Short Day Nursery Treatment Promotes Photosynthesis in Interior Spruce Seedlings: Summary of Poster [1]

C.D.B. Hawkins, R.Y.N. Eng and M.J. Krasowski [2]

Hawkins, C.D.B.; Eng, R.Y.N.; Krasowski, M.J. 1994. Short Day Nursery Treatment Promotes Photosynthesis in Interior Spruce Seedlings: Summary of Poster. Proceedings, Forest and Conservation Nursery Associations. 1994, July 11-14; Williamsburg, VA. Gen. Tech. Rep. RM-GTR-257. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 268-270. Available at: http://www.fcnanet.org/proceedings/1994/hawkins.pdf

---

The ideal nursery cultural treatment would promote seedling photosynthesis (Ps) and decrease respiration (Rd). Realistically, a treatment promoting Ps and not affecting Rd would be most acceptable. The next best scenario would be for a cultural treatment that did not affect either process.

Blackout is a very powerful nursery cultural tool for controlling the height of interior spruce *(Picea glauca*, *P. engelmannii* and their naturally occurring hybrids) in central British Columbia (Hawkins and Draper 1991, Hawkins and Hooge 1988). Hawkins and Draper (1991) suggested that blackout treatments may promote Ps after exposure to shortened days ends. They used changes in plant weight as the basis for their hypothesis. Others (Hawkins and Hooge 1988, Odlum and Colombo 1988, Krasowski et al. 1993) have suggested blackout could also have negative impacts on seedling morphology, physiology and phenology.

In 1993, three photoperiods, ambient about 19h (control), 14h and 11h, were applied for 17 days at Red Rock Research Station to seedlings of registered BC Forest Service seedlots 6866 and 8779. Treatment commenced when mean seedlot height was 10 ± 1 cm . At the end of blackout treatment, all seedlings were returned to ambient photoperiod. At this time, Ps and Rd assessments started. Assessments were done 4 times over 8 weeks. Ps and Rd were measured with a LiCor 6200 (Lincoln, NB) infrared gas analyzer (IRGA) with a different sample of 36 seedlings for each date. The measurement frequency is approximately one seedling every 6 minutes.

Control Ps was significantly lower on all test dates (Table 1). Photoperiod had no affect on Rd for the dates where Rd is not shown (Table 1). Seedlot had no affect on Rd but 8779 had greater Ps rates on 30 June and 23 Aug. There was no interaction between seedlot and photoperiod demonstrating the applicability of the results. Increased Ps rates for the short day treatments is further supported by the increased fertigation required by the 14h and 11h treatment seedlings over the eight weeks of observation.

---

[1] Funded by Silviculture and Research Branches of the British Columbia Forest Service.

[2] Red Rock Research Station, RR #7, RMD #6, Prince George, BC, Canada V2N 2J5, Ph: 604-963-9651
FAX: 604-963-3436

Table 1. Photosynthesis (Ps) and dark shoot respiration (Rd) of spruce seedlings subjected to shortened days (blackout). Seedlots are pooled and only significant (ANOVA) parameters are presented. On a date, means followed by the same letter are not different.

Photoperiod	30 Jun	6 Jul		26 Jul	23 Aug	
	Ps	Ps	Rd	Ps	Ps	Rd
11 h	3.83a	7.39a	2.57a	6.10a	5.84a	1.79a
14 h	3.63a	6.70b	2.91a	6.15a	5.29b	1.74a
19 h	2.77b	5.52c	3.36b	3.16b	5.28b	2.02b

Short day treated seedlings were not as tall as ambient photoperiod treated stock. Root collar diameter and root mass were similar among photoperiod treatments at lifting in late October. Short day treated seedlings also developed terminal buds earlier, became glaucous sooner, developed increased frost resistance and were ready for lifting and storage earlier than their ambient treated counterparts. It is hypothesized the increased net photosynthesis provided the energy required to accelerate the observed developmental and physiological changes for these seedlots.

