EFFECT OF SPRING SEEDING DATES AND FERTILIZERS ADDITION TIME ON GROWTH AND YIELD OF SWEET CORN

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Received 16 April 2020; accepted 22 May 2020

ABSTRACT

The experiment was carried out at two sites north of Dhi-Qar governorate (Dawwaya and Shatrah courts, 45 km apart) for spring season (2019) to study the response of sweet corn to three planting dates (1 March, 15 March and 1 April) and DAP fertilizer (di-ammonium phosphate) in four applications : control, adding all fertilizer (120 kg ha^{-1}) at seeding time, division the fertilizer half at seeding stage and at 8 leaves stage or -half at seeding and the other at 12 leaves stage . Split plot design with three replications was used. The fertilizer was adding in line 10 cm down of planting line. The results showed that seeding dates caused significant effect on plant growth and yield and seeding on March 15 achieved significant increase in all growth and yield parameters (plant height, number of leaves, leaf area, chlorophyll content, Fresh ear weight with and without sheaths, edible ear yield and 100 dry seed weight) for both sites compared to March 1. On the other hand, adding fertilizer caused significant effect on all traits compared to control and split fertilizers had no significant effect on growth traits, while split fertilizer at seeding and 12 leaves achieved significantly the highest values of edible ear weight (229.7 and 233.7 g) in both sites. The interaction between seeding dates and fertilizer treatment caused significant effect on most of the traits studied in both sites.
KEY WORDS: *sweet corn, seeding dates, fertilizers*

INTRODUCTION

Sweet corn (*Zea mays* L. saccharata. Sturt) is one of maize types that is rich in food compounds which are used in direct consumption or manufacturing (Abdel-Hamid & Dora, 2001; Amcheslavskiy, 2010). Sweet corn has been planted on a pilot scale in Iraq with the knowledge that sweet corn ears import has a market in Iraq. Maize is grown in Iraq in spring and autumn seasons. For spring planting, it is recommended not to delay in planting date for fear of rising temperatures during flowering and thus poor fertilization takes place due to the death of pollen, and also advised not to planting early for fear of exposure to late frost (Tarabichi, 2005), in contrast to the autumn season (Jasim & Kateb, 2016). Garcia et al (2009) showed the relation between seeding dates and temperature and their effects on maize productivity. Late planting exposes plants to the problems of high temperature at flowering stage.

Early planting also exposes plants to problems of low temperatures and thus influence farm establishment as well as poor fertilization. High temperatures also weaken the grain and thus reduce production. Shrestha *et al* (2018) found that the best date for maize in spring planting in Nepal is the first week of April. Nitrogen and phosphate fertilizers are important in plant growth, including sweet corn, which increases plant ability to exploit solar energy and synthesis carbon by increasing leaf area, which is positively reflected in improving production and quality (Al-Mutawary, 2002; Amanullah *et al,* 2009; Ianovici *et al*, 2015; Datcu *et al*, 2017; Datcu *et al*, 2018). In the stages of plant growth and development nitrogen is an essential element in the composition of compounds such as amino acids that form the protein (Abdel-Hamid & Dora, 2011). Kole (2010) showed that the addition of nitrogen fertilization leads to increase grain weight compared to control. This increase is due to the fact that nitrogen helps to increase the accumulation rate of dry matter during the grain filling stage. Nitrogen also increases chlorophyll and cell division which leads to increase leaf area. Nitrogen affects leaf area and its index during vegetative growth stages (Al –Alusi, 2000). Phosphorus is also important for plants to encourage root growth and proliferation, enzymes and energy compounds (Onasanya *et al*, 2009). Fertilizer split leads to its availability during all stages of plant growth, particularly during flowering and seed formation (Datcu *et al,* 2019). The study aims to determine the optimum seeding time of sweet corn in spring season, and to determine the best way to add fertilizer and their interaction on some traits of growth and yield.

