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# EFFECT OF SOWING DATE ON SWEET CORN PRODUCTION AND ITS DAY-DEGREE UNITS

BY

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## ABSTRACT

Two field experiments were conducted during the two years of 2001 and 2002 at northwest of Egypt, Bohaira Governorate, in sandy soil to investigate the effect of sowing date on the two sweet corn cultivars Prima plus and Supersweet jubilee concerning their vegetative growth, yield and ear characteristics. The results showed that sowing date significantly affect the yield performance of both cultivars. Early planting reduced the vegetative growth, the total yield/m$^2$, delayed the plant emergence, silking and harvesting, but no clear effect was noticed on the ear characteristics. Sweet corn plants need about 843 day-degree units (DDU) to reach the optimum harvest stage representing 94 days for Prima plus cultivar and about 862 DDU for Supersweet jubilee cultivar standing 97 days. So, sweet corn should be planted according to the requirements of day- degree units.

## INTRODUCTION

Sweet corn (*Zea mays var. rugosa.* Banof) is a warm-season crop, frost-sensitive with a preferred growing season temperature of 15–32°C. Sweet corn is very similar to field maize plant and it is ready to pick up within 75 – 105 days from planting, depending on the cultivar, locality and sowing time. Planting time is strongly influenced by the temperature of soil at sowing depth which should be at least 12°C; ideally soil temperature should be between 15°C and 35°C with a minimum of 14–16°C. Hot, dry and windy conditions at flowering time, when temperature exceeds 35°C can severely stress plants and disrupt pollination and seed set (Dinkel, 1966; Long *et al.*, 1983 and Wolf, 1991).

Using the equation of calculating the day degree units for three months period showed that the approximate developmental period for sweet corn was 29 days with an average number of day degree units 25 during sweet corn season (Arnold, 1960). In another report planting dates used in conjunction with thermal units were found effective sometimes in reducing the error of the productive system. It is hypothesized that they reflect differences in climatic factors that show a trend during the growing season. The establishment of 80% silking stage by field observation increased the accuracy of harvest date prediction (Arnold, 1974).

Successful sweet corn production depends on well management planning before sowing specially suitable planting date to insure that harvesting meets the most profitable market.

This experiment was conducted to study the effect of early sowing dates on the sweet corn plants in order to produce this crop as early as possible in Lower Egypt depending on computing heat units.

## MATERIALS AND METHODS

Sweet corn (*Zea mays var. rugosa.* Banof) cvs. Prima plus and Supersweet jubilee were used as plant material. The seeds were obtained from Rogers Company, USA. Two field experiments were conducted in sandy soil at Bossaily Protected Cultivation Unit (BPCU) farm belonging to the Central Laboratory for Agriculture Climate (CLAC) at Rashid Bohaira Governorate during the two successive seasons of 2001 and 2002. The 1st of the three months February March and April were the early three dates tested, as well as the 1st of July as a control.

The treatments were arranged in split plots of complete randomized block design with three replicates. However, cultivars were considered as the main plots meanwhile the various sowing dates were assigned as the sub-plots. The area of each plot was 9.4 $m^2$ and it consisted of five rows. Each one was 2.5 m long and 0.75 m wide. Three seeds were sown in each hill which in 25 cm apart. After two weeks of sowing; the plants were thinned to one plant in every hill. Drip irrigation was applied and fertilization was done as recommended by the Ministry of Agriculture and Reclamation. The other agricultural practices were employed whenever it was necessary.

The following data were recorded on:

1. **Vegetative characteristics:** plant height, stem diameter and number of leaves per plant at the tasseling time.
2. **Earliness**: Number of days elapsed from seed sowing to plant emergence, silking and harvesting.
3. **Total yield**: Weight of ears per $m^2$.
4. **Ear characteristics**:
   a. Physical characteristics: Fresh weight without husk, length and diameter.
   b. Chemical characteristics: Total sugars and dry matter contents.
5. **Day Degree Units (DDU)**: The degree units which the plants need from planting to full emergence, 50% silking and the time of harvesting was calculated daily by using the following equation:

   DDU = [(Max. Temp. + Min. Temp.) / 2] - 10 °C (Arnold, 1960)

The daily maximum and minimum temperatures for heat-unit calculation were obtained from (CLAC) for experimental zone.

