15 Stromquist, L -H and L Eliasson 1979 Light inhibition of rooting in Norway spruce (*Picea abies*) cuttings *Can J Bot* 57 1314-1316

16 Stromquist, L -H and J Hansen 1980 Effects of auxin and irradiance on the rooting of cuttings of *Pinus sylvestris* *Physiol. Plant* 49 346-350

17. Webster's Third New International Dictionary 1961 Bell, London

ETIOLATION OF STOCK PLANTS FOR THE IMPROVED ROOTING OF CUTTINGS II. INITIAL EXPERIENCES WITH HARDY ORNAMENTAL NURSERY STOCK

DAVID J. ROWELL
ADAS, Cambridge

Work at East Malling Research Station has shown that the etiolation of stock plants of apple rootstock M9 can result in an increased rooting percentage of softwood cuttings. An observation was carried out to see if there was a similar response on ornamental species, and in 1980 and 1981 a range of species was tested in cooperation with Mr. J. Watts, propagator for Darby Nursery Stock Ltd. Results to date have been variable. In 1980 a number of species, especially lilacs, showed a marked response to etiolation but in 1981 results have been disappointing.

1980 TRIALS

At bud burst in spring stock plants of the following species were covered with a black polythene tent supported over and around the plants on a simple wooden frame. Immediately prior to covering, the plants were sprayed with benomyl as a precaution against *Botrytis* infection.

		Covering date
Species covered	*Polygonum baldschuanicum*	April 4
	Cotinus coggygria 'Royal Purple'	April 4
	Corylus maxima 'Purpurea'	April 1
	Corylus avellana 'Contorta'	April 1
	Syringa vulgaris 'Charles Joly'	April 8
	S vulgaris 'Madame Lemoine'	April 8
	S vulgaris 'Ludwig Spaeth'	April 8

In the 2 to 3 weeks after covering, the growth rate of the buds was monitored and when the shoots had grown approximately 8 cm the black polythene was raised on the north side of the tent about 30 to 45 cm to allow the shoots to green up. After a further week cuttings were taken and placed in a mist house for rooting.

RESULTS

Effects on Growth. The effect of the blackout treatment

and the higher temperatures under the black-out was increased growth compared with uncovered stock plants. This was particularly noticeable with *Polygonum baldschuanicum* which had grown up to 15 cm within two weeks of covering. Of the lilacs, S. 'Ludwig Spaeth' gave the fastest growth, approximately 8 cm in 3 weeks compared with 2 cm on the control plants.

Corylus avellana 'Contorta' did not respond as much to the treatment and after 4 weeks it had only made 4 cm of growth compared to 2 cm on the control plants. As a result it was necessary to extend the blackout period and, during this time, caterpillars and aphids developed rapidly, causing extensive damage which meant that thee was no suitable cutting material of this cultivar.

Effects on Leaf Characters. Leaves on cuttings of the red-leaved, *Cotinus coggygria* 'Royal Purple' and *Corylus maxima* 'Purpurea' were green after the "hardening off" treatment and only gradually regained their red colouration. Also the leaves on *C. maxima* 'Purpurea' were very thin and soft. Leaves on the *Syringa* species were softer and more shiny than those on the control plants.

Cutting Production. There was generally a significant in-

Table 1. Increase in cutting material in etiolated treatment over non-etiolated.

	percent increase in cuttings
Polygonum baldschuanicum	122
Cotinus coggygria 'Royal Purple'	42
Corylus 'Purpurea'	8
Syringa 'Charles Joly'	78
Syringa 'Madame Lemoine'	31
Syringa 'Ludwig Spaeth'	37

Table 2. Rooting obtained from cuttings in the etiolated and non-etiolated treatments.

