posejana v treh različnih terminih, 15. aprila, 10. maja in 5, junija. Učinki izvlečkov komposta, vermikomposta in kokošjega gnoja s polovičnim dodatkom komposta so bili primerjani z obravnavanjem s polnim dodatkom komposta. Rezulatati so pokazali, da je imela zgodnja setev pozitivne učinke na rast, pridelek in lastnosti storžev sladke koruze. Uporaba polovičnega odmerka komposta z dodatkom vermikomposta je dala najboljšo rast, največji pridelek in najboljše lastnosti storžev sladke koruze brez značilnih razlik v primerjavi z obravnavanjem s 50 % komposta in izvlečkom kokošjega gnoja glede na višino rastlin in število listov na rastlino. Obravnavanja s polovičnim odmerkom komposta so bila boljša kot tista s polnim odmerkom komposta v vseh preučevanih lastnostih. V raziskavi je bilo ugotovljeno, da je bil dosežen največji pridelek in dosežene najboljše lastnosti storžev sladke koruze pri zgodnji setvi (15. april) in uporabi polovičnega odmerka komposta z dodatkom izvlečka vermikomposta.

Ključne besede: sladka koruza; datum setve; izvleček komposta; izvleček vermikomposta; izvlečki gnojil

1 Central Lab of Organic Agriculture, Agriculture Research Center, Egypt
2 Corresponding author, e-mail: saad0777@yahoo.com
3 Central Laboratory for Agricultural Climate, Agricultural Research Center, Egypt

1 INTRODUCTION

Sowing date greatly affects the growth and yield of sweet corn. Either early or late cultivation can result in lower yield since the probability exists that adverse climatic conditions can happen after planting or during the growing season (Nielson et al., 2002). For optimization of yield, planting at the appropriate date is very critical as delay in sowing date can lead to a linear decrease in growth and yield (Anapalli et al., 2005, Namakka et al., 2008, Kamara et al., 2009, Peykarestan and Seify, 2012, Ibrahim et al., 2013, Maga et al., 2015, Rah Khosravani et al., 2017, Kaur and Kaur, 2018). They also indicated that early planting in the spring is optimum and more efficient than delayed planting.

Sweet corn (*Zea mays* L. var. *rugosa*) is one of promising vegetable crops in Egypt for local market and exportation. It is different from other maize crops (field maize and popcorn), where its kernels have high sugar content in the milk or early dough stage. Sweet corn has been widely considered more beneficial than maize production due to the shorter growing season and higher sale price, which reduces production costs and eventually increases farmers' income (Thakur et al., 2009). In addition, its economic values might be double when it is organically grown due to increasing consumer's demands and limited supply of it.

Organic farming products are becoming very essential in today's world to maintain the ecosystem and human health; there is a growing global demand for organic products in the world. The total organic area in the world reached 57.8 million hectares; the cultivated area in Egypt is about 105.9 thousand hectares according to FiBL and IFOAM (2018). Organic agriculture depends on compost as the main source of fertilization. Compost is usually added at once before planting, this leads to the nutrients available from compost insufficient to crop requirements. Consequently, most organic crops need some additives that improve growth and productivity during the growing season (Gross et al., 2008 and Abou-El-Hassan et al., 2014). Some organic extracts (compost, vermicompost and chicken manure extracts) can be used for improving organic production (Lopez-Espinosa et al., 2013; Ibrahim and Ibrahim, 2014; Nawar and Ibraheim, 2014).

Compost is an aerobically decomposed organic material derived from plants and/or animal residues by mesophilic and thermophilic microorganisms (Martens, 2000 and Insam & de Bertoldi, 2007). Vermicompost is product of organic matter degradation through interactions between earthworms and microorganisms (Edwards and Neuhauser, 1988).

