Results of Supplemental Lighting to Improve Winter Rooting of Evergreen Cuttings©

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INTRODUCTION

Goal: To improve rooting success of winter propagated hardwood evergreen cuttings, and to reduce unacceptable levels of variability in rooting from year to year.

Location: Grand Haven, Michigan, approximately 5 miles from Lake Michigan. Days are short with frequent cloud cover from November-February.

Rationale: Despite a lack of data for minimum required light intensity to root evergreens, Dr. Paul Fisher of Young Plant Research recommends a minimum Daily Light Integral (DLI) of 3–5 $mol \cdot m^{-2} \cdot d^{-1}$ (pers. commun. 16 Oct. 2008).

Monitored greenhouse 2008 DLI values were found to be well below target values January until March, (Fig. 1).

High pressure sodium (HPS) lights were installed in December 2008 to provide a minimum light level of 3 $mol \cdot m^{-2} \cdot d^{-1}$ on rooting plants.

Twenty-eight species of evergreen cuttings were trialed: 66,000 cuttings under HPS lights and 311,000 cuttings under natural light as control.

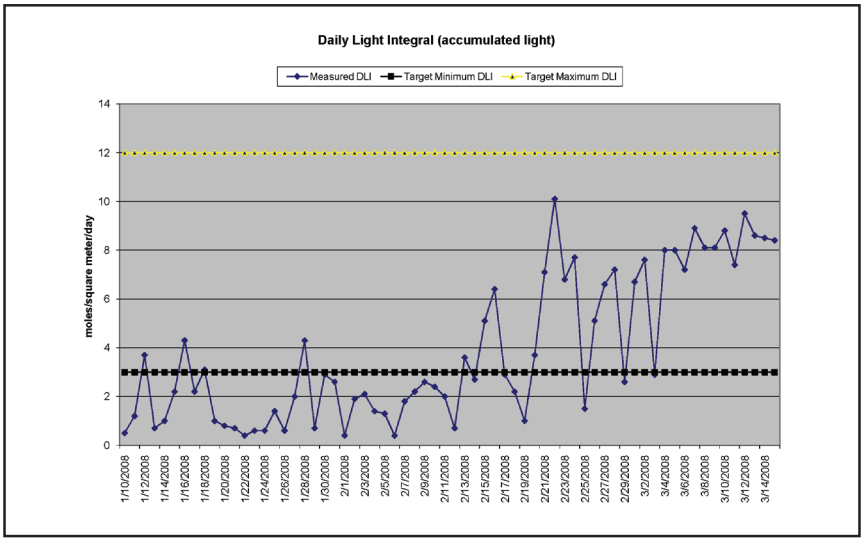

Figure 1. Monitored greenhouse 2008 daily light integral values.

MATERIALS AND METHODS

Daily Light Integral (DLI): Described by Dr. Eric Runkle, DLI refers to the number of light particles, or photons, received during one day, measured in the number of moles of light per square meter per day.

Light Monitor: A Model 305 Watch Dog Weather Tracker by Spectrum Technologies was mounted on an irrigation boom approximately 2 ft above crop level to monitor accumulated light during the winter of 2008 which determined the need for supplemental light.

HPS Lights: Twenty-two PAR Source 1000 Watt HPS lights with electronic ballasts were installed at truss height of 12 ft, spaced in a double column 12 ft apart, illuminating a 24-ft by 130-ft (~3100 sf) portion of a Westbrook open-roof style greenhouse.

Light Map: PAR Source predicted an average light level of 648 ft-c on the greenhouse floor. Photosynthetically active radiation (PAR) light corresponds to a DLI of 85 micromol·m^{-2}/sec. Therefore, hourly accumulation of PAR with the HPS lighting was 0.306 mol·m^{-2}·d^{-1}.

Light Sensors: Two LI-COR quantum sensors were installed 6 ft above the floor — one in the lighted area and the other in the unlighted (natural light) area. The sensors were connected to a QCOM greenhouse control computer for tracking purposes. The boom-mounted Weather Tracker unit must be manually recorded and stores only 30 days of data. The HPS lights and sensors were installed 10 Dec. 2008. Some of the trial cuttings were previously stuck and then moved under the lights, which could have skewed final results.

Lighting Goal: Lights were programmed to be on for a maximum of 9.5 h per day, if required, to achieve a minimum acceptable DLI of 3 mol·m^{-2}·d^{-1} in the lighted area.

Media: Cuttings were stuck in a 50% peat/perlite medium in 72- or 98-cell trays.

Temperatures: Air temperatures were maintained between 40 and 55 °F. Root zone temperatures were maintained at 68 °F.

Rooting Percentages: Final rooting percentages were based on live counts following transplanting during the Spring of 2009 (Table 1).

RESULTS AND CONCLUSIONS

Recorded average daily light levels were as shown in Fig. 2.

Positive Results: High pressure sodium lighting had a positive effect on the rooting of 10 taxa, notably *Cephalotaxus harringtonia* and several taxa of *Thuja occidentalis* (Table 1).

Inconclusive Results: Fourteen taxa exhibited less than a 10% difference in rooting results. More controlled studies are required with these taxa (Table 1).

Negative Results: Negative results were exhibited by four taxa (Table 1).

Re-trial: A new trial will be initiated this winter to provide a minimum of 3 mol·m^{-2}·d^{-1} from the time the cuttings are stuck.