	Etiolated			Non-etiolated		
Species	Cuttings taken	Type of cutting	Percent rooting	Cuttings taken	Type of cutting	Percent rooting
Polygonum baldschuanicum	April 30	nodal	39	May 13	nodal	0
Polygonum baldschuanicum	April 30	heeled	51			
Polygonum baldschuanicum	May 9	heeled	68			
Cotinus coggygria	May 9	nodal	48	May 14	heeled	82
Corylus 'Purpurea'	May 6	nodal	33			
Corylus 'Purpurea'	May 9	nodal	8			
Corylus 'Purpurea'	May 12	nodal	0	May 12	nodal	45
Syringa 'Charles Joly'	May 6	nodal	83			
Syringa 'Charles Joly'	May 9	nodal	92			
Syringa 'Charles Joly'	May 12	nodal	67	May 13	nodal	48
Syringa 'Ludwig Spaeth'	May 6	nodal	78			
Syringa 'Ludwig Spaeth'	May 9	nodal	70			
Syringa 'Ludwig Spaeth'	May 12	nodal	56	May 12	nodal	46
Syringa 'Madame Lemoine'	May 12	nodal	27	May 28	nodal	0

crease in the number of cuttings produced by the etiolation treatment compared with control plants, as shown in Table 1. Rooting obtained is shown in Table 2.

Additional treatments: Nodal cuttings of *Polygonum baldschuanicum* taken from young non-etiolated plants gave 55% rooting. Cuttings of *C. coggygria* 'Royal Purple' forced under clear polythene gave 66% rooting.

DISCUSSION

Rooting of cuttings taken from the untreated stock plants, especially *Cotinus coggygria* 'Royal Purple' was much better than was expected based on the previous experience of the propagator.

Polygonum baldschuanicum. The stock plants used in the trial were 5 years old, and it is known that the rooting percentage declines with age of the plant. Thus, when cuttings were taken from 1 year old container plants as an additional treatment, rooting was increased from 0% (unreated stock plants) to 55%. The effect of the etiolation treatment was to overcome the problem of age of the stock plant and to greatly increase the numbers of cuttings available.

Cotinus coggygria 'Royal Purple'. The etiolated plants rooted less well (48%) than either the control plants (82%) or the plants forced under clear polythene (66%).

Corylus maxima 'Purpurea'. The etiolated plants had very soft thin leaves and were susceptible to scorching. Obviously additional shading is required if the technique is to be successful. Etiolation did not give much increase in cuttings.

Syringa cultivars. With *S.* 'Charles Joly' and *S.* 'Ludwig Spaeth', rooting was almost doubled in the etiolated plants compared with the control plants and there was also a considerable increase in cutting production. The much more difficult to root cultivar, S. 'Madame Lemoine' also gave some response to etiolation. The roots produced on the etiolated cuttings appeared to be more fibrous than those on the control. There was also considerably more extension growth on the etiolated plants after cutting.

1981 TRIALS

Following the encouraging results in 1980 the work on lilacs was continued and new species were included in the trial. With the lilacs it was hoped to see if there was any carryover effect of the etiolation treatment in 1980

		Covering date
Species covered	*Syringa* 'Charles Joly'	April 15
	Syringa vulgaris 'Madame Lemoine'	April 15
	Syringa vulgaris 'Ludwig Spaeth'	April 15
	Syringa vulgaris 'Katherine Havemeyer'	April 15
	Viburnum × *juddii*	March 24
	Viburnum carlesii	March 24
	Elaeagnus × *ebbingei*	March 29

Immediately before covering, the stock plants were sprayed with benomyl and chlorpyrifos as a precaution against disease and pests. Rooting obtained is shown in Table 3.

RESULTS

Table 3. Percent shooting obtained under etiolated and non-etiolated treatments

Cultivars	Cuttings taken	Etiolated 1981 Etiolated 1980	Etiolated 1981 only	Etiolated 1980 only	Non-Etiolated
Syringa 'Charles Joly'	May 28	36	55	34	58
Syringa 'Madame Lemoine'	May 18	*	*	28	6
Syringa 'Ludwig Spaeth'	May 18	32	20	1	3
Syringa 'Katherine Havemeyer'			37		28

Other species	Cuttings taken	Etiolated	Non-etiolated
Viburnum × *juddii*	May 19	8	7
Viburnum carlesii	May 19	11	16
Elaeagnus × *ebbingei*	July 2	57	46

* These treatments were lost during propagation because of severe botrytis infection The Katherine Havemeyer was not included in the trial in 1980

DISCUSSION

There does not seem to have been any marked response to the etiolation treatments in 1981. It proved to be a much more difficult season with *Botrytis* infection, both under the black polythene and in propagation and, despite additional spraying, considerable losses occurred, especially with lilacs. If the technique is to be of use commercially then a system of blacking out which is easier to manage must be developed. A walk-in black polythene covered tunnel would seem to be a possibility. This would allow easy access to inspect the stock plants and to carry out operations such as spraying and taking cuttings.

