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# Influence of Weather Parameters on Groundnut (*Arachis hypogaea* L.) under Middle Gujarat Region

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**AUTHORS CONTRIBUTION**

S. T. YADAV :
Carried out experiment, supervision, data collection, and data analysis

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**ABSTRACT**

Field experiment for the two-years were conducted to study the influence of weather parameters on groundnut (*Arachis hypogaea* L.) under middle Gujarat region at Agronomy farm, B.A. College of Agriculture, Anand, AAU, Anand during 2019 and 2020. The results revealed that onset of monsoon (first date of sowing) was significantly superior for yield character due to well distributed rainfall and favourable weather condition during crop growing period. Significantly higher pod yield (2176 kg ha$^{-1}$ and 1862 kg ha$^{-1}$) was recorded during both years of the experiment under onset of monsoon sowing which was statistically on par with 10 days after onset of monsoon sowing (1937 kg ha$^{-1}$ and 1592 kg ha$^{-1}$) and significantly higher than the 20 days after onset of monsoon sowing (1614 kg ha$^{-1}$ and 1369 kg ha$^{-1}$). Among the varieties, GG 20 recorded significantly higher pod yield (2043 and 1701 kg ha$^{-1}$) over other varieties (GJG 34 and TAG 3A). Hence, variety GG 20 is promising under onset of monsoon (first date of sowing) in terms of pod yield in middle Gujarat region. The higher rainfall was recorded in onset of monsoon sowing date as compared to other dates of sowing during 2019 and 2020. Also, the values of beyond for mean maximum air temperature of 36.0 $^0$C, evaporation rate of 3.6 mm and bright sunshine of 5.9 hours were found detrimental. The higher in each unit of maximum air temperature, evaporation rate and BSS hours had resulted in increase of pod yield. The overall performance of groundnut crop showed higher yield during 2019 as compared to 2020 due to favourable weather conditions.

*Keywords* : Groundnut, Middle Gujarat, Weather parameter, Yield.

GROUNDNUT (*Arachis hypogaea* L.) is an important oilseed crop of tropical and subtropical regions of the world. In India, it is one of the most important cash crop occupied an area of 5.5 m ha producing 9.6 m.t. with a productivity of 1750 kg ha$^{-1}$ (Shwetha *et al.,* 2017). The importance of rainfall in crop production depends mainly on commencement of sowing rains and amount and distribution of rainfall as water deficit is a major constraint in groundnut production, especially during pod formation which affect the pegging (Chandrika *et al.,* 2008). The well-distributed rainfall of at least 500 mm during crop growth period and abundance bright sunshine hours with relatively warmer temperature favours the crop. Sowing, emergence, germination, flowering, vegetative and pod development of groundnut requires good rainfall distribution and soil moisture. Moisture stress affect flowering, pod setting and resulting in lower yield.

The principal groundnut growing states in the country are Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Rajasthan, Madhya Pradesh, Orissa and Uttar Pradesh which accounts for more than 80 per cent of the Indian area and production. Variation and uneven distribution of monsoon is the main cause of fluctuations in groundnut yield in India (Basu and Ghosh, 1995). Gujarat stands first in area



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and production. It occupies 1.95 m. ha., 28.93 per cent of the total area of the country producing 3.39 m.t. (42.43%) with a productivity of 1777 kg $ha^{-1}$. In Gujarat, Anand district occupies area about 7000 ha, producing 1200 m.t. with averge yield of 1701 kg $ha^{-1}$ (Anonymous., 2011).

Optimum sowing time of groundnut depends upon the type of variety and growing season due to variation in agro ecological conditions. Sowing date is most important factor influencing the growth and yield of groundnut. Late or delayed sowing results in declining crop yield. Also, the maximum and minimum temperature during different growth stages *viz.* emergence, branching, flowering, pod initiation and pod development, *etc.* are equally important. Kulkarni *et al.,* (1988) observed that water deficit reduced the pod yields of Spanish type groundnut (cv. JG-11 and GG-2) at all the stages (vegetative, flowering and pod development). Thus, weather parameters being one of the most precious inputs and balanced with due consideration to the growth, development and yield of groundnut (Lal *et al.,* (2013). Keeping the above in view, the present investigation was carried out to study the influence of weather parameters on groundnut (*Arachis hypogaea* L.) and to identify the suitable sowing date for rainfed situation in middle Gujarat region.

