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CONTRACT REPORT
INTERIM

THE INFLUENCE OF PRUNING, ROOTSTOCK TYPE, PLANTING METHOD AND UNDERCUTTING ON THE CONTAINERISATION OF BUSH ROSES

Horticultural Development Council
Project HNS 56
1994 - 1995

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Trial Commenced: March 1994

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CONTENTS

SUMMARY

An increasing proportion of field grown roses are containerised before sale, and the potting operation often involves pruning away a significant amount of root in order to accommodate the plant in the container. This can affect establishment and final quality, as well as slowing down the potting operation. A trial was established at HRI Efford to investigate a number of factors and potential treatments which might improve the fibrousness and distribution of roots on plants in the field, and reduce the amount of root pruning required at potting.

This interim report covers the field growth phase of the project from rootstock planting in March 1994 to lifting finished bushes in November 1995 prior to potting.

Rosa 'Laxa' and *R. canina* 'Inermis' were compared as rootstocks for the hybrid tea and floribunda cultivars Amber Queen, Indian Summer, Margaret Merril, Silver Jubilee and Royal William. In a second trial alongside, 'Inermis' alone was used for the patio and compact floribunda cultivars Baby Love, Trumpeter, Sweet Dream, Rosy Future and Festival.

Neither hand vs. machine planting, nor 'severe' vs. 'normal' pruning of the rootstocks at planting, had a very significant effect on rootstock establishment, budtake or subsequent root or shoot development.

Half the plants were given a shallow undercutting treatment to about 150 mm below soil level using an Egedal angled blade undercutter in October 1994 to try and encourage fine root production from high up the root system near to the neck. This treatment significantly reduced shoot growth of all cultivars the following year. Undercut plants were between ⅔ and ¾ the height of non-undercut bushes, had about ¾ the number of shoots in total and only ½ the number of thick shoots by October 1995. How this will affect final quality of the containerised plant remains to be seen. However, the distribution and form of the roots were improved for potting, with the creation of a more fibrous root and compact root system. The number and weight of roots requiring pruning at potting was greatly reduced by the undercutting treatment. Effects were particularly pronounced for 'Laxa', where many more thick and deep roots required pruning on non-undercut plants. Although 'Inermis' was also affected by the undercutting treatment, non-undercut bushes naturally produced a finer root system with fewer deep, thick roots than 'Laxa' requiring less severe pruning prior to potting.

Undercut and non-undercut plants on both rootstocks for selected cultivars were potted in December 1995. Their establishment, growth and quality in the container up to the point of marketing in summer 1996 will presented in the final report due November 1997.

INTRODUCTION

In order to meet the increasing demand both for quantity and quality of containerised roses, it has been necessary to adapt and develop production practices. Of key importance is the successful survival, establishment and subsequent growth of the rose after potting. Many factors, including growing media structure, nutrition and timing of potting may influence this, but in addition, dealing with the root system from a field grown crop during the potting operation can be a significant problem. *Rosa* 'Laxa' rootstocks typically produce long tap roots with relatively little fibrous root. This, together with the long rootstock 'neck' which also needs to be buried, typically means that extensive root pruning is needed to pot the plant centrally and deeply enough, unless much larger containers are used than are strictly necessary, adding to the costs. Deep pots were developed in an attempt to overcome the problem, and those such as the 4 litre Optipot 17RX are now standard for many nurseries. Nevertheless, the absence of much fine root on many plants, together with the severe root pruning still needed for the remaining structural roots, may be significant factors in contributing to the slow establishment or even death of some rose plants following containerisation.

The overall objective of the project was to examine potential techniques to improve the distribution and fibrousness of the root system formed in the field prior to lifting and potting, and to monitor these effects on subsequent growth in the container.

This interim report covers results up to November 1995, ie. the effects of treatments on budtake, shoot growth, and root growth and structure observed at lifting prior to potting. Samples of selected treatments were potted to monitor their effects on subsequent growth and flowering in 1996.

MATERIALS AND METHODS

Site and nutrition

The trial was planted on a silty loam of the Efford soil series in Field S11 (North). The site had grown a previous bush rose crop in 1990 - 1991, and had then been down to a short term ryegrass ley. A soil sample taken 1 March 1994 gave the following analysis:

pH	6.8	
P	49 mg/litre	(ADAS Index 4.1)
K	335 mg/litre	(ADAS Index 3.5)
Mg	92 mg/litre	(ADAS Index 2.8)
Organic matter	3.7%	
Texture	Silty loam	

Following a glyphosate application to destroy the grass ley (see Crop Diary in Appendix II, p. 20), a heavy stable manure dressing of about 200 tonnes/ha was applied in early March 1994, primarily to improve soil structure. This manure was relatively low in nitrogen compared to most farmyard manures. No base dressing was applied, but nitrogen top dressings were used in the summer of the rootstock year, and a top dressing of a compound fertiliser in spring of the production year.

Treatments

See also Field Plan (Appendix I, p. 19).

Rootstock selections:	L	*Rosa dumetorum* 'Laxa'
	I	*Rosa canina* 'Inermis' ('Inermis' only for Trial 2)
Planting methods:	H	By hand
	M	By Super Prefer planting machine
Initial root pruning:	RP1	Normal pruning leaving about 150 - 180 mm of root measured from top of root collar
	RP2	Severe pruning leaving about 100 mm of root measured from top of root collar
Undercutting:	UC0	Not undercut
	UC1	Undercut to about 150 mm depth with Egedal angled fixed blade undercutter in mid October 1994

Flowering cultivars:

Trial 1

RW	Royal William	HT	Deep Crimson
SJ	Silver Jubilee	HT	Pink
MM	Margaret Merril	FL	Pearly White
IS	Indian Summer	HT	Creamy Orange
AQ	Amber Queen	FL	Amber

Trial 2

Fe	Festival	Patio	Scarlet
RF	Rosy Future	Patio	Bright Pink
SD	Sweet Dream	Patio	Apricot
Tr	Trumpeter	Dwarf FL	Scarlet
BL	Baby Love	Patio	Yellow

Previous work within project HNS 6a (New Rootstocks for Bush Roses), had highlighted some differences in root architecture between rootstock selections. *Rosa canina* 'Inermis', for example, tended to have a more finely branched and compact root system compared with the deep, thick and sinuous tap roots typical of *Rosa* 'Laxa'. Project HNS 6a showed improved plant grade-outs could be achieved on 'Inermis', but at the expense of increased sucker production. However, it was felt that the influence of contrasting rootstocks on containerisation merited further investigation. As rootstocks were ordered well before project details were finalised, only 'Inermis' rootstocks were available for Trial 2 and were budded with patio and dwarf floribunda cultivars.

From observations, and experience from growers, it was apparent that a 'lop-sided' root system could sometimes result from machine planting if the rootstock seedling's neck or roots were trailed in one direction along the base of the planting furrow, making it impossible to centralise the plant in a container without completely severing the root system, particularly if the neck of the plant had become angled. This effect has been noticed particularly with standard stems, which must be potted vertically, and where difficulties have arisen even when wide 10 litre pots are used. Although planting rootstocks by hand, to overcome the problem, is unlikely to be commercially viable, this factor was included to determine its relative importance for containerised bush roses.

The use of hard root pruning prior to planting is potentially a relatively simple job if it could encourage new roots to form from or near to the neck, without unduly checking establishment of the rootstocks (Appendix IV, Plate 1, p. 24). Some root trimming is normally required to aid handling and machine planting, but the effects of a more severe than normal pruning needed to be examined.

A range of flowering cultivar types were chosen for budding including HT's, floribundas and patios. Most of these are containerised commercially, although some make more suitable compact container plants for marketing than others. It was felt important, though, that any applied treatments were tested over a wide range of types, as growth responses before and after containerisation might be very cultivar dependant.

Finally, a very shallow undercutting treatment (to about 150 mm depth) applied at the end of the budding year was included in an attempt to encourage new roots to be formed from high up on the root system the following year prior to lifting for potting. This method of undercutting is becoming increasingly used in tree nurseries for the production of one year bare root seedlings where it is carried out in summer. It encourages the formation of new fibrous roots during the remainder of the growing season, before lifting in winter. Marked improvements in establishment after transplanting can be obtained for some coarse rooted species such as oak in response to summer undercutting. However, to try to minimise checks to rose rootstock growth and budtake, timing of this undercut was delayed until mid October. To further delay undercutting to the second year was felt to be too great a risk to top growth.

The compacted soil between the bed rows and in the wheelings was loosened using a rigid tine drawn to a depth of about 300 mm, prior to undercutting. Plate 2, p. 25 illustrates the Egedal machine used, and the effect of the undercutting operation on a selection of rootstocks.

Design and layout

See Appendix I, p. 19 for details of the field planting layout. Plants were spaced nominally 0.2 m apart within rows in wide double rows 0.8 m apart at 1.83 m wheelings giving a plant density of 54,645 plants / ha (22,114 plants / acre). In practice, in-row spacings were slightly wider for machine planted beds because of technical difficulties in achieving precisely the desired spacing. At budding, divisions between flowering cultivars were made with straight lines across all beds. Consequently, plot sizes varied between about 24 - 30 plants per plot.

All treatments were factorially combined, but the large number and complexity of treatments meant that a replicated trial design could not be employed in the field stage of the project.

Culture

A summary of the key cultural points is given here. The crop diary in Appendix II, p. 20 details timings of operations, chemical rates used etc.

The site was chisel ploughed followed by rotary cultivations in early - mid March 1994. All hand planted beds were completed in mid March, but frequent rain delayed the completion of

machine planting until mid April. Stocks were budded in late July - early August, and were headed back in mid February the following year. Initial breaks were pinched back in early May 1995 for most cultivars to help encourage further basal breaks to develop, and to reduce the risk of 'blow-out'. Suckers were removed from rootstocks in mid June and late July. A Damcon 'J-blade' undercutter was used to deeply undercut the crop in mid - late October 1995 before lifting and root assessments were made. This was a standard cultural operation throughout the crop as opposed to the shallow undercutting treatment applied to half the plants in October 1994. Plants from selected cultivars, after root assessments were completed in mid November, were trimmed for potting and heeled back into the soil before being potted in early December.

Irrigations were applied in late June and mid July 1994 prior to budding, and were required again in late June to early July in 1995 which also activated a summer residual herbicide application. Rainfall data for 1994 and 1995 is shown in Appendix III, p. 23.

