1-1-1978

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Apple orchards to take a new look

By J. E. L. Cripps,
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Results of experiments by the Department of Agriculture could completely change the appearance of the apple orchard in the next decade.

The normal orchard scene will become hedgerows of chemically-thinned, irrigated, red varieties on dwarfing or semi-dwarfing rootstocks receiving just the right amount of fertiliser, and areas between rows will be mown, or sprayed with herbicide. The clean-cultivated, square-planted, vase-shaped tree will slowly disappear.

In the long run, it seems unlikely that export to Europe will revive, but increasing local demand and opportunities for the export of premium firm red apples to Asian markets give hope for the future. Also the apple is still the cheapest fruit to grow in Western Australia, and improvements in management and growing methods in new orchards will help maintain low costs.

In the Stoneville planting distance experiment, closer spacing gave fewer sunburnt apples. On the other hand red varieties may fail to colour properly if planted too close.

A hedgerow planting at the Manjimup Research Station

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Close square permanent planting creates an access problem, but this problem can be overcome with rectangular plantings with the trees in hedgerows. Hedgerows can easily be sprayed, pruned and picked, and are suited to trickle irrigation, contour planting, weedicide strips and mowing.

An important asset of close planting is that more fruit is produced per hectare without an increased requirement for water and fertiliser. This means that fertiliser and water costs per kilogram of fruit are reduced.

The typical West Australian orchard of widely-spaced, staggy trees allowing plenty of room for movement in both directions will become a thing of the past. Trees will be small and close-planted to minimise picking costs. This article summarises a number of the research findings which led to these suggested changes.

Planting distance

An experiment at Stoneville Research Station showed that apple trees hate exposure and prefer the protected environment achieved with close planting, in which they also produce more fruit per hectare. Of course very close planting ultimately leads to overcrowding and shading out of fruit buds, but subsequent removal of some trees, or the initial planting of filler trees for eventual removal, can overcome these problems.

The apple industry is faced with a changing market and increased production costs and will need to change radically in the future. Local and export markets are demanding a change from Granny Smith and Yates varieties towards Red Delicious and Lady Williams, and new plantings are insufficient to meet the demand.

The Stoneville planting distance experiment also showed that closer spacing gave fewer sunburnt apples. On the other hand red varieties may fail to colour properly if planted too close.
Planting distance will vary with management, variety and rootstock, and knowledge of local soil and climatic conditions should be used to finally determine distances. Suggested spacings are given in the Table.

<table>
<thead>
<tr>
<th>Training method</th>
<th>Rootstock</th>
<th>Planting distance</th>
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</thead>
<tbody>
<tr>
<td>Central leader</td>
<td>MM104</td>
<td>6 x 4 m</td>
</tr>
<tr>
<td>Palmette or delayed fan</td>
<td>MM104</td>
<td>5 x 4 m</td>
</tr>
<tr>
<td>Central leader</td>
<td>MM106</td>
<td>5 x 3 m</td>
</tr>
<tr>
<td>Palmette or delayed fan</td>
<td>MM106</td>
<td>5 x 3 m</td>
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</tbody>
</table>

**Rootstocks**

Rootstocks provide the cheapest way of controlling tree size, and three outstanding rootstocks have been selected from the experiment at Stoneville—MM109, MM104 and MM106. MM109 is vigorous, nematode resistant, and suitable for replanting. MM104 is of medium vigour and particularly suited to varieties such as Granny Smith and Golden Delicious which crop heavily and do not grow vigorously unless management is ideal. MM104 appears to be the most generally useful rootstock since vigour is easily maintained but tree size can be controlled. MM106 can be used for vigorous varieties if well managed and if the trees are not allowed to become overloaded with fruit. With the trend towards smaller trees, more use will be made of the MM106 rootstock but if not well managed, growth stops early in the life of the tree. This decline in vigour is very difficult to reverse.

**Tree training**

A trial at Manjimup Research Station on methods of tree training has indicated that the vase-shaped tree produces less fruit than any of the other tree forms in the experiment. Training of main branches at an angle of 45° maximises fruit bud production and such tree forms including the central leader, delayed fan and palmette, have proved fruitful and practical.

In general minimal pruning is used for all systems and this requires tying down of branches and summer pruning. Less detailed winter pruning will be required for these new tree forms.
The central leader tree is a simple and logical form of training since it approximates the natural growth of the apple tree. Wide strong branch angles may be encouraged with spreaders or clothes pegs, and branches may be tied to stakes driven into the ground to encourage fruiting.

The delayed fan is also a simple form of training and suits the modern hedgerow concept. Leaders which tend to grow toward the middle of the row are removed while those growing along the row are tied to leaders from adjacent trees when sufficiently developed.

The palmette involves more formal training and a two or three wire trellis is necessary. To form the tree a central leader is encouraged and three or more branches are trained out on either side in the tree row at an angle of 45° to the horizontal in a fishbone pattern. A strong framework is produced with easy access for orchard operations. The wide-angled crotches of these tree forms give much less limb breakage then do the old vase-shaped trees.

