

PAPERS IN FRUIT AND NUT PRODUCTION - BULLETIN B

PIP AND STONE FRUIT PRODUCTION

Proceedings of a course in "Fruit Production" at Lincoln College in November 1980, with an additional paper from an earlier course in "Alternative Land Uses" held in February 1979.

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LINCOLN COLLEGE

1981.



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## INTRODUCTION

*G.P. Ward,  
Grower,  
Loburn,  
and President New Zealand Fruitgrowers Federation.*

The *history of fruit growing* in New Zealand is not altogether a happy one. For example, after a major expansion of plantings just before, during and after the 1914 - 1918, war the industry sank into a trough - and this did not correspond to any sunspot activity but was due to something much closer to home - The Depression of the 1930's and the World War as we see in the following figures:

	1918	1930	1946
Acreage:-	53,000	27,000	17,920
Number of growers:-		6,050	4,813

Comparing 1918 with 1946, there was three times as big an acreage and two and a half times as many growers.

The trough happened when market returns fell in relation to cost of production i.e. fruitgrowers could not earn a living. From the commercial point of view, *marketing must match production*. Unless fruitgrowing can continue to be profitable there will be another exodus from the industry.

That is not gloomy talk but realistic. I have faith in the industry, but when the crunch comes, only the efficient will survive, and that is probably as it should be.

I am speaking here about the fruitgrower whose total livelihood depends on fruitgrowing. For nuts, the picture is, I think, different. To

my knowledge no nut-grower in New Zealand relies entirely on his return from nuts for his income. This bulletin is limited to pip and stone fruit and nuts. The picture of *pip-fruit* growers depends largely on the realisations of the Apple and Pear Board for export fruit. The international market is highly competitive and factors beyond our control such as quotas into the E.E.C. and freight costs can have a marked effect on the profitability. Provided growers maintain their high quality, the increasing production should be profitably marketed.

Canterbury's present production is below the local consumption. There appears to be room for modest expansion for the local market. Export from Canterbury will only take place if there is sufficient volume to warrant direct shipping from Lyttelton or Timaru. This could come about if new orchards were planted with varieties that grow particularly well here e.g. Cox's Orange, Red Delicious, Braeburn - but the scale would have to be large with strong financial backing.

*Stone-fruit*, especially peaches, grow well in Canterbury. There is likely to be over-production on the New Zealand market unless exports are expanded, and there does seem to be a good market in Australia for nectarines and peaches from February onwards. Canterbury, with good horticultural land close to an international airport, could have a future in the export of stone-fruit.

Though I am a member of the *Tree Crop Association* I am not qualified to speak on the prospects for nut production or marketing. However, as a general observation it would seem to me that only large scale nut production would have much chance of being profitable, unless it is combined with other forms of farming.

Success in fruitgrowing will largely depend on the human factor. Some qualities which are needed to be a good fruitgrower are:-

- \* Love of trees or growing things
- \* Ability to stick at the job, through disaster and success

- \* Good organisation of own time; ability to choose priorities
- \* Good employer of labour
- \* Practical and preferably a good mechanic
- \* Be prepared to work on your own
- \* Dedicated to the work, but not to the detriment of home and family
- \* Ability to budget and handle figures; business sense

The primary object of the last two days of the course is to assist new fruitgrowers in getting started along the right lines. I hope that those who have been in fruitgrowing for some time will give of their knowledge and experience at discussion time. For this is the way that we all learn and there is plenty to learn for all of us.

#### WHERE SHOULD THE FRUITGROWER GO FOR ADVICE?

Firstly, he should join his local Fruitgrowers Association which will be a member of the New Zealand Fruitgrowers' Federation. He should attend meetings of his association for in that way he can tap the collective knowledge and experience of its members and he can voice his own thoughts - hopefully for the betterment of the industry.

Through his association he takes his representation and the chain goes from grower to association, to district advisory committee and to the directors of the Federation. Once a year a Dominion Conference is held, and matters raised at Association level are discussed at Provincial Conferences and then, if passed, at the Dominion Conference. A very democratic procedure.

The Federation has branches in all fruitgrowing districts and these



branches supply everything that is needed for fruitgrowing. In addition the technical service has produced a "Growers Guide" which is a bible to most growers. If you can't find the answer there to your technical problem ask the technical staff.

The Ministry of Agriculture and Fisheries has Horticultural Advisory Officers in most districts and these are backed up by specialist staff in irrigation, engineering, economics etc. The Ministry publishes AG LINK bulletins on specialist subjects.

In addition the M.A.F. has Field Officers who advise growers on when to pick, inspect fruit, estimate crops and crop losses, do soil tests etc.

So the M.A.F. is a valuable front line service of information. The D.S.I.R. does field trial work in orchards and is especially valuable in Canterbury in advice on integrated mite control.

On the marketing side anyone intending to grow apples for the Apple and Pear Board should contact the local branch manager. While anyone intending to send stone-fruit to the auction markets should contact the manager of one of the local merchant firms.

Publications: The Orchardist of New Zealand is published monthly by the Fruitgrowers Federation. It's free to registered growers - otherwise \$8 for annual subscription. The Horticultural News (Auckland) is published bi-monthly \$5 per year. Overseas magazines include the American Fruit-grower, Good fruit Grower (Washington State), Deciduous Fruitgrower (South Africa) and the Grower (England).

#### SUMMING UP

Horticulture in New Zealand is on the move.

New knowledge, new techniques, new systems - enable us to produce a wider range of fruits by different methods. This course has given us some idea of what is possible.

It's all exciting. We can produce, but at what cost?

There's no shortage of enthusiasm, and perhaps the main benefit of this course is to point that interest in a direction which is more likely to succeed.

But, if you decide to become a grower, there is no guarantee of success.

Fruitgrowing is a calculated gamble - so much so that few growers need go to the Races!

It is not a 'safe' Government job.

It is not a cost-plus industry. It is a challenge.

We have to perform to survive.

And when, as the alternative life-stylers say "we are cheesed off with the climate", fruitgrowing gets pretty rugged.

Production and marketing must go hand in hand.

From a business point of view there is no point in producing if we cannot sell - and sell profitably.

The market within New Zealand is limited by our population. The increase in traditional crops will have to be exported or processed.

New crops grown in quantity will soon satisfy the local demand. Export markets for these crops should be established now before there's over-production on the local market.

The fruitgrowing industry is surprisingly strong. The growers' own organisation, the Federation, has striven over the last 64 years to make it so.

It is backed up by one of the best Government departments, the M.A.F.; by the D.S.I.R. which does the bulk of fruit research; by the Universities in training students in horticulture and with educational programmes such as this course; by merchants, exporters and many more. There is a spirit of co-operation abroad which should help us to grow better crops, to enjoy the life and unite the total fruitgrowing industry.

# APPLE PRODUCTION FOR MECHANISED HARVESTING ON THE LINCOLN CANOPY SYSTEM

*J.S. Dunn and M. Stolp,  
New Zealand Agricultural Engineering Institute,  
Lincoln College.*

## CAN WE PICK ALL OUR APPLES?

The shrinking and increasingly expensive rural labour force will not equate with the continuing steady rise in our apple tree numbers. The time has undoubtedly come to consider some form of mechanised help. Yet attempts to harvest apples by machine, mainly in the USA, have never been successful. Shake and catch methods have received most attention but the machines developed have been large and costly and both fruit and trees without exception have suffered unacceptable levels of damage.

## NZAEI APPLE HARVESTING PROJECT

Starting in 1970 the New Zealand Agricultural Engineering Institute at Lincoln College undertook a project to evolve an integrated growing and harvesting system for apples so that the overall requirements of hand work and skill were minimised.

Throughout the project the ultimate aim has been to produce a product equal to that of good hand picking without damage to either the fruit or the tree.

## APPROACH

Many of the difficulties of mechanical harvesting would disappear if apples could be produced on branches grown in a single horizontal plane. They could then be caught within a few centimetres of their

point of release before attaining a damaging velocity, and without striking any branches in their fall.

A canopy method of training has been devised to facilitate this, together with a simple method of fruit removal which will work in conjunction with canopied trees. The development of the agronomic and engineering aspects of the project have proceeded simultaneously.

#### CANOPY DEVELOPMENT

While canopy-trained trees will make a contribution towards supporting the fruiting canopy, a strong basic support framework is essential to hold young branches during the training period and to carry much of the fruit load.

End structures are the anchors for each row and must be soundly constructed to prevent subsequent movement (Figure 1). The dimensions of the various components shown in the accompanying sketches should not be reduced, particularly the depth of the end posts which must be driven in no less than 1.2 m.

Intermediate posts are required at approximately 10 m intervals or every four trees at the present 2.4 m tree spacing (Figure 2). Half round posts set 0.6 m deep have proved adequate on level ground. Longer posts which can be driven 0.9 to 1.2 m into the ground will be required in hollows to prevent posts lifting. Footed posts could be used as an alternative but they are expensive to install. Cross arms of 2.4 m x 100 mm x 75 mm rough sawn timber are bolted to the posts so that their top surface is 1.5 m above ground level.

It is recommended that all posts be driven before any trees are planted. A single wire (2.5 mm H.T.) should be run from one row end to the other at a height of 0.6 m to serve as a planting guide. It will also support the trees if they are attached as shown in Figure 3. Individual staking is not required.

FIGURE 1: END STRUCTURE

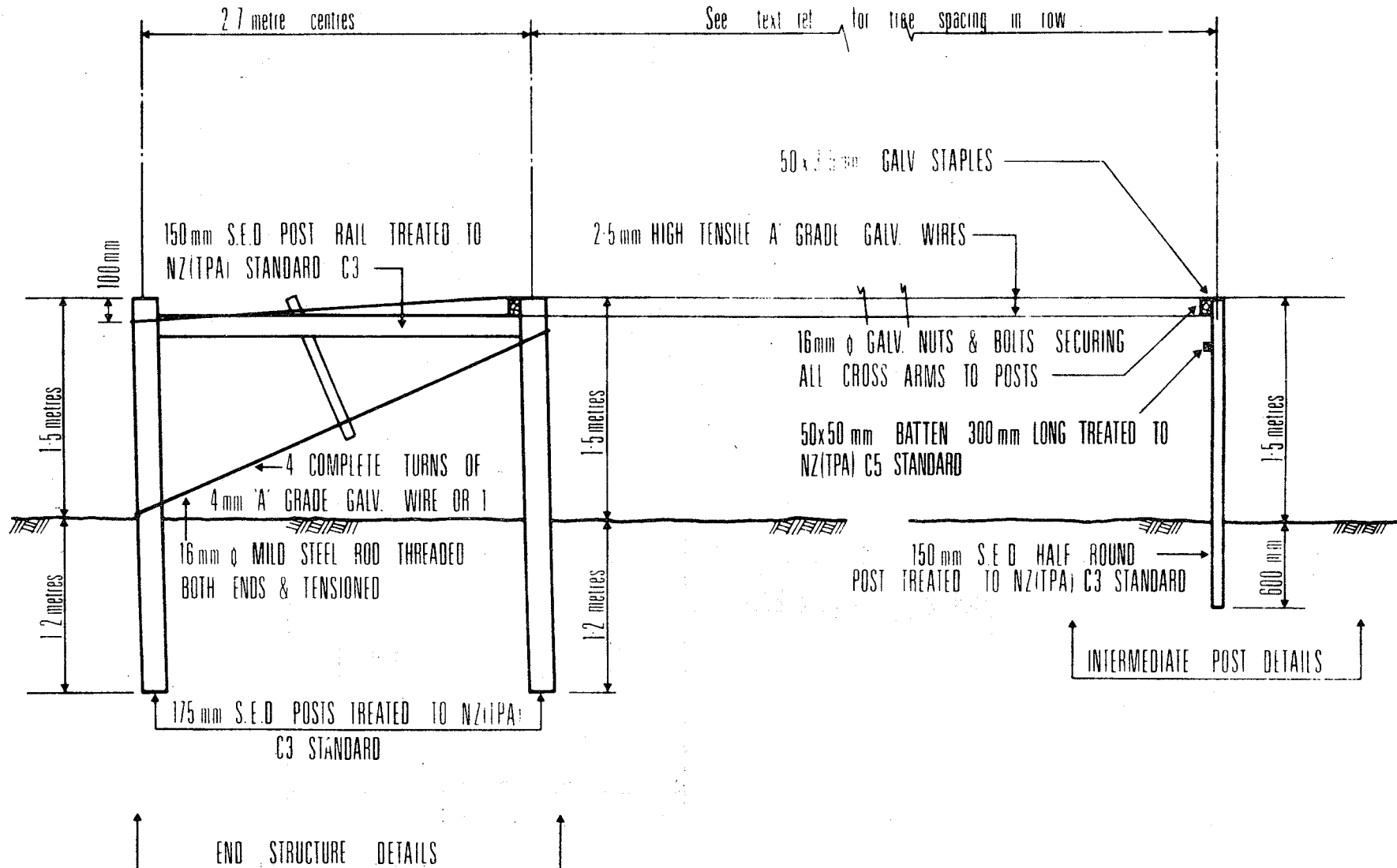
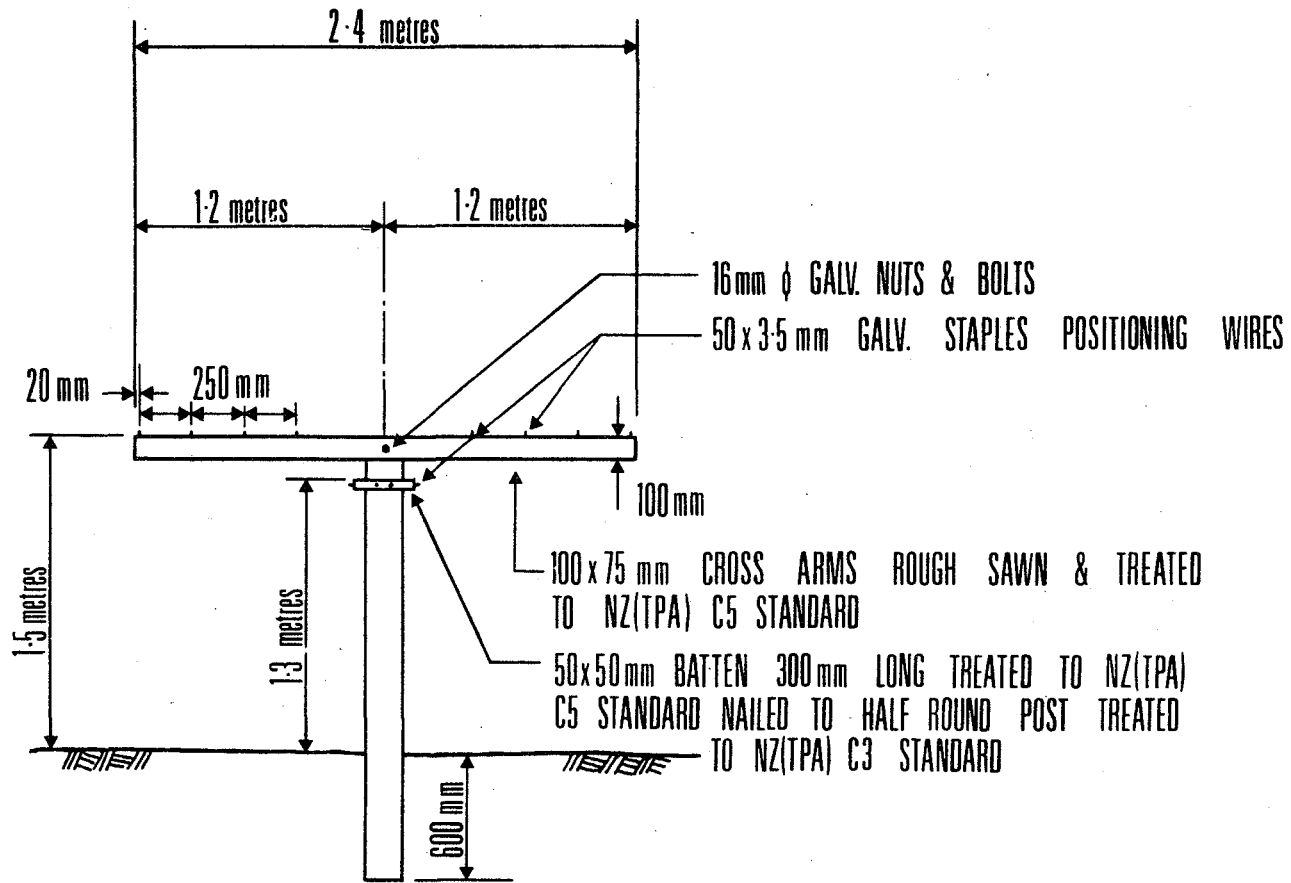


FIGURE 2: INTERMEDIATE POSTS



NB Longer posts which can be driven 0.9-1.2 metres into the ground will be required in hollows to prevent lifting

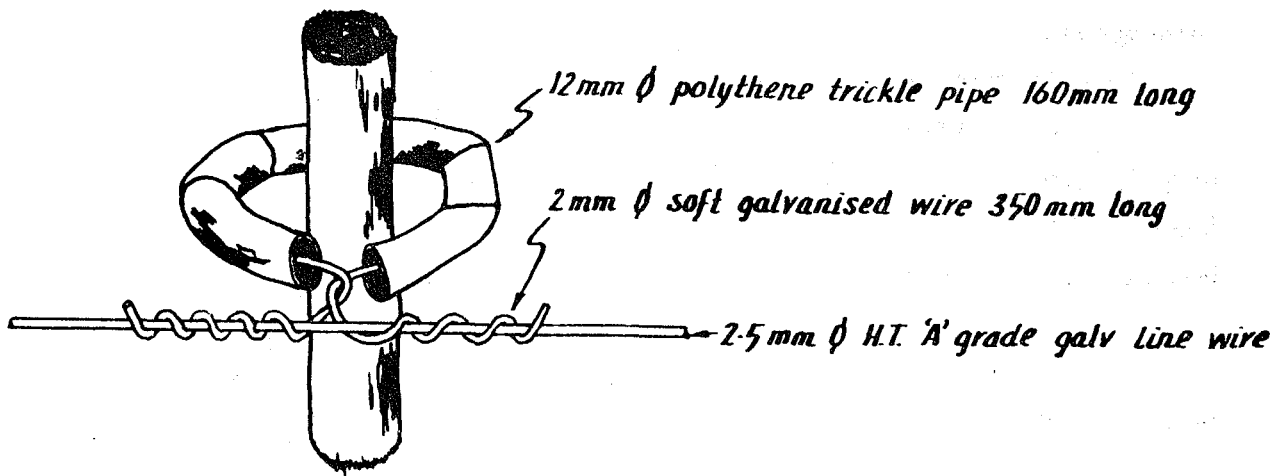


FIGURE 3: Support for young trees in first season -  
Discontinued once trees trained onto canopy wires.

When the leaders or main arms of the tree need to be secured, two support wires are run out down the row and stapled to the ends of 300 x 50 x 50 mm battens nailed to the face of the half round posts at a height of 1.3 m. Cross members are bolted to the uprights a year later when the wires to support the laterals are required. Four wires are then needed on each side stapled on top of the cross arms at a spacing of 250 mm. Staples must not be driven home. All wires are tensioned to 900 newtons (200 lb f) with permanent strainers in the centre of each row.

At the present time (1981), material cost for the supporting structure at the 4 m x 2.4 m tree spacing is approximately \$4.60 a tree made up as follows:

*Costing for an 80 tree row with trees 2.4 m apart*

End Structures		\$
4 strainer posts 2.7 m x 150 to 180 mm @ \$14		56
2 stays 2.7 mm x 125 to 150 mm @ \$10		20
2 tie rods 3.5 m x 16 mm mild steel		15
	carried forward	91



	brought forward	91
<b>Intermediates</b>		
19 half round posts 2.1 m x 150 to 180 mm @ \$3		57
21 cross members 2.4 m x 100 x 75 mm @ \$4		84
Wire 2.5 mm h.t. 12 lengths x 200 m @ \$30 per 648 m		120
Staples 252		3
Bolts, nuts and washers 21		10
	<b>Total</b>	<b>365</b>
<b>Cost per tree for materials</b>		<b>\$4.56</b>

#### TREE FORM AND TRAINING

Canopy training is a spring and summer occupation and cannot be left until the winter. We train the tree to grow our way rather than prune out unwanted growth after the tree has grown its way. There should be little wasted growth so that vigour is channelled into forming the fruit producing structure and ultimately, fruit.

#### *Leaders*

Well grown young trees if obtained as whips should be pruned back

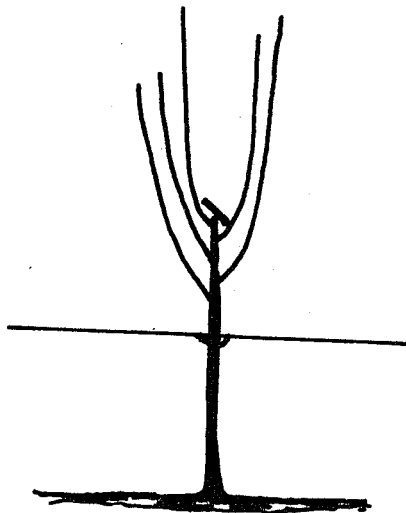


FIGURE 4: Prune at 1 metre high. Allow only 5 strong buds or feathers to grow.

to a height of 1.0 m after planting. Five vigorous buds or feathers are selected near the top of the tree and all others removed. The fifth bud or feather is left in case of mishap and it also provides some choice in selecting four uniform branches later (Figure 4).

To simplify drawing in Figures 5 to 9a only two of the four leaders on each tree are shown.

When the leaders are approaching a metre in length they are bent over and loosely attached to the leader wires as shown in Figure 5.

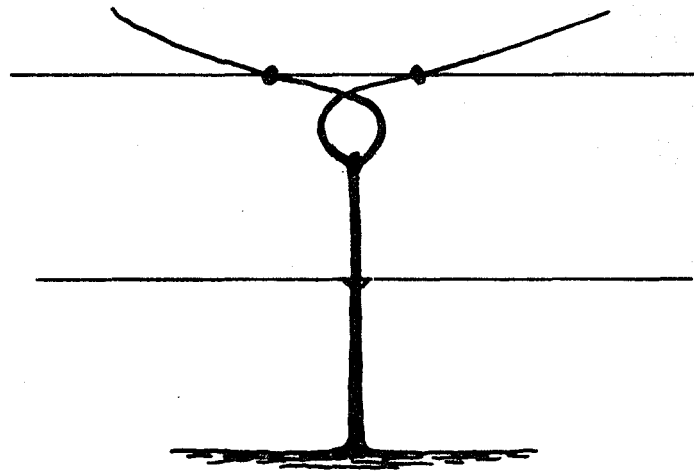


FIGURE 5: Tie loosely when leaders are 1 metre long.

If they are each restrained with a single tie the free end will soon turn upwards and continue growing as in Figure 6. The fifth leader should be removed at this stage.

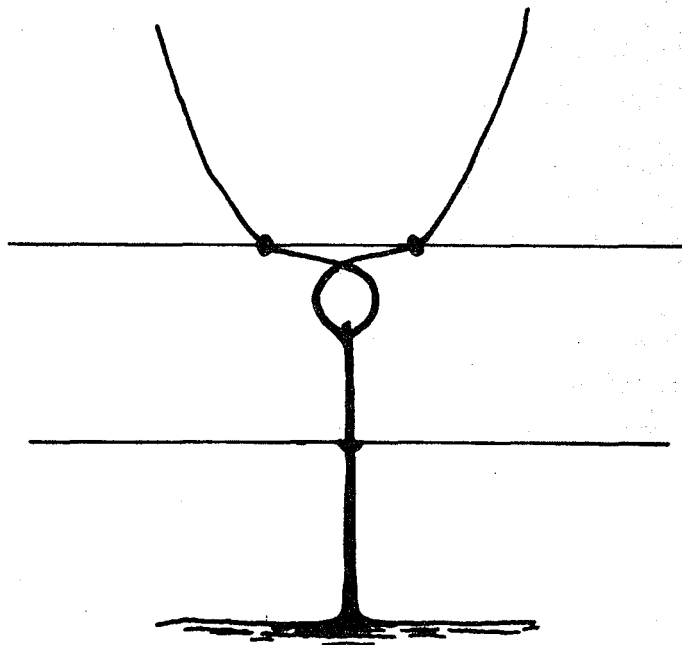


FIGURE 6: Allow growth to continue vertically.

In a windy situation such leaders are vulnerable to damage and may have to be tied down again nearer to their growing point, Figure 7. This will reduce their rate of growth but is preferable to the loss of leaders.

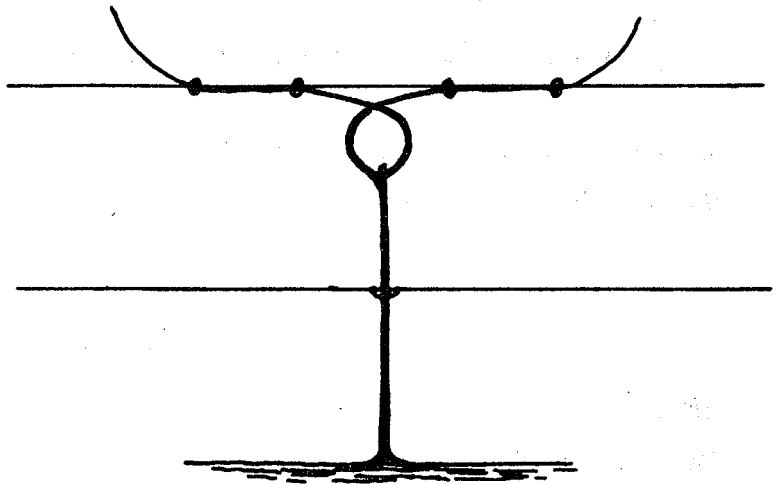


FIGURE 7: In a windy situation tie leaders to wires to prevent damage.

Do not allow the initial curvature of the leaders to rise above the supporting wire as in Figure 8. Strong growth will break out at the highest point and other laterals along the leader will be dwarfed. Make sure all wires are tensioned correctly before tying down starts.

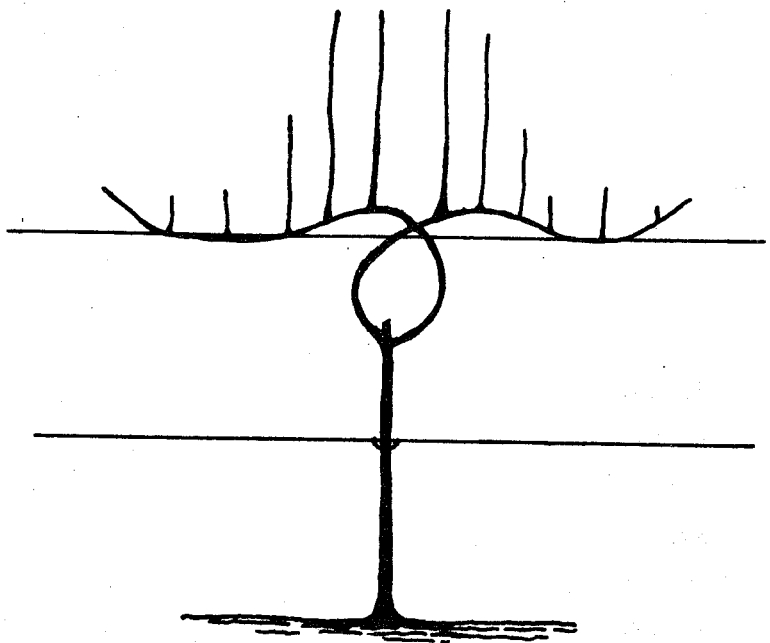


FIGURE 8: DO NOT allow leaders to rise above support wire as shown here.

At no time should fruit be allowed to develop on the leaders or lateral growth will be reduced.

