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

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Authors' contributions

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

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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, Eachangkottai 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^{-1}).

Keywords: Groundnut; growing degree days; yield.

1. INTRODUCTION

Groundnut (*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 [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

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rainfall zone (parts of peninsular region and western and central regions) with a short period of distribution (90-120 days). Production constraints, groundnut is grown mainly as rainfed crop there is high a level of fluctuation in the production depending on the rainfall. Temperature is one of the primary micro-climatic factors driving rates of growth. Rate of plant growth and development is dependent upon temperature surrounding the plant and each species has a specific temperature range represented by a minimum, maximum and optimum. The number of days required for cultivars to reach maturity depends primarily on location, date of sowing and temperature. Due to variations in daily minimum and maximum temperatures from year to year and between location, number of days from planting to physiological maturity varies and, is not a good predictor of crop development [2]. Meteorological indices *viz*. growing degree days (GDD), helio thermal unit (HTU), and photo-thermal unit (PTU) based on air temperature are used to describe changes in phenological behavior and growth parameters [3,4]. Plants have a definite heat requirement before they attain certain phenophases. A change in temperature during phenophases of a crop adversely affects the initiation and duration of different phenophases and finally the economic yield. Among the different management factors, sowing time plays a key role in obtaining higher yield. The optimum time is mainly dependent on prevailing agro-climatic conditions of an area besides the variety grown. Hence the present study was undertaken to find out the optimum sowing window and the amount of heat units required to change their phonological development for groundnut.

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 phonological phases were determined by the following formula

$$\text{Accumulated GDD} = \Sigma\ [(T_{max} + T_{min})/2] - T_b \ (°C \text{ day})$$

Where,

GDD = Growing degree days
T_{max} = Daily maximum temperature (°C)
T_{min} = Daily minimum temperature (°C)
T_b = Base temperature (10°C)

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)
T_1	177.5	529.5	944.3	1651.3
T_2	187.75	534.5	861.3	1583.5
T_3	200.75	511	839.5	1551.25
T_4	206.5	547.5	811.5	1565.5
T_5	214.5	546.25	795.5	155
S.Ed	18.4	19.9	25.4	29.2
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
T_1	19.6	43.2	62.4	0.150	1.90	2.91	795	2570	8200
T_2	18.6	37.3	53.2	0.130	1.45	2.70	718	2320	7350
T_3	18.4	36.2	52.2	0.125	0.98	2.50	690	2260	6900
T_4	15.1	31.3	46.5	0.112	0.71	2.35	654	2100	6700
T_5	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)
T_1	26.3	86.5	2370
T_2	24.2	85.15	2050
T_3	23.5	84.6	2000
T_4	22.2	80.2	1770
T_5	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 5th 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.

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