Growth substances
Growth substances may also be used to reduce shoot growth and encourage fruiting. Alar is most commonly used, being particularly useful in bringing young trees into crop. Once fruit bud initiation has been triggered and shoot growth checked there is a tendency for fruiting to continue, so repeated sprays are unnecessary.

Irrigation
The common view of irrigation has been that the more water which can be applied the higher the yield of fruit. However, a sprinkler irrigation experiment at the Department of Agriculture's Stoneville Research Station has proved this to be an over-simplification.

Irrigation does not increase production per unit of tree size. It merely increases tree size so that more fruit is carried because of the extra bearing surface. However, large trees mean more expensive harvesting and pruning, and frequent watering encourages weed growth which increases the need for mowing and weed control.

In the Stoneville irrigation experiment on light deeply-drained soil, three or four irrigations per year of 75 mm proved to be better than weekly watering of 37 mm.

It seems that enough water should be applied to achieve the desired fruit size but more water may cause excessive shoot growth. Excessive shoot growth is particularly undesirable with mature trees planted in hedgerows and the grower must be prepared to irrigate according to evaporation readings from an evaporimeter and tree growth and not by rule of thumb. Young trees of course require frequent irrigation.

Trickle irrigation is a vastly different technique but also allows control of tree vigour and fruit size.

Nutrition
Phosphorus
Research has emphasised the importance of phosphorus in apple tree nutrition although early investigations of orchard fertilisers gave inconclusive results. Trees deficient in phosphorus show dieback symptoms within four years but if superphosphate is applied, the tree begins to make new shoot growth from the base until eventually a new framework is formed. A tree may be rejuvenated in four years by heavy annual applications of 4 to 5 kg of superphosphate per tree.

Adequate phosphorus also improves fruit quality, resulting in lengthened storage life and improved colour of Granny Smiths. Cropping is increased due to improved fruit set.

Heavy dressings of superphosphate are particularly important for orchards planted on virgin soil. Most farming areas contain little phosphorus in the native state and phosphorus must be built up in the soil before enough for heavy fruit production becomes available to the trees. Phosphorus should be placed below the young tree at planting, and followed with a surface dressing in spring.

Nitrogen
It is impossible to make a general recommendation for the amount of nitrogen to apply. Nitrogen improves fruit colour of varieties such as Granny Smith and Cleopatra, but this is not the case with either red varieties or Golden Delicious which require just enough nitrogen to maintain tree vigour and health.

Nitrogen increases fruit bud formation and fruit set but with varieties such as Yates this is not an advantage. At Stoneville low levels of nitrogen have given moderate crops of well-coloured Yates apples.

The common practice of applying the same rate of nitrogen to all apple varieties can only give high quality fruit from some varieties. Rates must be varied with varieties unless the orchard does not include the Granny Smith or Cleopatra varieties.

Potassium
Many fruit growers consider that heavy dressings of potassium fertiliser improve fruit quality, but experiments suggest that moderate levels are enough. Heavy dressings are not beneficial unless the potassium leaf level is low, and high levels of potassium can lead to magnesium deficiency.

A leaf level of 1.2 to 1.5 per cent potassium is adequate and a balanced fertiliser programme supplying moderate levels of potash is recommended. Excessive applications are costly since potassium is expensive.

Trace elements
Maintaining adequate levels of major elements is of no value if trace elements are deficient. Trace elements can be applied by sprays but in recent years below ground dressing has been successful, particularly with zinc which is not readily absorbed into the tree.

Leaf analysis
In recent years extension officers from the Department of Agriculture
have provided advice on orchard fertiliser requirements based on inspection and leaf sampling of the orchard. Analysis of the leaf samples helps the extension officer to make specific and accurate recommendations. This service not only ensures that deficiencies are eliminated but also prevents the oversupply and waste of expensive fertilisers.

**Soil management**

On advice of the Department of Agriculture, commercial orchardists are tending away from cultivation and towards sod culture with weedicide strips which is probably the most practical treatment for most orchards. Cultivation not only damages tree roots but may fail to control weeds and certainly makes working conditions unpleasant.

In future, there will probably be a trend for weedicide strips to widen and the mown areas to contract. However, weed control by spraying alone necessitates fairly level ground or contour planting. Contour planting is not popular with orchardists but it fits in well with the hedgerow system of orchard planting and with trickle irrigation. Sawdust is ideal for weed control if enough is available at a reasonable price, as it not only eliminates weeds, but also conserves moisture.

**Biennial bearing**

Although it is commonly thought that young, well-watered trees are less prone to biennial bearing than are old non-irrigated trees, the irrigation experiment at Stoneville has shown this to be incorrect. Irrigation increased the severity of biennial bearing and the young trees in the experiment have proved to be very biennial in their cropping. Pruning has some influence on biennial bearing, increasing the fruit set if done before the “off” year. Chemical thinning is the only practical method, as detailed pruning is expensive. It has given good control in the Stoneville experiment and in numerous experiments on growers properties, and its widespread use has tended to iron out fluctuations in Western Australia’s apple crop.