CONCLUSIONS

Seed technologists around the world have studied methods of successfully storing seeds, as in vacuum, addition of carbon dioxide, removal of oxygen from the stored area, addition of nitrogen, deep freezing and the use of dessicants in the stored area. A problem encountered in successfully storing seeds of aquatic plants was the temperature of the water in which the seeds were held. Drying temperature appears to be an influencing factor with certain citrus seed species. A build-up of carbon dioxide in sealed storage is another difficult question. These and many more problems are not yet solved by man. Since the advent of dry-conditioning in Australia some 15 years ago, many thousands of dollars have been saved by all users of seed. My own experience with gerbera seed indicates we can now store it for periods in excess of 3 years where once one or two months was its life.

SOME SALT-TOLERANT NATIVE AUSTRALIAN PLANTS

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When discussing salt tolerance in native plants, it is necessary to understand that without a careful analysis of the nature of salinity in any given area it is seldom possible to predict, without the use of field trials, the success rate of any given species in new situations. However, despite this proviso, it is true that certain species have a considerable tolerance to wide ranges of salinity.

Again, it is necessary to arrange salt tolerant plants in two categories:

(1) Plants to be grown in soils with high salinity — for example, reclamation work around salt lakes and on farms.

(2) Plants to be grown in soils of rather lower salinity where sensible soil husbandry may produce a more favourable pH reading by admixtures of peat, compost, etc., but situations in which the plants are subject to wind-blown salt, and hence saline windburn. Category 2 refers, therefore, to plants to be grown on our sea coast in Belt 1 (after Menninger). These notes concentrate on plants which might be grouped in category 2, though some listed could be used for both purposes.

Before any generalizations are made regarding suitable species for use in either of these situations, it should be emphasized that

only too frequently morphological differences between plants of the same species have not been closely studied and that experience in the field tends to suggest that these differences are nowhere more clearly indicated than in the area of salt tolerance. This understanding is vital to the nurseryman. It is not sufficient to know that a species will grow at or near the sea. It is necessary to know that the plants one is selecting to repeat the performance are from parent plants which do, indeed, grow under the conditions we require. *Performance of inland Boobiallas, for example,* have been pathetic near our Western coast. However, the same species reproduced from material from coastal plants has been a success story in saline soils with a pH of 8+.

For this specialised purpose it may be necessary for the propagator to collect seed and vegetative material. In the case of seed it is a hit and miss business to depend on the commercial seed collector unless one can direct him to a source of seed. These difficulties would be overcome, of course, if we could encourage seed collectors to specify the area of collection on their labels, or if we are able to develop some cultivar names. As a purist I would regret the latter expediency and would much prefer a symbol or symbols (say) ST to indicate seed from plants in areas where they evidence salt tolerance.

Nothing in the foregoing should lead us to overlook the adaptability of certain inland plants to "near the sea" situations. There is an evident affinity between some desert environments and the coast. The success of arid land or desert species in dune and limestone situations has been dramatic. In Western Australia the large-flowered form of *Eucalyptus caesia* thrives in the dunes in Belt 2. and is equally successful growing on limestone reef areas in the wind-swept flats east of Kwinana and Rockingham.

*A note of warning should be included regarding the assess*ment of plant adaptability simply by observation. For example *Lagunaria patersonii* (= *Fiugosia p.*) — Norfolk Island hibiscus — is growing splendidly on the edge of one of the islands in the Swan Estuary. Its roots are necessarily in salt water, and it might well be reasoned that it will therefore grow permanently in an environment more suitable for mangroves. However, it should be realised that under these conditions it is subject to intense fresh water flushing from May to September. Similarly the beautiful *Casuarina equisetifolia* in the beach of the Inner Harbour at Bombay are surrounded by sea water in spring tides but are probably growing in fresh water underground seepage.

While this paper places emphasis on native plants it would be wrong to overlook certain exotics for beach conditions. The New Zealanders' *Pittosporum crassifolium, Metrosideros* spp., and *Phormium* spp. should be high on the list of plants suitable for

use near the sea. Western Australian experience must rate the *Pittosporum* as one of the most resilient and adaptable. Nor would it be wise to overlook the Athel tree — *Tamarix aphylla*, for both categories of use in the fight against salinity.

In the range of native plants for beach plantings, three shrubs have proved outstanding in the Western State. One would find it difficult to divide the three on merit. These plants are:

1. *Leptospernum laevigatum*, sometimes called Victorian Tea Tree, but having a continental range.
2. *Melaleuca nesophila* from South Western Australia.
3. *Melaleuca diosmifolia* from the same area. This species is only viable when the material for propagation is from hardy coastal plants. When this is so it is a very tough plant.

