



RECOMMENDED LIFTING DATES FOR DIRECT PLANTING AND COLD STORAGE OF SITKA SPRUCE IN BRITAIN, by Helen McKay and Bobby Howes

Summary

This Note revises and extends existing recommendations for the lifting, cold storage and planting of bare-root Sitka spruce in Britain. Normally, undercut and wrenched stock can be lifted, stored and planted from late November to early March whenever soil conditions are suitable. Plants may be handled safely outside this window, depending on provenance, nursery climate, storage conditions and planting site factors.

*Part 1***Introduction**

The following recommendations update the lifting and planting dates proposed by Tabbush (1988) for bare-rooted Sitka spruce. The recommended dates now cover all provenances in commercial use in Britain. Although these are based on a series of experiments using seedlings from Wykeham Nursery which were planted on the North York Moors, we provide guidelines to extrapolate to other nurseries and planting sites. The experiments used to form these recommendations are summarised in Part 2. Careful handling and planting are assumed.

Recommendations

- ◆ Dates for lifting and planting within one week.

Alaskan: early October to mid-April.

Queen Charlotte Islands and British Columbia origin: late October to early April.

Washington origin: late October to early April.

Oregon origin: late November to early April.

- ◆ Dates for cold storage with planting before the end of April.

Queen Charlotte Islands origin: mid-November to mid-March.

Alaskan: mid-October to mid-March.

Washington and Oregon: early December to early March.

- ◆ During the recommended lifting period for cold storage, 1u1 and 1+1 stock give equally good survival. Outwith this period, expect greater losses with 1+1 than 1u1 stock.
- ◆ Stock can be stored during the recommended period at +2°C or -2°C. Outwith this period, expect greater losses with -2°C storage than +2°C.

Extrapolating to other situations

These recommendations **cannot be extended automatically** to all nurseries, planting sites or years. However, the following generalisations are suggested to assist in any extrapolations:

- ◆ **Nurseries**

Safe lifting periods for warmer and moister nurseries will generally be shorter by 2 weeks at both the beginning and end of the period whereas the safe period for colder nurseries will increase at both ends by about 2 weeks compared with the Wykeham recommendations.

◆ Planting sites

On sites with greater soil moisture availability than the North York Moors, i.e. >150 mm rainfall per month in the month of planting and the two subsequent months, successful establishment may be possible before and especially after the recommended period provided good quality stock is used.

◆ Winter climates

In especially mild winters, i.e. mean weekly soil temperatures at 10 cm in the nursery of >3°C, lifting dates should be delayed in autumn and brought forward in spring by 2 to 3 weeks.

Part 2

Introduction

1. Experience has shown that Sitka spruce is the easiest of the commercially planted conifers to establish. However, the most recent recommended lifting and planting dates (Tabbush, 1988) are based on root growth potential patterns rather than field experiments. This Note summarises information from eight experiments planted between 1989 and 1992 using bare-root stock, mainly 1u1s, raised at Wykeham and planted on cultivated second-rotation sites on the North York Moors. Details of methods and results are given elsewhere (e.g. McKay and Mason, 1991 and McKay, 1993).

Results

Direct planting

2. Poor survival resulted when Queen Charlotte Islands Sitka spruce were lifted for direct planting in early September. Survival increased as lifting was delayed, reaching 90% or better in mid-September (1989) or late October (1990 and 1991). This level was maintained for all lifting dates until at least early April.

