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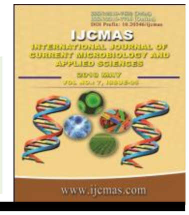

Original Research Article

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Study on Agrometeorological Indices, Thermal and Photothermal Use Efficiency of Summer Groundnut (*Arachis hypogaea* L.) at Allahabad Region, India

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A B S T R A C T

An investigation on effect of sowing time on growth, phenology and yield attribute of summer groundnut (*Arachis hypogaea* L.) was conducted at Agrometeorological Station Farm, School of Forestry and Environment, SHIATS-Deemed-To-Be-University, Allahabad during crop season 2013. Sixteen treatment combinations with four dates of sowing (1^{st} March, 11^{th} March, 21^{st} March and 31^{st} March) and four varieties (HNG-69, R-2(Girnar-2), HNG-10 and M-13) were tried in split plot design with four replications. The crop yield showed negative and highly significant correlations with average weathers parameters viz., maximum temperature, minimum temperature during early crop growth phases especially flowering and pegging period and the morning relative humidity, afternoon relative humidity during later crop growth phases especially pod maturity period. The crop yield showed negative and highly significant correlations with accumulated agrometeorological indices viz., growing degree days (GDD), photothermal unit (PTU), hygrothermal unit I, photo temperature and nycto temperature during early crop growth phase especially flowering period and positive during pod maturity phase, except GDD, PTU, HgTU-I and HgTU-II. The optimum maximum temperature during flowering (P_3) and pod maturity (P_5) phases were found to be 41.9 ^{0}C and 36.6 ^{0}C, respectively.

Introduction

Groundnut (*Arachis hypogaea* L.) is an annual legume crop and a major oilseed crop of tropical and subtropical countries, which is also known as ‘peanut’, ‘earthnut’, ‘monkey nut’ and ‘goobers’. It is the 13^{th} most important crop and 4^{th} most oilseed crop of the world. Groundnut is a widely adapted to varying agro-climatic conditions and soils, which has made its cultivation possible in most of the tropical and subtropical countries in the world. Groundnut is a C_3 plant where photo respiration is very high. Groundnut is a deep rooted a distinct tap root with secondary and deeply spreading roots make it drought resistant to some extent. Groundnut is a self-pollinated crop and pollination takes place early in the morning. If rainfall occurs in the morning then pollination is affected. As soon as fertilization is complete, the flowers fade. After fertilization, peg produced. The pegs are positively geotropic enter in the soil. In India, about 91 percent of total groundnut area is confined to the states of Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra and Odisha. The rest of the area and production is scattered mainly in the states of Rajasthan, Utter Pradesh, Madhya Pradesh and Punjab. In India, the total area under groundnut cultivation was 4.93 million hectares and total production was 5.94 million tonnes with productivity of 1144 kg ha^{-1} has been reported in the year 2010-11 (Anonymous, 2010a). Among the major groundnut states, Gujarat ranks first in production and second in area. In Utter Pradesh, the total area under groundnut cultivation was 2,61,950 hectares and total production was 2,39,000 tonnes with productivity of 1690 kg ha^{-1} has been reported in the year 2009-10 (Anonymous 2010b). The duration of specific stages of growth shows direct relationship with temperature and for particular species this duration may be predicted through summation of mean daily air temperature (Wang, 1960), because each growth stages effected from weather parameters (Patel *et al.*, (2010). Temperature, soil moisture, relative humidity, bright sunshine hours and solar radiation are the important weather parameters that influence the crop life cycle during summer season.

Materials and Methods

The experiment was conducted at the Agrometeorological Station Farm, School of Forestry and Environment, SHIATS-Deemed-To-Be-University, Allahabad during crop season 2013. The soil of the experiment plot was sandy loam in texture and slightly alkaline in reaction, low in organic carbon and available nitrogen, medium in available phosphorus and potassium status. Sixteen treatment combinations with four dates of sowing (1^{st} March, 11^{th} March, 21^{st} March and 31^{st} March) and four varieties (HNG-69, R-2 (Girnar-2), HNG-10, M-13) were tried in split plot design with four replications. The keep date of sowing in main plot and varieties as sub plot treatments. The crop was sown in line with spacing of 30 x 10 cm, using seed rate of 120 kg/ha with fertilizer dose of 25 kg N and 50 kg P_2O_5 /ha. Full dose of fertilizer in the form of urea and DAP was applied in furrows before sowing. Two interculturing and two hand weeding were carried out in groundnut crop to maintain weed free condition during crop season.

