Madras Agric. J., 86(1-3): 10 - 13 January - March 1999
https://doi.org/10.29321/MAJ.10.A00536

PHYSIOLOGICAL ANALYSIS OF HIRSUTUM COTTON FOR HIGHER PRODUCTIVITY UNDER RAINFED CONDITIONS

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ABSTRACT

Twelve cotton (*G. hirsutum* L.) genotypes were evaluated in terms of growth and yield attributing characters for higher productivity under rainfed conditions. Among the genotypes, DS-44 and IC-376 were high yielders. The higher productivity of these high yielding genotypes was largely influenced and controlled by low LAI, low LAD and high SLW (during peak growth period), higher boll number and increased boll weight.

KEY WORDS: Cotton ; Productivity ; Growth parameters, Yield components

Growth and yield analysis is one of the important approaches that would help in assessing the productivity of the genotypes under specific production system (Watson, 1952). Accumulation of dry matter during crop growth and its partitioning are very vital for achieving higher seed cotton yield in Hirsutum cotton and the seed cotton yield has correlation with leaf area and other growth parameters (Bharadwaj and Kalindi, 1986). Since information on analysis of growth and yield attributes for higher productivity is scanty in rainfed Hirsutum cotton, an attempt was made to assess the growth pattern and yielding potential of Hirsutum cotton under rainfed condition.

MATERIALS AND METHODS

Ten genotypes of Hirsutum cotton viz., IC-376, DRC-19, CPD-89-5, DS-27, MCU-5, NA-1269, AlleppoxRex, CPD-4-4-5 and DRC-264 along with two local checks Abadhita and Sharada were grown in medium black soil during 1990-91 and 1991-92 at Agricultural Research Station, Dharwad. Both the field experiments were laid out in randomized block design with three replications with a spacing of 90 cm between rows and 20 cm between plants. The plot size was 6.0 m x 2.7 m for both the years. The recommended doses of fertilisers were applied. Plants were sampled at 60, 90 and 120 days after sowing (DAS) and partitioned into different plant parts viz., stem , leaves and reproductive parts. The samples were first air dried and then oven dried at 60°C till they attained constant weights. From the observation, the total dry matter per plant and its distribution into above plant parts were worked out. These data were taken as the base for computing growth parameters.

Leaf area (LA) was computed by linear measurements using the formula A = LxBx0.707 (where, A = Area of the leaf in dm^2, B = maximum width of opened leaf and L=length of leaf). Three plants at random were used for recording LA and dry matter production recorded at 60, 90, 120. DAS and at harvest. From the above observations, LAI, LAD, NAR and SLW were determined using the formula given by Ashley *et al.* (1963), Power *et al* (1967), Radford (1967) and Watson (1952) respectively. The results obtained from the field experiments conducted during 1990-91 and 1991-92 on these growth parameters, yield and its attributes in 12 genotypes were subjected to pooled analysis as per the method suggested by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

The results on seed cotton yield (q/ha) (Table 1) indicated significant differences among genotypes. Alleppox Rex, DS-44, DRC-264, IC-376, NA-1269, DRC-19 and CPD-4-4-5 recorded significantly higher yield over both the checks. The major factor attributed for higher yield in AlleppoxRex (19.01) and DS-44 (18.78) was due to significantly higher number of good bolls per plant, while it was mean boll weight associated with higher yield in NA-1269, DRC-19, DRC-264, and

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Table 1. Genotypic differences in yield and yield attributes of hirsutum cotton

Genotypes	Seed cotton yield (q/ha)	Mean boll weight (g)	No.of bolls per plant
DS-44	18.78	3.81	8.69
IC-376	17.46	4.51	6.95
DRC-19	16.97	5.01	6.05
CPD-4-4-5	16.20	4.09	7.08
CPD-89-5	15.61	5.02	5.63
DS-27	12.76	4.87	4.72
MCU-5	11.77	4.06	5.22
Alleppox Rex	19.01	4.13	8.48
NA-1269	17.25	5.02	6.16
DRC-264	17.99	4.87	6.65
Sharada	13.15	4.23	5.63
Abadhita	11.11	4.02	5.04
Mean	15.67	4.47	6.35
S.Em.	0.69	0.22	0.27
C.D. at 5%	1.98	0.62	0.78

IC-376. It is also evident from the correlation studies (Table 2) that yield possessed significant positive association with boll number (r=0.832**) and HI (r=0.460**). Similar findings were reported by Channaveeraiah (1983), Bhardwaj and Kalindi (1986) and Singh (1988).

Table 2. Correlation analysis of seed cotton yield and its components

Characters	Mean boll weight	No.of good bolls	No.of fruiting points	Harvest index
Seed Cotton yield	0.195	0.832**	-0.089	0.460**
Mean boll weight	-	-0.068	0.156	-0.115
No. of good bolls		-	-0.094	0.392**
No. of fruiting points			-	-0.006
Harvest index				-

* Significant at 5% probability level

** Significant at 1% probability level

Leaf area index (LAI) : Although the dry matter accumulation is a product of net photosynthesis reflected in terms of growth components or leaf area, for rainfed cotton higher NAR in association with lower LAI for higher dry matter production is

Table 3. Genotypic differences in leaf area index and leaf are duration at different growth stages in hirsutum cotton