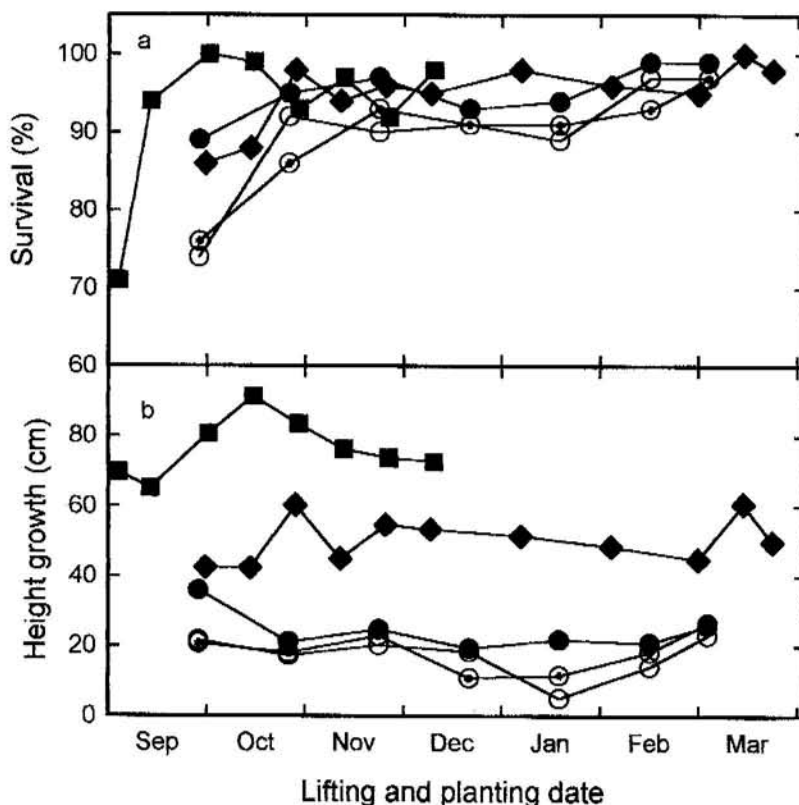


Figure 1. The survival (a) and height growth (b) of Queen Charlotte Islands Sitka spruce undercuts after direct planting on the North York Moors in 1991 (■), and 1991-92 (◆) and in 1992-93 of Queen Charlotte Islands (●), Washington (○), and Oregon (⊕) seed origin stock.

3. Height and diameter growth of stock planted in early September was poor. Height increment was slightly better in seedlings planted in late autumn (October to mid-November) and early spring (March) than in mid-winter. Diameter growth showed no obvious trend with planting date from October to March and is not illustrated.
4. Washington and Oregon origins had poorer survival and growth than Queen Charlotte Islands Sitka spruce when lifted early, i.e. September and October. As lifting was delayed, survival of all seed origins increased and from late November to mid-March survival of all three origins was greater than 90%, though survival of QCI Sitka spruce was consistently a little greater than that of plants of Washington or Oregon seed origins.

Cold storage

5. Undercutting and wrenching improved the performance, particularly survival, of Queen Charlotte Islands Sitka spruce that had been cold stored early, i.e. in October 1988 and October and November 1989 (Figure 2). Survival of both plant types stored on later dates and planted out in April was near maximum.

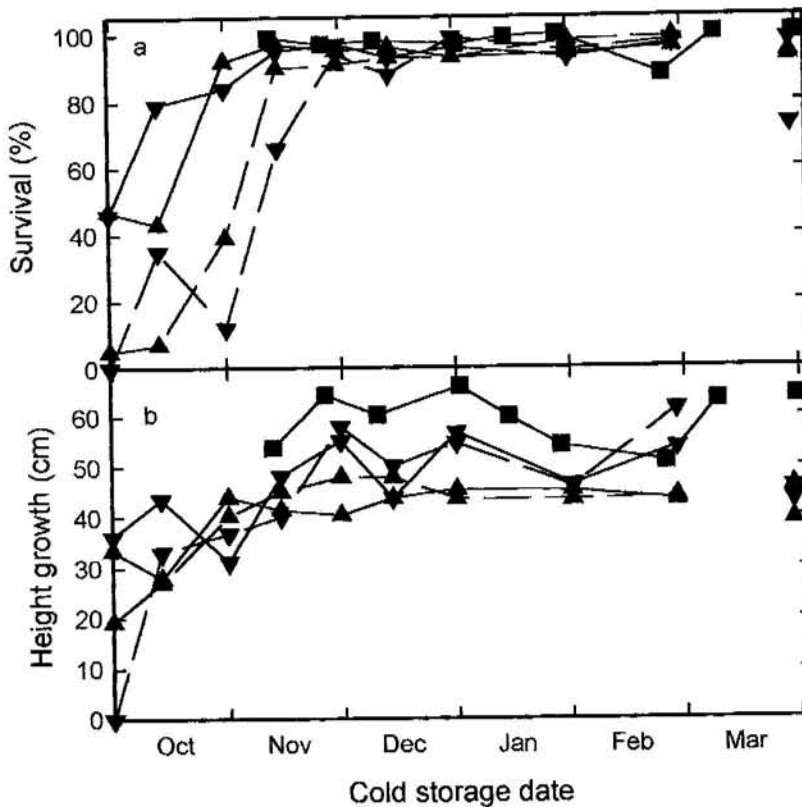


Figure 2. The effect of lifting and cold storage date on the survival (a) and height growth (b) of undercuts (---) and transplants (—) of Queen Charlotte Islands Sitka spruce planted at North York Moors in 1988-89 (▲), 1989-90 (▼), and 1991-92 (■) after cold storage at +2°C until early April plus stock planted directly in early April.

