materials handling.

To enable us to install a gantry we have:

a) installed the heating pipes with extra supports.
b) installed overhead mist and irrigation to keep the floor area clear.
c) planned the glasshouse layout to allow for easy transfer of the gantry across the main access path and also to transfer it transversely from one section to another.

Alarm System. We are currently installing an alarm system which will monitor ten pre-determined criteria including electricity supply, water supply, air temperature. In the event of breakdown, it will automatically ring a predetermined telephone number and report which of the ten criteria is faulty. If no one is home, it automatically dials a second number. This procedure is repeated up to five times and, by changing a casette, the order sequence of the numbers can be changed. We hope this will reduce the amount of weekend duty and reduce the time it takes to get a specialist mechanic to correct the problem.

The Cost. Allowing for grants, various other allowances and a return of 25% on capital, the capital cost will work out about 1p per liner produced.

TAKING STOCK — MANAGEMENT OF STOCK BLOCKS

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This is a review of the work with stock beds at Efford E.H.S. and deals with why and how they were started, their management, and some data on cutting production, particularly in relation to pruning treatments.

The experimental programme with hardy nursery stock deals mainly with container production plus some work on propagation. Between 1973-78 there was a rapid expansion in the volume of work. In order to have confidence in the accuracy of results from experiments, uniform batches of cuttings were required. This proved virtually impossible to obtain with bought-in material. Often greater differences occurred among plants within the same treatment than among the treatments themselves. Neither could there be firm guarantees of when cuttings would be available and occasionally mixed cultivars occurred which made interpretation of results more difficult. Hence it was decided to propagate our own material for trials.

At first plants in the grounds (and local gardens) were used as stock plants but this was unsatisfactory due to variability in the material, which was often floral, and unevenness in rooting. Therefore the planning of a stock bed area began in 1972; its main function would be to supply material for the trials but, at the same time, would provide information on stock management and cutting production.

The advantages of a separate stock area include:

1. Ease of management especially in relation to watching when cuttings are ready for taking.
2. The plant health status is known and can be carefully watched.
3. The plant history is known (this is particularly important in experimental work).
4. Growth of the stock plants can be influenced to produce the type of material as and when required, i.e.: nutrition, protection, forcing, pruning, etc.

It was decided to make the Efford stock block clonal by propagating the stock plants from a single parent, with each cultivar selected as being true-to-type. Clonal material was also felt to have several other advantages:

1. Growth would be uniform.
2. It would provide uniform batches of cuttings at any one time.
3. Successive batches of cuttings could be taken with the knowledge that they had exactly the same parentage.
4. Uniformity of the material could induce even rooting within batches.

The correct choice of parent plant material would be very important to ensure that it was:

1. correctly named.
2. of good form.
3. was a good rooting form.

In some instances non-clonal material was planted and ease of rooting monitored to enable the selection of the best form for cloning.

To ensure that stock plants were disease-free they were container-grown for a year. This also allowed adequate time for site preparation. Planting commenced in 1974.

Site. The site selected had natural shelter on all boundaries, either copse or well established *Escallonia* hedges. The field itself was approximately 2 ha; an area of ground 0.5 ha was fenced off against rabbits along the northern boundary. Later, fallow deer became a problem and the fencing was raised to just over 2 metres in height by two additional strands of wire.

The soil type was a fine sandy loam with a pH of approximately 5.5 overlying gravel at 60 to 75 cm which gave reasonable drainage. The surface structure, however, was unstable, easily slaking or capping and in need of building up with organic matter.

Preplanting preparation. The site was down to a grass ley and the first operation was a subsoiling of the area followed by ploughing and an initial cultivation. There was no perennial weed problem and a single application of Paraquat was sufficient to knock down the resulting weed sward. An application of 60 tonne/ha of FYM was then rotavated in. Cultivations were kept to a minimum to prevent excessive structural damage.

The site was divided into three areas for planting which received different base and top dressings to maintain appropriate pH levels. (1) Ericaceae, (2) Calcioles, and (3) Conifers.

