

Impact of Planting Date on Growing Degree Units, Grain Yield and Growth Traits of Some Egyptian Yellow Maize Inbred Lines

ABSTRACT

This study was conducted in 2021 to study the impact of planting date on maize inbred lines and determine their accumulated growing degree units (GDU). The experiment was held at three agriculture research stations (Gemmeiza, Ismaelia and Sids) with RCBD of four replications. It was planned to provide also some insights to optimize maize production and mitigate the impact of climatic changes to all researchers in the scientific community. Three planting dates i.e. April 20th (early), May 20th (optimal) and June 20th (moderately late) were applied to investigate their effect on number of days to 50% tasselling and silking, plant height and grain yield of 16 Egyptian yellow maize inbred lines. In addition, to determine accumulated growing degree units (GDU) from planting to 50% silking. Results revealed highly significant differences among tested inbreds for all studied traits at the three planting dates indicating presence of genetic diversity among tested inbreds. Also, the same trend was found for differences among locations and inbreds x location indicating climatic variability among the three testing locations and that inbreds behaved differently at different locations due to differences in climatic conditions among locations and also genetic diversity among inbreds. Number of days to 50% tasselling and silking was reduced from April to June planting as a result of increased temperatures during plant development. Longest plant heights were obtained in April planting as a result of prolonged vegetative growth due to cool - moderate temperatures prevailing at early vegetative growth. Grain yield of all tested inbreds was reduced, with few exceptions, in June 20th planting as a result of high temperatures prevailing at time of tasselling and silking which resulted in pollen, stigma or fertilization abortion and caused poor seed setting. Highest yield of studied inbreds was obtained at Gemmeize location in April 20th planting and it is recommended as a suitable production location for inbreds. Inbred Sakha 3 was the best performing under variable planting dates. Also, inbreds Sakha 1, Sakha 11, Gz 639 and Gm 1021 performed well on certain planting dates. Determination of accumulated growing degree units for tested inbreds revealed big variation among them as a result of genetic diversity of inbreds and matched well with variation present in their silking dates and specified earliness or lateness of tested inbreds. Results of GDU would help in expectation of timing for many agricultural practices such beginning of detasselling process and harvest time in hybrid breeding programs.

Key words: maize, inbred lines, agronomic traits and growing degree units (GDU).

INTRODUCTION

Maize is considered as one of the most grain strategic crops around the world. In Egypt, it comes second after wheat in terms of economic importance and production. For maximum production of each hybrid, it is important to decide its optimum planting date. In hybrid seed production programs, it is also crucial to decide the appropriate sowing date of parental inbreds

across different planting times during the season to obtain good ear seed setting. **El-mekser et al. (2012)** working on inbred lines, found that relatively late planting date (June 15th) produced the lower grain yield and reduced plant and ear heights. Climatic changes associated with different planting dates (sunshine, temperature etc.) have a modifying effect on growth and development of maize plants (**Sarvari and Futo, 2000**). They stated also that, late planting tremendously affected grain yield and early and mid-season planting are recommended for high yield. This is why testing of inbreds across different sowing dates is of great importance in hybrid breeding programs. **Varma et.al. (2014)** stated that early and mid-early sowings in India resulted in good yields and high quality seeds. **Liaqat et al. 2018** stated that planting dates significantly affected silking date, plant height and grain yield. Maize growth and development stages are normally sensitive and are affected by various weather parameters as affected by planting dates (**Shrestha, et. al., 2018**).

As an effect of delayed planting (off-season planting), **Gouda et al. (1998)** studied effect of different planting times on yield and some agronomic traits of some maize hybrids. They found that delayed planting affected all studied agronomic traits in addition to a noticeable yield reduction. A similar trend was found by **Hassan (1999)** where he found that late planting date significantly decreased flowering dates, plant and ear height and grain yield.

Dolapo and Albert (2017) found that late planting date negatively affected plant physiological growth and grain yield of maize and could have a considerable risk on maize growers. **Jiban et al. (2018)** stated that delayed planting dates affected anthesis and silking, photosynthesis, physiological maturity and dry matter production and consequently reduced grain yield.

