

and criticisms as to the quality and expected performance of the knitted shade cloth. There have been claims that the method of knitting creates sharp bends and tension on the yarn which will lead to early fatigue of the cloth and consequent breakdown of the fibre thread. However, my experience to date, although possibly a little premature, does not give me any indication of this claim being true. The manufacturer claims that the product is made from high density polyethylene which, after ageing, exhibits more resiliency and less tendency towards brittleness of the fibre threads than does polypropylene from which some other shade cloths are made.

MASS PRODUCTION OF EUCALYPTUS SEEDLINGS BY DIRECT SOWING METHOD

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INTRODUCTION

The tremendous growth rate of the city of Canberra during the sixties and early seventies brought an increased demand for inexpensive eucalyptus seedlings to be used in large landscaping and forward planting projects.

The time-honoured method in which seeds were sown in trays and the seedlings pricked off into another container tied up considerable labour and took six to nine months before the expensive seedlings were ready for planting. This prompted us to perfect a method of direct sowing into inexpensive throw-away polythene tubes packed into reusable wire baskets. Twenty-five tubes fit into a basket of 30 cm × 30 cm

Handling is reduced to a minimum by direct sowing into the tubes containing the growing medium. By using a balanced soil and nutrient mix we are able to produce 47 species of eucalyptus, (Appendix A) grown to a saleable size in about three months. By using heated glasshouses for the five cold months we can produce four crops each year.

Container. The throw-away container is a thin, ultra-high-impact black polythene tube 200 × 50 × 50 mm with eight 25 mm slits 20 mm from the base of the empty tube. The material is 50 microns thick. Each tube costs approximately one cent and contains approximately 547 cm³ of soil with an average weight of 705 g. when filled with moist soil.

Growing Medium. The medium is a modified U.C. (University of California) type mixture of 30 to 40% Australian

peat plus 60 to 70% coarse washed river sand Fertiliser is added to each m³ of soil as follows:

Blood and bone	1,153 g
Calcium carbonate	789 g
Superphosphate	1,057 g
Potassium nitrate	102 g
Potassium sulphate	111 g

The sand, peat and fertiliser is mixed for one minute in a large industrial type concrete mixer and transferred to a portable 1.53m³ capacity steam sterilising trolley. The trolleys are covered with a tarpaulin and steamed with aerated steam at 63°C for 20 minutes then cooled down by the injection of cold air, pH tests are carried out for each new batch of peat and the pH is adjusted to around 6.5 by increasing or decreasing the calcium carbonate added to the mixture.

Filling of Containers. To minimise handling cost and to reduce the possibility of contamination of soil with plant pathogens, the polythene bags are filled directly from the mobile, bench-high steam trolleys. Filling is carried out with the aid of a tapered spout funnel and the filled bags are then stacked into wire baskets.

Bulk Handling Baskets. These are constructed from galvanised A R C 2.5 cm × 2.5 cm grid, 2 mm gauge Weldmesh, 30 cm × 30 cm × 13 cm deep holding 25 filled black polythene bags. The baskets are reusable and last up to four years.

The baskets when filled with bags are transported to their final growing site, where they are stacked in rows of three wide for easy access for sowing, watering, and other maintenance work required. To discourage roots from growing into the base, the baskets sit on 25 mm × 25 mm laths.

Seed Source. To ensure a reliable seed supply we collect our own. Seeds of species growing within a 300 km radius are collected from trees growing naturally in the wild. Seeds of other species are purchased from seed merchants. As a rule we do not collect seeds from local planted species as there is always a danger of hybridisation. Once extracted, the seed is thoroughly dried and stored in glass bottles in a seed store-room at a constant temperature of 20°C.

Sowing. Seeds are direct sown into the containers at their final site and are not handled again until dispatched for planting. Sowing is done by making a shallow thumb depression in the middle of the container in which a small quantity of seed

is placed by hand and covered up with sterile sand/perlite mixture.

Since eucalyptus seeds contain a large percentage of unfertilised ovules (called chaff) and the good seed is, in some species, indistinguishable from chaff, it is essential to place enough seeds in each container to get more than one seedling on germination. Excess seedlings are cut off with a pair of scissors at the first leaf stage and only the strongest seedling remains.

Of the 47 species used only *E. dives* and *E. niphophila* need cold stratification to break seed dormancy. In *E. pauciflora*, only old seed needs such treatment. Germination takes place after 10 to 14 days.