### *Laterals*

Only vegetative buds growing vertically or inclined slightly outwards on the horizontal portion of the leaders should be allowed to develop; all others on the horizontal lengths should be rubbed off once bud movement occurs. A spacing between laterals of 150 to 200 mm has been used so far although varieties with particularly dense foliage e.g. Splendour, may need more space.

Naturally lateral growth will be strongest nearest to the crown of the tree but a more balanced development along each leader will be obtained if the strong laterals are inclined outwards by tying them back to the first fruiting wire only Figures 9a and 9b. This will reduce the height of their growing tips and should be done when they are about 0.6 m long.

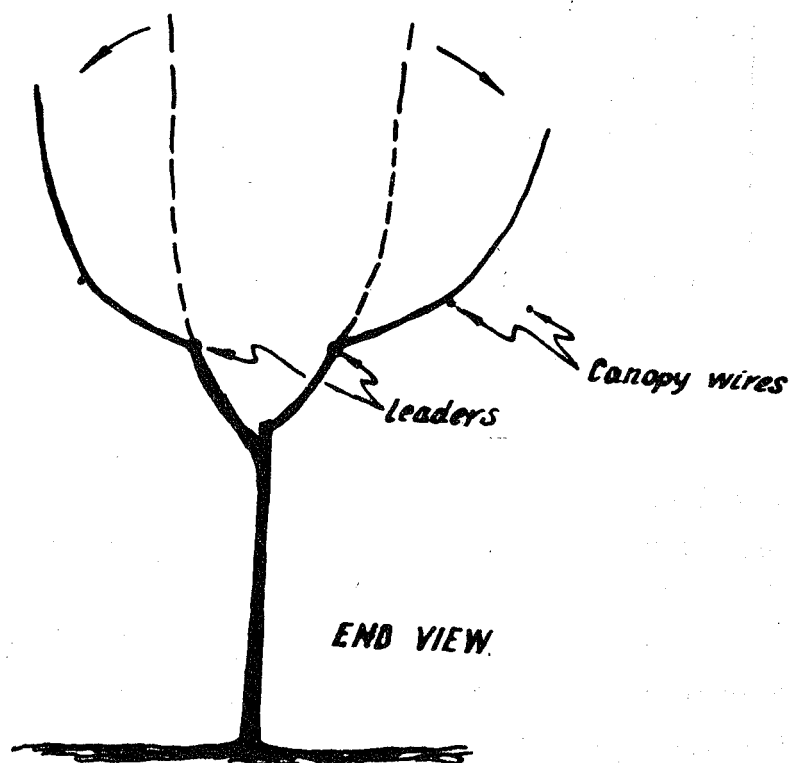


FIGURE 9a: Inner laterals tied back to first fruiting wire to reduce vigour.

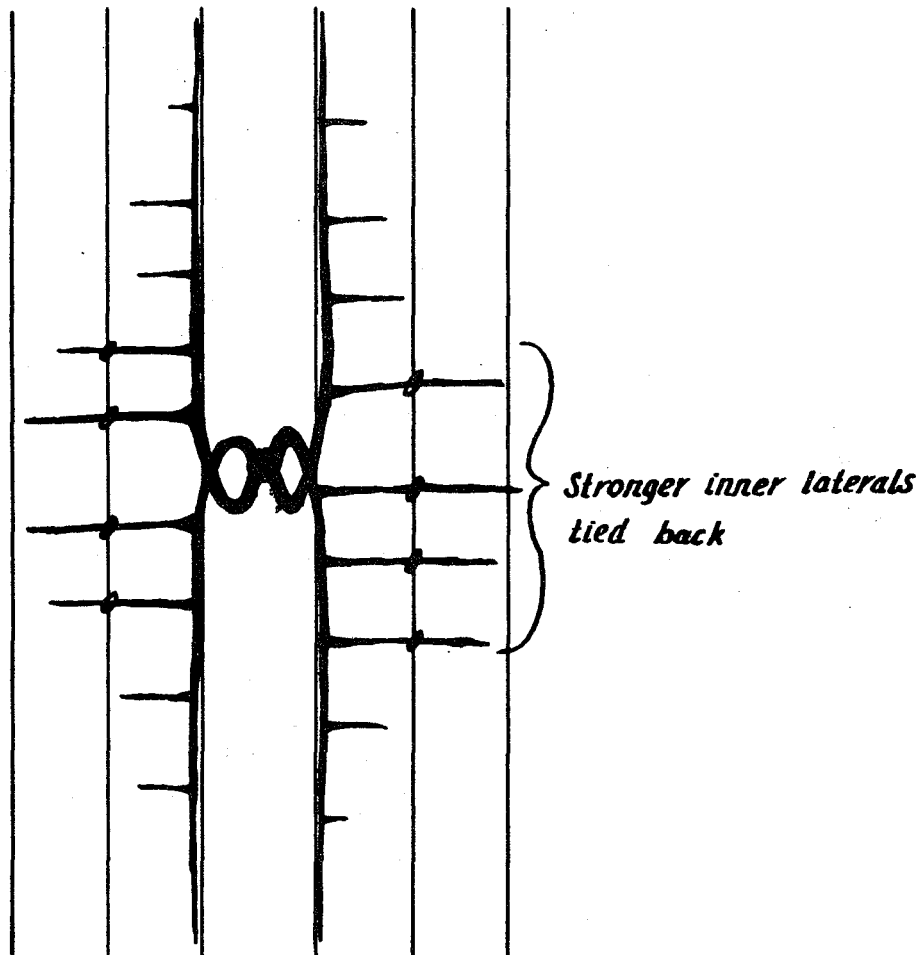


FIGURE 9b: Plan view.

Only when leaders reach a length of 1.3 m should they be tied down into the fully horizontal position. The same also applies to the laterals. A branch in a vertical position will grow faster than a horizontal one. To develop the canopy cover quickly it is important to keep both leaders and laterals in a vertical or near vertical position as long as possible until the required length is reached. However, growth does not continue indefinitely and tying down must not be delayed too long. As each growing season draws to a close, extension slows and newly formed wood begins to harden from the base. Training hardened wood results in breakages and bends of large radius.

A Max Tapener has been used most successfully for all tying down in

the canopy formation Figure 10. The black tape manufactured in New Zealand for this trial is strong enough to hold branches for a year yet will not restrict branch enlargement.



FIGURE 10: Max Tapener used for tying down leaders and laterals.

#### TREE SPACING AND CANOPY WIDTH

The existing row width is 4 m with an inter-tree spacing within the row of 2.4 m. Planting density is 1040 trees/ha. At a canopy width of 2.4 m a gap of 1.6 m is left between adjacent rows.

To hasten complete canopy cover, inter-tree spacing within the row may be reduced to perhaps 2.0 m. This would increase the planting density to 1250 trees/ha but would not affect the canopy support structure or its cost apart from changing the spacing of intermediate posts from 9.6 m to 10.0 m.

Observed tree vigour has been adequate to cover a greater canopy width and some experimental rows will be developed to 3.0 m. An additional wire will be added each side of the canopy, supported on 600 x 50 x 50 mm battens nailed to the existing cross arms. If

production is satisfactory, new plantings will be trained on to canopies with 3.0 m long cross arms. This will increase the fruiting area by 28% for very little extra cost.

Despite the increased canopy width, tree centres will still be easily accessible via the 300 mm gap between the paired leaders. The gap between adjacent canopies will be reduced to 1.0 m.

#### REPLACEMENT OF FRUITING WOOD AND PRUNING

Most unwanted annual growth originating from the laterals and leaders is cut 25 to 50 mm above the laterals some time before harvest. Varieties which develop horizontal growth e.g. Gala, may need some additional tidying afterwards.

Aging laterals can be replaced as required by tying down adjacent selected shoots arising from the leaders prior to summer pruning. The laterals are then cut out in the winter, leaving the new growth to fill the gap. In this way fruiting wood can be renewed and a full cropping canopy maintained. Leaders can be replaced in the same way from shoots occurring from the head of the tree.

#### YIELD

Canopied trees of Red Delicious on MM106, trained on to an earlier radial form of canopy (Figure 11) (planted 3 x 4.5 m) yielded the equivalent of 24, 39, 60, 10 and 70 tonnes/ha for the five seasons 1974 to 1978. Comparison yields for adjacent centre leader trees of the same age and variety were 25, 29, 49, 33 and 58 tonnes/ha. The low canopy yield in 1977 followed restructuring of the trees in the winter of 1976.

The 'H' form of canopy (Figure 12) has not been in existence long enough to obtain comparative yield figures but there is no reason why its production should be less than that of the radial canopy form.

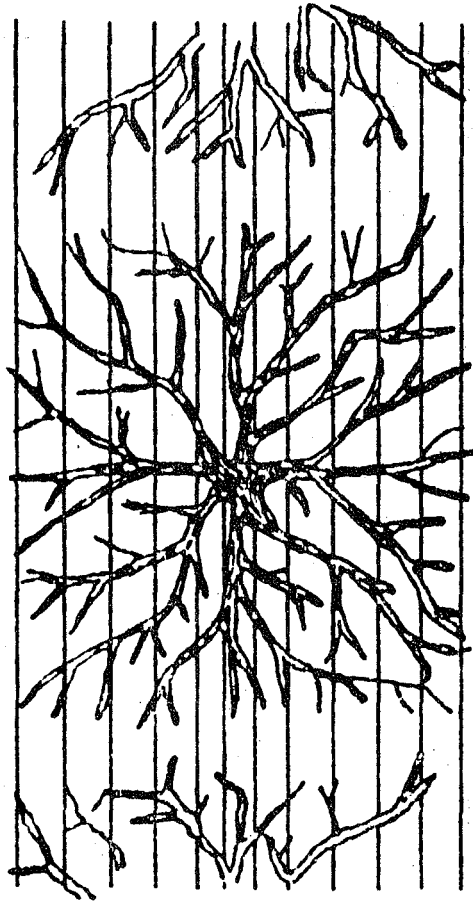


FIGURE 11: ORIGINAL RADIAL SYSTEM plan view

#### FRUIT QUALITY

Canopy grown apples have been remarkably uniform in size and maturity. No hand or chemical thinning has been necessary to achieve a good fruit size. The colour of Red Delicious was good.

#### HARVESTING

The 'H' canopy form permits continuous harvesting which can be confined to one side of the row only using a simple impacter with a low energy requirement.

The first impacter was merely a piece of wood 50 mm square and 1.4 m long which was brought up smartly in a horizontal position by hand



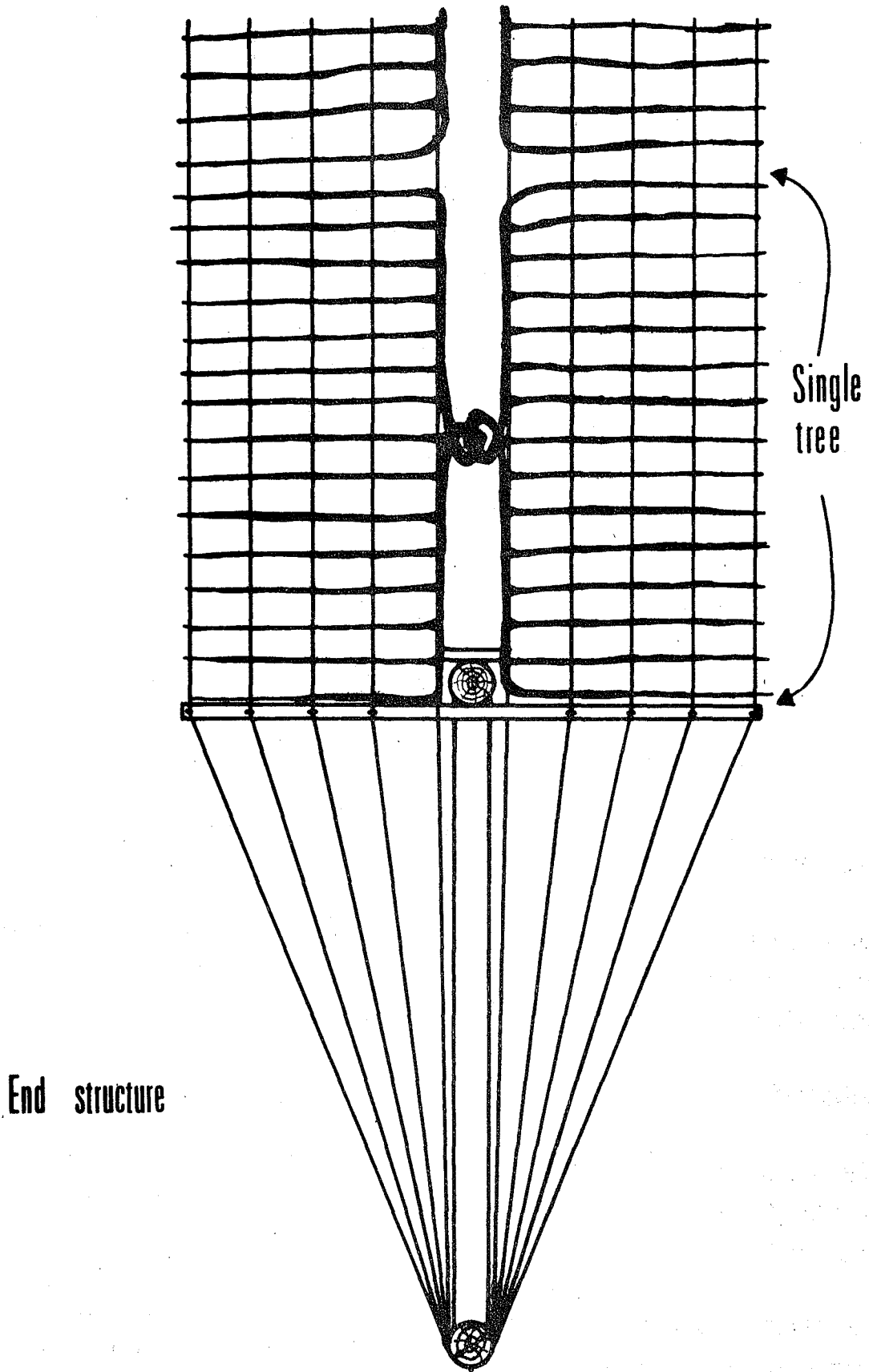


FIGURE 12: 'H' CANOPY TRAINING SYSTEM plan view

against the underside of the canopy. The operator stood just outside the canopy. The momentary lifting of the laterals in the region of the impact and the inertia of the apples resulted in the fruit being released.

Continuous removal was most effective at an impact frequency of once a second with an advancement of 150 mm down the row between each impact. This allowed sufficient time for the released apples to clear the canopy before the next impact. It is equivalent to a forward speed of 0.5 km/hour.

Fruit fell from laterals just ahead of the impact and removal was almost always complete.

A simple tractor drawn harvesting rig consisting of a mechanical impacter and a polyurethane foam covered conveyor has removed and collected Granny Smith apples with a damage figure comparable with that of hand harvested fruit. A spring-loaded, foam-covered roller to engage with the underside of the canopy was fitted behind the impacter to damp out any tendency of the canopy to sway with the frequency of the impacter (Figure 13).

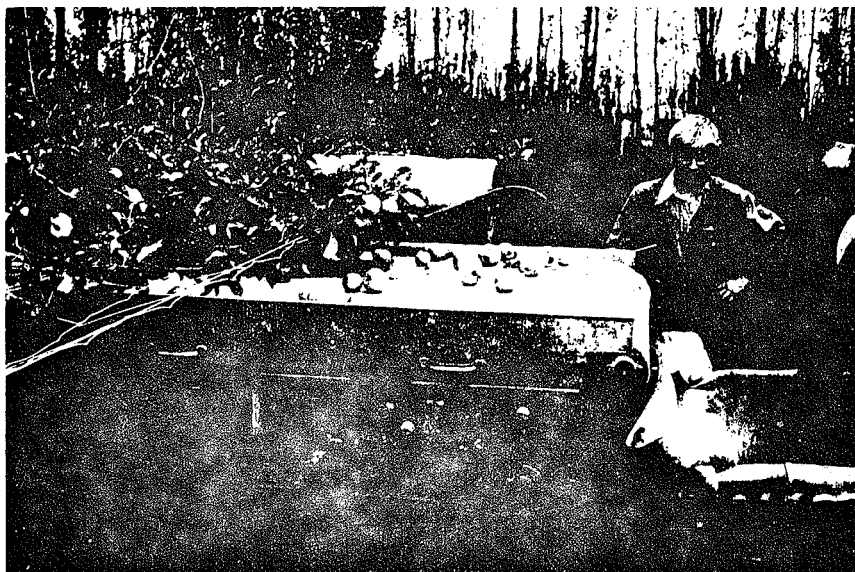


FIGURE 13: HARVESTING RIG SHOWING CONVEYOR, MECHANICAL IMPACTER AND FOAM COVERED ROLLER.

No growth regulating materials have been required to obtain a complete apple release when harvesting. No tree damage has been caused by the harvesting process other than the removal of an occasional spur attached to an apple.

#### FRUIT DAMAGE

The percentage of Granny Smith apples showing damage after removal with two forms of impacter (A and B) on the experimental harvesting rig are shown below. Harvested fruit was stored at room temperature for two weeks before inspection.

A. Swing arm impacter	Damage	% of fruit affected
	Stem pulls	61.1
	Bruises <1 cm <sup>2</sup>	13.0*
	Bruises >1 cm <sup>2</sup>	1.9
	Punctures	0.6
	Spurs removed with fruit	1.9
B. Parallel arm impacter	Damage	% of fruit affected
	Stem pulls	42.0
	Bruises <1 cm <sup>2</sup>	9.9*
	Bruises >1 cm <sup>2</sup>	6.7
	Punctures	1.9
	Spurs removed with fruit	0

\* Any depression however slight is classified under this heading. These occur frequently in hand picked fruit and are usually disregarded.

When harvesting canopied Red Delicious using an earlier form of impacter the amount of stem pull was less than 3%. Visual observations have indicated a similar low level with both Golden Delicious and Splendour.

Although the results were obtained from an incomplete canopy cover

there is no apparent reason why similar results should not be obtained when the canopy is fully developed.

#### ADDITIONAL BENEFITS OF CANOPY GROWING

While establishment costs for canopy training are somewhat higher than with conventional tree forms, other advantages which are appreciable may well compensate for this.

- \* Training follows a simple specific pattern. Skilled operators are not required.
- \* Regular spacing between laterals gives high light interception and good fruit exposure, but hail damage may be higher on canopy trained trees.
- \* The branch structure is not weight bearing; an increased number of apples can be carried.
- \* Propping and support tying as the crop develops each season is unnecessary.
- \* Wind damage and fruit drop is reduced or eliminated as branches are restrained and cannot flail.
- \* A canopy height of 1.5 m allows easy access and permits the use of normal agricultural tractors without risk to operators or trees. Special orchard tractors are not required.
- \* Summer pruning is by cutter bar after tying down any replacement laterals.
- \* Winter pruning is limited to occasional replacement of laterals only.
- \* Effective spray penetration is facilitated by the shallow

canopy. Nozzles may be positioned above and below the canopy and shrouded to reduce rates of application and wind effect (Figure 14).

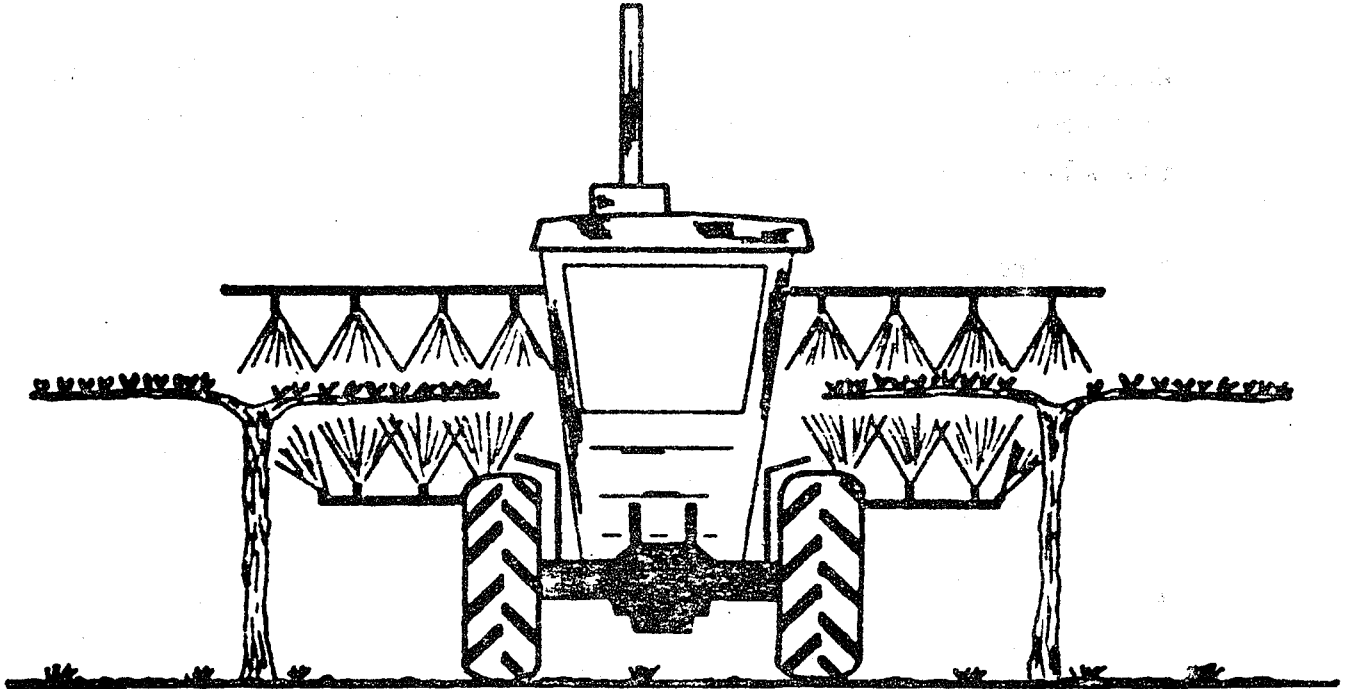


FIGURE 14: TWIN BOOM PROFILE SPRAYER

- \* A single pick harvest is possible. All fruit grows under identical conditions so that it sizes and matures uniformly (Figure 15).

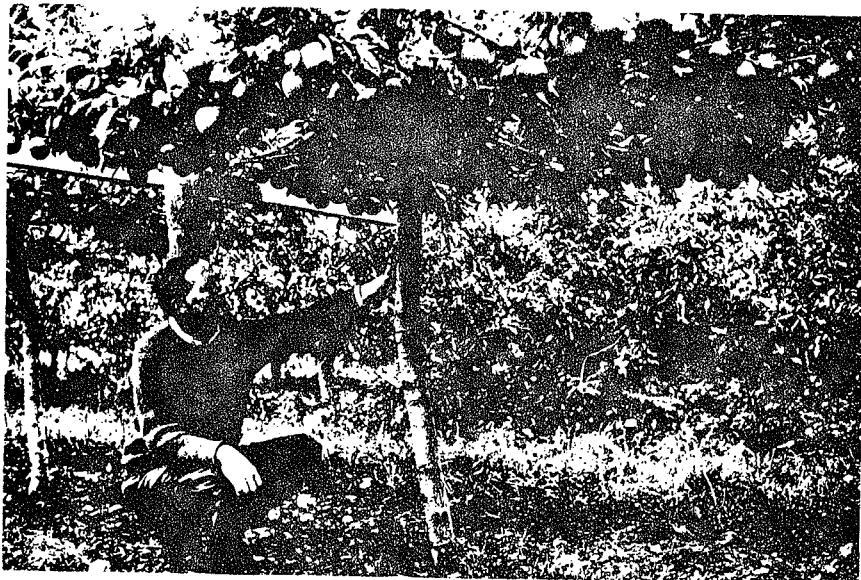


FIGURE 15: GRANNY SMITH APPLES AT HARVEST TIME SHOWING UNIFORMITY OF SIZE.

- \* The canopy produces a concentrated mass of blossom. Observed bee activity has continued longer in cold windy weather than on adjacent conventional trees (Figure 16).



FIGURE 16: CANOPIED TREES OF GRANNY SMITH IN BLOSSOM

#### GROWER INTEREST

Several thousand apple and some pear trees have been planted for canopy training on private holdings during the past three years in Blenheim and Lincoln areas. Two other canopied areas on established orchards have been planted more recently near Nelson. There are known canopied plantings in Australia, USA, England, Holland and Italy, mainly on research stations.

#### WHERE NOW?

The promising results from the present development phase must be confirmed in larger scale trials before extensive commercial acceptance of the canopy system is likely. The long term effect on yield and tree vigour is not yet known nor is the effect of canopy training on the behaviour of other varieties, on other stock and at different

planting densities. A trial covering some of these aspects is planned in conjunction with the Horticultural Department of Lincoln College.

Feedback from commercial growers applying the canopy techniques in other areas is of considerable value and will help to accumulate information on the response under a range of conditions.

The New Zealand Agricultural Engineering Institute will continue the development of a prototype harvester based on the under-canopy impacter, a profile sprayer and a cutter bar for summer pruning.

## THE ESTABLISHMENT OF AN ORCHARD

*A.G. Malcolm  
Grower,  
Canterbury.*

That you are reading this bulletin indicates that either at present or in the future you hope to make a profit out of growing fruit. But it should be made clear that in times of reasonable prices for crops like pip and stonefruits the individual results by growers will cover the whole spectrum, from substantial losses to substantial profit. This range of economic returns is probably greater in fruitgrowing than in any other type of farming because of the complexity and quantity of the inputs required to grow a crop.

Now I suggest that our aim should be to have as favourable a position up the scale of successful fruitgrowers as possible. To achieve this it is critical that we get the initial establishment of our orchard as near perfect as possible. Decisions at this stage of development have wide ranging and long term effects on the profitability of the venture. Mistakes are not readily rectified later.

A grower who plants his orchard in the right climate and soils, near his potential market, using the best rootstocks and varieties, trained correctly is similar to a manufacturer setting up a new factory and equipping it with the most up-to-date and efficient plant. He has an immense advantage over his competitors with inefficient factories. The same applies to orchards. They should be regarded as factories set up to produce quality fruit as cheaply as possible.

The biggest obstacle to establishing an efficient orchard is haste. I can't over emphasize the need for sound planning and decision making before a fruit tree goes into the ground. The following is a check list of requirements in order of implementation in establishing an orchard in Canterbury.



*Adequate Finance.*

Need for long range budgeting. Check bulletins by Dr. D.W. McKenzie. Years 2 and 3 from planting are a low point financially.

*Proven Markets*

Proven markets. This is reasonably satisfied in pip fruit at present but world planting trends for apples need watching. Pears appear to have a brighter future if they can be grown economically. Stonefruit - local market is adequately supplied - new planting only for export. Need for market research and development - preferably "single desk selling".

*Necessary Expertise*

Necessary expertise - critical for profitable establishment. If owner does not have expertise he should employ a qualified manager or consultant - much greater need for horticultural consultants in the future.

*Selection of (Micro) Climate*

Selection of suitable climate or micro-climate. With particular emphasis in avoiding hail belts - low pockets subject to frost - prevention is possible but expensive and disease-prone. Sloping land is less frost prone. Enquire from surrounding neighbours regarding hail history in the district.

*Soils and Market Proximity*

Selection of suitable soil in reasonable proximity to market. Soils may be improved by drainage - hence location or proximity to market is more important economically e.g. A typical apple orchard supplying a New Zealand Apple and Pear Marketing Board depot on present day freight costs. Total extra expenditure per 10 km from depot for a 20 acre orchard over 40 years would be approximately \$80,000.