The guidelines used for determining base and top dressings were from the Fertilizer Recommendations for Field Grown Nursery Stock published in the M.A.F.F. Bulletin GF 1 (p. 63). This is copied below in Table 1.

Table 1. Recommendations for base and top dressings for field-grown nursery stock.

	P_2O_5	K_2O	Mg*	P_2O_5	K_2O	Mg*
P, K or Mg	Before Planting			Top Dressing (Annual)		
Index	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
0	100	200	75	50	100	25
1	75	150	50	25	50	Nil
2	50	100	25	Nil	25	Nil
3	25	50	Nil	Nil	Nil	Nil
over 3	Nil	Nil	Nil	Nil	Nil	Nil

* At Efford magnesium limestone was used for the Calciole area but Kieserite for the ericaceous and conifer area to limit the rise in pH.

Nitrogen.

Before planting: 50-150 kg/ha N. (ericaceous area: 50 kg/ha in the form of Nitram to maintain a lower pH.)

Top dressing: 50-150 kg/ha N. (rates varied according to species. Ericaceous area limited to 50 kg/ha Nitram.)

Less nitrogen will be required on deep well-structured medium or heavy soils.

The decision as to the number of plants required for a given cutting production after x years was difficult since there was little information available on this subject nor yet on how long stock should be maintained before replanting.

Initially it was planned to keep the stock block for 10 years, but replant after 7 years to ensure there was no break in the continuity of cutting supply. This stage has just been reached

and replanting will begin in 1980, which will also allow comparisons to be made on effects of age of stock plants on rooting.

Spacing. With the exception of the heathers, which were spaced 45 cm^2, all planting was in rows. Spacing depended on the vigor of the species. In general, the slower growing ones were planted 90 cm apart with 1.20 m between rows. Moderately vigorous species were 1.20 m apart and 1.80 m between rows, while the faster growing species were 1.80 m apart with 2.40 to 3.00 m between rows. In certain instances double the number of plants required were planted with alternate ones being removed as growth increased, e.g. hardy hybrid rhododendrons.

Planting. This was done as and when material became available or new species were introduced into the trials. In this way the older plants acted as windbreaks aiding establishment of the newer plantings (Figure 1).

