Journal of Agrometeorology 9(1) : 122-124 (June 2007)

Short Communication

Heat use efficiency of Bt cotton cultivars in the semi–arid region of Punjab

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Hybrids occupy 28 % of cotton crop and 45% production in India (Tuteja, 2003). The development schedule of cotton is highly unpredictable and influenced by the temperature, soil moisture, nutrition and cultivars (Gipson and Ray, 1970). It is best adapted to sub tropical climates. The cultivation of Bt cotton is recently introduced in Punjab, therfore, there is a need to have sound knowledge about the thermal requirements of the Bt cotton and its biomass conversion efficiency.

A field experiment was conducted at Punjab Agricultural University Regional Research Station, Bathinda (30°17' N lat. and 74°58'E long at an altitude of 211 meters amsl). Six cultivars of Bt cotton namely MRC-6304, MRC-6301, RCH-134 , RCH -317, Ankur 651 and Ankur 2534 were grown. The cultivars MRC-6304, MRC-6301, RCH-134 , RCH -317 were sown on April 23, 2005 and Ankur- 651 and Ankur-2534 were sown on May 5, 2005. The phenology of the crop was observed regularly starting from the sowing to the physiological maturity. The yield and yield attributes were recorded at the harvesting of the crop. The weather data were recoded from the Agrometeorological observatory just 200 meters away from the experimental site. The growing degree-days (GDD), photothermal unit (PTU) were determined by using a base temperature of 12°C WMO, 1996). The yield was then related with the GDD and PTU to find out the best fit relationship.

Heat use efficiency = Yield / accumulated heat unit (kg ha^{-1} day^{-1} °C)

The phenology of Bt cotton and days taken by the crop (Table1) to reach a particular stage by all the cultivars were almost same (7-8days) up to the germination and they varied after germination is over.

The RCH 134 reached at the square formation stage in 53 days which was highest and was followed by RCH317 (51 days) and Ankur 2534 (50days). The RCH -134 took 175 days to attain the physiological maturity stage from the date of sowing. Whereas the Ankur 2534 and Ankur 651 reached at physiological maturity stage in 157 days and 155 days after sowing respectively. The lowest number of days (143) were taken by the MRC- 6301 reflecting that the cultivar is a bit early to complete its life cycle (Table 1).

(DAS) = days after sowing

Table 1 : Heat units requirements of Bt cotton cultivars at Bathinda

Cultivars	Heat unit requirements (day °C)						
	Dates of Sowing	Germination GDD (DAS)	Square formation	Flower initiation	Boll formation	Boll opening	Physiological maturity
MRC-6304	23.4.05	117 (7)	894 (48)	1164 (60)	1355 (69)	2323 (120)	2881 (151)
RCH-317	23.4.05	117 (7)	958 (51)	1239 (63)	1372 (73)	2420 (129)	2944 (150)
MRC-6301	23.4.05	117 (7)	878 (47)	1114 (57)	1303 (63)	2281 (112)	2844 (143)
RCH134	23.4.05	131 (8)	1001 (53)	1336 (73)	1419 (86)	2687 (149)	3077 (175)
Ankur-651	05.5.05	132 (7)	990 (47)	1129 (54)	1262 (62)	2513 (125)	2955 (155)
Ankur-2534	05.5.05	132 (7)	1065 (50)	1198 (57)	1305 (64)	2558 (126)	3008 (157)

Table 2: Heat use efficiency (HUE) of different Bt cotton cultivars at Bathinda

Cultivars	Yield (kg ha^{-1})	Heat units (day °C)	HUE (kg ha^{-1} day^{-1}°C)
MRC- 6304	2904	2881	1.01
RCH-317	2383	2944	0.80
MRC- 6301	2268	2843	0.81
RCH-134	3150	3077	1.02
Ankur -651	2534	2955	0.86
Ankur- 2534	2304	3008	0.77

Ankur-2534 took the highest (1065 day °C) up to square formation stage and was followed by RCH -134 (1001 day °C). From sowing to the physiological maturity RCH-134 consumed highest heat units (3077 day °C) followed by Ankur 2534 (3008 day °C) and the least heat units (2844 day °C) were consumed by MRC-6301 (Table 1)

Heat use efficiency

The heat use efficiency was also worked out for each cultivar and presented in the Table 2. The highest heat use efficiency (1.02 kg ha^{-1}/day^{-1} °C) was recorded in RCH-134.

Relationship of yield with heat units (GDD) and photothermal units (PTU)

The relationships between seed cotton yield (Y in kg^{-1}/ha^{-1}) and two heat units were worked out.

$$Y = 5428.3 - 1.9669X + 0.0004 X^2 \quad (R^2 = 0.48)$$

Where X is accumulated GDD

$Y = 1.2387 X + 31905$ $(R^2 = 0.56)$

$Y = 17211X^{0.0908}$ $(R^2 = 0.43)$

Where X is accumulated photothermal units

The PTU explained the variability in yield up to 56% as a linear function and 43 % as a power function. Other factors may have played role in the yield prediction of Bt cotton.

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