Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(2): 3397-3400
Received: 11-01-2018
Accepted: 12-02-2018

Nitish Kumar
Department of Agricultural Meteorology, Narendra Deva University of Agriculture & Technology Narendra Nagar, Kumarganj, Faizabad, Uttar Pradesh, India

AK Singh
Department of Agricultural Meteorology, Narendra Deva University of Agriculture & Technology Narendra Nagar, Kumarganj, Faizabad, Uttar Pradesh, India

SR Mishra
Department of Agricultural Meteorology, Narendra Deva University of Agriculture & Technology Narendra Nagar, Kumarganj, Faizabad, Uttar Pradesh, India

AN Mishra
Department of Agricultural Meteorology, Narendra Deva University of Agriculture & Technology Narendra Nagar, Kumarganj, Faizabad, Uttar Pradesh, India

Rajan Chaudhari
Department of Agricultural Meteorology, Narendra Deva University of Agriculture & Technology Narendra Nagar, Kumarganj, Faizabad, Uttar Pradesh, India

Praveen Kumar Singh
Department of Vegetable Science, Narendra Deva University of Agriculture & Technology Narendra Nagar, Kumarganj, Faizabad, Uttar Pradesh, India

Correspondence
Praveen Kumar Singh
Department of Vegetable Science, Narendra Deva University of Agriculture & Technology Narendra Nagar, Kumarganj, Faizabad, Uttar Pradesh, India

Performance & growth of chickpea (*Cicer arietinum* L.) cultivars on Dssat simulation model

Nitish Kumar, AK Singh, SR Mishra, AN Mishra, Rajan Chaudhari and Praveen Kumar Singh

Abstract
A field experiment was conducted during *Rabi* 2010 to generate the ground truth data of chickpea crop at Agro meteorological Research Farm of N.D.U.A&T, of Kumarganj, Faizabad (U.P.) as to asses the "Performance & growth of Chickpea (*Cicer arietinum* L.) cultivars on DSSAT simulation model**.**". The experiment was conducted in split plot design. The treatment comprised of three dates of sowing viz. October 26th (D_1); November 10th (D_2) and November 25th (D_3) kept as main plot with three varieties viz. Pusa-362 (V_1); Uday (V_2) and PG-186 (V_3) kept as sub plot. The historical field crop data of year 2008-09 and 2009-10 were used for calibration and validation in addition to field crop data of year 2010-11. The performance of model tested using SD and RMSE.

Keywords: Anthesis, first pod formation. first seed formation, physiological maturity

Introduction
Chickpea (*Cicer arietinum* L.) is the world third most important food legume and India is placed first in production. It is commonly known as Gram/Chana/Bengal gram and is grown in India as post monsoon winter (Rabi season) crop as it receives cold and dry weather for optimum growth and development. Chickpea crop is grown under diverse range of aerial environments hence, different genotypes are needed that are well adapted to the vagaries of weather and climate at different places. The crop needs cool weather conditions during early parts of its growth (Davis *et al*. 1990) [2]. Chickpea is grown over 2.5 million hectares in Madhya Pradesh which is subjected to continual heat stress environment. Chickpea may be categorized into cool-season and generally requires 1120 degree days to mature (Miller *et al*. 2002) [8]. In Uttar Pradesh, it is cultivated in an area of 0.82 million ha with an annual production of 0.69 m tones. The average productivity of the crop in UP is very low 9.1 q/ha. Crop growth simulation models provide the means of quantity the effect of climate, soil and management on crop growth, productivity and sustainability of agricultural production. DSSAT Crop simulation model is quite useful as it forms a bridge between crop process analysis and performance assessment in which process operation are in their natural context (Yazgan and Tatar, 2003) [10]. DSSAT model is applicable for wheat, rice, maize, chickpea etc. Validation of chickpea crop will be of immense useful as to predict the crop growth parameters and yields in advance. The process-based dynamic simulation crop models based on soil, crop and weather factors could be effective research tools for planning alternative strategies for crop management, land use and water management (Jordan, 1983; Whisler *et al*. 1986; Engel *et al*. 1997; Matthews *et al*. 2002) [4, 9, 3, 7] and also a useful tool for planning and developing technological interventions in diverse areas in India (Aggarwal and Kalra, 1994; Singh *et al*. 1994; Lal *et al*. 1999) [1, 6, 5].