In 1994, one seedlot (30664) was exposed to either a 14h or a 19h (control) photoperiod. Treatment commenced when mean seedlot height was 11 ± 1 cm. At the end of blackout treatment, all seedlings were returned to ambient photoperiod. At this time, Ps assessments were started using an EARS plant productivity fluorometer (PPM) (Delft, Netherlands). Assessments were done periodically in the nursery and after planting on the same sample populations of seedlings (c.f. IRGA). The PPM measured quantum yield (QY) of each seedling. The measurement frequency is approximately one seedling every 20s. Figure one shows how quantum yield for two populations (efficient and less efficient) is related to Ps. Generally the greater the quantum yield the greater the rate of Ps.

At the end of blackout, controll seedlings had a greater quantum yield (24 Jun). However in a very short time, blackout treated stock had a greater quantum yield and this held until the end of the nursery phase (20 Jul). 30 minutes after planting there was no difference between treatments (Jul 20). However by 22 July the 14h treatment had the greatest quantum yield and this was the case on July 28. Again, short day nursery treatment appears to promote Ps.

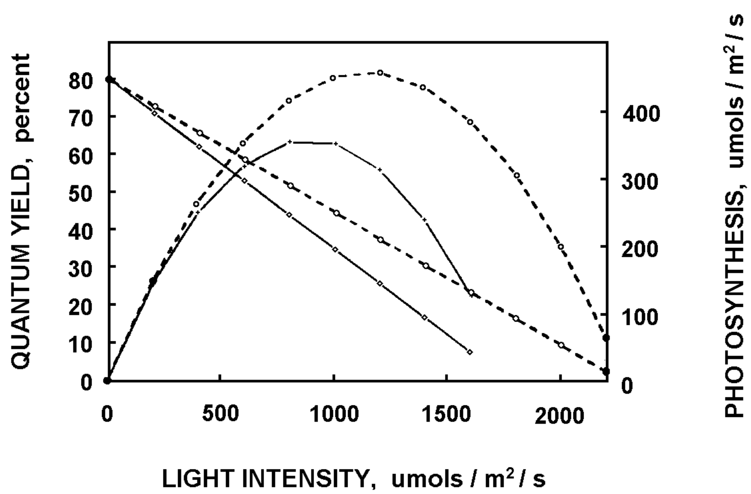

Figure 1. Theoretical quantum yield (straight lines) and photosynthesis (curved lines) for efficient (broken line) and less efficient (solid line) conifer populations.

In two different seasons with three different seedlots, short day treatment promoted Ps in the nursery. Planting did not affect the promoted Ps observed in the nursery for seedlot 30664 in 1994. Blackout did not appear to affect Rd but when it did it decreased it. The apparent overall result of blackout is to control seedling height, promote Ps and possibly reduce Rd. This provides needed carbohydrates for accelerated developmental processes and plug filling after blackout treatment.

REFERENCES:

Hawkins, C.D.B. & D.A. Draper. 1991. Effects of blackout on British Columbia spruce seedlots at Red Rock research Station. FRDA Res. Rep 170. BC Forest Service, Victoria, BC.

Hawkins, C.D.B. & B.D. Hooge. 1988. Blackout and post planting bud phenology in SxS spruce seedlings. -In Proc. W. For. Nurs. Assoc., 1988 August 8-11, Vernon, BC, T.D. Landis (ed.), pp. 54-56. USDA-For. Serv. Gen. Tech. Rep. RM-167, Ft. Collins, CO.

Krasowski, M.J., T. Letchford & A.M. Eastham. 1993. Growth of short-day treated spruce seedlings planted throughout British Columbia. FRDA Res. Rep 209. BC Forest Service, Victoria, BC.

Odlum, K.D. & S.J. Colombo. 1988. Short day exposure to induce budset prolongs shoot growth the following year. -In Proc. W. For. Nurs. Assoc., 1988 August 8-11, Vernon, BC, T.D. Landis (ed.), pp. 57-59. USDA-For. Serv. Gen. Tech. Rep. RM-167, Ft. Collins, CO.