International Journal of Microbiology Research
ISSN: 0975-5276 & E-ISSN: 0975-9174, Volume 12, Issue 6, 2020, pp.-1852-1854.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000234

Research Article

SIMULATION OF SUMMER GROUNDNUT PHENOLOGY UNDER DIFFERENT SOWING DATES USING CROPGRO-PEANUT MODEL IN MIDDLE GUJARAT

MOTE B.M.[1], YADAV S.B.[2], KUMAR N.[3], ZINZALA M.J.*[3] AND PANDEY V.[2]
[1]Directorate of Research Office, Navsari Agricultural University, Navsari, 396450, Gujarat, India
[2]Department of Agricultural Meteorology, B. A. College of Agriculture, Anand Agricultural University, Anand, 388110, Gujarat, India
[3]Department of Agronomy, College of Agriculture, Bharuch, 392 012, Navsari Agricultural University, Navsari, 396450, Gujarat, India
*Corresponding Author: Email - zinzalamanish99@gmail.com

Received: June 03, 2020; Revised: June 19, 2020; Accepted: June 20, 2020; Published: June 30, 2020

Abstract- Field experiments were carried out at College farm, B. A. College of Agriculture, Anand Agricultural University, Anand. The DSSAT v4.6 CROPGRO-Peanut model was used to predict the phenology of groundnut crop under combinations of three sowing dates and four groundnut cultivars. The model was calibrated with a 2015 dataset of growth and phenological parameters for estimating the genetic coefficients of all four cultivar and was validated with a 2016 dataset of the same parameters. Simulations of phenological parameters using the calibrated model were found to be quite accurate. The model was able to reasonably simulate the days to anthesis, first pod initiation and physiological maturity with low per cent error (± 4.80) between observed and simulated days for all cultivars under different sowing dates and high correlation coefficient (r> 0.61) but in case of LAI model simulated slightly high per cent error (9.58%) and low correlation coefficient (r> 0.61).

Keywords- *CROPGRO-peanut model, Calibration and validation, Groundnut phenology*

Citation: Mote B.M., *et al*., (2020) Simulation of Summer Groundnut Phenology Under Different Sowing Dates Using Cropgro-Peanut Model in Middle Gujarat. International Journal of Microbiology Research, ISSN: 0975-5276 & E-ISSN: 0975-9174, Volume 12, Issue 6, pp.-1852-1854.

Academic Editor / Reviewer: Rajpal Diwakar

Introduction

India is the Groundnut (*Arachis hypogaea* L.) is important oilseed as well as a high-value cash crop, can be considered as an alternative adaptation strategy for poor farmers who depend solely on agriculture. In India, about 75 % of the peanut growing area lies in a low to moderate rainfall zone with a short growing period (90–120 days). According to Bandyopadhyay, *et al*., (2005) [1] peanut cultivation under irrigated conditions during the summer season (March–June) may increase the productivity of the crop by two to three times relative to the monsoon crop. Due to underground fruiting and indeterminate growth habit there is tremendous scope to increase the groundnut yield through understanding of its physiology. In India and in many other countries its phenology was not well studied till 1960. The detail physiological studies of this crop started only in 70s, and in 80s and 90s a lot of studies were conducted [2]. The CROPGRO-Peanut is a process-oriented model that is part of the Decision Support System for Agrotechnology Transfer (DSSAT). The validated model can be used to predict phenology and growth responses to sowing dates. The objective of the present study was to evaluate the simulation performance of the model for phenology of groundnut cultivars grown in middle Gujarat.

Material and methods

The field experiment on groundnut was carried during the summer season of 2015 and 2016 at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Latitude of 22°35'N and longitude of 72°55'E and at an elevation of 45.1 m above mean sea level). The experimental site located near to the agro meteorological observatory and falls in the middle Gujarat Agro-Climatic Zone-III. The experiment was laid out in split plot design with four replications and the details of treatments are as follow. The four varieties of groundnut *viz*., GG-2, GG-20, GJG-31 and TG-26 were sown on three different dates *viz*., D1 early date (31th January), D2 normal date (15th February) and D3 late date (2nd March).