As a basis for seaside windbreaks the three plants are incomparable. *M. diosmifolia*, being slightly smaller than the other two, should be planted nearest the sea with *M. nesophila* and *L. laevigatum* as a backing. It should be stated at the outset that much better results are achieved with clump plantings rather than attempting to establish individuals as feature plants, though this latter type of planting is sometimes successfully achieved with *Melaleuca nesophila* without landward-side burning.

No beach planting could be considered complete without the inclusion of *Scaevola crassifolia*. This hardy shrub is found on the second line of dunes along the West Coast. Wherever it can find a little protection from sand blast, it colonises the foreward dunes. It is attractive in flower, and selected plants are almost as attractive as *Leschenaultia biloba*. It is entirely resistant to wind blown salt, highly tolerant of high pH, and reasonably resistant to sand blast.

Two wattles have a high reputation on the West coast. They are both indigenous to the area. These are (1) *Acacia cyclops*, generally growing from one to three metres, dependent on its proximity to the sea and the wind velocity; (2) *Acacia pulchella (A. lasiocarpa)*, a small "prickly Moses" type of plant.

Another shrub, also indigenous and very resilient to near-sea conditions is *Rhagodia baccata*. While little can be claimed for its floral capacity, *Rhagodia* produces a lush green mass under all conditions and its fruit-bearing heads add to its attraction.

Hemiandra pungens is indigenous to limestone and dune areas. It is adaptable over a wide pH range and, because of its "close to the ground" habit, it is resistant to high wind.

Given appropriate feeding *Anigozanthos flavida*, the so-called tree kangaroo paw is very hardy near the sea.

The native geranium *Pelargonium capitatum* is a useful soil binder and very hardy.

Tetragonia decumbens is a plant which will colonise the first dunes. It is able to do this because of its capacity to cope when covered by wind-blown sand. In this regard it may be the most useful plant for dune reclamation.

Calothamnus quadrifidus grows naturally in limestone areas, particularly those high above the sea, and is relatively unaffected by wind-blown salt. In the field, *Pimelea ferruginea* shares the cliff tops with *Calothamnus*.

These are only a few of the plants which may be used to combat adverse conditions in a beach garden. Windburn is a particular problem at the seaside. It is caused not only by salt borne in the wind but by the intense billowing effect when the plant becomes an obstruction in the path of the wind. The result is frequently intense burning on the landward side rather than on that side of the plant exposed to the sea. To combat such effects, native species plantings should be arranged in carefully ascending order. The more exposed slopes in the face of the sea should be covered with ground covers, (e.g.) *Hemiandra, Tetragonia, Galenia,* etc. These should be followed with low shrubs, then intermediate types, and finally taller plantings. The effect of such systematic design is to force the wind up and over the roof of the house thus mitigating the billowing effect. Such a planting is only a mirror of conditions in the field.

An examination of lists of plants recommended for seaside use by Meninger, Harrison, et al. show that for temperate plantings, at least, Australian species are given high priority. It is perhaps regrettable that their usage in Australia leaves something to be desired. Our own seasides have been neglected. We are all familiar with the success of Norfolk Island pines but few of us have made the great use of *Casuarinas* so common on exposed Florida coastlines. There are indeed great tasks ahead and experiments still to be set up. Most of the empirical knowledge we have is either recent or gained from a few persistent species planted by early coast gardeners from a very restricted range and choice.

A recent introduction to horticulture in Western Australia is *Melaleuca cuticularis*. This large shrub, or small tree, is an indigenous plant with a range extending from the Swan River around the coast far to the south for several hundreds of miles. It is found, too, at the verge of southern inland lakes both salt and brackish. In some areas it grows in soil continuously inundated with salt water. Near our south coast it grows strongly in several inches of salt water at the head of estuaries. In my opinion it is without peer for such use and its paper-bark trunk and stark silhouette makes it a plant well worth promoting. A plant with similar potential to *M cuticularis* is *M. viminea* (*M. lehmanii*). It is more

dense in foliage than the former but it is almost equally salt tolerant.

Near Albany, *Melaleuca baxteri* occurs. This beautiful and spectacular tree is at least the equal of *M. linarifolia* in beauty of form. It is a very rare tree and should be introduced to gardens. I know it only from half a dozen trees in one area at the head of an estuary. While it is growing only a few metres from *Melaleuca cuticularis* it is dependent on a fresh water creek and could not, therefore, be recommended for planting where salt water will intrude.

