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EFFECT OF AGROCLIMATIC INDICES AND YIELD IN GROUNDNUT (*Arachis hypogaea* L.) AT DIFFERENT DATES OF SOWING

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ABSTRACT

A field experiment was conducted at Regional Agricultural Research Station farm of S. V. Agricultural college , Tirupati in a split plot design with four main treatments i.e. Varieties (V1- Narayani, V2- Dharani, V3- K-6 and V4- TMV-2) and three minor treatments i.e. dates of sowing (D1-June 21st, D2- July 14th, D3- July 30th). The data on crop weather interactions in terms of temperature GDD (Growing degree days), day length (Photothermal unit), sunshine hours (Heliothermal unit) and Heat use efficiency (HUE) were calculated for the four varieties sown at three different dates of sowing at grain filling stage (days to first pod initiation to physiological maturity). Temperature, photoperiod and sunshine hours had positive influence with grain filling stage i.e. from days to first pod initiation to physiological maturity. Heat use efficiency (HUE) was also observed to be an important parameter for yield potential in groundnut. Significant variation was observed for yield among the varieties and dates of sowing. Among the varieties, yield and shelling percentage was higher for Dharani (V2) followed by K-6 (V3), TMV-2 (V3) and Narayani (V1) respectively. Evaluating the dates of sowing, June 21st sowing (D1) recorded higher yield followed by July 14th sowing (D2) and July 30th sowing (D3) respectively.

KEYWORDS: Agroclimatic indices, groundnut, GDD, HUE

INTRODUCTION

Groundnut is the 13th most important food crop and 4th most important oilseed crops of the world. Among oilseed crops in India, groundnut accounts for about 50 per cent of area and 45 per cent of oil production. In India, groundnut occupies an area of 5.5 m ha producing 9.6 m t and with a productivity of 1750 kg ha^{-1} (National Research Centre for Groundnut, Annual report, 2014). In Andhra Pradesh, groundnut is cultivated in 0.95 lakh ha with a production of 1.98 lakh tonnes and productivity of 2329 Kg ha^{-1} during *rabi* season. During *kharif* season, it is cultivated in an area of 6.8 lakh ha with a production of 5.9 lakh tonnes and productivity of 865 Kg ha^{1} (AICRP, 2016).

An assessment on the impact of climatic variability on groundnut would provide basic information required for evaluating climatic potential of the region. Tirupati is located in semi arid tropics classified under Southern Agroclimatic zone of Andhra Pradesh. Geographically it is situated at 13.65^{0}N & 79.42^{0}E and an altitude of 182.9 meters above mean sea level. As Southern Agroclimatic zone is near to equator, variability in photoperiod is less than two hours, but temperature is highly variable. Groundnut crop yields are highly variable in this region across the seasons as well as among different dates of sowings within a season. Hence an attempt was made for studying the effect of agroclimatic indices and yield in groundnut (*Arachis hypogaea* l.) at different dates of sowing.

MATERIALS AND METHODS

A field experiment was conducted in Regional Agricultural Research Station farm of S.V.Agricultural college, Tirupati in split plot design with four main treatments i.e. Varieties (V1- Narayani, V2- Dharani, V3- K-6 and V4- TMV-2) and three minor treatments i.e. dates of sowing (D1-June 21st, D2- July 14th and D3- July 30th).

During the period of study (21-06-2016 to 24-11-2016) i.e., from the time of sowing to physiological maturity, the weather data was recorded daily. From sowing to physiological maturity, agroclimatic indices such as GDD (Growing degree days), PTU (Photothermal unit), HTU (Heliothermal unit) and HUE (Heat use efficiency) was calculated for all the four varieties sown at three different dates of sowing.

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RESULTS AND DISCUSSION

Crop Weather Relationship

The data pertaining to weather parameters recorded during the crop growth period (from sowing to physiological maturity) of four groundnut varieties sown at different dates of sowing are presented in Table 1.

During the period of study from the time of sowing to physiological maturity, the mean maximum and minimum temperature for the varieties ranged from 33.58°C to 34.82°C and 24.88°C to 25.36°C respectively across the dates of sowing. The RH I and RH II ranged from 74.08 per cent to 80.2 per cent and 46.78 per cent to 54.52 per cent respectively with a mean RH ranging from 60.42 per cent to 67.34 per cent. Sunshine hours of four groundnut varieties across the dates of sowing ranged from 4.12 hours to 6.22 hours and day length period groundnut varieties ranged from 12.45 hours to 11.77 hours across the four dates of sowing. During the period of study rainfall varied from 95.5 mm to 356.2 mm and evaporation ranges from 4.76 mm day^{-1} to 6 mm day^{-1}.

