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Response of Sweetpotatoes to Continuous Light

C.K. Bonsi, P.A. Loretan, W.A. Hill, and D.G. Mortley
G.W. Carver Agricultural Experiment Station, Tuskegee University, Tuskegee, AL 36088

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Sweetpotato [*Ipomoea batatas* (L.) Lam.] is one of the four root crops with subsurface edible parts that have been selected as potentially important crops for the Controlled Ecological Life Support Systems (CELSS). Among other environmental variables in CELSS, the amount and duration of light available for plant growth is critical, since it will help determine the range and maximum response of various crop species.

No published data are available on the response of sweetpotatoes to continuous light. Studies of continuous light effects on five potato *(Solanum tuberosum* L.) cultivars showed differences in sensitivity among cultivars (Wheeler and Tibbitts, 1986b). Wheeler and Tibbitts (1986a) showed varietal differences in response of potatoes to photoperiod. When Cao and Tibbitts (1991) subjected four potato cultivars to continuous light, it significantly promoted tuber initiation but slowed tuber enlargement in all cultivars as compared with 6- or 12-h photoperiods, respectively.

Long days promote vine growth, and short days induce root enlargement and flowering of sweetpotatoes (McDavid and Alamu, 1980). Yield of storage roots under 11.5- to 12.5-h days was higher than under shorter (8 h) or longer (18 h) days when vine cuttings were used for propagation, but daylength had no effect on yield when rooted leaves were the propagules. Biswas et al. (1989) showed that 16 h of light stimulated vine length and weight while storage root count and yield and total biomass production were promoted by 9 h of light.

If sweetpotatoes are to be used in CELSS for space missions (Hill et al., 1989; Tibbitts and Alford, 1982), they will have to be grown under controlled-environment conditions. This study examines the growth and yield responses of three sweetpotato cultivars grown under continuous light compared to a 12-h photoperiod.

Vine cuttings (15 cm long) of ‘TI-155’, ‘GA 120’, and ‘Georgia Jet’, were transplanted to 4-liter pots filled with a mixture of 1 sterilized sand : 1 soil (v/v) (Norfolk sandy loam; Typic Paleudult). Four controlled-environment reach-in chambers were used. Plants were exposed to continuous light (24 h) in two of the chambers and 12 h light/ 12 h dark in the other two. Irradiance at canopy level ranged between 360 and 400 $\mu mol \cdot m^{-2} \cdot s^{-1}$. The light source was a mixture of cool-white fluorescent and incandescent lights. The relative humidity in each chamber was maintained at 70% ± 5%. A cycle of 28C (light) and 22C (dark) was maintained in the 12-h light treatment. Under continuous light, the temperature was maintained at 28 and 22C for 12 h each. Ten plants of each cultivar were positioned in each chamber at a spacing of 30 cm between plants. Plants were checked daily, watered as needed, and fertilized with (ppm) 683N-300P-567K of Peter’s soluble fertilizer (20N-20P-20K) (W.R. Grace, Fogelsville, Pa.) twice weekly. Plants were harvested 112 days after planting. Harvested foliage and fibrous roots were oven-dried for 72 h at 70C for dry weights.

To minimize potential chamber effects, the experiments were repeated in the same environmental chambers but with the light treatments interchanged. The results of the two experiments were pooled for data analysis.

Plants of all three cultivars exposed to continuous light produced more storage roots and higher fresh weights, fibrous root dry weights, and foliage dry weights than those kept under the 12-h photoperiod (Table 1). We observed that plants under the 12-h photoperiod had large, well-expanded leaves, while under continuous light, the leaves were smaller but more numerous. Sweetpotatoes are normally grown under a daylength > 12 h. This study did not consider photoperiods other than 12 and 24 h light. The results indicate that continuous light did not inhibit successful storage root initiation and enlargement in the cultivars used.

Plants under continuous light received twice the quantity of photosynthetic photons each day as plants under 12-h light duration, and this doubling of photons may have accounted for the increased yields, irrespective of daylength effects.

Table 1. Harvest data for ‘GA Jet’, ‘TI-155’, and ‘GA 120’ sweetpotatoes grown under continuous light and 12-h photoperiod for 112 days. Values are means of 10 replications.

Light duration (h)	Storage roots No.	Storage roots Fresh wt (g/plant)	Fibrous roots dry wt (g/plant)	Foliage dry wt (g/plant)
		GA Jet		
12	1.0	11.0	4.3	25.8
24	5.3	202.8	7.5	31.6
LSD 5%	2.3	86.0	1.7	4.8
		TI-155		
12	0.3	7.5	2.6	14.2
24	2.6	132.6	7.0	24.6
LSD 5%	1.3	97.0	1.7	4.3
		GA-120		
12	0.3	4.0	3.0	17.0
24	2.6	116.0	10.3	47.3
LSD 5%	1.1	56.5	2.9	7.9

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