Seed Orchard Systems for Herbaceous Indigenous Wildflowers

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INTRODUCTION

One limitation to the large scale revegetation of the Australian landscape is a lack of suitable seed. To restore the diverse flowering grasslands and herbaceous understoreys typical of south eastern Australia, enormous quantities of seed will be required (Lunt, 1994). Revegetating with seed collected from nearby remnant plant communities helps ensure that local forms of species are preserved and that plants are well adapted to the prevailing environment. A risk is that seed collection activities may harm remnant areas. Damage can be from physical impacts, such as trampling, and biological impacts, such as over collection or the inadvertent introduction of weed seeds and diseases by collectors.

The cultivation of wild species for seed production has the potential to reduce collection pressure on remnant communities and to ensure that reliable supplies of quality seed are available when needed. If local adaptations are to be preserved, seed produced in cultivation must reflect the genetic diversity of the population from which the original collection was made.

SEED PRODUCTION FROM HERBACEOUS PLANTS

Herbaceous plants from south eastern Australian understoreys and grasslands lend themselves to cultivation for seed production for a variety of reasons.

1) Most species are relatively easy to propagate and cultivate.

2) Most species flower and produce seed rapidly in cultivation, many within the first year.

3) Many species produce copious seed from a relatively small area, although this must not be taken for granted.

4) Because each individual occupies little space, numerous plants of each species can be grown. This may be important for the maintenance of local genetic diversity.

5) For species whose seeds store well, cultivation for seed production may be necessary only every few years, freeing resources for the cultivation of a wider range of species.

CAPTURING AND RETAINING GENETIC DIVERSITY

Writing on sampling strategies for the establishment of ex situ collections of endangered plant species, Brown and Briggs (1991) made a number of recommendations that seem to provide useful rules of thumb for local species seed producers. They concluded that collecting evenly from 10 to 50 individuals from the one site should capture most of the genetic diversity in that population. The collection can be in the form of seed or vegetative parts, as long as the individuals are genetically distinct. The cultivation of as few as 15 genetically distinct plants could be expected to maintain most of this diversity. If resources allow for collection and cultivation

of larger numbers of plants from each species, that is all to the good (Brown, A.H.D. 1996, pers. comm. 1 May).

An interesting question is whether the continued establishment of seed crops from seed produced in cultivation eventually changes the fitness of the progeny for survival in the wild. Until more information is available, it may be sensible to start again with wild seed after two or three generations in cultivation. For small, intensively grown crops it may be preferable to grow from wild collected material each time seed is produced.

SEED PRODUCTION SYSTEMS

The idea of cultivating herbaceous species for seed production seems straightforward. In practice a number of questions arise. Will the plants set seed in cultivation, how many, and for how long? Should the plants be grown in the ground or in containers? The research reported here has concentrated on wildflower species collected from grasslands and woodland understoreys in the vicinity of Melbourne (Table 1). Seedlings are raised following standard nursery practice. The rate and evenness of germination varies markedly between species. As seedlings emerge they are transplanted into cell trays. Ideally the seedlings should be moved into their final containers, or planted into field beds, as soon as they fill the cell volume. In practice, these plants can be stored in the cell tray for a number of months.

Both container-growing and field-growing systems have been trialed. Field growing reduces the day to day maintenance requirements, such as watering, and there is potential for large areas to be cultivated. The control of weeds is critical as they quickly outgrow the crop and it is vital that weed seeds are not present in harvested seed. A number of species failed to establish in field beds while others prospered (Table 1). It is likely that these problems can be overcome but more research is needed.

Container growing has much to offer for the small scale, intensive production of high quality, weed-free seed. Many of these herbaceous species will produce seed in containers as small as 25-mm tubes. Most trial plants have been grown in 140-mm standard containers, with one plant per container, in a conventional pinebark and sand medium with controlled-release fertiliser and micronutrients. The trials are grown on a sand capillary bed covered with weedmat. Overhead watering systems are inappropriate as seed must mature under dry conditions. An alternative is to grow in much larger containers with drip irrigation. Depending on the size of the container, each can hold a number of individuals of a given species. This may be a practical solution when the construction and maintenance of a capillary bed is not feasible. Drawbacks to multiple planting include some reduction in production flexibility and a tendency for diseases to move from one plant to another within the container.

PRODUCTION SCHEDULING

Flexible scheduling is one of the great benefits of producing seed within a containerised system. In spite of their seasonal character in the wild, many of these herbaceous grassland species continue to grow, flower, and produce seed for as long as they have access to appropriate levels of warmth, moisture, nutrients, and pollinators. For many species it is feasible to schedule intensive seed production for a portion of the season, collect the required seed, then replace that crop with another

Table 1. South eastern Australian understory and grassland herbaceous species cultivated for seed production. Plant names according to Ross (1993).

