NURSERY EXPERIMENT REPORT: THE RESPONSE OF CUTTINGS TO BASAL WOUNDING IN RELATION TO TIME OF AUXIN TREATMENT[1]

BRIAN H. HOWARD

East Malling Research Station, Maidstone, Kent

Abstract. Nineteen similar experiments were carried out on 16 nurseries by members of the Society.

Treatments, comparing the effect upon a range of species of making a basal wound, either before or after auxin application, together with non-wounding, gave results of three main types which appeared to be in part related to the kind of auxin preparation used, rather than the species

(1) Wounding before auxin treatment was beneficial, with the suggestion that this was through improved uptake of IBA applied as a powder formulation.

(2) Wounding before auxin treatment was also detrimental, usually when IBA was applied in a readily absorbed alcoholic solution, suggesting supra-optimal uptake through the wound.

(3) With some subjects wounding was beneficial irrespective of the time of auxin application

The value of a better understanding of these processes is discussed relative to the need for achieving optimal conditions for propagation

INTRODUCTION

Wounding the base of cuttings prior to insertion in the propagating medium is a recognised way of aiding root development, and is widely practiced for some plants (4).

Speculation as to the mechanism of the wounding response has been made (3). Enhanced auxin and water uptake through the wound may take place, or endogenous growth factors may be produced or caused to accumulate. It is also possible that the wound disrupts schlerenchymatus tissue which may be depressing root emergence (1).

Wounding necessitates an extra stage in cutting preparation which may be essential, or avoidable, depending upon the reason behind improved rooting following the wounding treatment. A better understanding of the mechanism may well enable more efficient use to be made of this method.

As one of three experiments proposed at the Second Annual meeting of the Great Britain and Ireland Region, an investigation has

[1]Ed. Note — This report is Dr. Howard's final assessment of this particular set of experiments and includes more information than was given in the Progress Report at the Conference.

been made into the value of wounding under nursery conditions, and of possible relationships between improved rooting following wounding and the more effective entry of auxin into the stem tissue.

MATERIALS AND METHODS

Of the 41 members who asked to take part in this experiment and who were supplied with detailed instructions of procedure, bench layout and recording, 16 members returned 19 completed trials. These were carried out on commercial nurseries or in the propagation departments of Institutes, Universities and Botanic Gardens.

Most of the subjects used were evergreen and the greatest proportion of these were conifers. Propagation was under mist with bottom heat in most cases.

Wounding was almost invariably by means of a slice of tissue removed from the proximal portion of stem, and 4 (indolyl-3) butyric acid (IBA) was used in all but two cases, as either a proprietary powder formulation (Seradix) or as an alcoholic solution applied as a "quick dip". Details of individual experimental conditions are given in the appendix.

The following treatments were applied:

A. Normal cuttings with usual auxin treatment—no wounding.

B. Cuttings wounded and then given auxin treatment.

C. Normal auxin treatment, followed by wounding.

Auxin treatment was to a sufficient depth to ensure the wound, when present, was treated.

Individually randomised layouts were used on each nursery, with five replicates of 20 cuttings per plot per treatment.

Recording. When cuttings were assumed ready for potting off, those in each plot were categorised into some or all of the following classes: *Dead, Poor, Satisfactory, Good, Excellent.* After the records were returned to East Malling, and prior to the analysis of variance, a weighting factor was applied which progressively favoured improved rooting. This was on the assumption that those cuttings with the best root systems would produce the best plants, and that nurserymen would not wish to handle dead or poorly rooted cuttings.

RESULTS

Wounding before treatment with auxin (B) was significantly better than wounding after treatment, or not wounding, in two cases (Table 1, Part 1). The results of seven other experiments showed a similar but non-significant trend (Table 1, Part 2).

All the subjects in Table 1 were treated with auxin in powder for-

Table 1. Mean rooting scores per cutting.