MATERIALS AND METHODS

A field experiment was conducted in two locations within the Iraq southern region in Al-Dawa and al-Shatrah districts/ Thi-Qar governorate in spring season 2018 to study the effect of three planting dates (1 March, 15 March and 1 April and four treatments of fertilizer adding (DAP at 120 kg. ha^{-1}): control, adding all the fertilizer at seeding, add half at seeding and the other at 8 or 12 leaf stage. Split plot arrangement within randomized complete block design with three replications was used. Table 1 shows some chemical and physical of farms characteristics. The main plots included seeding dates and the sub plots included fertilizer treatments. Each experimental unit included six lines (3m long and 25 cm between plants). Diazinon granulated pesticide at 6 kg ha^{-1} was added to control the corn stalk borer after 15 and 30 seeding days (Ahmed & Ahmed, 2015). The plants were manually weeding in both sites. Ten plants were taken randomly from each experimental unit to determine plant height, plant leaves number, leaf area (according to Al-Sahooki & Chyad, 2013), chlorophyll content (Calculated by Green Seeker, according to Mallikarjuna *et al*, 2015). At maturation, fresh weight of edible ear with and without - sheaths were measured (as average of ten ears). At full maturity, 100 grains were weighted and adjusted to the moisture content of 15.5%. The data were statistically analyzed using GenStat 12 and the results were tested according to least significant difference (L.S.D) at the probability level of 0.05 (Glaser & Biggs, 2010).

TABLE 1. Some chemical and physical characteristics of the soil before planting for both sites

characteristics			First site 2019	Second site 2019
Organic matter		$g\ kg^{-1}$	9.6	7.8
EC		($ds\ m^{-1}$)	4.0	3.7
pH			7.7	7.6
Nitrogen		$Mg\ kg^{-1}$	13.8	11.9
Phosphorus		$Mg\ kg^{-1}$	10.05	9.79
Potassium		$Mg\ kg^{-1}$	298	183
	Sand	$g\ kg^{-1}$	320	328
Soil	Clay	$g\ kg^{-1}$	230	242
particles	Silt	$g\ kg^{-1}$	450	430
Soil texture			Medium Loam	Medium Loam

RESULTS AND DISCUSSIONS

Table (2) shows that seeding dates caused significant effect on plant height, number of leaves, leaf area and chlorophyll content. Seeding at 15 March significantly gave higher averages than 1 March reached 135.08 and 130.67 cm , 12.00 and 11.75 leaf plant^{-1}, 3218 and 2557 cm^2, 63.00 and 60.92 for two sites, respectively, compared to the first date which gave the lowest averages of 122.83 and 115.08 cm, 11.25 and 11.25 leaf plant^{-1} , 2963 and 2529 cm^2 , 61.25 and 58.84 for both sites, respectively. This result was due to the effect of environmental conditions, especially temperature (Tarabichi *et al*, 2005). This is consistent with Al–Hassani (2015).

The addition of fertilizer caused significant effect compared to control treatment which gave the lowest averages of 125.56 and 111.22 cm, 10.78 and 11.56 leaf plant^{-1}, 2765 and 2134 cm^2, 60.22 and 55.56 for both sites, respectively. This is due to the fact that carbon assimilation increases with fertilization and then increases plant growth by increasing cells size and their rapid division (Mahmood *et al*, 2001). This is in line with Al-Alusi (2005) and Aref (2008). On the other hand, fertilizer split treatment at seeding and 12 leaves stage was significantly higher and gave the highest values of 132.78, 129.67 cm, 12.22, 11.89 leaf plant^{-1}, 3464, 2740 cm^2, 63.22, 61.67, respectively compared to adding all fertilizer at seeding time. This is because of fertilizer split at different stages of plant life ensures the availability of nutrients throughout the growth period, especially during the critical growth period, which regulates the biological processes (Faheed *et al*, 2016). This was agreed with (Faheed *et al*, 2016). The interaction between the factors had a significant effect. Seeding at 15 March with split fertilizer addition at seeding and at 12 leaves stages gave the highest averages of most traits studied for both sites, compared to the interaction of 1 March with control treatment, which gave the lowest average in all studied traits 103.33, 104.00 cm and 10.33, 11.00 leaf plant^{-1}, 2295, 2015 cm^2, 58.67, 54.67 for both sites, respectively.

