

Growth and Development Response of *Gossypium hirsutum* L. to CO₂ Enrichment under two Different Temperature Regimes

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Objectives

The increase of temperature and CO₂ concentration will affect the growth and development of plants. The objective of this study was to evaluate the and temperature effects on cotton growth and development in controlled environment chambers.

Materials and Methods

Environment : Six Conviron growth chambers (model CG72), with a floor space of 8.64 m² and a height of 2.20 m, were used in this experiment. Treatments were all combinations of two day/night temperatures (20/15 and 30/25°C) and three CO₂ concentrations (400, 600 and 800ppm). Crop sampling for growth analysis was conducted at seven harvest dates. The experimental unit was a plastic pot with one plant. The experimental design was completely randomized, with four replicates (plastic pots) per treatment. The light intensity of growth chambers was 753.7 moles m⁻² s⁻¹, measured at the top of the pots at planting and at the top of canopy during the course of the experiment.

Measurements : Plant height, number of leaves, number of squares and number of bolls were measured weekly. Leaf area (cm² plant⁻¹), leaf dry mass (g plant⁻¹), root dry mass (g plant⁻¹), petiole dry mass (g plant⁻¹), square dry mass (g plant⁻¹), boll dry mass (g plant⁻¹) and total above dry mass per plant (g plant⁻¹) were determined at each sampling.

$$\hat{Y}_{ijk} = \left[\cos \left[(X_{ij} + 2) * \frac{\pi}{2} \right] + 1 \right]^{\beta}$$

Statistical analysis : For total above ground biomass, the model as shown in equation 1 proposed by Dourado-Neto (personal communication, 2002) described its temporal variation:

where \hat{Y}_{ijk} represents the predicted ratio between total aboveground biomass (g plant⁻¹) and maximum total aboveground biomass for the CO₂ concentration i (i = 400, 600 and 800ppm), temperature regime j (j = 20/15 and 30/25C), and replication k (k =1, 2, 3, 4); X_{ij} represents the ratio between degree days after emergence (C. day) and maximum degree days after emergence for the CO₂ concentration i and temperature regime j; and β represents the biomass growth rate (slope of the linear regression model) (g C. day plant⁻¹).

Results and Discussions

1. Among 17 growth characteristics, most characteristics showed significant difference except number of squares, square dry weight and leaf mass ratio between CO₂ concentration and specific leaf area and leaf area ratio between temperature (Table 1).

2. According to the fitted model, plant height, number of leaves and number of squares at high temperature were always greater than those of at low temperature, while the difference between CO₂ concentration was not significant (Fig. 1).

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Table 1. Response of agronomic characteristics to CO₂ enrichment under two temperature regimes in *Gossyium hirsutum* L

Temp	CO ₂ concentration	Plant height (cm)	No of leaves	No of squares	No of bolls	Leaf area (cm ²)	Stem length (cm)	Root length (cm)	Agronomic characteristics											
									Leaf dry weight (g)	Stem dry weight (g)	Root dry weight (g)	Petiole dry weight (g)	Square dry weight (g)	Boll dry weight (g)	Specific leaf area	Leaf area ratio	Leaf mass ratio	Root/shoot ratio		
25/15°C (Day/night)	400ppm	35.9	19.5	15.3	0.3	2551.9	33.8	30.8	15.6	11.2	6.1	3.1	2.4	0.2	164.9	81.9	0.5	0.2		
	600ppm	44.8	18.5	17.3	0.5	2630.8	42.3	47.5	25.9	17.2	8.7	3.7	2.1	0.3	105.5	54.4	0.5	0.2		
	800ppm	46.8	20.0	24.8	4.0	2772.9	43.5	32.8	32.7	22.5	24.7	4.9	5.0	3.9	84.8	40.2	0.5	0.4		
35/25°C (Day/night)	400ppm	87.4	31.8	104.3	2.8	8411.4	85.6	37.8	55.3	70.8	54.2	8.9	9.5	0.7	152.3	57.9	0.4	0.4		
	600ppm	88.4	29.5	103.5	12.3	8305.5	86.4	45.6	71.7	75.9	45.7	9.9	8.0	21.9	115.6	44.2	0.4	0.3		
	800ppm	86.1	29.5	100.0	12.5	8146.2	84.3	43.1	89.2	82.2	89.8	10.5	7.3	15.1	91.3	39.8	0.4	0.4		
LSD(0.05%) bet																				
CO ₂ concentration		3.17	0.89	NS	4.86	NS	3.24	6.03	4.72	5.94	5.17	1.02	NS	7.43	28.86	17.94	NS	0.05		
LSD(0.05%)bet		2.60	0.73	7.01	3.97	670.23	2.64	4.93	3.86	4.85	4.22	0.83	1.33	6.07	NS	NS	0.03	0.04		
temperatures																				

