chapter 6

Trees for Salt-Affected Land

Overview

In this chapter, profiles of 18 different tree and shrub species with potential for growth on salt-affected land are presented.

Raising and planting trees

Farmers must be careful in specifying the tree *species* and *provenance* they wish to plant. A range of tree species and provenances may all have the same name in the local language.

Trees are generally raised in nurseries and transplanted into the field. Seedlings can either be raised in *polythene bag nurseries*, or in *field nurseries* as bare-rooted seedlings.

Field sites for planting out the trees and shrubs should be levelled, worked to break up hardpan or dense soils and appropriately treated with fertilisers and gypsum. The seedlings should be planted according to a predetermined plan with mounds, irrigation trenches, etc. appropriate for the soil type. Finally, grazing must be controlled.

Salt-tolerant trees for fuel and forage production

Plant characteristics, salt and waterlogging tolerance, adaptation, uses, propagation and management, and productivity are important factors for saline agriculture. Profiles of these features are presented for the following salt-tolerant species: salt wattle (*Acacia ampliceps*), kikar (*Acacia nilotica*), siris (*Albizzia lebbek*), jangli saru (*Casuarina equisetifolia*), suphaida (*Eucalyptus camaldulensis*), iple iple (*Leucaena leucocephala*), vilaiti kikar (*Parkinsonia aculeata*), jand (*Prosopis cineraria*), jangli kikar (*Prosopis juliflora*), dhancha (*Sesbania bispinosa*), jantar (*Sesbania sesban*) and frash (*Tamarix aphylla*).

Salt-tolerant fruit trees

Profiles are also presented for the following salt-tolerant fruit tree species: phalsa (*Grewia asiatica*), chiku (*Manilkara zapota*), khajoor (*Phoenix dactylifera*), amrood (*Psidium guajava*), jamon (*Syzygium cuminii*) and ber (*Ziziphus mauritiana*).

6.1 Raising and Planting Trees

6.1.1 Sources of seed

Farmers wishing to obtain seed of salt-tolerant plants must be careful to specify the exact species they need. They may identify the required plant by a local name, but end up receiving a plant of unexpected form or performance. The reason for this is that different tree species can have the same name in the local language. This is illustrated in Table 6.1

Table 6.1. Examples of local names and the species they apply to.[a]

Local name	Species to which local name applied
Saphaida	*Eucalyptus camaldulensis*
	E. rudis
	E. microtheca
	E. tereticornis
Kikar	*Acacia nilotica*
	A. tortilis
Jangli kikar	*Prosopis juliflora*
	P. chilensis
	P. alba

a These examples have been selected from Ahmad (1996)—there must be many others

Even within a single species like *Eucalyptus camaldulensis*, there can be great variation depending on the provenance of the seed. For example, the provenance Lake Albacutya produces tall relatively unbranched trees of high value. On the other hand, the provenance Wiluna produces short highly branched trees of little commercial value (Photo 6.1).

There can also be profound differences in salt tolerance between provenances of the same species. For example, with *Acacia ampliceps*, the salinity (EC_w) at which plants stop growing varies from 65 decisiemens per metre (Lake Dora and Wave Hill provenances) to 128 decisiemens per metre (Halls Creek provenance) (Aswathappa et al. 1987).

Photo 6.1. *The importance of seed provenance in trees. Both photographs show* Eucalyptus camaldulensis *at the same age. (A) Provenance Lake Agnes. (B) Provenance Wiluna. [PHOTOGRAPHS: R. MAZANEC]*

6.1.2 Nursery techniques

Trees and shrubs can be established in the field by planting seed, planting cuttings,[1] transplanting nursery-raised seedlings in polythene bags, and transplanting nursery-raised bare-rooted seedlings. The optimal method of propagation depends on the soil salinity of the field and the species to be planted.

For salt-affected soils, the chances of establishment are best using nursery-raised seedlings in polythene bags. Polythene bags are also required for the establishment of small seeded trees and shrubs like *Eucalyptus camaldulensis*.