Growing degree units (GDU) are used to measure corn growth relative to temperature and each corn hybrid can be identified with a GDU number that indicates GDU,s needed to reach certain growth stage and black layer formation. They added also that, growing degree days (GDD,s) and GDU,s refer to the same formula and can be used interchangeably (**AsgrowDekalb, 2020**).

For maize, **Marton et al., 2004** stated that growth development is strongly related to the accumulation of heat or temperature units above a threshold or base temperature below which little growth occurs. Scientists have determined that the lower base temperature for maize is 10 °C. In maize, there is also an upper threshold (30 °C) above which little or no growth occurs. However, subtropical and tropical maize varieties can grow in temperatures above 30 C⁰ (**Khalifa 2019**). Growing degree units (GDU) information is used to help in planning crop management decisions such as detasselling process time and harvest time. **Hassan (2017)** classified some Hungarian maize hybrids, under Egyptian conditions, into different maturity groups using accumulated heat units (HU) method and found that different maturity groups behaved differently for many agronomic traits. In a bulletin by **AsgrowDekalb (2018)** extension department, they stated that a corn plant requires a certain number of growing degree units (GDU,s) to reach maturity regardless of the number of calendar days it takes to accumulate. They also mentioned that, the relationship of GDU accumulation and corn development can help predict when an important growth stage will occur.

The objectives of this study are 1: study the **impact** of planting dates on tasselling and silking dates, plant height and grain yield, 2. **Determine** accumulated growing degree units (GDU) for tested inbreds from planting date to 50% silking.

MATERIAL AND METHODS

Sixteen yellow maize inbred lines with different genetic backgrounds (Table 1) were used in this investigation to study the effect of three planting dates i.e. April 20th (early), May 20th (optimal date) and June 20th (moderately late) on number of days to 50% tasselling and silking, plant height (cm) and grain yield (ton/ha.) and also to calculate accumulated growing degree "units (GDU) from planting date to 50% silking. Trials were conducted at Gemmeiza (30° 47' W), Ismaelia (30° 36' E) and Sids (30° 95' E) agriculture research stations, ARC, Egypt. A randomized complete block design (RCBD) with 4 replications was used. Experimental plot size consisted of one row of 6 m in length and 70 cm row spacing was used. All recommended cultural practices were applied. Data for 50% tasselling and silking were scored. Average plant height was measured on 5 guarded plants/plot. At maturity, ears were harvested, weighed and seed moisture content was measured. Grain yield was adjusted to 15.5% moisture. After which, yield/plot was converted to ton/ha.

Maize growing degree units (GDU) were calculated by subtracting maize lower base or threshold temperature (10 °C) from the average daily temperature in °C. Average daily air temperature is calculated by averaging the daily maximum and minimum air temperatures. Accumulated GDU are scored starting from planting date to the day where 50% silking was reached (**AsgrowDekalb Bulletin. 2018, 2020 and Monsanto 2015**). Daily GDU can be calculated as follow:

$$\text{Daily maize GDU (}^{\circ}\text{C)} = T_{\text{max}} + T_{\text{min}} / 2 - T_{\text{base}}$$

Where, T_{max} and T_{min} are maximum and minimum day air temperatures, while T_{base} is the base temperature (10 °C) for maize growing.

Trials data were statistically analyzed using SAS statistical analysis program (**SAS Institute, 2000**). Comparison of means was achieved according to **Steel and Torrie (1980) on the basis of (0.05) probability level**. Combined analysis for each trait across locations for each planting date was achieved

Table 1: Origin of the 16 inbred lines involved in the study.

