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HEAT USE, HELIO-THERMAL USE AND RADIATION USE EFFICIENCY OF BT. COTTON AS INFLUENCED BY SOWING WINDOWS UNDER RAINFED CONDITIONS OF ANDHRA PRADESH

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ABSTRACT

A field experiment was carried out during kharif, 2010-2011 and 2011-2012 on clay soils of Regional Agricultural Research Station, Lam, Guntur. The experiment consists of six dates of sowing windows viz., 2 FN of July, 1 FN of Aug, 2FN of Aug, 1 FN of Sept, 2 FN of Sept and 1 FN of Oct to know the heat use efficiency, heliothermal use efficiency and radiation use efficiency of Bt. cotton (NCS-145) in Krishna agro climatic zone of Andhra Pradesh. The results indicated that the Bt. cotton sown on 2nd FN of July has received maximum heat use efficiency, heliothermal use efficiency and radiation use efficiency (131.55 MJm-^{2}) and consequently resulted in to maximum seed cotton yield (2510 kgha^{-1}) followed by crop sown on 1st FN of August with a yield of 1820 kgha^{-1}. Statically significant correlation was found between radiation use efficiency and seed cotton yield of Bt. cotton under rainfed conditions of Andhra Pradesh.

I. INTRODUCTION

Cotton is a major fibre crop, is grown usually in heavy black soils under rainfed environments across semi-arid tracts of India. It is relatively withstand some extent to drought areas where day length varies from 11 to 14 h and large differences in temperature are experienced, largely due to variations in altitude and latitude. Variability in weather causes substantial fluctuations in cotton production and productivity. To overcome the productivity fluctuations, breeder creates new genotypes within their genetic limits but yield is determined by the surrounding environment. Exploiting the potentiality of any genotype, climatic plays a vital role. Climatic factors viz., temperature, rainfall and light are most important for optimum growth and development there by exploits the yield potentiality of a particular cotton genotype. Among these, temperature plays a key role in almost all biological processes of genotype right from sowing to harvest therefore, any possible understanding of climate-yield relationship of Bt. cotton may help to determine heat use efficiency of Bt cotton to maximize yield potentiality under rainfed environment. Thus, rate of development of Bt. cotton from planting to maturity is a function of radiation use efficiency which is the derived factor of temperature, GDD, HTU and solar radiation. So a field experiment was conducted to understand the effect of radiation use efficiency and yield response of Bt. cotton in balck cotton soils under rainfed environment.

II. MATERIAL AND METHODS

The field study was conducted at Regional Agricultural Research Station, Lam, Guntur-34 (Latitude: $16^{0}18^{1}$, Longitude: $80^{0}29^{1}$Altitude: 33 m.a.m.s.l '). The climate is subtropical with mean annual rainfall of 915 mm. The soil of the experiment field was clay loam in texture, neutral to slightly alkaline in reaction (pH 7.8 to 8.2), medium in organic carbon content (0.51%), low in available N (220 kgha^{-1}), high in available P (58.7 kgha^{-1}) and available K (1099 kgha^{-1}). The experiment was conducted during *kharif* 2010-11 and 201-12 under rainfed environment of Krishna agro-climatic zone of Andhra pradesh. Data on maximum and minimum temperatures, sunshine hours and rainfall were recorded from

Agrometeorological field unit (AMFU) in the premises. Daily readings averaged over standard weeks in to month during crop growing period against the normal are plotted in table 1. One seed was dibbled at an inter and intra row spacing of 120 and 60 cm, respectively to achieve density of 27,777 plants ha^{-1}. The popular Bt i.e. NSC-145 (bunny), , genotype were sown on 27-07-2010-11 and 2011-12 and replicated four times in R B D design. A common cultivation practices for cotton practiced in the zone were adopted. The cumulative degree days (GDD), helio thermal unit (HTU) solar radiation and radiation use efficiency were calculated by using the following equations (Girijesh *et al*, 2011)

$$GDD = \frac{\sum(T_{max}+T_{min})}{2} - T_{base}$$

$$HTU = GDD * SSH\ (bright)$$

Solar radiation= 1SSH =3.66 (mjm^{-2})

Radiation use efficiency= yield ÷ Solar radiation (mjm^{-2})

Base temperature for the cotton was taken as 10 ^{0}C (Patel N.R. and Mehta A.N. 2001) and solar radiation was calculated by using the standard units and conversions i.e., one bright sunshine hour is equal to 3.66 mjm^{-2} of solar radiation (www.http://pv.asu.edu).

