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EFFECT OF PHOTO-THERMAL UNITS AND SOLAR RADIATION LEVELS ON GROWTH, YIELD COMPONENTS AND YIELD OF WINTER IRRIGATED COTTON (HYBRID VARALAKSHMI)

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Investigations were carried out to quantify the effect of photothermal units (PTU) or heat degree units and Solar Radiation levels (SR) on growth, yield components and yield of hybrid cotton Varalakshmi. A mean reduction in seed cotton yield to the tune of 9.1 q/ha was observed when the date of sowing was shifted from 15th August to 13th September. The regression co-efficients revealed that SR levels had a significant positive effect on plant height, LAI and dry matter production. Seventy seven and 74 per cent of the variations respectively in boll number and seed cotton yield were contributed by the SR levels. It is predicted that an accumulated PTU of 27,000 and SR of 40,000 Cal-cm^{-2} are required to obtain 30 q/ha of seed cotton which could be achieved when sowings are taken up in the middle of August under Coimbatore conditions.

Optimum sowing dates take edvantage of the favourable light end ambient air temperature regimes of nature that best fit for maximum production under adequate soil moisture conditions Dastur *et. al.* (1957) found that in central India and Karnataka respectively early sowings increased the yield significantly, Chamy and Balasubramanian (1976) brought out the yield advantage of early sowings. They concluded that the first fortnight of August was the optimum period for sowing winter cotton under Coimbatore conditions. Memhan and Low (1972) observed that cotton plant required certain minimum number of heat units for each phase of growth and they have predicted that it was possible to obtain 3.000 kg of seed cotton/ha with a growing degree day of 2250 if the average level of solar radiation during the crop period was 580 w.m^{-2}/ day. The present study was taken up to quantify the effect of photothermal units (heat degree units) and solar radiation levels on growth, yield components and seed cotton yield of winter irrigated cotton. (hybrid Varalakshmi).

MATERIALS AND METHODS

A field experiment was conducted at the Department of Agronomy, Tamil Nadu Agricultural University Coimbatore, during the winter seasons of 1980 and 1981 under irrigated condition with hybrid cotton CV Varalakshmi (*Gossypium hirsutum X G barbadanse*). The experimental variables consisted of three dates of sowing viz., 14th August (normal), 29th August (late) and 13th September (very late), three levels of N (90, 120 and 150 kg/ha) and two population levels (18

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Table 1 Effect of dates of sowing on growth and yield components and yield in cotton

Treatment	Seed cotton yield (q/ha)		Dry matter production (kg/ha)		Number of fruiting points /plant		Number of bolls/plant		Boll weight (g)		Boll set (%)	
Dates of sowing	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
14th Aug.	36.8	31.7	5330	6271	136.7	144.8	43.1	34.7	3.2	3.5	31.5	24.0
29th Aug.	31.1	26.1	5162	5763	120.0	115.7	34.3	25.1	3.3	3.9	28.5	21.3
13th Sept.	27.7	22.6	4515	4612	121.2	112.2	24.1	21.2	3.8	4.1	19.8	18.8
S.Ed.	0.9	1.2	127	151	4.9	5.0	3.2	1.9	0.1	0.2	1.1	0.8
C.D. (P—0.05)	2.1	2.5	292	237	10.3	10.2	6.6	4.2	0.4	0.4	2.5	1.6

and 22 thousand plants/ha). The treatments were replicated thrice in split plot design with N and population levels in main plots and the date of sowing in subplots. The soil type of the experimental site was clay loam, low in available N, medium in P and high in K The pH was 7.9 and 8.1 respectively during the first and second year of the study. The size of the experimental plot was 4.5 m X 7.2 m thrown into ridges and furrows, 90 cm apart Identical cultural practices were followed to the treatments.

Accumulated heat degree units are the arithmatic summation of daily mean air temperature above certain threshold level. The heat degree units were reckoned by subtracting a threshold constant from daily mean air temperature as suggested by Wilsie (1974). A threshold constant of 12.8° C quoted for cotton by Young *et. al*. (1980) was adopted in the present study. The values of the heat degree units were converted to photothermal units (PTU) by multiplying with day length to eliminate the variations due to day length during the crop period Photothermal unit has been reported to be more appropriate and accurate than the heat degree unit for studying plant growth by Nuttonson (1955).

