EXTRACTION OF CONIFER SEED AT AVONDALE, CO. WICKLOW

By A. J. HANAHOE

In most countries to-day the aftermath of war with its consequent depletion of timber supplies has resulted in increased afforestation schemes. As in the case of other crops this brings the question of seed procurement much into the limelight. Unlike numerous other countries Ireland is not in a position to obtain all its seed requirements from home sources. The purpose of this article is, therefore, to explain in some detail what is being done to supplement imported supplies of conifer tree seed. The writer wishes to express his gratitude to Mr. O'Beirne for some practical hints on the collection and storage of cones and to Mr. W. J. Breslin for his yield figures over a period of years.

HISTORY OF SEED EXTRACTION.

The early planting enthusiasts relied almost entirely on foreign countries for their seed. They were handicapped to a great extent by having at their disposal only small and scattered blocks of cone-bearing trees. Gradually the progressive increase in conifer planting becams apparent in more abundant cone crops which gave the necessary fillip to the harvesting of home-grown seed.

The erection of the first Irish seed extraction kiln at Avondale in 1930 thus broke new ground in the field of Irish forestry endeavour. As with most new ventures it passed through a testing stage and not until about 1935 do we find it established on a firm footing. From then onwards it dealt with cones from the home and neighbouring forests, the results obtained being a good augury for the future. The increased difficulty of importing seed from 1939 onwards gave the work an added impetus so that we now find it dealing with cones coming from all parts of the country. Its output now represents about 60% of the conifer tree seed requirements of the State Forest Service.

STORAGE OF CONES AWAITING EXTRACTION.

Proper storage conditions from time of collection onwards are the first essential. Preliminary drying is good

economy as it enables the cones to be opened more easily in the kiln. When a consignment is received the cones should be spread thinly on a dry airy loft where they can be raked or turned at intervals to prevent mildewing. The loss of weight during storage is considerable. A few simple tests carried out at Avondale may be of interest. In a lot of Scots Pine cones received in December, 1946, the loss of weight after three weeks' storage was as high as 40%. Again in the case of Cupressus Macrocarpa collected in Avondale in November, 1946, the loss was about the same during a fortnight's storage. Whenever possible, however, cones should be allowed to ripen fully on the tree where loss of weight coincides with ripening. They should be collected in dry weather and never dispatched in a wet condition.

TYPE OF KILN (See Elevation).

The kiln at Avondale is a vertical wooden structure with, in the case of Scots Pine, an output in cones of 1 cwt. for each 8-hour day worked. Its full height is 8½ ft., its breadth 7¼ ft., the actual dimensions being determined by the size of the room in which the kiln is housed. Its trays or drawers number twelve and are set up in two stacks each of which is reached from the front by opening a door hinged to a central upright. Each stack of drawers has thus an independent door. The topmost drawer is within easy reach of the average man and all drawers are bottomed with wire mesh having 196 meshes to the square inch. This mesh is sufficiently small to hold the seed of practically all the common species. The drawers measure 3 ft. x 2 ft. x 11 ins. and bear a brass holder in front for a seed identification label. They fit snugly into position, resting on wooden cleats, the door providing extra insulation.

PRINCIPLE OF THE KILN.

Under natural conditions most cones open on the tree in dry weather in Spring. As warm dry winds withdraw moisture from the cone-scales, they bend backwards and release the winged seed. In the kiln extraction is also carried out by passing warm dry air over the cones. The air under the lowest drawers is heated by the horizontal flue from the stove and, as hot air is lighter than cold, it rises through the cone-filled drawers. The heated air having a lower relative humidity, its drying power is increased and its heat provides the reserve required for evaporation. As the hot air passes up through successive drawers its moisture content is increased and it becomes gradually cooler. Thus drying conditions are much less severe in the upper drawers. Incidentally, the heat radiated from the stove is not wasted as the air which is drawn from the

cellar through the vent surrounding the flue into the kiln is pre-heated so that its relative humidity is lowered and its drying power increased. For this reason doors and windows in the cellar are kept closed and ventilation reduced to the minimum consistent with safe working.

METHOD OF WORKING.

The fresh cones, previously screened to remove needles and other foreign matter, are placed in the top drawers. The loaded drawers are then moved downwards each time one is withdrawn underneath. In this way the cones receive the most severe treatment only after most of the moisture has been removed. The empty drawers are again filled with fresh cones and replaced at the top.

HEATING APPARATUS.