LITERATURE CITED

Fisher, Paul. 2008. University of Florida, Young Plant Research Center, IFAS Extension, 2549 Fifield Hall, Gainesville, Florida 32611. Personal Communication.
Runkle, E. 2006. Daily light interval defined; GPN. Nov. 2006.
Runkle, E. 2006. Do you know what your DLI is? GPN. Dec. 2006.

Table 1. 2009 rooting results.

Taxa	Cuttings stuck	Cuttings rooted	Week 7 rooting[z] (%)	Final rooting (%)
Positive results with HPS[y] lighting (10% or greater gain in rooting):				
Cephalotaxus harringtonia 'Duke Gardens'	6,860	2,176	0	32
	8,036	3,840	0	48
Cephalotaxus harringtonia 'Fritz Huber'	21,658	8,448	0	39
	5,880	3,168	0	54
Chamaecyparis pisifera 'Sungold'	1,764	1,184	74	67
	1,960	1,504	80	77
Juniperus horizontalis 'Hughes Gold'	3,312	2,528	40	76
	1,440	1,248	57	87
Thuja occidentalis 'Filiformis'	2,352	1,920	N/A	82
	2,156	1,984	77	92
Thuja occidentalis 'Golden Globe'	2,664	1,856	30	70
	1,440	1,184	43	82
Thuja occidentalis 'Nigra'	12,744	3,712	7	29
	2,160	1,088	7	50
Thuja occidentalis 'Smaragd'	6,120	2,400	3	39
	2,160	1,408	60	65
Thuja occidentalis 'Techny'	4,248	384	0	9
	2,880	640	7	22
Thuja occidentalis 'Techny Gold'	35,064	10,784	20	31
	3,600	2,528	37	70
Inconclusive (less than a 10% difference with HPS lighting)				
Buxus 'Green Velvet'	53,018	47,360	37	89
	1,372	1,248	80	91
Chamaecyparis lawsoniana 'Sullivan'	3,456	2,880	87	83
	1,440	1,280	97	89
Chamaecyparis lawsoniana 'Oregon Blue'	3,888	2,816	74	72
	1,440	1,120	93	78

Chamaecyparis pisifera 'Strathmore'	2,352	1,920	N/A	82
(syn. 'Mini Variegata')	1,666	1,440	87	86
Ilex glabra 'Compacta'	10,878	9,440	97	87
	1,960	1,568	93	80
Ilex glabra 'Shamrock'	33,712	28,768	97	85
	1,960	1,664	97	85
Taxus cuspidata, 'Fastigiata',	13,536	10,944	60	81
Captain™ Japanese yew	1,440	1,216	83	84
Thuja occidentalis 'Degroot's Spire'	3,096	2,560	73	83
	1,440	1,248	87	87
Thuja occidentalis 'Hetz Midget'	5,400	2,272	33	42
	2,160	960	57	44
Thuja occidentalis 'Wansdyk Silver'	4,464	2,592	7	58
	2,160	1,280	7	59
Thuja occidentalis 'Woodward Globe'	3,600	1,472	0	41
	2,160	1,024	13	47
Thuja occidentalis 'Yellow Ribbon'	10,152	6,862	63	68
	2,160	1,664	70	77
Taxus ×*media* 'Hicksii'	3,744	3,488	90	93
	1,440	1,280	10	89
Microbiota decussata	7,992	5,274	80	66
	2,160	1,296	87	60
Negative results with HPS lighting:				
Buxus sempervirens 'Wedding Ring'	3,332	2,720	27	82
	1,960	1,120	40	57
Cephalotaxus harringtonia 'Fastigiata'	13,680	6,400	10	47
	3,600	1,280	0	36
Chamaecyparis pisifera 'Vintage Gold'	28,224	24,992	97	89
	1,960	1,376	97	70
Taxus ×*media* 'Densiformis'	9,432	8,672	63	92
	2,160	576	87	27

[z]Random sampling of 28 plants
[y]HPS = High pressure sodium
Shading denotes HPS lighting

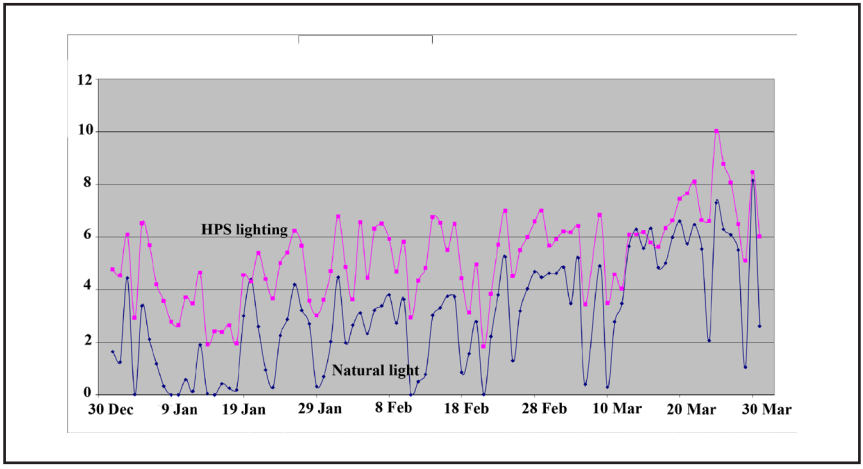

Figure 2. Average daily light levels.