All the recommended package practices for spring season were followed and care was taken against biotic stresses. The number of days from sowing to occurrences of different phenological phase was recorded. To study the phenology, three groundnut plants from each treatment were uprooted carefully, from the area earmarked for sampling at 3 days interval and phenological events like (Anthesis, first pod initiation, physiological maturity) were recorded. Similarly, three plants were uprooted from ring line of each plot of second replication and removing the leaves from each plant, the leaves were allowed to pass through the leaf area meter to recorded green leaf area (cm^2). The LAI was computed as LAI = leaf area (cm^2)/ ground area (cm^2). Daily weather data recorded in Class A observatory situated in adjoining field were used.

The data on plant growth and development, soil characteristics, weather and crop management for 2015 were used for calibration of the CROPGRO-peanut model as required for determining the genetic coefficients of GG-2, GG-20, GJG-26 and TG-26 cultivars using GLUE program. The calibrated genetic coefficients of groundnut cultivars [Table-1] were validated with data set of 2016

Results and discussion

Days to anthesis

The observed and simulated value of days taken to anthesis (DAS) under different dates of sowing and cultivars of groundnut are presented in [Table-2]. The results revealed that the observed days to anthesis under different dates of sowing were 32 to 35 DAS, while the simulated days were 34 to 38 days with deviation ranging between 3.6 to 5.5 percent. The lowest deviation was observed in second dates of sowing *i.e*., 15th February. In case of different cultivars close simulation is obtained *i.e*., the observed days to anthesis were 34-35 DAS, while model simulated 35-36 days with deviation ranging between 3.9 to 4.9 percent. The average error as computed by r, MAE, MBE, RMSE and PE were 0.94, 0.11, 0.11, 1.0 and 2.4 respectively indicating a fairly good simulation and this was also reported by [3].

Table-1 *Genetic coefficients for cultivars GG 2, GG 20, GJG 31 and TG 26*

Parameter	GG-2	GG-20	GJG-31	TG-26
CSDL	11.84	11.84	11.84	11.84
PPSEN	0	0	0	0
EM-FL	19.5	19.5	18.5	18.5
FL-SH	11	10	8	11
FI-SD	20	19	18	18
SD-PM	40	39	35	36
FL-LF	89	87	80	80
LFMAX	1.5	1.5	1.48	1.4
SLAVR	270	260	240	240
SIZLF	16	16	16	16
XFRT	0.84	0.84	0.84	0.8
WTPSD	0.155	0.2	0.2	0.2
SFDUR	24	22	24	22
SDPDV	1.46	1.65	1.46	1.55
PODUR	3	4	4	4
THRSH	76	74	74	80
SDPRO	0.27	0.27	0.27	0.27
SDLIP	0.51	0.51	0.51	0.51

Table-2 *Analysis of observed and simulated (CROPGRO model) phenology of groundnut crop*

Treatment	Anthesis (DAS)			First pod initiation (DAS)			Physiological maturity (DAS)			Maximum Leaf Area Index		
	Obs.	Sim.	D (%)	Obs.	Sim.	D (%)	Obs.	Sim.	D (%)	Obs.	Sim.	D (%)
D_1(31st January)	35	38	4.3	57	53	-6.2	102	99	-3.0	4.3	4.7	10.2
D_2(15th February)	35	36	3.6	55	51	-7.2	103	97	-5.9	5.5	4.7	-13.9
D_3 (02nd March)	32	34	5.5	52	48	-7.3	95	95	0.2	4.7	4.5	-2.6
V_1 (GG 2)	34	36	4.9	55	51	-6.1	101	101	0.5	4.7	5	7.0
V_2 (GG 20)	35	36	3.9	55	51	-7.3	102	100	-2.5	5.6	4.9	-12.6
V_3 (GJG 31)	34	35	4.9	53	50	-6.9	97	93	-4.8	4.1	4.2	4.6
V_4 (TG 26)	34	35	4.0	54	50	-7.4	99	94	-4.7	5.0	4.5	-7.5
r	0.94			0.98			0.61			0.47		
MAE	0.11			0.3			0.27			0		
MBE	0.11			-0.3			-0.27			0		
RMSE	1			2.61			2.55			0.46		
PE	2.94			4.8			2.55			9.58		