The crop was free form major insect pests by taking suitable plant protection measures. The five plants from net plot were selected randomly and were tagged in each treatment plots for the purpose of measured observation. The crop growth stages from each date of sowing were recorded as date of emergence, flowering, pegging, pod development and pod maturity.

Weather parameters *viz.*, maximum temperature (T_{max}), minimum temperature (T_{min}), Relative humidity (RH I & RH II), Bright sunshine hours (BSS) were recorded at the agrometeorological observatory located near the experiment field. The agrometeorological indices *viz.*, growing degree days (GDD), photothermal unit (PTU), heliothermal unit (HgTU I & II) were calculated following Chopada (2004) using base temperature of 10^0 C (Lavand, 2012).

GDD = ∑ (Tmax + Tmin)/2 – base temperature

PTU = GDD X N (maximum possible sunshine hours)

HTU = GDD X N (Actual duration of bright sunshine)

HgTU – I & II = GDD X Relative humidity at morning (I) and at afternoon (II)

The effective day temperature (T_{photo}) and night temperature (T_{nycto}) were calculated following Went (1957) while Interdiurnal range of temperature (T_{IDR}) was calculated following Wang (1960).

$T_{photo} = T_{max} – 1/4 X (T_{max} – T_{min})$
$T_{nycto} = T_{max} + 1/4 X (T_{max} – T_{min})$
$T_{IDR} = (T_{max})_i – (T_{min})_{i+1}$

Where, $(T_{max})_I$ = maximum temperature of the i^{th} day, $(T_{min})_{i+1}$ = minimum temperature of the $(i+1)^{th}$ day

Results and Discussion

Agrometeorological indices

Growing degree days

The data pertaining to accumulated heat units in different treatments are presented in Table 1. Different dates of sowing significant influenced GDD. The GDD accumulation was significantly highest in D_1 (1887.14 day ^{0}C) than other sowing dates. The minimum GDD was accumulated in D_4 sowing date (1656.98 day ^{0}C).

The GDD accumulation was highest in D_1 due to longer duration of crop growing period and lowest in D_4 sowing due to forced maturity caused by increase in temperature. The decrease in GDD may be due to decrease in the maturity period of the groundnut. These findings are agreement with Murty *et al.*, (2008), and Meena and Dahama *et al.*, (2004). The growing degree day was significant influenced by the crop varieties. The significantly highest GDD was accumulated by variety V_1 (1839.18 day ^{0}C) followed by variety V_2 (1809.43 day ^{0}C). However, significantly lowest GDD was analysed in variety V_4 (1738.79 day ^{0}C). These data are those for arranged in Table 1. The interaction effect between sowing dates and different varieties was found to be non-significant for GDD accumulation. The results are with the conformity with the findings of Jadhav *et al.*, (1990).

Photothermai unit

The photothermal unit (PTU) under various sowing dates is presented in the Table 1. Different sowing dates were found to be non-significant for accumulation of PTU. However, crop varieties were significantly differed for accumulation of photothermal unit (PTU). The highest PTU was obtained by variety V_1 (22998.1 ^{0}day hrs) followed by variety V_2 (22600.6 ^{0}day hrs). However, significantly lowest PTU was recorded by variety V_4 (20290.4 ^{0}day hrs). The interaction effect between sowing dates and different varieties was found to be non-significant for PTU.

Heliothermal unit

The accumulated heliothermal unit (HTU) under various sowing dates is presented in the Table 1. Different sowing dates significantly influenced heliothermal unit (HTU). The D_1 accumulated maximum heliothermal units (15469.7 ^{0}day hrs) to reach maturity stage. The lowest HTU was accumulated in D_4 sowing date that is 13129.6 °day hrs. This may be due to cloudiness prevailed during the pod development stage of D_4 sown crop. These results are reported by Chakravarty and Sastry (1983).