## Material and Methods

The field experiment was carried out during *kharif* season 2019 and 2020 at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, India under rainfed condition. Anand is located at the latitude of 22° 35' N and longitude of 72° 55' E and at an altitude of 45.1 m above the mean sea level. The treatments consisted of three dates of sowing *viz;* onset of monsoon - first date of sowing, 10 days after onset of monsoon - second date of sowing and 20 days after onset of monsoon - third date of sowing with three varieties *viz;* GG 20, GJG 34 and TAG 37A. The experiment was laid out in randomized block design (factorial) and replicated with four times. The crop was sown at a spacing of 30 cm X 10 cm. The soil at the experiment site is sandy loam in texture with water table deeper than 10 m (Lakkad, 1993). The experimental field can be characterized as a gentle slope with good drainage as well as fair moisture retentive capacity. The recommended dose of fertilizers (12.5 N, 25 $P_2O_5$ kg $ha^{-1}$) were applied to the crop as basal. All the package of practices was followed as per recommendation of AAU, Anand. Supplemental irrigations were given as a life saving irrigations. The agrometeorological data of various weather parameters were collected from the agrometeor ological observatory which is adjacent to the experimental site. The data in respect of pod yield were collected from net plot and were worked out in kg $ha^{-1}$ at the time of harvesting. The statistical analysis was computed by using 'Analysis of variance techniques'. The significance was tested by 'F' value at 5 per cent level of significance. The value of critical difference (C.D.) for examining treatment means for their significance was done at 5 per cent level.

### Meteorological Observations

Daily weather data for maximum and minimum temperature (°C), morning and afternoon relative humidity (%), solar radiation (MJ /$m^2$ /day), wind speed (m/s) and rainfall (mm) during crop growing period for Anand were recorded from the agrometeorological observatory, Department of Agricultural Meteorology, B. A. College of Agriculture, Anand Agricultural University, Anand.

## Results and Discussion

### Air Temperature

The result revealed that crop experienced highest maximum temperature of 36.0 $^{o}$C during the emergence to vegetative stage in 2019 while, it was 36.5 °C during 2020 in crop season (Fig.1). The average maximum temperature showed more or less similar trend upto flowering stage and after it decreases upto to physiological maturity and harvesting of crop during 2019. While, during 2020, it was higher upto physiological maturity and it decreased later at harvesting. It was observed that the maximum temperature was relatively lower than

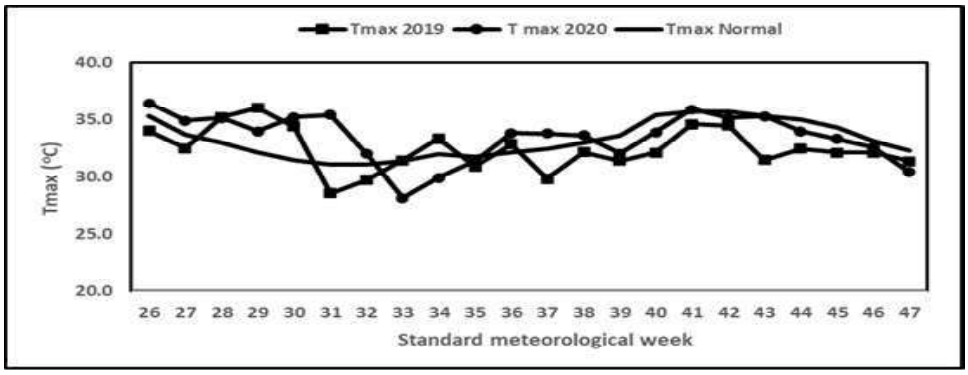


Fig. 1: Maximum temperature (°C) during crop growing season of 2019 and 2020

the normal from flowering to harvesting during 2019 and 2020.

