with the understock."

As soon as possible after grafting, the grafts are returned to the glasshouse and plunged back into the propagating medium to a depth just covering the graft union. Under no circumstances should the grafts be allowed to dry out. They are then given a drenching of Benlate or Terrozole to guard against attacks from any soil borne diseases.

Aftercare of Grafts. Regular attention to humidity and the amount of moisture given is very important as too much water can be disastrous.

Hygiene in the propagating pits is of the utmost importance and any dead or decaying material should be removed at once. Regular applications of fungicides should be used (e.g. every three weeks). The grafts are left in the pits for approximately two months with bottom heat to help stimulate callus formation. At the end of this period, when a good callus has formed, the grafts are lifted from the medium, stocks cut off and the grafts replunged into the medium for a further three weeks to recover. After this time the grafts should be ready for potting.

Conclusions. Once plants are potted up they are returned to the glasshouse where they are gradually weaned off the mist. They will eventually be transferred to the shade house. One point which is very important is that the new plants are very susceptible to bumps and knocks and so the rubber budding strips which bind the scion to the stock are not cut off at this stage but are left on until planting time. This is usually straight after the first flush of spring growth.

LITERATURE CITED

1. Leach, D.G. 1961, Rhododendrons of the World. p. 335-337. Chas. Scribner's Sons, New York.

FEIJOAS: SELECTION AND PROPAGATION

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Abstract. A series of trials in 1978 and 1979 showed that the rooting ability of feijoa cuttings was influenced primarily by the parent tree. Some parent trees produced cuttings which showed high rooting percentages whilst others produced cuttings of very low rooting ability. Other factors, such as the position from which the cuttings were taken from the tree and the size of the container in which the cuttings were grown, also influenced rooting ability. Longer exposure to indolebutyric acid in alcohol as a dip did not increase rooting ability. The taking of cuttings in late winter as opposed to late autumn had less effect than the parent tree on rooting ability.

REVIEW OF LITERATURE

The feijoa (*Feijoa sellowiana*) has attracted interest in recent years as a fruit with export potential. Bailey (1) commented that for successful commercial fruit production all trees planted should bear regular crops of fruit of a size and type desired by the market. Seedling trees produced fruit with a great variation in size and shape and so vegetative propagation was the only way to ensure a consistent type of fruit.

The fruit, to have export potential, must satisfy a number of criteria (Dawes, pers. comm). It must be consistent in shape and size, have a firm skin, and a firm layer of flesh beneath the skin to enable easy handling. The fruit must have an even green colour, large locules, a pale cream to white flesh colour, and a minimum amount of grit cells in the flesh. The fruit must also be capable of a reasonable period of cool storage.

Fruits of both the present commercially important cultivars, 'Mammoth' and 'Triumph' have satisfactory quality factors, but tend to have a short storage life — about 4 to 6 weeks at normal cool storage temperatures.

Feijoas can be propagated by either cuttings or grafting (1). A factor which must be considered in selecting new cultivars is the ease of propagation.

In April 1978, investigations were begun on a number of lines of seedling trees in the Hawke's Bay area to find trees with fruit of a consistent and desirable type. At the same time cuttings of promising selections were tested for ability to root under standard commercial conditions to see if there were any variations among individual parent trees.

MATERIALS AND METHODS

Two sets of propagation trials were carried out: one in 1978, the second in 1979. The first trial in 1978 was to test the ease of propagation of material from 15 different seedlings about ten years old, from two different properties, coded H and F. Approximately 50 cuttings of each selection were stuck on May 26, 1978. Each cutting was of current seasons mature growth taken once the trees had gone dormant. The cuttings were three nodes in length, the basal cut being just below a node. All leaves except the two at the top node were removed. A wound was made from the middle node nearly to the base.

Cuttings were quick-dipped with indolebutyric acid (IBA) at 3000 ppm in 50/50 isopropanol and water. Once prepared, the cuttings were stuck into plastic tubes containing a soil-less medium of equal parts of peat, sawdust, pumice and sand. They were then placed on a heated bed at 20°C in a plastic tunnel

house.

