Budbreak and late winter injury in exotic firs

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Background

This study is part of an overall project to examine the adaptability of exotic firs as landscape trees in Michigan. The firs (*Abies* spp.) are commonly grown as Christmas trees, but their use as landscape trees has been limited to a few species native to the US and a few exotic species such as nordman and Korean fir.

The overall goal of this project is to identify species variation in adaptive traits that may limit firs in Michigan. Early budbreak is a limiting factor for firs in Michigan. Late spring frosts tend to damage newly emerging shoots, stunting their growth and sometimes killing the shoot. In Michigan this is particularly a problem with balsam fir (Lantagne and Koelling, 2004).

Materials and methods

Mel Koelling and Jill O'Donnell established an exotic fir Christmas tree trial of over 30 species at the Kellogg Research forest near Augusta, MI in the early 1990s. As the trees grew, the trial needed to be thinned. In cooperation with the Kellogg staff, trees were dug and transplanted the trees to three locations in Michigan.

In the fall of 2002, twenty-three species of *Abies* were transplanted to the Horticulture Teaching and Research Center in Holt, MI, the Clarksville Horticulture Experiment Station in Clarksville, MI, and the Northwest Horticulture and Research Center in Traverse City, MI. Seventeen of these species (Table 1) were identified for detailed study based on their prior performance at Kellogg, their native range and habitat, and their available numbers.

In the spring of 2004, budbreak was observed weekly at the three locations and at the Kellogg forest. A late spring frost damaged newly emerged foliage at the Kellogg forest. Trees were rated for degree of frost damage by percent of shoots injured.

Results

Species broke bud first at the three locations in the southern lower peninsula in mid April while trees near Traverse City finished budbreak in mid June. Species differed in mean days to budbreak and budbreak was strongly correlated at all four locations (Table 2).

Temperatures dropped at the Kellogg forest to 29°F and 31°F on May 3 and 4, 2004 respectively (Figure 1) injuring newly emerged shoots (Photo 1). Damage from the frost was measured (Figure 2) and species differed in the degree of frost damage present. A strong correlation between the degree of frost damage present and mean budbreak indicated species breaking bud earlier are prone to damage from late spring frosts.

Discussion

Trees native to colder regions are cold hardy at lower temperatures but have a reduced chilling requirement for budbreak, resulting in early budbreak in the spring (Howe et al., 2003). Increased elevation reduces the threshold temperature necessary for bud burst in fir (Worrall,

1983) and spruce provenances from higher latitudes break bud earlier than provenances from lower latitudes (Morgenstern, 1978).

This is apparent in our study with the Siberian white and sub-alpine firs among others being the first to break bud in the spring (Table 3) suggesting a relationship between cold hardiness and budbreak. Currently experiments are underway to test this relationship by examining early, mid, and late winter cold hardiness.

Firs with early budbreak, such as the Siberian white fir, have shown promise in growth and overall adaptability to the Michigan climate. Provenance testing of these species would be useful to identify provenances adapted to Michigan and delayed budbreak.

Literature Cited

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Table 1. Species list

Common name	Scientific name	Geographic origin
Nikko fir (NIK)	*Abies homolepsis*	Asia
Korean fir (KOR)	*Abies koreana*	Asia
Veitch fir (VEI)	*Abies veitchii*	Asia
Siberian White fir (SIBW)	*Abies nephrolepis*	Asia
Needle fir (NEE)	*Abies holophylla*	Asia
Ernst fir (ERN)	*Abies chensiensis*	Asia
Balsam fir (BAL)	*Abies balsamea*	N. America
Fraser fir (FRA)	*Abies fraseri*	N. America
Sub-Alpine fir (SUB)	*Abies lasiocarpa*	N. America
Noble fir (NOB)	*Abies procera*	N. America
Cannan fir (CAN)	*Abies bal.* var *phan.*	N. America
Corkbark fir (COR)	*Abies bifolia*	N. America
Nordman fir (NOR)	*Abies nordmanniana*	Mediterranean
Turkish fir (TUR)	*Abies nord.* spp. Equi-trojani	Mediterranean
Korean x Veitch Hybrid (KxV)	*Abies koreana* x *veitchii*	Hybrid
Korean x Balsam Hybrid (KxB)	*Abies koreana* x *balsamea*	Hybrid
Fraser x Nikko Hybrid (FxN)	*Abies fraseri* x *homolepsis*	Hybrid

Table 2. Pearson correlation coefficients for budbreak of *Abies* at four locations in Michigan.

	Kellogg	Traverse City	Holt
Clarksville	0.884** N=13	0.732* N=17	0.825** N=17
Kellogg		0.748* N=13	0.842* N=13
Traverse City			0.888** N=17

* significant at $p<0.0001$
* significant at $p<0.05$

Photo 1. Frost damage at Kellogg forest, May 2004.

Table 3. Mean days to budbreak at the Kellogg forest in spring 2004.