*Land Tenure*

Purchase or lease of selected property. Initial purchase price is only a small part of total establishment costs, so a small increase initially to secure a more suitable property may pay an excellent return in increased profits over the life of the orchard. The advantages of leasing instead of buying should not be overlooked especially for short rotation intensive stonefruit crops. Particularly applicable if finance is a problem. It is widely practised in U.S.A. and Europe.

*Rootstocks*

Decision on which rootstocks to use.

*Apple* M IX The most dwarfing stock at present available needs to be supported. Grows large fruit, earlier maturity, shorter storage life, interstocks - EMLA IX

MM106 Semi dwarfing - very widely used especially in Hawkes Bay - needs to be used with caution on poorly drained or clay soils - collar rot - precocious and heavy cropping may need to be supported in Canterbury

M 793 Reasonably vigorous especially on good soils with a vigorous variety. Resistant to collar rot - fruit size, smaller

Effect of high working on vigour control

*Pears* W.B.C. seedling - too large - high costs

BAC29 Quince F.K.V. size still a problem

Quince A - similar - compatibility

Quince C - need for F.K.V. strain - precocious  
2/3 size of Quince A

*Stonefruit* peach and nectarine

Own roots - F.K.V.

Seedling Golden Queen - F.K.V.

#### *Nursery Orders*

Ordering of trees from Nurseries in advance to secure first grade stock - decision on whether to use rods or dormant buds. Ordering of peach stones for Golden Queen seedlings. Some advantages on buying rooted cuttings and growing your own trees - need to ensure top quality. Use of feathering materials are advocated (M & B 25, 105 or AVG).

#### *Shelter Establishment*

Establishment of shelter belts at least 2 years before planting fruit trees. Shelter species: *Populus lombardy*, *Populus tricocarpus*, *Salix matsudana*, *Alnus cordata* and various Eucalypts near tile drains. Establishment is improved by prior soil ripping and provision of irrigation and fertilizer.

#### *Initial Weed Control*

Spraying to eradicate problem weeds i.e. couch, californian thistle, wire weed, docks. Use of sulphate of ammonia - synergic effect on uptake of "Roundup" - Rates  $\frac{1}{2}$  normal Roundup +  $\frac{3}{4}$  kg sulphate of ammonia + 200 mls of spreader. Spraying should be done just prior to drainage. (The sulphate of ammonia must be clean and free from impurities.)

#### *Drainage*

Tile drainage if water table is in doubt. If using MM106 stock or stonefruit need to guard against at least a 20 year flood. Economics of buying cheaper land and draining it.

### *Budwood*

Clonal selection of superior budwood to send to nurserymen - type probably more important than F.K.V. status with some varieties.

### *Marking out Tree Rows*

Mounding - various spacing for different varieties and rootstocks - sufficient headlands. Need for straight rows or mechanical damage will harm trees in future. Mechanical marking out of rows with modified subsoiler on larger areas.

### *Planting*

Planting of trees or dormant buds

- \* By hand - 2 men, shovels, planting board
- \* Posthole auger, tractor, 4 men
- \* Mechanical planter - large areas, availability of machines

Trees need T.L.C. (Tender Loving Care) at all times. Avoid roots drying out. Ensure as little delay between lifting from Nursery and planting as possible. Planting should be completed before bud movement.

### *Tree Supports*

Provision of tree support system if necessary for rootstocks being used - stakes - post and wire.

### *Irrigation*

Installation of irrigation - preferably trickle because of low labour content and lack of pest and disease problems.

*On-going Weed Control*

Effective weed control either by hoeing or dessicant type sprays.

*Pest Control*

Effective pest controls.

- \* Pip Fruit - mildew, aphids, leaf curling midge, black spot.
- \* Stonefruit - silverleaf, bacterial blast, aphids, leaf curl.
- \* All Fruit Trees - eradication of hares and rabbits.

*Intercropping*

Primary advantage, shelter from wind with maize.

Finally I cannot emphasize too much the need for optimum growth conditions and T.L.C. Any stunting of young trees will have an adverse effect on yield of fruit considerably longer than the period of stunting or competition.

#### ADVANTAGES CANTERBURY HAS AS A PIP FRUITGROWING DISTRICT

- \* Large areas of suitable land for pip fruit growing.
- \* Price of land (as at August 1979) about one half of that asked for similar land in Hawkes Bay.
- \* Close proximity to large market for pipfruit (Christchurch).
- \* Plentiful supply of irrigation water - surface and sub-surface.
- \* Large pool of available labour.
- \* Close proximity of a New Zealand Apple and Pear Marketing Board Depot.
- \* Close proximity to a port (Lyttelton) if sufficient volume were available for export.
- \* Less frost risk than parts of Hawkes Bay.
- \* Location close to Lincoln College and D.S.I.R. - research, education, field days etc.
- \* Pipfruit grown in Canterbury and supplied to the New Zealand Apple and Pear Marketing Board for local sales receive a 'proximity to market' payment (1979 = 30c per bushel) which is not payable on local market fruit grown in Hawkes Bay or Nelson.
- \* Pipfruit production in Canterbury could be considerably expanded, before it over-supplied the local market, i.e. the New Zealand Apple and Pear Marketing Board received in 1979 approximately 88,000 bushels from local growers. It brought into Canterbury from other districts approximately 110,000 bushels. Some varieties are oversupplied i.e. golden delicious, sturmer.

#### DISADVANTAGES CANTERBURY HAS AS A PIP FRUITGROWING DISTRICT

- \* Cold easterly and north-easterly winds in Spring and Summer, make the provision of effective shelter before the planting of fruit trees, essential for their successful establishment.
- \* Some areas have a history of periodic hailstorms e.g. Loburn and Yaldhurst.
- \* Long distances from specialised fruitgrowing service industries i.e.  
Orchard machinery - Palmerston North, Hastings and Nelson  
Fruit tree nurseries - Nelson, Levin and Hastings.
- \* Lack of successful expansion of pip fruit in Canterbury in recent decades.
- \* Necessity of providing tile drainage on the heavier soils in Canterbury if the full advantage of new rootstocks (m.m. 106) are to be realised.
- \* The occasional incidence of damaging spring frosts (approximately once every 20 years).
- \* Some areas of Canterbury which are suitable for pipfruit growing, are too distant from the New Zealand Apple and Pear Marketing Boards depot at Kaiapoi, e.g. South Canterbury and Mid Canterbury.
- \* Because of New Zealand Apple and Pear Marketing Board policy, exporting of apples is not possible in Canterbury at present. (This policy is justified for economic reasons because Canterbury is a net importer of pipfruit.)

## EQUIPMENT, BUILDINGS, AND GENERAL DEVELOPMENT

*W.D. Mottram,  
Grower,  
Prebbleton.*

### INTRODUCTION

The planning and development of a new orchard, starting with a block of bare land, can be exciting and challenging work especially for someone who hasn't done it before. The decisions made relating to my new property may not necessarily be relevant to all those hoping to plant new orchards, but it could be of interest when it is explained why these decisions were made at various stages over the past twenty months.

The possibility of purchasing another established orchard was considered in 1977, but as the majority of orchards in the Christchurch area are similar to my own in that the trees are of the older "vase" shape, it was rapidly decided that it would be preferable to plant a new property. This would also give a large degree of flexibility of tree numbers and varieties, and the option of whether to sell at the gate or to the Apple and Pear Marketing Board. This latter option would largely be controlled by how close the new land was to the city.

The reasons for planting a new orchard were:

- \* Existing orchard has large "vase" shaped trees. The labour content for fruit production on such trees is high and labour costs are likely to become increasingly important in the future.
- \* The existing orchard has a confined area with no room for new planting, and thus new varieties can only be introduced by grafting. (Over the past twenty years there has been a continuing grafting programme in an endeavour to keep up to



date with new varieties.)

- \* With the existing orchard being in a residential area, a large number of neighbours make orchard operations difficult.

If a new orchard were to be planted, it was anticipated that the existing orchard would be maintained until such time that production off the new orchard made a transfer feasible.

The prerequisites for purchasing land were:

- \* Bare land, i.e. no house. This reduced mortgage requirements, and eliminated the need to lease the house
- \* soil of suitable fertility
- \* well drained
- \* 4 - 8 hectares
- \* situated reasonably close to Christchurch

An eight hectare block in Prebbleton was purchased at an auction, and was officially transferred in March, 1979. It was part of a larger farm complex, and had recently been cropped on a clover, barley, spring wheat rotation. There were no buildings, the fences were gorse, and the soil classification was Waimakariri Silt Loam. Prior to the auction, I had checked on soil suitability and likelihood of underground water availability with local M.A.F. advisors and had received favourable comments. It appeared that the block was self-drained.

The decision had to be made as to how much of the eight hectares was to be planted in orchard. To maintain a large degree of flexibility, it was decided to allow half the area, initially, for orchards; .75 ha for house, sheds, and possibly glasshouses, and the balance for extended orchard planting in the future, or small fruits or vegetables. It was believed that some degree of diversification would be essential in the years before the orchard reached full production.

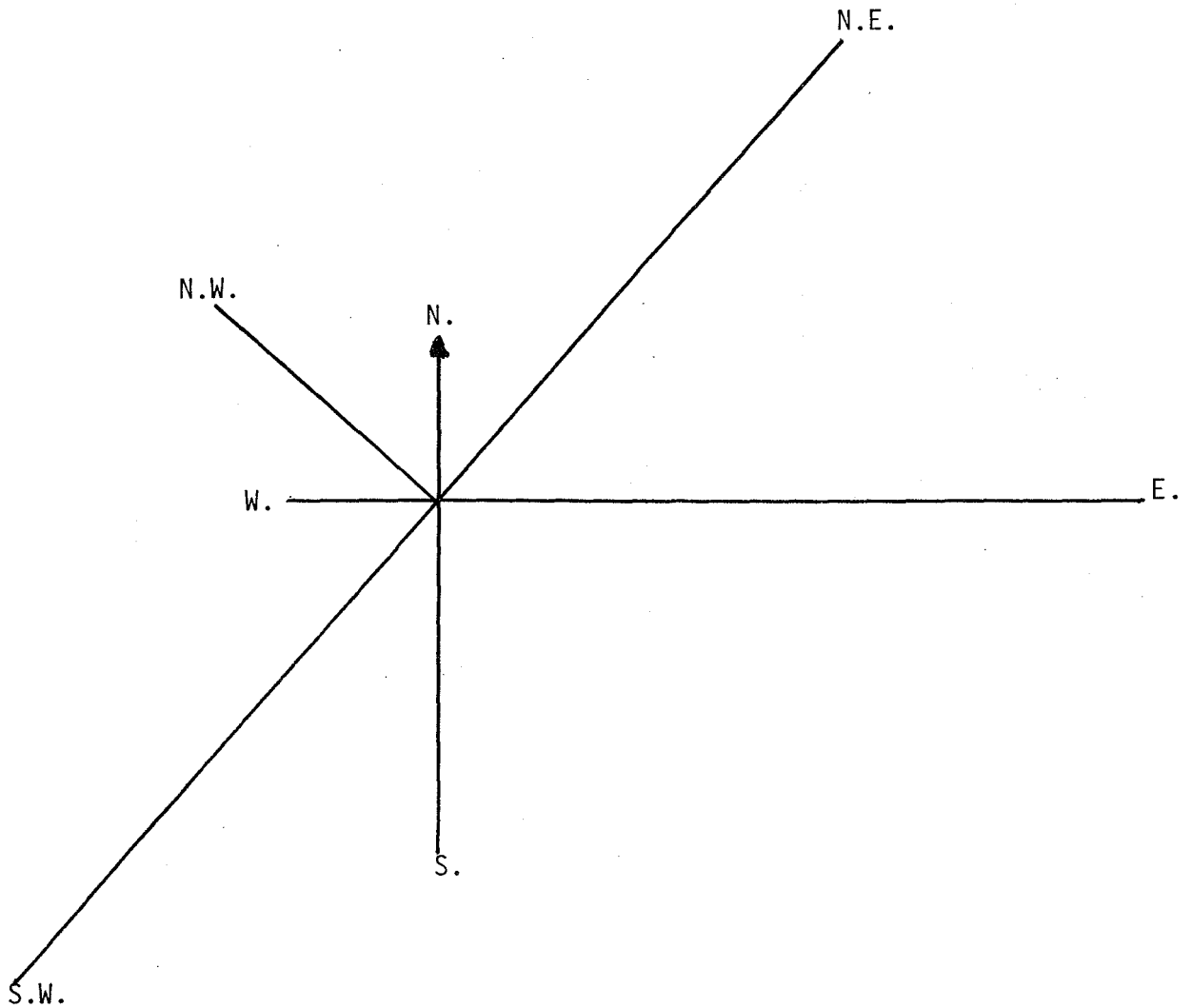
#### ORCHARD LAYOUT

The area is notable for its general lack of shelter, and is exposed to

winds from all directions. Meteorological records (1960 - 1978) from Harewood Airport show that of winds with a velocity in excess of 10 knots, 45% were E to N.E.; 16% were N. to N.W.; 39% were W. to S.W. to S. (see Figure 1). No separate records are available for the summer months.

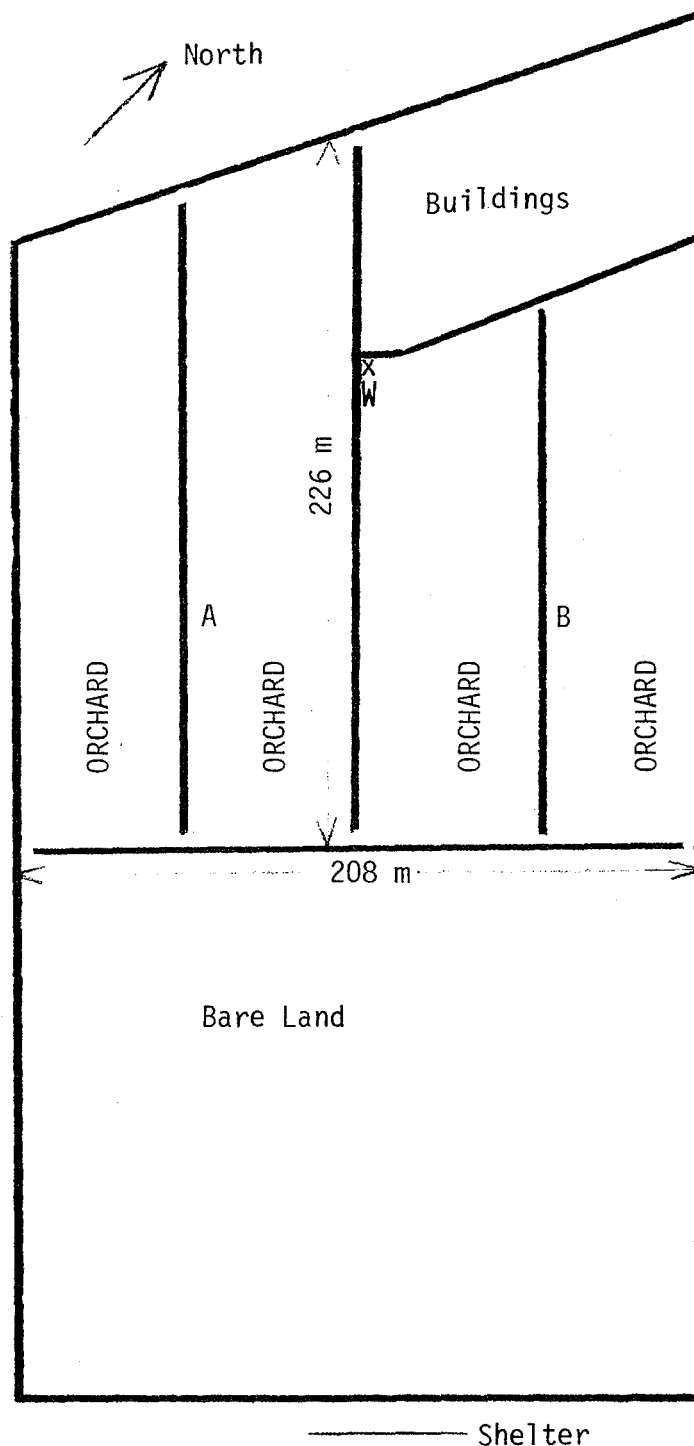
FIGURE 1

FREQUENCY (%) OF WINDS EXCEEDING 10 KNOTS, CHRISTCHURCH AIRPORT,  
JANUARY 1960 - DECEMBER 1978



It was decided to plant shelter first before considering the planting of fruit trees. People within the industry suggested that it would be desirable to delay orchard planting until two or three years after shelter planting, but it was felt that this was not possible considering the investment in the property. The shelter was therefore planted in 1979, and the orchard in 1980 (see Figure 2).

FIGURE 2



The layout gives good protection to wind from the N.E. and S.W. quarters. Whether there will be sufficient protection from the N.W. remains to be seen, and it is possible another intermediate wind break may be necessary.

It is envisaged that shelter lines "A" and "B" will be temporary, and likely to be removed within five to eight years, making room for more fruit trees.

Allowance had to be made for building a house, sheds and probably a shop and glasshouse(s). It was decided to allow an area which would be on the large side, as any surplus could always be utilised for growing a vegetable or berry crop. This would be preferable to having a very compressed layout of buildings.

The land slopes from N.W. to S.E. and because of trickle irrigation design, and the decision to site all buildings along the Springs Road frontage, the well was sunk at "W". Power reticulation was therefore cheaper than if the well had been in the centre of the property.

For the first twelve months, the land was leased to the previous owner, and currently the 3½ hectares of bare land is being leased.

There is an inherent difficulty in operating two properties ten miles apart, one an established orchard which is the guaranteed source of income, and the other a newly planted orchard plus bare land. The priorities are to maintain the productive orchard to as high a standard as possible, and to bring the new orchard into production as quickly as possible. Any extra commitment would be to the detriment of these two priorities, so bare land has been leased and there is no inter-row cropping.

#### WATER SUPPLY

It was decided that very soon after the property was transferred, a well would be sunk. It was realised that if water supply was a real problem, then there was no point in proceeding any further with

planting an orchard.

Under the Water and Soil Conservation Act, 1967, in order to take water from any source, whether it be underground or stream or river, application must be made for a grant of right to do so from the Regional Water Board/Catchment Board. The current application fee is \$40.

In the case of underground water, it is possible to sink a well, then apply for a permit, or alternatively having obtained a permit, proceed to have a well sunk. I prefer the latter course. Following receipt of the application, the Water Board advertises in the local newspaper, calling for any objections which must be received within 28 days. If the application is contested, the applicant could be involved in a special hearing before a Tribunal set up by the Water Board, and also legal expenses.

The well diameter was governed by whether it would be suitable for immediate trickle irrigation, or, in the longer term, for overhead sprinklers. In fact, it was logical to have a larger bore well sunk to cope with long term requirements.

Overhead sprinklers for four hectares required a 200 mm (8") well. The current cost from a local firm is \$105/m. (Other costs are: 6" \$72/m; 10" \$115/m.)

These charges include a stainless steel screen at the base of the well, and a pump test. A well log should always be given, showing the static water level, capacity, and draw-down, and also the lithology, which is a statement of the type of material at various depths.

An analysis of the water was carried out by a Government analyst, which showed that the quality was good (pH 7.1, slightly hard).

#### BUILDINGS

As mentioned previously, the land was devoid of any buildings, so at

a very early stage (May 1979) it was necessary to construct a small shed in which to keep a tractor, implements, tools, etc. It was sited next to the well so that electrical meters could be housed there. It was also envisaged that as it would be remote from where future sheds would be, it would be an ideal place to store spray chemicals, and probably, the orchard sprayer itself.

The shed was  $6\frac{1}{2}$  m x  $3\frac{1}{2}$  m, constructed of corrugated iron, treated pinus, and concrete foundation (dirt floor). The cost of materials in May 1979 was about \$700.

The Paparua Council will naturally be consulted about future building plans, but it is hoped to build a small shop/shed in 1981. The dwelling will probably be constructed sometime during or after 1983. Further sheds, glasshouses or coolstores will be built when required.

#### POWER SUPPLY

A decision had to be made as to whether to have a temporary or permanent supply; overhead or underground; single phase or three phase. A temporary supply would be adequate only for immediate needs, while a permanent supply would be calculated from long term requirements. The Central Canterbury Electric Power Board gave estimates (June 1979) for all forms of supply, the cheapest being single phase overhead at \$250, the distance from road to shed being approximately 70 metres. The highest was for an underground three phase supply, adequate for an estimated ultimate installed 60 H.P. of electric motors.

Cost of underground supply	488.00
Hire of trench digger	48.00
	<hr/>
	\$536.00
	<hr/>

As in the case of the well, it was decided to cater for the long term and have a "permanent" supply, especially as the investment in a temporary supply could never be recovered when the installed load

increased and a new power supply was required. The power lines were close to where it was hoped to site the future dwelling, and also close to a shelter belt. For appearance, and convenience, an underground cable was laid.

The Power Board has imposed a minimum power charge of \$90 per annum.

It must be emphasised, that power supply and water supply, should be tailored to suit individual requirements.

#### FENCING

This is an item which usually crops up when developing a property. The current cost of a standard post and 7-wire fence is \$50/chain.

Removal of gorse fences can be undertaken by contractors relatively cheaply (11 chain, \$86 - April 1979).

#### SHELTER

As mentioned when discussing the orchard layout, shelter has been of prime importance in trying to get the orchard established. I used what I considered was the best information available, most of which came from the Ministry of Agriculture and Fisheries.

The three most important factors were:

- \* type of shelter
- \* weed control
- \* irrigation.

The aim is naturally to establish shelter as rapidly as possible, providing that it does not continue to grow at an uncontrollable rate when mature.

It is only a few years since the type of shelter to be planted was a foregone conclusion i.e. Lombardy Poplar. However, the advent of

poplar rust has encouraged horticulturalists to look for alternatives. I believed, last year, that poplar still had a place in Canterbury, providing that it was well cared for.

*Salix matsudana*, an upright willow, had recently come on the scene, but cuttings were difficult to obtain. Information available suggested that *S. matsudana* shelterbelts were very pleasing in appearance, and growth levelled off at about ten metres.

But having had no first-hand knowledge of the behaviour of *Salix matsudana* under Canterbury conditions it was decided to be cautious, and plant both Lombardy and *S. matsudana*.

2,000 metres of shelter was planted in August, 1979, of which about 45% was Lombardy, and 55% *S. matsudana*. A small number of hybrid willow, *Tangoio* (*Salix matsudana* X *Alba*) was also planted.

Further short sections of Lombardy and *S. matsudana* were planted this Spring, making the total length of shelter for the eight hectare block 2.25 kilometres.

During the first twelve months of ownership, the land was leased, so access for chemical weed control was difficult. It was therefore decided to plant all shelter through a plastic mulch, which had the added benefit of moisture conservation.

The material cost in 1979 of 900 mm plastic film, plus a day's hire of a plastic layer (\$20) was about \$168. (The current cost of a 300 mm X 900 mm roll is \$38.)

Subsequently it has been found that the batch of plastic I bought was of very poor quality. Splitting was widespread last summer, and it is unlikely to last more than two seasons.

Prior to laying the plastic, the ground was subsoiled and rotary hoed, to make it easier to push in the shelter cuttings.



Planting through plastic can create problems, in that planting rooted cuttings is not really feasible.

The *Salix matsudana* were planted as 20 cm to 30 cm (8" to 12") cuttings, and poked through the plastic into the soft soil at about 90 cm (3') spacings.

The poplars were more difficult in that it had been decided to plant 1½ to 2 metre long "poles" so as to obtain more rapid shelter growth. It was necessary to punch a hole through the plastic, and about 0.5 metre into the ground. This had to be accomplished, without spoiling the plastic film, so it was done manually, using a long steel bar. The poplar spacing was 70 cm (2'3"). A rooting hormone was also used.

The cost of the poplar "poles" was nothing as these were obtained from my orchard, and another property nearby. If you have to buy *Salix matsudana* cuttings, the 1980 price ex North Island was \$15/100 cuttings plus freight. Material should soon be readily available in Canterbury.

The poplars were sprayed three times, from late November, for poplar rust, using Copper Oxychloride at 200 gm/100 litres (2lb/100 gals.).

#### IRRIGATION

Because of living remote from the new property it was decided that the simplest form of irrigation was trickle, operating off a time clock. Whiskers were used, but other more exotic forms of water applicators are available. The system was designed by Ministry of Agriculture and Fisheries staff.

The irrigation was installed on the shelter for the orchard area in 1979, and on the fruit trees during these last few weeks. Each shelter tree has one whisker, and each fruit tree has two whiskers.

#### Cost

For 10 acres of orchard, including shelter, and landscape trees:

Polythene tube (50 mm leader, 15 mm laterals, 0.7 mm whisker)	\$1,970.
Pump and fittings	940.
Electrical (meter installation, time clock, etc.)	310.
	<hr/>
	\$3,220.
	<hr/>

## SOIL PREPARATION

### *Subsoiling*

The area had been shallow cultivated for many years and consequently there was a hard "pan" which was best broken up by subsoiling prior to planting. This required a tractor more powerful than I owned, so a contractor carried out the job. The cost for four hectare was \$180 (May 1980).

### *Soil Analysis*

Samples were taken by a Ministry of Agriculture and Fisheries staff member, and tested for pH, phosphorus, potassium, calcium and magnesium. The test fee was \$5. The ground required liming at 2¼ tonnes per hectare (cost, spread by contractor, \$9.45/tonne. This includes subsidy deduction).

P and K levels were low, so 30% potash super was also applied by contractor, prior to orchard planting, at one tonne/hectare.

Total cost of this initial fertiliser programme for four hectares, was \$600.

It is anticipated that soil tests will be taken annually during the early years of orchard establishment.

Fertiliser programmes are obviously designed to suit individual requirements.

MACHINERY AND IMPLEMENTS

Tractor M.F. 35  
Plough 3 furrow Clough  
Rotary Hoe 50" Howard  
Cultivator 8' Aitcheson (23 tyne)  
Spray Unit Comet Pump (P.15)

Machinery and implements must always be purchased according to individual requirements. An important factor, too, is whether to buy new or second-hand.

## FINANCIAL CONSIDERATION IN STARTING A NEW ORCHARD

*Irene Parminter  
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*I.J. Ritchie  
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The establishment or purchase of an Apple Orchard can be very profitable both from the individual grower and national point of view. However, this is only true if the individual grower has access to a ready supply of finance and has a high level of management expertise. This paper sets out to examine the profitability of an apple orchard, the finance required and sources of finance in some detail.

### BUYING AN ORCHARD

Somebody interested in orcharding as a career and business should investigate established orchards as well as the possibility of purchasing bare land and establishing a new orchard. They might not find the orchard of their choice, which suits their financial situation, however, I believe it is worth a look and see. The advantages and disadvantages of buying an established orchard should be weighed carefully (Reference D.W. McKenzie: The Value of an Established Orchard; D.S.I.R. Publication).

#### *Advantages of Buying an Established Orchard*

- \* An established apple orchard in good condition would provide immediate full-time employment for the new owner and would produce a reasonable income from the start.
  
- \* In general, investment in equipment, over the years by the

previous owner, would exceed sale value and as a result the level of re-investment by the new owner would be reduced in comparison with a new planting of the same area. An orchard between ten and twenty years of age would usually provide the maximum benefit of this sort.

\* Existing permanent staff and some casual workers would probably continue to work on the property which would solve any labour problems.

\* Usually an established orchard would contain a house. This may be convenient if the new owner wished to live on the property. Alternatively an old house in sound condition may sometimes be converted into a useful storage space or even provide buildings materials for a new shed.

#### *Disadvantages of Buying an Established Orchard*

\* An established orchard, over twenty years of age, would require a continuous programme of tree replacement as old trees 'decline' in health. The cost of replanting and training new trees would be an added expense, and non-productive trees would reduce total yields. Younger orchards between ten and twenty years of age would remain in full production and should not suffer from this disadvantage.