The heliothermal unit (HTU) was significant influenced by the crop varieties. The highest HTU was obtained by variety V_1 (14611.3 ^{0}day hrs) followed by variety V_2 (14459.3 ^{0}day hrs). However, significantly lowest HTU was recorded by variety V_4 (141116 ^{0}day hrs). The interaction effect between sowing dates and different varieties was round to be non-significant for HTU.

Hygrothermal unit-I

The accumulated morning hygrothermal unit-I required by the crop for various Phenophases under different dates of sowing are presented in Table 1. The hygrothermal unit-I significantly influenced by sowing dates. The hygrothermal unit-I was highest (153927 ^{0}day percent) in the D_1 followed by D_2 (149174.0 ^{0}day percent). The accumulation of HgTU-I was the lowest in D_4 34352 ^{0}day percent due to short crop growth period. Hygrothermal unit-I (HgTU-I) was significant influenced by crop varieties. The highest HgTU-I was obtained by variety V_1 (149798 ^{0}day percent) followed by variety V_2 (147339 ^{0}day percent). However, significantly lowest HgTU-I was recorded by variety V_4 (141361 ^{0}day per cent). The decrease trend was found in variety V_1 to V_4 in all sowing dates due to shortening of maturity date. The interaction effect between sowing dates and different varieties was found to be not significant for HgTU-I.

Hygrothermal unit-II

The accumulated afternoon hygrothermal unit-II accumulated the crop during various phenophases under different sowing dates are presented in the Table 1. The hygrothermal unit-II (HgTU-II) significantly influenced by different sowing dates. The D_3 sown condition accumulated the highest hygrothermal unit-II (58309.9 ^{0}day percent) whereas, lowest hygrothermal unit-II was accumulated by D_4 sowing condition (53851.3 ^{0}day percent). Crop varieties significantly influenced the accumulation of hygrothermal unit-II (HgTU-II). The highest HgTU-II was obtained by variety V_1 (59826.9 ^{0}day percent) followed by variety V_2 (58159.1 °day percent). However, significantly lowest HgTU-II was obtained by variety V_4 (54020.9 °day percent). The decrease trend was found in variety V_1 to V_4 in all sowing date variations in days taken to maturity by different varieties. The interaction effect between sowing dates and different varieties was found to be not significant for HgTU-II.

Photo temperature (T_{photo})

The photo temperature (T_{photo}) significantly influenced by different sowing dates (Table 1). The photo temperature was the highest in the D_1 (4173.94 0C) followed by D_2 sowing condition (4057.44 0C). The lowest photo temperature was taken by D_4 sowing condition (3674.39 0C). Photo temperature (T_{photo}) was significantly influenced by the crop varieties. The highest Photo temperature was obtained by variety V_1 (4100.03 ^{0}C) followed by variety V_2 (4022.17 ^{0}C). However, significantly lowest photo temperature (T_{photo}), was recorded variety V_4 (3834.05 "C). The decrease trend was found in variety V_1 to V_4 in all sowing dates. The interaction effect between sowing dates and different varieties was found to be non-significant for photo temperature.

Nycto temperature (T_{nycto})

The nycto temperature (T_{nycto}) is significantly influenced by different sowing dates. The nycto temperature was the highest in D_1 sowing condition (3230.38 ^{0}C) followed by D_2 sowing condition (3190.08 ^{0}C). The lowest nycto temperature was taken by D_4 sowing condition (2962.21 ^{0}C). Among crop varieties the nycto temperature (T_{nycto}) was significantly influenced. The highest nycto temperature was obtained by variety V_1 (3259.43 ^{0}C) followed by variety V_2 (3188.22 ^{0}C). However, significantly lowest nycto temperature (T_{nycto}) was recorded by variety V_4 (3015.77 ^{0}C). The decrease trend was found in variety V_1 to V_4 in all sowing dates due to different days taken to maturity. These data are arranged in Table 1. The interaction effect between sowing dates and different varieties was found to be non-significant for nycto temperature.