Materials and Methods
The present investigation entitled "Performance & growth of Chickpea (*Cicer arietinum* L.) Cultivars on DSSAT simulation model**.**" was carried out during *Rabi* season of 2010 at Agromet. Research Farm of N.D. University of Agriculture and Technology Kumarganj, Faizabad (U.P.) as to generate the ground truth data for validation of model. The details of climatic and edaphic conditions, the materials used and methods employed have been described in the present text as follows; Days taken to anthesis, Days taken to first pod formation, Days taken to first seed formation, Days taken to Physiological maturity.

Result
Data pertaining to validation of simulated days taken to anthesis from observed in chickpea varieties sown under different dates of sowing for the year 2008-09 to 2010-11 are presented

in Table-1 and depicted in Error percentage was worked out between simulated observed days taken to anthesis of chickpea in all the years. It is evident from the data presented in Table No. 4.1 revealed that error per cent ranged between 6.8 (D_2V_1) to 14.6 (D_3V_2); -2.0 (D_2V_2) to 17.6 (D_3V_3) and 2.8 (D_1V_1) to 16.13 (D_3V_2) during 2008-09, 2009-10 and 2010-11 respectively. There was no any specific trend in error per cent were observed in different dates of sowing and varieties. During 2010-11 lowest was recorded in timely sown crop in all the treatment and increased with delay in sowing. Model provides accurate prediction of days taken to anthesis in case of timely sown crop. Overall, model overestimated the days taken to anthesis in all the years. Overall model provides a mean error per cent of 6.78, 9.33 and 11.46 for V_1, V_2 and V_3 respectively. The mean error % was found in V_1 as compared to other cultivars. The Standard deviation was 3.4, 5.9 and 4.3 days in V_1, V_2 and V_3 respectively with a RMSE value was found 7.35 in V_1 (Pusa-362) followed by 10.59 in V_2 (Uday) and 11.55 in V_3 (PG-186) respectively. Results revealed that timely sown crop (26th Oct.) in V_1 variety (D_1V_1) during 2010-11 could evaluate days taken to anthesis tolerable limit of 2.8 days.

Data pertaining to validation of simulated days taken to first pod formation from observed in chickpea varieties sown under different dates of sowing for the year 2008-09 to 2010-11 are presented in Table-2 and depicted in Error percentage between simulated and observed. was worked out for days taken to first pod formation of chickpea. It is evident from the data presented in Table- 4.2 revealed that error % ranged between 6.1 (D_3V_1) to 17.4 (D_1V_2); 4.4 (D_1V_2) to 14.7 (D_2V_1) and -5.2 ($D1V_2$) to 16.66 (D_3V_3) during 2008-09, 2009-10 and 2010-11 respectively. Results revealed that there was no any specific trend in error per cent observed in different dates of sowing in varietal treatment during 2010-11, in all the varieties under different dates of sowing. While during 2009-10, error % increased with delay in sowing in D1 V2 (sown on 26 Oct.) in Uday variety. Overall model overestimated days taken to first pod formation in all the varieties of sown under different dates of sowing Overall model provides a mean error per cent of 11.61, 6.77 and 10.69 for V_1, V_2 and V_3 respectively. The mean error % was found in V_2 as compared to other cultivars. The Standard deviation was 4.0, 8.8 and 4.2 days in V_1, V_2 and V_3 respectively with a RMSE value was found 14.04 in V_1 (Pusa-362) followed by 11.42 in V_2 (Uday) and 12.11 in V_3 (PG-186) respectively. Results revealed that timely sown crop (26th Oct.) in V_2 variety (D_1V_2) during 2010-11 could evaluate days taken to first pod formation tolerable limit of -5.2 days.

Data pertaining to validation of simulated days taken to first seed formation from observed in chickpea varieties sown under different dates of sowing for during the year 2008-09 to 2010-11 are presented in Table-3 and depicted in. Error percentage worked out between It is quite obvious from data that overall the model overestimated the days taken to first seed formation of chickpea crop during all the year of validation. Data also revealed that model have a mean error % of 11.7, 13.75 and 12.16 in V_1, V_2 and V_3 varieties respectively. While the SD and RMSE were estimated 2.4, 2.0, 5.9 days and 13.90, 15.82 and 15.90 days respectively in Pusa-362(V_1), Uday(V_2) and PG-186(V_3) respectively sown under different dates of sowing. It is quite obvious from data that overall the model overestimated the days taken to first seed formation of chickpea crop during all the year of validation. Data also revealed that model have a mean error % of 11.7, 13.75 and 12.16 in V_1, V_2 and V_3 varieties respectively. While the SD and RMSE were estimated 2.4, 2.0, 5.9 days and 13.90, 15.82 and 15.90 days respectively in Pusa-362(V_1), Uday(V_2) and PG-186(V_3) respectively sown under different dates of sowing.