\* Total yield per hectare may be limited by the waste space between trees, according to the planting pattern used in old orchards. Changes in tree training technique may be used to reduce this non-productive space to a minimum, but yields would never reach the peak production of the new semi-intensive orchards.

\* The cost of production would tend to increase as trees became older. As the trees become taller and denser, the cost of pruning, thinning, harvesting and spraying would increase.

In particular, old trees exceeding 25 years of age, would tend to become expensive to manage and this must be considered a disadvantage.

- \* Unpopular varieties may persist in old orchards, and some of these trees would require to be reworked to new varieties. This would cost money, and the trees may take three to four years to return to full production.
- \* Old fashioned or worn equipment may need to be replaced, and the layout of packing shed or pump-house may be inconvenient. Conversion may be expensive but necessary to avoid high labour costs in later years.
- \* Disease and pest control would generally become more difficult and more expensive in older orchards, and this may reduce fruit value.
- \* Finding the initial finance. A major disadvantage of purchasing an established orchard is the amount of finance required to be found at purchase date. When bare land is purchased and the orchard established over time several short cuts are available for financing the venture. Such short cuts include secondary employment, between-row crops and rented living accommodation during the establishment years.

#### *Finance for Purchase*

*Rural Banking and Finance Corporation* The Rural Banking and Finance Corporation operates a number of schemes aimed at getting young farmers (including orchardists) on the land. They will consider any viable, well thought out and presented proposition. Their scheme in this area include:

- \* Farm Settlement Finance
- \* Special Settlement Loans
- \* Farm Ownership Accounts
- \* Farm Vendor Settlement Finance Schemes

(Reference Farm Budget Manual, 1980, Lincoln College).

\* *Farm Settlement Finance:*

Preference for finance for farm settlement is given to:

- applicants such as sharemilkers, farm employees and farmers sons who are purchasing a first farm; and
- farmers who are purchasing additional land to make an existing unit economic.

Other factors considered are the applicant's qualifications and experience in the type of farming he proposes, personal contributions (cash, stock or land), the price being paid, other borrowing and whether farm earnings will cover commitments such as loan charges, farm expenses and maintenance and provide a reasonable standard of living for the applicant and his family.

Though most loans are granted to purchase self-contained viable units, some are granted as a stepping stone to farm ownership and to help retain competent workers in the industry. Experienced bona fide farm workers, such as shearers and fencers, with a proven record of thrift and initiative, may be granted loans to purchase suitable smaller units, provided the total loan commitments, as well as farm running and living expenses, can be met from the total income.

\* *Special Settlement Loans:*

The Special Settlement Loans Scheme aims to settle young farmers who would not otherwise have the opportunity of purchasing a farm and who have demonstrated qualities of thrift, initiative and outstanding ability to manage a farm enterprise.

Loans up to eightyfive percent of the Rural Bank's valuation of the essential land, buildings, stock and plan may be advanced. Interest is at the current farm purchase rate, presently nine percent, rebated to seven and a half percent for the first three years, and repayment terms are flexibly administered to accommodate fluctuations in farm income. Applicants must have a minimum unencumbered contribution of fifteen percent of the ingoing total, with a reasonable proportion from personal savings. Preference will be given to applicants in the twentyfive to forty year

age group, with their own transport and (desirably) with some academic farming qualification.

Properties are at the applicant's own choice, but must be reasonably priced, economic units, with an adequate standard of improvements. Most loans will be made for the purchase of sheep, dairying, or mixed-cropping farms, though other types of agricultural enterprises may be considered on their merits (e.g. orcharding).

\* *Farm Ownership Accounts:*

Farm Ownership Accounts, designed to help farm workers, share-milkers, students and others associated with farming to buy a farm, can be opened with the Post Office Savings Bank, a trustee savings bank, or some building societies.

The account is available for the purchase of a first farm, or for the purchase of stock and plant to go share-milking or share-farming for the first time.

With the written consent of the Rural Banking and Finance Corporation, an account can be opened by any New Zealand citizen who has attained the age of fifteen years and who -

- being a pupil at a secondary school in New Zealand, intends to become a farmer; or
- is undertaking a course of study which will assist him to become an efficient farmer; or
- is principally engaged or employed in the farming industry or in any associated servicing industry in New Zealand; or
- has some other relevant experience or qualification which, in the opinion of the Rural Bank, will enable or assist him to become an efficient farmer.

The depositor must elect to save under either a grant scheme or a tax-rebate scheme.

- Grant Option -

The depositor may save up to \$3,000 per annum and receive a



tax-free grant of between twentyfive and fifty percent of his savings, depending on how long the account has been open. The maximum grant is \$15,125 on maximum eligible savings of \$30,250. The minimum qualifying period for a grant is five years from the date the first \$250 is saved, if a farm is being purchased; or three years, if stock and plant are being purchased to go share-milking or share-farming.

- Tax-Rebate Option -

A depositor may deposit up to \$4,000 per annum (with a maximum of \$50,000 per account) in a special Farm Ownership Account and claim a tax-rebate of 45c for each \$1 of the annual increase in savings. There is a limit of \$1,800 (fortyfive percent of \$4,000) or the depositor's tax liability, if it is less than that amount.

Interest at the rate of three percent per annum is payable on balances in both types of account. A depositor who commences to save under the purchase grant scheme may transfer to the tax-rebate option during his savings term but not vice-versa.

\* *Farm Vendor Settlement Finance Schemes:*

These schemes, announced in the 1977 Budget, provide that fifty percent of the interest earned by retiring farmers from money left in farms sold to new farm purchasers approved by the Rural Bank is exempt from taxation.

The aim of schemes is to assist suitably qualified and experienced farmers to purchase their first farm by encouraging the outgoing farmer to invest in the industry. Retiring farmers have the option of investing in either a farm vendor finance bond issued by the Reserve Bank on behalf of the Rural Bank, or the more familiar farm vendor mortgage guaranteed by the Rural Bank. In both cases the minimum term is seven years and the interest rate nine percent. The maximum amount which can qualify for the concession is \$150,000 and the retiring farmer must have owned the farm for at least ten years or be selling because of ill health.

*Life Insurance Companies* Policies vary from company to company. However, generally they will consider finance up to fifty percent of valuation on a ten to thirty year table mortgage, with interest at fourteen to sixteen percent.

*Solicitors and Trust Companies* The Trustees Act defines where and to what extent these funds can be invested (e.g. first mortgage on land up to two-thirds of a registered valuer's value) unless there are special provisions in the will of Trust investment which govern investment.

Such loans are generally provided in medium term debt finance (three to five years) often renewable or at least able to be refinanced on a flat mortgage basis with interest at fourteen to eighteen percent.

Normally lend up to fifty percent of valuation on first mortgage or on second mortgage with Rural Bank guarantee.

*Stock and Station Agencies* Have agreed to limit their lending to seasonal only (thirteen and a half percent for arranged finance, fifteen for unarranged finance) but some medium term financing of stock and plant is done nevertheless - generally two to five year term. Loan facilities are very much on a personal basis and often unsecured, but an increasing trend to take a mortgage.

*Trading Banks* Normally medium term; plant purchase etc. at fourteen percent. Occasionally land purchase in exceptional circumstances. The normal suppliers of Bridging finance.

*Trustee Savings Banks* Farm lending policy varies with the institution, however normally

- loans up to fifty percent of valuation on first mortgage (no limit)
- terms: twentyfive years reducing instalment mortgage; with interest rates at thirteen to sixteen percent.

*Inland Revenue Department* Stamp Duty Exemption on First Farms:

A bona fide farmer who goes into farming on his own account may be exempted from the payment of stamp duty in respect of the purchase of his first farm. In general, the purchase must comply with the following criteria before the exemption will be allowed:

- the purchaser or his spouse, or both together, cannot own or have owned a substantial interest in farm land or a farming company.
- the property must be capable of supporting a full-time farming operation.
- the purchaser must actively farm the property within two years of purchase.
- the purchaser must acquire a controlling interest in the farm or farming company and not dispose of it within two years of acquisition. In the case of more than one person acquiring the land or shares, each of those persons who qualify for a first farm exemption in their own right must hold in the aggregate, a controlling interest in the farm land or farming company.

*Presentation of the Facts in Order to Obtain Finance*

The first point to remember in this area is the proposed financier is interested in your ability (i.e. the proposed grower) to produce and consequently service the loan. He is not interested in a consultant's accountant's or lawyer's ability to present information on paper. However, the financier will be interested to see information you prepare and present on paper, perhaps with the help of one of the above. Basically a financier requires to know two things:

- \* You can service the level of debt proposed and still have something in reserve for meeting all costs including personal living and taxation.
- \* If things do go wrong and you are forced to sell up then he, the financier, will get his money back.

Therefore you must supply a statement of how you propose to finance the venture, including all costs and sources of finance, a budget for the initial two/three years, and a monthly cash flow statement for the initial eighteen months.

In order to calculate the budget a considerable amount of time and effort must be put into establishing reliable yields for all varieties on the property. Furthermore, as we never have an "average year" a study must be made of the effect of something less than average on our budget, what effect on the budget will a late frost have? Don't just hope the financier will not ask. He will. If you are prepared with the information you are several steps ahead. Furthermore what effect does a twenty percent general wage order have, compared with your budgeted ten percent or a thirty percent increase in the cost of liquid fuels. This budget is not just a statement of income and expenditure directly related to orcharding; the grower must consider those hidden costs, taxation, principal repayments, new plant and equipment and personal living.

Once a reliable budget has been established, with a study made and evaluated of the key parameters, a cash flow must be prepared. Such a cash flow is a budget of full income and expenditure for each month of the year. It is very important, especially for the new grower. If purchase occurs in June (say) then our grower must have arranged seasonal finance to cover all expenditure, including mortgage repayments and personal living until first sale of fruit, which may be as late as February/March the following year. Therefore it is very important to arrange seasonal finance well before take-over date.

#### DEVELOPMENT OF A PIP FRUIT ORCHARD; AUGUST 1980

##### *Introduction*

The following study is based on an 11.6 ha (10 ha planted) model orchard, in the Riwaka area (Nelson). It has been planted up more or less as the New Zealand Apple & Pear Marketing Board recommend.

*Sources of Information*

*Yields* The following figures were collected from a semi-intensive Lower Moutere orchard over the years 1966-76.

TABLE 1

PRODUCTION (BU/TREE) IN A SEMI-INTENSIVE  
LOWER MOUTERE ORCHARD

Tree Age Years Variety	3	4	5	6	7	8	9
Cox's Orange	0.30	0.70	1.70	2.2	3.6	6.3	6.7
Red Delicious	0.20	0.50	1.70	4.0	5.9	7.5	8.8
Golden Delicious	0.25	0.75	1.25	3.4	6.0	8.5	9.2
Granny Smith	0.25	0.50	1.75	3.2	6.0	9.0	9.7
Red Dogherty	0.5	1.5	3.0	4.9	5.5	6.0	9.0

(Trees/ha = 600)

The yields for Cox's Orange, Red Delicious and Granny Smith in the analysis were taken directly from this table.

In order to spread the harvest period and to lower risk, two other varieties were also grown in the model orchard, Braeburn and Gala. The yields for these two varieties were estimated as follows:

TABLE 2

ESTIMATED PRODUCTION (BU/TREE)

Year	3	4	5	6	7	8	9
Braeburn and Gala	0.25	0.50	1.25	3.0	6.0	7.5	9.0

*Physical Inputs* These are based on good commercial practice.

*Prices* The input prices are those prevailing in early August 1980, and incorporate the 5th August 1980 diesel price increase. Prices were supplied by the appropriate manufacturer/retailer/contractor.

The pip fruit prices used were as follows:

Cox's Orange	\$2.35/bu
Red Delicious	\$2.33/bu
Granny Smith	\$2.09/bu
Braeburn	\$2.28/bu
Royal Gala	\$2.25/bu

These prices were derived by taking the district gradeout in the 1979 season, and the 1980 prices, and calculating a district average price per bushel for each variety. The 1979 district gradeout was used because:

- \* It was an "average" season in terms of rainfall
- \* The 1980 district gradeout is not yet available.

The district average price is flawed as an estimator of the model orchard's average price per bushel because:

- \* It includes unirrigated orchards, and the model orchard is fully irrigated
- \* The model orchard is entirely made up of young trees, and will therefore have a different gradeout pattern in the first few years to the district average.

Both these factors will tend to push fruit size up, and as long as good orchard practices are carried out, the fruit value should be higher than the figures actually used.

*Purchase Year Costs (10 hectares of effective orchard)*

Purchase an 11.6 ha block of flat bare land in  
Riwaka, soil type free draining, silt loam

	\$/whole block
Land 11.58 ha freehold say	80,000
House for Manager	40,000
Storage sheds for machinery, sprays, smoko room	7,500
Tractor	10,000
Trailer	500
Sprayer	7,000
Herbicide sprayer	1,000
Plough, discs, ladders, secateurs, sundry tools etc	2,250
	<hr/>
	148,250
	<hr/>

NOTE:

In year three also purchase an old tractor plus forks	2,000
In year four also purchase a mower	2,200

Assume grower is a member of the Packhouse.

*Cost of Trickle Irrigation*

	\$/whole block
Well pump, suction lines, control valves, pump housing, filtration units, power to site (well 10 m deep, 13 cm wide, \$100/m)	2,500
Main 425 m of 50 mm diameter, at \$135/100 m	574
Laterals 108 laterals of 160 m long, of 17 mm diameter at \$17.75/100 m	3,067
Laterals, 46 laterals of 50 m long, of 17 mm diameter at \$17.75/100 m	408
Whiskers, two/tree x 530 trees/ha x 10 ha = 10,600 whiskers of 0.9 mm diameter - Average length 30 cm at \$16.50/300 m coil	175
Installation: Mains trenching 425 m at \$20/20 m	425
Trenching under road 1080 m at \$20/20 m	1,080
Labour for cutting, laying out, whisker insertion, 500 man hours at \$3.14/hr	1,570
	<hr/>
	9,799
	<hr/>

*Shelter*

Shelter may be planted around the boundary if growers wish. Internal shelter is not considered necessary in this area. NB: shelter is critical in Canterbury.

*Block Design*

Assuming a modular type of design for ease of calculation I have planted ten square, one hectare blocks on the pattern as follows:

3 rows Cox	5.5 m x 3.7 m (18' x 12')	=	81 trees
3 rows Royal Gala	5.5 m x 3.0 m (18' x 10')	=	100 trees
4 rows Harold Red Delicious	5.5 m x 3.7 m (18' x 12')	=	108 trees
4 rows Braeburn	5.5 m x 3.0 m (18' x 10')	=	133 trees
4 rows Granny Smith	5.5 m x 3.7 m (18' x 12')	=	108 trees
			<hr/>
18 rows 100 m long			530 trees ha



*Direct Returns and Costs for First 9 years (\$/ha)*

Year	1	2	3	4	5	6	7	8	9
Irrigation equipment and installation	980								
Land preparation and tree planting	1367	28							
Fertiliser and lime	497	101	229	313	262	278	278	334	278
Tree training and pruning	66	160	182	183	183	277	355	418	481
Pest and disease control	138	161	565	685	804	941	1044	1163	1215
Hand-thinning	-	-	57	57	85	85	110	110	138
Weed control cultivation and mowing	148	148	98	177	95	95	95	95	95
Irrigation operating costs	200	200	200	200	200	200	200	200	200
Pollination	-		50	50	50	50	50	50	50
<b>SUB TOTAL</b>	<b>3396</b>	<b>798</b>	<b>1381</b>	<b>1665</b>	<b>1679</b>	<b>1926</b>	<b>2132</b>	<b>2370</b>	<b>2457</b>
Harvesting			59	127	361	745	1339	1818	2087
Packhouse Shares			32	36	116	360	300	240	136
<b>TOTAL COSTS</b>	<b>3396</b>	<b>798</b>	<b>1472</b>	<b>1828</b>	<b>2156</b>	<b>3031</b>	<b>3771</b>	<b>4428</b>	<b>4680</b>
<b>GROSS INCOME</b>			<b>293</b>	<b>638</b>	<b>1808</b>	<b>3733</b>	<b>6694</b>	<b>9080</b>	<b>10434</b>
<b>NET RETURN</b>	<b>-3396</b>	<b>-798</b>	<b>-1179</b>	<b>-1190</b>	<b>-348</b>	<b>702</b>	<b>2923</b>	<b>4652</b>	<b>5754</b>

NB: Land, machinery, buildings Year 0 whole block \$148,250  
 Year 3 whole block \$ 2,000  
 Year 4 whole block \$ 2,000

*Direct Return and Costs - Total Block 20 years*

Year	Gross Income	Total Costs	Land Machinery Buildings	Net Return
	\$	\$	\$	\$
0	-	-	148,250	-148,250
1	-	33,960	-	- 33,960
2	-	7,980	-	- 7,980
3	2,930	14,720	2,000	- 13,790
4	6,380	18,280	2,000	- 13,900
5	18,080	21,560		- 3,480
6	37,336	30,310		7,020
7	66,940	37,710		29,230
8	90,800	44,280		46,520
9	104,340	46,800		57,540
"	"	"		"
"	"	"		"
"	"	"		"
20	104,340	46,800		57,540
Salvage value (market value)				250,000

The above analysis makes the assumption that year 9 yields, and costs, continue through to year 20. Following year 20 a salvage value has been placed on the orchard at its current market value. For those more economically minded this investment from the national view point (excluding the initial cost of land, and land in the salvage value, i.e.: direct returns and costs) shows an internal rate of return of 16.4% (at the 10% discount rate a Net Present Value (NPV) of \$118,802 and at the 15% discount rate on NPV of \$17,665. The Internal Rate of Return (IRR) compares well with other agricultural and horticultural national investment. At present soil conservation and cover control work must achieve a 10% IRR and irrigation schemes a 15% IRR to attract Government assistance. Agricultural Development work carried out using the Land Development Encouragement Loan is achieving a similar IRR to the development and establishment of this apple orchard. Therefore we may say the expansion

of the Pip Fruit industry under conditions where we can achieve the yields quoted is profitable from the national view point.

However it is important to note the effect of only 10% per year less yield than that budgeted for. This will lead to a drop in the IRR to 14.2% (a 2.2% fall). Or on the other hand, a slip in production whereby you do not achieve a particular year's production as budgeted until the next year (i.e.: achieve year 5's production (yield) in year 6 and so on) will see the IRR fall to 13.4% (i.e.: a drop of 3%). Therefore, the challenge to new growers if they are to receive Government support, and for the growers themselves to make a profit, is for them to achieve good yields early in the life of trees.

Now we have detailed the national viewpoint, let us turn to the individual growers position.

#### *Incentives Available to the Individual Growers*

There are two basic incentives available to individual growers to help in financing a horticultural enterprise. These are the various taxation incentives and the Rural Export Suspensory Loan. In addition to these two, there are various incentives available through the Department of Trade and Industry, which are detailed in the booklet 'How to Export' (1980) published by the department for the Trade Promotion Council. However, the incentives available from Trade and Industries are generally involved with further processing of a product and market development. In this study, I have made the assumption that the farmer will be paid a farm gate price after minimal processing (i.e.: packed into cartons and cooled) and therefore will not directly receive any Trade and Industry export incentives. However, the farm gate price will indirectly take allowance of these incentives.

*The Rural Export Suspensory Loan* This scheme was introduced in 1974 to promote the export of non-traditional agricultural and horticultural products not previously exported or products where markets could be

further developed or expanded and where only limited exports were being made.

Suspensory loans are calculated according to total eligible expenditure as follows:

	Eligible Expenditure	%	Amount of Suspensory Loan
First	100,000	40	40,000
Second	100,000	30	30,000
Third	100,000	20	20,000
Fourth	100,000	10	10,000
	<hr/>		<hr/>
	\$400,000		\$100,000

The Export Suspensory Loan will be converted to a grant and written off provided the export target has been achieved in three consecutive years within the first five years. The total expenditure is eligible for normal taxation deduction. However, when the loan is written off, the written off portion must be added to taxable income in the year of write off plus the two following years. A list of Horticultural crops eligible under this scheme is attached (Appendix I) N.B.: An apple orchard is not eligible.

Most items of capital expenditure involved in setting up the eligible horticulture enterprise are eligible for the Rural Export Suspensory Loan. This would normally include shelter, irrigation, land preparation, cuttings, planting cuttings, cool store, sheds, grading plant, equipment to apply herbicides, weedicides, fungicides and fertilizer and a harvester. However, there is a maximum figure on the total cost of the harvester, which depends on the size of the block. Further details as they relate to this scheme are available from the Rural Banking and Finance Corporation.

*Taxation Incentives* The Farming Investment Allowance allows for 20% of the cost of new plant and machinery used for farming to be deducted from assessable income in the year the asset is first used. This

allowance does not affect ordinary depreciation allowances.

Depreciation is an allowance for loss in value of a fixed asset due to fair wear and tear, obsolescence, etc. This allowance may be deducted from assessable income. The rates in the first year of ownership are as follows:

Machinery	25%
Farm buildings	20%
Employee accommodation	20%

and in the second and subsequent years are as follows:

Machinery - motorised	20%
non motorised	10%
Buildings (wooden frame)	2 $\frac{1}{2}$ %

Depreciation is calculated as the percentage figures above on the initial cost price, and then each year on the diminishing depreciated value of the asset.

The other main taxation incentive is "the deferment of development expenses for taxation purposes". Such expenses are deductible capital expenses which need not be claimed for taxation purposes in the year in which they were incurred. Development expenses can be spread forward for a period of up to nine years plus the year of expenditure before being offset against a future income, and can be brought back into the accounting system in whole or in part in any one year.

A partial list of costs included in the development category related to orchard establishment are irrigation equipment, drainage, farm access, roading, shelter and land preparation but not the fruit trees themselves. Where the finance is borrowed or is obtained by way of a Rural Export Suspensory Loan the total cost of development is treated as normal development expenditure for taxation purposes. This means the total cost of development may be spread forward for a period of up to nine

years in addition to the year of actual expenditure before being offset against a future income. However, it must be noted that principal repayments must be paid out of tax paid income. Allowance for all these taxation considerations must be taken by the farmer in his planning for, and during the development of, an orchard enterprise. Therefore a very good farm accountant is a must.

*Rural Banking and Finance Corporation Farm Finance* In addition to the Rural Export Suspensory Loan there are two other sources of finance available from the R.B.F.C. for the farmer developing an orchard enterprise.

\* The Farm Development Loan

\* Finance for the purchase of Plant and Machinery

Normal R.B.F.C. development loans are available for this type of development (excluding plant and machinery). The term is flexible, but is usually fifteen to twentyfive years with a prime interest rate of 9 - 14%. However a concession is available in the first six years of the term of 7½%.

Finance is available from the R.B.F.C. for that portion of the total cost of plant and machinery not covered by a Rural Export Suspensory Loan. The loans are normally on a table mortgage of two to five years, with a 12% interest rate.

*Net Income to Grower*

In the example quoted we have assumed a well established grower has available considerable resources in the way of cash and managerial skills to help in the establishment of the orchard. He first of all has \$48,000 in year 0 of the project and is able to borrow \$100,000 to cover costs for year 0 (\$100,000 on a twentyfive year mortgage at 15% interest). He is then able to borrow \$35,000 from the Rural Banking and Finance Corporation on a twentyfive year term at 9% interest, with a concession

of 7½% for the first 6 years.

Now we must take the previous cash flow statement generated, make an allowance for inflation (at 12% per year) add in borrowed capital, subtract mortgage repayments and add/subtract taxation payments. It is important to make an estimate of inflation for two main reasons.

- \* to assess true borrowing requirements and make arrangements for such
- \* to assess the true profitability of the exercise as mortgage repayments and taxation concessions relate to the year of occurrence and not to their real \$ value. For instance \$1,000 borrowed in 1980 and repaid in 1990 has significantly less spending power in 1990 than 1980.

As has previously been discussed the taxation system offers the person with a large taxable income a considerable incentive to direct this finance towards agricultural development. Nearly all items of expenditure related to the establishment of an orchard attract some taxation incentive, except the purchase of land, dwelling and the orchard trees themselves. The calculation of taxation paid/not paid has been carried out making maximum one of the two main schemes available, which have been outlined earlier. (Deferment of Development Expenditure and Depreciation.) It has been assumed that the grower/farmer financing the venture has a taxable income of \$20,000 in year 0 available to be put into orchard development. This has been inflated each year of the development by 12%. A marginal taxation rate of 45% has been assumed throughout the exercise.

At the end of year 12 we have assumed the unit is sold up. To calculate the salvage price, the estimated market price in 1980 \$'s has been estimated at \$250,000. This has been inflated by 12% per year, to give a salvage value in year 13 of \$1,220,000 less principle still owing at that stage - \$113,054.

Farmer View Point Cash Flow  
Before Borrowing and Taxation

Year	Net Return	Plus other crop income	Inflation Factor	Net Return After Inflation
0	-148,250	-	-	-148,250
1	- 33,960	1500	1.12	- 36,355
2	- 7,980	1500	1.4	- 9,072
3	- 13,790		1.57	- 21,650
4	- 13,900		1.76	- 24,464
5	- 3,480		1.97	- 6,855
6	7,020		2.21	15,514
7	29,230		2.48	72,490
8	46,520		2.77	128,860
9	57,540		3.11	178,949
10	57,540		3.48	200,239
11	57,540		3.90	224,406
12	57,540		4.36	250,874

What does this inflated cash flow, after taxation, etc. tell us? It tells us that to establish an orchard the new grower must have a good source of income for the first five to seven years. If this is the case considerable taxation savings are possible.

Furthermore, the internal rate of return (IRR) from the farmer's view point is a very good 29.7% or at the 10% discount rate the Net Present Value (NPV) is \$424,198. If the grower/farmer was to have invested a similar amount of money over the development period in a bank account at 15% interest his IRR would have been between 6 and 9%, depending on whether he re-invests annual interest payments.

Perhaps the more important figure is if he had invested in the



Farmer View Point Cash Flow  
After Inflation, Borrowing, Mortgage Repayments

Year	Net Income After Inflation	Borrowed Capital	Mortgage Repayments	Taxation Not Paid/ Paid	Net Income
0	-148,250	100,000	-	9,000	- 39,250
1	- 36,355	35,000	11,032	10,080	- 10,307
2	- 9,072	-	19,032	11,289	- 16,815
3	- 21,650	-	19,032	12,644	- 28,038
4	- 24,464	-	19,032	14,161	- 29,335
5	- 6,855	-	19,032	15,861	- 10,026
6	15,514	-	19,032	17,764	14,246
7	72,490	-	19,032	- 8,524	44,934
8	128,860	-	19,032	- 49,926	59,902
9	178,989	-	19,032	- 72,626	87,291
10	200,239	-	19,032	- 82,646	98,561
11	224,406	-	19,032	- 93,436	111,938
12	250,874	-	19,-32	-105,986	125,856

same bank account the N.P.V. at 10% discount rate would have been between -\$6,000 and -\$15,000. This is because the true interest rate after taxation is only 8½% (i.e.: 55% of 15% interest at 45% taxation rate) which does not compare well with a 12% inflation rate. However, when studying the very high net cash figures towards the end of the cash flow, to appreciate their real \$ value we next divide by the inflation factor (4 to 5).

If our grower had purchased a developed orchard (if he could!) at the salvage price of \$250,000 (land and buildings) and borrowed \$200,000 initially then the IRR of this investment from the growers point of view would have been 37.3% or a N.P.V. at the 10% discount rate of \$525,802.

## CONCLUSION

The development of an apple orchard using the cost, yield and price assumptions in this report is very profitable both from the individual growers point of view and the national view point. However, finance over the initial years is a major problem. This study indicates that the grower who wishes to become involved in the establishment of an apple orchard must have considerable financial backing. However there are taxation incentives available to assist in the establishment of a new orchard, and the Rural Banking and Finance Corporation does have available development finance. Nevertheless a good capital backing is essential. This must be linked to a high level of management expertise.