Table.1 Effect of treatments on various agrometeorological indices to reach maturity stage in summer groundnut during crop season 2013

Treatment	GDD	PTU	HTU	HgTU-I	HgTU-II	T_{photo}	T_{nycto}	T_{IDR}
Sowing dates (D)								
D_1	1887.14	21871.8	15469.7	153927	58005.2	4173.94	3230.38	1890.63
D_2	1829.70	22747.5	14728.6	149174	57923.0	4057.44	3190.08	1736.91
D_3	1787.08	22438.7	14137.9	145358	58309.9	3977.82	3182.22	1591.97
D_4	1656.98	20951.4	13129.6	134352	53851.3	3674.39	2962.21	1420.56
F-test	S	NS	S	S	S	S	S	S
S.Em.±	13.089	-	68.678	1036.7	739.305	33.1	30.034	5.621
C.D. at 5%	29.608	-	155.35	2345.1	1672.31	74.873	67.937	12.715
C.V.%	0.52	3.09	0.34	0.5	0.92	0.59	0.68	0.24
Varieties (V)								
V_1	1839.18	22998.1	14611.3	149798	59826.9	4100.03	3259.43	1681.38
V_2	1809.43	22600.6	14459.3	147339	58159.1	4022.17	3188.22	1668.63
V_3	1773.51	22120.3	14281.7	144313	56082.4	3927.34	3101.48	1653.02
V_4	1738.79	20290.4	14113.6	141361	54020.9	3834.05	3015.77	1637.04
F-test	S	S	S	S	S	S	S	S
S.Em.±	8.365	992.632	43.249	698.31	486.916	21.819	19.929	4.361
C.D. at 5%	16.993	2016.53	87.86	1418.6	989.17	44.326	40.485	8.86
C.V.%	0.4	2.89	0.25	0.39	0.71	0.46	0.54	0.18
Interaction (D X V)								
F-test	NS	NS	NS	NS	NS	NS	NS	NS
S.Em.±	-	-	-	-	-	-	-	-
C.D. at 5%	-	-	-	-	-	-	-	-

Table.2 Phenothermal index during different sowing dates

Sowing Dates	Phenophases					Average
	P_1	P_2	P_3	P_4	P_5	
D_1	12.2	13.8	16.3	19.4	16.2	**77.9**
D_2	12.3	14.9	16.6	19.7	14.9	**78.4**
D_3	13.0	16.4	16.2	18.9	13.7	**78.2**
D_4	16.6	17.2	19.7	16.4	12.9	**82.8**

*P_1=Emergence, P2=Flowering, P3=Pegging, P4=Pod development, P5=Pod maturity

Table.3 Thermal and photothermal use efficiency in summer groundnut during crop season 2013

Treatment	HUE	PTUE	HTUE	HgTUE-I	HgTUE-II	T_{photo}UE	T_{nycto}UE	T_{IDR}UE
Sowing dates (D)								
D_1	0.847	0.065	0.106	0.010	0.03	0.38	0.48	0.92
D_2	0.749	0.058	0.094	0.009	0.02	0.34	0.43	0.82
D_3	0.679	0.052	0.085	0.008	0.02	0.31	0.38	0.74
D_4	0.625	0.048	0.079	0.008	0.02	0.28	0.35	0.69
F-test	S	S	S	S	S	S	S	S
S.Em.±	0.0132	0.0010	0.0017	0.0002	0.0001	0.006	0.008	0.014
C.D. at 5%	0.0300	0.0023	0.0038	0.0004	0.001	0.013	0.017	0.032
C.V.%	1.29	1.30	1.30	1.29	1.30	1.29	1.30	1.28
Varieties (V)								
V_1	0.790	0.064	0.096	0.010	0.03	0.36	0.46	0.79
V_2	0.713	0.055	0.086	0.009	0.02	0.32	0.41	0.76
V_3	0.762	0.057	0.099	0.009	0.02	0.34	0.43	0.86
V_4	0.634	0.046	0.083	0.007	0.02	0.28	0.35	0.77
F-test	S	S	S	S	S	S	S	S
S.Em.±	0.0132	0.0010	0.0017	0.0002	0.000	0.006	0.007	0.015
C.D. at 5%	0.0267	0.0020	0.0034	0.0003	0.001	0.012	0.015	0.029
C.V.%	4.48	4.60	4.34	4.62	4.60	4.50	4.57	4.24
Interaction (D X V)								
F-test	S	S	S	S	S	S	S	S
S.Em.±	0.026	0.002	0.003	0.000	0.001	0.012	0.015	0.029
C.D. at 5%	0.053	0.004	0.007	0.001	0.002	0.024	0.030	0.059

