POLYTHENE TUBE SIZE IN RELATION TO SEEDLING GROWTH IN THE NURSERY

by

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Abstract:—

In order to standardise the size of the polythene bag and the number of perforations in it, an experiment was started in 1970 *in the Research Garden, Peshawar. Different diameters, lengths, thickness of polythene were used. Miscellaneous species of Pines, Eucalyptus and Acacias were tested. On the basis of the data collected it has been found out that tube size* 6 X 2.5*-inches and* 6.0 × 2.0 *inches and with* 45 *and* 36 *Perforations of* 1/8" *dia. are the most useful ones for broad leaved and coniferous species respectively.*

INTRODUCTION.

Knowledge of proper nursery techniques is a pre-requisite to the success of an afforestation programme. Not only the best scientific methods are to be evolved but also these have to be economical to justify their adoption on a large scale. For raising potted plants use of earthen pots, metal containers, aluminium pots, paraffined paper cups, sphagnum moss etc. has been in vogue since long but use of polythene as planting bags in tree nurseries is quite recent, specially in Pakistan.

Artificial regeneration through transplanting nursery raised plants is expected to play very important role in the future mode of forestry in West Pakistan. The proposed intensive forest management will require millions of nursery raised plants for regeneration purpose. Many species cannot be transplanted with naked roots and the transport of transplants with ball of earth or other containers is very difficult and uneconomical. The use of polythene in nursery practices as containers has become almost universal and its techniques has been given in the "Nursery Techniques for Eucalypts" (2). Specifications of tubes such as length, diameter, number of perforations, etc. differs in different species under various climatic conditions. This study was, therefore, undertaken to find out suitable specifications of tubes for our species under local conditions and the conclusions have been reported in this paper.

Literature Reviewed:—

Polythene tubes are being used in many countries of the world for raising nursery plants. In Nyasaland polythene bags are being successfully used for propagation of conifer and other tree species (1). In 1960-61 Nyasaland's entire planting stock of some 3 million trees was raised in polythene tubes producing better results than the previous techniques of open rooted planting, ball planting or the use of either clay or tar paper tubes. Black opaque polythene of gauge 0.0025 was used in an extruded tube 10 inch in girth (3.2 inch diameter) and 6 inch in length. The tube was left open at both ends, being recovered at planting and used for as many as three seasons.

In Papua and New Guinea (1) 0.002 gauge clear polythene film has been used for both *Eucalyptus spp.* and *Araucaria spp.* Six inch circumference and 8 inch length bags were used for *Eucalyptus spp.*, whilst a considerably larger gusseted bag of 6 inch flat lay and 8 inch length was used for *Araucaria species.*

As a result of preliminary trials in the Pakistan Forest Institute (2) the black polythene tubes of 2 inch diameter, 7 inch length, 0.002 inch gauge, bottom sealed with 56 perforations in the tube wall were recommended for raising *Eucalyptus species.* Different tube sizes had not been tried in these preliminary trials and the work confined mainly to *Eucalyptus spp.*

Materials and Methods.

Experiment I:—

This experiment was initiated in January, 1970 to test a range of tube sizes in order to determine the relationship between tube size and seedling growth, (Fig. 1). Tubes of the following sizes were used:—

Diameter:— 3 inches, 2.5 in., 2.0 in., 1.5 in., 1.0 in.

Length:— 9 in, 8 in. 7 in, 6 in.

Material:— .002 inch gauge black polythene, bottom sealed and 4 perforations of 1/8." diameter per 3 square inches.

Species used:— *Eucalyptus camaldulensis, E. microtheca, Acacia arabica, Pinus roxburghii, Pinus griffithii, Cedrus deodara.*

Experiment II.—

It was taken up during April, 1970 to examine the degree of perforation necessary for optimum growth and survival using tubes of three diameters (3 inches, 2 inch and 1 inch) and 7 inch length. The tubes were treated so that they had three, four, five and zero (control) perforations of 1/8 inch diameter per 3 square inches of the tube wall,

Material:— .002 inch gauge black polythene, bottom sealed.

Species used:— *Eucalyptus camaldulensis* and *Pinus roxburghii.*

The trials were conducted in Research Nursery, Peshawar and Abbottabad. About one inch long seedlings were pricked out from germination trays to the tubes in cate of *Eucalyptus species* whereas in other four species seeds were sown directly into the tubes.