III. RESULTS AND DISCUSSIONS

Agroclimatic environment prevailed during crop growth period have been shown in table 1. Total rainfall of 792.5 and 1194.3 mm received as against the normal of 953.0 mm and with a deviation of -17 and 25 that indicates the normal during 2011 and excess during 2012 respectively in the crop growth period. An average mean maximum temperature received are 34.7^{0}C and 34.1 ^{0}C as against the normal of 34.1 ^{0}C, mean minimum temperature are 23.1 and 22.5 as against the normal of 22.7 and cumulative sunshine hours are 2660.2 and 2125.6 as angst the normal of 2300.3 respectively (Table 1.).

Table 1. Monthly metrological data for the year 2011 and 2012 against normal at RARS Lam, Guntur

month	Total rainfall			Mean maximum temperature			Mean minimum temperature			Total sunshine hours		
	Normal	2011	2012	Normal	2011	2012	Normal	2011	2012	Normal	2011	2012
JAN	17.6	0	88	30.7	30.6	29.9	17.3	16.5	17.5	232.5	241.8	225.3
FEB	18.4	7.7	0	32.7	32.1	33.4	18.9	18.2	17.4	238	195.2	232.9
MAR	15.7	0	2.5	35.6	35.9	36.3	22	21.1	23.2	241.8	252.9	220.5
APR	22.5	26.3	44.4	37.9	36.5	37.5	25.1	24.8	19.6	252	224.9	227.0
MAY	62.2	9.6	14.5	40.9	41.7	42	27.6	27.9	28.9	241.8	255.1	206.6
JUN	102.0	52.4	133.6	37.9	38.8	38.9	26.9	27.8	27.5	153	168.9	135.8
JLY	125.8	265.2	225.3	34.2	35.7	32.9	25.1	25.9	25.2	124	265.2	103.5
AUG	187.7	244.6	156.6	33.3	32.6	33.2	24.5	25.4	24.6	124	244.6	123.4
SEP	168.9	64	213.4	33.1	34.7	32.4	24.4	25.8	24.9	141	144.5	110.4
OCT	167.7	62.8	105.4	32	34.4	31.5	22.9	24.3	23.1	170.5	204.1	177.3
NOV	50.9	0	210.6	31	32.3	30.4	20.5	20.2	19.3	174	221.1	170.1
DEC	13.6	59.9	0	30	31.3	30.6	17.4	18.8	18.3	207.7	241.9	192.8
TOTAL	**953.0**	**792.5**	**1194.3**	**34.1**	**34.7**	**34.1**	**22.7**	**23.1**	**22.5**	**2300.3**	**2660.2**	**2125.6**

From sowing to physiological maturity of Bt. cotton, data on heat use efficiency (g/GDD), HTUE (kg/HTU) and RUE (mjm^{-2}) total drymatter and kapas yield (kgha^{-1}) were observed under rainfed conditions of Krishna agro- climatic zone of Andhra pradesh .The observed agro climatic conditions and drymatter and yield were differed significantly with climatic indices studied under different sowing windows.

Among the sowing windows studied under this experiment, the Bt. cotton sown on 2nd FN July recorded more cumulative degree days and significantly utilized maximum heat use efficiency (0.388 g/GDD) and radiation use efficiency (131.55 mjm^{-2}) which was resulted in maximum drymatter accumulation (783 gm-^{2}) and kapas yield (2510 kg ha^{-1}). It was on a par with 1st FN Aug sowing. As the delay in sowing from August to October the heat use efficiency, radiation use efficiency decreased significantly and resulted less drymatter accumulation and kapas yield significantly. The helio thermal units (HTU) was non significant effect on different sowing windows (Table 2.), this may be attributed due to that the phenology of the Bt. cotton crop matches the resources of the production environment mainly temperature . These results were in conformation with Richards, 1989 and Patel *et al*, 2000.

Table 2. Heat use efficiency (g/GDD) as influenced by sowing window in BT Cotton.

Sowing window	Cumulative Growing degree days	Total dry matter (gm^{-2})	Heat use efficiency	Kapas Yield (kg ha^{-1})	Cumulative sunshine hours	HTU	HTUE (kg/HTU)	RUE (mjm^{-2})
D1-2FN of July	2019.9	783	0.388	2510	828.4	1673244	0.0015	131.55
D2-1FN of Aug	1906.5	703	0.369	1820	856.9	1633680	0.0011	90.28
D3-2FN of Aug	1812.8	583	0.322	1450	872.6	1581849	0.0009	68.27
D4-1FN of Sep	1744.8	508	0.291	600	970.2	1692805	0.0004	25.64
D5-2FN of Sep	1662.2	333	0.200	130	1027.3	1707578	0.0001	5.23
D6-1FN of Oct	1634.1	200	0.122	16	1082.6	1769023	0.0000	0.61
SEM+/-		**22.82**	**0.027**	**61.9**		**85918.2**	**0**	**2.60**
CD (p=0.05)		**68.76**	**0.081**	**186.5**		**NS**	**0**	**7.85**
CV (%)		**8.8**	**19.0**	**11.4**		**10.1**	**35.6**	**9.7**

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