Effect of Growing Degree Days on Yield Attributes and Yield of Groundnut

R. Baskaran\textsuperscript{1*}, V. Karunakaran\textsuperscript{1} and A. Kamaraj\textsuperscript{1}

\textsuperscript{1}Agricultural College and Research Institute, Eeachangkottai, Thanjavur (TN), India.

Authors’ contributions
This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information
DOI: 10.9734/CJAST/2020/v39i2230842
Editor(s):
(1) Dr. Tushar Ranjan, Bihar Agricultural University, India.
Reviewers:
(1) Joel Ventura Rios, Universidad Autonóma Agraria Antonio Narro, Mexico.
(2) Aouadj Sid Ahmed, Abou Bakr Belkaid University, Algeria.
Complete Peer review History: http://www.sdiarticle4.com/review-history/59274

Received 20 May 2020
Accepted 27 July 2020
Published 11 August 2020

ABSTRACT

The objective of this study was undertaken to find out the optimum sowing window and the amount of heat units required to change their phonological development for groundnut. An field experiment was conducted at experimental farm of Agricultural College and Research Institute, Eeachangkottai during Margazhi pattam 2019. The experiment was conducted in Randomized Block Design. Different morphological indices were observed (plant height, number of branches, dry matter, number of pods) and yield attributes and yield of groundnut VRI-2 was recorded. The heat unit concept of Growing Degree Days also worked out for individual sowing windows. Among the sowing dates, 05.01.2019 recorded essential GDD of 1651.3°C and higher growth attributes, yield attributes and yield (2370 kg ha\textsuperscript{-1}).

Keywords: Groundnut; growing degree days; yield.

1. INTRODUCTION

Groundnut (\textit{Arachis hypogaea} L.) is an important oilseed crop grown under rainfed conditions. It is a very sensitive crop to climatic variations, especially rainfall, temperature and radiation \cite{1}. Among oilseeds crops in India, groundnut accounts for about 50 per cent of area and 45 per cent of oil production. In India, about 75 per cent of the groundnut area lies in a low to moderate

*Corresponding author: E-mail: rbaski73@gmail.com;
2. MATERIALS AND METHODS

The field experiment was conducted at experimental farm of Agricultural College and Research Institute, Eachangkottai during Markazhi pattam (January 2019) in randomized block design with four replication. The groundnut variety VRI 2 was sown at different dates of 05-01-2019, 12-01-2019, 19-01-2019, 26-01-2019 and 02.02.2019 and harvest was taken during 18-04-2019, 25.04.2019, 30-04-2019, 06-05-2019 and 12.05.2019 respectively. Nutrients were applied @ 25:50:25 kg NPK ha⁻¹ in the form of urea, SSP and MOP, respectively along with 10 tonne of farm yard manure. Gypsum was applied during the time of ear thing up @ 500 kg ha⁻¹. The seeds were sown at a depth of 5 cm with 30 x 15 cm spacing. The data on the parameters like plant height, leaf area index, dry matter production, number of pods and yield of ground nut VRI 2. Daily observations on maximum and minimum air temperature were recorded at meteorological observatory, Agricultural College and Research Institute, Eachangkottai. The weather data were used for the analysis. Growing Degree Days (GDD) is defined as the sum over the growing season of a crop of the difference between the daily temperature and a reference temperature. GDD was expressed in terms of °C day. The growing degree days (GDD) was worked out by considering the base temperature of 10°C (Patel et al. 1999). The total growing degree days (GDD) for different phenological phases were determined by the following formula:

\[
\text{Accumulated GDD} = \sum (T_{\text{max}} - T_b) \quad \text{°C day}
\]

Where,

\[
\begin{align*}
GDD &= \text{Growing degree days} \\
T_{\text{max}} &= \text{Daily maximum temperature (°C)} \\
T_{\text{min}} &= \text{Daily minimum temperature (°C)} \\
T_b &= \text{Base temperature (10°C)}
\end{align*}
\]

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

The weather parameters such as rainfall and light hours played a critical role on the crop growth, which in turn decides the crop yield. During the cropping period, the first sowing window (05.01.2019) recorded 177.5 HU to attain germination phase, 552.5 HU for germination to flowering phase and 944.3 HU for flowering to harvest with a total HU of 1653.3. The first sowing window recorded higher total heat units (HUA) of 1651.3 than other sowing windows. Higher plant height at 30 DAS (19.6 cm), 60 DAS (43.2 cm) and 90 DAS (62.4 cm), leaf area index at all the growth stages and dry matter production at all the growth stages 30 DAS (795 kg/ha), 60 DAS (2300 kg/ha) and 90 DAS. (8200 kg ha⁻¹) were recorded in the first sowing window of 05.01.2019. This might be due to the better sunlight for longer duration which produce more photosynthates, increase in the number of branches and increased the total dry matter per plant (Meena et al., 2015) (Table 1). Lower plant height, leaf area index and dry matter production was registered in the all the growths stages in sowing windows of 02.02.2019, which might be due to the short day conditions of the crop [6] (Table 2).
Table 1. Effect of heat units at different phenological stage and yield of groundnut

| Treatments | Sowing to germination | Germination to flowering | Flowering to harvest | Total (HUA) |
|------------|-----------------------|-------------------------|----------------------|-------------|
| T1         | 177.5                 | 529.5                   | 944.3                | 1651.3      |
| T2         | 187.75                | 534.5                   | 861.3                | 1583.5      |
| T3         | 200.75                | 511                     | 839.5                | 1551.25     |
| T4         | 206.5                 | 547.5                   | 811.5                | 1565.5      |
| T5         | 214.5                 | 546.25                  | 795.5                | 155         |
| S.Ed       | 18.4                  | 19.9                    | 25.4                 | 54.2        |
| C.D (P=0.05) | 39.4               | 42.6                    | 54.2                 | 62.3        |

