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Thermal indices for some wheat genotypes in Ludhiana region

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Wheat is a major crop of *rabi* season in Punjab State. Crop management strategies and technologies in the irrigated areas are significantly being affected by climate and weather variability. Therefore, a better understanding of the climatic resources can be helpful to increase the productivity of the crop. Several studies were reported to determine the effect of temperature on growth and development of wheat crop, but many of these were concentrated on the developmental stages such as grain growth (Sofield, 1977). Experiment with spring wheat by Mahi *et al* (1991) and Mc Master and Wilhelm (1998) revealed that the effect of temperature on growth and grain yield of cereal depends on the stage of development of crop.

The occurrence of different phenological events during growing season of any crop and the effect of temperature on plant growth can be inferred using accumulated heat units or growing degree days (GDD). The duration of each growth phase is a result of crop response to external environmental factors. The concept of heat units has been applied to correlate the phenological development of different crops to predict grain yield and physiological maturity (Swan *et al*., 1987). Moreover, information on heat unit requirements is very much helpful to crop modelers for calibration and sensitivity analysis of several crop growth simulation models. Hence, in this paper, the phenological

development of two wheat genotypes in relation to growing environment under field conditions in Ludhiana, Punjab has been reported.

A field experiment was conducted using two genotypes of wheat, viz. PBW343 and WH542 with three dates of sowing viz. D_1 (12 November). D_2 (27 November) and D_3 (12 December) during the *rabi* season of 2002 – 2003 at Ludhiana (30° 54' N latitude and 75° 48' E longitude, Elevation: 247m above msl). The treatments were replicated four times in randomised block design and crop was raised using normal package of practices. Observations on different phenological stages such as Sowing (S_0), Start emergence (S_1),

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Table 1: Effect of sowing dates and cultivars on duration and growth environment of wheat genotypes.

Phenology	Wheat Genotypes					
	PBW343			WH542		
	DAS	ΣGDD	ΣPTU	DAS	ΣGDD	ΣPTU
S_0 to S_1	5*	87	925	7	118	1248
	8#	100	1028	10	110	1141
	10$	125	1268	12	144	1465
S_0 to S_2	8	132	1396	10	159	1675
	12	142	1456	14	149	1654
	18	193	1961	18	193	1961
S_0 to S_3	21	291	3047	23	313	3273
	22	253	2588	25	274	2922
	29	240	2434	31	248	2515
S_0 to S_4	26	347	3614	29	375	3900
	29	324	3310	31	329	3475
	38	275	2804	39	279	2838
S_0 to S_5	65	631	6503	68	650	6704
	69	568	5853	72	582	6143
	67	533	5587	70	562	5913
S_0 to S_6	75	696	7190	78	729	7542
	76	629	6526	80	657	6961
	78	664	7080	81	703	7531
S_0 to S_7 (50%)	84(91)	781(843)	8098(8771)	87(95)	808(882)	8388(9207)
	82(88)	694(754)	7241(7920)	85(91)	711(782)	7567(8373)
	83(86)	718(749)	7707(8066)	85(88)	738(778)	7941(8414)
S_0 to S_8 (50%)	94(103)	872(967)	9094(10166)	96(107)	895(1023)	9346(10800)
	92(98)	809(879)	8554(9361)	94(101)	826(898)	8887(9721)
	88(93)	778(856)	8414(9337)	90(96)	808(907)	8763(9954)
S_0 to S_9 (50%)	107(111)	1023(1078)	10799(11317)	112(115)	1085(1113)	11518(11841)
	100(103)	899(939)	9595(10068)	103(107)	927(986)	10069(10762)
	25(98)	891(939)	9759(10338)	97(99)	923(956)	10145(10541)
S_0 to S_{10}	112	1085	11431	116	1123	11966
	105	969	10417	109	1023	11210
	100	973	10748	101	992	10984
S_0 to S_{11}	126	1282	13854	130	1347	14649
	114	1117	12195	118	1177	13077
	105	1064	11869	108	1118	12540
S_0 to S_{12}	139	1509	16640	143	1585	17599
	131	1425	16029	134	1478	16864
	122	1403	16152	124	1453	16794
S_0 to S_{13}	151	1752	19728	155	1851	21009
	137	1564	17806	141	1648	19052
	126	1499	17398	129	1568	18291

S_0 = Sowing, S_1 = Start emergence, S_2=Complete emergence, S_3= CRI Stage, S_4=Tillering, S_5= Jointing, S_6= Flag leaf initiation, S_7=Start booting, S_8=Start panicle emergence/Heading, S_9=Start anthesis, S_{10}= Grain filling, S_{11}= Soft dough stage, S_{12}= Hard dough stage, S_{13}= Physiological maturity

*Sowing =12 November, 2002 #Sowing = 27 November, 2002 $ Sowing = 12 December, 2002

*Figures in parenthesis are the values at 50% of that respective phonological stage.

Complete emergence (S_2), CRI Stage (S_3), Tillering (S_4), Jointing (S_5), Flag leaf initiation (S_6), Start booting (S_7), Start panicle emergence/Heading (S_8), Start anthesis (S_9), Grain filling (S_{10}), Soft dough stage (S_{11}), Hard dough stage (S_{12}), and Physiological maturity (S_{13}) were recorded from five tagged plants for every treatment.

For each phenophase the cumulative growing degree days (GDD), and photothermal units (PTU) were calculated by the following formula.

Accumulated GDD = $\Sigma(T_{mean} - T_{base})$

Where, T_{base} = Base temperature of wheat crop (4.5° C) (Nuttonson, 1955).

Accumulated PTU = Σ (GDD X Day length) (Nuttonson, 1946).

The investigation on the development of crop was examined by considering different phenophases and the number of days taken for completing each phenophase and it was found to be varied according to sowing dates and genotypes tested (Table 1).

On the basis of dates of planting the number of days taken for maturity were maximum in D_1 (151 and155 days), followed by D_2 (137 and 141 days) and lowest in D_3 (126 and 129 days). Number of days from sowing to anthesis (50%) decreased as sowing dates were delayed. Between the two genotypes the number of days taken for maturity were higher for WH-542 under all the sowing dates. For different sowing dates GDD from planting to maturity varied between 1499 to 1851(Table 1) and GDD was higher in 12 November sowing in both the genotypes. For the genotype WH-542, GDD required for attaining maturity was more due to its longer duration (Goswami *et al*, 2003).

The maximum PTU was accumulated in 12 November sowing, genotypes also differed significantly. This study reported the genetic differences for two different cultivars commonly grown in Ludhiana region in terms of thermal requirements at different phenophases.

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