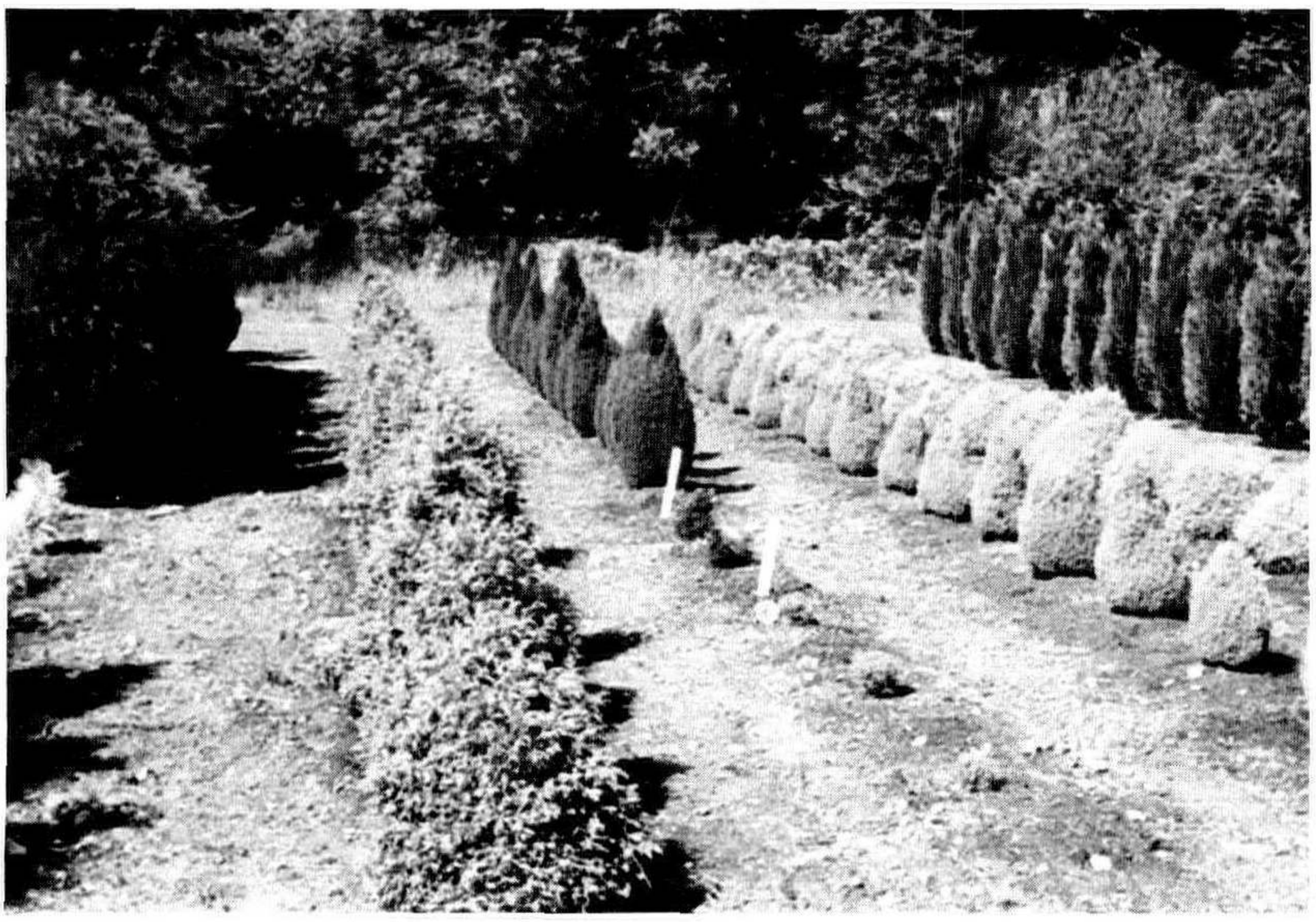

Figure 1. General view of clonal stock in conifer area at Efford Experimental Horticulture Station.

There was little irrigation facility on the stock site until 1978 when a new main was installed. Thus, after an initial "puddling-in" at planting, further irrigation was minimal. During 1975, and especially in 1976, plants suffered severe stress from prolonged periods of dry weather but, despite this, full establishment was achieved of those species already planted and growth in 1977 was excellent.

Weed Control. Weed control, particularly during plant es-

tablishment and early growth, is essential if reduced growth due to weed competition is to be avoided (4). A herbicide programme was preferred but it was decided not to use residuals for up to 3 years after planting to ensure that there was no possibility of their influencing growth or rooting of cuttings. While there have been previous reports at I.P.P.S. meetings that simazine was used on stock beds without adverse effects (1,2,3,5,6,7), there was evidence of some reduction in rooting as a result of simazine application with certain species, e.g. *Calluna* (7), some *Rhododendron* cultivars (1,5), *Juniperus*, and *Ilex* (5).

In the main damage was associated with taking softwood cuttings from treated container-grown plants but, in one instance, rooting of softwood cuttings taken from field-grown *Rhododendron* 'Daviesii' was affected following two successive annual applications of simazine + DCPA (1). Thus it was felt necessary to use simazine with caution and not until plants had become well established, especially as known simazine-sensitive species were included in the area.

Consequently only the contact herbicide, Paraquat was used in the pathways and the area around the plant was kept clean by hand. After 3 years a simazine/paraquat mix was used in the paths, though hand hoeing was continued around the plants. Weed control has been the largest labor input in the stock area and information on herbicide programmes which could safely be used is urgently required.

An alternative method of weed control is to plant through a black polythene mulch (4). This proved very successful when used for a hedge of × *Cupressocyparis leylandii* clones at Efford. In addition to controlling weeds the mulch also aids establishment by improving the moisture status around the root.