## RESULTS AND DISCUSSION

### 1. Vegetative growth characteristics

Data illustrated in Table (1) show that the vegetative growth characteristics of the two cultivars Prima plus and Supersweet jubilee in both seasons of 2001 and 2002 were the optimum when the plants were sown on the 1st of July. The values of the plant height stem diameter and number of leaves per plant were less when the sowing date was early with the exception of the plant height in the 1st of March in the second season. It may be concluded that early planting affected the pattern of growth in both cultivars.

**Table (1): Effect of sowing dates on the vegetative characteristics of the investigated cultivars of sweet corn in the two seasons of 2001 and 2002.**

| Cultivars | Sowing dates | Plant height (cm) | | Stem diameter (mm) | | Number of leaves per plan | |
|---|---|---|---|---|---|---|---|
| | | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 |
| Prima plus | 1st February | 118.70 c | 120.40 d | 32.27 b | 34.80 a | 8.87 d | 8.63 f |
| | 1st March | 122.10 d | 122.70 bc | 32.30 b | 34.50 a | 8.77 d | 8.87 de |
| | 1st April | 115.30 f | 120.90 cd | 32.10 c | 35.57 a | 8.87 d | 8.73 ef |
| | 1st July | 125.70 b | 120.50 d | 32.50 a | 35.48 a | 10.50 b | 9.50 b |
| Means | | 120.40 B | 121.10 A | 32.29 A | 35.09 A | 9.25 B | 8.93 B |
| Supersweet jubilee | 1st February | 122.10 d | 123.80 b | 29.87 e | 30.37 b | 8.77 d | 8.83 ef |
| | 1st March | 125.00 c | 126.20 a | 29.67 f | 29.60 b | 9.27 c | 9.23 c |
| | 1st April | 122.40 d | 120.50 d | 29.97 e | 30.10 b | 9.33 c | 9.07 cd |
| | 1st July | 131.90 a | 121.60 cd | 30.27 d | 30.40 b | 10.97 a | 10.07 a |
| Means | | 125.30 A | 123.00 A | 29.94 B | 30.12 B | 9.59 B | 9.30 A |
| Average of all means | 1st February | 120.40 c | 122.10 b | 31.07 b | 32.59 ab | 8.82 c | 8.73 c |
| | 1st March | 123.60 b | 124.50 a | 30.99 b | 32.05 b | 9.02 b | 9.05 b |
| | 1st April | 118.80 d | 120.70 c | 31.03 b | 32.83 ab | 9.10 b | 8.90 b |
| | 1st July | 128.80 a | 121.10 bc | 31.39 a | 32.94 a | 10.73 a | 9.79 a |
| L.S.D at 0.05 for | Cultivars (c) | 0.072 | 2.444 | 0.164 | 0.867 | 0.308 | 0.152 |
| | Sowing dates (s) | 0.273 | 1.391 | 0.119 | 0.871 | 0.119 | 0.164 |
| | c*s | 0.386 | 1.967 | 0.169 | 1.231 | 0.169 | 0.232 |

### 2. Earliness

Negative correlation was found between the early planting dates and earliness of plant emergence, silking and harvesting. Data in Table (2) show cleared that the number of days to full emergence, silking and harvesting was increased gradually with the advancing of sowing date. The number of days from sowing to the plant emergence in the early sowing dates (Feb. – Apr.) was about two folds as compared with the common sowing date in July. The differences between the common sowing date in July and the earliest one (1st Feb.) was about 22 days in the first season and 26 days in the second one for earliness of silking in both cultivars, and 26-29 days from sowing to harvesting. These results confirmed with Granberry and McLaurin (1986) who reported that delaying sowing shortened the maturation period by 14-16 days. This picture was expressed clearly by Dobben (1962) and Brouwer *et al.* (1970) who showed that the temperature of the growing point of the stalk is the controlling factor; and thus, the rate of development from planting to anthesis depends almost on the

temperature prevailed around the growing point over the whole period. It is obvious that this delay is attributed to the low temperature degree during the early sowing dates.