Alternatively, the trees are established in the nursery in raised beds, removed from these, and transplanted into the field as bare-rooted seedlings. Species for which this is possible include: kikar (*Acacia nilotica*), jand (*Prosopis cineraria*), jamon (*Syzygium cuminii*), ber (*Zizyphus mauritiana*), amrood (*Psidium guajava*) and phalsa (*Grewia asiatica*).

1 Species for which this is possible include: sheesham (*Dalbergia sissoo*) and poplar (*Populus deltoides*).

Photo 6.2. *Polythene bag nursery being irrigated. [PHOTOGRAPH: E. BARRETT-LENNARD]*

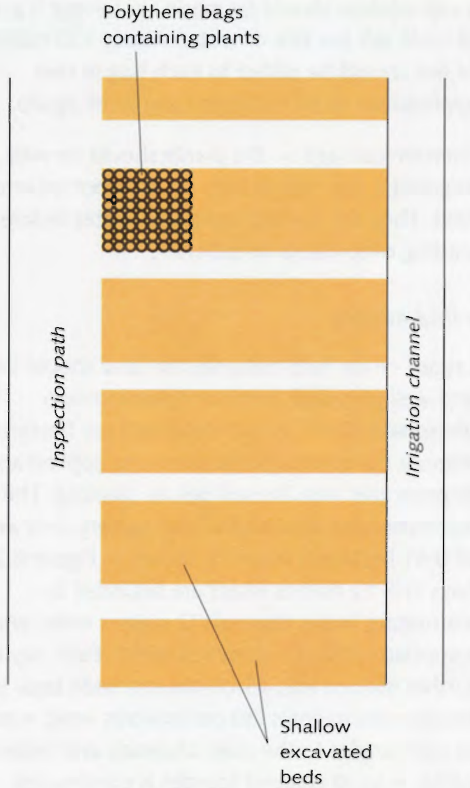

Figure 6.1. *Typical layout of a polythene bag nursery.*

The polythene bag nursery

- *Location* — nurseries should be easily accessible, free of frost and sheltered from wind. They should have a good supply of irrigation water (Photo 6.2). The soil in the area should be level, non-saline, well drained, and loamy in texture.
- *Layout* — the typical layout of a polythene bag nursery is shown in Figure 6.1. The nursery is bounded by an inspection path (1.5 metres wide) on one side and an irrigation channel (0.75–1 metre wide) on the other. The 4 to 5-metre wide area between these is subdivided into shallow excavated beds about 1–1.5 metres wide and 20 centimetres deep, each bounded by small paths (45 centimetres wide). The filled polythene bags are stood upright in the beds. Each bed can be separately irrigated from the nearby irrigation channel.
- *Preparation of soil mixture* — silt from canals or watercourses is completely mixed in equal amounts with good-quality loamy soil. Well-rotted organic matter (one-third by volume) is added to this mixture to improve soil moisture retention.
- *Preparation of polythene bags* — the bags generally used are 10 centimetres wide and 22 centimetres high. These are sold on a weight basis (about 400 plastic bags per kilogram if they are made of 0.002-millimetre thick polythene). Excess water is drained from the bags through 3-millimetre diameter holes made with a cork borer or a hollow punch. Each bag should have 12–16 holes. After filling with soil mixture, the bags are placed upright in the nursery beds.
- *Seed sowing and thinning* — seeds are sown onto the surface of the soil in the bags in September to October, or February to March, when temperatures are 20–30°C. Fine seeds are covered with a thin layer of dust. The bags are irrigated by seepage through the nursery beds or by light sprinkling. The bags can be covered with rice straw mulch to decrease evaporation. Once germination has occurred, seedlings are thinned so that there is no more than one seedling per bag.
- *Weeding, moving and culling* — bags should be kept free of weeds and moved regularly (at least once per week when the seedlings are growing quickly) to prevent the seedlings rooting into the nursery beds. The establishing plants are sorted into different beds according to size; weak plants should be culled.
- *Hardening* — if seedlings are to be transplanted into salt-affected soils, it is advisable to harden the plants by applying some salt to each bag. We suggest that

a salt solution should be made containing 5 grams of table salt per litre of water. About 100 millilitres of this should be added to each bag in two applications of 50 millilitres (one week apart).