Part 1	Potential	A	B	C	SE±	P<
1) *Prunus lauro-cerasus* 'Otto Luyken'	3.00	1.13	1.99	1.20	0.083	0.001
2) *Juniperus squa-mata* 'Meyeri'	4.00	1.98	2.45	1.41	0.195	0 05
Part 2						
3) x *Cupressocyparis leylandii*	2.00	1.55	1.62	1.54	0.082	
4) x *Cupressocyparis leylandii* 'Stapehill'	4.00	2.04	2.42	2.11	0.176	
5) x *Cupressocyparis leylandii*	4.00	1.62	1.85	1.41	0.151	
6) *Rhododendron ponticum*	4.00	2.70	2.73	2.41	0.152	
7) Floribunda rose 'Ohlala'	4.00	2.38	2 49	2 31	0.162	
8) *Euonymus fortunei* 'Silver Queen'	3.00	2.85	2.90	2.82	0.072	
9) *Juniperus virgin-iana* 'Grey Owl'	2.00	1.60	1.64	1.54	0.082	

mulation with the exception of X *Cupressocyparis leylandii* (item 3). Full details are given in the appendix.

A preliminary sample of the juniper cuttings (item 2) after three weeks showed that all cuttings in treatment C, but only about half those in treatments A and B, were callused. Rooting had commenced in two out of 25 cuttings in A and B but none in C. After a further two weeks, treatment B showed superior root development as in the final assessment.

For three subjects, wounding before auxin treatment (B) was detrimental (Table 2, Part 1) and two others showed a similar but non-significant trend (Table 2, Part 2).

Table 2. . . Mean rooting scores per cutting

Part 1	Potential	A	B	C	SE ±	P <
10) *Chamaecyparis lawsoniana* 'Allumii aurea'	3.00	2.62	2.40	2.64	0.057	0.05
11) x *Cupressocyparis leylandii*	4 00	2.73	1.66	3.96	0.146	0.001
12) *Rhododendron* 'Lady Clementine Mitford'	2.00	1 75	1.15	1.80	0.070	0.001
Part 2						
13) *Juniperus sabina* 'Tamariscifolia'	4.00	2.48	2.03	2.49	0.139	
14) *Thuja plicata* (Lobbii)	2.00	1.67	1.60	1.68	0.063	

All the subjects in Table 2 were treated with alcoholic preparations of auxin with the exception of X *Cupressocyparis leylandii*. Full details are given in the appendix.

For X *Cupressocyparis leylandii*, wounding after auxin treatment (C) was markedly beneficial. It is therefore possible that wounding was of general value in this case, as for subjects shown in Table 3, but that this was masked by a superimposed detrimental effect of previous auxin application.

Wounding, irrespective of when the auxin was applied, was significantly better than not wounding in two cases, (Table 3, Part 1). Two other subjects gave a similar but non-significant trend (Table 3, Part 2).

Table 3. Mean rooting scores per cuttings

Part 1	Potential	A	B	C	SE ±	P <
15) x *Cupressocyparis leylandii*	4.00	2.08	2.94	2.98	0.185	0.05
16) Apple rootstock M.26	4.00	1.38	2.07	2.14	0.108	0.01

continued

continued

Part 2					
17) *Ilex* x *altaclarensis* 'Purple Shaft'	3.00	2.25	2.80	2.76	0.161
18) *Polygonum baldschuanicum*	4.00	1.00	1.49	1.61	0.333

For one subject wounding after auxin treatment (C) was inferior to other treatments, (Table 4).

Table 4. Mean rooting scores per cuttings

	Potential	A	B	C	SE±	P<
19) *Daphne* x *burkwoodii*	3.00	2.23	2.31	1.72	0.117	0.05

DISCUSSION

The results obtained fell into three main categories:

(1) Improved rooting was obtained by wounding cuttings before auxin treatment and is probably explained by the more efficient uptake of the auxin through the wound than through the cut end of the shoot. A powder formulation of auxin was used for both subjects which gave a significant response to wounding before treatment (Table 1, Part 1), and also for six of the seven subjects showing a similar but non-significant trend (Table 1, Part 2). It is reasonable to suppose that IBA applied as a powder is less efficiently absorbed than when applied as an alcoholic dip, and consequently it would be expected to improve most in effectiveness when applied to a wounded stem.