The lowest minimum temperature of 17.8 °C and 15.20 °C recorded at physiological maturity to harvesting phase during 2019 and 2020, respectively (Fig.2). During establishment stage (26th to 27th SMW), minimum temperature was lower than normal in 2019 whlie, in 2020, it was higher than the normal. The minimum temperature showed increasing trends upto physiological maturity in both years. The minimum temperature was higher continuously upto pod development and it was lower at harvesting stage in 2020 as compared 2019. The variability in mean minimum temperature was lower during 2019 as compared to 2020. Minimum temperature was relatively higher than the normal from flowering to harvest during both the years.

**Bright Sunshine Hours**

The bright sunshine hours (BSS) during 2019 and 2020 crop growing season (Fig. 3). Analysis showed that weekly BSS during crop growth and development varied from 0.0 h to 10.5 h and 0.0 h to 10.1 h during 2019 and 2020, respectively. More bright sunshine hours were recorded during 2019 as compared to 2020, favored for crop growth and pod yield.

Higher weekly sunshine hours (9.5 h) was observed during 2020 compared to 2019 while, lowest value of sunshine hours was 0.1 h in 2019. The result showed that BSS was higher than the normal from sowing to flowering whereas, it was lower than the normal from flowering to harvesting.

**Rainfall**

The onset of monsoon took place on 29th June 2019 (26th SMW) and 25th June 2020 (26th SMW) with rainfall of 94.2 mm and 19.2 mm, respectively. Overall, total rainfall of 1289 mm and 894.8 mm were recorded during crop growth period of the year 2019 and 2020, respectively as compared to normal rainfall of 817.9 mm. The variability in weekly rainfall was more during 2019 crop season as

