PAULOWNIA SEEDLINGS RESPOND TO INCREASED DAYLENGTH[1]

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Paulownia seedlings grown under four photoperiods were evaluated after a growing period of 97 days. Height growth and total dry weight production were both significantly increased in the 16- and 24-hour photoperiods.

Paulownia (Paulownia tomentosa (Thunb.) Steud.), a native of China, is a little-known species in the United States. Recently, however, there has been increased interest in this species for surface mine reclamation (*1*).[2] Paulownia seems to be especially well adapted to harsh micro-climates of surface mines; it grows very rapidly and appears to be drought resistant. In Kentucky and surrounding States, wood of paulownia is actively sought by Japanese buyers and has brought prices comparable to black walnut (*2*). This increased interest in paulownia has resulted in several attempts to direct seed it on surface mines, but little success has been achieved. The high light requirements and the extremely small size of paulownia seed (approximately 6,000 per gram) may be the limiting factors. Planting paulownia seedlings is preferred; but, because of their succulent nature, seedlings are usually produced and outplanted as container stock rather than bareroot seedlings. Daylength is an important factor in the production of vigorous container plants (*5*). Our study compares the effects four photoperiods, 8,12,16, and 24 hours, had on the early growth of container-grown paulownia seedlings over a period of 97 days.

Methods

Seeds used in this study were stratified in a 1:1 mixture of peat moss and sand at 4° C for 2 years. Following cold storage, seeds were placed on a 1:1 potting soil-sand mix and mulched with cheesecloth. They were then placed under continuous light until germination occurred. Germination percentages were high, indicating paulownia seeds can survive long periods of storage

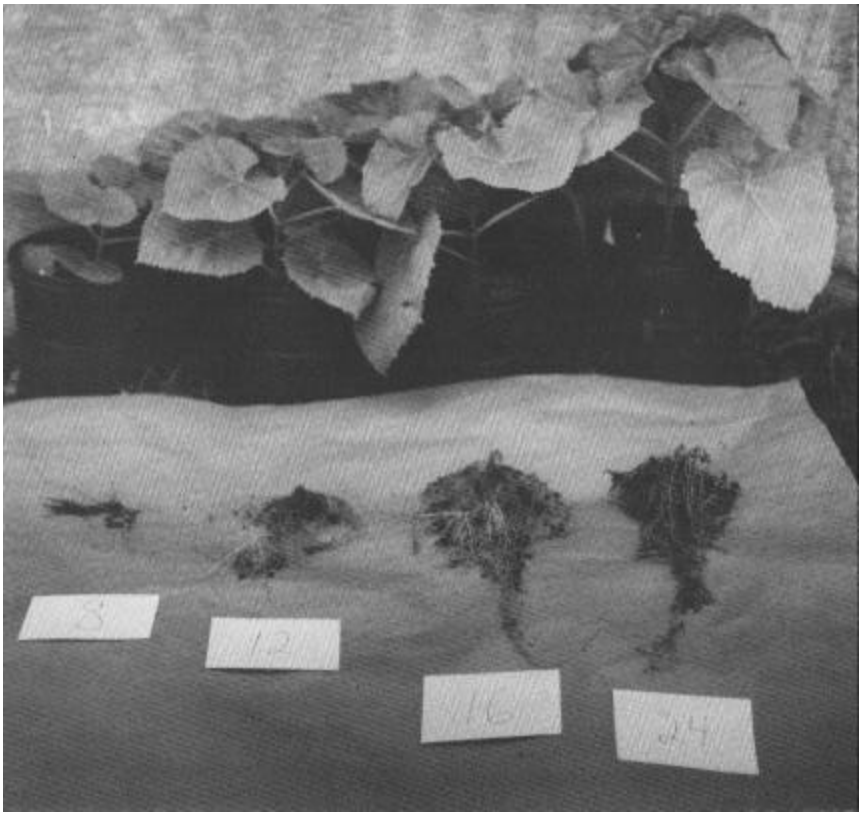

Figure 1.—*Paulownia seedlings grown under four photoperiods—8, 12, 16, and 24 hours-after 97 days.*

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[2]Italic numbers in parentheses refer to Literature Cited at the end of each article.