Simazine (Gesatop 500L) + metazachlor (Butisan S) residual herbicides were applied post planting and post budding, and simazine + oxadiazon (Ronstar Liquid) was used post heading back in spring 1995. Some additional hand weeding was required, particularly in the SE corner of the trial to keep some patches of field bindweed (*Convolvulus arvensis*) in check. An additional application of simazine + Butisan S was made in late June 1995 to ensure weeds were well suppressed through to autumn when final growth records were made.

A routine programme for control of pests and diseases (mainly aphids, powdery mildew, black spot and rose rusts) were applied during the crop. Fungicides were rotated between bupirimate + triforine (Nimrod T) and myclobutanil (Systhane 6W or Systhane Flo) in the first year, and carbendazim + dodemorph (Bavistin + F238) in addition to these fungicides in the second year. Applications commenced in early May in both years and continued through to late October on a nominal 10 - 14 day cycle, but increasing in frequency down to 7 day intervals as disease pressure increased from late September. The aphicides pirimicarb (Pirimor), demeton-S-methyl (Metasystox 55) or malathion (Malathion 60) were tank mixed with many of the fungicide applications as required.

Records

Initial rootstock survival

An initial establishment assessment of rootstocks was made on 12 July 1994 by counting those plants alive, or dead or missing, in each row.

Budtake and plant survival

Budtake and plant survival was assessed the following year, 27 - 29 June 1995. The number of active bud unions (ie those that had produced shoots), and inactive / dead unions were counted on plants present, as well as an assessment of gaps or missing plants per plot. Missing plants would have included those which failed to establish from the rootstock planting, but most gaps were due to losses from the October 1994 undercutting operation. From this data, budtake could be derived as a percentage of rootstocks present, as well as some estimate of the plant losses due to treatments.

Top growth assessment

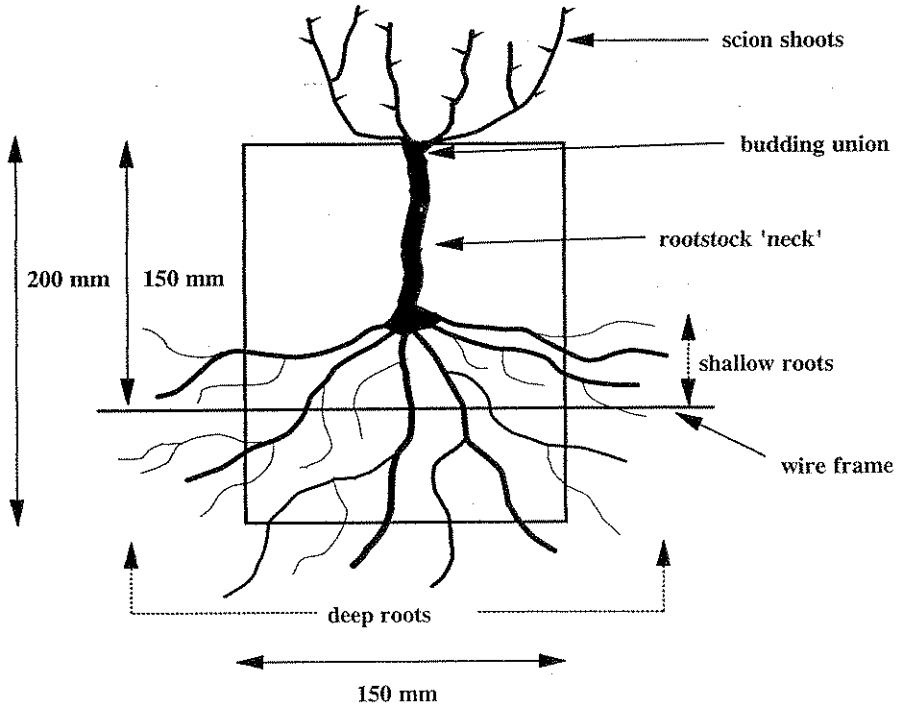
Top growth for each flowering cultivar was recorded on 9 October 1995. The vertical height from soil level of the longest shoot was measured, and also the height to the top of the bulk of the foliage canopy as estimated by eye. The number of 'thick' and 'thin' basal shoots were counted. A shoot was included as basal if it arose from within 50 mm of the bud union, and any very short (<150 mm long) or very thin (<2 mm thick) shoots were ignored. 'Thick' shoots were ≥ 6 mm thick and 'thin' shoots were <6 mm thick for most cultivars except the patio cultivars Baby Love, Sweet Dream, Rosy Future and Festival, where 5 mm was used to divide thickness categories. The appropriate sizes of knitting needle were used as guides for recording. Finally, plants were categorised into 'heavy' or 'light' based on whether they had a minimum of 3 basal shoots ≥ 5 or 6 mm thick and >150 mm long. As there are no formalised standards of plant quality for roses specifically destined for containerisation, this criterion was based on what 'felt right' as a commercial standard and provided a starting point for developing a more soundly based guideline following results from this project.

Root growth assessment

The final record of treatment effects on growth in the field, was the assessment of root growth and root distribution. Ten plants per plot of Amber Queen were assessed on 9 November 1995. These results were used to test the methodology devised for root recording, and to give an indication of whether there were field applied treatments that had not given large differences in root and shoot growth that could be combined to take on for assessment in the containers. It was clear that not all cultivars could be handled to provide the detailed recording needed for the root growth assessment, and to allow sufficient plants to be taken through to a replicated container trial. It was therefore decided to restrict root assessments and follow on containerisation to Amber Queen, Indian Summer and Silver Jubilee in Trial 1, and Baby Love, Rosy Future and Festival in Trial 2. These were assessed on 15 November.

The shoots of all plants were trimmed to about 120 mm from the bud union when lifted for recording the root system. A wire frame was used as a guide for recording and trimming plant roots ready for containerisation (Fig 1 and Plate 7, p. 31). The width and the depth of the frame were based on the dimensions that a root system needed to be pruned to for accommodation in a 4 litre Optipot 17RX container. The top of the frame was placed at the top of the neck at the scion union representing the ideal level that the growing media would need to be after potting. Counts of 'thick' (>5 mm dia.) and 'thin' (3 - 5 mm dia.) roots were made, both as the total numbers emerging from the 'neck' of the rootstock, and numbers extending beyond the edges of the wire frame. There was an additional horizontal wire above the baseline at 150 mm depth which was used to further classify roots as 'deep' or 'shallow'. Shallow roots were those which emerged from the side of the frame before crossing the 150 mm depth line. Roots outside the wire frame were then pruned, 'shallow' and 'deep' roots collected separately, and roots from all plants per plot bulked and oven dried to give dry weight data. An estimate was also made at pruning as to whether the proportion of the root system removed was <40%, 40 - 60% or >60%.

Figure 1 Wire frame for recording root system and as a guide for pruning roots before potting



Analysis of results

Because individual treatments could not be replicated in the field, formal statistical analysis of the results was not possible. However, treatment means were obtained by summarising data on a spreadsheet, and where some treatment factors appeared to have had a negligible effect, then main effects for other factors could be averaged across these treatments with greater precision. The problem of different size plots was overcome for some records by expressing data as percentages where appropriate.

RESULTS

Initial rootstock survival

Counts of the rootstocks in July 1994, prior to budding, revealed small losses from those that had been machine planted (averaging 2.2%), compared to those which had been hand planted (<0.2%). However, the delay in planting the machine planted treatments, due to wet soil conditions, may have been partly responsible for this difference. Amongst those that had been machine planted, the harder root pruned stocks suffered twice as many losses, on average, than those that had received 'normal' root pruning (3.0% vs. 1.4%). However, this must be viewed in the context of relatively few losses overall at this stage. No greater losses were experienced from the severe root pruned stocks that were hand planted earlier, and it therefore appears that under normal planting conditions, rootstocks will establish successfully following quite severe root trimming.

Budtake and plant survival

In Trial 1, a few plants were lost during the undercutting operation (Plate 2, p. 25), mainly as a result of being dragged and buried by the undercutting blade until the correct machine set-up had been achieved.

Table 1, p. 10 shows that for Trial 1, up to 6% of the original rootstocks planted were missing in the summer following the undercutting treatment (UC1), losses being slightly worse for the severely root pruned treatment (RP2), compared to only about 1% loss for the non-undercut plots. Losses also included those rootstocks which failed to establish after planting. Relatively few plants were lost by the undercutting treatment on Trial 2, possibly because initial problems in the use of the machine had been overcome by the time these beds were undercut.

Budtake data is expressed as successful takes as a percentage of rootstocks present, and appeared to be little affected by the undercutting, rootstock type, initial root pruning and planting method treatments. Budtake was well in excess of 90% for most cultivars, but was low for Amber Queen which averaged only 77%, due probably to poorer budwood quality.

Table 1 Effect of treatments on budtake and plant survival - late June 1995

Treatment		Mean take as % of rootstocks present	Mean plants missing as % of rootstocks planted
		Trial 1	
Undercutting x Cultivar			
UC0	AQ	74.9	0.9
	IS	97.2	0.9
	MM	93.9	0.9
	SJ	94.2	1.8
	RW	92.4	0.4
UC1	AQ	78.5	3.7
	IS	96.4	1.8
	MM	89.8	4.6
	SJ	97.1	4.7
	RW	96.1	6.4
Root pruning x Undercutting			
RP1 UC0		92.7	0.7
RP2 UC0		88.6	1.3
RP1 UC1		91.8	2.8
RP2 UC1		91.4	5.6
Rootstock			
Inermis		91.7	3.5
Laxa		90.5	1.8
		Trial 2	
Undercutting x Cultivar			
UC0	BL	89.1	0.8
	Tr	97.3	0.0
	SD	98.2	0.9
	RF	93.9	0.9
	Fe	95.7	0.9
UC1	BL	89.5	0.9
	Tr	93.5	0.0
	SD	97.5	0.0
	RF	95.6	0.0
	Fe	95.6	0.9
Root pruning x Undercutting			
RP1 UC0		93.4	0.4
RP2 UC0		95.5	0.3
RP1 UC1		96.2	0.7
RP2 UC1		93.3	0.7

Top growth

Budtake appeared unaffected by the undercutting treatment, probably because well formed bud unions had already been achieved by the time this operation was carried out. However, subsequent growth of shoots was clearly checked and growth was much slower from the undercut bushes the following spring and summer (Plates 3 & 4, pp. 26 - 27). Although some irrigation was applied to the crop in June 1995, it is likely that the dry spring and summer accentuated the differences observed.

