

Short communication

Crop weather relations in maize (*Zea mays* L.)*

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Maize is one of the important cereal crops of India next to rice and wheat. Its acreage and production are substantial, but its productivity is quite low. Various biotic and abiotic factors play an important role in decreasing its productivity. The heat unit or growing degree day (GDD) concept assumes that there is direct and linear relationship between growth of plants and temperature. The scientific way of assessing and qualifying the effect of temperature and photoperiod on plant growth, development and yield by applying GDD theory which advocates that the plants have a definite temperature requirement to pass through a certain growth portion or phenophase. The technique has widely been used to study the growth rate phenology (Kiniry *et al.*, 1983) and yield (Shukla and Vasuniya, 1998). Very early sowing exposes the crop to high risk of crop failure due to erratic rainfall distributions associated with the start of the rainfall season, while with late sowing dates, the crop is vulnerable to early rainfall cessation before it fully matures. It is therefore important to strike a balance between reducing the risk of sowing too early and ensuring the crop is sown early enough to mature before the end of the season. The period between sowing date and cessation of rainfall season should cover the major part of the crop growth cycle that leads to the other important factor i.e sowing strategy management, that of variety selection. Short growing cycle varieties, which generally have a higher yield potential, will yield in long rainfall season.

Keeping above in view, a field experiment was conducted during *kharif* 2005 and 2006 under rainfed conditions at Agricultural Research Station (ARS), Amberpet, to study the crop weather relations in maize. The soil of the experimental site is sandy loam in texture, neutral in soil reaction with low organic matter (0.5%) and medium in soil P and K. In both the years maize was sown in the 1st week of June maintaining a spacing of 60 cm x 20 cm. And

subsequently sowing was taken up at fortnightly intervals. Uniform dose of 120 kg N - 60 kg P₂O₅ - 40 kg K₂O ha⁻¹ was applied to the crop at the time of sowing. There were ten treatment combinations which comprise of two maize cultivars (DHM105-hybrid and Harsha-variety) as main plots and five dates of sowing starting from June 1st with an interval of 15 days as sub-plots and replicated thrice in split plot design during both the years of experimentation. The crop observations at various phenological stages of growth were recorded. Maximum and minimum temperature data during crop growing seasons were collected from Automatic Weather station of the Institute and GDD were calculated at different phenological stages of crop growth during both the years.

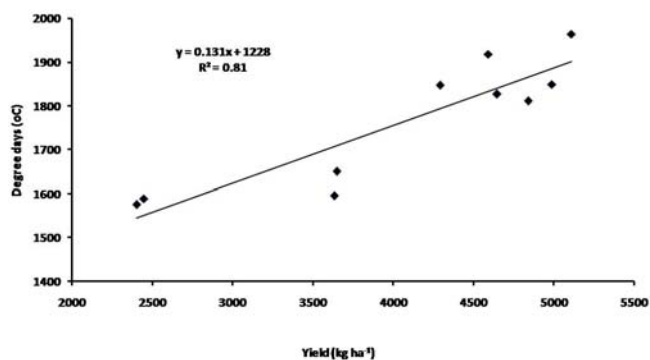
Results revealed that early sowing (June 1st) significantly influenced the yield of maize than subsequent dates of sowing because of higher accumulation of heat units. Delay in sowing resulted in reduction of cob yield which might be due to minimum accumulation of heat units. DHM 105 performance was superior to Harsha and there was a yield difference of 22-25 % during both the years (Table 1). Among different dates of sowing early sowing on June 1st outperformed all the other dates. If the sowing was delayed up to August 1st there was a yield reduction to an extent of 47-52 % . Therefore the first fortnight of June is always better to avoid moisture stress and also weed and pest problems in maize.

Effect of temperature was pronounced in maize cultivars and at different dates of sowing. Maize yield was significantly high in DHM-105 over Harsha during both years of experimentation (Table 1). Early sowing also resulted in significantly higher yield compared to sowing at later dates. Total Growing degree days (GDD) was more in DHM-105 (1773 and 1788) than Harsha (1589 and 1575) at first date of sowing i.e., in June 1st sown crop during 2005 and 2006;

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Table 1: Cob yield and growing degree days as influenced by different cultivars and dates of sowing

	Cob yield (kg ha ⁻¹)		Degree days (°C)	
	2005-'06	2006-'07	2005-'06	2006-'07
Main Plots(Maize Cultivars)				
C1 - DHM-105	5919	4507	1773	1788
C2 - Harsha	4406	3599	1589	1575
SEm±	89	103	—	—
CD(P=0.05)	262	306	—	—
Sub Plots (Dates of Sowing)				
D1 - June 1 st	5110	4591	1964	1918
D2 - June 15 th	4988	4646	1849	1827
D3 - July 1 st	4841	4292	1811	1847
D4 - July 15 th	3649	3633	1650	1595
D5 - Aug 1 st	2448	2403	1589	1575
SEm±	37	36	—	—
CD(P=0.05)	110	111	—	—

**Fig. 1:** Relationship between yield and growing degree days

followed by subsequent days sown at 15 days interval . Maximum GDDs were accumulated in early sown crop and minimum in August 1st sown crop (1589 and 1575) during both the years of experimentation. Maximum (1964) GDDs were registered in June 1st sown crop and minimum (1589) in August sown crop. There was positive correlation between heat units and cob yield with a determination coefficient of 0.807 (Fig. 1). The effect of temperature in reducing the length of growing cycle especially the grain filling phase is the most important factor in explaining reduced yields at warmer temperatures (White and Reynolds, 2003). By accelerating crop development, elevated temperatures limit the amount of solar radiation received by the plant during each developmental stage. Aggregated over the entire growing period, less interception of solar energy is problematic. With less fuel to drive photosynthesis i.e.,

conversion of CO₂ to organic compounds, plant structures (such as leaves) tend to be smaller and less abundant, bringing matured plant biomass below potential levels (Scott *et al.*, 2009).

Among the cultivars tested, it can be concluded that maize hybrid DHM-105 is superior to Harsha. Regarding dates of sowing irrespective of the cultivars evaluated early sowing was found to be better. Significantly superior yields were registered at early sowing due to accumulation of higher number of growing degree days or heat units.

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