On June 30, 1978 a further trial was laid down with cuttings from several different selected seedlings (from a property coded MD) to test the theory that cuttings from the lower shaded areas of the tree rooted more readily than those from the exposed upper areas. Approximately 50 cuttings were taken from either the upper or the lower areas of the selected trees and treated as described previously.

Cuttings were taken in a further trial on August 8, 1978 from most of the seedlings used in the May trial. Fifty cuttings, approximately, were taken from each tree and treated as above. The numbers of cuttings which were rooted, callused, or dead, were assessed on July 21, November 1, or December 18, 1978 for the various trials.

In 1979, samples of fruits were taken from a further 16 promising seedling trees from six different properties (coded F, H, M, MD, CR and W) and sent to Plant Diseases Division, Department of Scientific and Industrial Research, Auckland, for storage testing. Fifty to 200 cuttings of each of these 16 trees (all 8 to 12 years old) were stuck, as described previously, on May 28, 1979. The type of wood used, i.e. strongly vigorous or weak, was noted.

In addition, two small trials were laid down: firstly, to test the effect of dipping the cuttings in IBA for five seconds, compared to the normal quick dip; secondly to examine the effect of the size of the propagating container on rooting ability. Two containers were used for the latter experiment — plastic tubes of 75cc volume, or "Plexi 100" plastic trays — each receptacle being approximately 25cc volume. Assessments for all 1979 trials were made on August 22 and October 24, 1979.

RESULTS

Influence of Parent Tree on Rooting Ability. *Tables 1 and 2* present the results of the two years trials with the different selected seedlings.

The most obvious results from the data of these two trials is the tremendous variation in rooting capability of cutting material taken from different parent trees. In Table 1 the range is from 76% for H18 down to as low as 4% for H36 and yet all material selected was off trees of similar vigor. The data for the two sampling dates also indicate that after eight weeks from sticking, only about half the cuttings which finally produced roots had actually rooted. A similar pattern emerges in Table 2.

The percentage rooting for cutting material from tree F35 was 81.3% by the final sampling date, approximately five

Table 1. Rooting percentage of feijoa cuttings stuck on May 26, 1978 as determined by parent tree and assessment time.

Tree Number	Assessment Date					
	July 21, 1978 percent			Dec. 18, 1978 percent		
	Rooted	Callused	Dead	Rooted	Callused	Dead
H18	44	52	4	76	0	24
H23	32	47	21	74	0	22
H37	31	46	23	62	0	38
H20	21	48	31	57	0	43
H25	19	59	22	55	7	38
F10	28	56	16	52	0	48
F56	12	72	16	48	0	52
H47	24	45	31	45	0	55
H39	22	45	33	45	0	55
H28	17	52	31	45	12	43
H21	21	53	26	44	0	56
H31	3	86	11	31	0	56
H24	9	35	56	25	0	75
H49	20	17	63	24	0	76
H36	0	36	64	4	0	96

Table 2. Rooting percentage of feijoa cuttings stuck on May 28, 1979 as determined by parent tree and assessment time.

Tree Number	Type* of Wood	Assessment Date					
		Aug. 22, 1979 Percent			Oct. 24, 1979 Percent		
		Rooted	Callused	Dead	Rooted	Callused	Dead
F35	S	57.7	35.8	6.5	81.3	7.2	11.5
H52	W	52.0	12.0	36.0	56.0	2.0	42.0
F11	S	36.1	37.2	26.7	55.0	7.2	37.8
F10	S	33.7	30.8	35.5	51.9	1.9	46.2
F57	M	30.6	36.9	32.4	48.6	2.8	48.6
F56	M	26.5	38.5	35.0	42.4	6.6	51.0
MD	M	27.3	27.3	45.4	42.0	7.3	50.7
W	W	30.9	16.1	53.0	35.3	2.9	61.8
F33	S	9.6	68.5	21.9	33.7	16.9	49.4
CR1	W	20.0	20.0	60.0	27.3	0.7	72.0
M	W	16.1	20.1	63.8	22.8	3.4	73.8
H55	W	19.1	12.4	68.5	21.3	0	78.7
CR2	W	11.8	36.2	52.0	20.5	7.1	72.4
H50	W	11.5	12.5	76.0	15.4	1.0	83.6
H22	W	5.3	15.9	78.8	10.6	0	89.4
H40	W	0	5.1	94.9	1.3	0	98.7