APPENDIX I

RURAL EXPORT SUSPENSORY LOAN SCHEME  
LIST OF PRODUCTS

1. Below is a list of products which have been approved for the Rural Export Suspensory Loan Scheme:

Vegetables

Artichokes  
Asparagus  
Brussel sprouts  
Cabbages  
Cauliflowers  
Cucumbers  
Frozen vegetables  
Frozen corn on cob  
Frozen mushrooms  
Hops  
Mushrooms  
Parsley  
Rhubarb  
Spring Onions

Fruits

Apricots  
Cherries  
Feijoa plants  
Frozen apple slices  
Frozen small fruits  
Grapes (table)  
Macadamia nuts  
Melons and squash  
Nectarines  
Peaches

Berryfruits

Blackberries  
Blackcurrants  
Blueberries  
Boysenberries  
Marionberries  
Ollalie berries  
Raspberries

Flowers and Shrubs

Amaryllis bulbs  
Carnations  
Chrysanthemums  
Cut flowers and foliage  
Flax plants  
Freesia flowers  
Orchids  
Ornamental trees and shrubs  
Pot plants  
Rose blooms  
Seeds for multiplication  
Seeds (Kentia forsterenia)  
Tulip blooms

Animal and Processed Products

Ducks  
Game meats  
Goat meat  
Honey dew  
Liquid honey and retail packs  
Mohair  
Peppermint oil  
Processed dried deer velvet  
Sheepskin products  
Slinkskins  
Suede - lamb skins  
Turkeys  
Wine

Fish

(a) Pelagic species

Barracouta	Mullet
Kahawai	Pilchard
Kingfish	Trevally
Mackerel	

(b) Demersal species

Black bream	Moki
Blue hake	Monkfish
Chilled snapper	Red cod
Cream fish (leather jacket)	Southern blue whiting
Ling	Warehou
Mao mao	Whiptail or hoki

(c) Other types

Octopus	Mussels (farmed or cultivated)
Squid	Smoked fish (excluding snapper and blue cod)
Rock oysters	Eels (smoked or smoked fillets)
Pacific oysters	(not live eels)

(d) Other

Fats and oils of fish, canned and bottled fish, prepared fish dinners, prepared consumer fish packs, fish paste, fish balls, fish cakes, fish fingers, fish sausages, fish extracts, fish soups and fishmeal.

(e) Mussel extract.

2. Products which have been declined for the Rural Export Suspensory Loan Scheme are:

Frozen peas	Maize
Game birds	Onions
Hipes "wet blueing"	Peas
Kiwifruit	Potatoes
Live eels	Queen bees
Lucerne pellets and fodder cubes	Roller wholemilk powder
	Tomatoes

## SELECTION OF PLANTING MATERIAL, VARIETIES AND ROOTSTOCKS

*W.J.W. Wilton  
Horticultural Advisory Officer (Deciduous Fruits)  
Ministry of Agriculture and Fisheries  
Auckland*

In selecting varieties for an orchard planting, a number of factors which determine the variety mix have to be considered. These are:

- \* What type of orchard operation is intended i.e. monoculture of pip or stonefruit, or mixed orchards covering a range of fruit types.
- \* Required harvesting season.
- \* Envisaged marketing operation - i.e. gate sales, local wholesale, New Zealand-wide wholesale or export.

Having determined the answers to these questions we are now ready to consider which varieties should be planted. In today's highly competitive world it is necessary to plant varieties suitable to your locality or varieties for which you have some special marketing advantage. The following are some of the criteria to look for in a variety:

- \* The variety must perform well in your district.
- \* Crop regularly but not necessarily over-crop.
- \* Produce attractive, highly coloured, blemish-free fruit of optimum size for its kind.
- \* Have adequate handling and storage ability.

- \* Produce fruit of comparable, or better quality to that supplied from other competitor districts which may have earlier or later harvest seasons.
- \* Meet the standards determined by your buyer.
- \* Show reasonable degree of tolerance to pest and disease.

In some fruit crops it may not be possible to answer all these questions about a prospective variety. This is particularly so with the recently introduced stonefruit varieties. While few of the recent introductions can be considered fully tested early indications are that a number of the newer varieties show promise of improved performance for their harvest season compared with our established varieties and may supersede them. Planting of such varieties, particularly in marginal districts away from areas where their performance is already known has increased risks as there will be some which fail to measure up to expectation and will require grubbing before they have paid their way. The degree to which a grower plants newer untested varieties will depend on the degree of risk he is prepared to take. In this direction we cannot overlook the rewards a new variety that opens up new marketing opportunities will bring to growers with the foresight to capitalise on these opportunities, but the risk of failure is often high. Perhaps the French proverb "Profit is the reward for risk, where there is no risk there is no profit" sums up the present stonefruit variety situation.

The variety situation in apples is much more stable at present.

Having determined the varieties you wish to plant, the next step is to obtain trees. As a general rule few New Zealand nurserymen grow substantial quantities of trees on spec, consequently it is often difficult to secure trees for planting immediately on placing your order. The prudent orchard developer should be planning his new orchard development several years ahead so that this tree supply problem can be

taken care of and conversely his nurseryman can deliver trees to his requirements and specification on time. This time lag is usually eighteen months to two years but in times of high tree demand, such as at present, the nursery industry may not have the capacity to deliver within this time limit as it may not have the necessary rootstock supplies available.

#### TREE SPECIFICATIONS

At the time of placing an order with a nurseryman the opportunity should be taken to specify just what kind of tree you require. This specification should include:

- \* Variety and if necessary strain.
- \* Rootstock.
- \* Type of tree - e.g. dormant bud, one year whip, "feathered maiden" or headed branched tree.
- \* Height of budding or grafting.
- \* Preferred delivery period, i.e. early, mid or late winter.

In choosing a nurseryman it is important to select one with a good reputation among commercial fruitgrowers, and preferably one who produces substantially trees free of known viruses. The preferred strains of some varieties are not available yet virus-free, so it may not be possible to plant the entire orchard with virus-free material.

#### DORMANT BUD VERSUS ONE YEAR OLD WHIP TREES

In recent years a number of successful orchards have been established by planting dormant buds so this is a technique which should not be overlooked providing the site is suitable and adequate care of the new

tree is possible during the first year of growth.

Advantages of Dormant Bud	Disadvantages of Dormant Bud
Better tree anchorage.	Requires top notch management during first year in orchard.
Easier training - particularly for central leader.	Very vulnerable to pest, disease and rodent damage during first year in the orchard.
Greater initial yield from budding.	Ties up the orchard land for an additional non productive year.
Lower freight costs.	Problem of bud failure resulting in an irregular block if occurs.

To be successful the dormant bud tree requires detailed attention during the first year in the orchard. It should only be considered by the orchardist who is prepared to apply the detailed attention necessary to bring the dormant bud tree through the first year. It requires good shelter, possibly staking, to prevent blowing out, good hare, rabbit and possum control, as well as pest, disease and weed control.

## ROOTSTOCKS

### *Stonefruits*

- Apricots - Myrobalan Plum
- Peach - well-drained soils only
- Cherries - Mazzard
- Mahaleb - good soils only - incompatible with Van.
- Nectarines } Golden Queen Peach seedling
- Peaches } )
- Japanese Plums - Myrobalan Plum
- Peach - well-drained soils only

### *Apples*

(In order of ascending vigour)



*M9* - dwarf, requires support, although extensively used in Northern Europe not favoured in New Zealand for commercial orchard plantings. Possibly has a place for very vigorous varieties such as the Gravenstein group. No woolly aphid resistance.

*MM106* - semi-dwarf - 3.5 - 4.5 m height. Major New Zealand rootstock for good soils. Must be well-drained sites. Requires high working to realise full semi-dwarfing effect otherwise almost as vigorous as most standard rootstocks. Woolly aphid resistant.

*N.Spy* - moderate vigour, tolerates wider range of soils than *MM106* but should not be used in replant situations. On poorer soils, or with spur type scions is suitable for semi-intensive plantings. Resistant to woolly aphid.

*M793* - moderate vigour. Similar to *M.Spy* except that can be used in replant situations.

*MM115* - vigorous - appears to be reasonably precocious. In most circumstances would be too vigorous for semi-intensive plantings except in the case of weak growing spur type scions.

*M12* - very vigorous - not a heavy cropping rootstock and does not appear to be able to size full crops of fruit adequately.

#### *Pears*

*Pear Seedling* - Williams Bon Chretien - very variable in vigour. Winter Nellis seedlings preferred as are more regular in performance.

*Quince A* - Angers type Quince, semi-dwarfing, incompatible with many pear varieties so usually requires double working with a compatible interstock such as Beurre Hardy, Glou Morceau, Kieffer's Hybrid or Louise Bonne de Jersey. Beurre Hardy is the preferred interstock. Gives a tree of about forty percent of the size of a tree on pear seedling roots.

*Quince BA29* - Provence type Quince - semi-dwarfing but slightly more vigorous than Quince A. Reputed to be compatible with most pear varieties and likely to become the preferred rootstock. Suitable for intensive plantings and is widely used in Southern Europe for this purpose.

*Varieties* - (In order of ripening). This list, in particular the stonefruit section, will require regular updating as new variety testing proceeds. It refers to the 1980 knowledge level.

#### *Apricots*

*Newcastle* - marginal northern districts only - marks badly, very susceptible to blast. Early.

*Sundrop* - high quality appearance, colours very early to clear yellow followed by deepening of colour towards apricot - should not be picked until "apricot coloured" otherwise tastes terrible. Appears to perform quite well in Central Otago and has fruited for several seasons in Hawkes Bay - worthy of testing in other districts. Has export potential.

*Skaha* - similar to Sundrop but larger fruited and a few days later. No experience outside of Central Otago. Male sterile so requires pollinator. Has export potential.

*Stevens Favourite* - seedling of Roxburgh Red, similar in many ways except better flavour and large fruited. May not be suited to districts other than Central Otago and Waitaki Valley. Has export potential.

*Trevatt* - adaptable to marginal northern districts where it has become the main apricot cultivar. Very susceptible to blast.

*Moorpark* - Main Central Otago variety and should remain so because of outstanding flavour. Not adaptable to marginal districts. Well grown fruit has export potential.

*Dundonald* - suitable for canning.

*Youngs Late* - late apricot of Moorpark type.

### *Cherries*

*Early Rivers* - main early season variety, a pollinator for Dawson. Maturity can be advanced by using Mahaleb rootstock.

*Merton Premier* - first firmer-fleshed cherry to ripen. Vigorous upright grower, regular pruning necessary to maintain fruit size. First cherry suitable for export.

*Dawson* - main New Zealand variety. Large black-fruited, dark red, firm-fleshed cherry ripening mid-season.

*Van* - large black-fruited variety ripening a few days after Dawson. Tends to colour well before ripe but reputed to have some resistance to cracking. Incompatible with Maheleb rootstock.

*Bing* - large, hard reddish-purple fruit, ripens just after Dawson. Susceptible to cracking but has export potential where this is not a problem.

*Paul* - Marlborough variety.

*Noble/St. Margaret* - late, firm cherries which are both very similar to one another.

The following are several recently introduced varieties worthy of testing.

*Rainier* - large-fruited, firm, sweet white cherry with attractive red blush. Thought that this type may be preferred by the Japanese market.

*Summit* - V. large-fruited black-dark red skinned but light fleshed sweet cherry.

*Stella and Compact Stella* - self-fertile, dark cherry ripening mid-season.

*Japanese Plums*

Varieties marked \* are recently introduced varieties worthy of testing.

*Wilson's Early* - Main pre-Christmas plum variety - needs heavy thinning to give worthwhile fruit size.

*Duff's Early Jewel* - several days after Wilson's Early, larger but can be soft. Self-fertile and very good pollinator for other Japanese plum varieties which have overlapping flowering periods.

*Billington* - first full red-fleshed plum to ripen.

\**El Dorado* - mid/late January, large, flat almost black plum.

\**Queen Rosa* - Santa Rosa type, very heavy cropping - mid to late January possible replacement for Billington.

\**Friar* - large flat black plum ripening February - tree has shown unthrifty growth appearance until well established. Very susceptible to bacterial spot.

*Doris* - a standard mid season variety.

\**Laroda* - small to medium size, heavy crop but tree stunted.

*Black Doris* - important New Zealand variety, subject to bacterial spot problems and must have correct pollination conditions.

\**K42/46* - one of the most impressive of recently introduced plum varieties - ripens early March.

*George Wilson* - high quality red fleshed late plum with outstanding storage life. Major New Zealand variety, susceptible to bacterial spot and requires correct pollination conditions for regular crops.

*Nectarines*

Varieties marked \* are recently introduced varieties which have shown promise in testing programmes in major districts so would be worthy of consideration for trial plantings.

\**Early Red I* - very early - small - tree vigorous.

\**Armking* - an alternative to Early Red I, a few days later, better size fruit, but has shown cracking and irregular ripening in some districts - most widely planted early nectarine.

\**Early Red II* - late December (Auckland), good fruit size and shape, very vigorous. Flowers early so may be more subject to frost risk.

\**Firebright* - ripens early to mid-January in Auckland. High quality uniform fruit - considered replacement variety for Independence and Wilson's California. Vigorous grower.

\**Red Diamond* - ripens a few days after Firebright. Good size, excellent texture. Tree less vigorous than Firebright.

\**Harko* - ripens ten to fourteen days after Independence. Medium sized very dark red fruits - heavy cropper. A Harrow bred variety with a certain amount of tolerance to bacterial diseases and brown rot.

\**Flavortop* - ripens about a week ahead of Redgold. Probable replacement for Sunglo. Good size and flavour. Has been light cropping in Auckland but satisfactory in colder districts.

*Redgold* - remains standard variety for its season.

*Fantasia* - ripens about a week later than Redgold. Large fruit, similar to Flavortop.

\**Royal Giant* - ripens 2 - 3 weeks after Redgold. Promising late nectarine of medium size and good skin finish.

\**Fairlane* - ripens one month after Redgold. Appears to require long hot growing season in order to develop good colour otherwise can be pale and insipid. Showing promise in Hawkes Bay.

#### *Peaches*

Varieties marked \* are recently introduced varieties which have shown promise in testing programmes in major districts so would be worthy of consideration for trial plantings.

\**Springold* - ripens 6 weeks ahead of Redhaven in Auckland. Yellow-fleshed clingstone with very small stone. Fruit very small unless thinned early and hard.

\**Springcrest* - ripens about 1 week later than Springold. Best early peach - supersedes Candor and other varieties of same season.

*Dixired* - still has a place in districts where it crops well.

\**Royal May* - brilliant colour and good fruit size - possible alternative to Dixired.

\**June Lady* - ripens a few days after Dixired. Firm peach with excellent appearance and flavour. Some bacterial spot.

\**Improved Flavorcrest* - ripens just ahead of Redhaven. Exceptionally firm-fleshed, excellent shape, dark blush.

*Redhaven* - remains the main commercial cultivar but if recently introduced cultivars such as Improved Flavorcrest continue to show their early promise the popularity of Redhaven could diminish.

\**Flamecrest* - Glohaven season; will probably supersede Glohaven. Brilliant colour, excellent shape and texture.

\**Fayette* - ripens 3 - 4 weeks after Redhaven. Good size, shape, colour and texture, heavy cropper.

\**O'Henry* - several days after Fayette. Brilliant colour, large firm fruit of very high quality. Vigorous grower with some doubts about cropping. Weaker growing trees have shown best crop performance to date. Very susceptible to bacterial spot.

\**Cal Red* - ripens 5 - 6 weeks after Redhaven, freestone, good colour, large fruit. May be too late for late districts.

### *Apples*

*Gravenstein group* - possibly Red Gravenstein or highly coloured selection of Oratia Beauty. Best of early varieties. Triploid variety, extremely vigorous giving most easily managed tree from point of view of size and cropping or M9. Very susceptible to mildew.

\**Akane* - early red apple ripening between Gravenstein and Gala. Small, flattish apples with some stem end russet.

\**Abas* - alternative to Akane, slightly later, but better flavour, thought to be a seedling of Gravenstein.

*Gala and Royal Gala* - first of early main season varieties. Very popular on the local market and showing promise on certain export markets. Relationship between the two varieties not yet clear.

Mixed maturity a serious problem requiring multiple harvesting over a period of about a month. Virus free trees essential. Susceptible to fireblight.

*Cox's Orange* - Very important export variety for the European market. New Zealand is the only Southern Hemisphere producer of this variety so has a special place in export districts. Susceptible to powdery mildew and bitter pit. Green-meadows strain is the preferred strain. Tendency to biennial bearing if allowed to overcrop.

*Red Delicious* - Major New Zealand local market variety and important export variety, particularly in South East Asia where large red type fruit is preferred. Canterbury and Otago can produce this type of fruit well giving this variety the potential to revive the apple industry in these districts. At present the preferred strain is not clear. Hawkes Bay Red and Harrold Red are the most widely planted at present. Spur-type varieties are available, in particular Star-krimson and Oregon Red. Most Red Delicious types show colour reversion problems so the importance of selecting true to type budwood for propagation and regular roguing of "off" colour types from established blocks cannot be over-stressed. Tolerant of mildew but susceptible to black spot.

*Jonathan* - potential juicing variety in districts with a process outlet. Very prone to mildew and susceptible to fireblight.

*Golden Delicious* - at present over planted but still has a limited place in the New Zealand Industry. Some gate sales demand for large well-grown, attractively presented Golden Delicious of the correct stage of maturity. Absolutely no demand for small green or over mature Golden Delicious fruit.

*Braeburn* - recently introduced variety with a good future, particularly on the European Market. Strain very important, subject to calcium deficiency, related lenticil blotch pit and powdery mildew. Weak growing tree, subject to biennial bearing if overcropping allowed. The development of a stable red strain will improve this variety immensely. At present a stable full red sport has not been developed



but there are selections of the standard variety which have almost full bright red colour. Poorer forms with rusty brown colour should be avoided.

*Sturmer* - at present overplanted - particularly in Canterbury and Otago, but still has a limited place in the industry.

*Splendour* - late red of high eating quality. Good potential for gate sales but needs specialist handling for other markets.

\**Red Fuji* - late red worthy of trial.

*Granny Smith* - the major New Zealand apple variety. Not really suited to areas further south than Nelson/Marlborough because some seasons too cool to mature it properly. For gate sales planting on M9 which advances apple maturity by a week or so over standard rootstocks may improve the eating quality of this variety in cooler districts.

*Red Dougherty* - late red of mediocre quality which seems to sell well on the export market. Has limited place in industry but should not be grown south of Nelson/Marlborough.

#### *Pears*

*Clapps Favourite* - Williams Bon Chretien type but 2 - 3 weeks earlier. Very subject to bird predation.

*Williams Bon Chretien* - main process variety. Good cropping performance but has short storage life, particularly when grown in districts with cool summers. Good gate sales demand but no export potential.

*Packhams Triumph* - main export variety, very susceptible to fire-blight and requires good provision for cross pollination.

*Beurre Bosc* - has good export potential.

*Winter Cole and Winter Nelis* - established varieties with continuing demand. *Winter Nelis* is a good pollinator and is well known in U.S.A.

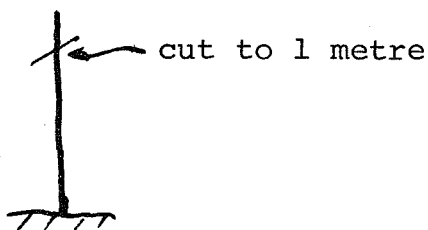
## TRAINING A YOUNG TREE

*Dr. D.I. Jackson,  
Reader in Horticulture,  
Lincoln College.*

The most common method of training apples and pears at the moment is the semi-intensive centre-leader system, while for stone fruit, the open-centre system is still widely used. I shall describe the early training of a centre-leader apple and an open-centre peach, as examples of the two types, together with some new ideas for pruning stone fruits.

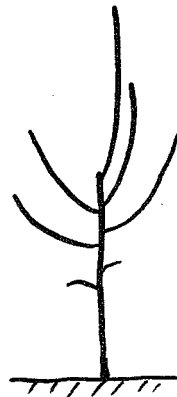
### TRAINING AN APPLE TO A CENTRE-LEADER

Apples and pears are normally bought from a nursery as single rods which will be 1 to 1.5 m high. These, after planting in the orchard, are normally cut back to a height of 1 metre - as shown below.



Planting in  
first winter

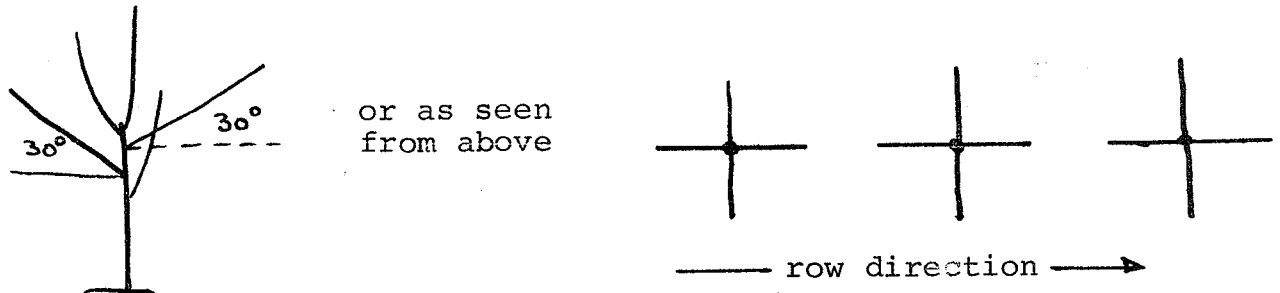
The following season the  
plant will grow as follows:



Growth in first season after  
planting.

It is hoped that the top bud will grow most vigorously in an upright direction and that four other strong shoots are formed which will not be quite so upright.

The ideal we aim for is:

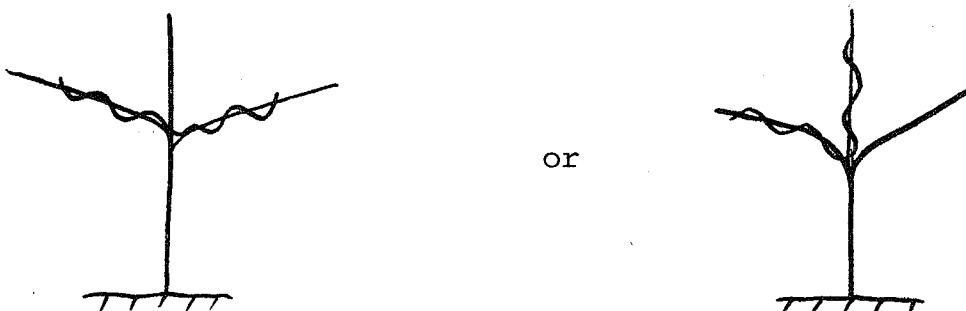


In other words two branches should grow along the row and two at right angles to the row, the ideal angle to the horizontal being  $30^\circ$ . It is better, if possible, to have the leaders which go out into the row higher than the others. This gives easier tractor movement down rows.

To achieve this state of affairs a number of techniques are adopted.

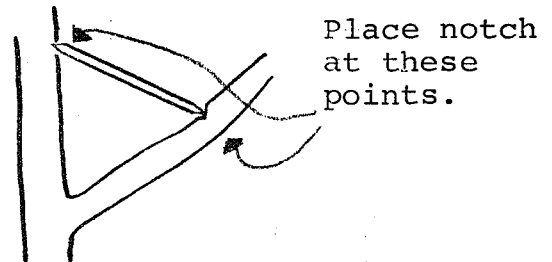
During the first season's growth any vigorous shoots not growing in the correct direction should be removed to encourage vigour in those which are more favourably positioned. Small shoots not competing can be retained. Growers sometimes will use a clothes peg, between the shoot, when it is about 30 cm long, and the main stem to encourage the branch to grow at the correct angle.

In the second winter or early the second spring further training of this lower tier of branches will be required. It is possible to buy lengths of No. 8 fencing wire twisted into a spiral. This can be wrapped around the branches and then bent to encourage development in the correct direction.

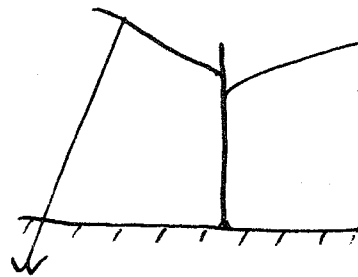
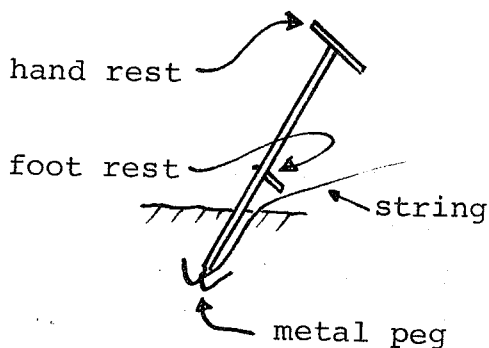


Sometimes a piece of wood is placed between the upright and the branch to increase the angle.

The wood can be a piece of pruning sharpened - as indicated. It is amazing how this will stay in position, even in strong winds.



There is a relatively new 'Ciwelco Applicator' which has been very useful. It is available from the New Zealand Fruitgrowers Federation and is used to place pegs and string below the ground which can then be used to tie down branches.

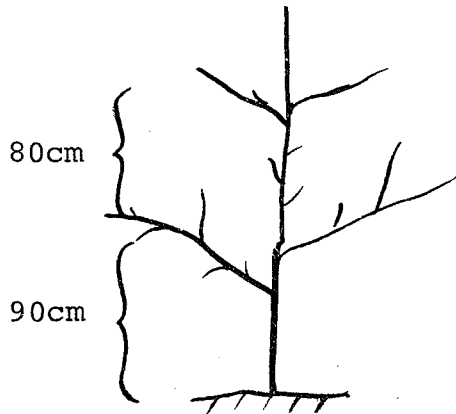


The string should be resistant to rotting and a nylon base twine is often used.

There are other ingenious methods growers have used to tie down branches. Once growth in the second season is six to eight weeks old the branches will be established in their new position and strings etc. can be removed. Failure to do this will often result in damage to the tree.

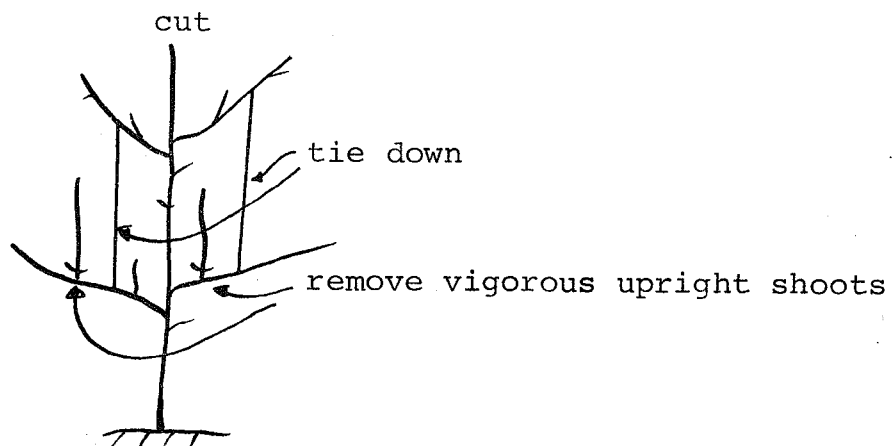
Weaker branches should not be tied down or should be pulled down to a lesser extent since branches close to the horizontal make less growth and promote flowering. This may weaken an already weak shoot and it may never catch up to other branches on the tree which then becomes lopsided.

In addition to tying down the lateral branches, the top and upright branch, which continues the growth of the centre-leader, is normally cut back to 80 cm from the last branch of the first tier. It then grows in a manner similar to the rod the first year.