Days to first pod initiation

The observed and simulated days taken to first pod initiation (DAS) under different dates of sowing and cultivars are shown in [Table-2]. It is found that the model simulated days to pod initiation were very close to the observed one under different dates of sowing the observed days to first pod initiation were 52-57 days, while the simulated values were 48-53 days with deviation ranging between 6.2 to 7.3 percent. Among the cultivars close simulation is obtained *i.e.* the observed days to first pod initiation were 53-55 DAS, while model simulated 50-51 days with deviation ranging between 6.1 to 7.4 percent. The average error as computed by r, MAE, MBE, RMSE and PE were 0.98, 0.30, -0.30, 2.61 and 4.80, respectively.

Days to physiological maturity

The observed and simulated days taken to physiological maturity (DAS) under different dates of sowing and cultivars are presented in [Table-2]. It is found that the model simulated days to physiological maturity were very close to the observed one under different dates of sowing, the observed days to physiological maturity were 95-103 days, while the simulated values were 95-99 days with deviation ranging between 0.2 to 5.9 percent. Among the cultivars close simulation is obtained *i.e.* the observed days to physiological maturity were 99-102 DAS, while model simulated 95-99 days with deviation ranging between 0.5 to 4.8 percent. The model has underestimated days to physiological maturity under most of the treatments except third date of sowing and cultivar GG 2. The average error as computed by r, MAE, MBE, RMSE and PE were 0.61, 0.27, -0.27, 2.55 and 2.55 respectively. The results are in good agreement with the findings of Guled et al., (2012) for days to physiological maturity in groundnut as simulated by PNUTGRO model [4].

Leaf area index

The comparison between observed and simulated value of maximum LAI under different dates of sowing and cultivars of groundnut are presented in [Table-2]. The results revealed that the observed value of max. LAI under different dates of sowing were 4.3 to 5.5 percent, while the simulated value was 4.5 to 4.7 percent with deviation ranging between 2.6 to 13.9 percent. The lowest deviation was observed in third dates of sowing *i.e.* 02nd March. In case of different cultivars observed value to max. LAI were 4.1 to 5.6 %, while model simulated 4.2 to 5.0% with deviation ranging between 4.6 to 12.6 percent. The model was found to overestimate the maximum LAI under first date of sowing and for cultivars GG 2 and GJG 31. The statistical test criteria computed by r, MAE, MBE, RMSE and PE were 0.47, 0.00, 0.00, 0.46 and 9.58 respectively.

Conclusion

Overall results show that the calibrated CROPGRO- Peanut model performance was somewhere underestimated or overestimated but found within quite acceptable limits for simulation of phenology (*viz.*, anthesis, first pod initiation and physiological maturity) with error percent less than 4.8. Hence, this model can be used for simulating the phenology of groundnut cultivars.

Application of research: Simulation model for Groundnut, CROPGRO model
Research Category: Agro-meteorology

Abbreviations: LAI: Leaf area index, RMSE: Root mean square error, MAE: Mean absolute error, MBE: Mean Bias Error, PE: Potential error

Acknowledgement/Funding: Authors are thankful to Department of Agricultural Meteorology, B. A. College of Agriculture, Anand Agricultural University, Anand, 388110, Gujarat, India.

***Research Guide or Chairperson of research: Dr V. Pandey and Dr B.M. Mote**
University: Navsari Agricultural University, Navsari, 396450, Gujarat, India
Research project name or number: PhD Thesis

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Anand, Gujarat

Cultivar / Variety / Breed name: (GG 2), (GG 20), (GJG 31) and (TG 26)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Bandyopadhyay P.K., Mallick S. and Rana S.K. (2005) *Irrig. Sci*., 23 (4), 161-169.
[2] Singh A.L. (2003) *Advances in Plant Physiology*, 6, 295-382.
[3] Kaur P. and Hundal S.S. (1999) *J. of Agric Sci.,* 133, 167-173.
[4] Guled P.M., Shekh A.M., Patel H.R., Pandey V. and Patel G.G. (2012) *J. of Agrometeorology*, 14 (2), 154-157.