No.	Inbred	Origin
1	Sakha- 1	Local x subtropical germplasm

2	Sakha- 2	Local x subtropical germplasm
3	Sakha- 3	Local x subtropical germplasm
4	Sakha- 4	Local x subtropical germplasm
5	Sakha- 10	Local x subtropical germplasm
6	Sakha- 11	Local x subtropical germplasm
7	Giza-639	American - Temperate germplasm
8	Giza- 653	Subtropical germplasm. CIMMYT _ Mexico
9	Giza- 656	American - Temperate Germplasm
10	Giza- 657	American -Temperate Germplasm
11	Giza- 658	American -Temperate Germplasm
12	Giza- 666	American -Temperate germplasm
13	Gemmeiza- 1002	Subtropical DMR population, Nigeria
14	Gemmeiza- 1004	Subtropical germplasm – IITA – Nigeria
15	Gemmeiza- 1021	Local population developed from the subtropical cross (Sd.121x DMR – ESR).
16	Sids- 3120	Population 45- Local – Egypt

Results and discussion

Analysis of variance

Analysis of variance for all studied traits is illustrated in Tables 2-5. Results revealed highly significant differences among inbred lines, locations and inbred x location (IxL) interaction **at 0.05 probability level**. These results indicated real genetic differences among tested inbred lines and also climatic differences among testing locations. In addition, significant IxL interaction indicated that inbreds behaved differently at different locations as a result of different climatic conditions at testing locations.

Table 2: Mean squares for number of days to 50% anthesis under three planting dates of 16 yellow maize inbred lines across three locations.

Source of variation	Df	MS		
		April 20 th	May 20 th	June 20 th
Location (L)	2	892.94**	24.54**	79.89**
Rep/L	9	2.20	5.78	2.71
Inbred Lines (I)	15	87.43**	77.65**	44.21**
IxL	30	11.38**	6.88**	15.62**
Error	135	3.08	1.33	2.60

Table 3: Mean squares for number of days to 50% silking under three planting dates of 16 yellow maize inbred lines across three locations.

Source of variation	Df	MS		
		April 20 th	May 20 th	June 20 th
Location (L)	2	1005.81**	43.15**	125.77**
Rep/L	9	2.48	7.84	2.35
Inbred Lines (I)	15	92.48**	78.01**	41.34**
IxL	30	10.97**	4.87**	15.05**
Error	135	3.42	1.67	4.11

Table 4: Mean squares for plant height under three planting dates of 16 yellow maize inbred lines across three locations.

Source of variation	Df	MS		
		April 20 th	May 20 th	June 20 th
Location (L)	2	22614.19**	5925.52**	15246.22**
Rep/L	9	334.16	189.58	145.79
Inbred Lines (I)	15	2497.63**	2855.97**	2957.70**
IxL	30	1297.94**	487.33**	1001.50**
Error	135	84.07	138.38	81.25

Table 5: Mean squares for grain yield under three planting dates of 16 yellow maize inbred lines across three locations.

Source of variation	Df	MS		
		April 20 th	May 20 th	June 20 th

Location (L)	2	17.90**	103.29**	60.57**
Rep/L	9	0.13	0.19	0.11
Inbred Lines (I)	15	6.36**	3.92**	1.31**
I×L	30	2.17**	1.40**	0.61**
Error	135	0.07	0.08	0.03

Days to 50% tasselling and silking

Results for average number of days to 50% tasselling and silking are shown in Tables 6 and 7. Results revealed highly significant differences for both traits among the 3 planting dates. As a result of climatic differences among locations, inbreds behaved differently from one planting date to another. At Gemmeiza station (Mid-delta), where weather in April is relatively cool, the early vegetative growth was slow which illustrates longer time that plants took to reach both tasselling and silking. Difference between April (early) and May planting (optimal) for both traits reached 10 and 9 days, respectively and only one day difference was obtained for both traits when moving from May planting to June planting (moderately late) at the same station. For Ismaelia station (west- delta) where weather temperature is moderate in April and warmer in May and June (32-36 °C), differences for both traits among the 3 planting times was reduced to 4 days only. For Sids station (mid-south delta) where high temperature are prevailing starting from late April up to September, no significant differences (only one day) were found among the 3 planting dates for both traits, but plants reached tasselling and silking earlier than April planting. However, inbreds behaved differently with increasing temperatures in mid-summer where some inbreds were affected more than others. This information is very important for the national maize seed production program to adjust planting time of parental inbreds of each hybrid **according to results obtained in this investigation**. **El-Mekser et al. (2012)** found that late planting (beyond June) of inbreds reduced number of days to anthesis and silking. Same results were reached by **Liaqat et al. (2018)** **Gouda et al. (1998)**; **Jiban et al. (2018)** and **Hassan (1999)**.