TABLE (2 a). Effect of spring season dates (2019) and fertilizer treatments on sweet corn growth

	First site	Plant height	Leaves number	leaf area	Chlorophyll
Seeding date	1 March	122.83	11.25	2963	61.25
	15 March	135.08	12.00	3218	63.00
	1 April	133.50	11.75	3189	62.67
	L.S.D $_{0.05}$	2.51	0.71	192	1.66
Fertilizer treatments	control	125.56	10.78	2765	60.22
	At seeding	130.89	11.56	2916	62.66
	At seeding+ 8 L,S	132.67	12.11	3350	63.11
	At seeding+ 12 L,S	132.78	12.22	3464	63.22
	L.S.D $_{0.05}$	2.90	0.82	222	1.91
1 March	control	103.33	10.33	2295	58.67
	At seeding	122.00	11.67	2951	61.33
	At seeding+ 8 L,S	130.00	12.00	3283	62.33
	At seeding+ 12 L,S	135.00	12.33	3373	62.67
15 March	control	130.67	10.67	2547	61.33
	At seeding	133.33	11.33	3229	63.33
	At seeding+ 8 L,S	137.33	11.67	3325	63.67
	At seeding+ 12 L,S	139.00	13.00	3724	63.67
	control	132.67	10.33	2798	60.67
1 April	At seeding	133.33	11.67	3223	63.33
	At seeding+ 8 L,S	133.33	12.67	3293	63.33
	At seeding+ 12 L,S	134.67	12.67	3440	63.33
	L.S.D $_{0.05}$	5.02	1.41	384	3.31

TABLE (2 b). Effect of spring season dates (2019) and fertilizer treatments on sweet corn growth

Second site		Plant height	Leaves number	leaf area	Chlorophyll
Seeding date	1 March	115.08	11.25	2529	58.84
	15 March	130.67	11.75	2557	60.92
	1 April	122.67	11.75	2587	59.58
	L.S.D $_{0.05}$	2.48	0.49	135	2.13
Fertilizer treatments	control	111.22	11.56	2134	55.56
	At seeding	121.67	11.67	2647	60.67
	At seeding+ 8 L,S	128.67	11.78	2713	61.22
	At seeding+ 12 L,S	129.67	11.89	2740	61.67
	L.S.D $_{0.05}$	2.86	0.56	156	2.46
1 March	control	104.00	11.00	2015	54.67
	At seeding	116.00	12.00	2648	59.00
	At seeding+ 8 L,S	118.33	12.00	2690	61.67
	At seeding+ 12 L,S	123.00	12.00	2762	60.00
15 March	control	130.00	11.33	2179	56.33
	At seeding	132.00	11.67	2562	62.67
	At seeding+ 8 L,S	136.00	11.67	2762	61.00
	At seeding+ 12 L,S	138.0	12.67	2724	63.67
1 April	control	105.00	12.33	2207	55.67
	At seeding	123.00	11.33	2733	60.33
	At seeding+ 8 L,S	125.67	11.67	2685	61.00
	At seeding+ 12 L,S	129.00	12.33	2733	61.33
	L.S.D $_{0.05}$	4.95	0.97	269	4.27

Table (3) shows that planting dates caused significant effect on ear fresh weight with or without sheaths, edible ear yield and 100 dry grains weight. The date of 15 March was significantly higher than the date of 1 March which gave the lowest average of 198.0 and 195.8 g, 170.8 and 171.6 g, 10.718 and 10.210 t ha^{-1}, 36.19 and 37.87 g for both sits, respectively. This may be due to its effect on increasing leaf area and chlorophyll content (Table 2). The grain components are related to plant leaf area and its chlorophyll content (Sheikh Sharoush, 2013), and the grain filling period which is reflected in increasing grain weight (Al-Hadidi, 2007). On the other hand, it is clear that fertilizer adding caused significant effect on yield traits compared to control treatment. This is due to the fact that fertilizer increases source size (leaf area and chlorophyll content) as shown in (Table 2), which increased plant metabolism and then reflected in suitable sink with a heavier grain weight (Al-Kinani, 2013). This is consistent with (Jasim & Kateb, 2016). Fertilizer split treatment at seeding and 12 leaf stage was significantly higher than adding all fertilizer at seeding stage, reached 266.2 and 251.6 g, 229.7 and 233.7 g, 9.567 and 9.707 t ha^{-1}, 39.88 and 41.19 g for both sites, respectively. This may be due to increase accumulation from source to sink and thus increase dry matter in grains as well as the role of nitrogen fertilizer in increasing the leaf area and maintaining leaf activity during grain filling stage. This is in line with Riaze *et al* (2002) and Moraditochaee *et al* (2012). The interaction between the factors caused significant effect. Seeding date at March 15, with the addition of the split fertilizer at seeding and at 12 leaves stage gave the highest average of all the studied traits, reaching 310.1 and 297.1 g, 274.4 and 265.1 g, 11.855 and 11.804 t ha^{-1}, 41.33 and 43.70 for both sites, respectively.