Cutting Production. Not all the data collected can be given but a representative sample of species with age and potential cutting production is given in Tables 2 and 3.

These cutting counts were of graded cuttings of the medium size range. The actual potential was looked at in 1979 by taking all available material and grading into large, medium and small, the relative sizes dependent on species.

Pruning. Pruning of stock plants is an important aspect of management in relation to:

a. Maintenance of juvenility to improve rooting.
b. Plant shaping.
c. Timing of flushes of cutting material.
d. Increasing cutting production.

Table 2. Number of cuttings available per plant per annum. Year 1: Plants container grown. Year 2: Planted out in stock field. Year 3: Start of taking cuttings.

Species	Year				
	3	4	5	6	7
Berberis stenophylla	30	140	300	NC	500+
Elaeagnus pungens 'Maculata'	5	30	45		
Rhododendron 'Pink Pearl'	3	8	25		
Ilex aquifolium ('Pyramidalis'; 'Argentea Regina', (Syn.: 'Silver Queen'), 'Handsworth New Silver')	15	35	60	NC	200-250
Viburnum × *bodnantense*	7	20	35		
Viburnum × *burkwoodii*	30	60	100	NC	250+
Chamaecyparis lawsoniana 'Stewartii'	15	60	200		

NC = Not counted.

Table 3. Potential cutting production from stock after 5 to 7 years.

Species and cultivar	Age of stock (from cuttings)	No. of cuttings/plant			Size Grades (cm)		
		Large	Medium	Small	Large	Medium	Small
Ilex aquifolium 'Argenta Regina' (Syn.: 'Silver Queen')	7	108	77	38	10	7-6	6
Chamaecyparis lawsoniana 'Ellwoodii'	6	150	500	200	10-12	7-10	5-7
C. lawsoniana 'Ellwood's Gold'	6	200	300	100	9-10	7-9	5-7
C. lawsoniana 'Allumii'	7	870	370	380	15*	15+	10-15
C. lawsoniana 'Fletcheri'	7	640	1160	200	15+	10-15	5-10
Chamaecyparis pisifera 'Boulevard'	7	300	450	250	7.5+	6-7	5-6
C. pisifera 'Sulphurea' (Syn.: 'Squarrosa Sulphurea')	5	150	400	200	7-9	6-7	5-6
Thuja occidentalis	7	180	600	200	20+	15-20	10-15

* 'Triangular' well-shaped cuttings
+'Narrow' lanceolate-shaped cuttings
} *C. lawsoniana* 'Allumii'

With some species, particularly conifers, the only pruning has been the taking of cuttings each year but with other species a limited amount of work has been started to compare effects of various pruning treatments.

Hydrangea hortensia, Senecio greyii. Stooling the plants back each year produced the best flush of cutting material. With *Senecio* unless the plants were cut back each year growth became predominantly floral.

Deutzia scabra. Three pruning treatments have been compared.

1. Hard prune (Plants stooled to two buds).
2. Medium prune (Half total length of shoots removed).
3. Light prune (Removal of cuttings each year).

The results in Table 4 show that the stooling treatment produced the wrong type of shoot growth for suitable cutting material, better treatments being the medium or light prune, though flowering increased markedly as pruning was reduced.

The following season these plants were either left untouched or sheared back to within 10 cm of new growth in June. While all plants flowered heavily in the second year following the original pruning treatments there was a marked fall-off in cutting production from plants which had only received the light pruning treatment due to the majority of growth being floral. Cutting production was improved by the mid-season prune in the second year.

As a result of these treatments the pruning now adopted for deutzia is the "medium" system of cutting back half the growth each year, early spring if summer cuttings are required, or in June/July if a later batch is needed.

Table 4. *Deutzia scabra:* Effects of pruning treatments on cutting production over two seasons.