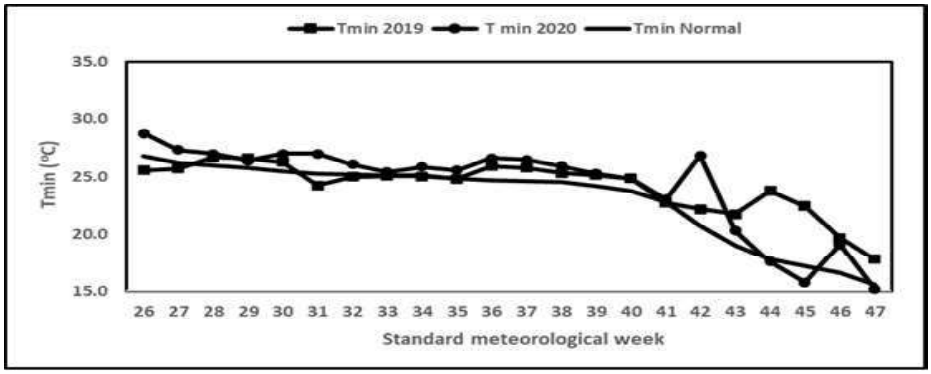


Fig. 2: Minimum temperature (oC) during crop growing season of 2019 and 2020

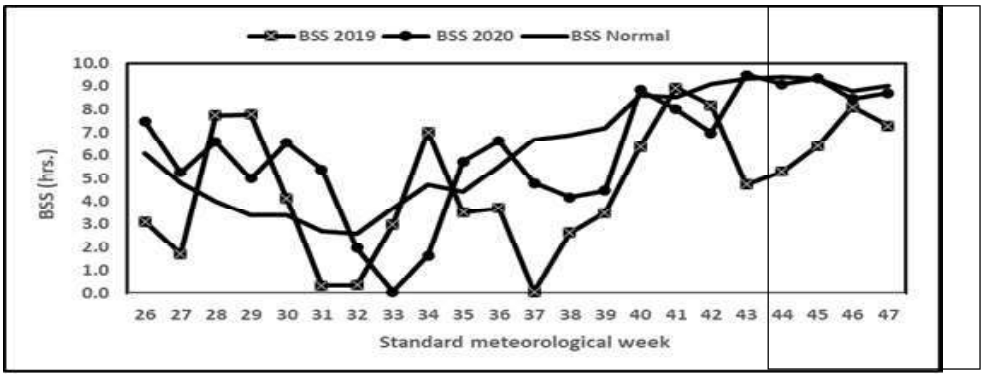


Fig. 3: Bright sunshine hours (h) during crop growing season of 2019 and 2020

compared to 2020. The higher rainfall was recorded from emergence to pod filling crop stage for all dates of sowing during 2019. During 2019, rainfall quantum and distribution were good, in turn resulted in better available soil moisture. While, during 2020, just after onset of monsoon, due to dry spell resulted in depletion in available soil moisture at time of sowing. Also, there was depletion soil moisture from peak leaf area stage to maturity had moisture stress condition due to low rainfall. The first date of sowing recorded higher groundnut yield due to higher rainfall and soil moisture. The result also showed that the final yield

TABLE 1

Evapotranspiration, rainfall and irrigation of groundnut for different crop growth stages by different dates of sowing and varieties during 2019

| Crop stage | Evapotranspiration (mm) | | | Rainfall (mm) | | | Irrigation (mm) | | |
|---|---|---|---|---|---|---|---|---|---|
| Varieties | $V_1$ | $V_2$ | $V_3$ | $V_1$ | $V_2$ | $V_3$ | $V_1$ | $V_2$ | $V_3$ |
| *Onset of monsoon (First date of sowing)* | | | | | | | | | |
| Emergence | 20.1 | 22.2 | 20.1 | 70.4 | 119.6 | 70.4 | - | - | - |
| Flowering | 39.8 | 42.2 | 41.9 | 208.2 | 213.0 | 250.2 | - | - | - |
| Grain filling | 104.8 | 100.3 | 100.6 | 686.6 | 632.6 | 644.6 | - | - | - |
| Peak LAI | 20.2 | 20.2 | 22.4 | 83.0 | 83.0 | 83.0 | - | - | - |
| Maturity | 59.3 | 59.3 | 59.3 | 140.0 | 140.0 | 140.0 | - | - | - |
| *10 days after onset of monsoon (Second date of sowing)* | | | | | | | | | |
| Emergence | 2.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | - | - | - |
| Flowering | 52.1 | 52.1 | 50.1 | 573.8 | 573.8 | 409.4 | 40.0 | 40.0 | 40.0 |
| Grain filling | 100.4 | 100.4 | 99.0 | 362.4 | 362.4 | 519.2 | - | - | - |
| Peak LAI | 29.4 | 29.4 | 32.8 | 131.8 | 131.8 | 139.4 | - | - | - |
| Maturity | 35.4 | 35.4 | 35.4 | 64.0 | 64.0 | 64.0 | - | - | - |
| *20 days after onset of monsoon (Third date of sowing)* | | | | | | | | | |
| Emergence | 17.0 | 19.7 | 17.0 | 38.4 | 47.0 | 38.4 | - | - | - |
| Flowering | 53.4 | 51.1 | 53.4 | 563.6 | 555.0 | 563.6 | - | - | - |
| Grain filling | 63.1 | 67.0 | 63.1 | 266.6 | 326.6 | 266.6 | - | - | - |
| Peak LAI | 66.1 | 61.8 | 66.1 | 200.0 | 140.0 | 200.0 | - | - | - |
| Maturity | 21.3 | 21.3 | 21.3 | 63.4 | 63.4 | 63.4 | - | - | - |

*$V_1$=GG20, $V_2$=GJG34 & $V_3$=TAG 37A

of the groundnut crop was more during 2019 as compared to the 2020.

