Applicability of DSSAT model for barley (Hordeum vulgare L.) in Hisar region

Article *in* Journal of agrometeorology · December 2009

Journal of Agrometeorology 9(1) : 92-95 (June 2007)

Applicability of DSSAT model for barley (*Hordeum vulgare* L.) in Hisar region

J. K. MANI, RAJ SINGH, DIWAN SINGH and V. U. M. RAO
Department of Agricultural Meteorology
CCS Haryana Agricultural University, Hisar-125004, India

ABSTRACT

Field experiment was conducted at Research farm of CCS Haryana Agricultural University, Hisar during *rabi* season of 2005-06 to study the applicability of DSSAT model for barley variety-BH-393 with respect to sowing dates and row spacing. Results revealed that the prediction of phenological development was over estimated with in the acceptable limits (± 1). The prediction of peak leaf area index (LAI) was significantly on the higher side and deviated between -0.1 to 0.8 and also within the acceptable limits. The model mostly overestimated the yields and yield attributes. The model predicted highest grain yield for 15 cm row spacing in the first date of sowing.

Key words : DSSAT, barley, applicability, LAI, grain yield and prediction.

The crop simulation models can be used as quantitative tools to evaluate the effects of climatic, edaphic, hydrologic, agronomic and genotypic factors on the crop yield and stability (Boote et al., 1996). Crop model programs are currently needed to study the impact of climate changes on agricultural production. Under IBSNAT, DSSAT was developed to assess yield, resource use, and risk associated with different crop production practices (Tsuji *et al.*, 1994). The system DSSAT (Tsuji *et al.*, 1994) is an example of a management tool that enables farmers to match the biological requirement of a crop to the physical characteristics of the land to attain specified objectives. This could help the decision makers to implement future agricultural strategies under different scenarios related to agricultural practices. DSSAT (Decision Support System for Agrotechnology Transfer) was used to evaluate and predict barley yield under different environments at Hisar conditions.

MATERIAL AND METHODS

A field experiment was conducted at Research farm of CCS Haryana Agricultural University, Hisar located at 29°10'N latitude, 75°46'E longitude and altitude of 215.2 m amsl; during *rabi* season of 2005-06. The experimental details are given in paper in this issue (Mani et al. 2007). The crop was inspected at two days intervals to follow the phenological events *viz.*, emergence, tillering, jointing, flag leaf, heading, anthesis, milking and physiological maturity (PM). The Leaf area was recorded at maximum vegetative stages. The yield and yield attributes were recorded at harvest.

RESULTS AND DISCUSSION

The grain yields were simulated by the tree crop growth models which are part of

Table 1 : Comparison of observed (o) and predicted (p) phenology of barley under different sowing time and crop spacing

Treatments	Emergence			Tillering			Jointing			Flag leaf			Heading			Anthesis			Milking			PM		
	O	P	D	O	P	D	O	P	D	O	P	D	O	P	D	O	P	D	O	P	D	O	P	D
10th November																								
15 cm	9	8	-1	37	36	-1	62	59	-3	73	72	-1	87	86	-1	99	97	-2	113	111	-2	134	131	-3
22.5 cm	8	8	0	36	34	-2	61	61	0	72	71	-1	86	88	2	98	98	0	112	113	1	133	130	-3
30 cm	6	6	0	34	34	0	59	61	2	70	71	1	84	84	0	96	94	-2	110	108	-2	131	131	0
15:30 cm	7	6	-1	35	36	1	60	59	-1	71	68	-3	86	87	1	97	99	2	111	111	0	132	130	-2
30th November																								
15 cm	10	9	-1	33	33	0	56	58	2	69	70	1	81	81	0	90	92	2	106	105	-1	113	113	0
22.5 cm	9	10	1	32	35	3	55	57	2	68	70	2	80	81	1	91	94	3	105	107	2	112	109	-3
30 cm	8	7	-1	30	32	2	53	53	0	66	68	2	78	80	2	87	90	3	103	104	1	110	112	2
15:30 cm	8	7	-1	31	31	0	54	52	-2	67	67	0	79	78	-1	89	89	0	104	102	-2	111	111	0
20th December																								
15 cm	12	11	-1	32	34	2	56	57	1	70	72	2	78	79	1	84	86	2	99	99	0	106	104	-2
22.5 cm	11	12	1	31	33	2	55	56	1	69	70	1	77	79	2	83	83	0	98	101	3	105	106	1
30 cm	10	10	0	29	30	1	53	56	3	67	69	2	75	78	3	81	83	2	96	99	3	103	103	0
15:30 cm	11	12	1	30	29	-1	54	55	1	68	68	0	76	76	0	82	85	3	97	98	1	104	105	1

O - Observed, P -Predicted and D - Deviation (days)

Table 2 : Comparison of observed (o) and predicted (p) peak leaf area index and number of grains per spike in barley under different sowing time and row spacing