- *Transfer/carriage* — the plants should be well irrigated 1 day before they are transported into the field. They are stacked upright in crates before loading onto trucks or trailers.

The field nursery

- *Layout* — for field nurseries the land should be level and well prepared. Fertiliser (diammonium phosphate [DAP] at 125 kilograms per hectare) and manure (50 tonnes per hectare) are applied and incorporated into the soil before planting. The recommended layout of a field nursery over an area of 0.41 hectares (1 acre) is shown in Figure 6.2. Bays (10–12 metres wide) are bounded by alternating water channels (2 metres wide) and inspection paths (1–2 metres wide). Each bay is further divided into 45-centimetre wide beds by smaller subchannels (30 centimetres wide) running at right angles to the main channels and inspection paths. A small channel (pustle) is constructed alongside and parallel to the bigger channel to irrigate the subchannels.
- *Planting* — seeds or cuttings are planted in two to three rows per bed. Irrigation is applied as and when required through the subchannels. This provides seepage to the seeds or cuttings planted on the beds. Over-irrigation and under-irrigation should be avoided.
- *Weeding/culling* — the nursery should be kept free of weeds and weak plants should be culled out regularly.
- *Removal of plants from the beds* — the soil is watered so that it is soft and one edge of the bed is cut open with the blade of a spade. The spade is then used to loosen the soil around the cut face so that the plants can be withdrawn without breaking any of their major roots.
- *Production* — field nurseries are able to produce large numbers of seedlings. For example, we estimate that a nursery planted on 0.41 hectares (one acre) of land would have more than 10 kilometres of row length, and could produce more than 200 000 seedlings per year.

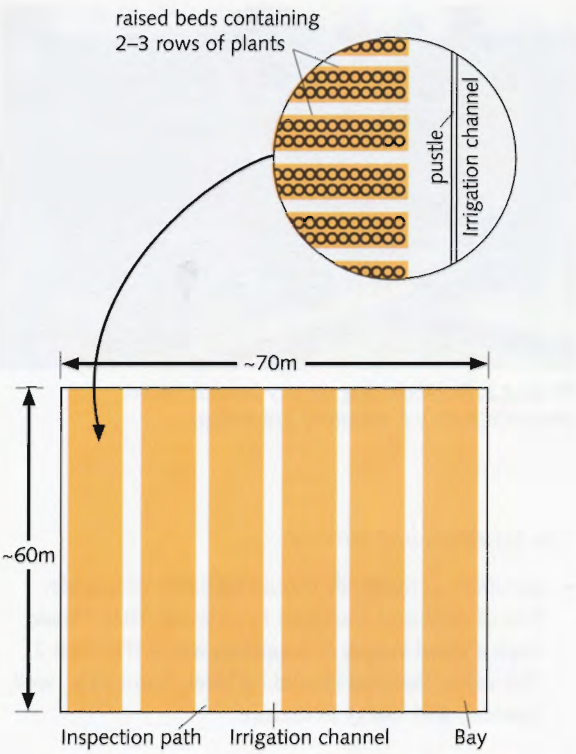

Figure 6.2. *Typical layout of a field nursery.*

6.1.3 Land preparation and planting

The steps involved in preparing land for the planting of trees and shrubs are summarised below.

