higher concentrations of zeatin, shoots develop fastigiate, multiple meristems.

All members of *Syringa* are easily rooted ex vitro using a simple peat and perlite mix. There does not seem to be a direct correlation between ease of micropropagation and rooting of microcuttings as even 'Ivory Silk' roots at nearly 100%. Of course, poor microcutting quality results in poor rooting.

We find that lilacs are one of our more rewarding plants to micropropagate and grow on to superior quality liners. This is especially true when we are able to go out to our plant collections in the spring and pick such fantastic bouquets!

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Seed Technologies to Increase Seed Value in Tasmania©

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INTRODUCTION

The performance of a seedlot of any species in the field depends on a range of factors. One of these factors is seedlot quality or vigour. It is becoming increasingly clear that seedlot quality is difficult to define and the ability of a seedlot to perform depends partly on the history of the seedlot, and partly on the environmental conditions during germination (Bradford, 1996). Factors including environmental conditions during maturation, harvest time (and thus seed maturity), seed storage, pretreatment prior to sowing, and field conditions during emergence can substantially affect seedlot performance (Coolbear, 1995; Finch-Savage, 1995). Technologies applied to crops grown commercially from seed in Tasmania have the capacity to increase the value of the seed to the producers, by improving the ability of a seedlot to perform in the field. This paper presents some examples of Tasmanian crops, which have benefited from technologies that improve seed quality.

The island State of Tasmania is located off the south east corner of the Australian mainland, within a temperate climate zone. The island experiences relatively consistent rainfall throughout the year, and soils are reasonably fertile. These factors have allowed the development of a strong agricultural sector. The area of Tasmania represents less than 1% of the total area of Australia, yet the State produces 2.3% of the country's agricultural commodities (Australian Bureau of Statistics, 2000). Some of the more valuable crops to the State are potatoes, onion, and carrots. Tasmania is also known for its forestry activities, poppies, and pyrethrum production.

TIME OF HARVEST

The onion seed industry in Tasmania produces about 7 tonnes of seed each year that is primarily used for Tasmania's export onion industry. A small proportion of the seed is sold nationally and internationally. However, some Tasmanian onion seedlots have produced up to 14% to 18% abnormal seedlings. The majority of the abnormal seedlings have a stunted or absent primary root. The proportion of abnormal seedlings is used as a guide to seedlot quality, and a level of 5% is considered acceptable (McKenzie, 1999). As a consequence, some production practices in Tasmania result in seedlots that contain an unacceptably high percentage of abnormal seedlings.

Studies conducted at the University of Tasmania have revealed that harvest time, umbel maturity at harvest, and postharvest drying affect seedlot quality. Studies on onion seed harvest date have indicated that seedlot quality may potentially be improved if harvest date is delayed (Spurr, 1998). Seed yield and seed quality parameters including percentage germination, germination rate and uniformity, seedling weight, and incidence of seedling normality were found to increase with seedlot maturity. Seed was obtained from six harvest times, the first of which was early in crop development, and the final was substantially later than commercial harvest date (Spurr, 1998). Seedling size was closely associated with seed size, which increased with harvest date. Throughout the period seed moisture content dropped from 85% to 31%. Optimum seed yield was found to occur between 48% and 31% seed moisture content.

Further studies on onion seed have demonstrated that both umbel maturity and the postharvest environment have the capacity to affect seedlot quality. Immature umbels at harvest produced low viability and low-vigour seedlots. Low-vigour seedlots produced a high proportion of seedlings that were abnormal or normal but slow to grow (McKenzie, 1998). Forced air movement to dry umbels (at 38°C) was also found to reduce seedlot viability and vigour compared with drying more slowly at a lower temperature (28°C). Umbel maturity and drying treatment interacted such that the effect of drying was considerably more severe on immature umbels.

Studies on onion seeds have thus revealed that delaying harvest may improve seedlot quality by increasing seed maturity at harvest, and variation in umbel maturity at harvest leads to seedlots of variable quality. There is, however, the potential to harvest umbels from within one crop separately, to give seedlots of uniformly mature seed. The separated seedlots could be treated differently in accordance with their quality. For example, forced air drying at high temperature would not be recommended for seedlots from immature umbels. These seeds may, however, benefit from the application of a pretreatment prior to sowing.

SEED PRETREATMENT

A range of pretreatments is currently in use to improve seedlot quality in a number of species. Some of the more commonly used pretreatments include application of gibberellins to seed, priming, and stratification or prechilling. Radiata pine (*Pinus radiata*) seedlots have been found to respond well to pretreatment (Donovan, 2001). Seed pretreatments have long been applied to seed in an effort to overcome dormancy and improve germination percentage, rate, and uniformity. Germination of seedlots from Australian radiata pine seed orchards has proven at times to be low and variable in field nurseries. Crossing of elite material to produce controlled pollination seed has increased the cost of the seed to the grower, so it is increasingly important to pine nursery operators that seedlots fulfil their potential for germination and growth. Current nursery practice is to soak the seed at or near room temperature prior to sowing. Treatments are usually carried out in large volumes of water for 24 to 48 h. The potential for anoxic conditions to develop is minimised by changing the water or running water continuously through the seed. This presoaking treatment is preferred to the traditional stratification treatment, which involves supplying seed with sufficient water for imbibition and holding at low temperature for a prolonged period. Presoaking is quicker, easier, and allows the nursery operator more flexibility in sowing date. Studies have demonstrated that soaking can improve nursery germination by decreasing the time to seedling emergence, but continuous aeration must be supplied (Table 1). Dissolved oxygen in soak water is depleted rapidly by metabolising seed. Seedlots vary in their response to soaking and it has been suggested that presoaking has the potential to be used as a seed quality or vigour test. Presoaking with aeration proved to be a rapid and simple method of improving germination rate in both incubator and field studies (Donovan, 2001). This confirms the benefit of the general industry approach provided adequate attention is applied to aeration.