* S denotes cuttings from trees of vigorous growth; M; moderate growth; W, weak growth.

months from sticking, whereas H40 produced only 1.3%. The range in both seasons was remarkably similar. Although most trees selected in 1979 were different than those used in 1978, cuttings from trees F10 and F56, which were tested both years, showed similar rooting ability in both years. For F10 in 1978

the percentage of cuttings rooted was 52% whereas in 1979 it was 51.9%. For F56 it was 48% and 42.4%, respectively.

Effects of Time of Year. In Table 3 the results show that material stuck in August 1978 also showed a wide range of variation in rooting ability — from 10% for the worst up to 81% for the best.

Table 3. Rooting percentage of feijoa cuttings stuck on August 8, 1978.

	Assessment Date					
Tree	Nov. 1, 1978			Dec. 18, 1978		
Number	Rooted	Callused	Dead	Rooted	Callused	Dead
H25	75	14	11	81	3	16
H20	65	15	20	80	0	20
H28	45	33	22	68	7	25
H24	46	17	37	48	2	50
H21	23	26	51	26	3	71
H36	12	44	44	19	15	66
H49	6	35	59	12	6	82
H31	8	72	20	10	68	22

A comparison of data for rooting performance of cuttings from the various trees tested in both May and August, as shown is Table 4, produced a pattern which shows that generally trees producing material of high rooting ability in May also performed well in August. Lower potential material tended also to be poor at both times.

Table 4. Percentage rooting of feijoa cuttings stuck either in May or August as assessed on December 18, 1978.

	Time of Sticking					
	May percent			August percent		
Tree Number	Rooted	Callused	Dead	Rooted	Callused	Dead
H20	57	0	43	80	0	20
H25	55	7	38	81	3	16
H28	45	12	43	68	7	25
H21	44	0	56	26	3	71
H31	31	0	68	10	68	22
H24	25	0	75	48	2	50
H49	24	0	76	12	6	82
H36	4	0	96	19	15	66

Position on the Tree from which Cuttings were Taken. There is an indication in Table 5 that cutting material selected from the lower areas of the trees tends to root more readily than that from the upper areas, even though the overall take was fairly poor. The percentage of cuttings forming roots was over three times greater for trees MD5 and MD2L for wood from the lower areas.

Table 5. Rooting percentage of feijoa cutting stuck on June 30, 1978 as influenced by portion of the tree from which the cuttings were selected.

Tree Number	Position*	Assessed November 1, 1978 Percent		
		Rooted	Callused	Dead
MD5	U	9	7	84
	L	30	10	60
M2L	U	8	8	84
	L	26	33	41
ML	U	13	25	62
	L	20	21	59

* U represents cuttings from the upper portion of the tree, and L the lower.

Time of Exposure to IBA. Results of dipping the feijoa cuttings for five seconds in IBA as opposed to the quick dip are shown in Table 6.

Table 6. The effect of a five-second dip in IBA as opposed to the quick dip or the rooting of feijoa cuttings.

Tree Number	*Dip Time	Assessment Date: August 22, 1979 Percent			Assessment Date: October 24, 1979 Percent		
		Rooted	Callused	Dead	Rooted	Callused	Dead
H52	C	52.0	12.0	36.0	56.0	2.0	42.0
	T	40.0	8.0	52.0	48.0	0	52.0
W	C	30.9	16.1	53.0	35.3	2.9	61.8
	T	20.3	18.8	60.9	30.4	0	69.4

* C denotes the quick dip, T the five-second dip.

It appears that there is no advantage in longer dipping in IBA. In fact there is a suggestion of a slight depression in rooting ability if treated longer.

Effect of Rooting Volume. The results in Table 7 show that a higher rooting percentage was attained in the 75cc plastic tube as opposed to the 25cc tray receptacles, even though the overall rooting percentage was low.

Table 7. Percentage rooting of feijoa cuttings as affected by volume of medium.