Atriplex isatidea, which occurs infrequently on the West coast, is a rugged salt bush forming clumps of tree-like shrubs with substantial trunks to 10 cm in diameter and reaching a height of 3 metres. Growing on the forward dunes in the very face of the sea, this fine grey shrub seems to be a promising subject. Shortage of vegetative material may delay its introduction.

Calocephalus brownii — pincushion bush — has merit in all beach plantings. Indeed it is worth planting wherever saline conditions exist as it is extremely salt tolerant. Occasionally it has been known to colonise rocks and reef. In mobile dunes, however, it is frequently wind affected, having a tendency to twist on its stem. Thus it needs to be planted in association with plants of other species or in rock-surrounded pockets which protect it from physical damage as a result of high wind.

Myoporum insulare — Boobialla — is a useful shrub for most salty situations. However as previously noted, the plants used must be propagated from vegetative material collected from known salt tolerant plants and preferably from those which are growing naturally in the immediate vicinity of the planting.

Melaleuca huegelii is a plant of variable form. Occasionally a tall shrub, and rarely a substantial small tree, it is frequently of bonzai proportions near the sea. Although it thrives in areas of sand blast and wind-blown salt it is not particularly tolerant to salty soils. On the other hand it thrives in areas of high pH, and it may be that it will grow in soils with a greater salt content once some adequate humus has been supplied. Frequently in making seaside plantings of melaleucas, particularly, we may overlook the fact that seed of melaleucas in the field normally germinate in areas which have a considerable build up of leaf mould from the parent plant.

The pigfaces, *Carpobrotus* species have shown marked tolerance. *Carpobrotus edulis* has been used in Western Australia for the purpose of stabilising seaside dunes. *C. chilensis* (*C. equilaterus*), though not quite as vigorous as *C. edulis*, shows even more salt tolerance and, in some instances, grows under reach of storm tides. Some of the "pig faces", notably

Drosanthemum floribundum (Mesembryanthemum f.) and *Disphyma blackii* may have future value. *D. blackii* grows in salt-catching flats around the edge of inland salt lakes. It grows in association with *Kochia amoena*, a "salt bush" which has considerable potential for cultivation. The latter plant is being used in some W.A. gardens as an ornamental but it would appear that its major purpose will be in "near-the-sea" plantings.

Having recognised two categories of plants under the salt-tolerant heading I have almost entirely neglected the first grouping of plants — those useful for reclamation work. However, many of the plants already mentioned are interchangeable within the categories. In reclamation situations *Melaleuca cuticularis* is, perhaps, the gem of the collection. Its value cannot be over estimated.

One final proviso seems necessary. The empirical evidence available seems to indicate that though a species may be very tolerant to salt and salt soils this does not necessarily indicate that the plants will not perform better in improved soils. For example to say, as has been said here, that a plant will tolerate a pH of 8+ is not to exclude the possibility of it reaching its maximum success in soils of pH 6.5. Thus even the use of carefully selected, known salt-tolerant species does not eliminate the task of improving soils. What a careful planting does offer is the possibility that the improvement in major plantations may be effected by natural means.

The plants I have mentioned are only a few of the natural species which show indications of salt tolerance. There are many species still to be "tamed" and tested. We have in our flora an almost unlimited source of experimental material. At the present time it is something of a national disgrace that more use of our plants has been made by Floridans, Californians and Israelis than by ourselves. It is time that we got on with the job.

Finally, may I commend to your notice in the attached reference list the Handbook by Gordon Smith which gives a fairly comprehensive treatment of the West Coast dunes and what grows on them. No one, I think has yet prepared that essential reading, namely "What Will Grow on Them."

PLANT LIST

Acacia cyclopis
A. pulchella
Anigozanthos flavida
Araucaria excelsa
Calocephalus brownii
Calothamnus quadrifidus
Carpobrotus chilensis (C. aequilaterus)
C. edulis
Disphyma blackii
Drosanthemum floribundum
Eucalyptus caesia
Hemiandra pungens
Kochia amoena

Lagunaria patersonii
Leptospermum laevigatum
Melaleuca baxteri
M. cuticularis
M. diosmifolia
M. huegelii
M. nesophila
Metrosideros spp.
Myoporum insulare
Phormium spp.
Pimelea ferruginea
Pittosporum crassifolium
Rhagodia baccata
Scaevola crassifolia
Tamarix aphylla
Tetragonia decumbens

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