Table 2 Mean height of longest shoot and to top of foliage canopy - 9 October 1995. Main effects of key treatments

	Height / cm			
	Longest shoot		Foliage canopy	
	Undercut	Not undercut	Undercut	Not undercut
	Trial 1			
Effect of cultivar *(mean across rootstocks)*				
Amber Queen	396	582	261	394
Indian Summer	404	577	252	411
Margaret Merril	521	698	295	433
Silver Jubilee	408	588	286	459
Royal William	523	726	299	471
Effect of rootstock *(mean across cvs.)*				
'Laxa'	428	632	268	431
'Inermis'	473	637	290	435
Mean	*450*	*635*	*279*	*433*
	Trial 2 (all on 'Inermis')			
Baby Love	393	566	255	386
Trumpeter	394	513	276	360
Sweet Dream	455	630	248	339
Rosy Future	490	749	256	368
Festival	392	430	269	326
Mean	*428*	*577*	*261*	*356*

The marked effect of the undercutting treatment is shown in Table 2, where, by October 1995, undercut bushes were on average between ⅔ and ¾ the height of the non-undercut plants. There was little evidence that the root pruning or method of planting treatments affected plant height.

As well as the expected height differences between flowering cultivars, in Trial 1, where the two different rootstocks were being compared, 'Inermis' produced longer shoots than 'Laxa'.

Visual observation during the growing season, suggested that the *number* of basal shoots produced by the undercut bushes was not affected by the undercutting treatment, although there were clearly fewer strong, thick shoots. When recorded in October, it became clear that both the thickness and total number of shoots over the minimum thickness recorded (2 mm), had been reduced by undercutting (Table 3). Undercut plants had about ¾ the number of total shoots, and ½ the number of 'thick' shoots of non-undercut plants. The difference in vigour between these treatments was convincingly illustrated by the proportion of plants with three or more 'thick' shoots, where mean results for undercut vs. not-undercut were 34% vs 86% and 24% vs. 73% for Trials 1 and 2 respectively. As with shoot height, plants on 'Inermis' also had slightly more and thicker shoots than on 'Laxa' in Trial 1.

Table 3 Mean number of shoots per plant, and proportion of plants with 3 or more 'thick' shoots - 9 October 1995. Main effects of key treatments

	Number of basal shoots						% plants with	
	'Thin'		'Thick'		Total		3+ 'thick' shoots	
	U/cut	Not	U/cut	Not	U/cut	Not	U/cut	Not
Trial 1								
Effect of cultivar (mean across rootstocks)								
A. Queen	3.2	2.8	1.0	3.5	4.2	6.3	8.0	82.9
I. Summer	2.7	2.6	1.9	3.9	4.6	6.5	34.4	88.7
M. Merril	1.3	0.9	2.3	3.6	3.7	4.5	47.0	85.9
S. Jubilee	2.8	1.6	1.9	4.3	4.7	5.9	32.2	90.5
R. William	1.2	0.9	2.2	3.2	3.4	4.2	42.4	79.8
Effect of rootstock (mean across cvs.)								
'Laxa'	2.3	1.7	1.5	3.5	3.7	5.2	20.2	84.0
'Inermis'	2.3	1.8	2.2	3.9	4.5	5.8	47.3	87.6
Mean	*2.3*	*1.8*	*1.9*	*3.7*	*4.1*	*5.5*	*33.8*	*85.8*
Trial 2 (all on 'Inermis')								
B. Love	2.7	2.6	2.3	3.0	5.1	5.6	40.0	69.8
Trump.	2.4	1.9	2.0	3.2	4.4	5.1	33.0	79.4
S. Dream	2.8	2.8	1.9	4.1	4.7	6.9	30.5	82.9
R. Future	2.1	1.9	1.3	2.9	3.5	4.9	13.2	64.8
Festival	3.7	2.8	1.2	3.5	4.8	6.3	10.4	70.0
Mean	*2.7*	*2.4*	*1.7*	*3.3*	*4.4*	*5.7*	*23.8*	*73.4*

Root growth

Table 4 Root counts and distribution. Mean numbers of deep and shallow roots per plant outside of wire frame and pruned for potting, 9 - 15 November 1995.

		Shallow			Deep			Total
		3-5mm	>5mm	total	3-5mm	>5mm	total	roots
				Trial 1				
Amber Queen								
'Laxa'	U/cut	2.2	1.0	3.2	1.6	0.5	2.1	5.3
	Not	2.1	1.9	4.0	2.2	3.1	5.3	9.3
'Inermis'	U/cut	2.3	0.8	3.1	0.4	0.1	0.5	3.6
	Not	2.1	0.9	3.1	2.0	0.6	2.6	5.7
Indian Summer								
'Laxa'	U/cut	1.8	1.2	3.0	1.4	0.7	2.1	5.1
	Not	1.8	1.5	3.4	2.1	2.8	4.9	8.2
'Inermis'	U/cut	1.9	0.5	2.4	0.6	0.1	0.7	3.1
	Not	2.0	1.2	3.2	2.4	1.5	3.9	7.1
Silver Jubilee								
'Laxa'	U/cut	1.6	1.8	3.5	1.7	0.4	2.0	5.5
	Not	2.1	2.0	4.1	3.1	3.7	6.7	10.9
'Inermis'	U/cut	1.9	0.8	2.7	0.9	0.1	1.0	3.6
	Not	2.2	1.5	3.7	2.4	1.1	3.5	7.1
				Trial 2 (all on 'Inermis')				
Baby Love								
	U/cut	1.6	0.2	1.9	0.2	0.0	0.2	2.1
	Not	2.3	0.3	2.6	2.5	0.3	2.8	5.4
Rosy Future								
	U/cut	1.9	0.2	2.0	0.5	0.1	0.6	2.6
	Not	2.6	0.6	3.2	1.8	0.3	2.1	5.3
Festival								
	U/cut	2.7	0.4	3.1	1.0	0.1	1.1	4.1
	Not	2.0	1.1	3.2	1.5	1.1	2.6	5.7

Table 4 shows the count of roots that protruded beyond the wire frame used as a guide for pruning ready for potting. It shows that for each cultivar, the total numbers of roots outside the frame was markedly reduced by the undercutting treatment, particularly the deep roots (see also Fig. 1, p. 8). Close examination of the data also shows that in Trial 1, 'Inermis' produced fewer roots requiring pruning compared to 'Laxa', particularly thick, deep roots. The scion cultivar affected the amount of root produced by the rootstock. For example, Silver Jubilee tended to

have higher root counts for comparable treatments, than the smaller cultivars such as Amber Queen and the patio cvs.

The dry weights of the root prunings are shown in Figure 2, and illustrate the relatively large amount of deep roots requiring pruning from the non undercut 'Laxa' stocks in Trial 1, and how the shallow undercutting treatment greatly reduced the amount of root requiring pruning. The differences between the undercut and non-undercut 'Inermis' were much less marked, reflecting the fewer numbers of long, thick roots requiring removal from this rootstock.

Figure 2 Dry weights of pruned shallow and deep roots removed for potting

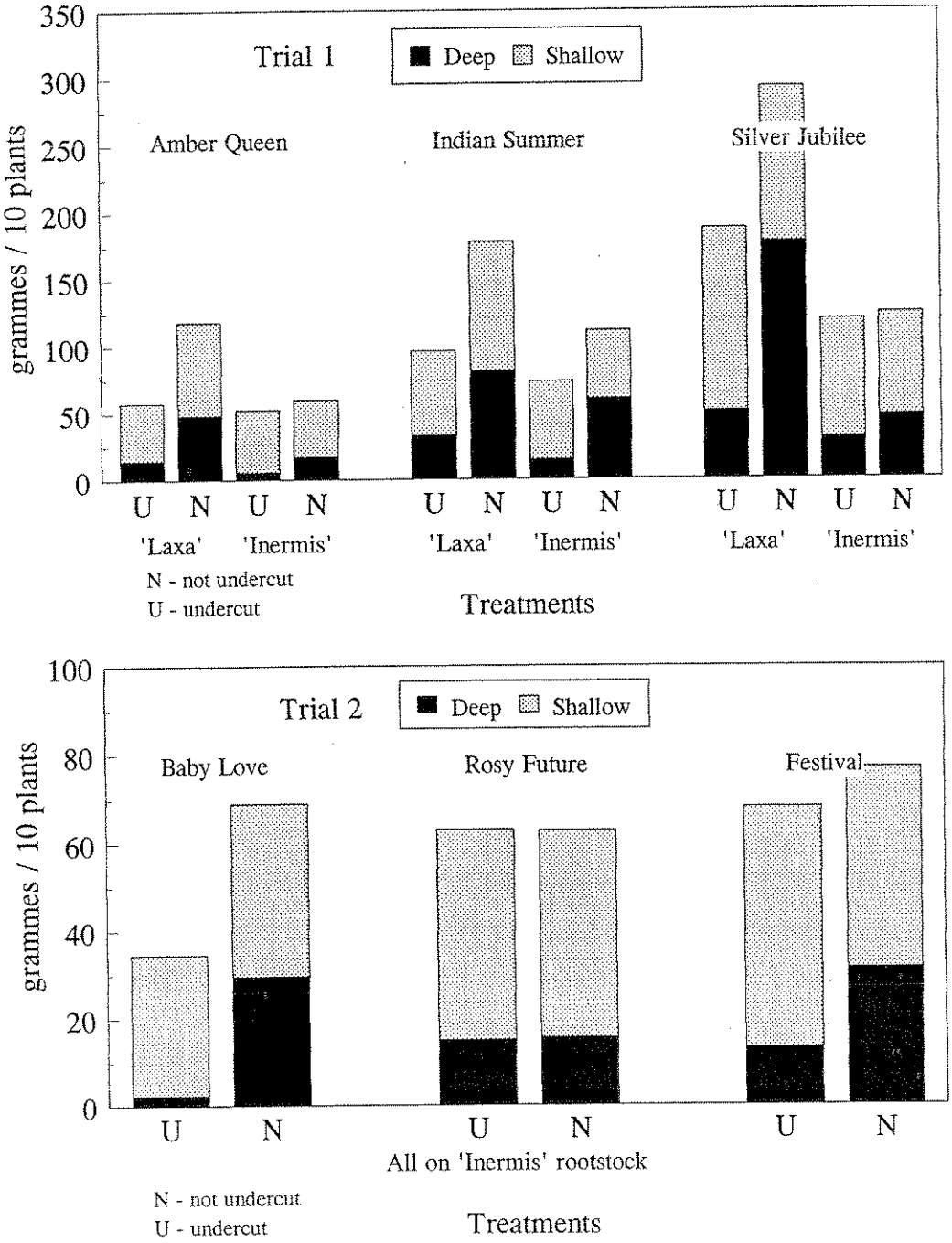


Table 5 **Percentage of plants in each treatment which had light, moderate or heavy root pruning for potting (ie <40%, 40-60% or >60% of root system removed).**