Plant Height

Average plant height for the 16 inbred lines in each location and planting date was illustrated in Table 8. Significant differences in plant height were found among inbreds and also among planting dates. In the 3 research stations, cool to moderate temperatures in April extended vegetative growth in early period of plant development which resulted in taller plant height in April planting as compared to May and June planting except, unexpectedly, at Gemmeiza station for unknown reasons. Reduction in plant height as a result of warming up in May reached 12 and 27 cm at Ismaelia and Sids research stations, respectively. At Sids station, temperatures are normally high (above 40 °C) during June- August which accelerated plant growth and reduced plant height compared to April and May planting except inbreds Sk. 4 and Gz. 666 where they were not affected and were slightly taller than May planting. This is can be interpreted on the basis of their genetic background and its response to climatic conditions. Many researchers reached same results (**Hassan 1999**, **El-Mekser et al., 2012**; **Sarvari and Futo, 2000**; **Gouda et al., 1998** and **Dalpo and Albert, 2017**).

Grain yield

Grain yield averages for the studied inbreds at each location and each planting date are shown in Table 9. Highly significant differences were found among inbreds at each location, among locations and also among planting dates. Results revealed that the highest average grain yield for all studied inbreds was obtained at Gemmeiza research station on May 20th (optimal planting time) and April 20th i.e. 3.50 and 3.03 t/ha., respectively, followed by Sids station (2.42 t/ha.) on April 20th planting date. In addition, Gemmeiza location produced the highest inbreds average grain yield across the 3 planting dates (3.27 t/ha.) followed by Ismaelia station (1.99 t/ha.), then Sids station (1.28 t/ha.). So, it is recommended for seed production purposes of these inbreds to be at Gemmeiza location on May and April planting dates or at Sids location on April 20th. The reduction in yield of inbreds at Ismaelia and Sids stations in May and June planting is mainly due to higher air temperatures specially June planting at Sids where temperature that were prevailing at flowering time were so high (above 40 °C) and caused poor seed setting due to pollen or fertilization abortion. On April planting, the highest yield producing inbreds were Gz639 (Gm), Gm1004 and Gz656 (Ism) Gz666, Sk11 and Gm1021 (Sids). In May planting, Sk1 and Sk3 (Gm), Sk2 and Sk3 (Ism) and Gz666, Sk11 and Gm1021 (Sids) were the best yield producers. In June planting (hot season), Sk11, Gz666 and Sk3 (Gm), Sk3 and Gz656 (Ism) and SK3 and Sd 3120 (Sd) produced the highest yield. Jiban *et al.* 2018 showed that delayed planting affected grain yield and flowering dates. Also, Sarvari and Futo, 2000 stated that weather conditions associated with late planting affected negatively growth stages and grain yield. Gouda *et al.* 1998 and Varma *et al.* 2014 reached similar results.

Table 6: Effect of planting date on number of days to 50% anthesis of 16 yellow maize inbred lines evaluated at 3 locations in 2021.