- *Level the land* — poor land levelling is one of the major obstacles to the effective management and irrigation of salt-affected soils. Efforts should be made to precisely level the land by cultivating and planking or, if possible, by laser levelling.
- *Plan the furrow lines and the location of each tree.*
- *Plan the fertiliser strategy.*
- *Overcome problems of dense soils/hardpans* — salt-affected soils frequently have profiles with a zone of high density or a hardpan. This can be a major hindrance to the downward leaching of salts, the development of roots and the growth of plants (Photo 6.3). Such problems can be overcome by deep ploughing, ripping or chiselling, or using a

Photo 6.3. *Effects of tillage in overcoming dense soils. The larger trees on the left were planted into rotavated soil; those on the right had only conventional cultivation. [PHOTOGRAPH: E. BARRETT-LENNARD]*

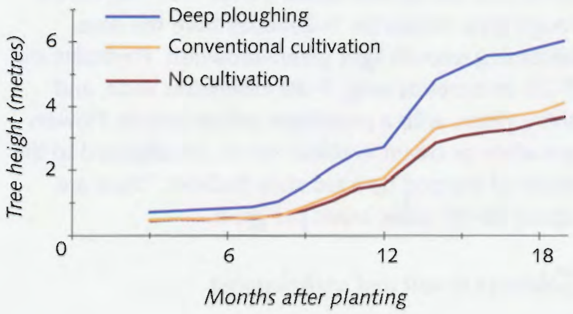

Figure 6.3. *Advantages of deep ploughing. The advantages of deep ploughing were particularly apparent on the growth of trees at a site near Aman Kot in the Peshawar Valley (unpublished data Prof. Abdur Rashid and Mr Pervez Khan). After 19 months growth, trees established with deep ploughing were nearly 2 metres higher than trees established with conventional cultivation or no cultivation.*

posthole digger to dig a hole about 15 centimetres in diameter and 1.5 metres deep for each tree. Figure 6.3 shows the advantage of deep ploughing over conventional or no cultivation.

- *Apply gypsum and farmyard manure* — one of two methods can be used to apply soil amendments.

  (i) Incorporate gypsum and well-rotted farmyard manure into the soil beneath the irrigation furrows. This can be done by laying down gypsum (0.75 kilograms per metre) and farmyard manure (2–3 kilograms per metre) in rows at 3-metre intervals across the field. The irrigation furrows (30 centimetres wide) are then ripped along these lines with a chisel plough. The ripping excavates the furrow to a depth of about 30 centimetres and incorporates the amendments into the soil on the bottom and sides of the furrow.

  (ii) Mix gypsum (0.75–1 kilogram per hole) and well-rotted farmyard manure (2–3 kilograms per hole) into the soil from each post hole[2]. The pits (holes) may be subsequently connected by 30-centimetre-deep channels for irrigation.

- *Plant the trees or shrubs* — the location of the planted seedling with respect to the irrigation trench depends on the degree of internal drainage in the soil (Photo 6.4):

  – soils with good drainage (high water intake rates) — the seedling should be planted in the bottom of 30-centimetre-deep irrigation trenches;

  – soils with poor drainage — the seedlings should be planted on the shoulder of the trench so they are not affected by waterlogging after irrigation; and

  – waterlogged soils — the trees should be planted on bunds or mounds to avoid waterlogging.

- *Control the grazing* — controlling grazing is essential if planted tree seedlings are to survive and grow. It is often forgotten that quite successful revegetation is possible simply by controlling grazing (Photo 6.5).

The density of tree planting depends not only on the tree species but also on whether the trees are to be planted in blocks, mixed with shrub species, or used in alley farming. In the Satiana area, we recommended that *Eucalyptus camaldulensis* should be planted in rows 3 metres apart, with the trees within rows at 2 metres apart (a planting density of about 1700 trees per hectare). After 1–2 years, saltbushes (*Atriplex lentiformis* or *A. amnicola*) can be planted between the trees.

In alley farming, belts of trees are planted across the landscape, leaving bays of unplanted land for the growth of crops. For example, Mr Adbul Rauf, a farmer from Jaranwala (near Faisalabad), is planting belts of

2 Note that if the roots of a transplanted seedling come into direct contact with gypsum or fertilisers, the plants may be severely burnt. Therefore, the gypsum and farmyard manure must be well mixed into the subsoil in the hole.