		Proportion of root system pruned		
		<40%	40-60%	>60%
		Trial 1		
Amber Queen				
'Laxa'	U/cut	64	33	3
	Not	23	54	23
'Inermis'	U/cut	67	33	0
	Not	52	48	0
Indian Summer				
'Laxa'	U/cut	48	52	0
	Not	28	52	20
'Inermis'	U/cut	80	20	0
	Not	30	60	10
Silver Jubilee				
'Laxa'	U/cut	35	60	5
	Not	8	64	28
'Inermis'	U/cut	57	40	2
	Not	25	75	0
		Trial 2 (all on 'Inermis')		
Baby Love				
	U/cut	93	8	0
	Not	30	65	5
Rosy Future				
	U/cut	85	25	0
	Not	40	57	3
Festival				
	U/cut	45	52	3
	Not	25	72	3

The proportion of the total root system pruned at potting might relate to the degree of check the plant could suffer during the establishment phase in the pot. This could only be estimated by eye during the recording and pruning operation, but the data in Table 5 above gives some indication of the treatments where a high proportion of root was removed. Between 20 and 28% of plants on the non-undercut 'Laxa' stocks required 'heavy' root pruning (ie >60% of root removed) reflecting the data shown in Fig. 2.

Plates 5 and 6, pp. 28 - 29, show examples of the root systems of some Amber Queen treatments as lifted, and the influence of the undercutting treatment in altering the spatial distribution and increasing the amount of fine root, is clear. Note also on the non-undercut plants, 'Inermis' has a larger number of thin roots than 'Laxa'. Plate 7, p. 31 shows the extent of the pruning required for potting from an Amber Queen treatment.

DISCUSSION

It is clear from the results so far, that the type of rootstock and the shallow undercutting treatment were the major factors affecting the nature of both the root system and top growth. The severity of the root pruning applied at planting did not markedly affect subsequent root growth. As establishment of the rootstocks was little affected, they may have withstood a more severe pruning at planting, but whether this would have encouraged significantly more fine or fibrous root to be produced from near the neck of the stock is not certain. It is possible that the production of thick anchor roots would still occur during the establishment phase of the rootstock in response to the need to provide physical support, particularly in selections such as 'Laxa' which have a tendency to grow long, thick roots. One of the main purposes of pruning the roots at planting is to aid handling, particularly when machine planting, and it is clear that under favourable planting conditions, quite severe root trimming can be tolerated without affecting establishment.

There was less evidence of severe 'one sided' root systems from machine planting in this trial than expected, and those root systems that were lopsided could usually be accommodated adequately in the pot after pruning. A certain amount of compensation by potting at an angle is possible with a pruned bush rose, however, compared to a standard rose which must be potted with a vertical stem.

A long necked plant can have little root left after it is pruned for potting if the neck is to be buried in the pot. Although individual rootstocks can vary a lot, the Dutch 'Laxa' used in this trial had longer necks on average than the 'Inermis', and this would have added to the root pruning problems experienced with 'Laxa'. The benefits of 'Inermis' for producing plants with better basal shoot grade-outs have already been demonstrated in trials, and as a stock for container production, it appears to have added advantages of a more fibrous root system and shorter necks. However, the downside of greater sucker production remains, and this appears to be the major reason for grower resistance to its wide scale adoption in the UK. Although not examined in this trial, English sources of 'Laxa' typically have shorter necks, and while these may not be as convenient for budding, they are likely to make potting easier. Encouraging budders to bud as low as possible on the rootstock neck will also help to reduce problems at potting, but this is difficult to achieve in practice if budding higher on a longer neck helps maintain greater outputs from piecework paid staff.

The severe effect of the shallow undercutting treatment on the vigour of top growth the following year clearly calls into the question the safety and reliability of such a procedure. The rainfall during September and early October 1995 did produce a good late flush of growth, and by the time roots were assessed in November, the shoot growth differences were not quite as marked as they were when assessed a month earlier. Nevertheless, differences between the undercut and

non-undercut treatments were still very visible when potted plants were compared. What is not clear from this one trial, is whether more irrigation in spring and summer 1995 would have improved shoot growth from the undercut plants, or indeed whether it would have eliminated some of the beneficial effects it had on producing a more compact and fibrous root system needing less pruning at potting.

Ultimately, of most importance will be the subsequent survival, establishment, growth and flowering of these treatments in the container during 1996. It is possible that a lighter weight plant could perform just as well in the container as a heavier stemmed one, particularly if the root system is good. The results of the container performance phase of the trial will be available in a final report in November 1996.

APPENDIX I

Planting plan and layout

HDC Roses - Influence of root pruning rootstock, planting method and undercutting on containerisation. HNS 56

Treatments

Rootstock
I - Inermis
L - Laxa

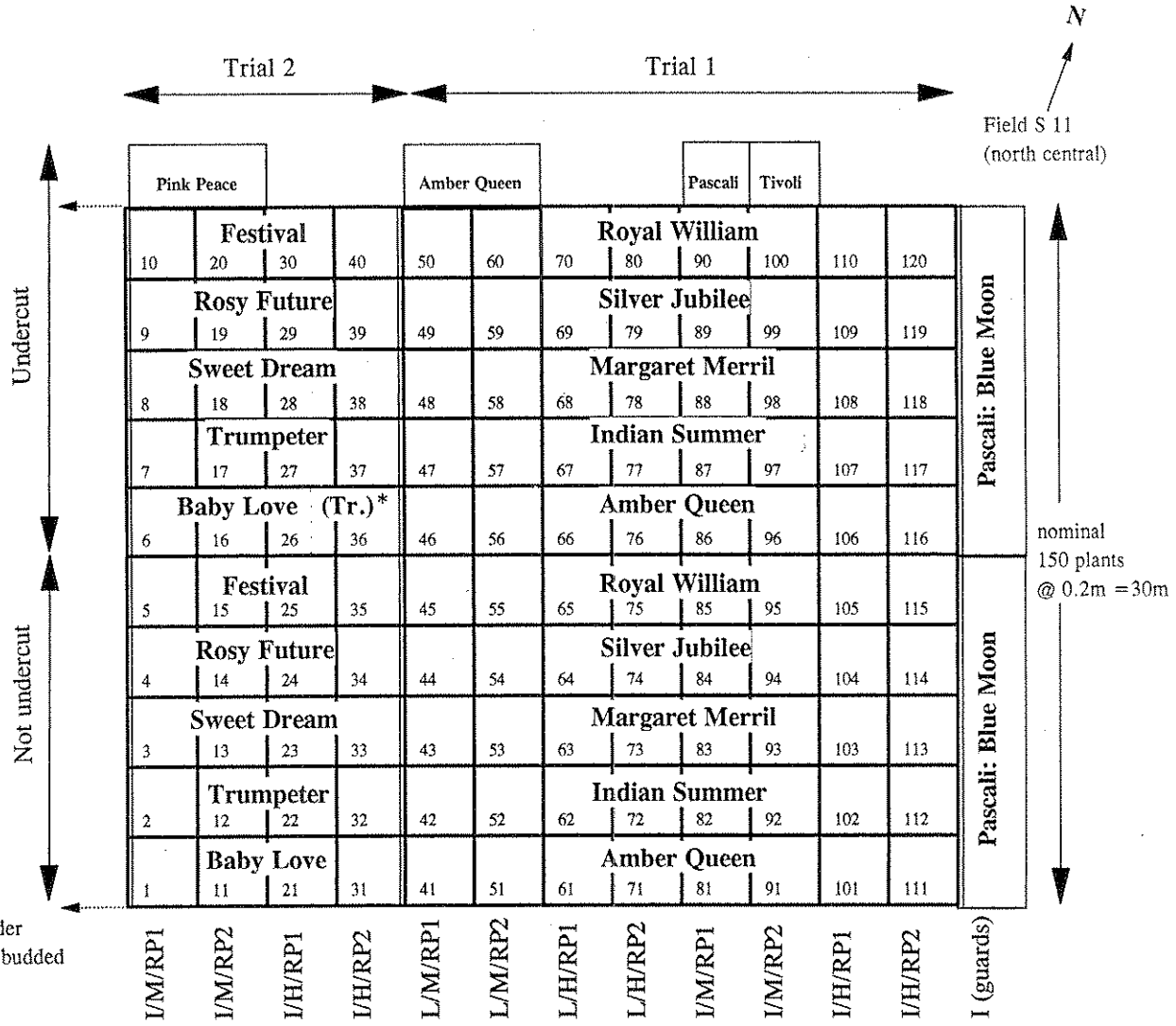
Planting method
M - by machine
H - by hand

Root pruning at planting
RP1 - Light - 150-180mm
RP2 - Hard - 100mm
} From top of neck

Undercutting
North half of rows undercut with Egedal undercutter at 150mm depth, Octoer 1994

Plots: 1 bed (2rows) wide
Beds: at 1.83m wheelings
Plants: 0.2m in-row x 0.8m between rows
Plot size: 24-30 plants/plot in 2 rows

* Plot 36 and part of plot 26 budded with Trumpeter due to shortage of Baby Love buds.