Organic extracts are a liquid extracts produced from soaking various kinds of compost or organic manure in water at rate 1 : 5 and is left for a defined period; to create a liquid rich in organic and inorganic soluble nutrients and a large number of beneficial microorganisms (ROU, 2007). Organic extracts became a common agriculture practice in sustainable farming (Gross et al., 2008) as a balanced source of nutrients in available form in the rizosphere, growth stimulant and disease suppressor. In addition to its beneficial impacts on soil physical and chemical attributes as well as soil biodynamic activity. Organic extracts have positive effects on plant growth and soil properties (Abbasi et al., 2002, Biocycle, 2004, Gharib et al., 2008 and Meshref et al., 2010). Many studies indicated that application of organic extracts enhanced the growth, yield and quality for many crops such as Abou-El-Hassan et al. (2002) on cantaloupe, El-Tantawy et al. (2009) on potato, Ghobrial et al. (2009) and Mahmoud (2011) on faba bean, Seran and Shahardeen (2013) on vegetable cowpea, Bulalin et al. and Kovacik et al. (2015) on maize, Rogelio (2017) on sweet corn, Pokhrel et al. (2017) on tomato and Shaheen et al. (2017) on common bean.

Therefore, this study aimed to evaluate possibility of improving the organic production of sweet corn via some organic extracts under different sowing dates.

2 MATERIALS AND METHODS

2.1 EXPERIMENTAL SITE

Field experiment on sweet corn was carried out at the experimental farm of the Central Laboratory for Agricultural Climate (CLAC), Agricultural Research Center, Giza, Egypt, during two successive seasons of 2017 and 2018.

2.2 PLANT MATERIAL

Seeds of sweet corn ('Misthi F1' hybrid) were sown in the field on three different dates on 15 April, 10 May and 5 June in the both seasons.

2.3 SOIL PROPERTIES

The experiment was conducted in clay soil using drip irrigation system, the soil was analyzed according to FAO (1980) and the results are tabulated in Table 1. Weather data in the experimental region as air temperature and relative humidity (RH %) were recorded by the

Table 1: Physical and chemical properties of the experimental soil

Clay %	Silt %	Sand %	Texture	pH	EC dS m^{-1}	Cations meq^{-1}				Anions meq^{-1}		
						Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
48.76	40.91	10.33	Silte clay	7.87	1.03	2.32	1.14	5.33	1.52	2.27	4.84	3.13

Table 2: Weekly average of air temperature and relative humidity in Dokki region during growing seasons

		First season (2017)						Second season (2018)					
		Air temperature [°C]			Relative humidity [%]			Air temperature [°C]			Relative humidity [%]		
Months	Weeks	aver	min	max	aver	min	max	aver	min	max	aver	min	max
April	1st	20.4	14.8	27.3	55.3	26.4	85.7	20.7	14.8	27.2	55.5	27.4	84.3
	2ed	21.5	16.6	26.7	52.3	31.7	82.0	21.1	15.9	26.5	52.9	32.1	79.6
	3rd	26.1	18.9	31.0	34.5	15.1	62.7	26.1	18.9	31.0	34.5	15.1	62.7
	4th	23.9	18.1	29.2	38.5	21.2	66.6	24.9	18.8	30.2	36.6	20.1	63.7
May	1st	26.1	20.4	30.5	44.1	26.9	74.2	26.7	21.0	33.3	48.9	27.3	75.8
	2ed	31.1	23.5	36.5	28.9	15.3	56.5	25.5	19.1	32.3	46.8	24.6	76.6
	3rd	28.5	22.9	33.3	36.0	20.0	62.9	28.3	21.5	35.9	43.0	19.2	70.9
	4th	30.1	24.7	34.3	29.5	17.5	51.0	29.3	23.5	36.0	44.6	23.7	68.0
June	1st	31.5	26.2	35.8	33.4	20.2	55.9	27.3	21.8	33.7	51.4	27.7	78.7
	2ed	30.8	25.3	35.4	39.9	24.6	63.9	29.9	22.6	37.6	46.9	22.2	80.1
	3rd	30.9	25.7	35.7	41.9	24.4	65.9	30.9	25.7	35.7	41.9	24.4	65.9
	4th	30.0	24.2	35.7	47.6	24.9	76.8	30.0	24.2	35.7	47.6	24.9	76.8
July	1st	32.9	27.5	37.6	45.3	27.0	71.7	30.1	24.6	36.7	55.1	27.2	80.6
	2ed	31.7	25.7	37.4	46.6	22.4	77.9	29.9	24.9	36.1	55.4	29.1	79.7
	3rd	32.7	27.2	37.5	43.8	23.4	70.4	29.9	24.5	36.7	56.1	30.3	80.5
	4th	31.1	26.3	36.1	51.5	30.5	74.0	30.8	25.2	37.2	53.3	28.8	78.0
August	1st	32.4	27.8	36.7	47.4	28.1	72.0	30.7	25.9	36.8	56.9	31.1	80.2
	2ed	32.2	28.1	36.5	52.8	36.9	72.9	30.3	25.1	36.5	56.0	28.5	81.7
	3rd	31.8	27.1	36.4	45.9	28.0	70.9	29.8	25.1	35.7	55.5	30.6	78.4
	4th	30.5	26.2	34.9	48.9	30.3	70.2	29.6	25.0	35.1	57.4	33.3	79.2