**Table (2): Effect of sowing dates on the number of days from sowing to plant emergence, silking and harvesting of the investigated cultivars of sweet corn in the two seasons of 2001 and 2002.**

| Cultivars | Sowing dates | Days to full emergence | | Days to silking | | Days to harvesting | |
|---|---|---|---|---|---|---|---|
| | | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 |
| Prima plus | 1st February | 10.0 a | 11.00 a | 79.53 a | 79.30 ab | 103.50 a | 102.90 c |
| | 1st March | 9.67 ab | 9.33 c | 75.80 c | 75.07 d | 99.14 bc | 98.03 d |
| | 1st April | 9.33 bc | 10.00 b | 74.40 d | 73.53 e | 98.50 c | 97.00 d |
| | 1st July | 5.00 d | 5.00 d | 56.33 f | 53.67 g | 77.67 e | 73.67 f |
| Means | | 8.50 A | 8.83 A | 71.51 A | 70.39 B | 94.69 A | 92.90 B |
| Supersweet jubilee | 1st February | 10.00 a | 10.00 b | 77.67 b | 80.00 a | 103.30 a | 107.30 a |
| | 1st March | 9.33 bc | 9.00 c | 73.00 e | 78.67 b | 99.70 b | 105.70 b |
| | 1st April | 9.00 c | 9.00 c | 73.30 e | 77.33 c | 97.64 d | 102.70 c |
| | 1st July | 5.00 d | 5.33 d | 55.00 g | 56.00 f | 77.33 e | 77.67 e |
| Means | | 8.33 A | 8.33 B | 69.74 B | 73.00 A | 94.49 B | 98.35 A |
| Average of all means | 1st February | 10.00 a | 10.50 a | 78.60 a | 79.65 a | 103.40 a | 102.10 a |
| | 1st March | 9.50 b | 9.17 b | 74.40 b | 76.87 b | 99.42 b | 101.90 b |
| | 1st April | 9.17 b | 9.5 b | 73.85 c | 75.43 c | 98.07 c | 99.85 c |
| | 1st July | 5.00 c | 5.17 c | 55.67 d | 54.83 d | 77.50 d | 75.67 d |
| L.S.D at 0.05 for | Cultivars (c) | 0.463 | 0.327 | 0.510 | 1.121 | 0.152 | 0.760 |
| | Sowing dates (s) | 0.419 | 0.362 | 0.471 | 0.741 | 0.477 | 0.847 |
| | c*s | 0.593 | 0.513 | 0.666 | 1.048 | 0.675 | 1.197 |

### 3. Total yield

Data recorded in Table (3) reveal that the average yield of ears Kg/m$^2$ were reduced significantly in the three early sowing dates compared with the common one for the two cultivars in the two seasons of the experiment. This depression was more obvious in Supersweet jubilee cultivar than prima plus. This result was in harmony with the results given by White (1984) who found that the yield was increased with late sowing dates. The decline in the yield ranged between 40-60% of the optimum and this may be attributed to the decrease in temperature which led to the decrease in photosynthesis and assimilate accumulation.

### 4. Ear physical and chemical characteristics

Data in Table (4) show that there is no obvious effect on ear physical characteristics due to earliness of sowing date except the increase in the length due to planting in the early three dates in the second season. There is a significant difference between the two cultivars in the length of ear in the two seasons and in diameter in the first one, but this difference attributes to the genetic coefficient not to the sowing date.

**Table (3): Effect of sowing dates on the total yield of the investigated cultivars of sweet corn in the two seasons of 2001 and 2002.**

| Cultivars | Sowing dates | Total yield (kg/m²) | |
|---|---|---|---|
| | | 2001 | 2002 |
| Prima plus | 1st February | 1.48 c | 1.53 c |
| | 1st March | 1.66 bc | 1.63 b |
| | 1st April | 1.69 b | 1.69 b |
| | 1st July | 3.10 a | 2.77 a |
| Means | | 1.98 A | 1.91 A |
| Supersweet jubilee | 1st February | 1.22 d | 1.27 d |
| | 1st March | 1.18 d | 0.94 f |
| | 1st April | 1.25 d | 1.17 e |
| | 1st July | 3.11 a | 2.76 a |
| Means | | 1.69 B | 1.54 B |
| Average of all means | 1st February | 1.35 b | 1.40 b |
| | 1st March | 1.42 b | 1.29 c |
| | 1st April | 1.47 b | 1.43 b |
| | 1st July | 3.11 a | 2.76 a |
| L.S.D at 0.05 for | Cultivars (c) | 0.176 | 0.156 |
| | Sowing dates (s) | 0.138 | 0.056 |
| | c*s | 0.195 | 0.080 |