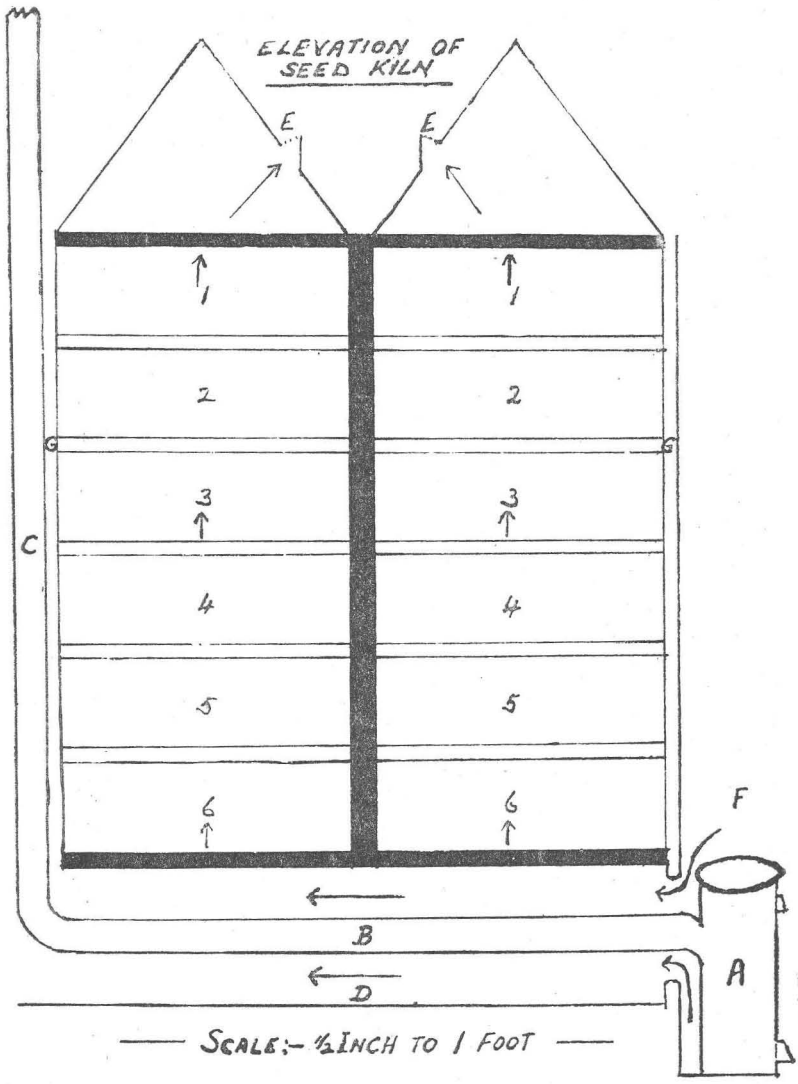
The kiln is heated by means of a small closed iron stove in an adjoining cellar with a 4 in. bore iron flue pipe. This pipe runs horizontally through the dividing wall and enters the kiln proper under the bottom drawer. Having passed underneath both sets of drawers it bends vertically and at this point is provided with a soot door for cleaning purposes. It continues upwards along the side of this stack and projects some 6 ft. above the roof in order to create the necessary draught.

FUEL USED.

During the extracting year 1946/47 the stove was operated on various types of wood fuel. Finely split 6 in. blocks of Ash and Birch gave best results but Oak and Beech were also good when fully seasoned. With a small stove it will be understood that a "lively" wood is needed, not a slow-burning one, even though the latter may have a higher calorific value. The daily consumption of the stove was approximately 1¼ cwt. of blocks. Spent cones were found very useful for kindling but did not prove satisfatory as fuel.

MAXIMUM SAFE TEMPERATURES.

The supply of hot air is controlled at the top of the kiln by means of hinged openings or ventilators, one for each set of drawer stacks. These openings are kept closed until the required temperature is reached and then opened together or singly to regulate it. A Fahrenheit thermometer is used for testing the temperature at frequent intervals. Cones are placed in a single layer in the drawers to ensure the passage of dry air over the surface of each cone. In the case of a large mass, its journey would be impeded and output lowered. Obviously the higher the temperature of the air passing through the kiln the faster



KEY

A - STOVE B - HORIZONTAL FLUE C - VERTICAL FLUE
D - SPACE FOR COLLECTING DUST NEEDLES ETC. E - VENTILATORS
F - CELLAR G - WALLS. 1 - 6 DRAWERS