Rootstocks planted March 1994, budded late July 1994

APPENDIX II **Diary of cultural operations**

1994

17 Feb	Grassed area sprayed with glyphosate as Roundup at 6.0 litres/ha.
4 Mar	Stable manure applied at about 200 tonnes/ha.
7 Mar	Shallow rotary cultivation to chip turf, then site chisel ploughed.
18 Mar	Hand planting treatment rootstocks planted and ridged up.
18 Apr	Completion of machine planting treatment using Super Prefer planter.
27 Apr	Post planting residual herbicide, simazine as Gesatop 500L 3.4 litres/ha + metazachlor as Butisan S 2.5 litres/ha.
5 May	Commenced pest and disease sprays with myclobutanil as Systhane 6W 1.0 g/litre + pirimicarb as Pirimor 0.5 g/litre in 700 litres/ha.
7 Jun	Demeton-S-methyl as Metasystox 55 0.38 mls/litre + Systhane 6W 1.0 g/litre.
20 Jun	Top dressing with 40 kg/ha N as Nitram.
27-29 Jun	About 30 mm overhead irrigation applied with Wright Rain sprinklers.
5 Jul	Bupirimate as Nimrod T 3.2 ml/litre + Pirimor 0.5 g/litre.
13-18 Jul	About 15 mm irrigation.
20 Jul	Commenced hoeing out ridges prior to budding.
22 Jul	Systhane + Pirimor spray as above.
26 Jul	Commenced budding.
9 Aug	Budding completed.
12 Aug	Nimrod T spray as above.
16 Aug	Nimrod T + Pirimor spray as above.
18 Aug	Post budding application of Gesatop 500L + Butisan S as above.
31 Aug	Systhane spray as above.
12 Sep	Nimrod T spray as above.
27 Sep	Nimrod T spray as above.

30 Sep	Hand weeding.
4 Oct	Systhane spray as above.
6 Oct	Used rigid tine to 300 mm depth to loosen soil between rows and in wheelings.
11 Oct	Nimrod T spray as above.
17 Oct	Undercut north half of rows with Egedal machine to 150 mm depth.
19 Oct	Systhane spray.
2 Nov	Nimrod T spray.

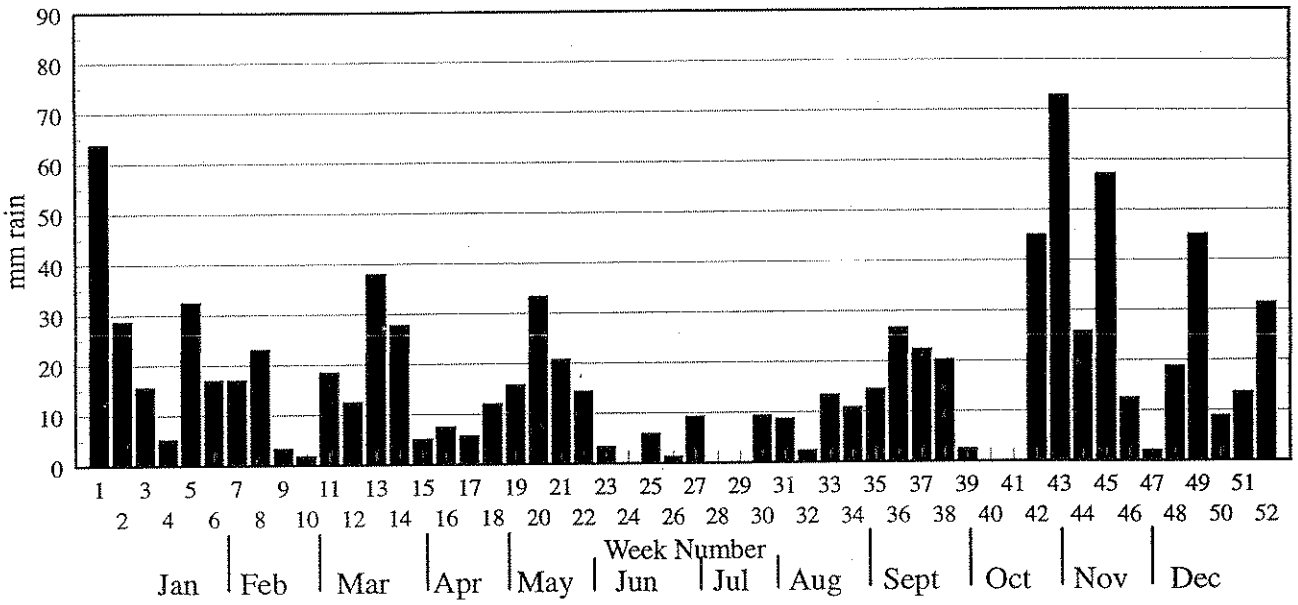
1995

13 Feb	Commenced heading back stocks.
20 Feb	Heading back completed.
27 Feb	Rootstock prunings cleared.
9 Mar	Gesatop 500L 3.4 litres/ha + oxadiazon as Ronstar Liquid 4.0 litres/ha post heading back residual herbicide applied.
28 Mar	75 kg/ha N + 19 kg/ha P_2O_5 + 50 kg/ha K_2O top dressing applied overall as Kemira 20:5:15 compound fertiliser.
2 May	Commenced pest and disease spray programme with Systhane Flo 1.0 ml/litre + Pirimor 0.5 g/litre.
10 May	First round of pinching back shoots completed. Hand hoed weed patches.
11 May	Nimrod T 3.2 mls/litre spray.
18 May	Systhane spray as above.
26 May	Nimrod T spray as above.
2 Jun	Scuttle deer repellant applied to strip of soil around trial. Low electric fence erected against hares / rabbits. Flashing amber lights used at night as further deterrent.
9 Jun	Dodemorph as F238 2.5 mls/litre + carbendazim as Bavistin DF 0.5 g/litre + malathion as Malathion 60 1.9 mls/litre applied in approx 800 litres/ha.
13 Jun	Desuckering and second round of pinching back single shoots completed.
16 Jun	Hoed weed.

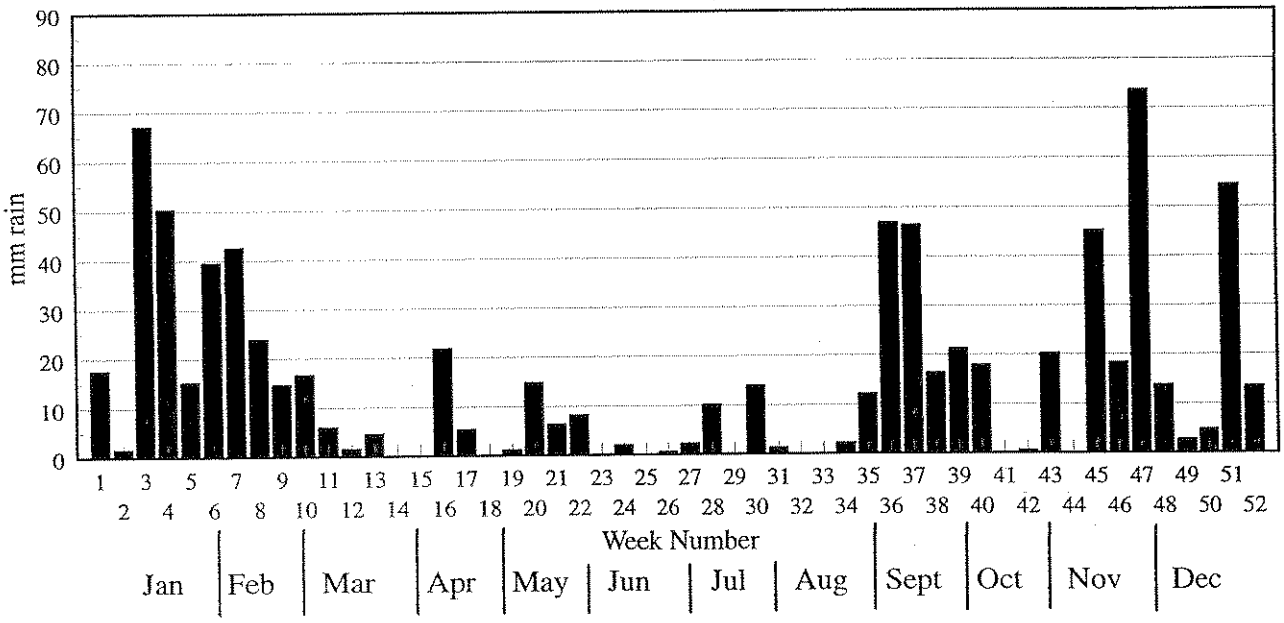
21-22 Jun	About 20 mm irrigation applied.
28 Jun	Nimrod T + Pirimor spray as above. Also Gesatop 500L 3.4 litres/ha + Butisan S 2.5 litres/ha residual herbicide applied.
29 Jun - 3 Jul	About 25 mm irrigation applied.
11 Jul	Nimrod T + Pirimor spray as above.
24 Jul	Desuckering and spot weeding.
25 Jul	Systhane + Pirimor spray as above.
9 Aug	F238 + Bavistin DF + Malathion 60 spray as above.
18 Sep	Nimrod T spray as above.
21 Sep	Systhane + Pirimor spray applied by hand lance at above concentrations.
5 Oct	Nimrod T spray as above.
11 Oct	Systhane spray as above.
19 Oct	Commenced trimming excess shoot growth from bushes with hedge trimmer to enable undercutting with J-blade Damcon undercutter to commence.
1 Nov	Damcon undercutting prior to lifting completed.
9 Nov	Amber Queen lifted for root recording, tops and roots pruned for potting, and heeled back in plots.
15-16 Nov	Indian Summer, Silver Jubilee, Baby Love, Rosy Future, and Festival recorded pruned and heeled back in.
5-11 Dec	Trial cultivars above lifted, potted and placed under cold ventilated polythene tunnel for protection overwinter.