Inbred line	Gemmeiza	Ismailia	Sids
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	April 20th	May 20th	June 20th	April 20th	May 20th	June 20th	April 20th	May 20th	June 20th
Sk1	76.25	63.50	63.25	72.25	66.00	63.50	65.75	68.00	67.50
Sk2	74.75	64.75	65.00	71.00	65.75	62.50	68.75	67.75	71.50
Sk3	74.75	65.00	65.00	65.25	65.50	61.50	67.25	65.75	64.25
Sk4	76.50	64.75	65.00	70.50	65.00	65.00	67.75	67.00	64.75
Sk10	73.50	63.75	64.25	67.50	64.75	61.25	64.75	63.75	65.25
Sk11	72.50	64.75	64.50	68.50	63.25	62.25	64.75	65.00	63.25
Gz 639	75.75	68.25	65.25	72.00	70.00	65.50	69.25	69.50	70.00
Gz 653	85.00	72.00	66.50	78.00	70.00	66.00	71.75	71.75	70.25
Gz 656	75.75	68.25	67.75	72.75	70.50	67.25	69.00	66.75	67.75
Gz 657	79.75	70.00	63.00	75.75	71.50	66.25	72.00	72.00	69.75
Gz 658	73.75	68.00	64.25	71.75	69.25	63.25	69.00	65.25	68.00
Gm 1002	71.00	64.50	64.00	71.25	67.00	61.25	67.00	64.75	60.25
Gm 1004	76.50	65.00	65.25	71.25	69.00	65.25	68.25	66.50	64.25
Gm 1021	71.25	64.00	65.00	71.25	65.50	63.25	67.75	63.75	64.75
Sd 3120	73.50	63.75	64.50	71.00	66.50	62.50	67.25	66.00	64.00
Gz 666	71.25	62.50	63.00	69.75	63.00	61.50	62.00	60.50	58.25
Average	75.11	65.80	64.72	71.23	67.03	63.63	67.64	66.50	65.86
LSD 0.05	0.86	1.13	1.19	0.83	0.57	0.87	4.16	2.55	3.70

Table 7: Effect of planting date on number of days to 50% silking of 16 yellow maize inbred lines evaluated at 3 locations in 2021.

	Gemmeiza	Ismailia	Sids
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Inbred line	April 20th	May 20th	June 20th	April 20th	May 20th	June 20th	April 20th	May 20th	June 20th
Sk1	78.25	65.00	65.25	74.25	68.25	65.50	66.75	68.25	70.00
Sk2	76.00	66.25	67.00	73.25	68.00	65.25	69.75	68.00	74.50
Sk3	75.75	67.00	67.00	68.25	67.75	64.25	68.50	67.75	66.00
Sk4	78.50	66.75	67.00	72.75	67.00	67.25	68.50	68.00	70.00
Sk10	74.75	65.75	66.25	69.50	67.25	63.75	66.00	64.75	66.75
Sk11	74.50	66.50	66.50	71.00	65.75	64.75	65.75	65.00	64.50
Gz 639	78.25	70.00	67.25	74.00	72.00	67.25	71.00	70.25	73.50
Gz 653	87.00	74.00	68.50	80.00	71.75	67.75	73.25	73.25	71.50
Gz 656	77.25	70.25	69.75	74.75	73.00	69.00	70.00	69.50	69.50
Gz 657	81.75	72.00	65.50	77.75	73.25	67.50	74.00	73.25	73.50
Gz 658	76.75	69.75	66.25	73.75	71.00	65.25	70.75	69.00	69.00
Gm 1002	72.25	66.50	66.00	73.50	69.00	63.50	68.50	65.25	61.50
Gm 1004	78.25	67.00	67.25	73.50	71.25	67.75	70.25	69.00	67.75
Gm 1021	72.75	66.00	67.00	73.50	68.00	65.25	68.75	64.50	67.00
Sd 3120	75.50	65.50	66.75	73.25	68.75	64.75	68.00	67.25	68.25
Gz 666	72.50	63.75	65.00	72.00	65.00	63.75	63.75	64.50	63.50
Average	76.88	67.63	66.77	73.44	69.19	65.78	68.97	67.97	68.55
LSD 0.05	1.02	1.16	1.27	1.04	1.01	1.02	4.32	2.80	4.73

Table 8: Effect of planting date on plant height of 16 yellow maize inbred lines evaluated at 3 locations in 2021.