Survival and height growth of seedlings in the tubes were recorded periodically. Height growth of *Eucalyptus* and *Acacia species* was studied upto one year and that of conifer species upto 1½ to 2 years. The data was analysed and results drawn.

RESULTS AND DISCUSSION.

1. *Size of Polythene Tubes:*

(a) Broad leaved Species.

Average height growth data of one year old seedlings of *Eucalyptus camaldulensis*, *E. microtheca* and *Acacia arabica* in tubes of various sizes is summarised below:—

Species	Height of seedlings by tube length			
	9″	8″	7″	6″
E. Camaldulensis ..	1′—8″	1′—8″	1′—7″	1′—7″
E. microtheca ..	1′—9″	1′—9″	1′—8″	1—8″
Acacia arabica .	1′—7″	1′—7″	1′—7″	1—6″

Species	Height of seedlings by tube diameter				
	3.0″	2.5″	2.0″	1.5″	1.0″
E. camaldulensis	2′—1″	1′—9″	1′—6″	1′—6″	1′—3″
E. microtheca ..	2—0″	1′—10″	1′—10″	1—8″	1′—3″
Acacia arabica ..	1′—11″	1′—9″	1′—6″	1′—4″	1′—1″

Length of tube has not shown any appreciable effect on the height growth of seedlings of any species. Thus out of four lengths tried, 6 inch long tube would be more economical to use than others.

Effect of tube diameter is, however, more clear and the height growth of seedlings goes on decreasing with smaller diameters. As considerable savings in cost result from even a small reduction in tube diameter, tubes of2.5 inch diameter will be recommended because the difference in growth between 3 inch and 2.5 inch diameter tubes is not much as compared to the savings expected by the reduction in diameter by 0.5 inch.

(b) Coniferous Species.

Height growth data of the seedlings of *Pinus roxburghii*, *P. griffithii* and *Cedrus deodara* in tubes of various sizes is given below in summarised form:—

Species	Age	Height of seedlings by tube lengths			
		9″	8″	7″	6″
Pinus roxburghii ..	1½ Years..	11″	11″	12″	12″
P. griffithii ..	1¼ Years..	3″	3″	2.6″	3″
Cedrus deodara ..	1¼ Years..	4.7″	5″	4.8″	4.8″

Species	Age	Height of seedlings by tube diameter				
		3.0″	2.5″	2.0″	1.5″	1.0″
P. roxburghii ..	$1\frac{1}{2}$ Years	13″	12″	13″	11″	8″
P. griffithii ..	$1\frac{1}{4}$ years	3″	3″	3″	2.6″	2.4″
C. deodara ..	$1\frac{1}{4}$ years	5.3″	5.1″	4.8″	4.1″	3.9″

Height development of the seedlings has not been affected by the length of tubes. Hence 6 inch long tube will be used in practice.

In case of *Pinus roxburghii* and *P. griffithii* the height of seedlings is same for 3 inch 2.5 inch and 2.0 inch diameter tubes whereas for *C. deodara* very little difference is present in these three diameters so that 2.0 inch diameter can safely be taken as the best size considering its economic aspect also.

2. *Number of Perforations in Tube Wall.*

Average height growth of seedlings of *E. camaldulensis* and *Pinus roxburghii* in tubes with varying number of perforations is given below:—

Species	Age	Av. height of seedlings by degree of perforations			
		Not perforated	3 per 3 sq. inches	4 per 3 sq. inches	5 per 3 sq. inches
E. camaldulensis ..	1 year ..	1′—6″	1′—9″	1′—9″	1′—8″
P. roxburghii ..	$1\frac{1}{2}$ years ..	8″	10″	10″	10″

There is some difference in height growth between perforated and not perforated tubes but there is little difference in height growth between various degrees of perforation. So 3 perforations of 1/8 inch diameter per 3 spuare inch of tube wall should suffice for all these species. In other words, tubes of 2.5 inch × 6 inch and 2 inch × 6 inch size should have 45 and 36 perforations respectively.

3. *Tube Size in Relation to Cost.*

When tubed stock is to be used in plantation establishment the following processes are involved:—

Tubes are filled with soil and seedlings inserted. The tubes are then placed on a storage platform (Fig. 2) where they are watered to maintain a soil moisture level adequate for seedling growth. At planting time the tubes are transported to the field and then carried by hand while planting. All of these processes require the expenditure of effort and contribute to total cost of the operation.