Species	Rate	Culture *(a) Pot	Culture *(b) Field	Flowering *(c)	Production *(d)	Cleaning *(e)
Arthropodium strictum	S	Y	Y	1	+++E	
Brachycome dentata	FY	Y	1	+++	E	
Brunonia australis	F	Y	Z	1	++	D
Bulbine bulbosa	F	Y	Y	1	+++	E
Burchardia umbellata	S	Y	Z	2	NT	E
Caesia calliantha	P	Y	Z	1	+++	E
Calocephalus citreus	F	Y	Y	1	++	D
C. lacteus	F	Y	Y	1	++	D
Chrysocephalum apiculatum	F	Y	Y	1	++	D
Convolvulus erubescens	Fii	Y	Y	1	++	E
Craspedia variabilis	F	Y	Z	1	++	D
Dianella revoluta	P	Y	Z	>2	++	E
Eryngium ovinum	F	Y	Y	1	++	D
Helichrysum scorpioides	F	Y	N	1	+	D
Hypericum gramineum	F	Y	Y	1	++++	E
Leptorhynchos squamatus	F	Y	Y	1	+++	D
Leptorhynchos tenuifolius	F	Y	N	1	+++	D
Leucochrysum albicans	F	Y	Z	1	++++	D
Linum marginale	Fiii	Y	Z	1	+++	E
Microseris lanceolata	Fi	Y	Y	1	+++	E

Patersonia occidentalis	S	Y	Y	2	+++	E
Pelargonium rodneyanum	P	Y	Z	1	+	D
Podolepis jaceoides	F	Y	Y	1	+++	D
Ptilotus macrocephalus	F	Y	N	1	+	D
Pycnosorus chrysanthes	F	Y	Y	1	++	D
Ranunculus lappaceus	F	Y	Z	1	+++	E
Rutidosis leptorrhynchoidus	F	Y	N	1	++	D
Stackhousia monogyna	P	Y	Z	2	++	E
Stylidium graminifolium	F	Y	N	1	++++	E
Thysanotus tuberosus	P	Y	Z	1	+	E
Velleia paradoxa	F	Y	Y	1	++++	E
Wahlenbergia stricta	F	Y	Z	1	++++	E
W. luteola	S	Y	Z	1	++++	E
Wurmbea dioica	S	Y	Z	>2	NT	E

*Notes:

(a) Rate

F - most freshly harvested, viable seed germinates within 6 weeks.

S - most freshly harvested, viable seed takes longer than 6 weeks to germinate.

P - protracted, spasmodic germination to be expected.

i - germination enhanced by stratification at 4C for 14 days.

ii - germination enhanced by scarification.

iii - germination enhanced by leaching in aerated water.

(b) Culture

Y - successful pot/field cultivation for at least one season.

Z - yet to produce seed in cultivation.

N - unsuccessful in pot/field culture.

(c) Flowering

1 - flowers during first season.

2 - flowers second season in cultivation.

3 - flowers third season in cultivation.

(d) Production

++++ - copious seed produced in cultivation.

+++ - heavy seed production in cultivation.

++ - light seed production in cultivation.

\+ - seed production rare in cultivation.

NT - not trialed in pot/field culture.

(e) Cleaning

E - seed easy to clean by hand.

D - seed difficult to clean by hand.

species. This same strategy can be applied if different provenances or collections of a particular species must be flowered separately to avoid cross pollination.

HARVESTING AND HANDLING SEED

Optimum harvest time and method has to be determined for each species and will depend on inflorescence type and the harvesting equipment available. Generally, seed will be harvested when it is about to be shed from the plant. For small-scale crops, both hand and vacuum harvesting allow a high recovery of mature seed. One of the considerable benefits of intensive cultivation is that seed can be harvested conveniently and regularly. Many species have small seeds that must be harvested with large volumes of other material such as flower parts, bracts, unfilled fruits, and seeds. Inspection under low magnification will confirm if filled seeds are present. Unless seeds clean readily by sieving, it may not be worthwhile spending the time needed to clean small lots of seed to normal commercial standards. The number of seeds per mass of harvested material can be determined by sampling. Seed should be air dried immediately after harvest and stored in a cool, dry place. Sachets of the desiccant, e.g. silica gel, will maintain a relative humidity of 45% in a sealed storage environment, ideal for medium term storage of most seed. While much is still to be learned about the storage potential of these species' seed, it seems that most will store for at least 2 or 3 years with little loss in viability.

CONCLUSION

The production of herbaceous wild species seed in cultivation can relieve seed collection pressure on local remnant plant communities and provide a reliable source of quality local seed for large scale revegetation. The processes described in this paper are well within the technical capability of most individuals and organisations producing plants for revegetation.

LITERATURE CITED

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