Journal of Agrometeorology 17 (2) : 253-255 (December 2015)

Short Comminucation

Influence of growth regulators on thermal energy requirement at various phenophases in transgenic cotton

D. P. NAWALKAR, Y.G. BAN, B. M. MOTE and V. KUMAR

Department of Genetics & Plant Breeding,Agricultural Meteorological Cell, Department of Agricultural Engineering,

[2] Main Cotton Research Station, N.A.U., Navsari (Gujarat)

Corresponding author E-mail- dineshnawalkar@gmail.com

Cotton is an important commercial crop in India. It has a prominent share in our national economy. Since majority of cotton area in the country in rainfed meteorological variables such as daily minimum and maximum temperature, solar radiations and precipitation play a decisive role in cotton production; second order variables such as soil temperature, relative humidity are also important (Hoogenboom, 2000). However, Climatic factors such temperature, length of daytime and relative humidity can have negative effects on the synthesis of some plant hormones (Abscisic acid, Gibberellic acid and Cytokinins). This directly affects physiological processes of the plant and as a result, growth potential is limited. However, external application of synthetic plant growth regulators can have such similar functions and have effect as phytohormones, thereby allow physiological processes to continue at their normal pace. Plant growth regulators are known to modify the source to sink relationship and increase the translocation and photosynthetic efficiency resulting in increased square and boll retention and boll setting per cent in cotton (Kumar, 2001). Cotton often produces more vegetative growth than is needed for maximum boll production and yield especially when climatic conditions favour vegetative growth, thereby directing the photo-assimilates towards the vegetative growth rather than reproductive growth. At the same time in *Bt* cotton early vegetative growth in restricted due to early switch over to reproductive growth by virtue to inbuilt protection to fruiting bodies. Plant growth regulators have been used in cotton often with inconsistent results; however, there are hardly reports on the effect of growth regulators on morpho-phenological events. Hence, there is a necessity for assessing phenological stages through using plant growth regulators.

The investigation was carried out during *Kharif* 2011-13 at Main Cotton Research Station, Navsari Agricultural University, Surat, Gujarat (India). The experiments were laid out in randomized block design (factorial) with treatments of growth regulators *viz.,* Control (00 ppm), Ethylene 45 ppm at squaring stage, MH 500 ppm at 85 DAS and Ethylene + MH and sub treatments comprised of three cotton hybrids *viz.,* RCH 2 (BG-II), Vikram 5 (BG-II), G.Cot Hy-12 replicated three times. The crop was sown on 6th and 7th July during 2011 and 2012, respectively. Row to row spacing of 120 cm and plant to plant spacing of 45 cm was maintained and recommended agronomic practises and plant protection measures were taken as and when necessary. The mean meteorological data on maximum and minimum temperature, relative humidity, rainfall and sunshine hours during the course of investigation were recorded and used for computation of agrometeorological indices.

For recording days required for a phenophase two middle lines in each plot were selected and daily observations were made when 50 per cent of the population showed boll bursting and maturity. Days between emergences to that particular event were taken days to 50 per cent boll bursting and maturity. On this background, growing degree days (GDD) also computed using Jones and Wells (1998) formula.

$$\text{GDD } (^0\text{C day}) = \sum_{a}^{b} \left[\left(T_{\max} + T_{\min}\right)/2\right] - T_b$$

Where,

Tmax - Daily maximum temperature (^{0}C)

Tmin- Daily minimum temperature (^{0}C)

Tb - Base temperature as 15.5 ^{0}C for cotton crop

a - Starting date of phenophase

b - Ending date of that phenophase

Seed cotton from five randomly selected plants was picked at 15 days interval starting at 140 DAS and weighed separately. The weight yield of these plants was added to the net plot seed cotton yield. Total weight of the three pickings

Table 1: Effect of ethylene and MH on crop phenological stages, degree days and yield in cotton hybrids (Pooled for year 2011-12 and 2012-13)

	Phenological stages (days		Growing degree days (^0C)		
	Days to 50 % boll bursting	Maturity	Emergence to 50 % boll bursting	Emergence to maturity	Seed cotton yield (kg ha^{-1})
A. Treatments (T)					
Control (00 ppm)	119	174	1521	2126	2158
Ethylene 45 ppm	111	169	1417	2019	2453
MH 500 ppm	126	190	1602	2249	2400
Ethylene + MH	123	181	1563	2150	2645
S. Em. ±	1.8	3.6	22	37	53
C.D. at 5%	5.1	10.3	62	105	151
B. Variety (V)					
RCH 2 Bt (BG-II)	115	172	1472	2055	2482
Vikram 5 Bt (BG-II)	118	176	1505	2111	2645
G. Cot Hy-12	126	188	1601	2243	2115
S. Em. ±	1.6	3.1	18	32	46
C.D. at 5%	4.4	8.9	53	92	132
C. Interaction V x T					
S. Em. ±	2.9	5.8	35.3	61.8	89
C.D. at 5%	NS	NS	NS	NS	NS
C.V.%	6.3	8.6	6.0	7.5	9.5

along with that of five plants was used to compute seed cotton yield per hectare and analysis.

Phenological stage

The results indicated that application of 45 ppm Ethylene at the time of square initiation had significantly enhanced bolls bursting (111 days) and reduced maturity (169 days) over control (119 days) and required lesser days for these events. This may be due to ethylene known as ripening hormone was boosted up in the bolls due to external application leading to weakening and dissolving of cell walls and build-up of internal pressure causing carpels to split apart and allowing the bolls to open naturally early. Weir and Gaggero (1982) and Rajni *et al,* (2011) and also observed similar results and accounted for it to increased level of Ethylene in bolls. Contrary, MH showed significantly delayed boll bursting (126 days) and maturity (190 days) over control as well as over Ethylene. MH is a known as growth inhibitors and an anti-gibberellins which delayed senescence and retained greenness through greater chlorophyll content, LAI and LAD which resulted into delayed boll bursting and maturity.

