The Production and Use of Tubed Seedlings in Irish Forests

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Summary

THIS paper deals with the production of tubed seedlings in a forest nursery situation. It costs the process from start to finish. Also the matter of planting out in the forest is dealt with in some detail.

Introduction

The planting of container-grown stock has been carried out in many parts of the world for a considerable length of time. Different countries have developed different ideas in this regard (Low, 1975). In continental Europe transplants have been produced in small pots and balled roots in an effort to eliminate transplanting shock in young stock. These methods have also been used in establishing forest plantations on degraded and eroded sites in an effort to reduce establishment costs to a minimum, which is particularly useful in tropical countries and arid areas, as well as areas that are covered by snow for long periods each year (Unsat and Uutaru, 1974; Low 1970). A technique of raising transplants in peat/polythene rolls was devised by Nisula of the Finnish Forest Research Institute. The probable production total of these transplants in Finland in 1971 was between 20 and 30 million. Finnpots (known as Jackpots in this country) are peat pots manufactured by using a 65:35 by weight ratio of Sphagnum peat to groundwood pulp. A wide range of sizes is produced for horticultural use, both as single pots and trays. The Kopparfors Method is a method of producing ball-rooted planting stock in which the plant is removed from the pot prior to sowing. The method is based on the use of injection moulded polythene units which form moulds for the plant root ball. The shape is tapered to allow easy withdrawal of the plant at planting time (Low, 1972).

Another method of producing and planting bare root stock is worthy of mention. This was developed by Charles Tottenham of Ballycurry, Ashford, Co. Wicklow for use on land at Inagh, Co. Clare. Two-year plantable seedlings are produced in seedbeds which are root-pruned frequently. This yields a plant which has a larger crown than normal, and a compact root system. The method of planting is quite simple when use is made of a modified bulb planter. This device works on the same principle as a leather punch – push it into a plough ribbon and then pull it out – this action makes a socket for the plant and the plug is retained in the planter until pushed into the ribbon again. On the second stroke the plug is ejected from the planter

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and a new plug and socket are formed. (Prof. T. Clear, U.C.D., personal communication, 1975).

By 1966 an adaptation of the above methods was devised in Canada to replant cleared woodland with young seedlings in such a way that costs could be reduced to a minimum (Low, 1970). This pattern of regeneration called for a simple yet effective type of container – a small, rigid, split polystyrene tube. These containers were each filled with a growth medium and seeded. After twelve weeks the seedlings had grown and both tube and contents were planted out – the Ontario tube seedling.

The Finns wanted some method of speedy regeneration of their forests and decided that this procedure might fit their needs. However it proved unsatisfactory for them and they changed to Japanese Paperpots, which are at present extensively used, (Low and Brown, 1972). The British Forestry Commission (B.F.C.) also took advantage of the tubed seedling system and carried out some preliminary trials in 1967 which continued from 1968 to 1971 as a research programme (Low, 1975). The results of this programme were very promising. It is from this, that the Forest and Wildlife Service initiated their own trial and investigation of the possibilities of using the system to plant trees in our extensive peatland areas. The main advantages were expected to be:

(1) An extension of the planting season;
(2) Increased speed of planting;
(3) Greater suitability for development of mechanical planting;
(4) Rapid production which makes it easier to match plant requirements;
(5) The possibility of cheaper planting stock;
(6) The possibility of a reduction of basal sweep in conifer stands especially those of Lodgepole Pine *(Pinus contorta)*.

Production

The production of tubed seedlings was started early in 1973 at Glenealy Nursery, Co. Wicklow, which was equipped with a 20m polythene tunnel. The general specifications of the operation were similar to those used by the British Forestry Commission, (Low, 1970).