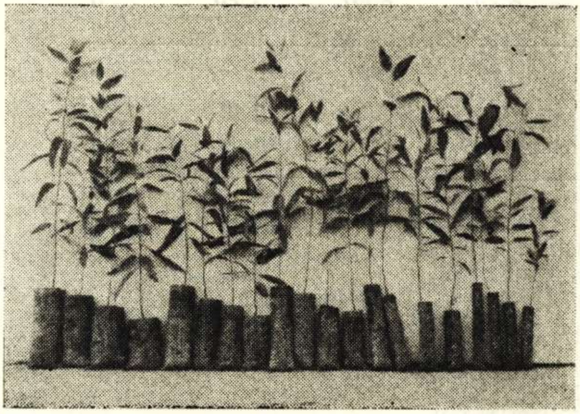

Fig 1 A range of sizes of polythene tubes investigated.

Fig. 2 Tubes seedlings lying on a storage bed.

Fig. 3 Tubes of 3″x9″ size lying in a wooden tray.

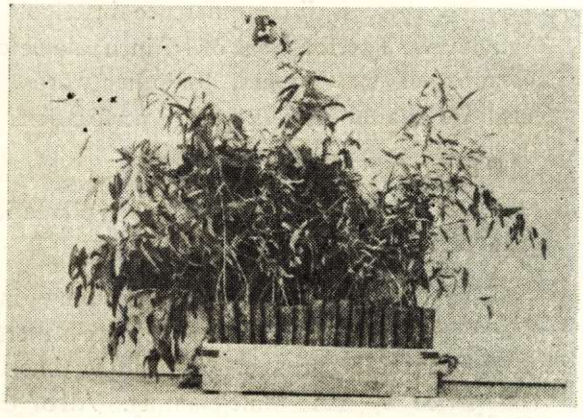

Fig. 4 Tubes of 1″x9″ size lying in a wooden tray.

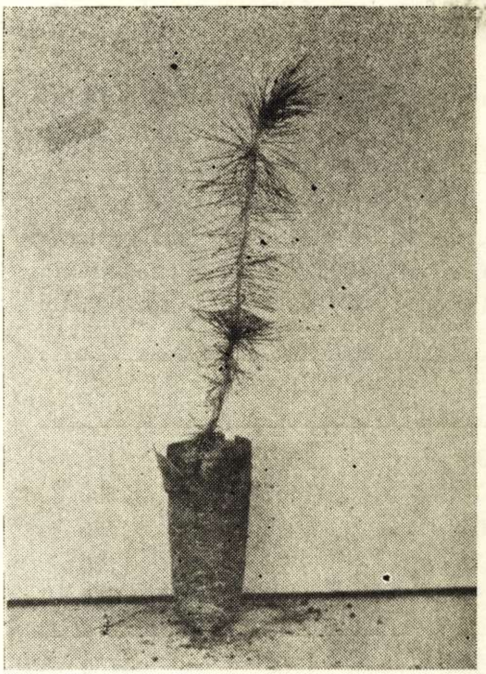

Fig. 5 Polythene tube affected by sunlight.

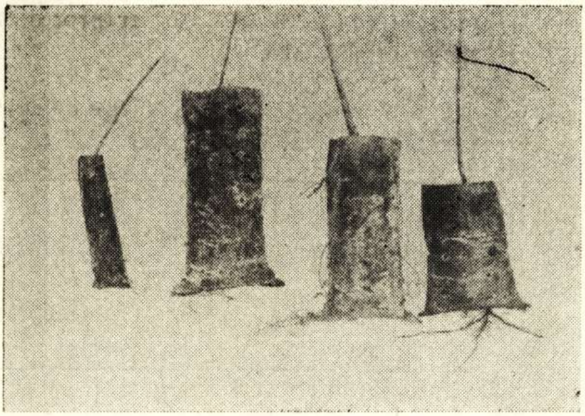

Fig. 6 Root emergence from perforated polythene tubes.

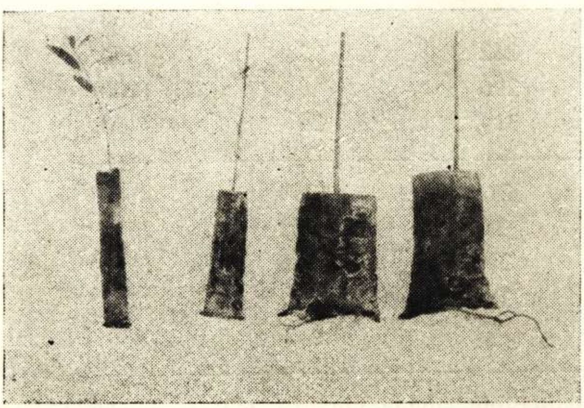

Fig. 7 Root emergence from the bottom portion of the non-perforated tubes.