Data with respect to validation of simulated days taken to physiological maturity from observed in chickpea varieties sown under different dates of sowing for the year 2008-09 to 2010-11 are presented in Table-4 and depicted in Error percentage between simulated and observed was worked out for days taken to physiological maturity of chickpea. It is evident from the data presented in Table-4 revealed that error % ranged between 6.2 (D_2V_1) to 19.4 (D_3V_2); -1.3 (D_3V_2) to14.4 (D_3V_3) and -2.8 (D_2V_3) to 19.7 (D_1V_2) during 2008-09, 2009-10 and 2010-11 respectively. There was no any specific trend in error per cent were observed in different dates of sowing in varietal treatment during 2008-09 and 2010-11 while during 2009-10 D_1V_1 and D_1V_3 and accuracy decreased with delay in sowing. Overall model overestimated the days taken to physiological maturity in all dates of sowing of the chickpea variety used under study. The model provided accurate days taken to maturity in case of timely sown crop of chickpea. Overall the model provided a mean error %, SD and RMSE in the tune of 9.1, 11.1, 9.4%, 5.7, 8.6, 7.1 days and 14.82, 19.11 and 16.10 days in Pusa-362(V_1), Uday(V_2) and PG-186(V_3) respectively sown under different dates of sowing

Table 1: Validation of simulated days taken to anthesis from observed in chickpea varieties sown under different dates of sowing

Date of sowing Year 2008-09	Varieties								
	Pusa -362(V_1)			Uday(V_2)			PG-186(V_3)		
	Obs.	Sim.	Error %	Obs.	Sim.	Err. %	Obs.	Sim.	Err. %
D_1	107	115	7.5	106	116	9.4	106	120	13.2
D_2	103	110	6.8	100	114	14.0	102	115	12.7
D_3	93	100	7.5	96	110	14.6	87	98	12.6
Year 2009-10									
D_1	106	109	2.8	105	113	7.6	104	110	5.8
D_2	102	106	3.9	100	98	-2.0	101	111	9.9
D_3	91	98	7.7	98	103	5.1	85	100	17.6
Year 2010-11									
D_1	107	110	2.8	106	116	9.4	105	112	6.7
D_2	103	114	10.7	102	112	9.8	101	110	8.9
D_3	97	108	11.34	93	100	16.13	95	110	15.79
Mean			6.78			9.33			11.46
SD			3.4			5.9			4.3
RMSE			7.35			10.59			11.55

Where, D_1-26th October, 10th November and 25th November

Table 2: Validation of simulated first pod formation from observed in chickpea varieties sown under different dates of sowing

Date of sowing Year 2008-09	Varieties								
	Pusa-362(V_1)			Uday(V_2)			PG-186(V_3)		
	Obs.	Sim.	Error %	Obs.	Sim.	Error %	Obs.	Sim.	Error %
D_1	116	128	10.3	115	135	17.4	114	132	15.8
D_2	110	122	10.9	107	122	14.0	112	125	11.6
D_3	98	104	6.1	96	102	6.3	94	101	7.4
Year 2009-10									
D_1	116	130	12.1	114	119	4.4	113	123	8.8
D_2	109	125	14.7	107	118	10.3	112	118	5.4
D_3	96	110	14.6	105	120	14.3	92	103	12.0
Year 2010-11									
D_1	117	132	12.8	115	109	-5.2	115	128	11.3
D_2	110	127	15.5	109	100	-8.3	109	117	7.3
D_3	93	110	7.52	103	111	7.76	102	119	16.66
Mean			11.61			6.77			10.69
SD			4.0			8.8			4.2
RMSE			14.04			11.42			12.11

Where, D_1-26th October, 10th November and 25th November

Table 3: Validation of simulated first seed formation from observed in chickpea varieties sown Under different dates of sowing