(2) Wounding prior to auxin treatment was detrimental (Table 2) and is most likely explained by supraoptimal absorption of IBA through the wound It is significant that four of the five subjects giving this response were treated with alcoholic preparations of IBA which would be expected to be absorbed more efficiently than powder formulations. This argument is supported by the fact that in practice much higher concentrations of auxin in talc are found necessary to obtain similar results to those from using alcoholic solutions.

(3) Wounding both before and after IBA treatment was beneficial and this may be connected with various of the suggestions made for the success of wounding treatments mentioned earlier. The most likely would seem to be enhanced water absorption in the early stages of propagation. The possibility of this has already been considered (2), and wounding hardwood cuttings of fruit rootstocks has been found to differentially affect the response of cuttings to propagation in dry and moist environments (Howard, unpublished data). The absence of a specific wound mechanism in these experiments is supported by the observations that in the case of apple rootstock 'M.26', floribunda rose 'Ohlala', and *Rhododendron ponticum* the position of roots was definitely not associated with the wound in the first two cases and only partly so (lower portion and cutting base) for the last subject.

Some other observations are worth noting. The results from the preliminary sample of *Juniperus squamata* 'Meyeri' cuttings gave support to the view that rapid callusing does not necessarily predispose or indicate subsequent optimal rooting.

The replicated layout used in these experiments also enabled a substandard section of bench to be pinpointed in the case of X *Cupressocyparis leylandii* shown as item 3 in Table 1, Part 2. Total dead cuttings from the three treatment plots arranged across the bench were, in order along the bench, 7, 3, 5, 2 and 32.

The main conclusion from these results is that the benefit, or otherwise, of wounding cuttings appears to be related to the conditions of propagation, such as the method of auxin application and possibly moisture regime, than to the species involved; x *Cupressocyparis leylandii* featured in each type of main response.

A better understanding of the role of basal wounding in both the response to auxin and to moisture conditions of the rooting environment is clearly necessary to achieve optimal propagation conditions. With this understanding these conditions might be achieved in some cases by modifying the auxin treatment or the rooting environment, rather than resorting to wounding, which is an extra stage in the preparation of cuttings.

Accordingly, provision was made at the 1971 Annual Conference at Merrist Wood Agricultural College to investigate in a new nurserymen's experiment, the interplay of wounding with the method of IBA application and the moisture regime of the propagating environment using x *Cupressocyparis leylandii.*

ACKNOWLEDGEMENTS

Thanks are due to Miss C. Jackson of East Malling Research Station for handling the statistical aspects of these trials. Participating nurserymen are to be congratulated on the standard of records taken.

LITERATURE CITED

1. Beakbane, A. B. 1970. Relationships between structure and adventitious rooting. *Proc. Inter. Pl. Prop. Soc.* 19:192-201.
2. Day, L. H. 1933. Is the increased rooting of wounded cuttings sometimes due to water absorption? *Proc. Amer. Soc. Hort. Sci.* 29:350-1
3. Hartmann, H. T. and D. E. Kester. 1968. Plant Propagation: - Principles and Practices. 2nd ed., Prentice-Hall, Englewood Cliffs, New Jersey, p. 266.
4. Wells, J. S. 1955 Plant Propagation Practices. Macmillan, New York, p. 93.