Seedlings were raised in split, open ended, polystyrene tubes 75mm long by 13mm internal diameter, filled with a 50:50 mixture by volume of moss peat and sand. The moss peat is passed through a quarter inch screen to remove any coarse or fibrous material which may be present and could cause uneven mixing. The sand is likewise passed through a one-eighth inch screen. To the mixture is added 1.5kg/m^3 slow release

NPK fertiliser, 1.5kg/m^3 ground magnesian limestone and 0.25kg/m^3 trace element frit.

The mixing of the sand and moss peat is carried out manually on a clean concrete floor. The fertiliser is then added to the sand/peat mixture using a cement mixer to ensure homogeneity.

Before filling, the polystyrene tubes are soaked for a few minutes in a fungicide to sterilise. Filling is done manually. The tubes are filled brim full with the medium and are then tamped down to 1cm below the top of the tube. The tubes are now ready to be seeded with one seed per tube. After sowing, the seed is covered with about 3-4mm washed sand of particle size ca. 1.5mm diameter. Trays are then allowed to stand in 5cm water for 24 hours to ensure complete absorption of moisture and afterwards are put into a germination room for 5-7 days at 25°C constant temperature. The trays are covered with plastic sheeting to prevent dehydration.

As soon as germination has commenced in about 10% of tubes, the trays are removed to the polythene tunnel where they remain for 8 weeks. The temperature in the tunnel is 21°C during the day and 15°C at night. For the first four weeks the 15°C night temperature is thermostatically controlled and heat is supplied by electric glasshouse heaters. Heat is only used when production of a batch begins in early April. Subsequent batches do not require any heat at night as the difference betwen outside day and night temperature is not as great as in the early part of the year. This fact is worth noting as there is a considerable reduction in heating cost with the heaters switched off at night. Also the effect of cooling during the night when the seedlings have reached a responsive age helps to harden them off. During the day if the house temperature rises above 21°C a 60cm extractor fan is automatically switched on and provides a through draught of air along the tunnel.

During the period of maximum growth i.e. 2-8 weeks, trays are watered once every two weeks by standing in 5cm water until saturated. One of the main problems associated with production has been a high incidence of damping off by *Pythium, Fusarium* and other wilt-causing fungi. This however, has been almost eliminated by virtue of the fact that the seedlings are watered from below. Watering from above has the tendency to permit dispersal of fungal spores by splashing.

Nevertheless, a check must be made at regular intervals to ascertain the correct amount of moisture per tube, and to make sure the temperature regime within the tunnel is correct. Apart from this minor amount of supervision, production is a relatively simple operation and any problems that arise can be dealt with as they occur. Any damping off that did occur, during the production of

Lodgepole pine *(Pinus contorta)* seedlings in the Spring of 1975, was caused by one of the *Pythium* fungi. The fungicide marketed as "Aaterra," which has 35% 5-ethoxy-3-trichloromethyl-1, 2, 4-thiadiazole (atridiazol) as the active ingredient, was extremely effective in controlling the attack at a dosage of 22g/18 litres water/m^2.

After a period of eight weeks in the polythene tunnel, the trays are moved outside for a minimum of two weeks to enable the seedlings to harden off before planting out. In the period up to the beginning of June it is necessary to cover the tubed seedlings with polypropylene mesh or some other type of screen as protection against late Spring frost. The average height of seedlings after 10 weeks is about 3.5-4.5cm. As there was some doubt as to the optimum period for retention within the polythene tunnel, a small test was carried out. The total number of trays was divided into four batches of 25 and each was treated differently as follows:

Batch 1	Moved out at 5 weeks protected for 3 weeks unprotected for 2 weeks
Batch 2	Moved out at 8 weeks protected for 2 weeks
Batch 3	Moved out at 8 weeks unprotected for 2 weeks
Batch 4	Moved out at 10 weeks unprotected

In 1975 all batches were ready for dispatch at 12 weeks of age.

Result of Test

Batch 1 having been moved outside after five weeks indoors was most susceptible to climatic fluctuations; the period of drought that lasted from the end of April 1975 until early September 1975 caused a loss of about 75%.