Table.4 Correlation coefficient between agrometeorological indices and different phenophases in summer groundnut during crop season 2013

Weather parameters	Phenophases				
	Emergence	**Flowering**	**Pegging**	**Pod development**	**Pod maturity**
GDD	0.0758	-0.8049**	-0.7045**	0.5243*	0.2727
PTU	-0.0480	-0.7137**	-0.7237**	0.4113	0.2729
HTU	0.1567	-0.5846*	-0.7750**	0.5720*	0.7864**
HgTU-I	0.0893	-0.7886**	-0.6450**	0.5930*	0.3485
HgTU-II	0.3340	-0.6092*	0.6109*	-0.4978*	-0.6015*
T_{nycto}	0.0043	-0.7398**	-0.5424*	-0.7991**	0.8152**
T_{photo}	0.2306	-0.7143**	-0.6025*	0.1198	0.8376**
T_{IDR}	0.6339**	-0.4680	-0.4316	0.7502**	0.8419**

Inter diurnal temperature (T_{IDR})

The inter diurnal temperature (T_{IDR}) was significantly influenced by different sowing dates. The highest inter diurnal temperature was in the D_1 sowing (1890.63 ^{0}C) followed by D_2 sowing (1736.91 ^{0}C). The lowest inter diurnal temperature was taken by D_4 (1420.56 ^{0}C). The crop varieties significantly influenced the inter diurnal temperature (T_{IDR}). The highest inter diurnal temperature was obtained by variety V_1 (1681.38 ^{0}C) followed by variety V_2 (1668.63 ^{0}C). However, significantly lowest inter diurnal temperature (T_{IDR}) was recorded by variety V_4 (1637.04 ^{0}C). These data are arranged in Table 1. The interaction effect between sowing dates and different varieties was found to be non-significant.

Phenothermal index

The phenothermal index (PTI) for different dates of sowing dates are presented in the Table 2. The phenothermal index was the highest in D_4 sowing (82.8 degree days/day) whereas, the lowest phenothermal index was analysed in D_1 sowing (77.9 degree days/day). The phenothermal index increase from emergence to pod development in D_1 to D_2 sowing date. The average phenothermal index was increased in P_1 to P_4 phenophases in different sowing date.

Thermal and photothermal use efficiency

Heat use efficiency

The heat use efficiency (HUE) significantly influenced by different sowing dates (Table 3). The heat use efficiency was highest in the D_1 (0.847 kg/ha/ ^{0}C day) followed by D_2 (0.749 kg/ha/ ^{0}C day). The lowest heat use efficiency was taken by D_4 (0.625 kg/ha/ ^{0}C day). These results are analogous with Meena and Dahama (2004) and Sahu *et al.,* (2007). The heat use efficiency (HUE) was significantly influenced by crop varieties. The highest HUE was obtained by variety V_1 (0.790 kg/ha/ ^{0}C day) followed by variety V_3 (0.762 kg/ha/ ^{0}C day). However, significantly lowest HUE was recorded by variety V_4 (0.634 kg/ha/ ^{0}C day). These data are arranged in Table 3. The interaction effect between sowing dates and different varieties was found to be significant for HUE.

Photothermal use efficiency

The photothermal use efficiency (PTUE) was significantly influenced by sowing dates (Table 3). The photothermal use efficiency was highest (0.065 Kg/ha/ ^{0}C day) in the D_1 sowing condition followed by D_2 sowing condition (0.058 Kg/ha/ ^{0}C day). The lowest photothermal use efficiency was taken by D_4 sowing condition (0.048 Kg/ha/ ^{0}C day). The interaction effect between sowing dates and different varieties for PTUE was found to be significant for PTUE.