CONCLUSIONS

Etiolation has not yet given the same consistent result on ornamentals as on M9 apple rootstock. However there would seem to be potential for its use on lilacs, especially if the improved extension growth is a regular feature of the treatment and if *Botrytis* can be controlled.

J. GAGGINI: Could I ask David Rowell if the etiolation effect can be related to the extra heat under the polythene and if he has compared transparent or translucent polythene with black?

D. ROWELL: We did not measure temperatures, but since East Malling has been able to produce the effect by black taping of cuttings, temperature does not seem to be the main factor involved. Temperature would affect rate of extension growth. Our trials did not compare clear polythene, but Darby's have found use of clear polythene a better material for *Cotinus*.

R. GARNER: We need to be clear of the meaning of etiolation. True etiolation is the total exclusion of light, and the plant responds by no lamina development. Under black polythene sufficient light enters to allow lamina development, so this is not true etiolation and would be better termed, "partial blanching".

B. RIGBY: Is the speed of growth conducive to producing a faster rate of auxin production from the tip or is it related to the stretching of the pericyclic sheath allowing easier root growth?

R. HARRISON-MURRAY: We have no evidence of enhanced auxin concentration in the "etiolated" shoots, and equally the anatomical effects are numerous. There is still some lignification in the phloem which may act as a barrier to roots, but it is not stretched in any way since the diameter of the etiolated shoots is less than control shoots. A characteristic of the etiolated shoots is their inability to increase in girth for some time after treatment. They lag behind the controls for a considerable period of time. So far we have no strong leads as to the basic mechanism involved, but results vary considerably among species. In M9 the extension growth is not really stimulated and the internodes are not conspicuously longer.

H. SHEPHERD: Was the failure to root of certain species in the Darby trial due to decay in the softer cuttings or was it a genuine failure to root?

D. ROWELL: In general, the 1981 cuttings took longer to root than in 1980, but the etiolated material was more susceptible to *Botrytis* under mist.

P. GAUT: The covers have to be opened at intervals for inspection. Is there any information on how long covers can be opened before adverse effects occur? If you were able to open them for a period each day perhaps disease risks would be reduced?

R. HARRISON-MURRAY: With M9 we know we can open

them up every day for 5 minutes without adverse effects. We have started this ventilation as it does reduce the *Botrytis* problem. In fact, with M9 continuous exposure to low light does not reduce the "etiolation" effect, so complete exclusion of light is not a prime requisite for improvement of rooting.

MY EXPERIENCE WITH DOUBLE CLAD TUNNELS

JONATHAN VAN DER BORGH
Toxward Nursery
Horsham, West Sussex

We have always been concerned with waste in our business. We have tried to prevent waste of resources where possible, and have used waste products if available.

On our dairy farm, for example, we installed a Retriever unit in 1974. This is a water tank with a copper coil inside which uses the waste heat from the compressors for the refrigerated bulk milk tanks, and uses it to heat 60 gallons of water to 128°F from the ambient temperature of the day. We need water at 150°F to circulate and clean the milking pipelines, so we only have to buy the energy for the additional 22°F required. For an outlay of £740 in 1974, we are saving currently £1,250 a year in fuel costs.

Also on our dairy farm, we use old railway sleepers for silo walls, old motor car tyres to cover the silo sheets, wood shavings for cow bedding and we feed wet brewers grains to the cows as a part of their bulk winter ration.

In 1974 we started our container nursery on an acre of waste land, that is to say, land which was unsuited for dairying, but with frontage on the farm drive.

We built and installed everything ourselves, aiming at a low-cost enterprise, and we were guided from the outset by Don Gilbert of ADAS. A great deal of the credit for the present state of our nursery must go to my colleague, John Miller, who as well as propagating and growing our plants, has been builder, joiner, plumber, electrician, designer and innovator.

We started with two Robinsons tunnels 54 × 16 ft., in one of which we installed a mist bench with a capacity of 35,000 cuttings at a time. This tunnel was clad with 600 gauge UV clear polythene and the floor was concreted. The bench is raised 2½ ft. above ground level, constructed of Dexion slotted angle and old corrugated asbestos and timber from the dairy farm. To prevent heat loss underneath the bench, we made an envelope of black polythene sheeting, filled with surplus polystyrene granules, in all 1½ in. thick.