6. Survival of 1u1s increased as lifting for cold storage was delayed during October (Figure 2a). Thereafter 90% survival or better was obtained with stock lifted on dates from mid-November up to March and planted in early April.
7. Growth of surviving plants stored in October was poorer than that of plants stored later in the year (Figure 2b). There was no consistent difference in growth after 2 years among plants with later lifting dates.
8. Storage until mid-May or mid-June resulted in moderate survival (83% and 76% respectively) though the plants did not flush in the year of planting. The second-year height increment of stock stored until May and June was greater ($P < 0.05$) when plants were stored in November (31.0 cm) and January (29.4 cm) than when they were stored in March (23.3 cm).

9. The performance of Queen Charlotte Islands Sitka spruce stored at + or -2°C was equally good for normal cold-storage dates but the survival of plants stored below zero in late October was significantly poorer than that of plants stored at +2°C (Table 1).
10. Sitka spruce of Alaskan seed origin had even greater tolerance to cold storage than plants of Queen Charlotte Islands origin; 1u1s could be successfully stored 2 to 4 weeks earlier than QCI stock (data not shown). The response of Washington and Oregon provenances has not been examined in this series of experiments but the safe lifting period is likely to begin 2 to 4 weeks later in autumn and end 2 weeks earlier in spring than the period for Queen Charlotte Islands stock.

Table 1. The effect of storage temperature and date on the performance of Sitka spruce undercuts after two growing seasons.

Lifting and storage date	Survival %		Height increment as a % of initial height	
	+2°C	-2°C	+2°C	-2°C
October 27	87	47	69	59
November 24	95	98	101	107
January 11	92	95	100	84
January 26	98	96	91	114
February 16	96	97	90	63
SED	4.3	4.3	19	19

Discussion

11. These results confirm that Sitka spruce, especially undercut and wrenched stock, is a particularly robust species. This presents nursery and forest managers with a wide range of possible management strategies. Provided stock is of good morphological quality, free from disease, and is handled carefully, 2-year-old plants of Queen Charlotte Islands origin from Wykeham can be lifted and planted directly with >90% survival and good height growth on dates from late October until early April. Satisfactory survival (i.e. >90%) can also be obtained if stock is cold stored at + or -2°C from mid-November until mid-March for outplanting before the end of April. These recommendations are generally similar to those of Tabbush (1988). However, we suggest that freshly lifted stock can be planted throughout the winter in most of Britain except on cold exposed sites. On the other hand, cold-stored stock planted after mid-May on dry sites may not give satisfactory survival with losses being greater than 10%.
12. Stock of northern seed origin becomes inactive earlier in the autumn than plants of southern origin. The physiological condition of plants will also vary from year to year and nursery to nursery depending on the climate. **Soil temperature is especially important and mean weekly soil temperatures at 10 cm in the nursery should be 5°C or lower before 1u1 Queen Charlotte Islands Sitka spruce can be lifted for successful cold storage.**
13. The good performance of Sitka spruce on a comparatively severe site (in terms of soil water deficit and temperature) over a wide range of lifting dates can be the result of several factors. The root system becomes inactive early in the winter and a very complete level of inactivity is maintained throughout the winter (see McKay, 1993); this may contribute to its stress tolerance. The fine roots of Sitka spruce are comparatively tolerant of stresses such as desiccation (McKay and White, in press), rough-handling (McKay *et al.*, 1993) and frost (McKay, 1994) which may damage the nursery root system between lifting and planting. Unlike most evergreen conifers, Sitka spruce can produce roots from stored photosynthate (Phillipson, 1988) therefore it can extend its root system even when the shoot cannot photosynthesise. Sitka spruce characteristically produces many fibrous roots (Deans *et al.*, 1989) which has two consequences. Firstly, the nursery root system will have access

to larger volumes of soil water than species with coarser roots or less well developed root systems. Secondly, root growth after transplanting is mostly from existing root tips (Deans *et al.*, 1990), so the nursery root system of Sitka spruce provides more points for regrowth than other species. Sitka spruce has one other characteristic that enhances its stress tolerance; it can produce adventitious roots providing a new root system if the original nursery root system is damaged.

Acknowledgements

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