Tree Number	Container Type*	Assessment Date: August 22, 1979 Percent			Assessment Date: October 24, 1979 Percent		
		Rooted	Callused	Dead	Rooted	Callused	Dead
H50	Tu	11.5	12.5	76.0	15.4	1.0	83.6
	Tr	3.7	22.2	74.1	3.7	0	96.3
H55	Tu	19.1	12.4	68.5	21.3	0	78.7
	Tr	5.9	26.5	67.6	5.9	0	94.1

* Tu, denotes plastic tubes; Tr, the "Plexi 100" trays.

The depth to which cuttings could be placed in the medium appeared to be the problem in the plastic trays. The

cuttings tended to be top heavy and move around opening a hole around the base of the cutting. This may have caused some desiccation and subsequent leaf drop on the cuttings, which then resulted in death.

DISCUSSION

Along with the selection of feijoa seedlings for desirable fruit characteristics, it would appear necessary also to examine their ability to reproduce the parent tree from cutting material, if this is to be the desired method of propagation. The results from both seasons trials show a wide range of rooting capabilities for cuttings from various parent trees from extremely low levels up to commercially viable levels. It also appears that there may not be a great difference in rooting ability of cuttings whether taken in May or August, the better rooting selections being satisfactory and the poorer types remaining relatively difficult at either time.

The position from which cutting material is taken on mature trees seems to influence the rooting capability. Material from the lower areas generally appears more satisfactory.

Longer dipping of the cuttings in IBA appears to give no improvement in rooting. On the contrary, it appears to depress root development.

The size of container into which the cuttings are stuck seems to have an important influence on rooting ability. Feijoa cuttings tend to be large and top heavy and need to be deeply set in the propagating mix to prevent movement and to obtain adequate rooting.

Two areas which require further investigation are the time of taking cuttings and also the quality of the wood. It may be that there are times of the year other than May and August when cuttings may root readily. However, observations with the cultivars 'Mammoth' and 'Triumph' suggest that taking cuttings while the tree is in active growth will result in relatively poor rooting percentages.

In Table 2 there is a suggestion that cuttings from trees with vigorous growth may root more readily than those with slow growth. However, all trees in Table 1 were showing weak extension growth and yet the variation in rooting ability was similar. Overall, it appears that the parent tree exerts a marked influence on the ability of cuttings taken from that tree to root. This could have an important bearing on the development of new feijoa cultivars for the future.

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LITERATURE CITED

1. Bailey, F.L. 1952. Culture of feijoa trees. *N.Z. Jour. Agr.* 84:291-296.

FASTER BULKING UP NEW INTRODUCTIONS OF FRUIT CROPS

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The most pressing problem facing the nursery industry is the need for new methods to speed the bulking up process with new introductions. At present, using ordinary outdoor nursery techniques, it requires at least four years to propagate 1,000 plants from one source plant that is moderately difficult to grow, like most fruit trees. We need to reduce this time to one year — so that we can make faster progress in introducing:

(1) new rootstocks, e.g. BAC 29, 'Colt' cherry, Aotea selections
(2) new cultivars from quarantine, e.g. 'Red Fuji', 'Jonagold', 'Gloster'
(3) new hybrids from breeding
(4) new virus-free selections
(5) new colour sports, e.g. 'Red Delicious', 'Royal Gala', 'Braeburn'
(6) new kinds of fruit, e.g. Nashi pear, persimmon, loquat

The New Zealand Tree Crops Association has recognized the problem in the development of new kinds of walnuts, hazelnuts and chestnuts and, in order to find some solution to this frustrating delay, they have decided to establish a special trust fund that would be used to support research and development of new rapid propagation methods, including laboratory and glasshouse production of meristematic tissue culture, micro-grafting, nurse-root grafting and very small softwood cuttings. The Nurserymen's Association is also studying a similar project and finds the tax-free aspect of trust funds attractive (since individuals may legally invest up to $1,000 and companies 3% of profits).

It is possible that since the fruitgrowing industry is vitally concerned with speeding up the introduction of new material, that the N.Z. Fruitgrower's Federation should consider similar