APPENDIX III **Rainfall Data**

HRI Efford Rainfall / mm - 1994

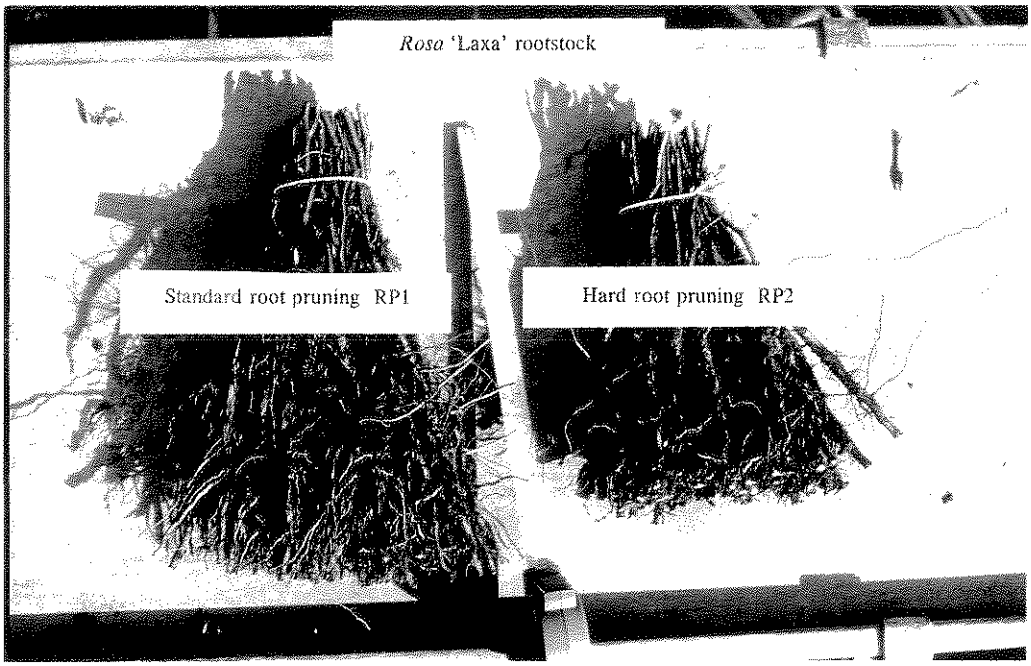


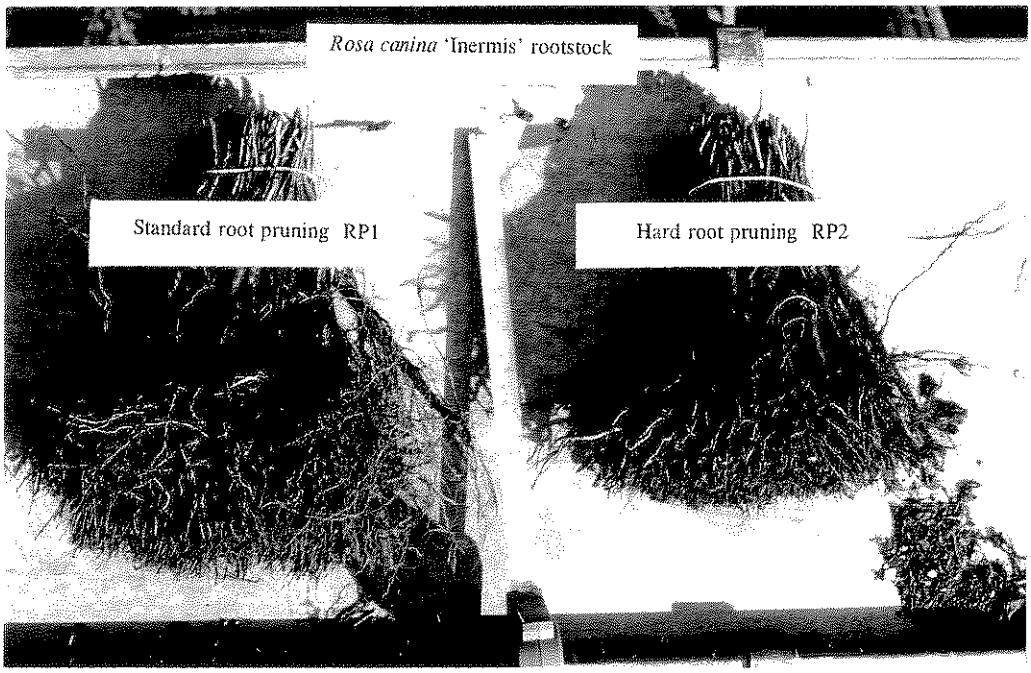
HRI Efford Rainfall / mm - 1995



APPENDIX IV

Plate 1 **'Standard' and 'Hard' root pruning treatments on 'Laxa' (top) and 'Inermis' (bottom). Note difference between rootstocks in amount of root fibre present.**





APPENDIX IV

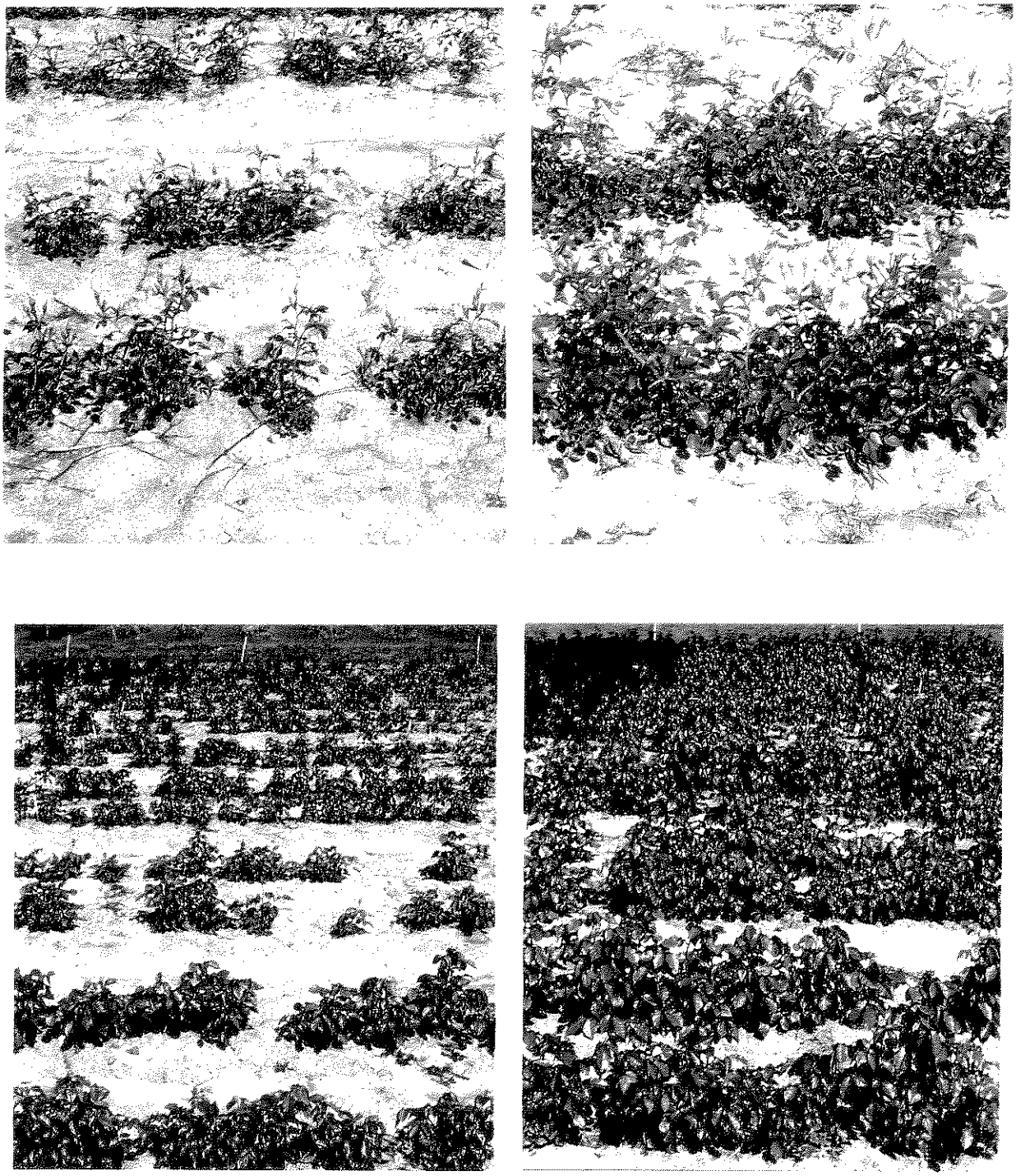
Plate 2 Egedal undercutting operation, Oct 1994, and its effect on a selection of rootstocks.

APPENDIX IV

Plate 3 Growth of the undercut plants (top) cf. non-undercut (bottom) by 27 June 1995.

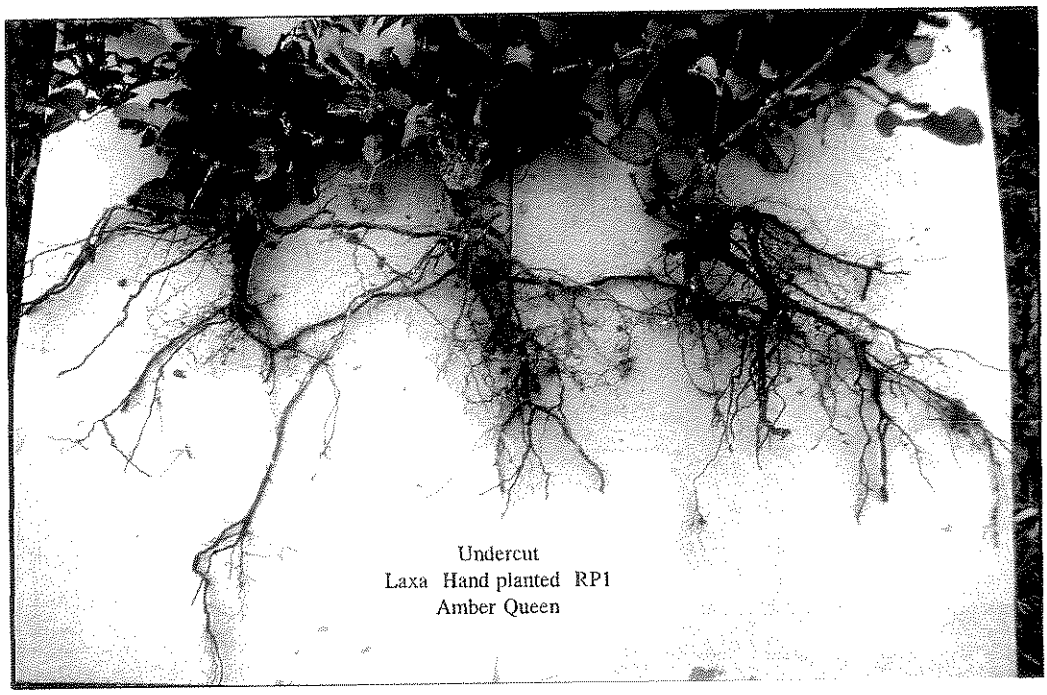
APPENDIX IV

Plate 4 **Undercut (left) vs. non-undercut (right) bushes of Baby Love (top) and Silver Jubilee (bottom), 27 June 1995.**

