ROOT FORMATION IN *MALUS PUMILA* 'NORTHERN SPY' CUTTINGS USING ETIOLATION

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There has been a renewed interest in the use of etiolation as a technique for aiding propagation of difficult to root plants. Etiolation occurs when plants or shoots are grown in the absence of light and was reported in the 19th century to be of assistance in propagation (9). Reid (8) studied etiolation in relation to propagation of camphor cuttings and an anatomical study suggested, among other things, that etiolated shoots were less lignified and had decreased cell wall thickness. Many people over the years have investigated etiolation (1, 5) but the mechanism whereby etiolation promotes rooting is still poorly understood. Delargy and Wright (1) have shown the benefit of etiolation on the apples, 'Bramley's Seedling' and 'Malling Merton III'.

Severe pruning and proximity to roots are known to influence the rooting potential of shoots (5) and stool beds have been used to provide a source of apple shoots that result from both very severe pruning and a close proximity to roots (7).

The experiments reported here investigated the effects of etiolation and auxins on the rooting of stool bed cuttings of the apple, 'Northern Spy', which is widely used as a clonal rootstock in the Australian apple industry.

MATERIALS AND METHODS

Pre and post harvest treatments were applied to cuttings produced on a 9-year-old Northern Spy stool bed. The main treatments for etiolation and IBA are shown in Table 1. The combinations of treatment factors are shown in Table 2. These treatments were applied in spring, 1987, and repeated in spring, 1988.

Etiolation was achieved by covering the stool-bed with a tunnel 750 mm high and covered with a sheet of 0.152 mm black polythene plus an outer hessian cover. The bed was sprayed with Benlate prior to placing the cover in situ when shoots were 7 to 10 mm high. Daytime temperatures under the cover were on average 9 °C above ambient. However, to prevent possible heat damage, an additional white plastic cover was added on days when ambient temperature reached 23 ° C. This limited the temperature in the tunnel to a maximum of 29 ° C. After 4 weeks, when shoots had grown 120 to 150 mm, etiolation was halted by removing the light-proof covers and replacing them with 50% black shade cloth to prevent damage caused by rapid exposure of etiolated shoots to full sunlight. This shading remained in place until cuttings were harvested (10 to 15 days).

Table 1. Main effects of etiolation and IBA treatment on root parameters

Treatment		Rooting percentage	Root number	Root length (mm)
Etiolation	-	26 2	2 0	24 5
	+	64 1	8 4	51.1
LSD 5%		17 7	3 4	20 6
IBA	-	34 2	3 1	43 6
	+	68 8	9 5	40 9
LSD 5%		16 7	3 2	NS

On the day etiolation was halted, approximately one-third of the shoots were banded to maintain a localized area of etiolation. Banding was achieved by covering the stem in the region 20 to 70 mm above soil level with black Velcro strips as described by Maynard *et al.* (6).

Semi-hardwood cuttings (six weeks old) 100 to 120 mm with soft tips removed, taken from the stool beds, and with proximal ends cut to a node, were propagated in tubes (25 mm × 75 mm), and irrigated by intermittent mist in a glasshouse. Banded cuttings were trimmed to a node within the continuously etiolated area. Propagation medium consisted of equal parts by volume peat, perlite, and coarse granite sand (particle size 2-6 mm). The rooting medium was heated to ensure a minimum temperature of 21 ° C, and 50% black shade cloth was placed 500 mm over the cuttings. The maximum and minimum air temperatures in the glasshouse during the rooting period were 28 ° C and 18 ° C, respectively. When auxins were used, idolebutryic acid (IBA) 2500 mg/l (50% aqueous acetone) was applied to the basal 8 mm via the concentrated quick-dip method as described by Howard *et al.* (5).

After 4 to 6 weeks in the propagation bed cuttings were examined to determine the number of rooted cuttings per treatment. Root number and root length were also recorded.

With the exception of two treatments (see Table 2) the number of cuttings per treatment was 20 Results were analyzed by analysis of variance using years as blocks. The statistical package used for analysis was Genstat 5.