**Table (4): Effect of sowing dates on the ear physical and chemical characteristics of the investigated cultivars of sweet corn in the two seasons of 2001 and 2002.**

| Cultivars | Sowing dates | Length (cm) | | Diameter (mm) | | Total sugars (gm/100 gm d.w) | | Dry matter (gm/100 gm f.w) | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 |
| Prima plus | 1st February | 16.77 c | 16.53 d | 4.73 c | 4.80 ab | 12.83 d | 12.63 cd | 20.87 cd | 21.40 c |
| | 1st March | 16.77 c | 16.63 d | 4.80 c | 4.83 ab | 12.73 de | 12.60 d | 20.83 d | 12.61 c |
| | 1st April | 16.90 c | 16.60 d | 4.80 c | 4.77 ab | 12.90 cd | 12.63 cd | 21.08 bc | 22.46 b |
| | 1st July | 16.83 c | 15.90 e | 5.43 a | 4.90 a | 12.47 e | 12.93 c | 24.33 a | 24.87 a |
| Means | | 16.82 B | 16.42 B | 4.94 A | 4.83 A | 12.73 B | 12.70 B | 21.78 A | 22.58 A |
| Supersweet jubilee | 1st February | 18.39 a | 19.00 a | 4.13 d | 4.63 b | 13.77 a | 14.00 a | 19.70 e | 20.98 c |
| | 1st March | 17.90 b | 18.60 b | 4.07 d | 4.23 c | 13.37 b | 14.03 a | 19.91 e | 21.05 c |
| | 1st April | 18.42 a | 18.69 ab | 4.07 d | 4.37 c | 14.08 a | 14.17 a | 21.16 b | 20.97 c |
| | 1st July | 18.37 a | 17.36 c | 5.10 b | 4.77 ab | 13.20 bc | 13.36 b | 24.35 a | 24.76 a |
| Means | | 18.27 A | 18.41 A | 4.34 B | 4.50 A | 13.60 A | 13.90 A | 21.28 B | 21.94 B |
| Average of all means | 1st February | 17.58 a | 17.77 a | 4.43 b | 4.72 ab | 13.30 a | 13.32 ab | 20.28 c | 21.19 c |
| | 1st March | 17.33 b | 17.62 a | 4.43 b | 4.53 c | 13.05 b | 13.32 ab | 20.37 c | 21.33 bc |
| | 1st April | 17.66 a | 17.65 a | 4.44 b | 4.57 bc | 13.49 a | 13.40 a | 21.12 b | 21.72 b |
| | 1st July | 17.60 a | 16.63 b | 5.27 a | 4.84 a | 12.83 b | 13.16 b | 24.34 a | 24.81 a |
| L.S.D at 0.05 for | Cultivars (c) | 0.218 | 0.393 | 0.095 | 0.351 | 0.221 | 0.268 | 0.259 | 0.388 |
| | Sowing dates (s) | 0.164 | 0.225 | 0.199 | 0.160 | 0.225 | 0.225 | 0.154 | 0.481 |
| | c*s | 0.232 | 0.318 | 0.281 | 0.225 | 0.318 | 0.318 | 0.218 | 0.680 |

Regarding the ear chemical characteristics, there is no obvious trend in the total sugars content (Table 4) that can be attributed to the effect of sowing date. In case of the ear dry matter content, the common date (1st July) was the best. This may be due to the climatic conditions in July which was more suitable for growth and photosynthesis of sweet corn. These observations were obtained also by Darbyshire *et al.* (1979), who found that the early sowing dates caused more rapid increase in water-soluble polysaccharides content in the grains of sweet corn in relation to moisture loss.

## 5. Heat unit accumulation

Data in Table (5) show the accumulation of day-degree units (DDU) that sweet corn cvs. Prima plus and Supersweet jubilee required from sowing to harvesting. The results indicate that the two cultivars need about 45-47, 600-612 and 834-872 DDU from sowing to each of plant emergence, silking and the harvest stage, respectively. The accumulation degree units differ according to cultivar and sowing or growing time. These units of day-degree were increased by increasing the period from sowing to full emergence, silking and/or harvesting. This information helps in determination and forecasting harvest date in any planting season. The DDU needs for the plant to grow and develop are taken from the available daily temperature by accumulation from planting till harvesting (Lass *et al.*, 1993).