Daily observed and simulated soil moisture for the entire growing season during 2019 and 2020 are graphically presented in Fig. 2. It showed that during 2019, there was good amount of soil moisture from flowering initiation to physiological maturity stage of the first and second dates of sowing. Whereas, in the third date of sowing, higher moisture observed from sowing to peak leaf area index stage. During 2020, except first date of sowing there was decreasing trend noticed from sowing to harvest but soil moisture was sufficient during crop growing period. The result revealed that maximum soil moisture and higher pod yield was recorded in the first date of sowing during both the seasons.

**Evapotranspiration (ET), Rainfall and Irrigation of Groundnut at Crop Growth Stages**

The ET, rainfall and irrigation of groundnut as influenced by different dates of sowing and varieties during 2019 and 2020 are given in Table 1 to 2. Crop phenology was divided into five growth stages during both the seasons as a function of days after sowing (DAS). The maximum ET (mm) and rainfall (mm) were recorded in grain filling stage of the crop, whereas, it was minimum at harvesting stage during first date of sowing. The irrigation was applied 40.0 mm at flowering stage in second date of sowing during 2019 (Table 1). In 2020, ET (mm) and rainfall (mm) were higher in grain filling stage (first date of sowing) and flowering stage (second date of sowing), respectively. The irrigation was applied 60.0 mm immediately after each date of sowing during 2020 to facilitate better establishment (Table 2).

TABLE 2

Evapotranspiration, rainfall and irrigation of groundnut for different crop growth stages by different dates of sowing and varieties during 2020

| Crop stage | Evapotranspiration (mm) | | | Rainfall (mm) | | | Irrigation (mm) | | |
|---|---|---|---|---|---|---|---|---|---|
| Varieties | $V_1$ | $V_2$ | $V_3$ | $V_1$ | $V_2$ | $V_3$ | $V_1$ | $V_2$ | $V_3$ |
| *Onset of monsoon (First date of sowing)* | | | | | | | | | |
| Emergence | 14.0 | 14.0 | 14.0 | 15.4 | 15.4 | 15.4 | 60.0 | 60.0 | 60.0 |
| Flowering | 50.1 | 50.1 | 48.0 | 663.2 | 663.2 | 622.6 | - | - | - |
| Grain filling | 112.2 | 112.2 | 110.8 | 147.0 | 147.0 | 174.4 | - | - | - |
| Peak LAI | 19.5 | 19.5 | 23.0 | 0.0 | 0.0 | 13.2 | - | - | - |
| Maturity | 7.0 | 7.0 | 7.0 | 10.4 | 10.4 | 10.4 | - | - | - |
| *10 days after onset of monsoon (Second date of sowing)* | | | | | | | | | |
| Emergence | 5.6 | 5.6 | 7.9 | 7.0 | 7.0 | 9.8 | 60.0 | 60.0 | 60.0 |
| Flowering | 67.5 | 67.5 | 63.2 | 718.2 | 718.2 | 715.4 | - | - | - |
| Grain filling | 99.5 | 99.5 | 101.0 | 82.4 | 82.4 | 82.4 | - | - | - |
| Peak LAI | 3.6 | 3.6 | 4.1 | 10.4 | 10.4 | 10.4 | - | - | - |
| Maturity | 3.6 | 3.6 | 3.6 | 0.0 | 0.0 | 0.0 | - | - | - |
| *20 days after onset of monsoon (Third date of sowing)* | | | | | | | | | |
| EEmergence | 17.6 | 17.6 | 17.6 | 502.6 | 502.6 | 502.6 | 60.0 | 60.0 | 60.0 |
| Flowering | 43.1 | 43.1 | 42.6 | 212.4 | 212.4 | 212.4 | - | - | - |
| Grain filling | 77.7 | 78.3 | 77.6 | 90.8 | 90.8 | 90.8 | - | - | - |
| Peak LAI | 4.2 | 3.6 | 4.8 | 0.0 | 0.0 | 0.0 | - | - | - |
| Maturity | 0.7 | 0.7 | 0.7 | 0.0 | 0.0 | 0.0 | - | - | - |