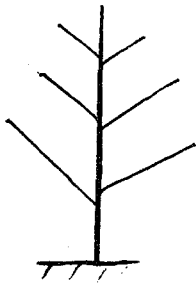


Growth in second summer after planting - only branches in one plane are shown.

In the following winter - i.e. the second after planting - the branches of the second tier are tied down in exactly the same way as the first tier. In this case however it is more simple since they can be tied to the branches of the first tier. Little pruning is done on the established tier except that any strong upright growths are removed.



The pattern is repeated each year until a tree with three-four tiers is established with each branch or each tier being directly above the one on the tier below to preserve the four bays.



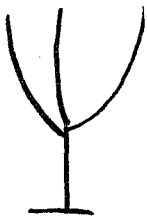
### TRAINING A PEACH TO AN OPEN CENTRE

Peaches naturally have a more bushy and open growth habit and are trained mostly to an open-centre or vase-shaped tree. This training is more simple and less detailed than the centre-leader used for apples.

Orchardists, in general, have two approaches to training peach and other stone fruits. The first is more detailed and the second adopts a minimum-pruning technique.

#### *Detailed Pruning*

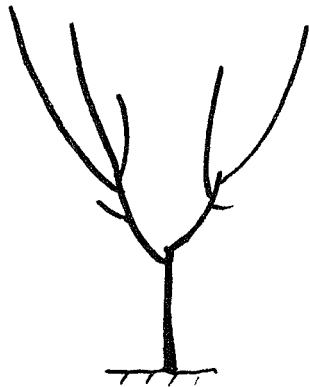
Trees are normally bought from the nurseryman headed back to about knee height with three to four branches already formed.



These are cut to 20-30cm long to an outwards pointing bud.

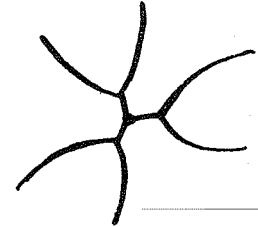
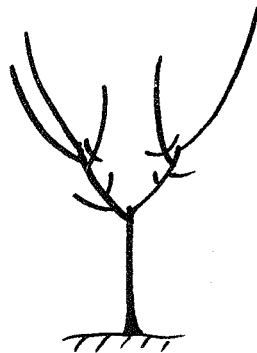


The following season vigorous growth will ensue as shown on the diagram below - only two of the leaders are shown:



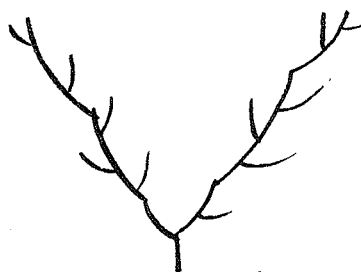
The shoots growing outwards are retained and the more vigorous inward-growing ones are removed. The number of main leaders will normally be increased by retaining two leaders not one.

i.e.

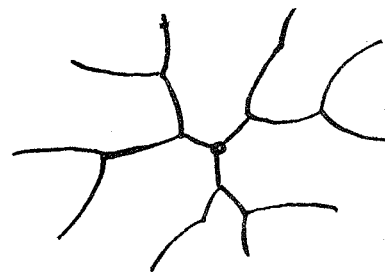


bird's eye view

Some growers head back the main leaders by about 2/3 and cut out more of the other shoots, believing that a good framework built up at this stage will stand the tree in good stead for its subsequent life. However the more we cut a stone fruit tree the later will it come into bearing and the more likely it will be to succumb to such disorders as silver leaf, blast or gummosis. Ultimately there should be about eight leaders placed in a vase shape, with an open centre in the middle - as shown in the figure below.



lateral view



bird's eye view

### *Minimum Pruning*

Many growers now prefer to do an absolute minimum of pruning in the first four to five years and rely on the natural tendency for stone fruit trees to adopt a vase habit. This has several advantages. Firstly it encourages early cropping, even in the first year after planting and



quickly gives a financial return to the grower. Secondly the very much lower pruning reduces silver leaf and other disorders, as we have already seen. Thirdly we now find that stone fruit cultivars change very quickly and by cropping early we can more easily change over to another cultivar - in doing so there is less financial loss since we have a lower non-productive period between change-overs. The technique is very simple. On receiving the tree from the nurseryman it is left unpruned, except for any very weak or broken shoots, or those at an inappropriate angle. From then on virtually no further pruning is done for the next four years although branches obviously growing in the wrong direction may be removed. After four to five years the tree will be nearly full height, almost in full production, and corrective pruning to tidy up the vase shape will be used.

#### *Minimum Pruning - Close Planting*

This is a further development in the move to close planting and minimum pruning. Trees are generally planted two metres apart in rows which are 4.5 - 5.0 metres apart, often as a dormant bud, (a tree that was budded last summer). The bud is allowed to grow unchecked for the first season although any branches within 50 centimetres from the ground are removed. The centre-leader is not checked and a centre-leader tree is ultimately achieved. In the second season of growth some summer pruning is adopted with the aim of opening up the tree to achieve a tiered arrangement - a little like the centre-leader apple tree. This is the most important pruning that will be done. After this the tree is left almost to its own devices, apart from keeping it relatively open and removing strong competitive upright shoots. As it matures, renewal pruning is used to maintain the fruiting capacity.

If a one-year-old nursery tree is planted instead of a dormant bud the grower should ensure the nurseryman does not head it back in the nursery.

Cropping in this system begins in the second season and by the third is very heavy. The life of the orchard is however reduced.

## GENERAL

In all cases growers will need to keep a careful watch on the trees during the growing season. For both apples and peaches the timely removal of unwanted shoots in the summer can prevent a lot of extra training in the winter. Additionally, for stone fruit the complete pruning operation, normally undertaken in winter, may be carried out before the leaves fall. This greatly reduces the risk of silver leaf. In all cases the use of 'Prunect' or similar sealing compounds to cover cuts - especially the big ones - will reduce risks of diseases gaining entry. It should be applied as soon as possible after cuts are made.

It is important to remember that no tree ever grows perfectly. In Canterbury for example it is not always possible to add one tier in each season as indicated above, the second and third tier sometimes takes longer. The shape will likewise never exactly correspond to the ideal, and growers must always follow a course somewhere between perfection and chaos. A grower who is too demanding will often suffer by getting poorer crops than another who is more tolerant of the trees idiosyncracies.

Lastly we need to mention early cropping for apples. Some fruit will be produced from the second season onwards. It is not always necessary to remove this as it used to be considered essential. If the trees are growing vigorously then fruit can be left since they will reduce some of the vigour and will help to bring the tiers down towards the 30<sup>0</sup> mark. Weak trees however should have all or most of the fruit removed as quickly as possible to encourage them to make the maximum growth.

## NUTRITION AND SPRAYING OF YOUNG FRUIT TREES

*G.I. Langford,  
Horticultural Advisory Officer,  
Ministry of Agriculture and Fisheries,  
Christchurch.*

### NUTRITION

The starting point for any study of young tree nutrition is a soil test. It should be realised that the utilisation of fertilisers depends on a pull from the tree rather than a push from the fertiliser. In other words, trees do not necessarily grow just because you throw some fertiliser at them; the trees must be growing first in order to take the nutrients up. Generally recommended rates for Canterbury soils, assuming that the soil has already been brought up to what we consider an adequate standard of fertility are 848 NPK rating at a half kg per tree per year from year of planting, doubling each year until the rate reaches 800 kgs/ha. These figures, it must be emphasized, are general figures and would vary depending on the individual situation. I believe that where possible, dressings should be split so that half is available early in Spring and the other half is available early Summer, around December time, to keep growth continuing. My attitude towards foliar fertilisers is that they are a good way of getting fertilizer into the tree when the root system, for one reason or another, is not working. However, for other situations they are an expensive way of applying NPK. I do recommend their use in times where there is an apparent nutrient problem which may be associated with micro-elements. In these situations foliar fertilisers often help.

### SPRAYING OF YOUNG TREES

#### *Equipment*

The first point about the equipment on young orchards, is that it should include spraying gear capable of spraying the total block within six

hours. If it takes longer than this, sprays are likely to be missed because of weather conditions, ground conditions and so on. It is absolutely essential that equipment used for spraying the trees is at no stage used also for weed control. Although this would seem to be only common sense, I have seen the same gear used with disastrous results many times.

## DISEASES.

### *Apples*

*Mildew:* In the prevention of powdery mildew, start with the trees clean. While most varieties are susceptible to this disease, the most susceptible varieties are Braeburn, Jonathan and Golden Delicious. Other varieties of Delicious are not susceptible.

*Black Spot:* All varieties are susceptible. This is a wet weather disease and to maintain clean orchards in some years, spraying in the rain, particularly where rain lasts more than a week may be necessary. It is unlikely that new orchards could be maintained entirely free of this disease because neighbouring properties and home gardens usually contain apples infected to some extent with it. The spray programme aims at prevention, and with young trees it is aimed at keeping foliage infection to an absolute minimum.

### *Stone Fruit*

The main disease of young stone fruit trees are Bacterial Blast and Leaf Curl.

*Blast:* This is a widespread bacteria which multiplies rapidly under wet conditions. It is normally found all over trees, leaves and so on, and will enter the plant through injuries to the tree caused by some other factor, such as wind or pruning. It is important to keep bacterial blast levels as low as possible with copper sprays and streptomycin.

*Leaf Curl:* This fungus disease, (*Taphrina deformans*) has been a

problem with stone fruit for many years. In particular the new varieties of nectarines seem susceptible. The fungus twists and distorts young leaves as they expand in Spring. The disease is easily recognised but very difficult, if not impossible, to control once infection has occurred. Copper sprays work well as preventatives and Difolotan and warm dry weather will prevent infection spreading.

Peach and Nectarine young tree spray programme would depend:

- \* initially on the health of the tree
- \* whether the fruit are being grown in conjunction with others, such as apples
- \* type of equipment being used, as with apples
- \* the attitude towards toxic chemicals
- \* whether it is intended to fruit the trees the year of planting.

A typical spray programme might be:

- \* immediately after planting - copper oxychloride
- \* leaf bud movement - copper oxychloride
- \* one month late and monthly intervals until Autumn - gusathion plus captan
- \* pre leaf fall - copper oxychloride
- \* eighty percent leaf fall - copper oxychloride.

## PESTS

### *Apples*

*Leaf Roller* Apples may be infested by a wide range of pests, the most important of which is probably leaf roller. There are three main species which affect apples, and these occur throughout New Zealand and have a very wide host range. The moths fly in late October and November and the first grubs are usually found in early December. Initially they are slightly larger than pin-head size, but as they grow can reach in excess of one centimetre. At this stage, few chemicals will control this pest - it is well protected by the webbing that surrounds it which often sticks leaves together.

*Leaf Curling Midge* This can be quite a severe problem on young trees. This small midge which is white first, later turning orange, attacks the young shoots causing a reddening of the foliage and curling leaves tightly. Severe attacks may reduce overall growth. They are fairly easily controlled with preventative insecticides but once infestation has occurred, systemic insecticides are required.

*Aphids* Suspected to be a green peach aphid, this pest has been noted in the last few seasons on young trees. A watch should be kept for it but it is not a major problem.

*Woolly Aphids* Quite characteristic with their white woolly appearance, these are not generally a problem on young trees as they are easily picked off by birds because they are easily seen while trees are young. Spraying is necessary only if a severe attack occurs.

*Mites* Both the two-spotted and European Red mite can be serious pests of young trees. Miticides at early stages of buildup will give good control. As mites can build up rapidly in warm weather, it is important to keep a regular check of trees for the first signs of this pest.

*Rabbits/Hares* Immediately after planting and in the first winter after planting these can cause serious damage by chewing the bark from trees

and in some cases can kill trees completely by ring-barking. Recommended control is regular use of the shotgun, and the Pest Destruction Board can sometimes help.

Bearing the above factors in mind, a spray programme could be designed. This programme will depend on:

- \* initial health of the trees
- \* whether the grower is living on the property and, therefore, whether spraying needs to be preventative or curative
- \* the type of equipment. If the equipment is unlikely to give good coverage, materials with systemic action may need to be used.

#### *Stone Fruit*

These include Leaf Roller, Aphids and occasionally European Red mite.

#### ATTITUDE TOWARDS TOXIC CHEMICALS

Eventually growers must get used to using toxic materials and at some stage full preventative clothing will be required. I believe that it is sometimes better to gradually get used to using these chemicals and perhaps initially less toxic materials may be selected.

A typical apple spray programme might be:

- \* Bud movement: Pallinal + Lindane
- \* 3 weeks later: Pallinal,  
Mid November: Pallinal + Gusathion  
and repeat at monthly intervals until growth ceases
- \* Peropal used for mites on appearance.

## MAINTENANCE OF FRUITING TREES AND PRODUCTION OF QUALITY FRUITS

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Auckland.*

In this session I shall attempt to highlight some of the problems I see in the field which limit tree performance and results in the failure of orchards to attain their full potential.

These problems fall into the following categories (descending order of significant):

- \* Tree management - in particular control of growth, vigour and tree form.
- \* Regulating crop load.
- \* Tree debilitating diseases - in particular powdery mildew, silverleaf and root diseases.
- \* Climatic and site limitations.

### TREE MANAGEMENT

The production of high quality fruit is very dependent on the fruit-bearing laterals receiving adequate light intensity throughout the growing season. The principle objective of mature fruit tree management is to ensure that optimum light penetration into the fruiting zones of the tree is maintained. The optimum tree form for the modern semi-intensive orchard is the central leader pyramid. The pyramid shape places the bulk of the crop in the lower half of the tree where the various manual operations such as pruning, thinning



and harvesting can be carried out most efficiently. The pyramid shape allows good light penetration into this zone as with this configuration, shading of lower branches by upper tree parts is minimised because any excess growth is concentrated into the tree centre thus limiting the spread of the tree top.

Today, due to our pre-occupation with high and early yields the tendency is to plant at densities which are less than that required to accommodate comfortably the tree when it is fully grown. It is general then, for the modern orchard to become overcrowded as the trees mature unless tree management has been correct from an early stage in the tree's life. As the tree ages there is a natural tendency, because of strong apical dominance, for heavy branches to develop towards the top of the tree. These result in shading of the lower tiers of fruiting arms which show a marked fall off in growth and fruit quality. When this happens the tree takes on a cylindrical form and the crop, particularly quality fruit, follows the light up the tree. If this ageing process continues unabated, the cylindrical tree quickly becomes the umbrella tree in which all fruit is carried in the upper canopy at the top of the tree making all orchard operations expensive and difficult. This is one of the tree responses to overcrowding that can be seen in mature semi-intensive orchards.

An alternative response happens where the lower fruiting arms become over-dominant and allowed to form a whorl of secondary leaders. In this situation the apical dominance is quickly transferred from the central leader to the out of control fruiting arms which are in a more competitive position. The transformation from ordered orchard to absolute chaos in this situation is even more dramatic than with the progression through the "cylindrical" to the "umbrella" tree.

While the "cylindrical" tree can be brought back to the optimum pyramid shape relatively easily with minimum tree surgery and crop loss the "umbrella" tree and the out of control secondary leader situations require substantial tree surgery and result in severe disruption of crop and crop/growth balance while the tree is being brought back to the desired pyramid shape.

To maintain continued high production of top quality fruit it is essential that the pyramid tree shape be maintained through the entire life of the tree.

Many of these problems can be avoided with careful attention to the following:

- \* Correct positioning and training of fruiting arms. Fruiting arm gradient determines its growth behaviour. The steeper the gradient, the greater the terminal extension growth. Conversely the more horizontal the arm, the weaker the terminal extension growth. Steep fruiting arms generally become secondary leaders. A common fault is to begin fruiting arms too close to the ground. In this situation it is not possible because of tractor access problems to control excess arm extension through tying to the horizontal or beyond. (Motto - when it is long enough - flatten it.)
  
- \* Do not allow heavy fruiting arms to develop high up in the tree. My view is that no more than two or possibly three well defined tiers of permanent arms are required, above which only relatively short replaceable growth is maintained in a similar way to that on the permanent arms themselves. (Motto - when it is too big for its boots, chop it out.)
  
- \* Heavy regular crops maintained. Fruiting is a powerful growth retardant. (Motto - when it is big enough, crop it.)
  
- \* Always remove over-vigorous branches back to the leader, or at least to a point well within the tree canopy.
  
- \* Control excessive vertical and watershoot growth within the tree. Left uncontrolled vertical growth along the backs of the fruiting arms will cause almost as great a

shading a problem by overcrowding within the confines of the tree as will excessive tree to tree overcrowding. This type of growth should be eliminated, or if the more desirable horizontal growth is sparse, tied down. On no account should such growth be shortened while still in an upright position. The best solution is to remove it completely.

During the formative years this type of growth may be minimised by delaying fruiting arm spreading until the spring growth flush has petered out - say late December, January.

Elimination by summer pruning during January and February is also an effective way to deal with this type of growth in over vigorous trees. This allows light through to the fruit and future fruiting laterals to improve fruit colour and bud development. The resultant loss of effective foliage also weakens the tree system through reduction in root and trunk growth.

#### GROWTH REGULATORS

In the case of apples, sprays of Alar and combinations of Alar and Ethrel sprays will retard vegetative growth and enhance fruit bud initiation. Although not generally used in New Zealand for this purpose, such growth retardant chemical treatment could have a place in tree management. Unfortunately the degree of tree response to these treatments is not always constant and usually accompanied by less desirable side effects. The treatments need to be developed to suit our local conditions. Their role in tree management should be programmed into the orchard development and they are not a back stop which can be used to correct an out of hand situation caused by earlier poor management.

For growth control Alar is usually applied several weeks after bloom. This gives moderate reduction in shoot extension but has the side effect of reducing fruit size, and in some cultivars flattening the fruit shape at the rates required to give worthwhile vigour reduction.

Ethrel applied around six weeks from full bloom either following an earlier Alar spray, or in combination with Alar at the same time will induce a much greater growth retardation than Alar alone. Time and rates are quite critical and if the concentration is too high will cause heavy over-thinning. Its use does enable the Alar spray concentration to be reduced making the treatment much less costly. Ethrel does not have a label claim for use in this manner in New Zealand at present.

#### REGULATING CROP LOAD

Continued regular cropping is dependent on maintaining a continual supply of healthy, relatively young fruiting wood and the avoidance of over-cropping which induces biennial bearing.

In apples the best quality fruit is born on the terminal buds of one year old wood and the spurred lateral buds of two and three year old wood. Buds in these positions are strong and healthy with direct access to the tree sap stream. This means that potentially fruit on such buds will produce the largest size. Consequently for a given sized fruit at harvest carrying the bulk of the crop on this class of fruiting wood will produce the highest yield.

The maintenance of this class of fruiting wood is dependent on operating a vigorous renewal pruning system in which about one quarter of the established fruiting wood is replaced with a similar amount of one year old wood annually.

#### FRUIT THINNING

In Springs favourable for fruitset, or in years following seasons with light crops the crop set is invariably greater than the tree is capable of bringing through to an adequate fruit size at harvest. Where fruit set is particularly heavy, fruit bud initiation for the following season is suppressed. With some varieties, such as Cox's Orange

Pippin which is very prone to biennial bearing, over-cropping to induce the biennial cycle can occur the first year the tree produces flower in any quantity - as early in the tree's life as the second or third season. As this suppression of future flower bud initiation occurs immediately after blossom it is not possible to hand thin in time to affect flower bud initiation. Chemical thinning is necessary to enhance fruit bud initiation and can become an important aspect of tree management to avoid biennial bearing problems.

The usual materials are ANA which is a hormone, and the insecticide carbaryl. ANA is effective at full bloom or just after, and again when the developing fruitlets are about 9 - 10 mm in diameter. It has strong progressive action with increasing concentration and is usually used on hard to thin varieties such as Golden Delicious, Red Dougherty, Gravenstein and Splendour. It has drawbacks of foliage injury at high rates and can adversely affect quality and cause pygmy fruits on some varieties such as Sturmer, Gala and Cox's Orange. Carbaryl has milder thinning action and can be used from petal fall to about four weeks from full bloom, the thinning action becoming weaker the later it is applied. Overseas information suggests the thinning action ceases once the fruit diameter exceeds 15 mm. It is used on the more easily thinned varieties such as Cox's Orange Pippin, Gala, Red Delicious and Braeburn. Granny Smith is very sensitive to carbaryl sprays and can be over-thinned even at quite low rates in some situations. If applied in frosty conditions carbaryl may induce some russet particularly on Delicious varieties.

Combinations of ANA and carbaryl applied together show a synergistic effect and may have a role where exceptionally heavy thinning is required.

Blossom period sprays of thiram will thin some easy-to-thin varieties such as Granny Smith and the Delicious group.

#### HAND THINNING

While chemical thinning plays a major role in regulating crop load, it

is usually necessary to touch up later with hand thinning.

The objectives of hand thinning are to:

- \* remove malformed, diseased and damaged fruits.
- \* regulate fruit numbers to the crop load that the tree can size.

The degree of hand thinning required will depend on the crop load and the size of fruitlet at the time of thinning. The critical factor will be the number of fruitlets remaining on the tree after thinning is completed. This should be based on tree size, vigour and past performance. Remove damaged fruit incapable of making fancy packout first, then progressively from small to larger fruit until the desired crop load remains on the tree.

#### TREE DEBILITATING DISEASES

Only healthy trees attain optimum performance. Serious pest and disease problems which limit tree performance include:

- \* Root diseases and poor drainage - careful attention to site selection.
- \* Powdery mildew - apples - regular spray programmes.
- \* Silverleaf - stonefruits - protect all wounds and prune at correct time - i.e. late summer/early autumn when disease is less active.
- \* Red Mite infestation - particularly early in the season
- \* Bacterial Diseases - stonefruit blast and Bacterial canker in stonefruits, and fireblight in pears - Bacterial suppressant spray programmes must be adhered to.

## FROST CONTROL

The modern intensive orchard relies heavily on regular cropping for control of tree vigour. Loss of a crop, particularly at a key stage in the development of the orchard frequently results in out of control trees, not to mention future battles with biennial bearing. Sites free of spring frost damage or provision for frost control is an essential part of modern orchard management.

Due to soaring fuel prices and problems with air pollution the use of frost pots is no longer possible. For frost protection this leaves the choice of overhead water sprinklers and/or wind machines.

*Overhead Water Sprinklers* reliable, capable of handling as heavy a frost as oil burning frost pot methods if correctly designed and managed properly. Has the drawback of requiring vast and reliable water supply - (requires around 40,000  $\ell$ /ha/hr), free draining soil and possible, but unproven increase in bacterial and fungi disease problems, structural damage from weight of ice.

A recent development in water sprinkling for frost control has been the use of under tree sprinklers - the theory behind and effectiveness of this approach is not fully understood yet.

*Wind Machines* to be effective these machines require a warmer inversion layer within reach of their effective operating height. In the absence of an inversion layer will give a little frost protection by creating air movement within the tree but if ambient temperature falls below the critical temperature for any time, or the frost is more than a degree or so under this temperature will not give protection in the absence of a supplementary heat supply, which in the United States is usually some form of orchard heating. A recent development has been to try under-tree sprinkling as the heat source.

A wind machine in isolation will protect around three hectares of orchard. Multiple machines enhance the efficiency of one another consequently cover a greater area per machine than a single isolated

machine.

Capital outlay for wind machines is not greatly different to that required for overhead water sprinklers if the cost of an additional irrigation system is included. As frost control from water sprinklers is more certain than for wind machines, water sprinklers should be the preferred protection system wherever water supply, soil type and crop allow the system to be used with safety.

#### MAINTAINING THE HIGH FRUIT QUALITY

Each year in New Zealand orchards a significant portion of fruit is lost from fancy grades because of:

- \* Poor control of fruit blemish diseases - e.g. black spot in apples, brown rot in stonefruit.
- \* Russet - intensified by applying sprays under slow drying conditions, with poorly calibrated machines, or excessively complex mixtures and "hot" sprays in the first four to six weeks after bloom.
- \* Handling damage - particularly bruising and stem punctures.
- \* Delays between harvesting and cool storage.

Careful attention to eliminating these particular problems will go a long way towards improving the National Fruit Crop.



## WEED CONTROL IN PIP AND STONE FRUIT

*K. Jeffery,  
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The subject of this paper is weed control in orchards with emphasis on orchard development.

Firstly an orchardist should consider why he requires weed control, the method he wishes to employ to achieve this and then formulate a control plan. This is vital if he wishes to obtain maximum control with minimal costs and damage to his future crop.

Good control of weed species is vital in growing your future crop.

Weeds compete with the trees for the available water and soil nutrients which results in poor growth and crop yields. Excellent root growth studies at Long Ashton Research Station, England and the Academie Agriculture, France, have shown that trees do not compete well with weeds and respond very well to strip spraying and total overall spraying techniques.

The weeds can smother young trees with the result of reducing growth.

The weeds provide an alternate host for pests - insect species which are a problem, may use the weeds as a harbour, increasing their populations before migrating up into the trees. Two spotted mite *Tetranychus urticae* finds many hosts e.g. *Chenopodium* sp. *Trifolium* sp. *Solanum* sp. *Rubus* sp. etc. Another major pest is Leaf Roller species living in these and other alternate hosts. The weeds also host diseases and provide a micro-climate of high humidity in which the disease collar rot (*Phytophthora cactorum*) may flourish.

Weeds also make water management difficult as growers are not able to

see if drip or trickle lines are operating. Dr. Slade has reported improved colour resulting from weed control and some frost protection.

So the benefits of weed control are easily seen; the next question is how to achieve this control? In the young orchard it is very important to control perennial weeds. Before you plant out this may be accomplished through cultivation, cropping and selective herbicides.

Cultivation requires high energy input and corresponding costs and is not in itself sufficient to eradicate all perennial weeds.

Cropping is good in that weeds will be removed in selective spraying - remember some crops are hosts to diseases i.e. potato to verticillium wilt - stone fruit are very susceptible. A cover crop also adds to the humus content of the soil improving the soil structure, reducing erosion and smothering out undesirable weeds.

Selective herbicides like 'Roundup' or 'Amitrole' will control perennial weeds; apply to good, actively growing weeds that have sufficient growth to ensure all rhizomes are up and can be covered.

Strip spraying is the most commonly practised means of weed control, this allows for most of the benefits, still leaving a sward for between the row which tends to counter compaction from heavy vehicles, reducing dust, making for good working conditions and a good aesthetic value.

Before we discuss the chemicals used I feel it should be emphasized that your spray outfit should first be calibrated to ensure correct application rates. This is not difficult and requires little time. Most failures and plant damage can be attributed to a lack of correct calibration.

To obtain application rate per hectare of your strip sprayer

$$\frac{\text{Total output from the 2 nozzles (litres/minute x 600)}}{\text{Total spray swath (metres) x speed (km/hr)}}$$

In a recent Pesticide course, Dr. J. Hardin of Queensland Agricultural College reported they had inspected hundreds of growers herbicide units to find not one was correctly calibrated. I hope this is not the situation here.

Remember most of our chemicals for weed control in horticulture are wettable powders which require good agitation, and will increase nozzle wear - so your nozzles too should be checked regularly by timing and collecting the spray output.

Also your tractor speed should be checked - not by reading the rpm meter but by timing over a set distance.

#### THE YOUNG ORCHARD

Growers are restricted in products here for spraying. Paraquat for some grass species and some broad leaved weeds and Diquat for broad leaved weeds. These chemicals should not be sprayed on the young green bark. Complete coverage of the weed is essential - these are not residual herbicides and repeated applications will be necessary.

Problem perennial weeds may be spot sprayed with Roundup - avoiding drift on young bark or leaves.

Simazine is used by some nurserymen at low rates to provide residual control. However, it should be noted that the manufacturers of this chemical recommend it for trees over one year old.

