Journal of Agrometeorology 10(2) : 209- 212 (Dec. 2008)

Heat unit requirements for phenophases of wheat genotypes as influenced by sowing dates

A.K. SINGH, P. TRIPATHI and SHABD ADHAR
N.D. University of Agriculture & Technology, Kumarganj Faizabad (U.P.) – 224 229
Email : pmtmausam@india.com

ABSTRACT

A field experiment was carried out during winter season of 2002-2003 and 2003-2004 on the silty loam soil at Faizabad (U.P.) with three wheat genotypes viz, HUW-234, HD-2285 and HP-1633 sown at three different times viz., 5 November, 20 November and 5 December to assess the Heat unit requirements for phenophases of wheat genotypes as influenced by sowing dates. Results revealed that wheat sown on 5 November and 20 November recorded higher accumulated GDD, Heliothermal units, photothermal units and phenothermal index at all the phenopheses over sowing done on December 5th in which higher yield of wheat. Higher thermal units under 5 November and 20 November sowing were not found conducive for a better yield of wheat crop. Lesser value of cumulative PTI during crop period produces higher grain yield in December 5th sowing.

Key words: Growing degree days, heliothermal unit, photothermal units, phenothermal index, genotypes.

Temperature is one of the important elements of the climate which determines directly the potential productivity level particularly for winter crops. Heat unit requirement or GDDs has been used for characterizing the thermal response in wheat crop (Rajput *et al* 1987) and other crops. (Shanker et al, 1996). Light response i.e. photoperiodism which not only controls the temperature factor but also regulates the vegetative growth as well as flowering of the plants is important weather element for wheat crop to assess the thermal response and its requirement at different phenophases to harvest the potential yield. In view of above, present investigation was undertaken**.**

MATERIALS AND METHODS

A field experiment was conducted at Agraomet. Research Farm of N.D. University of Agriculture & Technology, Kumarganj ,Faizabad. (U.P.) during winter season of 2002-2003 and 2003-2004 to assess the Heat unit requirements for phenophases of wheat genotypes as affected by sowing dates. The research farm is located at $26^0$47' N latitude, 82^0.12' E longitude and at an altitude of 113m from mean sea level. The experiment was conducted in split-plot design. Treatments with three replications comprised of three sowing dates (viz. , 5 and 20 November , 5 December) in main plot and three genotypes viz,. HUW-234, HD-2285 and HP-1633 in sub plot. Soil of the experimental field was silty loam, PH -8.3, EC-0.24 mmhos/ cm. at 25^0C and organic carbon 0.20 per cent. Crop was raised using recommended agronomic package of practices for irrigated wheat. Periodical observations on various phenophases and its development, dry matter accumulation and grain yield were recorded during both the years. Bright sunshine hours, day length, maximum and minimum temperature during the wheat period were recorded from meteorological observatory of the university (Fig.1) Growing degree days (GDD) were computed by taking a base temperature 5^0C (Nuttonson, 1955).

The photothermal and heliothermal units were also computed following Rajput (1980) Heliothermal units=GDD x actual sunshine hours.

Photothermal units= GDD x day length

Phenothermal index (PTI) for each phenophase was calculated as per following formula given by Sastry and Chakravarty (1982).

$$PTI = \frac{\text{Growing degree days (GDD)}}{\text{No. of days taken between two phenophases}}$$

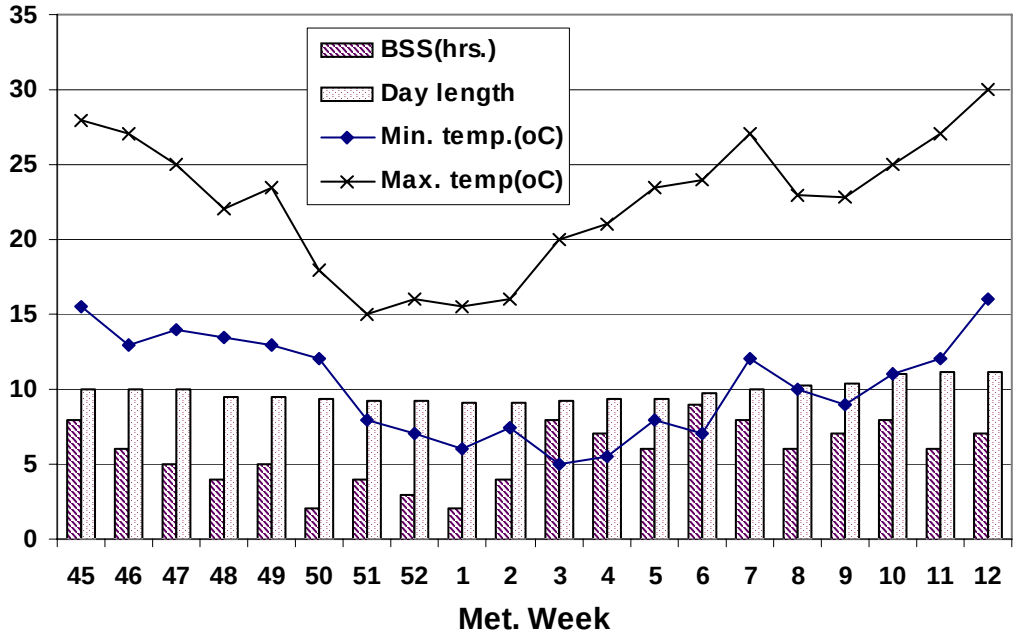

Fig. 1 : Weather during the crop growth period (average of two years)

RESULTS AND DISCUSSION

Growing degree day (GDD)

Higher GDD was recorded under 5 Nov. sowing followed by 20 Nov. sowing at all the phenophases of wheat, while the lowest GDD was obtained under sowing done on 5 Dec. (Table 1) due to comparatively both lower temperature and growth duration. Accumulated GDD from sowing to maturity were 1733, 1506 and 1401 degree days in 5 Nov.,20 Nov., and 5 Dec. of sowing, respectively. Decreased heat units requirement with delay in sowing were also reported by Rajput *et al*, 1987 and Agrawal *et al*, 1999.

