Short Day Treatment of Conifer Seedlings in British Columbia Forest Nurseries[1]

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Abstract.--Short day treatment of conifer seedlings has become standard practice at many B.C. forest nurseries. This paper will relate the various procedures used and benefits gained from an operational perspective.

INTRODUCTION

Short day treatment, or blackout, has widespread application in the horticulture industry. It is commonly used in floriculture to initiate flowering in short day - long night plants. When the night lengthens beyond a critical point the plants switch from a vegetative (leaves) to a reproductive (flowers) mode. The phytochrome system within the plant, which registers changing photoperiod, is largely responsible for the initiation of this process.

Some of our northern temperate conifers could be considered short day – long night plants. Overwintering buds, dormancy and hardiness cycles, and the cessation of the annual vegetative growth phase, are all initiated by photoperiod clues. When the seedling is subjected to artificial short day treatment it responds physiologically as it would with the onset of fall.

REASONS FOR ADOPTION

In B.C. over 90 % of seedling production is in containers, of which much is greenhouse grown for all or at least part of the season. This optimization of environmental conditions results in greatly accelerated and often prolonged, growth. If not curtailed this can result in the production of sub-standard stock, both morphologically (tall, skinny, small buds, etc.) and physiologically (lacking sufficient cold hardiness, disease resistance, etc.). Traditional methods of control such as nutrient and drought stressing were not found to be effective or reliable.

As an alternative, short day treatment was found to be a very effective, low stress method of control. For stocktypes which require growing seedlings out of sink with the natural seasons, it can be used to keep them under control, within operational schedules. Growing seedlings at a nursery outside of their latitudinal range creates similar difficulties. So photoperiodic treatments have proven very helpful in guiding crop development.

Stock standards, growing costs, and the competitiveness of the industry, are such that growers need every available tool to help “steer” crops into the desired “specification window”.

SPECIFIC EXAMPLES

There are several stocktypes for which short day treatment is an excellent tool. Some specific examples are outlined as follows.

1) Container coastal Douglas fir 313B 1-0, spring (March/April) sown, for ultimate overwinter cold storage and subsequent spring planting.

Grown in a nursery within its native habitat, and started in a greenhouse,

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these seedlings will have a tendency to grow too late into the season producing tall, succulent stock.

Short day treatment is applied in July to initiate budset, stopping height growth. For the remainder of the season resources are then allocated to the production of stems, roots, leaf primordia for next years' flush, and the earlier development of cold hardiness and disease resistance.

2) Container early sow/summer plant spruce 313B 1-0, grown in any nursery location within B.C.

This stocktype is normally sown in the greenhouse in late winter (January/February) for "hot" planting in midsummer (July/ August), of the same year.

During early growth, these seedlings require photoperiod extension to offset winter daylengths. Then, for shipping and planting a visible bud and a reasonable degree of stress resistance are required. Short day treatment is used to initiate budset and foliar hardening as well as the post budset root growth phase which aids seedling establishment after outplanting.

3) Crops, grown in sink with the natural seasons.

Some of these crops will shut down on time, naturally. However, genetic variability within a seedlot with respect to critical daylength, as well as slight differences in nutritional status, etc., results in increased height variability during this "natural" shutdown.

A short day treatment **shorter** than the critical daylength of **all** the seedlings withing the seedlot, initiated at the onset of the natural shutdown period, forces a more uniform response.

4) 2-0 crops in their second year.

These crops often display successive ref lushes after the initial determinate growth is finished. If the stock is too soft for summer planting, it may be held until the following spring. Invariably, this results in seedlings becoming too tall.

Short day treatment has been found effective here as well, but not as consistently as would be desired. This may be because the initial flush is predetermined. It is the indeterminate growth which follows that can be more effectively slowed or stopped by short day treatment.

OPERATIONAL PROCEDURES

Actual procedures used (night length, treatment duration, timing of initiation, etc.) vary from nursery to nursery and are basically up to the individual grower. When deciding a particular strategy, information such as seedlot origin (latitude and elevation), species, stocktype and associated planting schedule, nursery location and growing regime, and system constraints, is invaluable.

Treatment initiation may commence when stock has reached 60-75% of the desired (target) height. This assumes 25-40% of coasting in height growth from commencing the treatment. Another method commences the treatment when the average height of the crop reaches contract minimums, or reaches the minimum height required to allow the whole crop to coast into the specification range. Both of these methods require knowledge of the degree and/or duration of coasting, hence the growth rate and the variability within the crop. Graphical tracking of morphological parameters such as height is warranted.

In B.C. current night lengths chosen are in the range of 10-16 hours. The longest nights are applied to more vigorous, southern latitude, low elevation seedlots.

Treatment duration ranges from several days to several weeks. Summer plant 1-0 high latitude spruce may require only 5-10 days to achieve the desired effect. In contrast, for 1-0 coastal Douglas-fir some growers will chose to wait 3-4 weeks, until a terminal bud is visible, before terminating the treatment.

Overall, the shortest possible night length that will give the desired result should be used for the shortest necessary period of time.

POSSIBLE PITFALLS

There are a few things one needs to be aware of when applying short day treatment. One is that the timing of budset influences dormancy and hardiness cycles and hence may affect days to bud break the next season, as well as the storability of the seedlot.

If there are other stresses coinciding with the treatment this may cause an accelerated shutdown, possibly resulting in under height stock.

The climate in the treatment area may be very conducive to the infestation and spread of diseases and pests. Also, when applying the treatment in summer the 24 hour carbon balance may be negative if night time respiration outweighs daytime

photosynthate accumulation. Long warm nights coupled with short hot days for extended periods of time could have a very negative effect.

Post treatment nutrient and climatic regimes need to compliment the treatment if the desired result is to be achieved and **maintained**.

ADDED BENEFITS

Black-out screens can be used as energy curtains on cold nights during winter growing.

REFERENCES

Colombo, S.J., Glerum, C. and Webb, D.P. 1989. Winter hardening in first-year black spruce (Picea mariana) seedlings. Physiol. Plant. 76: 1-9.

Colombo, S.J. 1990. Bud dormancy status, frost hardiness, shoot moisture content, and readiness of black spruce container seedlings for frozen storage. J. Amer. Soc. Hort. Sci. 115(2): 302-307.

Eastham, A.M. 1990. Regulation of seedling height in container grown spruce using photoperiod control. Proc. combined meeting of the Western Forest Nursery Associations. August 13-17, 1990, Roseburg, Oregon.

Grossnickle, S.C., Major, J.E. and Arnott, J.T. 1990. Morphological development of field-planted western hemlock seedlings from various dormancy induction treatments. Combined proceedings of the Western Forest Nursery Associations. August 13-17, 1990, Roseburg, Oregon.

Krakowski, M.J., Owens, J.N. and Hawkins, C.D.B. 1990. Effect of nursery short day and drought treatments on development and early farm-field performance of western redcedar. B.C. Min. For., Victoria, B.C. FRDA Report No. 155.

Odlum, K.D. and Colombo, S.J. 1989. The influence of night temperature under declining photoperiod on bud initiation in black spruce seedlings. Canadian Journal of Forest Research. Vol 19(2): 274-275.

Ritchie, G.A. 1989. Integrated growing schedules for achieving physiological uniformity in coniferous planting stock. Forestry 62 (Supplement): 213-227

Simpson, D. 1991. Day length and drought effects on shoot and root growth of container-grown interior Douglas-fir, lodgepole pine, and western larch. B.C. Min. For. FRDA Project 3.18.