#### THREE YEAR TREES AND OVER

There is a wide range of chemicals from which to choose for your individual orchard weed species. These are knockdown and residual herbicides:

##### *Knockdown Chemicals (Herbicides)*

Amitrole: a good knockdown herbicide of annual and some

perennial grasses and broad leaved weeds. Do not apply after fruit set - caution on apricots. 6-11 litres per ha.

Asulox: very good but slow knockdown (6 weeks or more) control of docks. 3-4 litres per ha.

Krenite 48AC: for blackberry control only, spot application. Mid February to late April. Avoid drift 10 litres per ha.

Paraquat, Diquat and Preeglone: Mentioned above.

Roundup: excellent control of many perennial and annual grasses and broad leaf weeds. Wait for good weed growth before spraying. Avoid drift onto bark or leaves. 4-6 litres per ha.

#### *Residual Chemicals (Herbicides)*

Caseron and Prefix: both give good residual and some knockdown of many perennial and annual grasses and broad leaf weeds, rather expensive, irrigation or rainfall preferable after applications.

Simazine: good residual control - 6-9 months against a wide range of grasses and broad leaf weeds. Apply to bare soil 3 kg per ha.

Sinbar: good residual knockdown of many grasses and broad leaf species. Should not be used on pear, apricot or plums as damage may result 2-3 kg per ha.

It is important to note that the continued use of any one chemical should be avoided as in nature's diversity there is always resistant weed species which will build up in numbers unless the programme is changed. Unfortunately there is not space enough to advise of the weed species resistant to each chemical but one should be able to spot them as they invade the sprayed strip. Identifying these weeds is

important and there is a good inexpensive book titled "Weeds of Crops and Gardens in New Zealand" by R.L. Taylor, recently published and it is available from the New Zealand Fruitgrowers Federation. If you are still unsure consult your Federation fieldman or local advisory officer.

The use of a knapsack or a weed wiper will allow spot application of these problem weeds before they become established and produce seeds.

There are a number of new herbicides that we at present are screening which may have a place in our programmes in the future. The Federation Growers Guide Bulletin 14 will keep you informed of these - remember that correct timing of your herbicide is vital to success.

## FRUIT SYSTEMS

*G.F. Thiele,  
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### INTRODUCTION

The word "system" seems to have been overused to the extent that it can cause an instant "turn-off" in the minds of listeners. A simple budget represents a model of an orchard system in the same way as more complex computer-based models can describe and plan or simulate an orchard system.

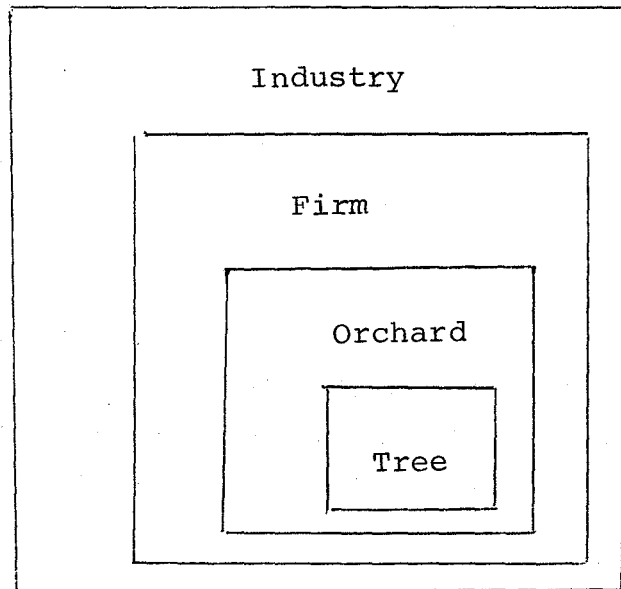
The "tree" is a "system" too, in that it has roots, structure (or shape), leaves and fruit. Extend this to a number of trees planted and trained in a particular manner and it becomes an "orchard" system. With its machines, buildings, land, finance and people, it becomes an "orchard 'firm' system". Put the orchard firms into an environment involving marketing of the produce and servicing of the individual firms with materials and expertise and it becomes an "orchard industry" system, (see Figure 1).

What interactions exist in and between these systems. What is known and not known within these systems? What form of measurement should be used for comparing various parameters within a system - physical yield per hectare, gross income per hectare, net income per hectare or profit per orchard firm? What limitations must be applied to the system - cost of labour, availability and cost of capital, local market, export and processing outlets?

### THE TREE

What type of fruit should be grown?

FIGURE 1  
SYSTEMS INVOLVED IN FRUIT PRODUCTION



Apple, peach, apricot, Japanese pear.

Climatic requirement

Capital requirement

Profitability

Risk-difficulty

Market

What varieties?

Golden Delicious - (Holland has increased production of this variety by 152 percent in two years)

Red Delicious - (trend towards red apples)

A range of varieties to

spread the work load

spread the risk

provide for the market

pollination, disease

What rootstocks?

Size of tree

Compatability  
Soil, climate  
Disease, pest resistance

Tree shape

Central leader  
Hedgerow  
Canopy  
Tatura system

Pruning method

Hand  
Chain saw  
Pneumatic pruning  
Mechanical system  
Unpruned  
Prune during harvesting

Tree efficiency

Pollination/setting  
Leaf: fruit ratio  
Photosynthetic efficiency  
Balance between growth and cropping  
Fruit quality/colour/size  
Root efficiency/fertiliser placement  
(quantity)/water placement (quantity)  
Disease/pest control  
Age for tree replacement

Harvesting

Fruit distribution  
Fruit number  
Fruit size  
Tree shape, density, height  
Hand, mechanical, harvesting aids.

It is possible to review research work in all of these areas but this



would require a book. Work on breeding varieties invariably seems to reflect present day needs rather than prediction of future needs. There is little integration of production and profitability with market demand. In a fruit study in Scandinavia I found growers still planting Cox's Orange in proportions of 30-40 percent in new plantings because of what appeared to be a high price and good market demand without considering the economics of the variety. Another variety, Ingrid Marie, was the most popular with growers because of yield and still being planted in spite of the marketing people indicating no increase in supplies needed. The researchers were still conducting detailed pruning trials although the growers had opted for mechanical pruning because of the labour cost. What was needed was to determine the relationship between fruit distribution and fruit size with this new pruning method and how the fruit could be effectively thinned or sized. Many experiments are conducted without irrigation, when in fact, standard practice is to irrigate.

Shouldn't we be taking simple measurements on our orchards of, for instance, fruitset and density? Winter (1976), in a simulation model for studying the efficiency of apple and pear trees, suggests measuring fruit density through a window  $.36 \text{ mm}^2$  at a distance of 3 m (an average taken from 10 counts). Could we not determine a theoretical capacity for a tree in the same way that we can theorise on size and yield of carrots on a rectangularity basis? In apples, we are well aware of using the tree volume effectively, but in stone fruit and other fruit trees the work is minimal.

Can we harvest apples at 1.5c/kg? Other countries can. Research in Poland has found a determination coefficient in relation to fruit size of  $r^2 = 0.41$  and in relation to tree shape of  $r^2 = 0.32$ . That is, picking performance is determined by these factors in 41 and 32 percent of the cases respectively. A reduction of 20 percent in picking rate can be expected when 40 percent of fruit is picked from a ladder. If mechanical harvesting is to be used we must integrate tree efficiency, fruit quality, and cost factors into the equation.

## THE ORCHARD

### What spacing?

- Tree cost in relation to yield
- Rootstock : Tree size interaction
- Supporting structures and training systems
- Ease of cultural operations
  - spraying
  - pruning
  - soil management
  - harvesting, irrigation

### Varieties

- Varietal mix
- Variety arrangement
- Position in orchard (soil type, climate)

### Orchard layout

- Size of blocks
- Shelter/pollination

Again there has been a great deal of research in these areas, some of it long-term and with little reward. With apples, rootstocks in relation to tree size and characteristics have been well researched. Similar progress has not been made with stone fruit either in breeding or spacing research. In citrus, peaches and cherries for instance, there are dwarf mutants. What training systems are most suited - espalier or tree wall, close planted annual cropping like the meadow system, the tatura system, or the central leader system?

Assuming constant vigour up to maturity there is a linear relationship between yields and planting densities. Once full bearing is reached the influence of plant density is less critical and also at the stage when yields are reducing. The interrelationship between density, fruit size, quality and disease are other questions. With intensive systems, advantages after the sixth or seventh season are due mainly to the reduction in pruning and picking needed with smaller trees. If tree

size is reduced further than the maximum labour savings possible then no advantage results.

All this presupposes grower acceptance. Results clearly indicate that double and triple row planting increases yield/ha but the integration of cultural costs and ease of operation is another question.

## THE FIRM

### Objectives

- Profitability
- Gate sales/Export
- Way of life
- Quality
- Capital gain

### Area

- Co-operative/Company
- Private ownership
- Usage of resources
- Management control
- Expertise and advice

### Equipment

- Private/shared/hired/contract
- Irrigation/frost control
- Harvesting, handling equipment
- Cold storage

### Financial

- Profit after tax
- Gross margins/variety
- Return on capital
- Capital gain
- Trends

This is the part of the system most simple to document, but little has

been done in New Zealand due to the individuality of orchardists and the attitude to sharing confidential information. This is not a criticism but an observation. It makes it very difficult to make accurate comparisons between varieties and fruit types. A firm has its own future in mind, either from a survival or development point of view. Unless it is important to share information for mutual development of firms, orchardists tend to restrict dissemination of information. In fact, the information is not gathered at all in most instances.

I listened to an address delivered to Advisory Officers recently at East Malling. The speaker indicated that double rows of apples or M9 at 2470/ha planted in 1968 would have given an internal rate of return of 39.5 percent but less than 15 percent if planted now. But the whole picture is altered in the case of each firm by the individual's taxation situation which never seems to be considered.

## THE INDUSTRY

### Regional Development

- Use of servicing facilities - coolstores
- Climate, water, soils
- Transport
- Processing facilities

### Marketing

- Marketing Boards/Co-operatives/Auctions
- Packaging
- Storage
- Advertising
- Consumer preferences/requirements

### Government/Growers' Organisations/Service Firms

- Regulations
- Incentives - Export/Taxation
- Finance - Rural Bank Subsidies

In New Zealand, the industry organisation is strong and respected by many overseas countries. World competition is intense but New Zealand's pip fruit continues to compete well with other Southern Hemisphere produce and has a good name for top quality. Nevertheless, during the last twenty years the apple price in Europe has increased only about fifty percent, while the consumer price index has increased nearly 250 percent during the same period. The cost of labour on orchards in Europe during the same period has increased by 800 percent.

Although the Pip Fruit Industry has stability under the Apple and Pear Board regulations, the Stone fruit industry is more subject to supply and demand fluctuations. The Fruitgrowers' Federation is a vital force in the New Zealand Fruit Industry and the development of its export divisions is another important step.

The new export incentive regulations need careful evaluation in the Orchard Industry system, particularly in the development of further processed products for export. Although storage of pip fruit has been well evaluated, much is still to be done with other fresh fruit.

#### CONCLUSION

This is the "fruit system" - the trees, the orchard, the firm and the industry. It seems rather simple, but is it? How much of this system do we really know and how many of the interactions can we express in equation form?

All the fruit producing countries are striving to produce more fruit of the type required by the consumers at a lower cost of production and through a post harvest system of storage, processing, packaging and transport which will allow the product to compete on World markets.

Either New Zealand follows suit or its government must subsidise or provide tariff protection. If New Zealand's fruit industry is to compete it must continue to improve the efficiency of the tree, restrict the costs of production and marketing on a per kg basis, and market strongly with a top quality product both fresh and processed.

Fruit industries in countries with low yields per tree, poor weather conditions and high costs are already struggling to survive. One of New Zealand's major disadvantages is remoteness from world markets. In such a fiercely competitive situation there is no room for a poor orchard system unless for subsistence production.

One final point. We seem to be entrenched in a research and servicing method which treats fruit as a whole or where research stations and personnel do their own thing remote from the influence of others. Approaches to research studies recently in Israel and Germany are worthy of consideration. Israel, in particular, is aware of citrus or peach or apple orchard systems as distinct systems, each with their own characteristics. Commodity advisory committees or working groups study and allocate funds for research and development for each fruit or group of fruits according to the projected benefit and likely success of the proposed investigation. How would you view the pip fruit industry, the peach industry, the apricot or cherry industry from a whole system point of view?



# TREE TRAINING FOR SEMI-INTENSIVE APPLE ORCHARDS

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## INTRODUCTION

### *Economics*

The arguments that stress the necessity for careful economic planning of new orchards have already been presented in detail in previous cyclostyled reports by McKenzie (1970) and McKenzie and White (1980). Every aspect of orchard management must be judged in terms of profitability to the fruitgrower and this includes the choice of tree training system. Most fruitgrowers do not have enough time to consider the full range of tree training methods that are being promoted in various parts of the world at the present time; but experimental plantings have been made at research orchards, (followed by commercial trials) which have demonstrated that a semi-intensive orchard of centre leader pyramid trees is very profitable in New Zealand and still appears to be the best system to use. Nobody would consider returning to the traditional multileader open-centre trees that were popular twenty years ago and, as yet, the more interesting of the new very-intensive trellis systems have still to prove themselves in economic terms.

### *Local Conditions*

In New Zealand, we are very fortunate in having a mild climate with long sunshine hours that induce very heavy fruit crops on apple trees. The fertile soils promote very healthy vigorous growth and our apple trees naturally produce very heavy yields from an early age. The yields from some mature orchards in New Zealand may be double the amount expected in overseas countries and therefore extra precautions have to be taken



to provide a very strong framework of branches to support heavy crop weights. Many tree designs developed in other countries to support relatively light crops are quite inadequate for New Zealand conditions and this applies particularly to the slender spindle bushes or unsupported dwarf bushes in Europe.

The more intense sunlight in New Zealand penetrates more deeply into the canopy of foliage in apple trees and therefore shading inside the tree is reduced, compared with Northern Europe. Any heavily-shaded zone inside an apple tree is non-profitable because it produces only small, poorly-coloured fruit, and in extreme cases, no fruit at all. Since internal shading is less important in New Zealand than in Europe, larger tree volumes can be considered, and semi-dwarf rather than true dwarf trees are recommended. Nevertheless, light penetration remains a very important factor in tree design, and open-textured trees with well-spaced tiers of branches are necessary for maximum yields.

#### THE IDEAL TREE UNIT FOR NEW ZEALAND

##### *Tree Size*

Direct observation of existing orchards will clearly show that even with well-formed open-textured trees, a maximum height of 4.2 m (14 ft) cannot be exceeded, without losing all fruit production at the base of the tree due to shade. Similarly, a maximum spread of 4.2 m (14 ft) cannot be exceeded, without loss of yield from the heart of the tree. Light penetration is the major factor that limits the tree dimensions, but spray penetration and ease of manual harvesting are contributing considerations. Therefore, to obtain maximum yields in New Zealand, the mature dimensions of the orchard trees should be as near as possible to 3.6 to 4.2 m (12 to 14 ft). Because maximum yield has such a beneficial influence on profit, it is generally recommended that every effort should be made to produce from each hectare, as much crop as local environmental conditions will allow.

### *Shape of Tree Outline*

The natural shape of an unpruned young apple tree has the pyramidal outline of a Christmas tree and this is ideally suited to the presentation of the maximum amount of foliage and fruit to sunlight. This can be observed directly in apple seedlings in home gardens or along waysides. Theoretical studies of light interception have also confirmed the benefits of the pyramid shape. Pruning experiments in New Zealand have proved that pyramid trees yield more fruit than traditional wide-topped open-centre trees of the same size. In addition to the main advantage of increased fruit-bearing capacity, the pyramid tree presents a high proportion of the crop within easy reach of the ground, which helps to reduce harvesting costs. The larger quantity of fruit in the lower part of the tree can also be sprayed more adequately than fruit at the top of the tree, (which may be near the limit of spray machine efficiency in windy weather). Pest and disease control are therefore improved in pyramid trees.

For maximum yield the widest spread of the pyramid tree would be at the base. However, horizontal limbs cannot be allowed to interfere with the passage of orchard traffic along the alleyways and there should be a minimum clearance for narrow tractors and low trailing gear to pass underneath the bottom tier of fruiting arms. With a maximum wheel base of 1.2 m (4 ft) and an overall limit on height of 1.8 m (6 ft), orchard traffic will determine the exact placement of the lower limbs at about 1.0 m (3½ ft).

### *Tree Framework*

The design of multileader open-centre trees was not very strong and temporary props and wires were required when the trees were fully laden. By comparison the centre-leader tree with a single very strong axis, (provided with several tiers of horizontal fruiting arms) requires no additional support in the fruit season. It is important, however, to develop strong, wide-angled crotches between the central axis and the side branches. Narrow crotch angles, which are structurally weak, must

be avoided or else whole branches can snap off at the junction.

The bottom tier, consisting of four fruiting arms, should be developed at about 1.0 m (3½ ft) above ground level. Each limb should develop as a large fan-shaped structure of branches that, in turn, should support a canopy of smaller fruiting laterals, with plenty of healthy foliage to develop large apples. The main limbs should be directed outwards at an angle of 30° above the horizontal, because this promotes optimum vegetative growth in association with maximum yields. If the limbs were permitted to take a more upright position, the terminal shoots would be stimulated into excessively vigorous growth which would discourage flowering and fruit set. On the other hand, if the main branches were depressed to a lower angle, then very heavy cropping would certainly result, but this would usually occur at the expense of later shoot extension. Therefore, in order to achieve the heaviest yield over an extended period, it is necessary to accurately achieve this 30° angle of growth in the fruiting arms.

The position of the four branches on the central trunk should be carefully placed, but they need not be confined to exactly the same height of 1.0 m above ground. The tier of branches should originate from within a reasonably short section of the central axis, about 0.3 m (1 ft) in length. Two branches should be trained at right angles to them, i.e. on either side, into the alleyways. This arrangement should produce a four-leaf clover shape, in ground plan, with the four limbs spaced apart by four narrow picking bays (obliquely placed with two bays on either side of the tree).

Directly above the lowest main tier of fruiting arms and separated by a well-defined vertical space of 0.8 m (2½ ft) another slightly smaller tier of four branches should be established, with the same clover-leaf outline. Another third smaller tier should be stacked above the second tier with a similar clearance of 0.8 m (2½ ft). In most orchards, a fourth, much smaller tier of branches should be developed near the top of the tree.

The mature pyramid tree consists of four or five tiers of fruiting arms that have well-defined clear spaces between them. In addition, equally well-defined but narrow picking bays extend vertically from the base to the top of the tree. This open-textured design is essential to the success of the system and dense overcrowded areas must be avoided at all costs.

*Practical Application*

The ideal tree should be used as a guide but it is not compulsory to always reproduce the model exactly. It is natural, because of many variations in growth response to pruning treatment, that few trees will actually be perfect. It would be slavish to attempt to correct every imperfection and certainly not worth the effort. Common sense is necessary and as long as yields remain heavy and regular, fruit quality is good and cost of production stays within bounds, a fair degree of variation may be permitted.

SOME GENERAL COMMENTS ABOUT TREE TRAINING

*All Pruning Reduces the Size of the Young Tree*

After a severe winter pruning cut, new growth may appear to be very vigorous, but many experiments have shown, that the regenerated shoot is, in fact, not as large as the equivalent unpruned shoot. In other words, regrowth does not keep pace with growth of intact shoots. For maximum tree size, therefore, pruning should be kept to a minimum. Since a fast rate of increase in potential fruit-bearing volume is of major importance to early profit, very light pruning is recommended for young trees.

Summer pruning has a much greater effect than winter pruning in reducing tree size, because potentially, productive foliage is removed at the same time. Excessively vigorous growth can sometimes be controlled by summer pruning.

*The Tallest Shoots Continue to Grow Most Strongly*

Vigorous shoots produce growth inhibitors that diffuse back into the rest of the plant and these inhibitors tend to reduce the growth of any competing side shoots. Apical dominance of terminal shoots is a natural controlling factor that can be observed in the well-balanced development of young unpruned trees (that produce centre-leader pyramid shapes). In general, the shoot in the highest position will dominate, especially if it also terminates the largest branch. When the equilibrium is upset by pruning, the growth response will depend upon the position of the affected shoot in the hierarchy of branches.

*The Angle of the Branch Also Influences Vigour of Growth*

A branch in a vertical position will produce much more terminal growth than a similar branch in a horizontal position and as the pose of other branches are found in the intermediate positions, growth decreases as the angle increases. If a branch becomes depressed even further, below horizontal, it is possible that terminal growth may very well cease altogether.

By bending or tying down branches it is possible to artificially reduce the vigour of terminal shoots. Conversely it is possible to increase shoot growth by elevating branches to a more upright position. The manipulation of the pose of branches is an important feature in training of trellis trees such as palmettes and oblique cordons, but it can be used on all kinds of trees.

*The Presence of Flowers and Fruits Reduces Terminal Shoot Growth*

It appears that not only do flowers and fruit compete directly for food reserves with shoot growth, but they also produce their own growth inhibitors that reduce vegetative growth. The presence of new spurs on branches can reduce subsequent growth compared with unspurred branches, and the larger the number of spurs, the greater the effect. Growth response to pruning cuts will be greatly reduced if the spurs

produce flowers and will be further reduced again, if heavy crops of fruit are successfully matured.

*A Concentration of Healthy Mature Foliage, in the Absence of Active Strong Vegetative Shoots will Usually Induce Some Fruit-bud Formation*

A weak side shoot in a horizontal position may cease to make any terminal growth, thus producing a lot of mature foliage in isolation, and as a result fruit-buds will form in the leaf axils during the following season. The basal segment of a long shoot may produce a mass of large mature leaves, and with increase in length the inhibiting influence of the active terminal bud may be attenuated. Consequently, fruit-buds may develop but only among the leaves crowded on the lower portion of the stem. Summer pruning, which removes the terminal shoot, leaving only mature foliage, has a similar effect and results in increased fruit-bud formation - and bending or tying down branches reduces shoot growth and increases fruit-bud formation. Any change in equilibrium that favours an increase in the proportion of mature foliage will encourage fruit-bud formation.

*Very Vigorous Growth is Antagonistic to Fruit Production*

Very vigorous terminal shoots produce a great deal of growth inhibitors that, not only prevent side shoots from developing, but also reduce fruit-bud formation. In addition, a sudden flush of growth may cause existing fruit-buds to remain dormant or even abort. At a later stage, with continued vigorous extension growth, fertilised flowers may abscise and fruitlets may be shed. It follows that severe pruning will obviously reduce the crop by the physical removal of some spurs, but it may also prevent remaining fruit-buds from developing through this antagonistic effect. Therefore the reaction to such pruning may exceed expectations and lead to a regrettable loss of crop, especially in young trees.

*Fruit Spurs Reach a Senescent Stage After About 6 - 8 Years*

On healthy trees, vigorous young spurs, for three or four years, produce

well-formed flowers associated with large strong leaves, and they produce large apples of good quality. However, as the spurs age, the sap flow is progressively reduced and fewer weaker flowers are developed with small flimsy leaves. After a further three or four years of continued deterioration, fruit size and quality begins to decrease rapidly, and then biennial bearing commences. The initial population of spurs have become so weakened that flowering occurs only on alternate years. This six to eight year cycle appears to be normal for most varieties and it explains why trees require more and more attention for intensive pruning as they become older. It is clear that geriatric spurs are a waste of time and they must be removed. It is only by maintaining a steady sequence of young efficient spurs with replacement pruning that heavy regular crops will be produced in older trees.

#### *Women and Tree Training*

Women are particularly adept at tree training, and make a very good job in young orchards. There is no better work force to assist the new orchardist than a team of housewives and young girls and they would be preferable to 'experienced' men trained in traditional methods who may find it difficult to adjust to the more lenient administration of pruning cuts of the new system.

## TREE TRAINING SYSTEMS FOR STONE-FRUIT

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Before attempting to describe the various training systems which are used in the production of stone fruit it is important to point out that yield is the dominant factor in the profitability of such crops. Fruit quality is also an important factor. It is therefore worth spending a few minutes examining the growth and fruiting characteristics of stone fruit which need to be considered if a training system is to be effective in achieving high yields with these crops.

These can be summarized as follows

- \* The yield per hectare is directly related to the absolute number of fruit contained in the canopy volume covering the hectare or orchard. (The greater the fruit number the higher the yield.)
- \* The number of fruit produced is directly related to the number of flowers. (The greater the flower numbers the greater is the potential fruit numbers.)
- \* As flowers are formed in the axils of leaves the number of flowers produced is related to the number of mature leaves which are present and exposed to satisfactory levels of sunlight over the critical flower initiation period during the previous summer.
- \* Flowers are only borne on one-year-old wood. Wood older than one year can only be considered as structural and non-flower bearing. Spur-like structures can form on some types of plums, apricots and cherries. However, such spurs can be considered as very compressed or very short laterals.



- \* The total number of leaf nodes formed on any lateral in a season, apart from the general effects of climate, nutrition and water availability, is related to the position of laterals in the tree canopy.

The angle of the branch from which the lateral arises and the position of that lateral along the length of the branch will strongly influence the rate of growth and number of leaf nodes produced by a lateral.

It should be pointed out that a high extension growth rate of a lateral does not necessarily mean that more leaf nodes are produced when compared to a shorter lateral. The greater length in the first case may simply result from a greater distance between the leaves and not more leaves.

However within a given variety the general rule is that the greater the length of a lateral the greater will be the number of leaves produced.

In general laterals arising from the base of a branch will grow longer than laterals located nearer the tip of the branch. The relative growth difference between these two positions however is less pronounced as the branch changes from horizontal to the vertical.

The general principle however, only applies when all laterals are equally exposed to sunlight. Extreme shading of a part of a branch will retard the growth of laterals arising from that area.

- \* Experiments carried out with peach show that under conditions of good light exposure, slower growing laterals produce more flowers per unit of length than faster growing laterals. In extreme situations the slower growing lateral however, may be so fruitful that it produces insufficient leaves to support all the potential fruit it could develop. Even with thinning the

result can be undersized fruit. The most satisfactory laterals are therefore those of moderate vigour. Unfortunately there is no general rule relating rate of growth of a lateral to the ideal level of fruitfulness as this varies for each variety.

In summary if we wish to maximize the yield of stone fruit the objective of any training system should be to produce and maintain the maximum number of leaves per unit volume of orchard on laterals of moderate vigour, spaced in such a way that all the leaves are exposed to adequate levels of sunlight for photosynthesis and flower initiation. In practical terms we may have to sacrifice some yield for the sake of accessibility to the orchard or to improve the quality of the fruit. The price premium for fruit of high quality can more than compensate for the lower yield.

However I suspect that many growers sacrifice far more yield than is necessary to meet these competing objectives satisfactorily.

Much of the recent research work on stone fruits has been directed to developing training systems to achieve new plateaux of yield for stone fruit in much the same way that has been achieved with pip fruit. Some of these methods show promise, and peach and nectarine yields of 70 - 80 tonnes/hectare of good quality fruit are now possible.

I will now describe a few of these new training systems and how they are achieved.

The most obvious opportunity for improving profitability is to adopt systems which encourage maximum yields per hectare as early in the life of an orchard as possible.

Peaches and nectarines would appear to be well suited biologically to achieving this goal as generally they have a relatively short juvenile period and fruit regularly on one-year-old wood - unlike the pip fruit. In addition, the types of diseases present in New Zealand such as Blast and silver-leaf almost guarantees that peaches and nectarines remain productive for far less time than might be expected under more favourable disease situations. Standard training methods which are based on the

older fruit growing philosophy of first growing the tree and then cropping it, is seriously under question when we consider the longevity factor which is essential to such a philosophy.

In essence the most effective means of achieving early high production of peach and nectarine orchards is based on two concepts

- \* The use of high initial plant densities
- \* The occupation of the orchard volume with as much one-year-old wood of the most fruitful type as possible. This is achieved in a variety of ways and is relatively easy to achieve in the early years of a high density orchard as with young trees, the natural proportion of one-year-old wood to older wood is high.