Heliothermal use efficiency

The heliothermal use efficiency (HTUE) significantly influenced by sowing dates (Table 3). The heliotherrnal use efficiency was the highest in the D_1 (0.106 Kg/ha/ degree day hrs) followed by D_2 (0.094 Kg/ha/ degree day hrs). The lowest heliothermal use efficiency was taken by D_4 (0.079 Kg/ha/ degree day hrs). The results obtained with accordance with Sahu *et al.,* (2007). Among crop varieties, the heliothermal use efficiency (HTUE) was significantly differed. The highest HTUE was obtained by variety V_3 (0.099 Kg/ha/ degree day hrs) followed by variety V_1 (0.096 Kg/ha/ degree day hrs). However, significantly lowest HTUE was recorded by variety V_4 (0.083 Kg/ha/ degree day hrs). The interaction effect between sowing dates and different varieties for HTUE was found to be significant.

Hygrothermal use efficiency-I (HgTUE-I)

The Hygrothermal use efficiency-I (HgTUE-I) significant influenced by sowing dates (Table 3). The hygrothermal use efficiency was the highest in the D_1 (0.010 kg/ha degree day %) followed by D_2 (0.009 kg/ha degree day %). The lowest hygrothermal use efficiency was taken by D_4 (0.008 kg/ha degree day %). Among crop varieties, the hygrothermal use efficiency (HgTUE-I) was significantly differed. The highest HgTUE-I was obtained by variety V_1 (0.010 kg/ha degree day %) followed by variety V_2 (0.009 kg/ha degree day %). However, significantly lowest HTUE was recorded by variety V_4 (0.007 kg/ha degree day %). The interaction effect between sowing dates and different varieties for HgTUE-1 was found to be significant.

Hygrothermal use efficiency-II (HgTUE-II)

The hygrothermal use efficiency-II (HgTUE-II) is significant influenced by sowing dates (Table 3). The hygrothermal use efficiency was highest (0.03 kg/ha degree day %) in the D_1 followed by D_2 (0.02 kg/ha degree clay %). The lowest hygrothermal use efficiency was taken by D_4 (0.02 kg/ha degree day %). Among crop - varieties, hygrothermal use efficiency (HgTUE-II) was found to significant. The highest HgTUE-II was obtained by variety V_1 (0.03 kg/ha degree day %) followed by variety V_2 (0.02). However, significantly lowest HgTUE-II was recorded by variety V_4 (0.02 kg/ha degree day %). The interaction effect between sowing dates and different varieties for HgTUE-II found to be significant.

Nycto temperature use efficiency (T_{nycto}UE) ^{0}C

The nycto temperature use efficiency (T_{nycto}UE) significant influenced by sowing dates (Table 3). The D_1 sown crop recorded highest nycto temperature use efficiency (0.48) followed by D_2 sowing condition (0.43). The lowest nycto temperature use efficiency was taken by D_4 (0.35). Among varieties, the nycto temperature use efficiency (T_{nycto}UE) was significantly varied. The highest T_{nycto}UE was obtained by variety V_1 (0.46) followed by variety V_3 (0.43). However, significantly lowest T_{nycto}UE was recorded by variety V_4 (0.35). The interaction effect between sowing dates and different varieties was found to be significant.

Photo temperature use efficiency (T_{photo}UE) ^{0}C

The photo temperature use efficiency (T_{photo}UE) significant influenced by sowing dates (Table 3). The photo temperature use efficiency was the highest in the D_1 (0.38) followed by D_2 (0.34). The lowest photo temperature use efficiency was taken by D_4 (0.28). Among crop varieties, the photo temperature use efficiency (T_{photo}UE) was significant influenced. The highest T_{photo}UE was obtained by variety V_1 (0.36) followed by variety V_3 (0.34). However, significantly lowest T_{photo}UE was recorded by variety V_4 (0.28). The interaction effect between sowing dates and different varieties was found to be significant for T_{photo}UE.