with little loss of viability (*3*). Thirty days after germination, 3- to 4-centimeter seedlings were transplanted into 8-quart plastic pots filled with an equal mixture of potting soil, sand, and peat moss. Seventy-five seedlings were randomly assigned to each of the four treatments. Treatments were four photoperiods-8, 12, 16, and 24 hours—replicated three times in 12 light chambers. Each chamber was 1.2- by 1.2-meters in size with an artificial light source 71 centimeters above the chamber floor. The light source consisted of eight fluorescent lights: four 40-watt plant growth lamps alternated with four 40-watt cool white lamps. Light intensity averaged 550 foot-candies (13401 einsteins/m^2/sec) at the top of each pot and temperature averaged 23° C (±2° C). Seedlings were kept watered and were fertilized after transplanting with a 6-gram 14-4-6 agriform container tablet. Beginning 1 month after transplanting, two seedlings were randomly selected and harvested from each chamber for a total of 24 trees. Height, root collar diameter, length of longest root, and ovendry weight (at 65° C) were determined for each seedling. Harvests continued every week for 5 additional weeks.

Results and Discussion

Results indicate that early growth of paulownia is influenced by photoperiod (table 1). Increasing the photoperiod from 8 to either 16 or 24 hours increased height growth by 100 percent. Height growth in the 12-hour treatment also increased, but did not differ significantly from the 8-hour treatment. Heights under photoperiods of 8, 12, 16, and 24 hours were 13.1,17.8, 27.3, and 29.2 centimeters, respectively. Previous studies have also shown that photoperiod affects the growth of paulownia seedlings (*4, 6*). Sanderson (*6*) found that paulownia seedlings grown under continuous light averaged 27.2 centimeters in height after 101 days compared with 29.2 centimeters for our 24-hour seedlings. Other corresponding photoperiods were equally comparable. Downs and Borthwick (*4*) also concluded that height growth of paulownia was affected by extending the photoperiod.

The greatest treatment differences were shown in total dry weight production (table 1). The mean weight of 1.65 grams for seedlings in the 8-hour treatment was significantly less than that of any of the other photoperiods. The 16- and 24-hour treatments did not differ significantly, and more than doubled the average weight for seedlings in the 12-hour treatment.

Root-to-shoot ratio (R/S) indicates the relative proportion of growth allocated to roots versus shoots for the seedlings in each photoperiod. In this study, shoots were developing at nearly three times the rate of the roots for seedlings in the 12-,16-, and 24-hour photoperiods. The 0.18 R/S ratio for seedlings in the 8-hour

Table 1.—*Height, diameter, root length, total dry weight, and R/S ratio for paulownia seedlings grown under four photoperiods after 97 days*[1]

Photoperiod (hrs.)	Height (cm)	Diameter (cm)	Root length (cm)	Total dry weight (gm)	R/S ratio
8	13.1b[2]	0.48	16.0	1.66c	0.18[3]
12	17.8b	0.67	34.7	7.27b	0.32
16	27.3a	0.93	31.1	16.92a	0.39
24	29.2a	0.90	43.9	18.66a	0.33

[1] n=6.

[2] Means followed by different letters in the same column are significantly different at the 0.05 level of probability by analysis of variance and Duncan's Multiple Range Test. Means without letters are not significantly different.

[3] R/S ratio based on ovendry weight of roots over ovendry weight of stem and leaves.

treatment was much lower. It indicates that relative growth of the shoot is approximately five times that of the root. The shorter photoperiod therefore decreased root development relative to shoot development as well as significantly reduced total dry weight production.

Although root collar diameter and root length did not significantly differ under the different photoperiods after 97 days, there was a trend for greater diameter and root growth with longer photoperiods.

Conclusions

Results indicate that the growth of paulownia seedlings is affected by changes in the photoperiod. By increasing the photoperiod, height growth and total dry matter production were both significantly increased. The distribution of dry matter (R/S ratio) was altered by increasing the photoperiod; the ratio was larger in the longer photoperiods. In contrast to earlier studies (*4*), we found paulownia seedlings subjected to extended photoperiods to be still growing after 97 days.

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