Table 2. Effect of heat units on plant height, leaf area index and dry matter production of groundnut

| Treatments | Plant height (cm) | Leaf area index | Dry matter production (kg/ha) |
|------------|--------------------|-----------------|-------------------------------|
|            | 30 DAS 60 DAS 90 DAS | 30 DAS 60 DAS 90 DAS | 30 DAS 60 DAS 90 DAS |
| T1         | 19.6 43.2 62.4 0.150 1.90 2.91 | 795 2570 8200 |
| T2         | 18.6 37.3 53.2 0.130 1.45 2.70 | 718 2320 7350 |
| T3         | 18.4 36.2 52.2 0.125 0.98 2.50 | 690 2260 6900 |
| T4         | 15.1 31.3 46.5 0.112 0.71 2.35 | 654 2100 6700 |
| T5         | 14.1 23.2 42.8 0.05 0.66 1.60 | 598 1950 4355 |
| S.Ed       | 1.10 2.27 3.27 0.01 0.090 0.160 | 43.37 103.5 355.5 |
| C.D (P=0.05) | 3.58               | 7.35 10.65 0.03 0.290 0.520 | 141.30 224.5 772.1 |

Table 3. Effect of Heat Units on plant height, leaf area index and dry matter production of groundnut

| Treatments | No of pods/plant | Shelling (%) | Yield (kg/ha) |
|------------|------------------|--------------|---------------|
| T1         | 26.3             | 86.5         | 2370          |
| T2         | 24.2             | 85.15        | 2050          |
| T3         | 23.5             | 84.6         | 2000          |
| T4         | 22.2             | 80.2         | 1770          |
| T5         | 19.9             | 73.3         | 1230          |
| S.Ed       | 3.6              | 26.1         | 125.1         |
| C.D (P=0.05) | 10.8             | 79.3         | 271.4         |

3.2 Yield Attributes and Yield

The maximum number of 26.2 pods plant\(^{-1}\) was recorded in first sowing window followed by second, third sowing window at 18 and 17, respectively (Table 4). The higher grain yield of 2370 kg ha\(^{-1}\) was obtained from the first sowing window (05.01.19) followed by second and third sowing which recorded 2050 and 2000 kg ha\(^{-1}\), respectively. The yield increase might be due to accumulation of more heat unit in the first sowing window than the other time of sowing. Adequate soil fertility, climate, water, daylight hours, and other factors that aid plant performance. Thus, variation in the growth parameters varies the pod yield. Mohite et al., [5] and Naik et al., [6] also obtained similar results. The crop sown during 5\(^{th}\) January recorded significantly higher pod yield which was due to the favorable weather conditions that prevailed during crop growth period and similar findings were reported by Canavar and Kaynak [7] and Bala et al. [8] (Table 3).

4. CONCLUSION

The present study indicated that the sowing dates, it can be concluded that, the first date of sowing (05.01.2019) can produce higher pod yield due to better vegetative growth, which can translocate photosynthates to the sink and produce more number of pods than other date of sowing.

COMPETING INTERESTS

Authors have declared that no competing interests exist.
REFERENCES

1. Banik NC, Nath R, Chakraborty PK. Effect of dates of sowing on growth and yield of groundnut crop. Journal of Crop Weed. 2009;5:59-62.

2. Hatfield JL, Boote KJ, Kimball BA, Ziska LH, Izaurralde RC, Ort D, Thomson AM, Wolfe DW. Climate impacts on agriculture: Implications for crop production. Indian Journal Agronomy. 2011;103:351-370.

3. Girijesh GK, Kumarswamy AS, Sreedhar S, Kumar MD, Vageesh TS, Rajashkearappa KS. Heat unit utilization of kharif maize in transitional zone of Karnataka. Journal of Agrometeorology. 2011;13(1):43-45.

4. Prakash V, Niwas Ram, Khichar ML, Sharma Dinesh, Manmohan, Singh Baljeet. Agrometeorological indices and intercepted photosynthetically active radiation in cotton crop under different growing environments. J. Cotton Res. Dev. 2015;29(2):268-272.

5. Mohite UA, Mohite AB, Jadhav YR. Effect of sowing windows on growth and yield of groundnut varieties during Kharif season. Contemporary Research in India. 2017;7:189-192.

6. Naik AHK, Pallavi N, Sannathimmappa HG. Performance of different Spanish- Type groundnut varieties suitable under Central dry zone of Karnataka, India. International Journal of Current Microbiology and Applied Sciences. 2018;7:1394-1397.

7. Canavar O, Kavnak MA. Effect of different planting dates on yield and yield components of groundnut (Arachis hypogaea L.). Turk Journal of Agriculture. 2008;32:521-528.

8. Bala HMB, Ogunlela VB, Kuchinda NC, Tanimu B. Response of two groundnut (Arachis hypogaea L.) varieties to sowing date and NPK fertilizer rate I a semi-arid environment: Yield and yield attributes. Asian Journal of Crop Science. 2011;3:130-140.

© 2020 Baskaran et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/59274