ARROWS INDICATE DIRECTION OF AIR MOVEMENT

the drying and the greater the output. The limiting factor in this case is the damage to the viability of the seed by excessive temperature. The critical temperature is lower for fresh undried cones than for partly dried ones. Hence the advantage of gradual drying by moving the drawers from top to bottom. The critical temperature varies also for different species—for most species it is 120° F. This final degree of heat is needed for Scots, Mountain, Corsican and Contorta Pines, except towards the end of the season in March and April when the cones have become well dried out. The opening of Pinus insignis, Pinus maritima and Cupressus macrocarpa cones may be effected with a temperature of from 100°—110° F. while Douglas fir and the Spruces will open with a temperature of from 90°—100° F. Larch is a more difficult species and will not yield all its seed even with temperatures in excess of 120° which may damage the seed. Maceration of the cones is necessary but this method has not yet been followed to any great extent at Avondale. Species like Cupresses lawsoniana and Thuja plicata open readily if placed thinly in an airy loft and need no kilning. The scales of Silver Fir cones fall apart when fully ripe thus freeing the seed.

TIME REQUIRED.

At a constant temperature of 120° F. and provided the cones are mature, Scots Pine opens in about 8 hours. Generally speaking most other species take less time but here again maturity and even distribution of heat are important factors.

Occasional agitation of the cones during the drying process is very useful. It helps to liberate some of the winged seed locked between cone scales and also allows the hot air to come in contact with cone surfaces not already touched.

REMOVAL FROM THE KILN.

With some species a few small cones generally remain unopened but these are not worth waiting for as their seeds are usually blank or of low germinative power. The contents of the drawers are emptied into a large bin to await shaking which is done at convenient intervals. At this stage care must be taken to avoid mixing lots of the same species which have been collected in different areas. It is here that the identification label on the drawer face serves its purpose. When a change is taking place drawers must be thoroughly cleaned out otherwise one runs the risk of not having seed true to strain or label.

OTHER METHODS OF EXTRACTION.

With small quantities of cones, extraction may take place in the open in dry sunny weather in Spring. An open site,

facing south if possible, is selected and a platform of small mesh netting erected 2 feet above the ground. The cones are spread in a thin layer and a canvas is spread underneath or suspended from the netting to catch the seeds. This method of using solar heat has been tried with most species and has given good results late in the season. It is a method which conforms very closely with the work of nature where the cones hang thinly on the tree and have an enormous volume of dry air passing around them.

SHAKING.

A revolving box shaker, 4ft. long by 1⅜ ft. square section, with wooden ends, is used. The sides of the shaker are of wire mesh with holes large enough to release the winged seed but not the cones. A stout wooden frame is needed for support and to withstand the stress of rotation. Lengthwise through the centre of the shaker runs an iron axle supported at both ends and fitted with a handle for turning. One side is fitted with a hinged door. With the shaker working at a speed of 20—30 revolutions per minute the winged seed drops through onto a collecting canvas. Light poles around 3 ins. diameter are placed lengthwise in the shaker to increase the jarring effect on cones which do not give up their seeds readily. A few short timber blocks added to the cones have proved useful with troublesome species.

DETACHING THE WINGS.

The seed of practically all conifers have wings which must be removed for easy handling and sowing. The method in use at Avondale is to place the winged seed on a table covered over with 2 or 3 sheets of coarse sacking and rub by hand until the wings are broken off. Some species, however, cannot be completely deprived of their wings, e.g. Silver Fir and Larch, as the union between seed and wing is too close.

WINNOWING AND FINAL CLEANING.

The common hand-operated corn winnower with wire riddles of varying mesh has given good results. The horizontal air current first separates pieces of cone scales, twigs and any remaining needles. The remaining riddles hold the finer chaff and broken wings and finally the clean seed is directed through a chute into a box on the floor.

WEIGHING AND IDENTIFICATION.

The seed is now weighed and packed in small sacks and labelled with its identity number which has now followed it from the cone to the naked seed stage and will accompany it in the nursery and later in the forest. A few years ago a straightforward system of identification was put into use by the Forestry Division. Every forest unit was given a code

number. To this number is added the season of collection, Thus the identity number of seed produced from cones collected, say in Cong, during the collecting season October, 1946 to March, 1947 would be HC/93/47, HC standing for home collected; 93 being the code number of Cong Forest and 47 being the year of collection. It is the collecting season that counts not the actual calendar year of cone collection. Again seed held over from one year to another still bears its original number. If this were not so it would be impossible to distinguish in the seedling or transplant stage seed held over for a year or more from that extracted and sown the following Spring.

