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Influence of weather on groundnut (*Arachis hypogaea* L.) yield, growth and development in central zone of Kerala

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Abstract
An experiment was conducted to study the influence of weather parameters on growth indices of groundnut using split plot design with four planting dates *viz*., November 1st, November 15th, December 1st, and December 15th. The groundnut variety TNAU CO-6 was used in the experiment. The seasonal variation of different biotic events of groundnut was pronounced in the study. The result indicated that, for all the growth characters such as plant height, number of leaves and dry matter accumulation were found to be highest during November 1st planting. The highest pod yield, shelling percentage and harvest index were also recorded during this period. Number of days taken to reach each phenophases varies significantly with date of planting. The maximum duration was recorded during December 1st planting while minimum during November 1st planting. The influences of weather parameters on various critical stages of groundnut were distinct. As the crop is short day plant, negative influence of sunshine hours during flowering period was much noticeable hence adjusting date of planting coinciding with short days favors the yield.

Keywords: Plant height, number of leaves dry matter accumulation, leaf area, dates of planting, pod yield, shelling percentage, harvest index

Introduction
Groundnut (*Arachis hypogaea* L.), one of the important oil seed crop in India, popularly known as "King of oil seed crops". The crop is grown on a large scale in almost all the tropical and subtropical countries of the world. India is the second largest producer as well as consumer of groundnut in the world with (68.57 lakh tones), (Groundnut outlook, 2019), In Kerala groundnut is cultivated in an area of 274 ha (Agricultural statistics report on 2017-2018). Weather plays an important role in groundnut production. It has a profound influence on growth, development and yields of this crop. This study focuses on the influence of weather on growth, phenology and yield of groundnut.

2. Materials and Methods
2.1 Field experiment
The field experiments were conducted at Instructional Farm, Kerala Agricultural University Vellanikkara (10.54°N, lat. and 76.27°E, long. at an elevation of 22 m) by adopting split plot design with five replication. Spacing adopted was 15 cm × 15 cm. Recommended dose of fertilizers (10 N, 75 P2O5, 75 K2O kg ha^{-1}) were applied to the crop as basal. Variety used in the experiment was TNAU CO-6. Four dates of planting such as 1st November, 15th November, 1st December, and 15th December were used as main plot treatments. All the management practices were done according to the package of practices recommendations by Kerala Agricultural University (2015). The plant height and number of leaves were measured at weekly interval and dry matter accumulation and leaf area index were measured at fortnightly intervals. The crop period was divided into six growth phases, P1 (sowing to germination), P2 (germination to first flowering), P3 (first flowering to 50% flowering), P4 (50% flowering to peg formation), P5 (peg formation to pod development stage), P6 (pod development stage to physiological maturity) based on critical stages.

2.2 Weather data
Weather data for the experimental period were recorded at principal agromet observatory, Department of Agricultural Meteorology, Kerala Agricultural University and the weekly prevailed weather parameters experienced period was plotted against standard meteorological week (Fig. 1 to 6).