meteorological station of CLAC during two growing seasons and the data are presented in Table 2.

2.4 EXPERIMENTAL PLAN

The soil of the experiment was ploughed and divided into ridges; each plot included three ridges of 60 cm width and 3 m length. The space between plants was 25 cm on one side of ridge.

The treatments included three sowing dates (15 April, 10 May and 5 June) and four fertilizer treatments as follow:

1- Full dose of compost (100 % C) as control

2- Half dose of compost (50 % C) + compost extract (CE)

3- Half dose of compost (50 % C) + vermicompost extract (VE)

4- Half dose of compost (50 % C) + chicken manure extract (ChE)

The design of experiment was split plots with three replicates, where the three sowing dates distributed in the main plots and the four fertilizer treatments were randomly arranged in the sub plots. The plot area was 6 m^2 (3 m length and 2 m width).

Full and half doses of compost were calculated based on nitrogen requirement for sweet corn plants (80 kg/ feddan); that were 8.4 and 4.2 tons /feddan (feddan = 0.42 hectare) respectively. These quantities of compost were added as one dose during soil preparation.

The stock solution of compost extract was prepared

Table 3: The properties of compost, vermicompost and chicken manure

Item	Compost	Vermicompost	Chicken manure
Density (%)	0.77	0.86	0.54
Mositure (%)	18	22	10
pH 1:10	8.43	8.62	8.82
Ec (ds/m) 1:10	4.09	6.34	5.3
OM (%)	28.39	32.03	43.32
OC (%)	17.32	19.54	26.43
Ash (%)	81.61	77.98	56.68
C/N ratio	18.2	12.6	13.3
Total N (%)	0.95	1.55	1.98
$N\text{-}NH_4$ (ppm)	129	48	250
$N\text{-}NO_3$ (ppm)	65	157	45
Total P (%)	0.63	2.22	2.76
Total K (%)	1.18	1.90	1.57

by soaking 10 l compost in 50 l of water without chlorine for two days and was filtrated by plastic net, the clear stock solution was diluted by water without chlorine at rate 1 : 10 according to El-Shinawy et al. (1999) and Abou-El-Hassan (2010). The same procedures were followed to prepare extracts of vermicompost and chicken manure. An air composting process was conducted on the chicken manure for three weeks before use. The properties of compost, vermicompost and chicken manure used in preparation of extracts are illustrated in Table 3. All organic extracts were applied to the soil surface weekly at a rate of 1l m^{-2} beginning after two weeks of planting for two months.

2.5 DATA RECORDED

Sweet corn ears were harvested at early dough stage after 75 to 80 days from planting and total yield was recorded for each plot. Five plants were randomly taken from each plot for measuring plant growth characteristics that included plant height from soil surface to the highest point of the plant, number of leaves per plant, fresh mass of plant and stalk diameter, as well as chlorophyll reading in the fourth upper leaf was recorded by using Minolta Chlorophyll Meter SPAD 501. Nutrient content of N, P and K in sweet corn plants were determined in the fourth upper leaf according to Cottenie et al. (1982). Total nitrogen, phosphorus and potassium were determined by Micro Kjeldahl, spectrophotometer and flame photometer on respectively according to FAO (1980). Ten ears from each plot were taken randomly at harvest to measure ear parameters of mass, length and diameter at central ear. Total soluble solid (TSS) was measured using digital refractometer and total sugars were determined in fresh kernels according to AOAC (2005). Dry matter percent was determined in 100g of fresh kernels.

2.6 STATISTICAL ANALYSIS

Data of the two seasons were arranged and statistically analyzed by the analysis of variances according to Snedecor and Cochran (1980) with SAS software, version 2004. Treatment means were compared using Tukey test at significance level 0.05.