Batches 2 and 3 were much hardier when moved and did not succumb to the effects of drought so readily; thus no advantage was gained in protecting the crop. Batch 4, the last to be moved was almost unaffected. It should be pointed out that no additional water was supplied save an initial watering on moving outside. The height growth was retarded in the case of Batch 1, but maintained in Batches 2 and 3. The height growth of Batch 4 was greater; this reflects the longer period of growth under optimum conditions.

It would appear on a visual assessment that it does not matter whether a crop is kept inside for either eight weeks or ten weeks as the extra period of growth did not produce a significantly larger plant. In order to keep costs to a minimum the eight week period of growth would seem best suited to Irish needs. Certainly a five week period (Batch 1) is not sufficient in that it results in enormous losses, as indicated below.

The survival rates for each batch were as follows:

Batch No.	1	2	3	4
Survival %	25	80	82	80

Production Cost of Tubed Seedlings

The overall cost of production of tube seedlings may be broken down to components, each of which can be costed by means of work values which are applied when the job is being done. (Table 1) At £1.45 per hour the labour cost amounted to £407.45. The cost of materials was £250.00, giving a total cost of £657.45 (1975 prices).

Table 1 — Costs of various operations in Standard Man Hours (S.M.H.) based on 40,700 tubes.

Operations	Per 100 trays S.M.H.
1. Put tubes into tray	35
2. Grade Sand – 0.2 m^3	24
3. Grade Peat – 0.2 m^3	14
4. Mix Sand and Peat – 0.4 m^3	8
5. Weigh fertiliser (nutrient) and mix with medium – 0.4 m^3	8
6. Sterilise trays and tubes	6
7. Transport from Glenealy to Avondale and return	4
8. Fill tubes with medium	10
9. Tamp down	20
10. Sow seed	95
11. Cover seed with sand	15
12. Water and move to germination room and subsequent moves	42
Total S.M.H.	281

Production costs (cost per live plant) with 33⅓% added for overheads for the four batches of seedlings were as follows:

Batch No.	1	2	3	4
Cost (p)	6.65	2.05	2.00	2.05

Planting Out

Instrument

Planting of tubed seedlings is currently done with a simple steel dibble hereafter called a planting stick. This instrument in the shape of a walking stick, is made up from stainless steel tubing 15mm in diameter and approximately 1m in length. At one end, half the tube is cut away for a length of 12cms. a stop which controls the depth of planting is placed on the otside of the stick at a distance of 1.2cm up from an internal stop, which is itself placed 75mm from the bottom of the stick.

Method of Planting

The tray of seedlings is carried on an aluminium frame, which is secured by straps over the shoulders and round the small of the back. Tubes are selected by the left hand from the tray and inserted into the channel of the planting stick with an upward and sliding motion, so they are brought up against the internal stop. This is performed with the planting stick held by the right hand, in front of the tray. The seedling shoot points up the channel. The planting stick and tubed seedling are pushed vertically into the peat, and, on withdrawing the stick, the tube remains behind. While the right hand is pushing the stick into the peat, the left hand is selecting the next seedling. Using this method a forest worker can, with some practice, achieve a planting rate of 740 seedlings per hour with easy walking conditions and good peat, and 415 seedlings per hour with difficult walking and poor peat (Low, 1975). Up to 3,000 seedlings per man per day was achieved by Forest and Wildlife Service in 1974, which rates lower than British Forestry Commission, but in practice planting rates increase with experience (J. Deasy, Forest and Wildlife Service, personal communication, 1976).