Inbred line	Gemmeiza	Ismailia	Sids
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	April 20th	May 20th	June 20th	April 20th	May 20th	June 20th	April 20th	May 20th	June 20th
Sk1	197.50	185.00	185.00	172.50	198.75	216.25	220.00	198.75	173.75
Sk2	135.00	142.50	150.00	160.00	167.50	156.25	161.25	137.50	125.00
Sk3	156.25	161.25	165.00	167.50	176.25	177.50	175.00	136.25	131.25
Sk4	158.75	190.00	172.50	197.50	192.50	201.25	220.00	188.75	193.75
Sk10	190.00	157.50	153.75	175.00	163.75	192.50	167.50	145.00	131.25
Sk11	160.00	180.00	158.75	242.50	211.25	200.00	201.25	175.00	146.25
Gz 639	167.50	152.50	182.50	167.50	185.00	201.25	170.00	153.75	145.00
Gz 653	161.25	162.50	152.50	200.00	177.50	201.25	207.50	188.75	148.75
Gz 656	150.00	160.00	162.50	202.50	171.25	167.50	191.25	145.00	151.25
Gz 657	135.00	138.75	141.25	195.00	165.00	158.75	171.25	122.50	101.25
Gz 658	138.75	160.00	161.25	176.25	170.00	180.00	187.50	146.25	143.75
Gm 1002	127.50	158.75	162.50	170.00	177.50	188.75	195.00	178.75	166.25
Gm 1004	135.00	151.25	173.75	178.75	153.75	116.25	146.25	135.00	130.00
Gm 1021	137.50	166.25	151.25	208.75	161.25	162.50	187.50	166.25	160.00
Sd 3120	155.00	158.75	165.00	187.50	165.00	155.00	170.00	165.00	153.75
Gz 666	156.25	177.50	165.00	206.25	183.75	163.75	181.25	140.00	143.75
Average	153.83	162.66	162.66	187.97	176.25	177.42	184.53	157.66	146.56
LSD 0.05	9.23	12.38	11.73	15.80	15.84	15.39	13.30	20.93	10.95

Table 9: Effect of planting date on grain yield (t./ha.) of 16 yellow maize inbred lines evaluated at 3 locations in 2021.

Inbred line	Gemmeiza	Ismailia	Sids
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	April 20th	May 20th	June 20th	April 20th	May 20th	June 20th	April 20th	May 20th	June 20th
Sk1	3.12	4.31	1.33	2.14	2.10	2.84	3.62	1.07	0.18
Sk2	3.66	4.00	1.12	2.06	2.34	2.34	2.14	1.67	0.32
Sk3	3.83	4.29	1.86	1.94	2.31	3.27	3.56	1.75	0.92
Sk4	3.73	3.91	0.92	1.81	1.75	2.62	2.81	0.82	0.24
Sk10	2.06	2.27	1.11	1.83	1.49	1.82	2.70	0.83	0.20
Sk11	3.62	3.87	2.35	2.50	1.28	2.62	4.03	1.24	0.31
Gz 639	3.96	4.03	2.01	2.34	2.16	2.71	1.82	0.94	0.41
Gz 653	2.30	1.92	0.85	1.27	1.68	2.29	0.07	0.08	0.63
Gz 656	2.79	3.62	1.37	2.55	1.77	3.12	1.34	0.51	0.28
Gz 657	0.78	0.54	1.25	1.85	1.08	2.26	0.10	0.03	0.07
Gz 658	1.40	4.21	0.90	1.53	1.37	2.51	1.39	1.02	0.47
Gm 1002	3.40	3.81	0.85	1.64	2.09	1.60	2.60	0.62	0.07
Gm 1004	3.53	3.98	0.86	2.59	1.40	1.83	1.83	0.96	0.28
Gm 1021	3.80	4.20	0.81	1.78	1.40	1.48	4.00	2.22	0.18
Sd 3120	3.23	3.45	0.99	1.65	1.38	1.95	2.69	2.31	0.90
Gz 666	3.32	3.66	1.95	2.18	1.47	1.45	4.08	0.81	0.12
Average	3.03	3.50	1.28	1.98	1.69	2.29	2.42	1.05	0.35
LSD 0.05	0.40	0.50	0.21	0.35	0.37	0.34	0.39	0.31	0.14