3 RESULTS AND DISCUSSION

3.1 GROWTH CHARACTERISTICS

The growth characteristics for sweet corn plants under different sowing dates and fertilizers were presented in Tables 4 and 5. Data in both seasons revealed that the highest values of growth characteristics were obtained by sowing on 15 April followed by 10 May, while the sowing on 5 June gave the lowest values. This result may be due to the weather conditions in the early sowing date were the most favorable to sweet corn growth more than other sowing dates as reported by Anapalli et al. (2005), Namakka et al. (2008), Kamara et al, (2009), Peykarestan and Seify (2012) and Ibrahim et al. (2013).

The treatment of 50 % compost + vermicompost extract had the maximum growth characteristics of sweet corn plants compared to other treatments in both sea-

Table 4: Effect of sowing dates and organic extracts on vegetative growth characteristics of sweet corn plants during 2017 and 2018 seasons

	Plant height (cm)							
	First season				Second season			
Fertilizer	Sowing dates							
treatments	15-Apr	10-May	5-Jun	Mean	15-Apr	10-May	5-Jun	Mean
100 % C	205.3 f	198.7 f	189.7 g	197.9 C	210.3 fg	202.7 g	192.7 h	201.9 C
50 % C + CE	221.3 cde	218.7 de	214.7 e	218.2 B	224.3 cde	221.0 de	218.3 ef	221.2 B
50 % C + VE	235.0 a	227.7 bc	225.0 cd	229.2 A	239.3 a	230.7 bc	228.0 cd	232.7 A
50 % C + ChE	232.3 ab	224.7 cd	223.3 c	226.8 A	237.0 ab	226.7 cd	225.0 cde	229.6 A
Mean	223.5 A	217.4 B	213.2 C		227.7 A	220.3 B	216.0 C	
	Leaf number/plant							
100 % C	14.17 ef	13.83 f	12.67 g	13.56 C	14.67 d	14.50 d	13.33 e	14.17 C
50 % C + CE	16.00 b	15.00 cde	14.33 def	15.11 B	16.00 bc	15.00 cd	14.67 d	15.22 B
50 % C + VE	17.67 a	16.00 b	15.50 bc	16.39 A	17.67 a	16.17 b	15.83 bc	16.56A
50 % C + ChE	17.00 a	15.83 bc	15.17 bcd	16.00 A	17.33 a	16.00 bc	15.50 bcd	16.28A
Mean	16.21 A	15.17 B	14.42 C		16.42 A	15.42 B	14.83 C	
	Stalk diameter (cm)							
100 % C	3.04 de	2.97 e	2.70 f	2.90 D	3.11 ef	2.98 f	2.77 g	2.95 D
50 % C + CE	3.30 c	3.15 d	3.02 de	3.16 C	3.32 cd	3.19 de	3.09 ef	3.20 C
50 % C + VE	3.62 a	3.44 b	3.38 bc	3.48 A	3.65 a	3.47 b	3.40 bc	3.51 A
50 % C + ChE	3.36 bc	3.40 bc	3.37 bc	3.38 B	3.41 bc	3.40 bc	3.39 bc	3.40 B
Mean	3.33 A	3.24 B	3.12 C		3.37 A	3.26 B	3.16 C	

Means followed in same column by similar letters are not statistically different at 0.05 level according to Tukey test.
C = Compost; CE = Compost extract; VE = Vermicompost extract; ChE = Chicken manure extract

Table 5: Effect of sowing dates and organic extracts on vegetative growth characteristics of sweet corn plants during 2017 and 2018 seasons