During spring and summer, sowing is done in the open and the baskets are put on decomposed granite standing areas with rows of 25 mm × 25 mm timber laths to prevent plants rooting into the ground. No shading is necessary. Sowing during the hottest summer months to December and January is avoided, as shading may be required during the germination period.

During the winter months crops are raised in glasshouses under clear glass for maximum light. Night temperatures of 18°C and day temperature of about 25°C are provided.

Watering. During the germination period the seedlings are lightly watered by hand with a fine rose spray once or twice a day depending on the day temperatures and evaporation rate. Once the seedlings have reached the one to two leaf stage, when the roots have penetrated deeper into the soil, watering is carried out by overhead sprinklers or by subirrigation if bays are provided. When grown in glasshouses, crops are hand-watered.

Follow Up Fertilising. The initial nutrients incorporated in the soil last only approximately six weeks, after which weekly applications of 0.1% liquid Aquasol are required or one application of dry broadcast of 10.9:8 at the rate of 12.5 g per basket or 0.5 g per tube.

Plants grown in glasshouses during winter are hardened off for a week in the open before going out into the field. A 30% shade cloth protection is provided for the hardening-off period. None of the species have been frost-affected to date.

About three months from the time of sowing all medium to fast growing species have reached 30 to 50 cm in height and are suitable as planting stock for plantation and shelter belt planting. Slow growing species might require an additional 14 days growing period before reaching the required planting height.

Up to 150,000 eucalyptus seedlings are raised annually by this method with up to 20,000 or more plants of some species

An advantage of using this fairly large size tube is that plants not required immediately may be held for up to 12 months in the nursery. Growth can be checked by withholding fertiliser and, once applied again, growth resumes immediately, apparently without any undesirable effect

Pests and Diseases. Diseases are rare and only powdery mildew and *Botrytis cinerea* have occasionally been found on seedlings when grown under low light in glasshouses in winter, or during long wet spells during spring or summer. Effective control is achieved with TMTD and Karathane.

Pests are more prevalent, particularly sap-sucking psilids and the painted apple moth (*Orgyia anartoides*). These are controlled with application of Malathion or Carbaryl when the pests appear.

This method of direct sowing into containers is not restricted to eucalyptus but is also used for other native genera, such as *Acacia*, *Banksia*, *Hakea*, *Melaleuca*, *Callistemon*, exotic species such as *Quercus*, *Ulmus*, *Pyracantha*, *Picea*, *Liquidambar* and *Pinus*, just to mention a few. In general, any species in which good germination is expected are propagated by this method, but in larger containers if larger plants are desired.

Appendix A. Eucalyptus Species Grown by the Direct Sowing Method

<i>E acaciaeformis</i>	<i>E moorei</i>
<i>E aggregata</i>	<i>E nicholii</i>
<i>E albens</i>	<i>E niphophila</i>
<i>E alpina</i>	<i>E nitens</i>
<i>E andreana</i> (<i>E elata</i>)	<i>E nortonii</i>
<i>E blakelyi</i>	<i>E olsonii</i>
<i>E bridgesiana</i>	<i>E ovata</i>
<i>E camphora</i>	<i>E parvifolia</i>
<i>E cinerea</i>	<i>E pauciflora</i>
<i>E coccifera</i>	<i>E perriniana</i>
<i>E crenulata</i>	<i>E polyanthemos</i>
<i>E dives</i>	<i>E pulverulenta</i>
<i>E glaucescens</i>	<i>E radiata</i>
<i>E globulus</i> subsp <i>bicostata</i>	<i>E risdonii</i>
<i>E gomicalyx</i>	<i>E rodwavi</i> (<i>E aggregata</i>)
<i>E gregsoniana</i>	<i>E rosii</i>
<i>E kybeanensis</i>	<i>E rubida</i>
<i>E leucoxydon</i>	<i>E scoparia</i>
<i>E linearis</i>	<i>E sideroxydon</i>
<i>E macarthurii</i>	<i>E sieberi</i>
<i>E macrorhyncha</i>	<i>E stellulata</i>
<i>E maidenii</i>	<i>E subcrenulata</i>
<i>E mannifera</i> subsp <i>maculosa</i>	<i>E viminalis</i>
<i>E meliodora</i>	