**Table (5): Effect of sowing dates on the day-degree units (DDU) of the investigated cultivars of sweet corn in the two seasons of 2001 and 2002.**

| Cultivars | Sowing dates | DDU to Full Emergence | | DDU to Silking | | DDU to Harvesting | |
|---|---|---|---|---|---|---|---|
| | | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 |
| Prima plus | 1st February | 38.3 d | 39.6 c | 483.1 f | 467.6 e | 693.5 e | 692.0 h |
| | 1st March | 43.9 c | 41.6 c | 563.8 d | 552.0 d | 852.9 d | 805.3 f |
| | 1st April | 49.3 ab | 46.6 b | 692.9 b | 690.2 b | 893.2 b | 898.4 d |
| | 1st July | 53.4 a | 53.4 a | 710.4 a | 707.4 a | 965.9 a | 943.8 b |
| Means | | 46.2 A | 45.3 A | 612.5 A | 604.3 B | 851.4 A | 834.9 B |
| Supersweet Jubilee | 1st February | 40.7 cd | 40.6 c | 466.5 g | 473.8 e | 694.8 e | 716.2 g |
| | 1st March | 44.0 bc | 40.8 c | 553.3 e | 563.6 c | 859.7 c | 871.7 e |
| | 1st April | 50.5 a | 51.1 a | 680.6 c | 690.3 b | 890.7 b | 908.7 c |
| | 1st July | 53.4 a | 52.8 a | 695.7 b | 705.1 a | 964.2 a | 992.1 a |
| Means | | 47.2 A | 46.4 A | 599.0 B | 608.2 A | 852.4 A | 872.2 A |
| Average of all means | 1st February | 39.5 c | 40.1 c | 474.8 d | 470.7 d | 694.2 d | 704.1 d |
| | 1st March | 44.0 b | 41.2 c | 558.6 c | 557.8 c | 856.3 c | 838.5 c |
| | 1st April | 49.9 a | 48.9 b | 686.7 b | 690.3 b | 892.0 b | 903.6 b |
| | 1st July | 53.4 a | 53.1 a | 703.0 a | 706.2 a | 965.1 a | 968.0 a |
| L.S.D at 0.05 for | Cultivars (c) | 1.79 | 2.40 | 3.99 | 3.52 | 1.47 | 3.29 |
| | Sowing dates (s) | 3.72 | 2.02 | 4.88 | 5.55 | 4.07 | 5.29 |
| | c*s | 5.26 | 2.86 | 6.89 | 7.58 | 5.76 | 7.48 |

From the previous result it may be concluded that inspite of the reduction in the total yield of this crop due to planting early in February, March and April but the gain income is high as there is lake in this favorite crop in the market during these periods.

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## تأثير ميعاد الزراعة على إنتاج الذرة السكرية واحتياجاتها من درجات الحرارة المتجمعة

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أجريت تجربتان حقليتان خلال عامي ٢٠٠١ و٢٠٠٢ فى محافظة البحيرة فى أرض رملية بهدف دراسة تأثير مواعيد الزراعة على نمو وإنتاج صنفى الذرة السكرية "بريما بلس" و"سوبر سويت چوبيلى" تحت ظروف هذه المنطقة حيث جربت ثلاثة مواعيد مبكرة هى أول فبراير وأول مارس وأول أبريل إلى جانب الموعد الرئيسى لزراعة الذرة السكرية فى أول يوليو. وقد أظهرت النتائج تأثيرا معنويا على كلا

الصنفين المنزرعين، حيث قل النمو الخضرى للنبات وتأخر ظهور الحريرة والحصاد وقل المحصول الناتج من المتر المربع ولم يكن هناك تأثير واضح على صفات الكوز المورفولوچية والكيماوية نتيجة الزراعة فى المواعيد الثلاثة المبكرة مقارنة بالميعاد المعتاد لزراعة الذرة. وقد وجدت علاقة عكسية بين مواعيد الزراعة المبكرة وتبكير الأزهار والحصاد. وأظهرت نتائج حساب الوحدات الحرارية المتجمعة أن الذرة السكرية تحتاج الى ٨٣٤ – ٨٧٢ وحدة حرارة متجمعة من الزراعة حتى الحصاد وإن أختلفت هذه الوحدات باختلاف الصنف وميعاد الزراعة. لذا، فانه من الممكن زراعة ونمو محصول الذرة السكرية متى توفرت إحتياجاته الحرارية.