The skill however, is to sustain this high ratio as the tree gets older. Inevitably this involves some form of pruning. Structurally high yields on young wood means dispensing with the supporting strength of older frame wood, usually associated with more traditional forms of tree training.

There are two approaches to this.

- \* By keeping fruiting wood close to the ground and having a very large number of trees each carrying a very small amount of fruit
- \* Growing the trees on trellis or canopy systems where the trellis provides the support for the crop load.

Trellising or canopy systems have the potential advantage of regulating shape more accurately for leaf exposure purposes or for mechanization purposes.

Both systems have their advantages and disadvantages. Some systems have been developed which combine features of both.

The Israeli meadow orchard system or the Tatura trellis system are

dependent for their success in filling the orchard volume with as much one-year-old wood as possible. As indicated by Dr. McKenzie, centre leader peach trees can be developed which by virtue of conical shape can be high producing but planted at high initial densities to achieve early yield.

As indicated by Dr. McKenzie with pip fruit the successful establishment of high yielding early producing peach orchards depends on the quality of the planting material. The bigger the tree from the nursery the quicker the yield is obtained.

## TWENTY QUESTIONS ABOUT APPLE TREE PRUNING

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### WHAT IS THE BEST KIND OF NURSERY TREE?

On deep fertile soils, order trees on M.M.106 rootstocks; and for shallower soils order trees on Merton 793 rootstocks. A large tree is best. A reliable nurseryman will provide large healthy trees that are true to label and free from known virus infection, and obviously it is worthwhile to buy only plants of best quality at all times. If possible, avoid using any second-grade, or diseased trees, even if they are less expensive.

A skilful nurseryman will begin the tree training process during the first season of growth after budding. Unwanted side shoots will be trimmed from the lower part of the trunk. Strong side laterals will be encouraged in the zone that is one metre above ground, so that the first tier of branches may be already partly formed when the tree is bought. As a general rule, the more vigorous and numerous the side shoots, the wider the crotch angles of the branches that develop; and therefore larger nursery trees are usually well supplied with plenty of widely spread laterals. It is a great advantage to be given a wide choice of suitable branches to select the best positions for the strong framework limbs, and this adds to the value of purchasing large trees.

It is a good idea to visit the nursery and examine the trees that have been allotted to you. In some instances, it may be possible to supply your own transport and take delivery at the nursery as soon as the trees have been lifted. However it is most important that the trees must not be allowed to dry out, and the roots must be kept damp at all times. Dehydrated plants may remain dormant for months after planting and they may take two or three seasons to return to their normal activity.

Cover the roots with damp sawdust, damp sacking and plastic sheets and protect from strong wind and direct sunshine, until they are planted.

#### WHY BUY VIRUS-FREE TREES?

Experiments have shown that healthy trees produce heavier crops than infected trees and they are also free from fruit blemishes caused by russet-ring spot, stoney pit and green crinkle viruses, and growth will not be reduced by rubbery-wood virus. Without the debilitating effect of these virus diseases, apple trees may grow somewhat larger than expected, although yields will be relatively heavy. On very fertile soils and with strong-growing varieties, some allowance should be made for the additional height and spread of these healthy trees, by planting them a bit further apart; or alternatively ordering trees that have been budded at a higher level. Instead of working the scion varieties in the nursery at the normal height, at about 15 cm above ground, the buds are inserted at 35 cm. This results in an additional length of the butt of the rootstock, and this enhances the dwarfing influence of the M.M.106 rootstocks. This in turn effectively reduces tree size slightly and counteracts the extra vigour of growth.

A more elaborate method for neutralising the excess vigour relies upon grafting intermediate stem-pieces of Malling IX (or Malling 26) between rootstocks and scions. This is a reliable but more costly method than the high budding system.

There are more advantages than disadvantages in using trees that are free from all known virus diseases.

#### WHAT IS THE BEST WAY TO PLANT THE TREES?

It is preferable to retain as much root as possible at the time of planting to ensure rapid establishment. Only damaged roots need to be trimmed. It would be better to enlarge the planting hole rather than cut off roots to fit the hole! A mechanical post-hole borer may be very useful in friable soils for opening up the planting site, but can not be recommended for wet clay land. The rotary action of the

blades may seal the margins with an impervious layer of mud that restricts root growth and traps rainwater that encourages root diseases.

When planting a large tree with many well-formed laterals, it should be rotated in the planting hole until the best branches fall into the most favourable positions for future framework development. Even small trees with few branches can be given some consideration in selecting the most advantageous placement in the planting hole. Single rods, of course, offer no options.

For later convenience in use of trailing equipment, such as grass mowers, it is necessary to accurately align the rows of trees. By using planting boards, it is possible to place the trees exactly and the extra time and effort is well worth while.

As with any tree planting, best results will be obtained with apple trees, if all the roots are carefully spread outwards and downwards in the hole. Then the soil must be evenly and firmly compressed around the roots, leaving no air pockets. No upwardly directed roots or coiled roots should be left near the surface as this encourages the sprouting of sucker growths.

Keep the bud union well above ground level to prevent scion rooting. Most scion varieties produce very vigorous growth on their own roots, (similar to trees on seedling rootstocks). Such large trees would be very inconvenient among the semi-dwarf trees of a close-planted orchard, requiring a great deal of special pruning, and producing lower yields.

After planting, the disturbed soil will naturally consolidate and, in the process, the trees may eventually sink 5 cm, so it is necessary to allow for subsidence when setting the trees. If a permanent depression is formed, the tree will have seasonal ponding around the trunk in wet weather, and this may lead to serious root disease problems. In fact, it would be preferable to ensure good drainage by planting the trees on low mounds (or ridges for rows of

trees). It is recommended that on flat ground the soil should be graded into ridges before planting. A bulldozer can be used cheaply and efficiently, for this task.

In exposed windy sites it may be necessary to supply extra support by driving in stakes by each tree, or else using a strand of wire along each row of trees. However, in reasonably sheltered areas this will not be necessary, unless the soil is so soft or sandy that root anchorage is precarious at all times.

Ideally, trickle irrigation should be installed immediately after planting, so that there is no need for the trees to ever suffer from lack of moisture. This is particularly important if the earlier recommendation is followed and large trees have been purchased. Large trees normally produce a large amount of foliage that transpires a great deal of moisture. Until the new root system has regenerated, the large trees are very vulnerable to desiccation. During this period of imbalance, the tree may be badly influenced by drought and may persist for several months, in spite of any later improvement in available soil moisture. Sometimes, an affected tree may take a year or two to return to normal rate of growth. Therefore, every effort should be made to prevent any stress from lack of water just after planting.

#### HOW IS THE NEWLY-PLANTED TREE PRUNED?

##### *Large Trees*

If the tree is a large one and it is already supplied with a good selection of lateral shoots in the zone where the first tier of laterals will be developed (at about one metre above ground-level), the tree training is relatively simple. Four laterals must be chosen, preference being given to those with wide crotch angles. In many cases, the four laterals may already be situated in positions very close to the ideal (i.e. two branches along the row and two branches at right angles to them). However, sometimes the available branches do not provide four correctly placed limbs and then it will be



necessary to redirect them by manipulation into their proper positions. This is most easily achieved, later in the spring, using coiled training wires (which can be used to bend a limb in almost any direction). At the time of planting, the main job will be to remove any superfluous shoots leaving the four main limbs of the first tier intact.

Sometimes, it is possible to develop two rather small fruiting branches on either side along the row beneath the first tier. These branches will provide some very early yield from the young trees which will return a small but very important profit. However, these two branches must not develop too low down, otherwise the fruit will drag on the ground. They must not be closer than 0.5 m from the ground.

Unless the centre leader is more than 1.8 m (6 ft) tall it will not need to be shortened on a tree with first tier established.

#### *Large Single Rod*

If the tree is a first-grade large single rod, without any side laterals it must be pruned back, after planting, to a height that will encourage a good selection of strong shoots next season, in the region one metre above ground level (i.e. at about hip-height). By cutting to about 1.2 m (4 ft), a good growth response can be expected in the appropriate segment.

#### *Small Tree*

If the tree is small, or unevenly-developed with weak lateral growths, it will require special treatment. A young weak-growing tree is very difficult to train. Experience has shown that it is unprofitable to fiddle with bud-notching and shoot spreaders on such trees, because the growth response will always be inadequate. It would be preferable to trim back to a single leader and encourage strong regrowth by applying extra fertiliser and by irrigating regularly in dry periods. In the following season the tree should be more suitable

for training in the same way as already described for strong trees. In effect, small nursery trees will take a year longer to produce the first tier of limbs, and in the long term, this will delay profit by one or two years. Therefore it is not a good strategy to buy cheaper trees.

#### DO THE TREES REQUIRE SPECIAL CARE IN THE FIRST SEASON?

One of the most common errors in the management of young trees is the lack of weed control. The roots of weeds and grass compete with the roots of the young apple trees for moisture and in dry seasons can severely limit growth. Hand hoeing is very efficient but time consuming. The use of chemical weed-killers may be effective but care must be taken to ensure that no chemical is applied to the young trees themselves. A sheet of black plastic may be pegged down around each tree, and this not only prevents weed growth but also conserves moisture. It is very important that no weeds should grow within 0.7 m (2 ft) of the tree. (Similar attention should be given to any hedge plants that form the shelter belts of the orchard.)

Shelter from wind is more important in young trees than in mature trees and many new orchards are planted before the hedges have been properly established. Apple trees, especially large ones, may take a season or two to establish new root systems. The young trees may be top heavy and tend to blow over in windy weather and then sometimes require extra support. The ties on staked trees need to be examined at intervals to make sure they are secure, and any broken ones renewed. Any ingrowing ties need to be released and retied in a new position; otherwise a permanent weakness in stem structure may be created that would eventually lead to breakages. For similar reasons, ties onto wires can not be neglected and require similar attention. However it is usually possible to grow self-supporting trees without any stakes or wires. When the trees are blown askew in wet soil or soft sandy land, it is important to return the trees to their original upright position within 24 hours. Pull each tree gently back to its former position and ram the soil. Sometimes it helps to add sand or fine gravel if the movement of the tree has created an open cavity in

puggy soil. This will improve drainage and reduce the risk of collar rot infection. While the soil remains wet and before the tree extends any new roots, this re-adjustment will cause no root breakages; but if the movement is delayed until the soil hardens and new roots are established, then many roots will be broken causing permanent weakness. It becomes a tiresome task to return these weak trees to the upright position after every gale and eventually a permanent support may be required. This situation can be avoided if all unstable trees are corrected at the earliest opportunity after falling over.

It is worthwhile to consider maize as part of the shelter system for young trees, especially if the hedges are still immature. As long as this field crop is properly managed, the general influence is beneficial to the apple trees. Field crops can be grown between the trees during the first season (and may continue for another year or two). The advantages include not only additional income but also the extra attention to weed control, use of fertilisers and frequent irrigation on the field crop has a good effect on the apple trees. In the case of some other tall field crops such as broad beans or sweet corn, the apple trees will benefit from some protection from wind.

During the first season of growth it is essential to supply enough moisture, so that the trees never suffer from water-stress. In this way the trees will produce maximum growth and increase rapidly in size. Trickle irrigation is the cheapest and most convenient method of applying water, but sprinkler irrigation and flood irrigation can also be used. Even tanks or buckets of water can be considered in an emergency, when a few litres of water per tree may make the difference between continued growth or stagnation in a dry period.

Many new plantings of apple trees receive no pest and disease controlling sprays and yet often succeed remarkably well. However, a severe outbreak of mildew, black-spot, fireblight, canker or leaf-roller may have a disastrous effect on young tree growth. Therefore it is simply a good insurance policy to apply a few essential

protective spray applications as recommended by the Ministry of Agriculture and Fisheries, even though it may mean a disagreeable effort with a motorised knapsack sprayer or a bucket pump.

In most districts, young apple trees will benefit from frequent light dressings of recommended fertiliser mixtures, in which the proportion of nitrogen may be increased to encourage shoot growth. The fertiliser must not be flung by the cupful at the base of each in a single application. A strong concentration of chemical may severely burn the butt of the tree, so the mixture should be spread out thinly over a square metre or so. If possible the manure should be divided into several portions and they should be applied in sequence throughout the growing season.

#### WHEN IS THE BEST TIME TO USE THE TRAINING WIRES?

The late spring when mature apple trees are in blossom, is the time of maximum sap flow, and the limbs become very pliant. At this time, it is possible to bend quite thick branches without breaking them and there is a reduction in the danger of splitting-out at the crotch angles between fruiting arms and the centre leader.

Only a few of the largest newly-planted trees will have four well-placed branches that are long enough to require training wires. Two wires will be needed for each tree; one directed through the tree, along the row, and the other at right angles to the first. One half of each training wire should be wound around one branch, beginning at the centre and working outwards. The other half of each wire is then wound around the branch directly opposite. The direction of these branches can then be exactly placed, correcting any slight deviations from the best position, and the angle of elevation can be accurately set at  $30^{\circ}$  above horizontal.

Some trees may have four branches of suitable size and at the right height, but some of the branches may be growing in the wrong direction. By applying a coiled training wire, any branch may be bent through  $45^{\circ}$ ,  $90^{\circ}$  or even  $180^{\circ}$  around the circumference of the tree, so the

initial positions of the branches may be readily changed. Therefore, as long as the tree has four branches, they can be put to good use. This is one of the major advantages of using coiled training wires, that will not be possible when other methods are used, such as tying down with twine or spreading with wooden spacers.

The training wires should not be left on the branches for more than six weeks; otherwise the wires become slightly embedded in the bark of the branches creating shallow pressure marks. These grooves may seem quite insignificant at the time but some of them may react later to form wound tissue. Such tissue remains permanently unstrengthened forming a weak crevice that may become the focal point for branch fracture at a later stage, when the limb is carrying a heavy load of fruit. In any case, after six weeks, the splint action of the training wire should have fixed the growing branch in its new position, so there would be no advantage in leaving the wire on the branch any longer. Occasionally a branch may spring back from the desired position, in which case, the training may be replaced for another six weeks, but in contact with different parts of the bark.

Similar considerations limit the time that twine or spacers are allowed to remain on a limb, and all trees should be examined after six weeks to make sure that no pressure marks develop.

#### IS IT NECESSARY TO SUMMER PRUNE YOUNG APPLE TREES?

It is not essential to summer prune apple trees and most fruitgrowers have difficulty in finding time during the harvesting season anyway. However, in a new plantation, it is possible to improve tree development by some summer pruning. Unwanted sucker growth can be removed from the base of the tree and any laterals below 0.6 m can be trimmed off the main trunk. Shoots that protrude across any of the picking bays can be trimmed off. Very strong growing trees may produce dense thickets of shoots from the central leader, and these can be thinned out, with advantage, during the summer, reducing the work of pruning in the following winter. Do not shorten any branches on young trees.

#### HOW ARE ONE-YEAR-OLD TREES PRUNED?

By the end of the first season of growth, most trees on well-managed orchards will have produced a mass of vigorous growth. At this stage of development a vigorous tree would be much preferable to a weak tree. Some thinning out of crowded branches will be essential but compared with old traditional tree training, the pruning will be very light and there will be no shortening back of branches. Some whole branches will be removed, and the remainder left intact with some bending down with training wires (or twine etc.) for six weeks in the late spring.

#### ARE THE SMALLER ONE-YEAR-OLD TREES MORE DIFFICULT TO PRUNE?

With fewer smaller branches the choice of suitable limbs will be restricted, and the weaker trees generally produce weak narrow-angled crotches between the centre leader and branches. However, any trees that were planted as single rods will have produced a good bushy top, dominated by the central leader and with plenty of side shoots. Pruning will concentrate on the selection of the first tier of fruiting arms (and possibly a few smaller laterals beneath the first tier for early cropping). Competing branches will be removed entirely, leaving four well-placed fruiting arms and these will be spread out at  $30^{\circ}$  above the horizontal using training wires in the spring (for six weeks only). Only a few weak horizontal laterals can be left on the main axis, apart from the main fruiting arms. Unwanted shoots near the ground or above the first tier of branches should be removed.

The centre leader will need to be redefined, removing any competing shoots near the top of the tree. If the tree has grown strongly and exceeds 2 - 3 metres ( $7\frac{1}{2}$  ft) in height, the top may need to be cut off to encourage a second tier of branches at 2 metres (7 ft).

#### WILL THE LARGER ONE-YEAR-OLD TREES PRODUCE TOO MUCH GROWTH?

As long as the trees are growing on M.M.106 or Merton 793 rootstocks,

the strong growth will not persist or interfere with later heavy cropping. If the terminal shoots on the main fruiting arms are too upright (as occurs sometimes with Granny Smith trees), it may be necessary to use training wires to spread the ends of the branches (or else tie down with twine) for a second season.

Water shoots from the central leader will need to be entirely removed, leaving only a few weak horizontal fruiting laterals. In addition strong upright shoots on the first tier of branches (within 0.4 m (18 ins) of the central axis), must be removed altogether, because this area must not develop into a dense thicket. Since each fruiting arm will be developed as a horizontal fan-shaped area, many upright shoots may be left intact on the main branches. (This is at variance with orthodox pruning techniques that always used to remove all strong-vertical growth.) However, there will usually be too many of these laterals and they must be thinned out, so that when they bend outwards with weight of crop, there will be no overlapping. The long-pruning technique depends upon the weight of the crop to spread the branches. It is very important that none of the upright shoots should be shortened. If the shoot is pruned, or even lightly tipped, it will remain fixed in an upright position, and lose its pliability. In addition, fruit will not set as heavily on a shortened branch. Therefore shoots must either be removed entirely or left untouched. (Weak horizontal and oblique shoots can be left intact to produce fruit buds.)

At the end of the first season, some of the largest trees may have already produced strong laterals suitable for producing the second tier of branches. Four suitable limbs may be selected and the remainder removed. There will be no need to spread these limbs, with very few exceptions. Usually, any occasional upright branches can be tied down with twine (for six weeks in the late spring) to the branch directly below in the lower tier. The formation of the second tier is usually much easier than the first tier of branches.

The top of the centre leader will need to be defined by removing any competing shoots, and the third tier will usually develop quite

naturally later without requiring any shortening of the axis at this stage. The four picking bays also need to be examined to make sure that no laterals encroach on the free space. Certainly no branches must pass across the bays to interfere with light penetration and easy access.

#### ARE THERE ANY SPECIAL PROBLEMS DURING THE SECOND GROWING SEASON?

Apart from maintaining normal management (with regular spray applications, adequate weed control, plenty of irrigation and so on), the trees will tend to be top-heavy and require extra care in wet windy weather. Any trees that lean, should be returned to the upright position within twentyfour hours, and the earth consolidated around the roots.

Some attention to fruit thinning by hand will pay dividends, by greatly improving young tree shape. Fruit weight is very effective in spreading branches, but too much weight can bend the branches too far down, especially at the ends of long thin shoots. It will be important to remove fruitlets from the ends of the four main fruiting arms, so that the angle of  $30^{\circ}$  above horizontal will be maintained and terminal growth will continue. It is not a difficult job to clear the ends of the main branches, and the earlier in the season, the better the result. (Any time from full bloom to late December will be effective.) It will become a matter of experience to estimate the correct amount of thinning to produce the weight of crop that will depress the fruiting arms to the optimum slope, and different varieties may require different treatment. If time is available, fruit thinning is a very effective way of preventing over-cropping on the ends of the fruiting arms.

As in the previous season, any coiled training wires, wooden braces or twine will require close observation to ensure that they do not cut into the bark of the branches.

#### IS THE WINTER PRUNING IN THE THIRD SEASON VERY LIGHT?

It is very important that in this year when the first crops will be



set that pruning should be very light. The thinning out of branches in the previous season will have stimulated some growth but the lack of shortening and predominance of spreading branches will also have encouraged a good fruit set. Only very light pruning should be necessary in the lower part of the tree, mainly to define the picking bays and spaces between the tiers. It would be preferable to err on the side of too little pruning, rather than too much.

The top of the tree may require some attention to define the third tier of branches. However, because this is a relatively small part of the tree, when it is fully developed, the third (and fourth) tier may be treated a little more casually and the placement of the branches need not be so exact as in the lower tiers.

ARE THE TREES STRONG ENOUGH TO CARRY CROPS IN THE THIRD SEASON?

Apart from clearing the ends of the main fruiting arms in the first and second tiers (and sometimes clearing the centre leader itself), there will be no need to thin off fruit. There will be no problems in producing large fruit and the tree will easily support the weight of crop produced by a three-year-old tree.

In the third growing season the orchard is usually sown down in permanent sward and this usually has a slight effect in reducing tree growth. Usually extra nitrogenous fertiliser and extra irrigation will be applied but this may not always be necessary on deep fertile soils.

WILL THE TREES NEED TO BE PRUNED MORE HEAVILY IN THE FOURTH WINTER SEASON?

Although the trees continue to grow vigorously it will not yet be appropriate to thin out any branches in the lower part of the tree. Apart from clearing the picking bays and removing a few vigorous shoots from between the tiers of fruiting arms, the trees require very little pruning.

The result will be very heavy crops of apples that will tend to weigh

down the long branches. Thinning of the ends of all the main limbs will be important. Passage of traffic through the orchard may become a little hazardous at the peak of the season, and some branches may need to be tied up to the centre leader using plastic straps or wire, to keep them out of the way. If each branch involves a carton of fruit it will become very economic to support this extra crop rather than cut it off. This 'untidy' phase is part of the process of developing a good centre leader tree and it is important not to react by shortening back any 'inconvenient' branches at this stage.

IS THE SIXTH WINTER THE APPROPRIATE STAGE TO BEGIN TO LIGHTLY PRUNE THE TREES?

By this time most trees will have reached full height and spread with some branches extending beyond the ideal limit. Branches will have begun to interlace along the rows and the tops of the trees will exceed arm reach from the top of a 2 m ladder. Very heavy crops will be produced over the whole tree and there will be no problems with fruit size and quality.

The usual attention should be given to defining the picking bays and clearing the spaces between the tiers of fruiting arms. The bottom tier of main branches may now be shortened back at the ends, cutting to three-year old spurred wood. This mature wood will not respond as vigorously to pruning as young vegetative branches, and the tree will become moulded to this new outline. The alleyways between the trees will now be free from drooping laterals and the trees will just fill their allotted spaces in the rows without encroaching on each other.

In the sixth season (or the following year depending upon growing conditions and scion varieties), the leader may also receive similar treatment i.e. it will be shortened back to three-year-old wood at about 4 m (12 ft). In this way excessive regrowth can be avoided. If necessary, the process can be repeated after another three years.

#### WILL THE TREES BE MATURE BY THE SEVENTH SEASON?

Although the trees will be beginning to produce very heavy crops, they will still not have reached full maturity. However, because of the very heavy cropping, it will be safe to begin thinning out the trees without fear of inducing excessive growth. The main framework will now be fully developed and should be strong enough to carry the maximum yields that the tree will be able to produce. There will be areas in the tree, particularly in the bottom tier, where overlapping has created dense thickets, and these may now be carefully thinned out. The amount of pruning will begin to increase each year. Much of the overcrowding will have been created when heavily laden branches were depressed and screened out the lower limbs. Where large fruiting arms are concerned, it will not pay to remove them but rather strap them up or wire them out of the way. Medium-sized 'droppers' (i.e. pendant fruiting laterals), can be trimmed back to produce new growth. Since all fruit from small growths on the undersides of large branches are small and very poorly coloured and therefore of no value, it would be wise to prune off these weak shoots entirely.

#### WHEN WILL THE TREES REACH MATURITY?

By the time the trees reach their tenth year, they will be fully mature. After the seventh year, the trees will continue to crop without much encouragement. As the trees get older more attention will need to be given to fruit thinning in order to maintain good fruit size and the use of chemical thinners will become most important. This will also help to control any tendencies towards biennial bearing.

As the trees continue to age, the cost of pruning will become progressively greater and more and more spur pruning will be required to maintain heavy crops of large good quality apples.

#### WHAT IS THE BEST METHOD FOR PRUNING MATURE TREES?

Regulated pruning developed by Dr. Preston at East Malling Research Station is the most effective pruning system for mature trees. The

method entails the regular renewal of fruiting laterals over the whole of the framework of the tree. In the case of the centre leader pyramid, the fruiting laterals are produced as a fringe over the upper surface of the fanshaped fruiting arms. A proportion of these fruiting laterals that are old must be cut back each season to remove aged spurs and to regenerate new growth; another proportion of young shoots will be left intact to mature and produce strong new spurs; and another proportion of mature laterals may be lightly tipped to encourage the production of some foliage as well as heavy spur formation. By regulating the proportions of the three types of lateral growth, the population of relatively young fruit spurs can be maintained in healthy condition and provide heavy crops.

#### WHAT CAN BE DONE TO CONTROL TREES THAT PERSIST IN GROWING VIGOROUSLY?

Root pruning and trunk girdling can be used to impart temporary reduction in terminal growth and at the same time induce heavier fruit-bud formation. A tree that is reluctant to crop may respond well to this short, sharp treatment. However there may be some danger of introducing root-rotting diseases or silver-leaf fungus through the wounds, so this method must be used with some caution. Summer pruning can be used but this is a very expensive way of controlling growth and is unsuitable for large voluminous trees. Use of growth-controlling substances such as alar or maleic hydrazide may be used as sprays to reduce terminal growth, but expert guidance will be needed to avoid some unwanted side effects on fruit size etc. None of these methods will permanently solve the problem.

The most effective counter agent to vigorous growth is heavy cropping, and as long as a large tree has large shaded areas there will be little hope of increasing yields. Therefore the first step should be to 'open out' the trees to expose the maximum amount of foliage to the sun. If the branches are crowded together they must be thinned out by removing whole limbs, leaving the remainder untouched. It will be very important that no branches should be shortened back (and especially not to short vertical stubs which simply activate vigorous regrowth). Because horizontal branches naturally crop more readily,

they should be given preference over vertical shoots in the thinning out process.

On very vigorous trees it would be a good policy to spread the corrective treatment over three years rather than to prune heavily in one season and risk a large growth response. In order to keep control of the thinning programme, the unwanted limbs may be marked with dabs of paint, (using a different colour for each year). In this way, an orderly policy can be agreed upon and followed to completion without argument. Many unco-operative mature trees, (whether centre leader or open-centre shape) may be persuaded to crop more heavily and grow less furiously if they are given this extended period of 'opening out' treatment. (It has been most effective on large apple trees in Malling XII rootstocks or pears on seedling rootstocks.)

In addition to opening out the trees, a certain amount of branch manipulation may be helpful in reducing growth. Large whippy upright branches can be tied down. Since the aim is to reduce growth, they can be brought right down to the horizontal or even lower, and, on a large tree, a few heavily laden pendant limbs can do a great deal to sop up excessive vigour and increase yields.

Finally, if the rootstock/scion combination is far too vigorous for the soil and planting system (e.g. Gravenstein on Merton 793), then it may be necessary to consider grafting over to a weaker-scion variety such as Golden Delicious or a spur-type selection of Red Delicious. However, this is an expensive method of correction and in addition, the risk of infection from wood-rotting fungi would have to be considered.

#### WHAT IS THE ECONOMIC LIFE OF AN APPLE TREE?

As the tree ages it will become more expensive to manage and the cost of pruning is one of the important factors that influence profitability of old trees. There is no doubt that apple trees may remain healthy and productive for more than a hundred years but they will certainly require detailed spur pruning which is very expensive. It is sus-

pected that after twentyfive years, a fruitgrower may have to compare the profitability of his mature orchard, with that of a young newly planted orchard and decide whether or not it will be advisable to replant. It is purely a matter of economic costing and could not be settled in a hurry, much depending upon tree health and the varieties that are used.