	Plant fresh mass (g)							
	First season				Second season			
Fertilizer	Sowing dates							
treatments	15-Apr	10-May	5-Jun	Mean	15-Apr	10-May	5-Jun	Mean
100 % C	1.02 e	0.95 f	0.94 f	0.97 D	1.05 e	0.96 f	0.92 f	0.98 D
50 % C + CE	1.16 c	1.08 d	1.04 e	1.09 C	1.17 d	1.09 e	1.05 e	1.10 C
50 % C + VE	1.34 a	1.26 b	1.23 b	1.28 A	1.34 a	1.26 b	1.24 bc	1.28 A
50 % C + ChE	1.25 b	1.19c	1.16 c	1.20 B	1.26 b	1.19 cd	1.16 d	1.21 B
Mean	1.19 A	1.12 B	1.09 C		1.21 A	1.12 B	1.09 C	
	Chlorophyll reading (SPAD)							
100 % C	45.17 ef	45.83 e	42.41 f	44.47 D	49.67 f	49.67 f	46.00 g	48.44 D
50 % C + CE	52.17 cd	50.67 d	49.84 d	50.89 C	57.33 cd	56.67 de	54.00 e	56.00 C
50 % C + VE	57.33 a	55.03 ab	54.18 bc	55.51 A	64.33 a	61.00 b	60.33 bc	61.89 A
50 % C + ChE	54.33 bc	53.89bc	52.17 cd	53.47 B	61.33 ab	60.67 b	58.67 bcd	60.22 B
Mean	52.25A	51.36 A	49.65 B		58.17 A	57.00 A	54.75 B	

Means followed in same column by similar letters are not statistically different at 0.05 level according to Tukey test.
C = Compost; CE = Compost extract; VE = Vermicompost extract; ChE = Chicken manure extract

sons. No significant differences between the treatments of 50 % compost + vermicompost extract and 50 % compost + chicken manure extract in properties of plant height and leaf number per plant. The lowest values in all growth characteristics of plants were resulted from 100 % compost treatment. Improvement in the growth of sweet corn plants with treatment of 50 % compost + vermicompost extract may be due to the role of this extract in the development of the root and enhanced the vegetable growth of plants. Where, vermicompost extract contains high levels of beneficial microorganism, soluble nutrients, organic acids and soluble growth regulators (Keeling et al., 2003; Edwards et al., 2006; Arancon et al., 2007). These results are confirmed with those obtained by Rogelio (2017). He reported that vermicompost extract could be used as growth enhancers of sweet corn, which improved the vegetative growth of plants in terms of stalk diameter, plant height and number of leaves per plant.

The interaction between sowing dates and organic extracts had significant effect on vegetative growth characteristics in both seasons. The highest values of all vegetative growth parameters were recorded by using 50 % compost + vermicompost extract with sowing on 15 April. The lowest vegetative growth parameters were obtained by 100 % compost treatment with sowing on 5 June.

3.2 NUTRITIONAL STATUS

Data in Table (6) indicated that sowing on 15 April in both seasons gave the highest nutrient content of N, P and K in sweet corn leaves without significant differences with sowing on 10 May in N and K content of leaves. Sowing on 5 June gave the lowest N, P and K content. The low nutrient content associated with late planting may be attributed to shortening the vegetable growth period, leading to less vegetable growth (Tables 4 and 5) and lower plant capacity to absorb nutrients. These results confirmed with those reported by Ibrahim et al. (2013) and Rah Khosravani et al. (2017).

The highest concentrations of N, P and K were found in plants that treated by 50 % compost + vermicompost extract without significant differences with 50 % compost + chicken manure extract treatment in N

Table 6: Effect of sowing dates and organic extracts on nutritional status of sweet corn plants during 2017 and 2018 seasons

	N (%)							
	First season				Second season			
Fertilizer	Sowing dates							
treatments	15-Apr	10-May	5-Jun	Mean	15-Apr	10-May	5-Jun	Mean
100 % C	1.469 g	1.447 g	1.317 h	1.411 C	1.487 f	1.470 f	1.322 g	1.426 C
50 % C + CE	1.772 e	1.743 e	1.637 f	1.717 B	1.781 e	1.757 e	1.549 f	1.695 B
50 % C + VE	2.591 a	2.477 bc	2.377 cd	2.481 A	2.593 a	2.493 b	2.389 cd	2.492 A
50 % C + ChE	2.507 ab	2.453 bcd	2.367 d	2.442 A	2.527 ab	2.480 bc	2.363 d	2.457 A
Mean	2.085 A	2.030 A	1.924 B		2.097 A	2.050 A	1.906 B	
	P (%)							
100 % C	0.228 f	0.223 f	0.205 g	0.219 D	0.237 e	0.217 fg	1.247 g	0.567 D
50 % C + CE	0.255 d	0.240 e	0.230 f	0.242 C	0.268 d	0.243 e	0.229 ef	0.246 C
50 % C + VE	0.378 a	0.358 b	0.348 bc	0.361 A	0.382 a	0.362 b	0.345 bc	0.363 A
50 % C + ChE	0.358 b	0.353 b	0.343 c	0.351 B	0.360 b	0.356 bc	0.339 c	0.352 B
Mean	0.304 A	0.294 B	0.282 C		0.312 A	0.295 B	0.540 C	
	K (%)							
100 % C	1.333 g	1.333 g	1.222 h	1.296 D	1.367 g	1.348 g	1.222 h	1.312 D
50 % C + CE	1.740 e	1.699 ef	1.625 f	1.688 C	1.757 e	1.724 e	1.638 f	1.706 C
50 % C + VE	2.456 a	2.409 ab	2.370 bc	2.412 A	2.462 a	2.427 ab	2.383 bc	2.424 A
50 % C + ChE	2.299 cd	2.296 cd	2.272 d	2.289 B	2.333 cd	2.321 cd	2.285 d	2.313 B
Mean	1.957 A	1.934 A	1.872 B		1.979 A	1.955 A	1.882 B	