*V1=GG20, V2=GJG34 & V3=TAG 37A

The total water, drainage and water entering soil were increased with delayed sowing during both the years. Higher rainfall, maximum temperature and ET were observed in both the year. Results showed that amount of rainfall, water entering soil and mean temperature were well distributed in the first date of sowing. Also, during flowering stage, the amount of rainfall and bright sunshine hours was higher. Hence, the pod yield of groundnut was higher in first sowing date as compared to other sowings. Less amount of rainfall, mean temperature as well as bright sunshine hours was recorded in pod formation during second and third dates of sowing.

**Effect of Dates of Sowing and Varieties on Pod Yield**

The individual as well as pooled statistical results of pod yield of groundnut as influenced by different dates of sowing and varieties are presented in Table 3.

TABLE 3

Pod yield of groundnut as influenced by sowing dates and varieties during 2019 and 2020

| Treatments | Pod yield (kg ha$^{-1}$) | | |
|---|---|---|---|
| | 2019 | 2020 | Pooled |
| Onset of monsoon (First date of sowing) | 2176 | 1862 | 2019 |
| 10 days after onset of monsoon (Second date of sowing) | 1937 | 1592 | 1764 |
| 20 days after onset of monsoon (Third date of sowing) | 1614 | 1369 | 1492 |
| S.Em. ± | 46.7 | 47.9 | 33.4 |
| CD at 5% | 135.3 | 138.7 | 95.1 |
| Variety | | | |
| GG 20 | 2043 | 1701 | 1872 |
| GJG 34 | 1915 | 1612 | 1763 |
| TG 37A | 1769 | 1511 | 1640 |
| S.Em. ± | 46.7 | 47.9 | 33.4 |
| CD at 5% | 135.3 | 138.7 | 95.1 |
| CV (%) | 8.5 | 10.3 | 9.3 |

**Effect of Date of Sowing**

Significantly higher pod yield (2176 kg ha$^{-1}$ and 1862 kg ha$^{-1}$) was recorded during both years of the experiment under first date of sowing onset of monsoon which was statistically at par with second date of sowing (10 days after onset of monsoon) and significantly higher than the third date of sowing (20 days after onset of monsoon). The higher pod yield was recorded during 2019 compared to 2020. Similar trends were observed in pooled over years. The present study revealed that onset of monsoon is the better time for obtaining higher pod yield of groundnut during *kharif* season under middle Gujarat agroclimatic condition. In early sowing, there was a sufficient time to exploit the soil and environmental resources such as rainfall and availability of soil moisture for growth, development compared to delay sowing. Hence, result showed that the first date of sowing realizing higher pod yield than the other dates of sowing in middle Gujarat. Shah *et al.* (1999) was found similar results. Similar results were also reported by Sogut *et al*. (2016), Canavar and Kaynak (2008) and Munda and Patel (1998). Guled *et. al.,* (2013) recorded the higher yield (2244 kg ha$^{-1}$) I first date of sowing (onset of monsoon) as compared to other sowing dates.

**Effect of Varieties**

Effect of varieties on pod yield was found significant during both years and pooled results of field experiment. Significantly higher pod yield (2043 kg ha$^{-1}$ and 1701 kg ha$^{-1}$) was observed with GG 20 over other varieties GJG 34 and TAG 37A. Hence, variety GG 20 is the promising one in terms of growth and yield in middle Gujarat agro climatic zone. Variety GG 20 was well respond to soil moisture at crop growth stages of groundnut crop. Guled *et. al.* (2013) was observed more yield (1969 kg ha$^{-1}$) in the variety M 335 than the other two varieties GG 20 and GG5.

It could be concluded from these results that the varieties and sowing dates had significant influence on yield of groundnut. Thus, to obtain higher pod yield of groundnut GG 20 variety should be sown earlier at onset of monsoon particularly in middle Gujarat agro climatic zone.

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