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Banasmita Barman
Department of Agrometeorology, Assam Agricultural University, Jorhat, Assam, India

Bondita Goswami
Department of Agrometeorology, Assam Agricultural University, Jorhat, Assam, India

R Hussain
Department of Agrometeorology, Assam Agricultural University, Jorhat, Assam, India

PG Khanikar
Department of Agrometeorology, Assam Agricultural University, Jorhat, Assam, India

RL Deka
Department of Agrometeorology, Assam Agricultural University, Jorhat, Assam, India

Kushal Sarmah
Department of Agrometeorology, Assam Agricultural University, Jorhat, Assam, India

Gulab Singh
Division of Agrometeorology, RPCAU, Pusa, Samastipur, Bihar, India

Abhinandan Singh
Department of Agronomy, RPCAU, Pusa, Samastipur, Bihar, India

Correspondence
Banasmita Barman
Department of Agrometeorology, Assam Agricultural University, Jorhat, Assam, India

Influence of GDD in different growth parameters of potato at agroclimatic condition of Jorhat

Banasmita Barman, Bondita Goswami, R Hussain, PG Khanikar, RL Deka, Kushal Sarmah Gulab Singh and Abhinandan Singh

Abstract
A field experiment was carried out during *Rabi* season, 2016-17 at the Instructional-Cum-Research (ICR) Farm of Assam Agricultural University, Jorhat to study crop-weather relationships of potato grown under different micro-climatic environments: MR-I: 16th November, MR-II: 1st December and MR-III: 16th December with three varieties: Kufri Jyoti, Kufri Pokhraj and Local following a split plot design with four replications. Different growth parameters, viz plant height, leaf area index and total biomass were recorded periodically. With increasing Accumulated growing degree-days (AGDD) significantly increased the plant height, LAI and total biomass in case of all different growth stage. Among all the variety Kufri Pokhraj was found highest Accumulated GDD that was 2822 corresponding to maturity phase. Highest correlation of coefficient in case of biomass was found at maturity phase that was 0.743 (At 5% level of significant).

Keywords: GDD (Growing degree-days), potato, plant height, LAI (Leaf area index), total biomass

Introduction
Today Potato (*Solanum tuberosum* L.) is the fifth most important crop worldwide, after wheat, corn, rice and sugar cane. It is contributing to food and nutritional security in the world. Over the past few decades, potato has become the fastest growing staple crop and for vegetable purposes, it has now become one of the most popular crops in India. Potato is a plant typical mainly of temperate climate and when day length is shorter. It is characterized by specific temperature requirements. India potato is generally grown when maximum day temperature below 35 °C and night temperature not more than 20 °C. Optimum temperature for potato growth is 15 to 20 °C. Under high temperature conditions, tuberization is significantly inhibited and photo assimilate partitioning to tubers is greatly reduced (Ewing, 1981). High temperature (more than 25 °C) may have two effects. One is to extend the period of leaf growth and hence prolong the growth cycle (Marinus and Bodlaender, 1975) [4]. High temperature also increases the leaf senescence rate (Menzel, 1985) [5] and through this they shorten the growth cycle of crop.
Research results have indicated that GDD are a useful tool to determine harvest dates and yield in such crops as broccoli (*Brassica oleracea* L.) (Dufault, 1997) [2], peas (*Pisum sativum* L.) (Hoover, 1955); corn (*Zea mays* L.); cucumber (*Cucumis sativus* L.) (Perry *et al.*, 1996) [7]. Sterrett *et al.* (1991) [8] evaluated a revised accumulated heat unit system (Lee *et al.*, 1992) [8] to predict when potato tubers would go off-grade. With this system growers could determine when to harvest to avoid economic losses due to tuber quality issues.

Materials and Methods
The experience was conducted at Jorhat district of Assam during 2016-17 with split plot design. Planting dates (3nos) were assigned to main plots and three varieties (V_1: Kufri Jyoti, V_2: Kufri Pokhraj and V_3: local) were assigned as a subplot. There were 9 treatment combination (V1D1, V_1D_2, V1D3, V2D1, V2D2, V2D3, V3D1, V3D2 and V_3D_3). Field was divided into 36 numbers of plots with plot size 4.5m × 3.5m and maintaining the spacing row to row 50 cm and plant to plant 20cm. Growing degree days (GDD) were calculated throughout the season for each planting date. Growing degree days (GDD) were calculated throughout the season for each planting date. The formula GDD = [(min T + max T)/2-T_b].T_b = Base temperature/or minimum threshold temperature taken as 4.5 for potato (Narayan *et al.*, 2014) [6]. GDD were noted at key growth and developmental stages (vegetative, reproductive, maturity). Different growth parameters i.e plant height, leaf area index and total biomass production were taken at different intervals of days after planting.