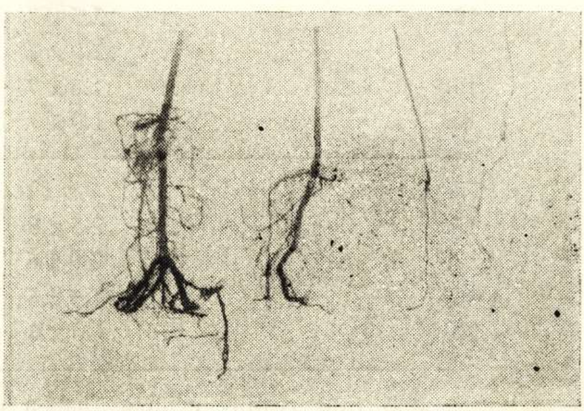

Fig. 8 Root development in polythene tubes of different sizes,

When each of the processes are examined individually it becomes evident that, with the exception of pricking out, a relationship exists between size of the tube and the cost of the process. The cost of polythene film used bears a linear relationship to tube diameter, and in all other processes costs are a function of the square of the diameter of the tube.

The validity of these statements has been confirmed by actual measurements of the operational values as given below:—

Serial No.	Tube size (inches)	No. of tubes per 1 lb. of polythene	Tubing soil required for 100,000 tubes (C. tt.)	No. of hand carrying trays required for 100,000 tubes
1	2	3	4	5
1. ..	3 × 9	130	2000	4150
2. ..	2.5 × 9	170	1467	2500
3. ..	2.0 × 9	204	1047	1650
4. .	1.5 × 9	232	628	1100
5. .	1.0 × 9	256	393	480
6. ..	3.0 × 8	158	1760	4150
7. ..	2.5 × 8	198	1297	2500
8. ..	2.0 × 8	232	880	1650
9. ..	1.5 × 8	260	500	1100
10. ..	1.0 × 8	284	319	480
11. ..	3.0 x 7	188	1517	4150
12. ..	2.5 x 7	228	1047	2500
13. ..	2.0 x 7	262	721	1650
14. ..	1.5 x 7	290	404	1100
15. ..	1.0 x 7	314	259	480
16. ..	3.0 x 6	216	1294	4150
17. ..	2.5 x 6	256	862	2500
18. ..	2.0 x 6	290	586	1650
19. ..	1.5 x 6	318	330	1100
20. ..	1.0 x 6	342	212	480

It is thus readily evident that a considerable savings in cost will result from even a small reduction in tube diameter (Fig. 3 & 4).

CONCLUSIONS.

Based on these experiments and observations in the Research Nursery, following conclusions are drawn:—

1. Black polythene sheet of 0.002 inch gauge is a suitable material for the manufacture of tubes for the propagation of tree seedlings. Such tubes are sufficiently durable to allow the growth of seedlings in the nursery for a period of two years. The tubes are weathered by sun light particularly on the edges of tube storage beds but not to the extent which prevents handling at planting time. (Fig. 5).

2. The height growth of seedlings of different species is affected by the size (soil volume) of the tube. Tubes of 6 *x* 2. 5 *inch and* 6.0 *x* 2.0 *inch* size are most suitable for raising nursery seedlings of broad-leaved and coniferous species respectively.

3. It has been demonstrated that small increase in tube diameter causes a large increase in plantation establishment cost. In order to achieve economy in the overall operation of plantation establishment the minimum practical tube diameter should be adopted.

4. The experiment to examine the degree of perforation for optimum growth showed that 45 and 36 perforations of 1/8 inch diameter in 6 x 2.5 inch and 6 x 2.0 inch size tubes respectively are sufficient for optimum growth of the seedlings.

5. While pricking out seedlings into the tubes, it is important that the entire hole is closed as an air cavity around part of the tube is most certain to cause death. Deaths occur after about three days if the operator is careless in the final closing of the hole.

6. With closely stacked polythene tubes little side light reaches the seedlings thus restricting the growth of side branches and the hardening of the main stem. The merits of wider spacing of tubes on nursery beds should be availed of.

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