Date of sowing Year 2008-09	Varieties								
	Pusa -362(V_1)			Uday(V_2)			PG-186(V_3)		
	Obs.	Sim.	Error %	Obs.	Sim.	Error %	Obs.	Sim.	Error %
D_1	128	141	10.2	126	144	14.3	120	142	18.3
D_2	122	135	10.7	118	136	15.3	121	136	12.4
D_3	107	123	15.0	112	129	15.2	105	123	17.1
Year 2009-10									
D_1	126	142	12.7	124	138	11.3	122	139	13.9
D_2	119	132	10.9	119	134	12.6	119	130	9.2
D_3	106	120	13.2	112	128	14.3	103	110	6.8
Year 2010-11									
D_1	125	138	10.4	120	131	9.2	126	152	20.6
D_2	120	13	8.3	121	139	14.9	120	130	8.3
D_3	112	128	14.29	115	129	12.17	114	117	2.9
Mean			11.74			13.75			12.16
SD			2.4			2.0			5.9
RMSE			13.90			15.82			15.90

Where, D_1-26th October, 10th November and 25th November

Table 4: Validation of simulated days taken to physiological from observed in chickpea varieties sown under different dates of sowing

Date of sowing Year 2008-09	Varieties								
	Pusa -362(V_1)			Uday(V_2)			PG-186(V_3)		
	Obs.	Sim.	Error %	Obs.	Sim.	Err. %	Obs.	Sim.	Err. %
D_1	153	165	7.8	144	161	11.8	141	163	15.6
D_2	146	155	6.2	142	166	16.9	142	158	11.3
D_3	133	151	13.5	134	160	19.4	133	155	16.5
Year 2009-10									
D_1	154	149	-3.2	145	158	9.0	151	149	-1.3
D_2	146	161	10.3	140	156	11.4	143	161	12.6
D_3	134	153	14.2	133	121	-9.0	132	151	14.4
Year 2010-11									
D_1	153	169	10.5	142	170	19.7	153	171	11.8
D_2	147	158	7.5	141	154	9.2	143	139	-2.8
D_3	135	156	15.6	134	149	11.2	131	140	6.9
Mean			9.1			11.1			9.4
SD			5.7			8.6			7.1
RMSE			14.82			19.11			16.10

Where, D_1-26th October, 10th November and 25th November

Conclusion

It is concluded that study in simulated seed yield and phenological events were close to observed values in timely sown crop suggested that the simulated yield were well within the accepted limits, therefore the model can be used for predicting chickpea yield and phenological events.

References

1. Aggarwal PK, Kalra N. Analysing the limitations set by climatic factors, genotype, water and nitrogen availability on productivity of wheat-II. Climatically potential yield and management strategies. Field Crops Research. 1994; 38:93-103.

2. Davis TM, Matthews LJ, Fagerberg WR. Comparison of tetraploid and single gene-induced gigas variants in chickpea (*Cicer* 147 *arietinum*). I. Origin and genetic characterization. American Journal of Botany. 1990; 77:295-299.
3. Engel T, Hoogenboom G, Jones JW, Wilkens PW. AEGIS WIN: A computer program for the application of crop simulation models across geographic areas. Agronomy Journal. 1997; 89:919-928.
4. Jordan WR. Whole plant responses to water deficits: An overview. In Limitations to Efficient Water Use in Crop Production Eds. Taylor, H.W., Jordan, W.R. and Sinclair, T.R. American society of Agronomy, Madison. 1983; 289-317.
5. Lal M, Singh KK, Srinivasan G, Rathore LS, Naidu D, Tripathi CN. Growth and yield responses of soybean in Madhya Pradesh, India to climate variability and change. Agricultural and Forest Meteorology. 1999; 93:53-70.
6. Singh P, Boote KJ, Rao AY, Irutharaj MR, Shekh AM, Hundal SS *et al*. Evaluation of the groundnut 'PNUTGRO' for crop response to water availability, sowing dates and seasons. Field Crops Research. 1994; 39:147-162.
7. Matthews RB, Stephens W, Hess T, Middleton T, Graves A. Applications of crop/soil simulation models in Tropical Agricultural Systems. Advances in Agronomy. 2002; 76:31-112.
8. Miller PR, Mc Conkey BG, Clayton GW, Brandt SA, Staricka JA, Johnston AM *et al*. Pulse crop adaptation in the Northern Great Plains. Agronomy journal. 2002; 94:261-272.
9. Whisler FD, Acock B, Baker DN, Eye DE, Hodges HF, Hambert JR *et al*. Crop simulation models in agronomic systems. Advances in Agronomy. 1986; 40:141-206.
10. Yazgan S, Tatar D. Simulation of crop growth (CERES wheat model), Zirrat Fakultesi Dergisi A taturk University. 2003; 34(2):161-166.