Table 1. Germination of an open-pollinated *Pinus radiata* seedlot soaked for 48 h at 20°C.

Treatment	Germination (%)	Day of first germinant
Unsoaked	81.9 ± 3.2	11.8 ± 1.5
Soaked	64.8 ± 3.4	12.3 ± 1.5
Soaked with aeration	85.7 ± 3.2	10.0 ± 0.8

Traditional stratification pretreatment has also been found to benefit pine seed germination. A study of four seedlots of varying origin has shown that germination rate is increased by stratification (Table 2). The germination percentage of three of the four seedlots also increased with a 12-week stratification (Table 3). In seedlots susceptible to damage from unaerated soaks, it was found that 4 or more weeks of stratification treatment improved percentage germination following an unaerated soak treatment (Table 3).

Table 2. Mean time to germination (days) of stratified seed of four *Pinus radiata* seedlots.

Seedlot	Control	4 weeks stratification	12 weeks stratification
a	18.1 ±0.4	13.8 ± 1.4	8.6 ± 0.5
b	19.2 ± 0.8	19.6 ± 0.7	14.2 ± 0.4
c	17.7 ± 0.9	11.1 ± 0.2	7.4 ± 0.7
d	17.5 ± 0.4	15.1 ± 1.7	7.9 ± 0.4

Table 3. Germination percentage of seed of four *Pinus radiata* seedlots presoaked for 48 h at 5°C then stratified at 5°C for 4 to 12 weeks.

Seedlot	Control	48 h presoak	48 h presoak +4 w stratification	48 h presoak +12 w stratification
A	87.6 ± 2.4	84.8 ± 3.0	90.9 ± 2.4	94.9 ± 0.5
B	42.8 ± 8.3	18.4 ± 2.4	49.5 ± 6.1	73.4 ± 3.0
C	73.3 ± 8.3	53.5 ±13.2	77.9 ± 6.4	88.0 ± 4.1
D	97.4 ± 1.0	87.6 ± 1.4	95.8 ± 1.3	91.3 ± 6.6

GRADING FOR IMPROVED CROP UNIFORMITY

Grading seed into size classes has the capacity to improve seedlot performance by increasing the uniformity of growth within a crop. A more uniform crop results in fewer losses to competition, and less variation in crop maturity at harvest. Carrot seedlots sown in Tasmanian paddocks are generally of high quality and exhibit rapid emergence and high germination percentage. However, studies have indicated that even within high quality seedlots there is substantial variation in embryo size which has been correlated with variation in seedling weight, as embryo size determines seedling size (Gracie, pers. commun.). Thus, there is the potential to further improve carrot crop performance by separating seed into different embryo size classes. However, it has been found that the effect of environmental conditions on emergence rate in the field is greater than the effect of embryo size on emergence rate. So, although uniformity of the crop will improve by further grading of the seedlot, improvement in germination rate cannot be expected from sowing seed of a given size as this aspect is greatly controlled by the environment.

SEED COATING

Seed coating has two main objectives. The first is to improve seed plantability, and the second is to provide the seed with substances required for optimum growth. Substances used include fungicides, hydrophilic or hydrophobic compounds, or nutrients (Scott, 1989). Seed coats are applied to many crops in Tasmania, including carrots, to allow precision sowing. Research at the University of Tasmania is currently being conducted into the potential to coat seed of eucalyptus and understorey species to aerially sow areas of the midlands that have been affected by the phenomenon known as rural tree decline. Rural tree decline has seen the premature death of paddock trees and areas of forest and woodland in central and eastern Tasmania, with an absence of regeneration and recruitment of young trees to replace dying older trees. It is hoped that rehabilitation will be achieved by broadscale sowing seed of the declining eucalyptus and understorey species into affected areas. Coating the seed will improve the distribution of aerially sown seed while providing the opportunity to supply the seed with substances to improve the likelihood of establishment including fertilisers and hydrophilic fillers.

CONCLUSIONS

It is becoming increasingly clear that the more knowledge we have about the background of a seedlot, the easier it is to obtain optimum performance from the seedlot in the field. The genetic background and range, maturity at harvest, conditions experienced during maturation and post-harvest storage are factors that affect seedlot quality before the seed goes into the field. Seed pretreatment , sowing rate and precision, coating treatment, and field conditions determine the ability of a seedlot to fulfil its potential and obtain optimum germination and growth performance in the field.

In the future, growers may require a lot more information on germination tests, seed genetics, environmental conditions prevailing during seed set, maturity of the seed at harvest, and post-harvest storage so that nursery treatment and conditions can be optimised for each seedlot. Growers could potentially benefit from information that should be made available by researchers and seed companies about seedlot history and recommended treatments.

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