Means followed in same column by similar letters are not statistically different at 0.05 level according to Tukey test.
C = Compost; CE = Compost extract; VE = Vermicompost extract; ChE = Chicken manure extract

content of leaves. While the lowest concentrations of N, P and K in plants were obtained by 100 % compost treatment. The superiority of vermicompost extract on compost extract might be due to that compost is higher in ammonium content, while the vermicompost is higher in nitrate content, which is the more available form for plant absorption. Besides, the nutrients are released from vermicompost during short time compared to compost and chicken manure. These results are in harmony with those obtained by Pant et al. (2011), Seran and Shahardeen (2013), Bulalin et al. (2015), Kovacik et al. (2015) and Shaheen et al. (2017).

Regarding the interaction between sowing dates and organic extracts, sowing on 15 April with using 50 % compost + vermicompost extract gave the highest N, P and K content of leaves. Sowing on 5 June with applying 100 % compost gave the lowest nutrient content.

3.3 YIELD AND EAR CHARACTERISTICS

Data illustrated in Tables 7 and 8 mentioned that sowing on 15 April produced the highest values of yield and ear characteristics of sweet corn compared to other sowing dates in the two seasons. The lowest yield was produced by sowing on 5 June. Low yield and ear characteristics in the delayed sowing is often due to unfavorable environmental effects such as high temperature, which has adverse effects like increase respiration and transpiration rates thus limit the accumulation of photosynthesis products, which reflected in the low yield and ear quality (Maga et al., 2015 Kaur and Kaur, 2018).

Application of 50 % compost + vermicompost extract produced the highest yield per plant and plot as well as gave the best ear characteristics compared to other treatments. The treatment of 50 % compost + chicken manure extract came in second order, whereas the treatment of 100 % compost gave the lowest values of yield and ear characteristics. The superior vermicompost extract on other extracts and compost only can be attributed to its superiority in stimulating vegetable growth of plants. Where, this treatment improved of growth characteristics as shown in Table 3 and 4, which led to an increase in the process of photosynthesis and better carbohydrate build up, thus improved yield and ear parameters of sweet corn. These results are consistent with those obtained by Bulalin et al. (2015), Kovacik et al. (2015) and Rogelio (2017). They revealed that vermicompost extract when used for nutrition of maize plants significantly improved the growth, yield and quality of corn ears. This is due to the presence of plant growth promoters and its ability to improve the soil condition in rhizosphere zone.

The interaction between sowing dates and organic extracts on yield and ear quality were significantly affected each other's. The highest values were recorded by sowing on 15 April with using 50 % compost + extracts of vermicompost or chicken manure. The lowest values were recorded with sowing on 5 June with adding 100 % compost.