APPENDIX

Conditions

1. J. G D. Lamb and J. C. Kelly, The Agricultural Institute, Kinsealy, Dublin. 16.1.70 to 10.2.70. 2.0 to 2.8 in nodal cuttings with 0.8 in wounds treated with Seradix No. 2 powder where appropriate.
2. J. P. Sutherland, North of Scotland Agricultural College, Inverness. 3.2.70 to 23.3.70. 4.0 to 4.7 in lateral cuttings with 1.0 in wounds treated with Seradix No. 3 where appropriate.
3. J. Watts, Darby Nursery Stock Limited, Thetford. 20.2.70 to 24.6.70. Nodal cuttings with brown wood at base. 5.0 in nodal cutting. 0.4 in wound treated with 1250 ppm IBA in alcoholic solution where appropriate.
4. A. Turner, Royal Horticultural Society's Gardens, Wisley. 11.11.70 to 8.3.71. 5.0 to 6.0 in heel cuttings with 0.5 in wound treated with Seradix No. 3 where appropriate.
5. Member not identified. 13.4.70 to 13.10.70. 2.5 to 3.0 in soft tip cuttings with 0.5 in wound treated with Seradix No. 2 where appropriate.
6. D. Mansell, Meadow Cottage Nursery, Chelwood Gate. 20.10.70 to 20.5.71. 3 0 in internodal cuttings with 1.5 in wound treated with Seradix No. 3 where appropriate.
7. M. E. Marston, School of Agriculture, Nottingham University, Sutton Bonington. 3.8.70 to 11.9.70 1.5 in leaf-bud cuttings. 0.75 in wound treated with Murphy Hormone Rooting powder where appropriate. (NAA and Captan).
8. J. G. D. Lamb and J. C. Kelly, The Agricultural Institute, Kinsealy, Dublin. 2.12.70 to 7.1.71. 2.0 to 3.0 in nodal cuttings. 0.8 in wound treated with Seradix No. 3 where appropriate.
9. P. D. A. McMillan-Browse, Hadlow College, Kent. 10.1.70 to 5.4.70.

4.0 to 5 0 in lateral cuttings, mature at base. 1.0 in wound treated with Seradix No. 3 where appropriate.

10 J. Watts, Darby Nursery Stock Limited, Thetford. 3.2.71 to 7.6.71. 4.0 in nodal cuttings. 0 4 in wound treated with 1250 ppm IBA in alcoholic solution where appropriate.

11. G. P. Chandler, Stewarts (Ferndown) Nurseries Limited, Wimborne. 21.1.70 to 7.4.70. 4.0 in cuttings of previous season. 1.0 in wound treated with Seradix No. 3 where appropriate.

12. B. Humphrey, Hillier and Sons, Winchester. 21.9.70 to 10.6.71. 3.0 in cuttings 1.0 in wound treated with 5000 ppm IBA in alcoholic solution where appropriate.

13. J. Hulme, University of Liverpool Botanic Gardens, Wirral. 12.2.70 to 7.7.70. 3.0 in lateral cuttings with trimmed heel. 0.5 in wound treated with 1000 ppm IBA in alcoholic solution where appropriate.

14. T. Allen, J. Coles and Sons, Leicester. 25.7.70 to 12.10.70. 3.0 in heel cuttings. 0.5 in wound treated with 500 ppm IBA in alcoholic solution where appropriate.

15. F. Willard, Messrs. A. Goatcher and Son, The Nurseries, Pulborough. 21.1.70 to 14.9.70. 4.0 to 6.0 in nodal tip cuttings. 0.6 in wound treated with Seradix No. 3 where appropriate.

16. B. H. Howard, East Malling Research Station. 19.3.70 to 16.4.70. 24 0 in basal hardwood cuttings propagated without mist. 0.7 in wound treated with 2500 ppm IBA in alcoholic solution where appropriate.

17. B. Humphrey, Hillier and Sons, Winchester. 5.10.70 to 10.6.71. 4.5 in cutting. 1.0 in wound treated with 10,000 ppm IBA in powder formulation where appropriate.

18. D. M. Donovan, F. Toynbee Limited, Croftway Nurseries, Bognor Regis. 11.1.70 to 5.4.70. 3.0 to 4.7 in nodal hardwood cutting, 0.6 in wound treated with Boots Hormone Rooting powder (NAA, IBA and Thiram).

19. R. J. Hares, Pershore College of Horticulture, Worcs. 17.6.70 to 4.7.70. 3.0 in soft tip cuttings. 1.0 in wound (incision) treated with 1000 ppm IBA in alcoholic solution where appropriate.