Accumulated agroclimatic indices

The data pertaining to accumulated agroclimatic parameters *viz.,* GDD, HTU, PTU and HUE from sowing to harvest of groundnut crops sown at three different dates of sowing are given in Table 2.

GDD (Growing degree days) (°day)

The GDD accumulation was higher in Dharani (V2) (2277.25 °day) followed by TMV-2(V4) (2142.30 °day) whereas lower GDD was accumulated by K-6 (V3) (2117.6°day) and Narayani (V1) (2074.12°day) respectively from sowing to physiological maturity. Among the dates of sowing, higher GDD was accumulated in D3 (July 30th) sowing (2204.98°day) followed by D2 (July 14th) sowing (2177.79°day) and D1 (June 21st) sowing (2152.26°day).

Longer days in June sown crop accumulated more GDD thereby resulting in better yields compared to other two late sown crops. As the sowings were delayed, July sown crops accumulated less GDD thereby took more days to attain maturity.

Heliothermal units (HTU) (°C day hr)

Among the varieties, the Heliothermal units was higher in Dharani (V2) (14164.81°C day hr) followed by TMV-2 (V4) (9833.20°C day hr) whereas lower GDD was accumulated by K-6 (V3) (9719.80°C day hr) and Narayani (V1) (8545.29°C day hr) respectively from sowing to physiological maturity. Among the dates of sowing, higher HTU was accumulated in D2 (July 14th) sowing (13545.85°C day hr) followed by D3 (July 30th) sowing (9790.11°C day hr) and D1 (June 21st) sowing (8867.31°C day hr).

Longer days in June sown crop accumulated more sunshine hours during the crop growth period resulting in high HTU compared to other two late sown crops. As the sowings were delayed, July sown crops accumulated more HTU thereby took more days to attain maturity. Sunshine hour with temperature played a major role in early sown crops resulted in good yields.

Photothermal units (PTU) (°C day hr)

Among the varieties, the Photothermal units was higher in Dharani (V2) (27691°C day hr) followed by TMV-2 (V4) (26050°C day hr) whereas lower GDD was accumulated by K-6 (V4) (25750°C day hr) and Narayani (V1) (25221°C day hr) respectively from sowing to physiological maturity. Among the dates of sowing, higher PTU was accumulated in D1 (June 21st) sowing (26795.64°C day hr) followed by D2 (July 14th) sowing (26699.71°C day hr) and D3 (July 14th) sowing (25952.61°C day hr). As the sowings were delayed, PTU decreased gradually due to decrease in day length hours. Since groundnut is a day neutral crop, there is not much variation in Photothermal unit (PTU) among the dates of sowing

Heat use efficiency (HUE) (kg/ha/°C)

Among the varieties, the HUE was higher in Dharani (V2) (0.88 kg/ha/°C) followed by K-6 (V3) (0.86 kg/ha/°C) whereas lower HUE was accumulated by TMV-2 (V4) (0.80) and Narayani (V1) (0.65 kg/ha/°C) respectively at physiological maturity. Among the dates of sowing, higher HUE was accumulated in D1 (June 21st) sowing (0.93 kg/ha/°C) followed by D2 (July 14th) sowing and D3 (July 30th) sowing (0.73 kg/ha/°C). HUE was higher in June 21st sowing (D1) due to higher accumulated GDD resulted in good yields compared to other two dates of sowing.

HUE was higher in June 21st sowing (D1) due to higher accumulated GDD resulted in good yields compared to other two dates of sowing. Similar results were reported by Sogut *et al*. (2016).

Yield and shelling percentage

The data on yield (Kg/ha) from sowing to harvest were collected from four groundnut varieties sown at three dates of sowing are presented in Table 3.