Table 7: Effect of sowing dates and organic extracts on yield component of sweet corn plants during 2017 and 2018 seasons

	Yield/plot (kg 6 m^{-2})							
	First season				Second season			
Fertilizer	Sowing dates							
treatments	15-Apr	10-May	5-Jun	Mean	15-Apr	10-May	5-Jun	Mean
100 % C	12.85 e	13.06 e	10.94 f	12.29 D	14.50 f	12.93 g	11.29 h	12.91 D
50 % C + CE	16.51 d	16.11 d	12.61 e	15.08 C	19.20 c	15.93 e	13.00 g	16.04 C
50 % C + VE	20.75 a	19.65 b	16.55 d	18.98 A	22.31 a	19.46 c	17.06 de	19.61 A
50 % C + ChE	19.67 ab	18.15 c	15.52 d	17.78 B	20.70 b	17.97 d	16.00 e	18.22 B
Mean	17.44 A	16.74 B	13.90 C		19.18 A	16.57 B	14.34 C	
	Yield/plant (g)							
100 % C	450.00 f	451.67 f	405.33 g	435.67 D	483.33 f	434.00 g	376.00 h	431.11 D
50 % C + CE	578.00 de	557.33 e	467.00 f	534.11 C	640.00 c	520.00 ef	433.33 g	531.11 C
50 % C + VE	726.33 a	679.67 b	613.00 cd	673.00 A	743.67 a	633.67 c	568.67 d	648.67 A
50 % C + ChE	689.00 ab	627.67 c	574.67 de	630.45 B	690.00 b	573.33 d	533.33 de	598.89 B
Mean	610.83 A	579.09 B	515.00 C		639.3 A	540.3 B	477.8 C	

Means followed in same column by similar letters are not statistically different at 0.05 level according to Tukey test.
C = Compost; CE = Compost extract; VE = Vermicompost extract; ChE = Chicken manure extract

Table 8: Effect of sowing dates and organic extracts on the characteristics of sweet corn ears during 2017 and 2018 seasons

Fertilizer treatments	Ear diameter (cm)							
	First season				Second season			
	Sowing dates							
	15-Apr	10-May	5-Jun	Mean	15-Apr	10-May	5-Jun	Mean
100 % C	5.50 fg	5.27 g	4.93 h	5.23 D	5.50 g	5.50 g	5.03 h	5.34 D
50 % C + CE	6.00 bcd	5.70 ef	5.33 g	5.68 C	6.03 cd	5.97 cd	5.63 fg	5.88 C
50 % C + VE	6.37 a	6.17 b	5.93 cd	6.16 A	6.60 a	6.37 b	5.87 de	6.28 A
50 % C + ChE	6.27 ab	6.03 bc	5.73 def	6.01 B	6.40 ab	6.20 bc	5.73 ef	6.11 B
Mean	6.03 A	5.77 B	5.47 C		6.13 A	6.01 B	5.57 C	
	Ear length (cm)							
100 % C	24.33 fg	23.33 gh	21.33 h	23.00 C	25.67 gf	24.33 gh	22.33 h	24.11 D
50 % C + CE	28.67 de	26.67 ef	25.00 fg	26.78 C	29.33 de	27.33 ef	26.33 fg	27.67 C
50 % C + VE	35.33 a	33.00 ab	31.33 bcd	33.22 A	36.33 a	34.00 ab	32.33 bc	34.22 A
50 % C + ChE	33.33 ab	32.33 bc	30.00 cd	30.92 B	34.33 ab	33.00 bc	30.67 cd	32.67 B
Mean	30.42 A	28.83 B	26.92 C		31.42 A	29.67 B	27.92 C	
	Ear mass (g)							
100 % C	224.67 f	226.00 f	202.67 g	217.78 D	241.67 f	216.67 g	188.33 h	215.56 D
50 % C + CE	289.00 de	278.33 e	233.33 f	266.89 C	320.00 c	260.00 ef	216.67 g	265.56 C
50 % C + VE	363.00 a	339.67 b	306.67 cd	336.44 A	371.67 a	316.67 c	284.33 d	324.22 A
50 % C + ChE	344.00 ab	313.67 c	287.33 e	315.00 B	345.00 bcd	286.67 d	266.67 de	299.44 B
Mean	305.17 A	289.42 B	257.50 C		319.58 A	270.00 B	239.00 C	

Means followed in same column by similar letters are not statistically different at 0.05 level according to Tukey test.
C = Compost; CE = Compost extract; VE = Vermicompost extract; ChE = Chicken manure extract

3.4 KERNEL COMPOSITIONS

Data in Table 9 showed the effects of organic extract treatments on kernel compositions for three sowing dates of sweet corn in the two seasons. The highest percentage of TSS, total sugars and dry matter in kernels was obtained by sowing on 15 April. The plants that planted on 10 May came in second order, whereas the plants that planted on 5 June gave the lowest values. This result may be due to that the weather conditions in the early sowing were the most favorable to plant growth, which increasing the vegetative growth and photosynthesis products that translocation to corn kernels (Maddonni et al., 2004, Ibrahim et al., 2013, Maga et al., 2015).