Growing Degree Units (GDU)

Accumulated growing degree units for each inbred at each planting date was **determined** and shown in Table 10 according to the formula described by **AsgrowDekalb Bulletin 2018, 2020**. Also, average GDU,s for each inbred across the three testing locations at each planting date was **determined** and shown in the same table. Variation in results of different inbreds reflected actual variation in silking dates of tested inbreds **and illustrated earliness or lateness of inbreds**. GDU,s for each inbred supposed to be the same regardless of planting time. However, in this investigation it was found that GDU,s of each inbred increased when moving **from April to June planting** i.e. with increasing seasonal temperature. This could be due to effect of other environmental factors such as soil temperature, day length and light intensity that affected growth development of plants and resulted in variation observed in **GDU,s of inbreds**. **Marakinyo et al., 2011** indicated the usefulness of GDU,s to classify maize genotypes into maturity groups.

Conclusion

Results of this investigation indicated that different planting dates (early, optimal and moderately- late) across maize growing season significantly affected tasselling and silking dates, plant height and also grain yield due to varying temperatures prevailing at each planting date. **It was clear that delayed planting affected negatively grain yield due to reduced plant size and/or poor seed setting or both as a result of high temperatures.** On April planting, the highest yield producing inbreds were Gz639 (Gm), Gm1004 and Gz656 (Ism) Gz666, Sk11 and Gm1021 (Sids). In May planting, inbred Sk1 and Sk3 (Gm), Sk2 and Sk3 (Ism) and Gz666, Skh11 and Gm1021 (Sids) were the best producers. In June planting (hot season), Sk11, Gz666 and Sk3 (Gm), Sk3 and Gz656 (Ism) and SK3 and Sd 3120 (Sd) produced the highest yield. **Determination** of accumulated growing degree units for different growth stages of investigated inbred lines can help when an important growth stage such detasselling time and harvest will occur which is very crucial in any maize hybrid program.

Table 10: Accumulated growing degree units (GDU) for number of days to 50% silking of 16 yellow maize inbred lines grown at 3 planting dates and 3 location in 2021.

Inbred line	April 20 th				May 20 th				June 20 th			
	Gm	Ism	Sd	Avg.	Gm	Ism	Sd	Avg.	Gm	Ism	Sd	Avg.
Sk1	1000	980	910	963	991	1041	1132	1055	1075	1183	1280	1179
Sk2	970	1115	955	1013	1009	1060	1138	1069	1101	1156	1211	1156
Sk3	970	1005	930	968	1025	1077	1130	1077	1101	1156	1219	1159
Sk4	1015	1005	930	983	1025	1077	1138	1080	1101	1156	1285	1181
Sk10	954	955	895	935	1008	1058	1180	1082	1092	1201	1250	1181
Sk11	955	950	885	930	1025	1080	1083	1063	1095	1204	1195	1165
Gz 639	1000	1135	1010	1048	1078	1132	1165	1125	1109	1165	1220	1165
Gz 653	1155	1140	1085	1127	1143	1200	1220	1188	1135	1249	1302	1230
Gz 656	985	1030	980	998	1078	1132	1180	1130	1151	1266	1272	1230
Gz 657	1070	1195	1050	1105	1110	1165	1185	1153	1080	1188	1224	1164
Gz 658	985	1035	985	1002	1078	1132	1156	1122	1092	1202	1266	1187
Gm1002	900	1015	980	965	1026	1077	1101	1068	1086	1195	1139	1140
Gm1004	1000	915	870	928	1026	1077	1156	1086	1109	1220	1235	1188
Gm1021	915	1005	930	950	1009	1060	1066	1045	1101	1211	1203	1172
Sd 3120	970	995	930	965	1008	1055	1135	1066	1095	1205	1250	1183
Gz 666	915	890	835	880	975	1024	1072	1024	1070	1177	1139	1129

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