Journal of Agrometeorology 17 (2) : 247-249 (December 2015)

Short Comminucation

Thermal indices for lentil in new alluvial zone of West Bengal

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Lentil (*Lens culinaris*) ranks second among *rabi* pulses in India, next to chickpea. It occupies 1.51 million ha land with the production of 0.95 millon tonnes in the country during 2007-08 (Dixit *et. al.*, 2009). Among different cultivation practices, sowing time is an important parameter which affects the production of lentil crop to a great extent. Its sowing becomes delayed even to the end of November particularly in rice-based cropping region. Besides, the phenological development of lentil varieties under different growth environments along with related thermal indices have not been determined and correlated with the yield of the crop in India, more preciously in the state of West Bengal. Thus, the optimization of sowing time along with selection of promising varieties can be done through a comprehensive study on phenology, thermal time indices and yield responses of lentil crop during *rabi* season.

A field experiment was conducted for lentil crop (*Lens culinaris*) during *rabi* season (November-March) of 2012-2013 on a medium land loamy soil at Instructional Farm (22°-93' N, 88°53' E and 9.75 m.s.l.) of Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India. Treatments replicated thrice were assigned in a split-plot design with three sowing dates (1 November, 15 November and 30 November) in main plots and four varieties (HUL 57, Moitree, KLS 218 and Ranjan) in sub-plots. Seeds of four lentil varieties were sown at 30 cm row spacing in the experimental plots (4 m × 3 m) as per sowing time schedule. The standard crop management practices like uniform fertilizer dose of 20:40:40 kg ha^{-1} of $N:P_2O_5:K_2O$, two hand weedings at 25-30 and 55-60 days after sowing (DAS) and one irrigation at 30-32 DAS were adopted.

The phenophases (*viz*. emergence, flower initiation, pod initiation and maturity) of lentil varieties at different sowing dates were noted by regular field inspection method. The daily meteorological data at Mohanpur for the period of investigation (November, 2012 to March, 2013) were collected from the Department of Agricultural Meteorology and Physics, B.C.K.V., West Bengal. Phenophase-wise growing degree days (GDD) were calculated following Nuttonson (1955) by taking a base temperature of 5ÚC. Heliothermal units (HTU) and photothermal units (PTU) were determined by the equations proposed by Singh *et. al*. (1990) and Nuttonson (1948), respectively.

Phenology

The duration of 1 November sown lentil crop was 114.7 days, which was reduced by 6.8 days (15 November) and 11.1 days (30 November) for delay in sowing in the investigation (Table 1). Singh *et. al.* (2005) reported similar type of reduction in time for 50% flowering and maturity of lentil (*cv.* LG 308) at Gurudaspur, Punjab. Although the variations in the phenophases among three sowing dates were complex in the study, but the trends during emergence to flower initiation (E – FI), and pod initiation to maturity (PI – M) primarily determined the differences in duration of lentil crop. Based on life cycle, four lentil varieties could be arranged as: HUL 57 (113.0 days) > Moitree (108.6 days) ≥ KLS 218 (104.4 days) > Ranjan (104.9 days).

Growing degree days (GDD)

Mean GDD from sowing to emergence (E), flower initiation (FI), pod initiation (PI) and maturity (M) were 174.4, 755.3, 980.4 and 1518.7 °C days, respectively (Table 1). HUL 57 required maximum GDD to attain each phenophase, excluding emergence to flower initiation (E – FI) as well as for entire life cycle compared to other three varieties (*viz.* Moitree, KLS 218 and Ranjan) in the experiment. Mean air temperature during flower to pod initiation (FI – PI) and pod initiation to maturity (PI – M) was higher for 30 November sown crop than 15 November, which accelerated the phenological development of the delayed sown crop during these two stages, but resulted in greater accumulation of GDD (273.3 °C days *vs*. 241.6 °C days and 521.0°C days *vs*. 516.3 °C days) than the mid November sown crop.

Table 1: Effect of sowing date and variety on phenology and thermal indices of lentil during *rabi* season

Treatment	Sowing to emergence (S - E)	Emergence to flower initiation (E - FI)	Flower initiation to pod Initiation (FI - PI)	Pod initiation to maturity (PI - M)	Sowing to maturity (S - M)
Phenological development (days)					
Sowing date					
1 November	8.0	49.1	14.6	43.0	114.7
15 November	12.3	40.5	21.1	34.0	107.9
30 November	10.8	41.8	21.1	29.9	103.6
Variety					
HUL 57	11.2	45.8	19.7	36.3	113.0
Moitree	10.0	44.2	18.7	35.7	108.6
KLS 218	10.1	45.6	18.4	34.3	108.4
Ranjan	10.1	39.7	18.9	36.2	104.9
Growing degree days (°C days)					
Sowing date					
1 November	160.4	721.8	160.4	577.7	1620.3
15 November	210.3	519.7	241.6	516.3	1487.9
30 November	152.4	501.2	273.3	521.0	1447.9
Variety					
HUL 57	188.6	597.1	236.9	577.5	1600.1
Moitree	169.0	588.0	222.3	542.4	1521.7
KLS 218	169.1	603.2	216.6	520.7	1509.6
Ranjan	170.7	535.4	224.6	512.7	1443.4
Heliothermal units (°C hour)					
Sowing date					
1 November	615.0	5542.3	958.1	3815.2	10930.6
15 November	1645.7	3603.3	1772.8	2942.7	9964.5
30 November	1362.5	3064.6	2156.4	3284.4	9867.9
Variety					
HUL 57	1313.5	4161.6	1768.7	3570.5	10814.3
Moitree	1165.0	4108.3	1626.5	3313.9	10213.7
KLS 218	1173.0	4210.1	1572.5	3239.0	10194.6
Ranjan	1179.2	3800.2	1548.8	3266.3	9794.5
Photothermal units (°C hour)					
Sowing date					
1 November	1820.0	7897.4	1736.2	6529.9	17983.5
15 November	2333.5	5603.2	2669.3	5853.8	16459.8
30 November	1656.1	5421.2	3084.2	6081.3	16242.8
Variety					
HUL 57	2093.5	6481.1	2641.3	6662.2	17878.1
Moitree	1878.5	6382.7	2464.9	6127.9	16854.0
KLS 218	1876.5	6549.6	2404.8	5981.5	16812.4
Ranjan	1897.7	5815.7	2475.2	5848.4	16037.0

Heliothermal units (HTU)

The variation in mean daily temperature and bright sunshine hour among three sowing dates resulted in varied accumulated heliothermal units at different phenophases and life cycle of lentil crop. Early sowing (1 November) of lentil recorded highest summed total HTU (10930.6°C hour), which was successively decreased due to delay in sowing on 15 November (9964.4°C hour) and 30 November (9967.9°C hour) (Table 1). Late sown crop (30 November) being experienced with greater temperature and bright sunshine hour during pod initiation to maturity (PI – M) accumulated more summed HTU (3284.4 *vs.* 2942.7°C) even with less number of days during the period (29.92 *vs.* 34.00 days) than the mid November sown crop.

Photothermal units (PTU)

Temperature generally governed the onset of different phenophases in lentil crop, but day length had also influence on photo-thermal requirements of the crop. Mean cultivar summed PTU at different phenophases were recorded as 1936.6°C hour (sowing to emergence), 6307.3 °C hour (emergence to flower initiation), 2496.6°C hour (flower initiation to pod initiation), 6155.0 °C hour (pod initiation to maturity) and 16895.4 °C hour (sowing to maturity) (Table 1).

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Received : February, 2015; Accepted: June, 2015