The solar radiation levels (SR) were obtained from a Bellani's pyranometer installed at the Meteorological observatory, Tamil Nadu Agricultural University, Coimbatore. The values recorded from 6.30 hours to 14. 22 hours and at 18. 30 hours were summed up and multiplied with a pecific constant factor for the instrument. The accumulated PTU and SR values for any period were obtained by adding the respective individual units/day for the respective sowing dates Multiple regression equations were computed with the mean data to determine the nature and the magnitude of influence of PTU and SR levels on the growth, yield components and seed cotton yield under different dates of sowing. The interaction effect between dates of sowing and other variables was not significant. The results on population and nitrogen levels are not discussed in this paper.

RESULTS AND DISCUSSION

In both the cropping seasons, there was a progressive decrease in the yield of seed cotton for every successive fortnight's delay in sowing beyond the normal period A mean reduction in seed cotton yield by 9.1 q/ha was observed under very late sown (13th September) conditions as compared to the normal sowing (15 th August). The steep decline in seed cotton yield might be attributed to the decrease in the DMP Consequently there was a considerable reduction in yield components such as boll number/plant, fruiting points/plant and boll set per cent except boll weight under late and very late sown conditions (Table. 1).

I. *Effect of PTU and SR on growth components*

1) *Plant height*

Multiple regression equation

Y = 0.475 PTU+4 463* SR−0 451 (R^2 0.85)-1

where Y = Plant height at maturity

PTU = Photo-thermal unit

SR = Solar radiation level Cal/cm^2.

* = Significant at 5 per cent level

Eighty five per cent of the total variation in plant height was accounted for by the PTU and SR levels during the entire crop period. Out of this SR had a significant contribution of 72. 6 per cent of the total variation. There was a progressive reduction in plant height as the sowings were delayed from the normal date. As observed from the regression coefficient, the reduction in plant height under late and very late sown crops was brought about by the decreased SR levels during the monsoonic months of October and November. The decrease in SR levels might have reduced the photo-synthetic efficiency of plants resulting in reduced plant height. Dustur (1959), observed that cloudy weather impaired the production of carbohydrates in leaves resulting in reduced plant growth. The PTU exhibited a nonsignificant effect on plant height. Since the PTU is the product of mean air temperature and day length, the variations in the mean air temperatures prevailed might have been too narrow to induce any significant change in the plant height especially with reduced SR levels Hearn (1976) observed a positive relationship between air temperature and plant growth only under adequate SR levels.

II) *Leaf area index* (LAI)

Multiple regression equations

Y = 0.004 PTU+0.041* SR−3083 (0.651)-2

where, Y = LAI

PTU = Photo-thermal units

SR = Solar radiation Cal/cm^2

* = Significant at 5 per cent level

The effect of PTU and SR levels with LAI exhibited a similar trend as observed with plant height. Low SR levels prevailed during the vegetative phase of the late and very late sown crops in the months of Octoper and November might have limited the growth and development of leves in the late and very late sown crops

III) *Dry Matter Production* (DMP)

Multiple regression equation:

Y = 9.514 PTU + 5 831* SR — 376.83 (R^2 0 665)—3

where, Y = DMP at harvest
PTU = Photo-thermal units
SR = Solar radiation (Cal/cm²)
= Significant at 5 per cent level

The DMP at harvest was appreciably influenced by SR levels as revealed by the significant regression coefficient. Greater accumulation of SR might have enhanced DMP in the normal sown crops by increasing the photosynthetic efficiency of the plants. Similar results have been reported by Gibban *et al.,* (1970) that DMP was promoted with increased SR levels in cotton.

II. *Effect of PTU and SR on yield components and yield*

I) *Yield components*

a) Boll Number:

The accumulated PTU and SR values from the date of flowering to maturity for each sowing were used to compute the regression equation (Fig. 1).