	Number of cuttings produced per plant following pruning in April Pruning severity		
	Hard (Stooled)	Medium (½ cut back)	Light (cutting removal)
1st Season			
Good material	11	40	47
Too vigorous	40	25	16
2nd Season			
Light prune	50	30	15
Shearing in June	150	100	50

Berberis × *stenophylla*. With this species, type of pruning, whether hard, moderate or light, did not appear to affect the total number of cuttings available, but timing of production was influenced, as well as ease of taking cuttings in relation to plant size and shape. Hedging with a moderately hard prune in February-March gave a good flush of cuttings for July/August. A second prune in June, cutting back to within 10 cm of the new growth, moved the cutting flush to October/November and this double prune in one season increased total cutting production.

Viburnum × *burkwoodii*. A moderate pruning regime, cutting plants back by half in the spring has produced an even batch of cutting material for early summer. Where only a light prune was given (i.e. removal of cuttings the previous season), growth was more uneven and total number of cuttings reduced. A second prune in June, cutting growth back to within 10 cm of new growth, produced cuttings for September/October and, as well as increasing numbers (Table 5), also produced a cutting with shorter internodes than those of the first flush.

Pyracantha 'Orange Glow'. This has flowered and berried so profusely that cutting material has been reduced and effects of timing of pruning similar to that discussed for *Viburnum*

Table 5. *Viburnum* × *burkwoodii*: Effects of pruning on number of cuttings per plant.

	April prune	
June prune	Light (Cuttings removed)	Medium (½ cut back)
Untouched	100 - 125	150 - 200
Sheared back	150 - 200	200 - 300

were considered. With this particular cultivar the earlier April prune was found best since with the later prune the size of spurs from the extension growth were shorter and much later ripening.

SUMMARY

There has been considerable interest recently in planting specialized stock block areas and there can be no doubt as to the benefits to be gained from having one's own stock plants. A major advantage is to have complete control of growth and all plants within one area so that management, especially in the taking of cuttings, is under the control of the propagator. However, perhaps of greater importance is the flush of uniform material available. The evenness of growth of the stock at Efford was striking due, in the main, to it being clonal in source. There could well be an increase in clonal material in the future when the clonal selection being carried out at Long Ashton Research Station is released back to the trade.

There are a lot of factors involved in obtaining the maximum use out of stock plants and more work is required as to management. In the limited amount of work done on pruning it was obvious that different species are going to need different degrees of pruning to achieve the best results. There are also many techniques to consider for timing of cutting production including forcing, and whether cutting pre-treatment on the stock could improve rooting (i.e. etiolation). The need for more work with herbicides to reduce labor input without adversely affecting rooting has been referred to.

In conclusion, the final quality of plant produced is dependent on many factors but starts right back with the stock and type of cutting taken. Attention to detail and the setting up of the highest standards possible in the stock area will ensure a good start to the production cycle which will be reflected right through the life of the crop in terms of improved quality and uniformity of growth.

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PROPAGATION OF CAMELLIAS

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We have been attempting to propagate and produce about 5,000 finished camellias for garden centre sales each year. Initially we purchased stock plants from various nurseries on the Continent and in the U.K. Variability in this stock was obvious, therefore the selection of the best plants was made to form the basis of our "mother stock." This material was potted and grown on, some of which was planted outside on a hedgerow system, the remainder grown on in 10" containers in a shaded cold house. In the meantime good specimen plants were located in an area to which we have access and this season it is hoped that up to 5,000 Williamsii hybrids will be produced.

Regrettably in the 1978-1979 winter we lost many of these hybrids growing outdoors, the amazing thing being that many of the Japanese hybrids came through better than say, 'J.C. Williams' or 'Donation'.

Under Rokolene net tunnels a similar situation occurred when the newer Williamsii hybrids stood up to the severe weather whereas 'Donation', etc. died.

Propagation. Shoots are taken from the parent plants using secateurs and placed into polythene bags; these are then placed into a domestic refrigerator overnight or until preparation takes place. We have found that refrigerated cuttings seem to perform extremely well, and this is now a standard practice.

Due to the limited amount of cutting material available and the system we have set up, we always take leaf-bud cuttings in