All treatments of 50 % compost + any organic extracts increased kernel compositions of TSS, total sugars and dry matter compared to 100 % compost treatment. The highest values of kernel compositions was produced by 50 % compost + vermicompost extract. This result may be attributed to the positive role of the vermicompost extract in improving vegetable growth and nutritive status of plants as show in Tables 4, 5 and 6, which led to increase photosynthesis products that translocation to corn kernels. These results are harmony with those reported by Bulalin et al. (2015), Kovacik et al. (2015) and Rogelio (2017).

The interaction between sowing dates and organic extracts had significant effect on kernel compositions. The highest values of TSS, total sugars and dry matter were recorded with sowing on 15 April with using 50 % compost + vermicompost extract. The lowest values were recorded with sowing on 5 June with adding 100 % compost.

4 CONCLUSION

It could be concluded that early sowing on April had improved the growth, yield and quality of sweet corn compared to sowing during May and June. As well as, substituting the full dose of compost by half dose of compost with adding any extracts of compost, vermicompost

Table 9: Effect of sowing dates and organic extracts on the characteristics of sweet corn ears during 2017 and 2018 seasons

Fertilizer treatments	TSS in kernels (%)							
	First season				Second season			
	Sowing dates							
	15-Apr	10-May	5-Jun	Mean	15-Apr	10-May	5-Jun	Mean
100 % C	16.00 g	15.93 g	15.57 H	15.83 D	15.97 fg	15.90 fg	15.60 g	15.82 C
50 % C + CE	16.67 de	16.47 ef	16.20 fg	16.44 C	16.50 de	16.47 de	16.13 ef	16.37 B
50 % C + VE	17.57 a	17.47 ab	17.17 bc	17.40 A	17.53 a	17.37 ab	17.07 bc	17.32 A
50 % C + ChE	17.40 ab	17.13 bc	17.00 cd	17.18 B	17.37 ab	17.13 bc	16.83 cd	17.11 A
Mean	16.91 A	16.75 B	16.48 C		16.84 A	16.72 AB	16.41 C	
	Total sugars (%)							
100 % C	12.30 e	12.19 e	11.53 f	12.01 C	12.18 e	12.13 e	11.58 f	11.97 C
50 % C + CE	12.72 d	12.59 d	12.19 e	12.50 B	12.59 d	12.56 d	12.14 e	12.43 B
50 % C + VE	13.41 a	13.33 ab	12.99 c	13.24 A	13.38 a	13.13 ab	12.93 bc	13.15 A
50 % C + ChE	13.28 ab	13.08 bc	12.65 d	13.00 B	13.25 a	13.07 ab	12.73 cd	13.02 A
Mean	12.93 A	12.80 AB	12.34 B		12.85 A	12.73 AB	12.35 C	
	Dry matter in kernels (%)							
100 % C	22.37 e	22.33 e	22.02 e	22.24 D	22.27 e	22.15 ef	21.83 f	22.08 D
50 % C + CE	23.22 cd	23.08 d	23.05 d	23.12 C	23.12 cd	22.98 d	22.95 d	23.02 C
50 % C + VE	24.10 a	23.81 ab	23.65 b	23.86 A	24.00 a	23.69 ab	23.53 b	23.74 A
50 % C + ChE	23.69 ab	23.65 b	23.59 bc	23.64 B	23.59 ab	23.52 b	23.47 bc	23.53 B
Mean	23.35 A	23.22 B	23.08 C		23.25 A	23.09 B	22.95 C	

Means followed in same column by similar letters are not statistically different at 0.05 level according to Tukey test.
C = Compost; CE = Compost extract; VE = Vermicompost extract; ChE = Chicken manure extract

or chicken manure had improved yield and quality of sweet corn. The plants that were sown early (April 15) and were given half dose of compost + vermicompost extract produced the highest yield and quality of sweet corn ears.

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