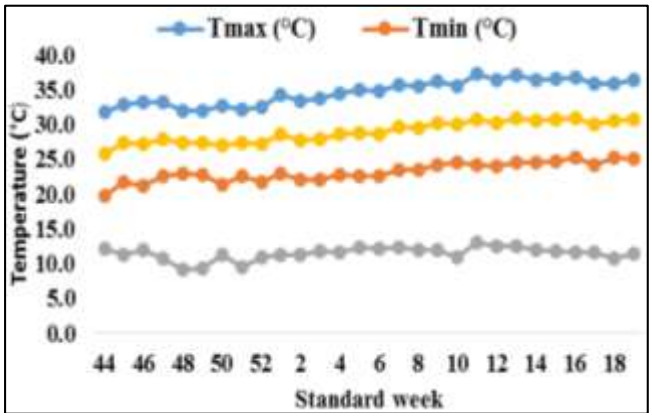

Fig 1: Weekly air temperature during crop period

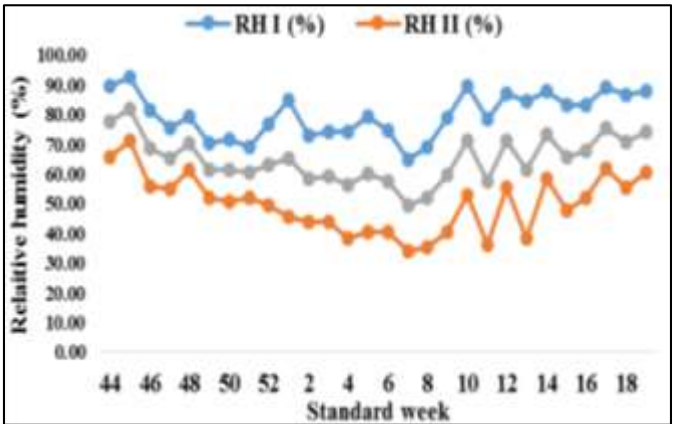

Fig 2: Weekly relative humidity (RH) during crop

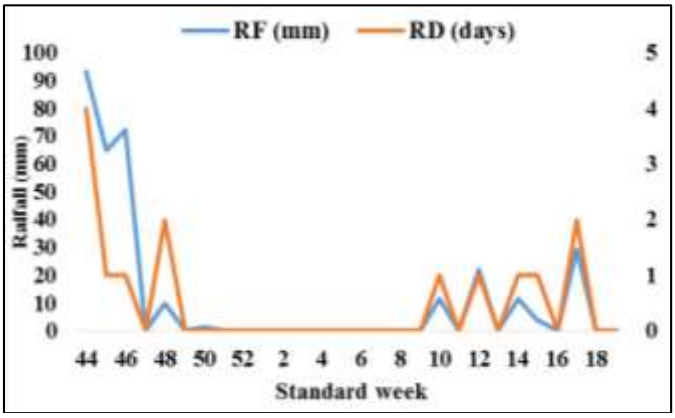

Fig 3: Weekly Rainfall and Rainy days during crop period

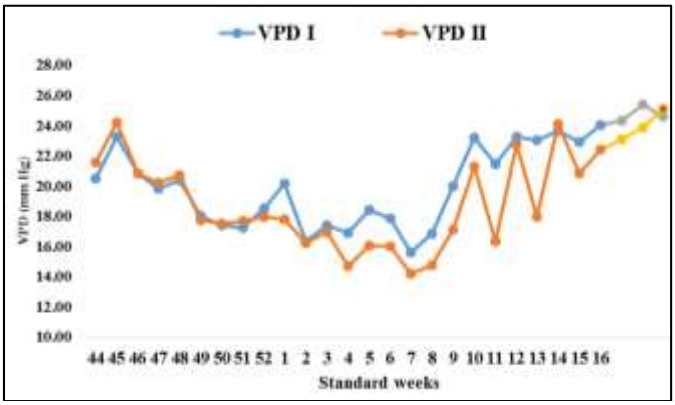

Fig 4: Weekly Vapor pressure deficit during crop period

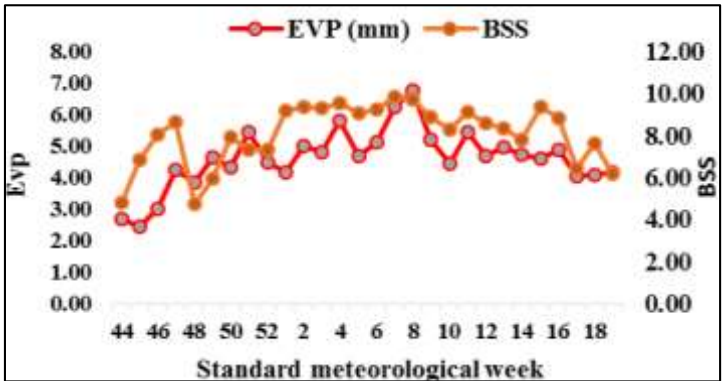

Fig 5: Weekly bright sunshine hours (BSS) and evaporation (Epan) during crop period

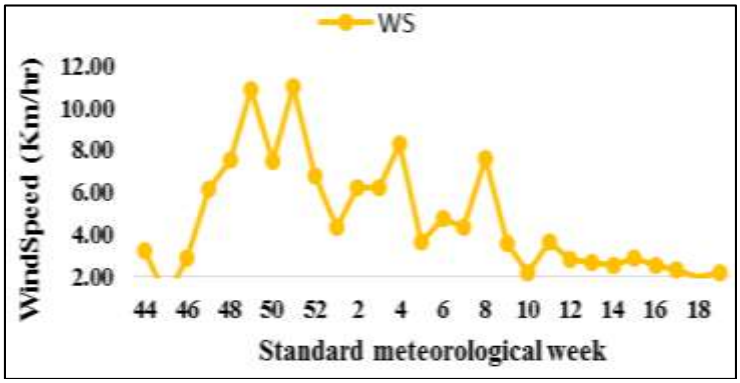

Fig 6: Weekly wind speed during crop period

2.3 Statistical analysis

Correlation was done between duration of phenophases and yield attributes (Table 2 and 3) with respect to the weather parameter experienced during each phenophase. Analysis of variance was done for yield, shelling percentage and harvest index.

