TREE AND SHRUB SEED: WARNING!—HANDLE WITH CARE

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INTRODUCTION

As Government policy in Britain shifts towards encouraging the planting of more broadleaved trees many nurserymen are increasing production with an emphasis on native species. For those nurseries which have produced such stock over a number of years this task is relatively straightforward, but those expanding into production of seedling stock for the first time are not as successful as they could be because of a lack of knowledge of the seed that they handle.

As one of the British companies supplying the home market it is of concern that seed improperly handled will generate poor results, cause significant lost production, waste valuable seed, and reduce future trading prospects. This paper therefore addresses the problems contributing to loss of seed viability from the parent tree to the new seedbed or container unit. Special reference is made to the storage of *Quercus robur* acorns.

WHERE IS SEED VIABILITY LOST?

A seedlot collected from a stand of trees can be handled many times before it is finally sown on the seedbed or in the container. Reducing the time interval between collection and sowing is the easiest way of minimising viability losses. For certain deeply dormant seeds this may also encourage germination 12 months earlier. A classic example is *Viburnum opulus*, where if the seed is cleaned from the fruit (collected just as it turns red in August) and sown in the seedbed it will germinate the following spring. Seed which is collected later, cleaned, dried, stored and dormancy broken artificially will take a further 12 months to germination, and viability will have decreased.

The main factors causing loss of viability are cited in Table 1. Temperature, moisture, and oxygen are the three prime factors to consider. Perhaps the best general guide is to remember what is happening to the seed dispersed naturally. If these conditions are suitably mimicked, viability can be maintained at or near the percentage at collection.

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Table 1. Loss of seed viability can occur at or during:

	Factors causing losses
Collection	Freezing/excessively high temperatures Excess moisture/drying Lack of oxygen/excess fermentation of fruit Physiological immature seed
Processing & cleaning	As above plus—physical damage
Storage-orthodox species	Too high a moisture content— Temperatures exceeding 5 °C
Recalcitrant species	Too low a moisture content Temperatures exceeding 5 °C Inadequate oxygen supply Premature chitting of seed
Treatment to break dormancy	Exposure to high temperatures Excess moisture/drying Lack of oxygen Premature chitting of seed Physical damage, e g. during acid scarification
Despatch & transport	Poor packaging allowing exposure to temperature extremes, lack of oxygen and physical damage
Pre-sowing storage	Exposed to temperature extremes and drying
Sowing	Radicles on chitted seed damaged Incorrect depth of sowing Uneven seedbed coverings Poor condition of soil in seedbed Poor condition of compost in container
In the seedbed	Inadequate irrigation Absence of shading Predation of seed Fungal and pest attack
In container production	Inadequate irrigation High temperatures Fungal & pest attack Predation of seed

WHAT KNOWLEDGE IS REQUIRED TO PREVENT VIABILITY LOSSES?

Intimate knowledge of the seed biology of each species sown by the nurseryman is the surest way of preventing viability losses. Table 2 summarises the basic data for four common British broadleaved trees. If the nurseryman buys from a seed house he may only have to acquaint himself with columns VI and VII in detail. If he makes collections of his own he must document the history of each seedlot to assist in building up his knowledge.

An example of the type of information which must be recorded is given in Appendix 4B of the *Forestry Commission Bulletin No. 59.* There are many other sources of information. (See Reference List).

Table 2. Basic seed biology of four common British broadleaved trees

	English oak *Quercus robur*	Wild cherry *Prunus avium*	Field maple *Acer campestre*	Common alder *Alnus glutinosa*
I Date of seed collection	Sept-Nov	July	Oct-Jan	Sept-Dec/Jan
II Dormancy type	None	Exogenous(Am) Endogenous (PIM strong)	Endogenous (PIM strong)	Endogenous (PIM weak)
III Seed type	Nut	Stone/drupe	Winged	Nutlet
IV Average no Viable Seeds/KG	220	4,000	8,900	250,000
V Processing/ Cleaning	Air-dry surface moisture only, riddle	Macerate & remove pulp, air-dry seed	Air-dry, hand-clean & riddle	Air-dry cones, extract seed, re-wet cones, air-dry & extract
VI Storage requirements	Recalcitrant Do not dry to less than 40%	Orthodox Dry to 12%	Orthodox. Dry to < 15% minimum	Orthodox Dry to < 10%
VII Treatment requirements	None. Storage in peat maintains viability	2-4 weeks WMP, 15-20 weeks CMP	4-8 weeks WMP, 12-24 weeks CMP	"naked" 4 weeks CMP

Am—Mechanical dormancy
PIM—Physiological inhibiting mechanism
WMP—Warm-moist pre-treatment
CMP—Cold-moist pre-treatment

WHAT HAPPENS IF A SEEDLOT IS HANDLED INCORRECTLY?

Let us take the example of English oak (*Quercus robur*) seedling production in Britain. The genus is not regarded as difficult to propagate, yet even with the English oak there are difficulties in obtaining a high seedling yield because basic seed biology is forgotten.