Treatments	Leaf area index			Grains/ Spike		
	O	P	D	O	P	D
10th November						
15 cm	3.6	3.9	0.3	39.5	40.1	0.6
22.5 cm	3.5	3.8	0.3	38.0	38.2	0.2
30 cm	3.5	3.5	0.0	37.8	36.8	-1.0
15:30 cm	3.4	3.3	-0.1	37.5	37.0	-0.5
30th November						
15 cm	3.4	3.7	0.3	38.9	40.1	1.2
22.5 cm	3.3	3.8	0.5	37.8	39.2	1.4
30 cm	3.3	3.3	0.0	37.5	38.5	1.0
15:30 cm	3.2	3.1	-0.1	36.8	37.5	0.7
20th December						
15 cm	3.4	3.5	0.1	37.2	36.8	-0.4
22.5 cm	3.1	3.9	0.8	36.8	37.4	0.6
30 cm	3.3	3.6	0.3	35.8	34.2	-1.6
15:30 cm	3.2	3.2	0.0	36.8	37.0	0.2

O - Observed, P -Predicted and D - Deviation

Table 3 : Comparison of observed (o) and predicted (p) yield (kg ha^{-1}) in barley under different sowing time and row spacing

Treatments	Grain yield kg ha^{-1}			Straw yield kg ha^{-1}		
	O	P	D	O	P	D
10th November						
15 cm	3846	3994	148	5822	6105	283
22.5 cm	3798	3812	14	5674	5742	68
30 cm	3781	3801	20	5516	5836	320
15:30 cm	3636	3690	54	5530	5642	112
30th November						
15 cm	3650	3723	73	5248	5324	76
22.5 cm	3589	3458	-131	5102	5346	244
30 cm	3568	3589	21	5067	4987	-80
15:30 cm	3412	3567	155	4876	4796	-80
20th December						
15 cm	3410	3502	92	4552	4687	135
22.5 cm	3301	3417	116	4356	4425	69
30 cm	3289	3178	-111	4235	4382	147
15:30 cm	3210	3325	115	4135	4085	-50

O - Observed, P -Predicted and D - Deviation

DSSAT (Decision Support System for Agrotechnology Transfer) software (Hoogenboom *et al.* 1994) with use of measured site-specific pedological, physiological, cultivation and meteorological data. Phenological parameters predicted by 'DSSAT' model and those actually recorded in the field are shown in Table 1. The model mostly over estimated the crop growth stages under all sowing dates. Among the row spacing in all dates of sowing the modeled results gave both over estimation and under estimation from emergence to physiological maturity. The deviation varied between -1 to 1 day at emergence and -3 to 2 days at physiological maturity for different row spacing in all the treatments. Observed leaf area index (LAI) *vs* predicted LAI under different growing environments of barley are presented in Table 2. In general, the model over estimated the LAI in all the treatments during crop growing season. The over estimation of LAI might be due to higher partitioning coefficients used for leaf. The values of peak LAI deviated between -0.1 to 0.8 for different row spacing in all the treatments. The model over estimated the grains per spike under all sowing dates and among all the row spacing during crop growing season (Table 2). The deviation varied between -1.6 to 1.4 for different row spacing in all the treatments. The results presented in Table 3 shows the comparison of observed and simulated yield parameters *viz.* grain yield and straw yield of barley. The model mostly over estimated the grain yield for all four spacing in three dates of sowing. The predictions deviated from -131 to 155 kg ha^{-1}. The model predicted highest grain yield for 15cm row spacing in the first date of sowing. The straw yield was over estimated during crop growing season. The deviations in straw yield prediction from the observed values ranged between -80 to 320 kg ha^{-1}. The model predicted highest grain yield for 30cm row spacing in the first date of sowing. This model was within the acceptable limits for Hisar conditions for the prediction of phenology, peak LAI and yield and yield attributes of barley crop.

REFERENCES

Boote, K. J, Jones, J. W. and Pickering, N. B. 1996. Potential uses and limitation of crop models. *Agron. J. 88: 704-716.*

Hoogenboom, G., Jones, J. W., Wilkens, P. W., Batchelor, W. D., Bowen, W. T., Hunt, L. A., Pickering, N. B., Singh, U., Godwin, D. C., Bear, B., Boote, K. J., Ritchie, J. T. and White, J. W. 1994. Crop models, DSSAT Version 3.0. International Benchmark Sites Network for Agrotechnology Transfer. University of Hawaii. Honolulu, Hawaii, pp.620.

Mani, J. K., Raj Singh and Diwan Singh., 2007. Study on agrometeorological indices for barley crop under different growing environments. *J. Agrometeorol.*, 9 (1) 86-91.

Tsuji, G. Y.; Uehara, G. and Balas, S. (eds.). 1994. DSSAT: a decision support system for agrotechnology transfer. Version 3.Vols. 1, 2 and 3. University of Hawaii, Honolulu, HI.