Table 1: Effect of dates of planting on yield and yield attributes

Date of planting	Yield parameters		
	Yield (kg ha^{-1})	Shelling Percentage (%)	Harvest Index
1st November	935.62^{a}	72.12^{a}	0.36^{a}
15th November	868.82^{c}	70.10^{b}	0.36^{ab}
1st December	897.65^{b}	71.53^{a}	0.37^{a}
15th December	776.97^{d}	69.51^{b}	0.34^{b}
CD	26.09	1.34	0.015

Table 2: Correlation between total phenophase and weather variables

Phenophases	Positive correlation	Negative correlation
P1	Tmin, Wind speed, Epan	RH1, RH2, VPD1, VPD2, BSS, Rainfall, Rainy days
P2	Tmax, Tmin, RH1, VPD1, BSS, Rainy days, Epan	RH2, Wind speed
P3	Tmin, RH2, VPD2, Wind speed, Rainfall, Rainy days	Tmax, RH1, BSS
P4	Tmin, RH2, VPD2, Wind speed, Rainfall,	BSS
P5	RH1, RH2, VPD2, Wind speed, Rainfall	Tmax, Tmin, VPD1, BSS, Epan
P6	Tmax, Tmin, RH1, RH2, VPD1, VPD2, Rainfall, Rainy days	Wind speed, BSS, Epan

Table 3: Correlation between yield and weather variables

Phenophases	Positive correlation	Negative correlation
P1	Rainfall, Rainy days, RH1, RH2, VPD1, VPD2	Tmin, Wind speed, Epan
P2	Rainfall, RH2, VPD2	-
P3	Rainfall, Rainy days, Tmin, RH2, VPD2, Wind speed	Tmax, BSS, Epan
P4	RH2, VPD2	Tmin, Epan
P5	Rainfall RH1, RH2, VPD2, Wind speed	Tmax, Tmin, BSS, Epan
P6	BSS, Epan	Tmax, Tmin, RH1, RH2, VPD1, VPD2, Rainy days

3. Results and Discussion

The data pertaining to pod yield of groundnut for different dates of sowing are presented in Table 1.The November 1st planting was produced significantly higher (935.62 kg ha^{-1}) yield compared to the November 15th (868.82 kg ha^{-1}), December 1st (897.65 kg ha^{-1}) and December 15th (776.97 kg ha^{-1}) planting. Shelling percentage and harvest index recorded during November 1st planting was on par with December 1st planting. Among the three irrigation treatment, yield, shelling percentage and harvest index were found to be higher when IW/CPE ratio was 1. The influence of different weather parameters on the pod yield of groundnut was analyzed by correlation studies. Correlation studies were performed between pod yield of groundnut and weather parameters experienced during different phenophases. The higher yield were observed for November 1st (D1) planting, with delay in planting yield was found to be decreasing. This result was in accordance with Giridhar (2019) [4] and Patil *et al.* (2007) [6]. The different weather conditions experienced under different dates of planting lead to difference in yield under each dates of planting. A significant negative correlation between yield and bright sunshine was seen during pod maturity stage and significant positive correlation was shown during physiological maturity stage by Chandoba (2012) [2]. A low value of bright sunshine hours experienced in pod maturity stage during first dates of planting might be reason for highest yield during this period (Fig.7) Afternoon and forenoon relative humidity experienced during P6 showed a negative influence on yield (Fig.8 and Fig.9).The results was in accordance with Chandoba (2012) [2]. The increase in relative humidity would reduce the transpiration rate. A reduction in transpiration rate, resulted in reduced rate of transfer of water, nutrients and photosynthetic assimilate, which would have affected yield. The mean temperature experienced during early planting was less and it was found to be increasing with delay in planting. The negative influence of temperature also would have contributed to yield reduction in delayed planting (Fig.10). Rainfall received during pegging stage would have influenced the yield. Rainfall received during this stage was higher under November 1st planting and was less under December 15th planting (Fig. 11). The sufficient rainfall received enriched soil moisture and the soils get loosened under high soil moisture conditions which favored pegging and resulted in higher yield. The yield of groundnut is directly depends on shelling percentage. Higher yield recorded under November 1st planting was attributed to higher shelling percentage and harvest index recorded during this period. Maximum leaf area index was observed for November 1st planting and the value of LAI reduced with delay in planting. This result shows similarity with the findings of Banik *et al.* (2009) [1] maximum air temperature showed a significant negative correlation with LAI. The effect of this maximum air temperature might have reduced the leaf area index with delay in planting (Fig.12). The growth parameters like plant height, number of leaves and leaf area index were found to be significantly higher under D1 (November 1st) planting and it was found to be decreasing towards delay in planting. According to Padmalatha *et al.* (2001) [5], high relative humidity during morning and evening would significantly reduce the plant height. Compared to other three plantings, D1 planting experienced a lower value of both forenoon and after noon relative humidity and relative humidity increased with delay in planting (Fig 13). The maximum number of leaves was observed for November 1st (D1) planting which was superior over D3 (December 1st), D2 (November 15th) and D4 (December 15th) respectively *i.e* with delay in planting Similar results was seen by Giridhar (2019) [4] and Desai (1989) [3]. P1 (sowing to germination), P2 (germination to first flowering), P3 (first flowering to 50% flowering), P4 (50% flowering to peg formation), P5 (peg formation to pod development stage), P6 (pod development stage to physiological maturity).