Genotypes	Leaf area index			Leaf area duration	
	60 DAS	90 DAS	120 DAS	60-90 DAS	90-120 DAS
DS-44	0.557	0.697	0.935	18.87	24.50
IC-376	0.493	0.647	0.580	17.17	18.48
DRC-19	0.547	1.013	0.722	23.45	26.06
CPD-4-4-5	0.533	0.990	0.629	22.90	24.31
CPD-89-5	0.533	0.907	0.853	21.65	26.41
DS-27	0.777	1.473	1.005	33.80	37.19
MCU-5	0.710	1.037	0.704	27.95	26.13
Alleppox Rex	0.563	0.980	1.905	23.20	43.29
NA-1269	0.713	1.310	1.863	30.40	47.62
DRC-264	0.647	1.373	2.836	30.37	63.59
Sharada	0.497	1.290	1.094	26.82	35.78
Abadhita	0.497	1.250	1.480	26.30	41.00
Mean	0.598	1.081	1.219	25.24	34.53
S.Em.	0.040	0.058	0.068	1.27	1.20
C.D. at 5%	0.114	0.167	0.195	3.64	3.43

desirable. Significant differences in LAI among the genotypes at different growth stages were observed in DS-27 (Table).

The low leaf area types DS-44, IC-376, DRC-19 and CPD-4-4-5 recorded low LAI as compared to high leaf area types DRC-264 and NA-1269 at all the growth stages, irrespective of their yielding ability. It is also evident from the correlation data (Table 5) that LAI was negatively associated with yield (r=-0.312** at 60 DAS) and at 90 DAS (r=-0.092). This clearly suggests that low LAI is a desirable character under rainfed condition for getting higher seed cotton yield (Nagabhushana, 1984).

Leaf area duration (LAD) : It is a useful growth index, used to measure the efficiency of photosynthetic system over growth period. The genotypic differences were significant at all the growth stages and the highest LAD was recorded during 90-120 DAS (34.53). During both the growth stages high yielding genotypes IC-376 and DS-44 maintained low LAD as compared to both the checks. Low LAD in IC-376 and DS-44 at both the growth stages revealed that high yielding genotypes were associated with low LAD under rainfed conditions. Watson (1956) also reported that variation in LAI and LAD contributed more to NAR and yield.

Net Assimilation rate (NAR) : Results on NAR (Table 4) revealed significant difference in NAR (at early growth stages only). During flower initiation to peak flowering period, only DS-44 recorded higher NAR which showed that NAR in DS-44 was closely associated with vegetative growth upto peak flowering and at later stages, it was also closely associated with seed cotton yield in DS-44, and IC-376 which resulted in optimum biomass and yield. Correlation studies (Table 5) also revealed positive association of NAR with yield (r = 0.282* between 60-90 DAS). Similar results were reported by Muramoto *et al.*, (1965).

Specific leaf weight (SLW) is an integral of leaf structure and is correlated with photosynthetic rate (Landiver *et al.*, 1983). SLW differed

Table 4. Genotypic differences in net assimilation rate and specific leaf weight at different growth stages in Hirsutum cotton

Genotypes	Net assimilation rate ($g/dm^2/day$)		Specific leaf weight (g/dm^2)		
	60-90 DAS	90-120 DAS	60 DAS	90 DAS	120 DAS
DS-44	0.067	0.054	0.816	1.150	0.747
IC-376	0.047	0.054	0.714	1.010	0.492
DRC-19	0.022	0.025	0.624	0.510	0.714
CPD-4-4-5	0.045	0.027	0.643	0.848	0.656
CPD-89-5	0.037	0.092	0.907	0.622	0.751
DS-27	0.043	0.046	0.602	0.621	0.649
MCU-5	0.040	0.033	0.750	0.600	0.347
Alleppox Rex	0.040	0.033	0.750	0.600	0.347
NA-1269	0.048	0.008	0.678	0.663	0.335
DRC-264	0.040	0.030	0.520	0.524	0.417
Sharada	0.050	0.035	0.774	0.515	0.848
Abadhuta	0.048	0.038	0.785	0.534	0.517
Mean	0.044	0.043	0.698	0.687	0.649
S.Em	0.0041	0.035	0.042	0.056	0.035
C.D. at 5%	0.0116	NS	0.121	0.159	0.101

Table 5. Correlation of yield with growth parameters at various growth stages

Characters	Seed cotton yield	
	60 DAS	90 DAS
LAI	-0.312**	-0.092
SLW	0.158	0.289*
LAR	0.317**	0.063
TDM	-0.430**	-0.182
60-90 DAS		
90-120 DAS		
AGR	0.185	0.040
CGR	0.176	0.125
RGR	0.268*	0.139
NAR	0.282*	-0.021
LAD	-0.214	0.189

* Significant at 5% probability level

** Significant at 1% probability level

significantly among the genotypes at all the growth stages. The higher SLW was observed at peak flowering (90 DAS) in low leaf area types viz., DS-44 and IC-376 as compared to both the checks. This might be due to higher photosynthetic rate during peak growth period which resulted in higher seed cotton yield in these two genotypes, as observed with the significant positive correlation between SLW and seed cotton yield (r=0.289*) during peak flowering stage (Table 5). Nagabhushana (1984) also reported that high yielding cotton genotypes were associated with higher SLW during active process of yield formation. Landiver *et al.* (1983) have also observed that increse in lint yield due to increased photosynthetic rate to the extent of 30 per cent through thicker leaves (higher SLW).

From the above results, it may be concluded that higher seed cotton yield in genotypes such as DS-44 and CI-376 under rainfed condition was due to higher boll number and increased boll weight which were highly dependent and associated with low LAI, low LAD and higher SLW during peak growth period.

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(Received : Jan 1998 Revised : Sep 1998)