Phenothermal index (PTI) and grain yield:

Phenothermal index decreased till jointing stage in 5th November sowing of wheat while in 5th December sowing it decreased till milking (Tabel 1). Maximum phenothermal index (25.8-33.7) was recorded during dough stage. Maximum PTI 33.7 was recorded at dough stage under 5th December sowing of wheat. Sastry and Chakravarty (1982) also reported similar results. Crop sown on 5th December recorded 25.7 per cent higher yield over 5 November sowing mainly due to the fact that crop sown on 5th December was most efficient in thermal response. While crop sown during 5 and 20 November yielded comparatively less due to higher temperature regime during vegetative growth. Tripathi et al, 2004 reported higher accumulated GDD and Heat use efficiency in November 25th sowing at different phenophases over delayed or much delayed sowing. They reported that 25th November to first week of December be identified as the normal sowing time of wheat in the Faizabad region and sowing done after first week of December comes under delayed or much delayed sowing.

Heliothermal units (HTU)

Wheat sown on 5 November accumulated higher heliothermal units over rest both of sowing dates at all the phenophases (Table 2). It increased successively till the maturity of the crop. To attain maturity, 5 November sowing required highest Heliothermal units followed by 20 November and 5 December sowing. However sowing done on 5 December recorded lowest HTU at all the phenophases.

Photothermal units (PTU)

Sowing of wheat on 5th November recorded higher photothermal units over 20 November and 5 December

Table 1: GDD and Phenothermal index at different phenophases of wheat as affected by sowing dates (averaged over 2 yrs.)

Sowing dates	Emergence		CRI		Tillering		Jointing	
	GDD	PTI	GDD	PTI	GDD	PTI	GDD	PTI
5 Nov.	108	17.4	363	15.6	656	10.0	762	7.8
20 Nov.	96	15.2	293	12.4	503	7.9	592	8.5
5 Dec.	88	12.5	200	7.6	393	8.3	473	7.0

Table 2 : Heliothermal (HTU) and Photothermal (PTU) units of wheat at different phenophases as affected by sowing dates (averaged over 2 years.)

Sowing dates	Phenophases																Grain yield (q ha^{-1})
	Emergence		CRI		Tillering		Jointing		50% flowering		Milking		Dough		Maturity		
	HTU	PTU	HTU	PTU	HTU	PTU	HTU	PTU	HTU	PTU	HTU	PTU	HTU	PTU	HTU	PTU	
5 Nov.	759	868	2427	2909	4092	4248	5333	6095	6978	7975	8452	9660	1045	12132	12131	13864	38.3
20 Nov.	675	772	2052	2345	3521	4024	4144	4736	5382	6151	7751	8858	9709	11096	10545	12052	41.9
5 Dec.	619	708	1402	1603	2751	3144	3314	3788	4668	5335	5296	6052	9169	10479	9807	11208	48.1

sowing at all the phenophases (Table 2). The lowest photothermal units were accumulated from sowing to maturity in 5th December sowing. The possible reason might be ascribed to relatively lower day length and temperature. To attain maturity sowin;g on 5 December required lowest value of Heliothermal and Photothermal units i.e. 9807 & 11208, respectively followed by sowing on 20 November & 5 November.

It is therefore, concluded that sowing on 5 December required lesser GDD during crop growth period and also required lesser Heliothermal, photothermal units and PTI than sowing on 5 & 20 November. In spite of lesser Heat units, 5 December sowing recorded maximum grain yield to the extent of 25.7% higher over sowing on 5 November indicating optimum thermal regime. Higher Heliothermal and photothermal units under sowing on 5 November was not found conducive for better productivity of crop. Wheat sown on 5 December was most efficient in the utilization of thermal energy.

REFERENCES

Agrawal, K.K., Shanker, U, Upadhyay, A.P. and Gupta, V.K. (1999). Accumulated heat unit requirements for different phenophases of wheat *(Triticum aestivum)* cultivars as influenced by sowing dates at Jabalpur. *J. Agromet.*, 1 (2): 173-176.

Nuttonson, M.Y. (1955). Wheat climate relationship and use of phenology in as certaining the thermal and photo thermal requirements of wheat. American Institute of Crop Ecology, Washington D.C.

Rajput, R.P. (1980). Response of Soybean crop to climatic and soil environments. Ph.D. thesis submitted to IARI, New Delhi (Unpublished).

Rajput, R.P., Deshmukh, M.R. and Paradker, V.K. (1987). Accumulated heat units and phenology relationship in wheat as influenced by planting dates under late sown conditions. *J. Agron. Crop Sci.*, 159: 345 – 349.

Sastry, P.S.N., Chakravarty, N.V.K. (1982). Energy summation indices for wheat crop in India. *Agric. Meteorol.*, 27: 45-48.

Shanker, U., Agrawal , K.K. and Gupta, V.K. (1996). Heat unit requirements of rainfed soybean. *Indian J. Agric. Sci.*, 66: 401-404.

Tripathi, P. Singh, A.K., Kumar, A. and Chaturvedi, A. (2004). Heat-use efficiency of wheat *(Triticum aestivum)* genotypes under different crop growing environment. *Indian J. Agric. Sci.*, 74 (1): 6– 8.

Received: May 2007; Accepted: August 2008