Number of days taken to reach each phenophases differed among different treatments. A maximum duration was observed In D3 (December 1st) planting and a minimum duration was observed in D1 (November 1st) planting,

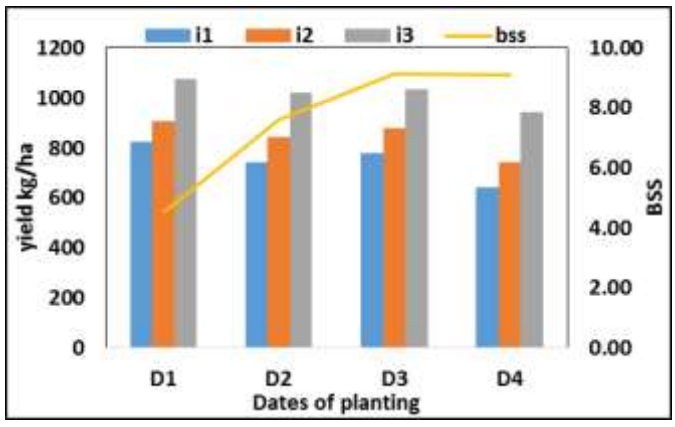

Fig 7: Effect of Bright sunshine hours on yield

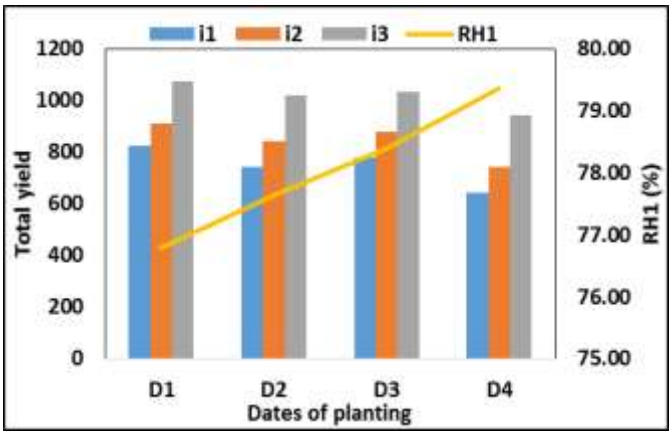

Fig 8: Effect of Forenoon relative humidity on yield

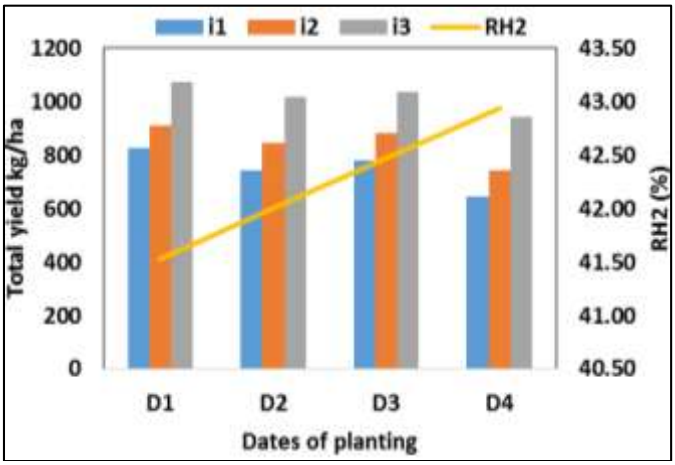

Fig 9: Effect of Afternoon relative humidity on yield

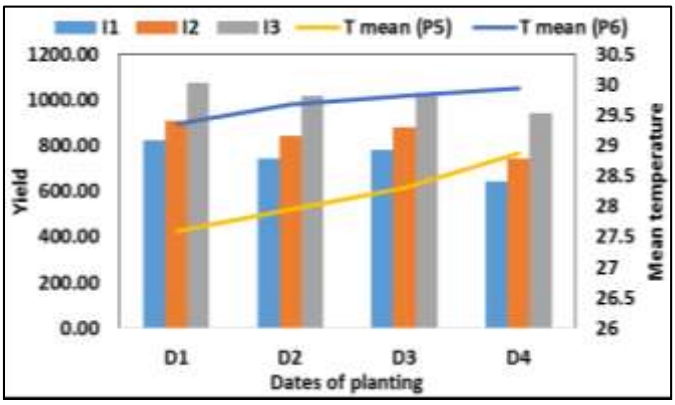

Fig 10: Effect of mean temperature experienced during P5 and P6 stage on Yield

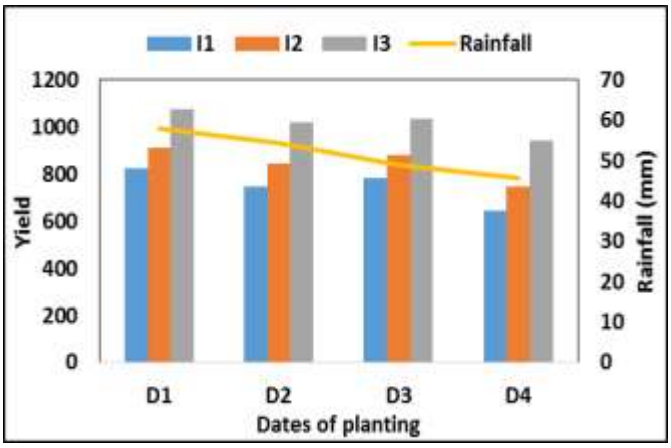

Fig 11: Effect of rainfall received during pegging stage on yield

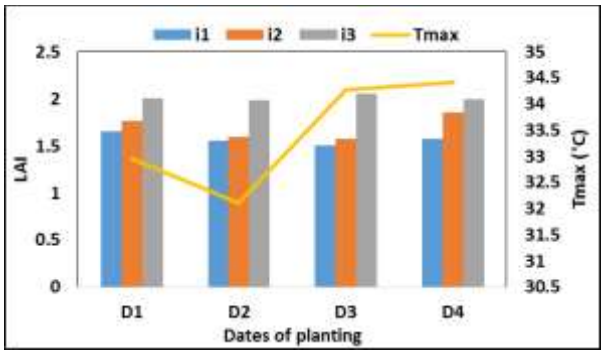

Fig 12: Effect of maximum temperature on LAI