Preparation of Planting Site

The site should be ploughed in the normal fashion. It is a distinct advantage to have the ribbons running at right angles to the direction of the prevailing wind. Steps are cut by hand in the leeward side of the ribbon to afford protection to the seedlings. The cost of cutting these steps is about 4 SMH per 1,000 plants, but if tubed planting stock is to be competitive with normal, bare-root planting a cheaper method of cutting these steps will have to be used. In the UK, a method of cutting a continuous step on the ribbon during the ploughing operation has been tried and results so far indicate that this treatment of the ribbon is as good as hand stepping as far as plant survival is concerned (Low, 1975). In order to achieve a continual step, a plough has been modified quite simply, and the rate of ploughing remains unchanged. With hand stepping it is essential that the floor of the step has an outward slope to prevent waterlogging in the proximity of the seedling.

If stepping-down could be eliminated by modification of the plough, then the actual cost for tubed seedlings would be 18.04 SMH which is 91% of the cost of 1+1 transplants (Table 2).

TABLE 2

Comparison of Costs per 1,000 plants.

	Tubed seedlings	1+1 Transplants
Cost of Production	17	8.8
Cost of stepping-down	4	NIL
Cost of Planting	1.04	11
	22.04 S.M.H.	19.8 S.M.H.

Planting Trials

In 1975, Mountrath and Camross forests reported a large number of failures of the 1974 planting due to the long period of partial drought which caused the ribbon to dry out and shrink. As a direct result of this a considerable number of tubed seedlings fell out of the ribbon. The performance at the other sites was good, Lodgepole pine having grown 20cm and Sitka spruce *(Picea sitchensis)* 13cm in the first year. As they measured 4cm when planted, this gives a total height of 24cm and 17cm respectively (Table 3).

TABLE 3

Assessment (1976) of 1975 planting trials of tubed seedlings.

Forest	County	Species	No. Plants	Surviving %	Healthy %	Root spread % Satisfactory	Basal Sweep %
Greenane	Wicklow	S.S.	3,000	58	97	N.A.	
(1973)		L.P.	3,000	44	83	N.A.	21
Mountrath	Laois	S.S.	5,000	90	95	89	
(1974)		L.P.	14,000	91	79	94	10
Clonaslee	Laois	S.S.	14,000	N.A.	N.A.	N.A.	
(1974)		L.P.	4,000	779	73	86	50
Camross	Laois	S.S.	2,000	46	86	7	
(1974)		L.P.	3,000	11	80	92	N.A.
Ballyfin	Laois	S.S.	10,000	84	96	39	
(1974)		L.P.	3,000	94	91	50	N.A.
L. Ennel (1974)	Westmeath	L.P.	1,000	5	N.A.	N.A.	N.A.
Glenamoy (1974)	Mayo	Mon.P.	1,000	N.A.	N.A.	N.A.	N.A.

N.A. = Figures not available

S.S., Sitka Spruce; L.P., Lodgepole Pine; Mon. P., Monterey Pine, (Pinus radiata).

Optimum Season for Planting

The best period for planting out was found by the British Forestry Commission to be from May to July. This was based on a 1970 assessment of the survival rate of tubed seedlings planted at Selm Muir during the period April to October, 1969. The percentage survival of those planted in May, June and July was 95% (Low, 1975).

Conclusion

The production of tubed seedlings under polythene does not require any really specialised production techniques, and can be carried out by forest workers with the minimum of training. The main advantage is that the whole cycle of production is carried out independently of prevailing weather conditions, i.e. there are no delays due to inclement weather. Added to this is the fact that at least 90,000 seedlings can be raised at short notice in a polythene tunnel only 20m long.

The main criterion for use of such methods is a lowering of planting cost combined with increased speed of planting. The latter is most essential in countries where the climate affects the length of the planting season. The situation in this country is quite different as the planting season can extend from November to April for bare root transplants.

From the foregoing it can be seen that a major item in the cost of planting tubed seedlings is the expenditure on stepping down, viz. 4 S.M.H. per 1,000. This, however, can be eliminated by modification of the plough share at no extra ploughing cost.

This would mean that the cost of production and planting of tubed seedlings would be broadly competitive with that of bare-root planting stock, and the method would have most, if not all, the advantages already listed.

References

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