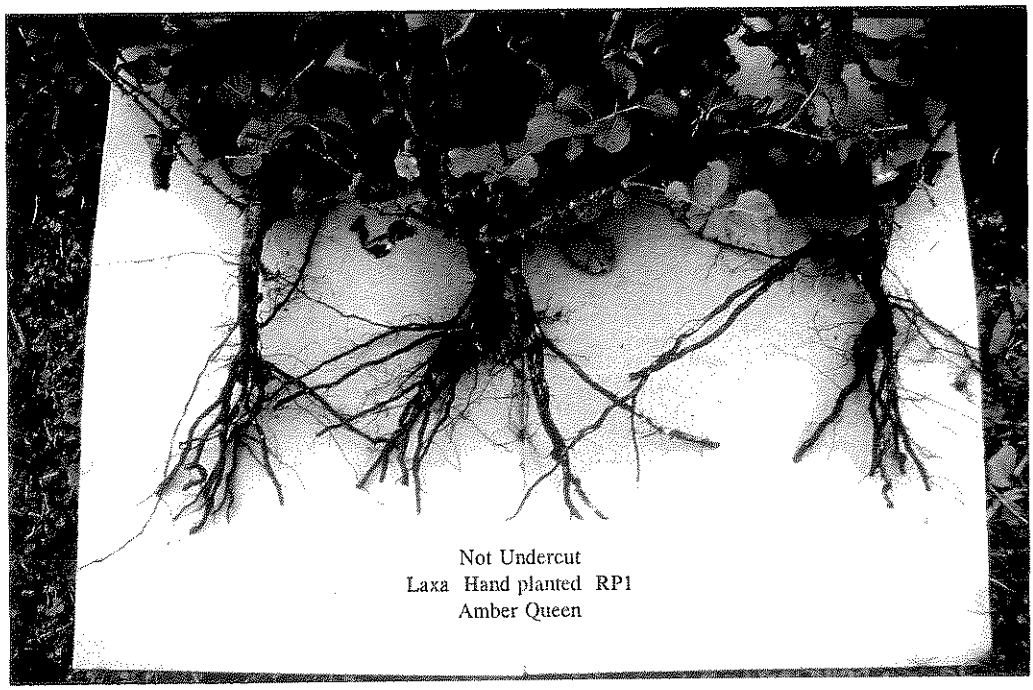


APPENDIX IV

Plate 5 Amber Queen on 'Laxa' rootstock, 9 November 1995.



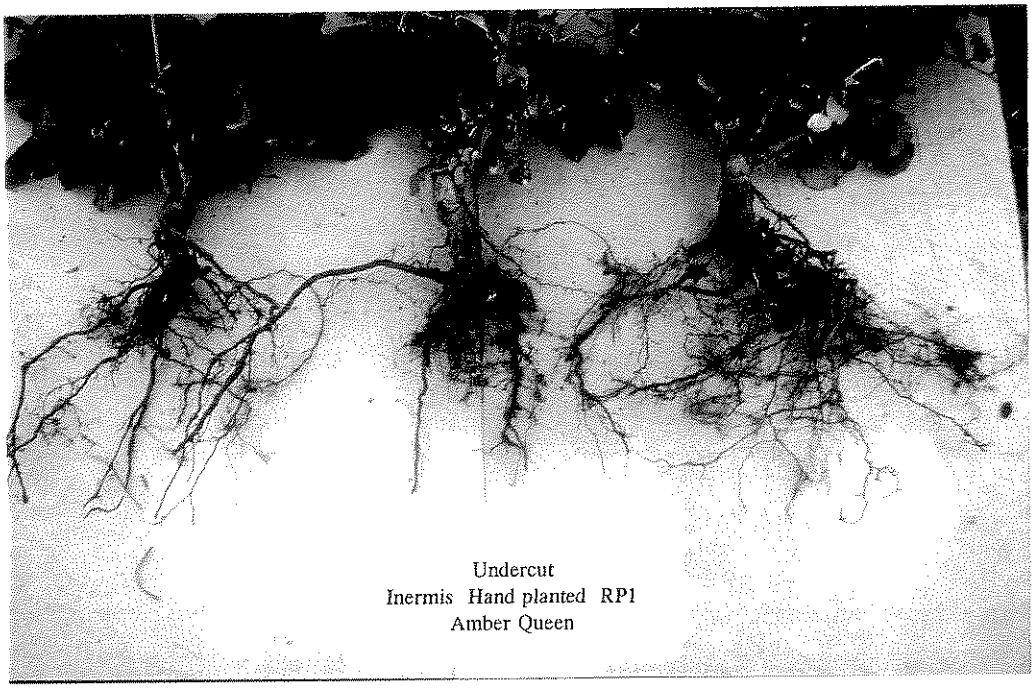
Undercut
Laxa Hand planted RP1
Amber Queen



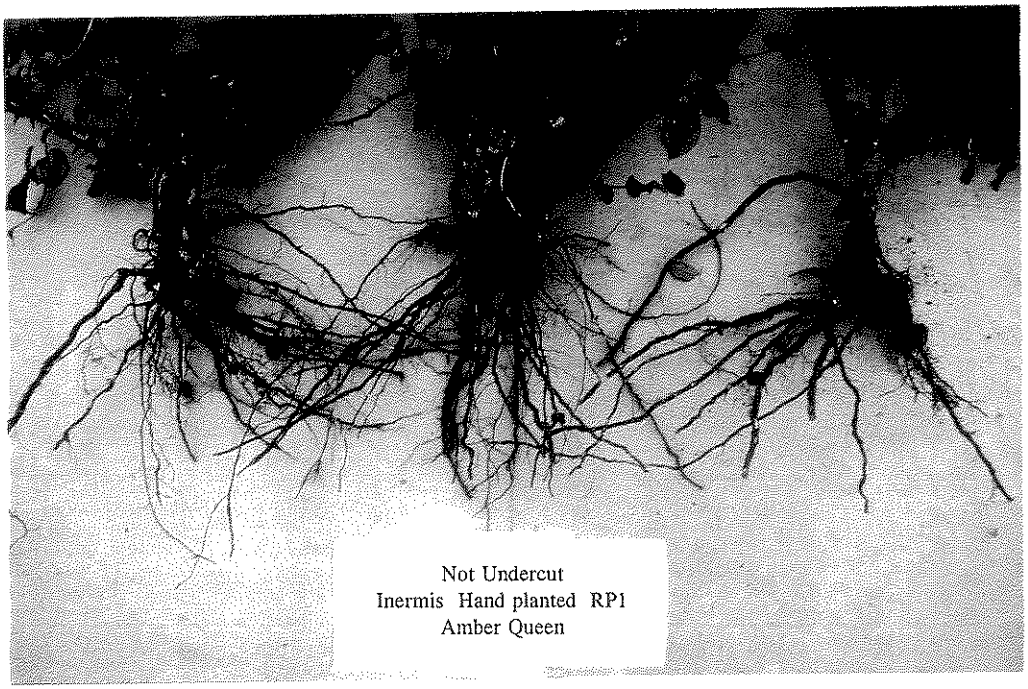
Not Undercut
Laxa Hand planted RP1
Amber Queen

APPENDIX IV

Plate 6 Amber Queen on 'Inermis' rootstock, 9 November 1995.



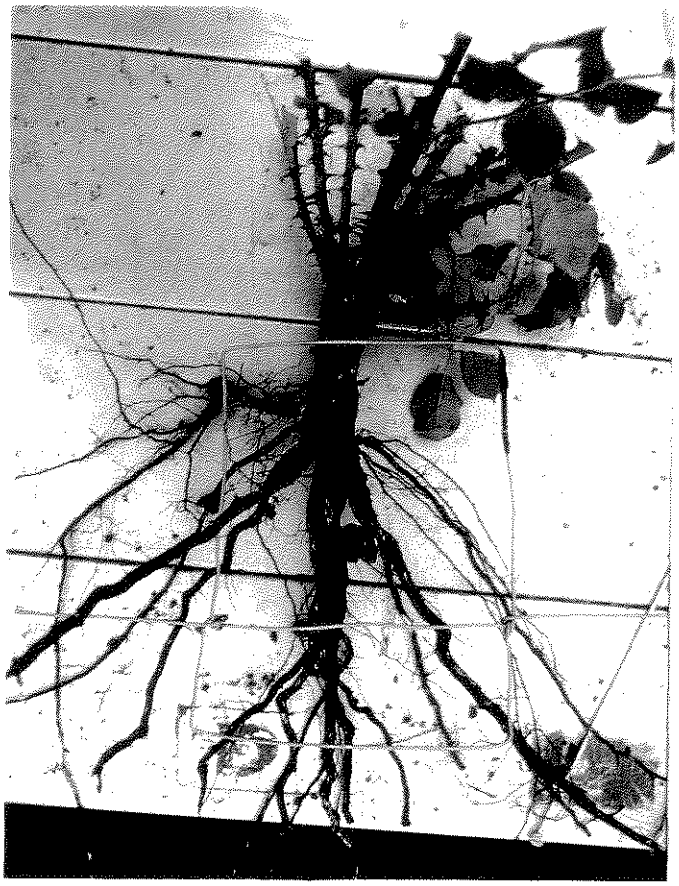
Undercut
Inermis Hand planted RP1
Amber Queen