Table 3 indicates the potential loss of seedling production of two seedlots from the 1988 acorn harvest sold in April 1989. The decrease in viability of the British provenance seedlot was 6.5% during five months of storage under correct conditions. The Dutch provenance seedlot showed a loss of 33.3% of the original viability over the same period—primarily due to incorrect storage conditions. The latter resulted in a potential lost seedling production of over 73,000 seedlings per tonne of seed.

Table 3. Potential seedling production losses due to storage conditions for two seedlots of English oak (*Quercus robur*).

	British	Dutch
Origin	Unknown	Unknown
Provenance	Suffolk, Thurlow Estate 88 (40)	Netherlands Region 3
Seed test data at cleaning	23/12/89, 91% viability*	10/11/89, 69% viability
Storage method	Air-dried, riddled, then mixed with an equal volume of moist peat and bagged into hessian, stored in cold store at +2 to -4 °C	Air-dried, cleaned, then bagged into fine mesh sacks, stored at ambient temperature in an unheated warehouse
Seed test data at despatch for spring sowing	20/4/89, 85% viability	21/4/89, 46% viability
Decrease in viability as a % of original viability	6.5%	33.3%
Potential loss of seedling Production**	14,300 seedling/tonne	73,260 seedling/tonne

* Viability is defined as normal + abnormal germination + fresh seeds

** Assumes a field factor of 80% for open ground production
Based upon an average viability of 220 viable seeds/kg

Why should such losses occur? The storage requirement of acorns of *Quercus robur* have been known since the 1950s (Table 4) and have recently been demonstrated again (Table 5), including the usefulness of soaking seed that has dried to between 30-40% moisture content (fresh weight basis) before storing it.

Table 4. Storage requirements to maintain satisfactory viability of oak (*Quercus robur*) over three years (Holmes and Buszewicz, 1955)

Temperature	+2 °C
Moisture Content	40-45% (fresh wt. basis)
Storage medium	Dry peat or sand
Storage method	Closed but not sealed containers
Other factors	High initial quality (viability) Free from disease/damage

Table 5. Conditions to maintain high viability for spring-sown oak (*Quercus robur*) (Gosling, 1988)

Temperature	+2 °C
Moisture content	Greater than 40% (fresh wt. basis)
Storage medium	Naked storage
Storage method	Acorns in hessian sack, surrounded by perlite in open-necked polythene bag
Other factors	Seed of 30-40% moisture content, should be soaked for 48 hours in water at +2 °C

The effects of poor storage of the 1988 acorn harvest on lost seedling production in Britain is calculated in Table 6. For the purposes of these calculations it was assumed that 75% of the seed was autumn-sown (i.e. before 30 December 1988) and that the remainder was sown in the spring (March-April 1989). Small viability losses were defined as 5% or less of the original viability, medium losses as 15%, and large losses as 30%. The viability loss classes were apportioned to the total tonnage of British and Dutch seed. While the figures are open to debate, and some nurserymen are losing less than 5 percent of the original viability at collection, substantial lost seedling production is indicated. An equivalent of 1.4 million plants were "lost", representing 6.4 tonnes of seed which was wasted!

Table 6. Estimated loss of oak (*Quercus robur*) seedling production in Britain due to losses incurred during storage of the 1988 seed crop

		VIABILITY LOSS CLASSES				
Provenance	Estimated seed useage (tonnes)	Small	Medium	Large	Total seedlings lost	Weight of seed crop lost (%)
Autumn/winter-sown stock (assumes 75% of seed sown)						
British	3.75	41,250	–	–	41,250	5
Dutch	60.0	660,000	–	–	660,000	5
Spring-sown stock (assumes 25% of seed sown)						
British *	1.25	3,440	28,875	4,125	36,440	13
Dutch **	20.0	55,000	396,000	198,000	649,000	15
				Total	1,386,690	

* Assume 25% crop has Small viability loss
70% crop has Medium viability loss
5% crop has Large viability loss
** Assume 25% crop has Small viability loss
60% crop has Medium viability loss
15% crop has Large viability loss

Reiterating an earlier point, it is often observed that autumn-sown seed can minimise loss of viability (assuming adequate protection and optimum conditions in the seedbed/container). The total weight of the acorn crop lost from autumn sowings was 5% compared to 13-15% for spring-sown seed. Also a significant factor, supported by evidence from British seed houses, is that it is easier to maintain the viability of seed collected from British forest stands since moisture content can be accurately controlled from the point of collection—a crucial factor for the recalcitrant acorn.

That *Quercus robur* represents a species whose seed biology is straightforward (it does not require protracted cleaning, difficult storage conditions or lengthy stratification procedures) would indicate that lost seedling production of other native broadleaves through inappropriate handling may also be significant.

The recent increases in demand for the supply of broadleaved tree and shrub seed are welcomed. Handling seed with care will not only increase seedling production, but will ensure careful use of a valuable asset, especially the hard-won harvests from British provenances.

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