Y = 0.59 PTU + 4.24** .SR — 48.99 (R^2 0.85)-4
Y = Boll Number / plant
PTU = Photo-thermal unit
SR = Solar radiation Cal/cm²
** = Significant at 1 per cent level

Out of 85 per cent of the total variability in boll number indicated by R^2 value. 76.9 and 8.1 per cent were respectively contributed by SR and PTU At the optimum SR levels there would have been a concurrent production of sympodial branches with new flower buds. The gradual reduction in the SR values with the late

Table 2 *Accumulated Photothermal units and solar radiation*

Dates of sowing	Sowing to flowering	Sowing to open boll	Sowing to Harvest	Flowering to open boll	Flowering to Harvest	Open boll to harvest
			Accumulated Photothermal units			
1980						
14th Aug.	12,094	19,261	29,750	8,193	17,656	9,463
29th Aug.	11,118	17,123	27,607	7,009	16,419	9,410
13th Sept.	10,497	16 010	26,030	6,638	15,533	8,895
1981						
14th Aug.	11,494	18,256	27,824	7,618	16,330	8,872
29th Aug.	10,765	15,790	25,163	6,931	14,398	8,467
13th Sept.	9,397	14,736	24,343	6,092	14,945	8,853
			Accnmulated Solar radiater Col. cm²			
1980						
14th Aug.	14,486	23,690	43,110	12,511	28,264	15,753
29th Aug.	13,545	22,530	40,106	10,485	26,561	16,075
13th Sept.	13,387	21,821	38,780	9,930	25,393	15,463
1981						
14th Aug.	13,635	22,831	41,697	10,699	28,062	17,364
29th Aug.	11,574	19,742	38,392	9,661	25,177	17,157
13th Sept.	9,823	18,563	37,837	10,222	26,736	17,792

and very late sown crops might have limited the production of new sympodial branches as well as the photosynthetic activity of the functioning leaves. This might have also increased the shedding of the floral parts as indicated by low boll set per cent due to nutrional imbalances. Similar observations of increased shedding of floral organs under reduced SR levels have been made by Guinn (1974). The accumulated PTU had no significant effect on boll number. Because the difference in air temperature (component of PTU) between the sowing dates might have been insufficient to produce any distinct effect on boll number. Ehlig and Lemert (1973) observed a non-significant relationship between boll retention and air temperature.

b) *Seed cotton yield*

The accumulated PTU and SR values for the total crop period were taken to study the regression of seed cotton yield.

Multiple regression equation

Y = 0.045 PTU + 2.81* SR — 95500.00

(R^2 0.848)-5

where Y = Seed cotton yield

PTU = Photothermal units

SR = Solar radiation (Cal/cm^2)

* = Significant at 5 per cent level

Eighty five per cent of the total variation in seed cotton yield was influenced by the SR levels. Out of this, 74 per cent was contributed by the SR levels as indicated by the significant regression coefficient. The progressive decline in seed cotton yield for the successive delay in sowings could be attributed to the reduction in plant height, LAI, and DMP. Consequently, the yield components like boll number, total number of fruiting points / plant and boll set were reduced. This was because of limited availabity of SR for the crops sown during the late and very late periods.

It is predicted that to produce about 30 q/ha of seed cotton, an accumulated PTU of 27,000 (.2500 heat degree units)and SR of 40,000 Cal/ cm^2 would be required with hybrid cotton. This is possible only when the crop is sown during the first fortnhigt of August in Coimbatore region.

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EFFECT OF DIFFERENT MOISTURE CONSERVATTION SYSTEMS ON THE YIELD OF SORGHUM (CSH 6) IN RAINFED VERTISOLS

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An experiment was condzcted at Cotton and Millets Experiment Station, Kovilpatti for three years to study the effect of different moisture conservation systems on the yield of sorghum. The result indicated that compartmental bunding was found to register significantly higher sorghum grain yield/ha over flat bed system and fonnd to be economically viable.

Drylands occupy about 75 per cent of the total arable land in India and contribute to 42 per cent of nations food production, which is unstable due to erratic rainfall. The main constraint limiting the crop production in dryland is moisture At the International Crop Research institute for semi-Arid Tropics, Hyderabad the technique of forming broad beds and furrows was developed for conserving moisture as well as to drain out the excees water during the period of heavy rainfall and this technology is found to be the appropriate land management technique on vertisols (Anonymous, 1976). The results of the experiment conducted at Coimbatore revealed that sorghum raised in ridges and furrows, and broad beds and furrows recorded 7.8 per cent and 5.2 per cent increased

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