An identical trend was observed in days required for bolls bursting and maturity wherein G. Cot Hy-12 required significantly more days than the two *Bt* hybrids. In general, it was observed that as *Bt* hybrids were early when compared with conventional cotton, as a consequence they are early in peak boll bursting and reduced maturity.

Growing degree days

Application of growth regulators had significant influenced the growing degree days (GDD) accumulation for emergence to 50 per cent boll bursting and maturity (Table-1). Application of 45 ppm ethylene resulted in significantly less degree days accumulates for 50 per cent boll bursting (1417 ^0C) and maturity (2019 ^0C) than untreated control (2126 ^0C) whereas 500 ppm MH application resulted in significantly more degree days accumulates (1602 and 2249 ^0C) for these respective phenological stages. These are in tune with phenological events discussed earlier. Treatment with both Ethylene and MH required significantly more degree days (1563 and 2150 ^0C) than Ethylene but less than MH for 50 per cent boll bursting and maturity. Similar results was obtained by Gwathmey and Hayes (1996) who reported that application of Ethephon significantly increased the boll opening of Deltapine 50 cotton, however, the boll opening response to Ethephon was highly correlated with degree days accumulation.

The results revealed that the *Bt* hybrids RCH 2 (BG-II) and Vikram 5 (BG-II) required significantly less degree days to attain 50 per cent boll bursting and maturity than non-*Bt* G. Cot Hy-12 which matches with the days required for 50 per cent boll bursting and maturity by these hybrids.

Seed cotton yield

The results on final yield (Table 1) revealed that Ethylene and MH recorded significantly higher seed cotton yield of 2453 kg ha^{-1} and 2400 kg ha^{-1} respectively, over untreated control (2158 kg ha^{-1}). Application of both Ethylene at squaring stage followed by MH at 85 DAS had supplemental effect on seed cotton yield which was increased by significant margin (2645 kg ha^{-1}) over MH and Ethylene alone. Similar, reports have appeared earlier (Thakare *et al.,* 2011; Buttar and Singh, 2013).

The seed cotton yield in individual years as well as in pooled was significantly highest in hybrid Vikram 5 (BG-II) (2645 kg ha^{-1}) which was significantly higher than RCH 2 (BG-II) (2482 kg ha^{-1}) as well as G. Cot Hy-12 (2115 kg ha^{-1}). Thus lowest seed cotton yield was harvested in non *Bt* G. Cot Hy-12. Higher yield in *Bt* hybrid may be because of increase in number of squares, flowers and bolls due to inbuilt protection from entomological damage and retention of boll. More energy was utilized in reproductive development in the *Bt* cotton rather than vegetative development as in non-*Bt* cotton. Sarlach and Sharma (2012) and Kumari and George (2012) also reported higher yield in *Bt* cotton than conventional cotton.

From this above results we can conclude that application of 45 ppm Ethylene at the time of square initiation stage is effective for early boll bursting and reduced maturity, Contrary to it, 500 ppm MH at 85 DAS is effective for delayed boll bursting and late maturity, in term of *Bt* hybrids, Vikram 5 (BG-II) and RCH 2 (BG-II) were significantly enhanced seed cotton yield than conventional cotton hybrid, *Bt* hybrids, earliest squares, flowers turned into early boll bursting and reduced maturity by virtue of inbuilt protection due to *Bt* toxin which was not there in conventional hybrid G. Cot Hy-12 for this reason above technology and hybrids beneficial on farmers field.

REFERENCES

Buttar, G. S. and Singh, S. (2013). Effect of ethrel dose and time of application on growth, yield ad duration of *Bt* cotton in semi ared region of punjab. *J. Cotton Res. & Dev*., 27(1):60-62.

Gwathmey, C. 0. and Hayes, R. M. (1996).Ethephon effects on boll opening and earliness of early and late planted 'Deltapine 50' *Proc. Belt wide Cotton Conf*,1161.

Hoogenboom, G. (2000). Contribution of agrometeorology to the simulation of crop production and its applications. *Agril. Forest Met*., 103:137-157.

Jones, M. A. and Wells, R. (1998). Fiber yield and quality of cotton grown at two divergent population densities. Crop Science, 38: 1190–1195.

Kumar, K. A. (2001). Effect of plant growth regulators on morpho-physiological traits and yield attributes in hybrid cotton (*G. hirsutum* L.). M. Sc. (Agri.) *Thesis,* University of Agricultural Sciences, Dharwad.

Kumari, S. R. and George, M. (2012). Physiological manipulation of plant morphoframes by Maleic hydrazide and through nipping for enhancing cotton yield. *Green Farming.*, 3 (6):677-679.

Rajni, S., Deol, J. S. and Brar, A. S. (2011). Effect of chemical defoliation on boll opening percentage, yield and quality parameters of *Bt* cotton (*Gossypiumhirsutum*). *Indian J. Agron*., 56 (1):74-77.

Sarlach, R. S. and Sharma, B. (2012). Influence of naphthalene acetic acid and Cobalt chloride on growth and yield of cotton hybrids. *Soc. Pl. Res.,*25 (1):76-80.

Thakare, H. S., Kumar, V. and Bardhan, K. (2011). Effect of square removal on growth, yield and fibre quality of transgenic *Bt* cotton hybrids. *Indian J. Pl. Physiol*., 16 (2):200-204.

Weir, B. L. and Gaggero, J. M. (1982).Ethephon may hasten cotton boll opening and increase yield. *California Agric.*, 36:9-10.

Received : November, 2014; Accepted: June, 2015