Species	Days to Budbreak [1]
Needle	112 a
Sub-Alpine	113 a
Corkbark	114 a
Siberian White	115 a
Balsam	122 b
Caanan	124 bc
Korean x Veitch	124 bc
Nordman	126 bc
Fraser x Nikko	128 cd
Ernst	133 cd
Fraser	137de
Turkish	139 de
Nikko	139 ef
Veitch	143 fg
Noble	143fg
Korean	143 fg
Korean x Balsam	147 g

[1] Days since January 1, 2004

Means followed by the same letter are not significantly different from each other. $\alpha = .05$, Tukey

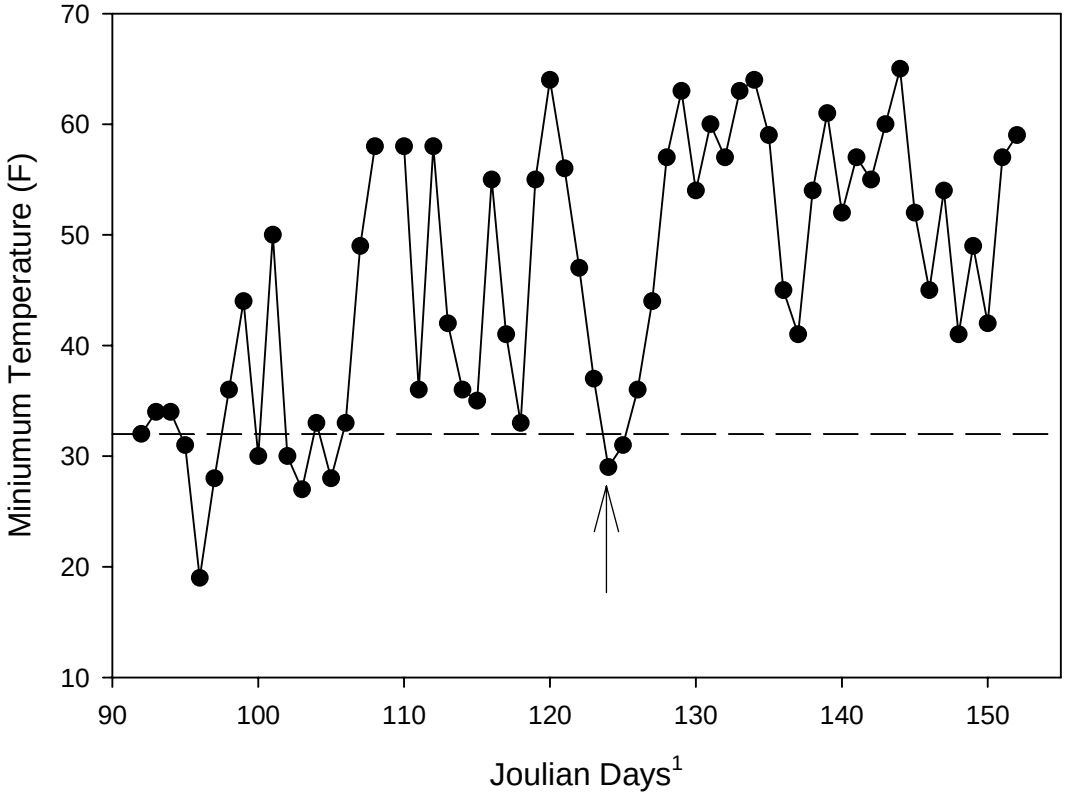

Figure 1. Daily minimum temperatures at the Kellogg forest near Augusta, MI for the period April 1, 2004 – May 31, 2004. Dashed line represents 32°F. Arrow indicates frost on May 3 and 4, 2004.

[1] Days since January 1, 2004

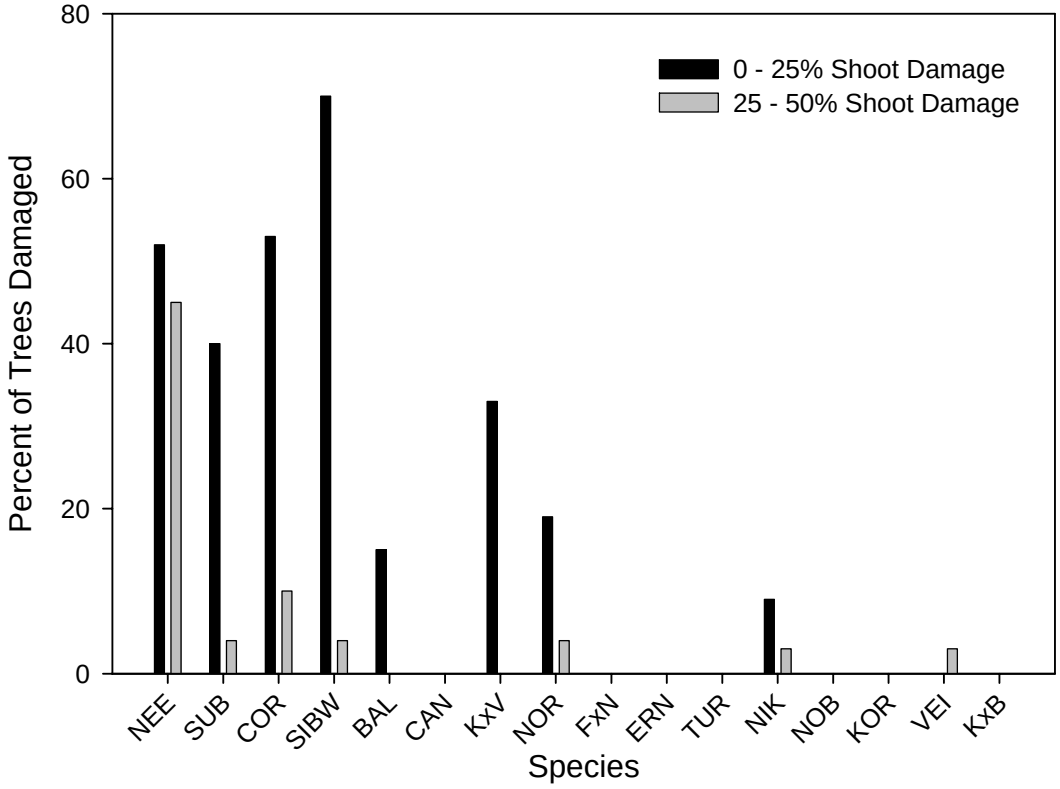

Figure 2. Frost damage to recently emerged shoots at the Kellogg forest, May 5, 2004.