Developing a Collection of Genetic Material

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INTRODUCTION

A systematic collection of plant material is normally done to improve crops which are already cultivated by adding such attributes as disease or insect resistance, higher yields, or cosmetic appearance, or to bring entirely new crops into cultivation. These objectives are part of the current focus of the Centre for Australian Plants, a cooperative venture between Agriculture Western Australia, the University of Western Australia, Kings Park and Botanic Garden, the Department of Conservation and Land Management, and industry.

The collection of plant material which will represent some of the genetic variance of a species needs to be well planned and well resourced. The reason for collecting the material should be clear, with some understanding of the biology and geographical location of the species.

Resources, both financial and physical, are needed for the actual collection, plus the maintenance of the collection for a number of years.

GERALDTON WAX

The collection of Geraldton wax (*Chamelaucium uncinatum* Schauer) is a project funded over the years by the Horticultural Research and Development Corporation, the Rural Industries Research and Development Corporation, the University of Western Australia, Agriculture Western Australia, and industry.

Geraldton wax has been cultivated in home gardens since the early days of settlement, both in Australia and overseas, and in the last 15 years has become highly sought after as a cut flower (Manning et al., 1996). However, the cultivars planted for cut flowers were selected mostly for flower colour while other important characteristics, such as flowering period, yield, stem length, colour range, plant form, disease resistance, and flower size, were largely ignored. The aim of collecting the genetic variance of this species was to improve on these aspects for the cut-flower trade, and to bring into cultivation plants suited to the pot- and amenity-plant trade.

Geraldton wax is primarily an outcrossing species, with some degree of selfing evident. Its height ranges from 0.5 to 5 m, and its form from prostrate to bushy to an upright single trunk. Flowering time is usually spring, however some populations are much later, flowering in early summer, while some individual plants flower in late autumn.

The level of funding for this activity was initially $100,000 per year over 3 years, later extended for 3 more years. Extra funds have been recently supplied for a breeding program using superior genotypes from the original collection. The funds included provision for a four-wheel-drive vehicle plus a salary and operating for a full-time research officer.

Following receipt of funding, the first task was to locate populations. A start was made using records of the Western Australian State Herbarium. Paradoxically, given that it is such a well known plant, there were few accurate records of population locations for this species. The majority were located through exploration and contact with wildflower pickers, farmers, and members of the Western Australian Wildflower Society.

All plant species researched in detail have shown widespread variability at the geographical level and within each population (Allard, 1970). It is, therefore, vital to sample all known populations, and the genetic variance within each population. A prime focus of the Geraldton wax project was, therefore, to locate as many populations as possible.

The sampling method chosen was a reflection of the need to collect as much of the genetic variance of the species possible within the confines of the space available for growing the sampled plants and the financial resources to maintain them. Random sampling allows the greatest variance of hidden characteristics, such as disease resistance and vase life, to be collected. Such characteristics can then be screened for under cultivation (Creech, 1970).

For each Geraldton wax population six plants were sampled at random, plus those outliers at the extremities of the population. The outliers were selected because these plants will be the least related within the population. In addition plants with rarely occurring though horticulturally important attributes, such as purple or white flowers, early or late flowering time, or multi-layered petals were sampled. Such biased sampling for particular attributes needs to be combined with random sampling to ensure the maximum possible genetic variance is collected for the particular purpose of the project (Bennett, 1970).

Cutting material was taken from each plant, and once propagated and grown on was planted out in the autumn under fertigation. Three replicates of each genotype were planted, both for statistical purposes and to secure the genotype in cultivation. Plants were assessed for attributes including flowering time, vase life, yield, flower colour, plant morphology, flower size, resistance to dieback disease (*Phytophthora cinnamomi*), and tolerance to alkalinity. Superior genotypes were selected for further trialing and a breeding program was undertaken to produce intraspecific, interspecific, and intergeneric hybrids.

To date over 60 populations of Geraldton wax have been located. These populations range from Perth to Kalbarri, and east to the Midlands Road. Within these populations eight different ecotypes, based on morphology and ecology, have been identified.

Nearly all populations are within 50 km of the ocean, and none are more than 100 km. Rainfall averages between 450 mm and 900 mm per year. Most of the Geraldton wax populations occur in deep sand. Two ecotypes have occasional silt associations, mostly due to their strong association with water bodies while one ecotype has a sandstone association.

Six of the eight ecotypes have good access to summer water, rarely needing to go more than 5 m to the water table. Some of these occur close to water bodies while others grow on a perched water table. Two of the eight grow over 20 m above the water table.

Flower size varies between ecotypes. The small-flowered taxa have sizes ranging from 9 to 16 mm, while four ecotypes have some flowers over 20 mm. Flowering time also varies with ecotype. Four ecotypes flower early to mid season, two flower predominantly in mid season, and two ecotypes flower mid to late season.

There are wide differences in form. One ecotype, which occurs on coastal dunes, is rarely more than 1.5 m high and often smaller than 1 m. This characteristic is maintained in cultivation. Three ecotypes have a bushy, multibranched form, often attaining 3 to 4 m in height. Three other ecotypes are usually few stemmed and upright, also often reaching 3 to 4 m, although they will bush out in response to

pruning. The final ecotype is very spindly and upright, few stemmed and usually 2 to 2.5 m in height. They are, however, very vigorous in cultivation.

Flower colour ranges from white to deep purple. Pale purples and pinks are the predominant colours. White is found rarely in most populations, although two have a much higher percentage. Dark purple is the rarest colour, not expressed in some populations and rare in others. Two of the northern ecotypes have much longer and thicker leaves, sometimes over 50 mm in length. Leaves of other types rarely exceed 30 mm.