Table 1. Weather parameters recorded during the crop growth period for three different dates of sowing

Dates of sowing	Max. Temp (°C)	Min. Temp (°C)	RH I (%)	RH II (%)	Mean RH %	SS (hr)	RF (mm)	Evaporation (mm day^{-1})	Day length (hours)
D1 : (June 21st)	33.58	24.88	80.20	54.52	67.34	4.12	356.2	4.76	12.45
D2 : (July 14th)	34.82	25.36	74.08	46.78	60.42	6.22	242.3	6.0	12.26
D3 : (July 30th)	33.98	25.2	74.68	49.14	61.9	4.44	95.5	5.52	11.77

Table 2. Agroclimatic indices calculated for the groundnut varieties sown at three different dates of sowing

Treatments	GDD (^{o}day)	HTU (°C day hr)	PTU (°C day hr)	HUE (kg/ha/^{o}C)
Varieties	2074.10	8545.29	25221	0.65
Narayani(V1)	2277.30	14164.81	27691	0.88
Dharani (V2)	2117.60	9719.80	25750	0.86
K-6 (V3)	2142.30	9833.20	26050	0.80
TMV-2 (V4)	**2152.82**	**10565.78**	**26178.26**	**0.80**
Mean	**87.61**	**2468.99**	**1065.32**	**0.10**
SD	**4.07**	**23.37**	**4.07**	**13.05**

Dates of sowing	GDD	HTU	PTU	HUE
D1 : (June 21st)	2152.26	8867.31	26795.64	0.93
D2 : (July 14th)	2177.79	13545.85	26699.71	0.73
D3 : (July 30th)	2204.98	9790.11	25952.61	0.73
Mean	**2178.34**	**10734**	**26482.65**	**0.80**
SD	**26.36**	**2478.10**	**461.53**	**0.12**
CV (%)	**1.21**	**23.09**	**1.743**	**0.15**

Among the varieties, Dharani (1198.33 Kg) recorded significantly higher yield followed by K-6 (1083.89 Kg) whereas lowest pod yield was recorded by TMV-2 (1016.08 Kg) followed by Narayani (853.78 Kg). The data of pod yield on three dates of sowing showed significantly higher pod yield in D1(June 21st) sowing (1238.58 Kg) followed by D2(July 14th) sowing (948.50 Kg) whereas lower pod yield was recorded in D3(July 30th) sowing (927.17Kg).

The variability of pod yield in D1 and D2 sowings are worth notable compared to the pod yield in D3. This can be due to the effect of temperature and photoperiod at pod filling of the crop growing period. These results revealed that at vegetative stage only GDD i.e., temperature played a pivotal role. At grain filling stage, temperature, photoperiod and sunshine hours had positive influence. Similar results were reported by Canavar and Kaynak (2008), Khan *et al*. (2009) and Caliskan *et al*. (2008).

Table 3. Yield and shelling percentage of four groundnut varieties sown at three dates of sowing

Treatments	Pod yield (kg/ha)	Shelling percentage (%)
V1 (Narayani)	853.78	62.69
V2 (Dharani)	1198.33	68.98
V3 (K-6)	1083.89	67.22
V4 (TMV-2)	1016.08	65.08
CD (0.05)	**65.33**	**4.21**
D1(June 21st)	1238.58	71.44
D2(July 14th)	948.50	65.46
D3(July 30th)	927.17	61.07
CD(0.05)	**71.37**	**4.04**
D1V1	903.67	67.67
D1V2	1630.33	75.01
D1V3	1419.67	72.49
D1V4	1000	70.59
D2V1	894.67	64.43
D2V2	1000	66.58
D2V3	910.67	65.07
D2V4	988.67	65.78
D3V1	763.00	55.97
D3V2	964.67	65.33
D3V3	921.33	64.10
D3V4	1059.67	58.87
Mean	1038.03	65.99
CD(0.05)	**113.17**	**NS**

Shelling percentage (%)

Among the groundnut varieties, highest shelling percentage was recorded by Dharani (68.98%) followed by K-6 (67.22%) whereas lowest shelling percentage was recorded by TMV-2 (65.08%) and Narayani (62.69%) respectively**.** Among the dates of sowing highest shelling percentage was exhibited in D1 (June 21st) sowing (71.44%) due to higher pod filling followed by D2 (July14th) sowing (65.46%) whereas lowest shelling percentage was recorded in D3 (July 30th) sowing (61.07%).

The results indicated that a significant variation exist for shelling percentage among the dates of sowing due to variability in photothermal units. Sogut *et al*. (2016) related the decrease in shelling percentage in late sowing to the lower soil temperature in seed filling period which resulted in delayed maturity.

CONCLUSION

The study on agroclimatic indices such as GDD, HTU, PTU and HUE indicated that for groundnut, only GDD i.e. temperature played pivot role at vegetative stage. At grain filling stage (days to first pod initiation to physiological maturity) temperature, photoperiod and sunshine hours had positive influence i.e., from days to first pod initiation to physiological maturity. Heat use efficiency (HUE) was also showed to be an important parameter for yield potential in groundnut.

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