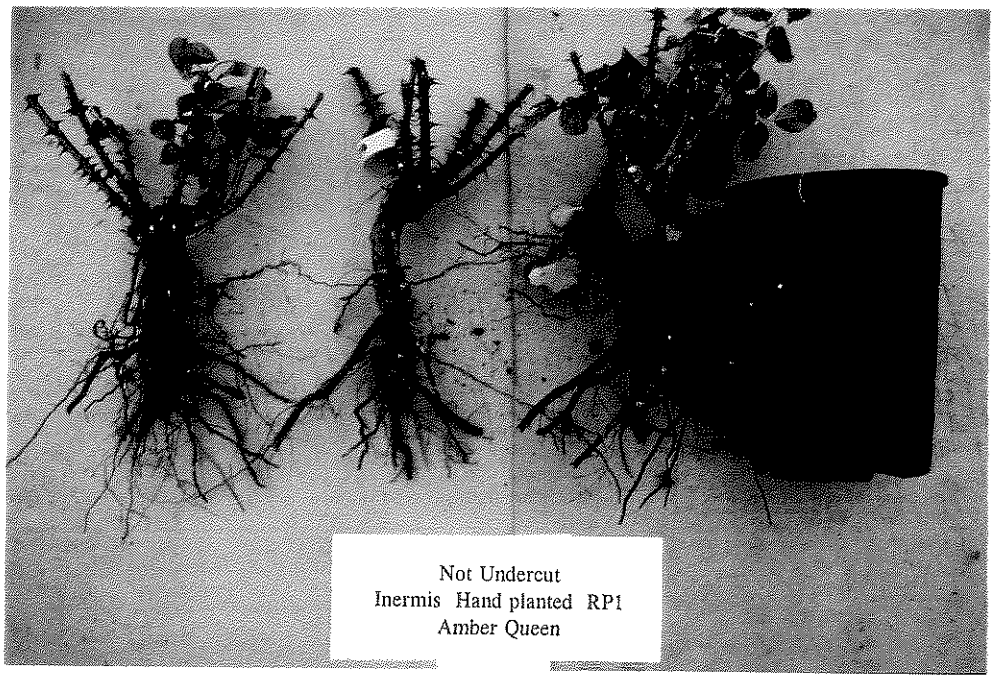


Not Undercut
Inermis Hand planted RP1
Amber Queen

APPENDIX IV

Plate 7 **Wire frame used for recording root system and as a guide for pruning (top). Plants pruned to fit deep 4 litre pot (bottom).**





APPENDIX V **Copy of contract**

Contract between HRI (hereinafter called the "Contractor") and the Horticultural Development Council (hereinafter called the "Council") for a research/development project.

1. TITLE OF PROJECT

Contract No: HNS 56
Contract Date: 19.08.95

THE INFLUENCE OF PRUNING, ROOTSTOCK TYPE, AND PLANTING METHOD ON THE CONTAINERISATION OF BUSH ROSES

2. BACKGROUND AND COMMERCIAL OBJECTIVES

The number of field grown roses produced in England and Wales is about 22.5 million annually, worth some £24 million farm gate value (1993 estimate) compared to a container grown nursery stock fgv of £127 million. It is not clear from the statistics whether the roses containerised before sale from nurseries are included in the fgv for container grown stock or not, but the trend is clear; the proportion of roses containerised or container grown continues to increase. Typically 25-30% of plants are now containerised before sale, with well over 50% on some nurseries. Garden centre sales are largely responsible for this increase in containerisation, but increasingly landscape and amenity markets are buying their plants in pots. Roses for patios are also an expanding market and ideal for container sales.

Rosa 'Laxa' rootstocks typically produce long tap roots with relatively little fibrous root. A 2 yr old finished plant from the field usually requires extensive root pruning in order to containerise it centrally and deeply enough into an acceptable sized (typically 4 litre) pot. Early potting in autumn is usually recommended in order to encourage active new root growth before plants become dormant to ensure strong growth the following spring. Root pruning of either the rootstock plants prior to planting, or undercutting the root system in the field part way through the production cycle, may encourage a more fibrous root system before potting which is both physically easier to containerise neatly, and which offers more sites from which new root can develop. This, together with its influence on the need for root pruning at the point of containerisation, requires investigation. The effect of treatments on the rate of establishment and subsequent development in the container will also need to be monitored.

3. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY

Containerisation can be a cost effective means of 'adding value' and increasing profitability of the rose crop, but it needs to be done well to avoid giving the product a poor reputation. Improvements in the quality of containerised or container grown roses should be reflected in the improved confidence of customers in the product, which in turn will lead to increased sales and a secured share in this expanding sector of the market.

Specific to this project, benefits to the nurseryman should include improved survival of rose bushes after potting, stronger growth and better grade-out leading to a maintenance of good prices and returns. There should also be fewer returned plants requiring refunds / replacements from garden centres and other outlets

which will also help to maintain good trading relations. It may be possible for the nurseryman to use smaller size or at least standard size containers (consistent with maintaining vigorous growth and quality through to the final point of sale). Also, a better root system may help to extend the recommended potting season if improved root regeneration is encouraged. This would be an advantage over the present tight potting window in October / November and would also help smooth the labour use profile.

4. SCIENTIFIC / TECHNICAL TARGET OF THE WORK

A greater understanding of how machine vs. hand planting affects rootstock form (and subsequent ease of potting such as being able to centralise a plant in the container) will be achieved. A measure of the severity of pruning that rootstocks are able to withstand at planting, and also whether subsequent undercutting operations in the field production phase affects survival will also be gained. The influence of rootstock pruning and field undercutting operations on the fibrousness and form of the root system at lifting will be observed, as will the influence of any subsequent root pruning required at potting on the survival, growth and performance. The effect and possible interaction of rootstock (*Rosa* 'Laxa' or *R. canina* 'Inermis') on the considerations outlined above will also be determined, as will any interactions with different scion cultivars (HT, floribunda, patio types) on their performance, or indeed influences scion cultivars may have on root growth.

5. CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS

Project proposal HNS 65 is aimed at developing scheduling techniques for containerised bush roses for successional spring and summer sales. Treatments include the manipulation of development using different holding and growing environments such as cold stores, polythene tunnels and cold glass for containerised plants of both 'dormant eye' and finished maiden bushes.

Project HNS 54 is examining aspects of standard stem rose containerisation, but is concentrating more on stem production systems suitable for containerised marketing. However, some of the problems highlighted in the containerisation of field grown stems are common to bush roses.

6. DESCRIPTION OF THE WORK

Five HT and floribunda cultivars will be budded in 1994 onto rootstocks of both Laxa (coarse root system), and Inermis (finer root system). Machine vs hand planting and normal vs severe root pruning treatments will be imposed onto the rootstocks at planting. Half of this material received a further undercutting in autumn 1994 and half was left.

Four patio cultivars and one dwarf floribunda will also be budded in 1994 onto Inermis rootstock. These will receive the same range of planting method and pruning treatments as the 'Laxa' and 'Inermis' above, and will receive undercutting as for the HT and floribunda cultivars.

All plants will be lifted as finished bushes and containerised in autumn 1995 and observed for fibrousness of root present, ease of potting, and final assessments on subsequent establishment and growth completed in spring / summer 1996.

Treatments

Trial 1 outline:

2 Rootstock selections x 2 Planting methods x 2 Initial root pruning treatments = 8 initial treatments

All initial treatments budded with 5 flowering cultivars x 2 Undercutting treatments in autumn

Trial 2 outline:

1 Rootstock selection x 2 Planting methods x 2 Initial root pruning treatments = 4 initial treatments

All initial treatments budded with 5 flowering cultivars x 2 Undercutting treatments in autumn

Plot sizes in field are about 26 - 30 plants (ie per lowest level sub-treatment). Technical difficulties with plant spacings mean that identical plot sizes between machine and hand planted treatments will not be possible, however there will be sufficient plants of each treatment available for recording at lifting, potting and monitoring through for subsequent performance.

The complexity and range of treatments used in this first experiment mean that plots can not be replicated in the field. However potted plants taken through for final assessments will be arranged in a replicated trial design.

Details of treatments

Rootstock selections:	L	*Rosa dumetorum* 'Laxa'
	I	*Rosa canina* 'Inermis' ('Inermis' only for Trial 2)
Planting methods:	H	By hand
	M	By Super Prefer planting machine
Initial root pruning:	RP1	Normal pruning leaving about 150 - 180 mm of root measured from top of root collar
	RP2	Severe pruning leaving about 100 mm of root measured from top of root collar

Flowering cultivars:

Trial 1

Royal William	HT	Deep Crimson
Silver Jubilee	HT	Pink
Margaret Merril	FL	Pearly White
Indian Summer	HT	Creamy Orange
Amber Queen	FL	Amber

Trial 2

Festival	Patio	Scarlet
Rosy Future	Patio	Bright Pink
Sweet Dream	Patio	Apricot
Trumpeter	Dwarf FL	Scarlet
Baby Love	Patio	Yellow

Undercutting:

UC0 Not undercut

UC1 Undercut to about 150 mm depth with Egedal angled fixed blade undercutter in mid October 1994

Plants will be potted into a standard peat based growing media with controlled release fertiliser into deep 4 litre containers (eg Optipot 17RX) and held under some form of protection to prevent waterlogging occurring overwinter. Growing on to flower will be on a Mypex based standing out ground with drip and/or overhead irrigation.

Records

To include:

a Survival and establishment of rootstocks in field in summer 1994

b Budtake by spring 1995

c Grade of individual bushes at lifting based on Grade 1, 2 and waste according to shoot numbers and diameters.

d Score of fibrousness and spatial distribution of root at lifting in autumn 1995

e Quantity of root pruning required for potting

f Time of shoot development and flowering spring / summer 1996 based on key growth stages as used for project HNS 65

g Overall visual appearance grading score of plants in spring / summer 1996 at point of sale appropriate to the individual cultivars

h Development and score of rootball in container prior to sale (% visible root cover over pot ball)

i Photographs at rootstock planting, lifting, pruning, potting, during growing on and at point of marketing as required

j Crop Diary, to include details of routine operations such as spraying, weeding etc, as well as key operations related to treatments.

7. COMMENCEMENT DATE AND DURATION

Start date: 01.04.94, duration 2¾ years.

The pruning and planting method treatments will be applied to rootstocks in Spring 1994 followed by budding in August. The experimental work will be completed by July 1996.

An interim report will be produced after lifting in December 1995 and the final report will be produced by November 1996.

8. STAFF RESPONSIBILITIES

Mr C M Burgess

9. LOCATION

HRI Efford

TERMS AND CONDITIONS

The Council's standard terms and conditions of contract shall apply.

Signed for the Contractor(s)

Signature.....

Position.....

Date.....

Signed for the Contractor(s)

Signature.....

Position.....

Date.....

Signed for the Council

Signature.....

Position.....

Date.....