The success of the sampling strategy can be judged on how many randomly sampled plants had superior characteristics. In the original collection 52% of the plants were selected randomly, 10% were outliers, and the remaining 38% were selected on horticultural merit. Of the superior genotypes, 35% originated as random selections, 12% as outliers, and 53% as plants selected on horticultural merit. This result verifies the crucial nature of random sampling when collecting the genetic variance.

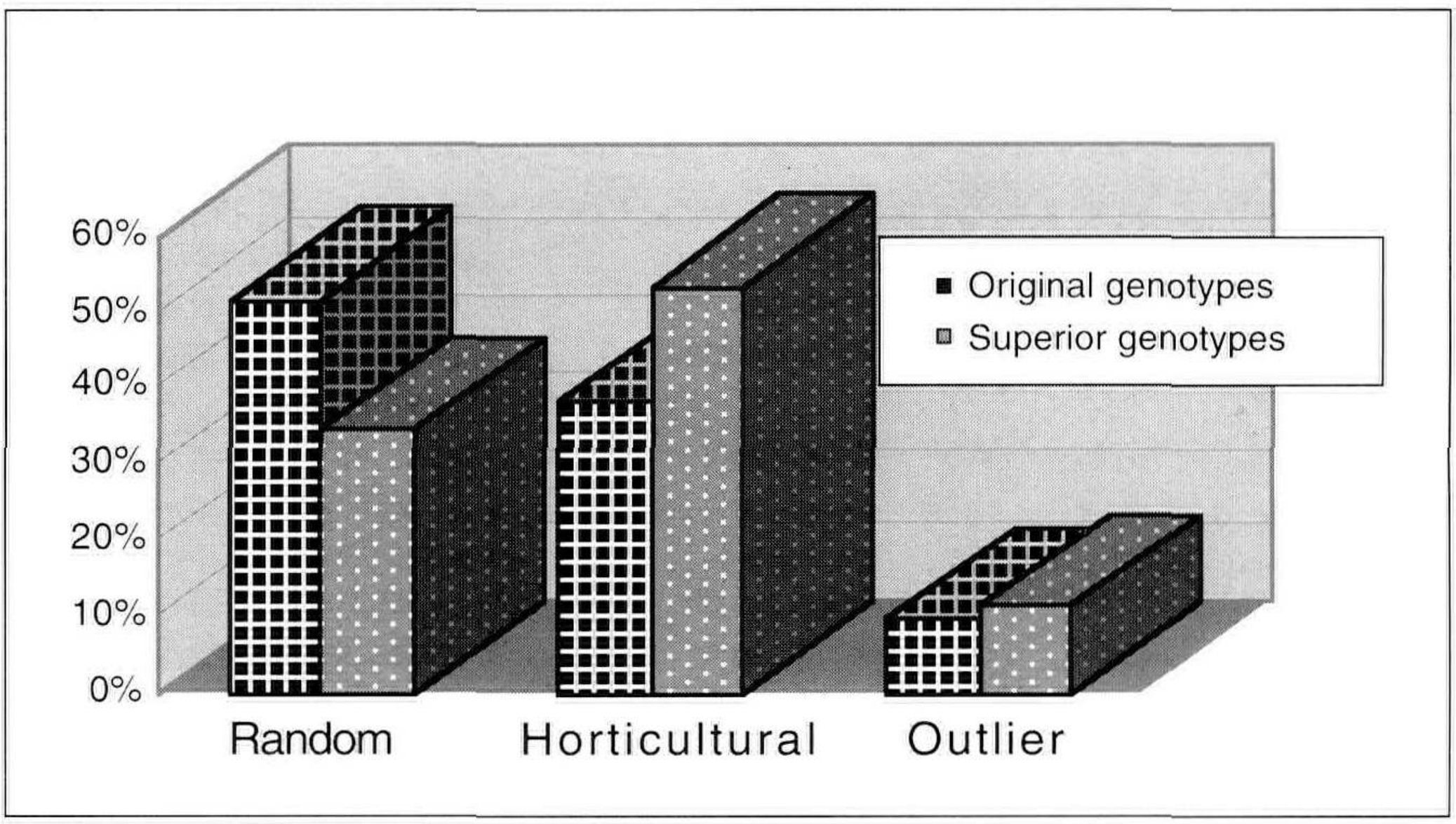

Figure 1. Percent variation in selection criteria between original and superior waxflower genotypes.

OTHER CROPS

Collections of other species made by the Centre of Australian Plants have shown similar variation at both the geographical and intrapopulation level. These include *Verticordia* spp. (Growns, Seaton pers. comm.), *Chamelaucium* spp. (Growns, Webb pers. commun.), yellow bells (*Geleznowia verrucosa*) (Growns, Crawford, Broadhurst pers. commun.) smokebush (*Conospermum* spp.) (Seaton pers. commun.) and *Boronia* spp. (Plummer, pers. commun.).

CONCLUSION

The wide variation both between and within populations of Geraldton wax and other species of Western Australian plants highlights the improvements which can be made to those species already in cultivation through collecting the genetic variance of a

species. However, this is an expensive and time-consuming process, therefore any project involving the collection of genetic material needs to have a clearly defined purpose and the resources committed to achieve the goals.

However, apart from critically endangered plants, any collection of genetic material will only represent a small amount of that present in nature. Changes in funding and vision may also affect the viability of such a collection. Therefore ensuring the conservation of ecological systems which will support the long-term survival of species is crucial to preserving the genetic variance of these species, and to preserving our ability to gain maximum benefits from them.

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