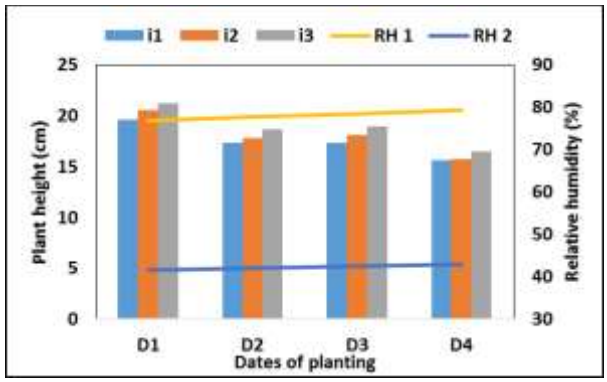

Fig 13: Influence of forenoon and after noon relative humidity on plant height

4. Conclusion

Groundnut cultivation is greatly influenced by various weather parameters. Weather parameters like maximum temperature, forenoon relative humidity, afternoon relative humidity and bright sunshine hours showed a detrimental effect on yield, growth and phenology of groundnut. Rainfall and irrigation supplemented soil moisture favored the growth and yield by providing and loosening soil. Among the different dates of sowing November 1st planting was found to be optimum for groundnut in central zone of Kerala. Irrigation scheduling at IW/CPE ratio 1 resulted in higher growth and yield.

5. References

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