STORAGE.

Until needed for allocation to the various nurseries the sacks of seed are hung in a cool storehouse. If not to be sown in the next Spring, however, this method is not ideal as the seed is likely to deteriorate. Seed in storage for more than a few months must be kept uniformly dry and should be kept in sealed airtight containers, preferably protected glass jars or carboys. The jars used for holding acid are suitable for the purpose when placed on a concrete floor with the temperature ranging from 40°—50° F.

YIELD OF SEED.

The working of the kiln has shown that the yield of seed from a given quantity of cones depends on several factors. A good seed year is most important while the time of harvesting, method of extraction, size of the cones and number of seeds they contain all have also a definite bearing on the output. The yield per hundred-weight of cones also progressively increases from small to large cones. The base of the cones contain the largest and best seed. The following is the average production of cleaned seed per hundred-weight of cones over a three year period :—

	lbs.		lbs.
Scots Pine	1	European Larch ...	1¾
Pinus Contorta	2¼	Sitka Spruce	1¼
Pinus Insignis	1	Cupressus Lawsoniana	6
Mountain Pine	2½	Cupressus Macrocarpa	7
Maritime Pine	5	Thuja Plicata	3½
Japanese Larch	2	Silver Fir	15
Douglas Fir	3½		

DAMAGE BY RODENTS AND FIRE.

Strict measures must be taken to prevent the entry of rats or mice into the kiln or seed store. It is a curious fact that mice have a special liking for Sitka Spruce and Mountain Pine seed and will seek them out in preference to other species stored in the same place. Strict precautions against fire, including cleanliness and the provision of fire extinguishers, is necessary owing to the very inflammable nature of the resinous cones.

QUALITY OF THE SEED OBTAINED.

No amount of care during the different stages of extraction work can ever compensate for defects in the cone before entering the kiln. Viable seed and later a fully stocked seed bed with sound healthy seedlings true to name are the acid tests of previous management. Therefore the choice of seed-bearing tree, time and method of collection, proper storage of the cones and segregation of seed in the kiln have all an important bearing on the result.

WORKING COSTS.

The unit at Avondale is capable of being worked by one man. This includes stoking, filling and removing the drawers, shaking, de-winging, winnowing, weighing and storage. To arrive at the cost per lb. of cleaned seed all operations (including transport costs) from the time the cones are sighted on the mother tree until the seed is fit for storage must be taken into account. Beyond any doubt whatsoever it is much cheaper than imported seed at current prices. The following prices are taken from a current catalogue.

Species	Price Per Lb.
Silver Fir	45/- to 80/-
European Larch ...	50/-
Japanese Larch ...	45/-
Sitka Spruce	65/-
Norway Spruce	57/6
Scots Pine	45/6
Douglas Fir	70/-

On the basis of these prices the output from Avondale kiln in 1946/47 (452 lbs.) represents a value of £1,200.

For comparison the following table gives detailed sample cost of home collected seed for several species and conditions of collection. In no case was the seed picked from felled trees—which is of course the cheapest method.

Species	Contorta Pine	Silver Fir (A. pectinata, (A. cephal-onica)	Norway Spruce	Scots Pine
Forest of origin...	Forth	Killakee	Avondale	Avondale
Mother trees ...	Young stand	Mature park trees	40 y.o. ride trees	16 y.o. stand
Wt. of cones (stones) ...	6	80	3	30
Costs	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Collection ...	2 0 0	17 0 0	18 6	2 15 6
Transport ...	5 0	1 10 0		4 3
Extraction ...	7 0	11 2 0	4 8	1 12 5
Fuel ...	2 3	6 9	1 1	9 0
Overheads ...	2 6	1 0 0	1 6	5 0
Total cost ...	2 16 9	30 18 9	1 5 9	5 6 2
Yield of seed (lbs.) ...	2	158	1	3½
Cost per lb. ...	£ s. d.	£ s. d.	£ s. d.	£ s. d.
	1 8 5	0 3 11	1 5 9	1 10 4

CONCLUSION.

It will be seen, therefore, that the home collection and extraction of seed is more than justified on the scores of quality and economy. But when we consider in addition that the scarcity of imported seed is one of the chief obstacles preventing an expansion of our planting programmes, the vital role of home collection will be readily appreciated.

We should see to it that no opportunity to collect sound suitable cones is lost. Every such cone wasted means the loss of upwards of one hundred potential forest trees and additional delay in the urgent task of clothing our bare mountains with protective and productive forest.