Three plants were selected randomly from 1m^2 area in each plot and the plant height was measured in cm from the base to the tip of the longest leaf of the plant with the help of a meter scale at different growth stages. The average of the recorded data of the samples was taken for statistical analysis. The leaf area was measured using Leaf Area Meter (LI-COR 3100). Mean value per plant was used in calculating the LAI using formula:

$$LAI = \frac{\text{Measured leaf area per plant } (cm^2)}{\text{Ground area covered by the plant } (50 \times 20 cm^2)}$$

Plant biomass were observed from 35 to 95 days after planting at 15 days interval. The samples for estimation of total biomass (leaf, root, stem and tuber). In order to estimate total biomass, these samples were oven dried at 50 to 55 °C for more than 48 hours until constant weight was obtained.

Result and Discussion

From (Table 1) revealed that increasing Accumulated growing degree-days (AGDD) significantly increased the plant height, LAI and total biomass in case of all different growth stage. Narayan *et al*. (2014) [6] also reported that similar result. In case of vegetative stage plant height, LAI and total biomass were found to be highest in 2nd date of planting (1st Dec) i.e 24.8 cm,2.5 and 10.1 gm/m^2 respectively corresponding to 915 Accumulated GDD which is the highest Accumulated GDD in this stage. Similar result was found in case of reproductive and maturity stage. Among all the variety Kufri Pokhraj was found highest Accumulated GDD that was 2822 corresponding to maturity phase. Cao and Tibbitts TW (1994) [1] also reported that higher temperature during the initial vegetative period produced a rapid establishment of foliar canopy and thus promoted plant growth.

Table 1: Effect of growing degree days on growth parameters

Stage	AGDD (°C)	Plant height(cm)	LAI	Total biomass(gm/m^2)
Vegetative				
V_1D_1	854	23.6	2.1	2.7
V_1D_2	887	23.8	2.2	7.1
V_1D_3	697	23.4	1.7	2.7
V_2D_1	907	24.5	1.1	4.7
V_2D_2	915	24.8	2.5	10.1
V_2D_3	697	24.5	0.9	1.2
V_3D_1	854	21.4	2.1	1.5
V_3D_2	861	21.7	2.2	6.3
V_3D_3	671	21.1	0.6	1.3
Reproductive				
V_1D_1	2104	29.3	3.7	72.7
V_1D_2	2560	33.2	3.8	74.0
V_1D_3	1970	25.1	2.1	65.3
V_2D_1	2214	32.1	2.5	85.6
V_2D_2	2257	34.1	3.8	90.9
V_2D_3	1970	29.2	2.1	76.5
V_3D_1	2052	27.1	2.7	67.0
V_3D_2	2136	31.1	3.1	73.3
V_3D_3	1912	31.0	1.4	63.9
Maturity				
V_1D_1	1934	25.4	1.7	46.8
V_1D_2	2712	26.2	1.9	53.3
V_1D_3	1772	23.4	0.8	28.0
V_2D_1	2105	30.4	1.8	49.5
V_2D_2	2822	27.2	1.9	56.0
V_2D_3	1772	24.5	1.7	47.1
V_3D_1	1849	25.1	1.0	33.0
V_3D_2	2653	23.2	1.2	45.5
V_3D_3	1679	23.0	0.7	27.8

Table 2: Correlation between Growth parameters and accumulated GDD in potato, 2016-17

Stage	Plant height	LAI	Biomass
Vegetative	0.288	0.690*	0.707*
Reproductive	0.660	0.767*	0.481
Maturity	0.307	0.562	0.743*

'*' 5% level of significant

From table No 2 GDD at all stages, data on correlation coefficient between various growth parameters in potato shows that both plant height and leaf area index highest correlation coefficient were found i.e 0.660 and 0.767 (At 5%level of significant) which was positive correlation corresponding to reproductive stage of potato. Highest correlation of coefficient in case of biomass was found at maturity phase that was 0.743 (At 5% level of significant).

Results obtained through the trial clearly indicated that potato sown during the first week of Dec accumulated intermediate amounts of heat units in terms of GDD (2822 °C) that resulted in highest tuber yield and quality as compared to earlier or late sown potatoes. Therefore, it can be concluded from the present experiment that the 1stweek of Dec is the most suitable time for planting of potato under Agroclimatic conditions at Jorhat.

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