TABLE (3 a) Effect of spring season dates and fertilizer treatments on sweet corn yield traits

First site		Ear weight with	Ear weight without	100 dry grains weight	Edible ear (t.ha^{-1})
Seeding date	1 March	198.0	170.8	36.19	8.309
	15 March	276.5	245.3	38.25	10.718
	1 April	231.8	202.2	36.75	9.339
	L.S.D $_{0.05}$	16.3	10.4	1.40	0.485
	control	195.9	164.4	31.47	8.961
Fertilizer treatments	At seeding	238.5	209.7	37.87	9.525
	At seeding+ 8 L,S	240.8	213.4	39.06	9.567
	At seeding+ 12 L,S	266.2	229.7	39.88	9.772
	L.S.D $_{0.05}$	18.8	12.0	1.62	0.560
	control	152.8	125.8	30.53	7.260
1 March	At seeding	189.4	159.7	37.27	7.442
	At seeding+ 8 L,S	208.3	179.5	38.10	8.365
	At seeding+ 12 L,S	241.4	218.3	38.87	10.173
	control	228.1	196.2	32.60	9.609
15 March	At seeding	286.3	257.7	38.50	11.077
	At seeding+ 8 L,S	281.4	252.7	40.57	10.378
	At seeding+ 12 L,S	310.1	274.4	41.33	11.855
	control	206.9	171.1	31.33	9.837

1 April	At seeding	239.9	211.7	37.73	10.238
	At seeding+ 8 L,S	232.9	207.9	38.50	8.477
	At seeding+ 12 L,S	247.3	218.0	39.43	8.807
	L.S.D $_{0.05}$	32.5	20.8	2.81	0.970

TABLE (3 b) Effect of spring season dates and fertilizer treatments on sweet corn yield traits

Second site		Ear weight with	Ear weight without	100 dry grains weight	Edible ear (t.ha-1)
Seeding date	1 March	195.8	171.6	37.87	7.880
	15 March	268.3	212.4	40.51	10.210
	1 April	223.4	200.7	38.77	9.432
L.S.D $_{0.05}$		20.5	22.4	1.28	0.523
	control	189.9	155.3	35.76	8.528
Fertilizer treatments	At seeding	229.9	202.5	39.30	9.264
	At seeding+ 8 L,S	241.8	221.3	39.95	9.199
	At seeding+ 12 L,S	251.6	233.7	41.19	9.707
L.S.D $_{0.05}$		23.7	25. 9	1.48	0.603
	control	163.4	133.7	34.97	7.162
1 March	At seeding	190.5	166.6	38.77	7.298
	At seeding+ 8 L,S	201.4	179.2	37.87	6.953
	At seeding+ 12 L,S	227.8	206.8	39.87	10.103
	control	218.4	170.0	36.73	7.922
15 March	At seeding	271.3	241.0	40.33	10.765
	At seeding+ 8 L,S	286.5	265.1	41.27	10.350
	At seeding+ 12 L,S	297.1	273.3	43.70	11.804
	control	187.8	162.2	35.57	10.355
1 April	At seeding	227.9	199.8	38.80	9.870
	At seeding+ 8 L,S	237.4	219.7	40.70	8.840
	At seeding+ 12 L,S	240.5	220.9	40.00	8.663
L.S.D $_{0.05}$		41.0	44.8	2.56	1.045

CONCLUSIONS

It is concluded that seeding date on March 15 was significantly superior in all growth and yield indicators for both sites. Fertilizer fragmentation was significantly superior in its effect on growth and yield indicators, as the addition of split fertilizer at seeding date and at 12 leaves stage showed significant superiority in all growth and yield indicators for both sites. The results also showed that the overlap between planting dates and fertilizer fragmentation had a significant effect on growth and yield components.

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