Inter diurnal temperature use efficiency (T_{IDR}UE) ^{0}C

The inter diurnal temperature use Efficiency (T_{IDR}UE) significant influenced by sowing dates and presented in Table 3. The inter diurnal temperature use efficiency was the highest in the D_1 sowing condition (0.92) followed by D_2 sowing condition (0.82). The lowest inter diurnal temperature use efficiency was taken by D_4 sowing condition (0.69). Among crop varieties, the inter diurnal temperature use efficiency (T_{IDR}UE) was significant varied. The highest T_{IDR}UE was obtained by variety V_3 (0.86) followed by variety V_1 (0.79). However, significantly lowest T_{IDR}UE was recorded by variety V_2 (0.76). The interaction effect between sowing dates and different varieties was found to be significant for T_{IDR}UE.

Correlation analysis

Agrometeorological indices Vs. phenophases

The correlation coefficients between accumulated agrometeorological indices and different phenophases are presented in Table 4. A highly significant and negative correlation was noted between GDD and different phenophases viz. flowering (-0.80), pegging stage (-0.70), while a significant and positive correlation was noticed during pod development stage (0.52). Highly significant and negative correlation was noticed between PTU and pegging stage. A highly significant and positive correlation was noted between HTU and pod maturity stage (0.78), while a highly significant and negative correlation was seen during flowering and pegging stage. These results are reported by Brar *et al.*, (1999). A significant and positive correlation between morning hygrothermal unit and pod development stage was noticed (0.59). While a highly significant and negative correlation was observed during flowering stage (-0.79) and pegging (-0.64). A significant and positive correlation was detected between afternoon hygrothermal unit and pegging phase (0.61), while a significant and negative correlation was noticed during flowering, pod development and pod maturity stages. A highly significant and negative correlation was analysed between nycto temperature and pod development phase (-0.79). A highly significant and positive correlation was noticed between photo temperature and pod maturity stage (0.83), while a highly significant and negative correlation was display during flowering (-0.71). A highly significant and positive correlation was analyzed between Inter diurnal temperature was show during emergence, pod development stages.

References

Anonymous (2010 a). State wise area, production and yield per hectare in India." Directorate of Agriculture Gujarat state Gandhinagar.

Anonymous (2010 b). "District wise area, production and important food crop and yield per hectare crops in Gujarat state." Directorate of Agriculture, Gujarat state Gandhinagar.

Brar, A. S., Dhingra, K. K. and Kaul, J.N. (1999). Phenological behaviour and heat unit requirement of groundnut (*Arachis hypogaea* L) genotypes under two dates of sowing during summer season. *Ind. J. Agri. Sci*., 69(6): 419-423.

Jadhav, A. S. Mundhe, M. S and Gaikwad, C. B. (1990). Influence of sowing dates of summer groundnut varieties. *J. Mah. Agric. Univ*., 15(2): 214-217.

Meena, R. P. and Dahama, A. K. (2004). Relevance of thermal units in deciding sowing time and yield prediction of groundnut (*Arachis hypogaea* L.) under irrigated condition of western Rajasthan. *J. Agromet*., 69 (1): 62-69.

Murty, N. S., Singh, R. K. and Roy, S. (2008). Influence of weather parameters on growth and yield of amaranth in Uttarakhand region. *J. Agromet., (special issue- part 2)*, 384-387.

Patel, G.G.; Patel, H.R.; Pandey, V.; Shekh, A.M.; Patel, J.S.; Vadoaria, R.P.; Bhatt, B.K. and Shroff J.C. (2010). Influence of weather parameters on pod yield of groundnut in middle Gujarat agro-climatic region. *J. Agromet*., 12(1): 74-76.

Sahu, D.D., Chopada, M. C. and Patoliya, B. M. (2007). Determination of sowing time for chickpea varieties in south Saurashtra, *Ind. J. Agromet*., 9(1): 68-73.

Wang, J. Y. (1960). A critique of the heat unit approaches to plant response studies. *Ecology* 41: 785-790.

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