RESULTS

The main treatment effects for etiolation and IBA are given in Table 1 and show that etiolation significantly increased percent rooting, root number, and root length, whereas IBA increased percent rooting and root number but did not significantly alter root length.

Individual treatment effects are shown in Table 2. IBA increased rooting but the effect was greatest when cuttings had not received any prior etiolation. When cuttings had been etiolated and banded, the increase caused by IBA failed to reach statistical significance. The percentage of rooted cuttings was higher on banded cuttings but in neither case did the difference between banded and equivalent non-banded treatment reach significance.

Either IBA or etiolation appeared to stimulate root number but data clearly shows that the largest and only statistically significant effect results from the combination of etiolation, banding, and IBA treatment. Differences among treatments with respect to root length were not statistically significant.

Table 2. Individual treatment effects on root parameters[x]

Treatment			Rooting Percentage	Root number	Root length (mm)
Etiolation	Banding	IBA			
-	-	-	5 0	0 5	10 2
-	-	+	47 5	3 5	38 7
+	-	-	37 5	3 7	57 1
+	-	+	75 0	5 4	47 5
+	+	-	60.0[1]	5 0	63 5
+	+	+	84.0[2]	19 7	36 5
LSD 5%			29 0	5 5	NS

[x] The number of cuttings per treatment was 20 except these indicated 1=15 cuttings in 1988, 2=17 cuttings in 1988

DISCUSSION

IBA or etiolation increased rooting but the increase was greater where cuttings received both treatments and the maximum response was obtained if localized etiolation was maintained until cuttings were harvested. These results are in close agreement with those reported (2) for 'M-9' cuttings produced on hedge rows. However, the relative increase caused by IBA alone was greater for 'Northern Spy' than for 'M-9'.

Maintenance of localized etiolation by banding did increase the number of rooted cuttings but the effect was not statistically significant. This is in contrast to the results of Delargy and Wright (1) who showed that continued local etiolation was critical for rooting.

However, they harvested cuttings almost twelve months after initial etiolation and presumably any root promoting effect due to only a short-term initial etiolation had been lost by extended exposure to light.

The strong effect of continued etiolation plus IBA on root numbers has not previously been reported for apples. Delargy and Wright (1) also obtained maximum root numbers with the same treatment combination but the relative increase over treatments receiving either continued etiolation or IBA was not as great.

These results show that 'Northern Spy' can be propagated from semi-hardwood cuttings produced on stool beds. In the short-term, beds could produce both summer cuttings and a winter harvest of rooted shoots but it is not known whether a bed could sustain dual production over a number of years.

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LITERATURE CITED

1. Delargy, J A and C E Wright 1979 Root formation in cuttings of apple in relation to auxin application and to etiolation *New Phytol.*, 82 341-347.

2 Harrison-Murray, R S , B H. Howard, and K A D MacKenzie 1980 Interaction between etiolation and auxin *Rep East Malling Res Stat.* p 60

3 Howard, B H 1978 Plant propagation *Rep. East Malling Res Stat* .67-73

4 Howard, B H , R S. Harrison-Murray, K A D. MacKenzie 1984 Rooting responses to rooting winter cuttings of M26 apple rootstock *Jour Hort. Sci.*, 59 (2).131-139

5 Howard, B.H., R S Harrison-Murray, J. Vasek, and O.P. Jones 1988. Techniques to enhance rooting potential before cutting collection *Acta Hort* , 227 176-186.

6 Maynard, B.K and N L Bassuk 1987 Stockplant etiolation and blanching of woody plants prior to cutting propagation *Jour. Amer Soc. Hort Sci* , 112 (2).273-276

7 Nelson, S.H. 1977 Loss of productivity in clonal apple rootstocks. *Proc Inter Plant Prop. Soc* , 27 350-355

8. Reid, O 1923. The propagation of camphor by stem cuttings. *Trans and Proc Bot. Soc Edinburgh,* 28 184-188.

9 Sachs, J 1864 Ueber die Neubildung von Adventivwurzeln durch Dunkelheit, Verhandlingen des naturhistorischen Vereines des preussischen Rheinlande und Westphalens. *Bull Soc Bot de France* , 12 (2) 221