12.5.4?Orchard design and canopy management

Perennial fruit orchards do offer great potential for modi?cation of light and temperature environments within canopies by pruning, tree training, tree size, row spacing and row orientation. Because of the great variety of ways of arranging the foliage in space, a number of computer models have been written to examine the relative importance of some of these factors in influencing not only light interception (Table 12.2) but also sunlight distribution within the canopy (Palmer 1989a; Wagenmakers 1991), as this can have such a profound effect upon the quality of the fruit. In addition, ?eld experiments to examine these effects are very expensive and time consuming to set up and run, so computer models offer a very economical way of examining light interception and distribution within innumerable canopy forms. As there is often a large dollar premium for quality, the economic success of any production system is largely determined by the yield of high-quality fruit, rather than the total yield. That does not mean, however, that high total yield and high-quality yield are mutually exclusive. With grapevines, Smart (1989) has consistently argued that high yields of high-quality grapes are achievable via correct canopy management.

Highly productive orchards and vineyards therefore have a balance of vegetative and fruit growth, with fruiting zones maintained in a high light environment. Examples of how this has been achieved will now be presented for apples, peaches and grapes. In each case only one system is described, although there are many other successfully managed systems, particularly in vineyards.

(a)??Apples

In New Zealand Tustin *et al*. (1990) have sought to combine requirements for precocity, high yields of high-quality fruit and good light penetration into the canopy in their slender pyramid tree form. This has largely been developed with trees on semi-vigorous rootstocks at a tree density of about 700 trees per hectare. The form is basically a central leader tree, that is, one central vertical trunk, on which are borne the fruiting branches. Early tree management is aimed at developing a permanent, strong, spreading basal tier of four to ?ve branches emanating from the central leader at wide angles for strength and to encourage early fruiting. Pruning is minimal in the early years, with unwanted shoots being removed during the growing season when they are still small. The upper part of the tree is developed as an open, well-spaced arrangement of whorls of shorter branches arising directly from the central leader. These upper branches are removed when they become too large or pendulant and are replaced by natural regrowth. Each tree is maintained in an overall pyramidal form to encourage light penetration into all parts of the canopy. Yields of Royal Gala apples, for example, have been over 50 t ha^{-1} in the third year rising to over 100 t ha^{-1} by year six.

(b)??Peaches

Trees on a Tatura trellis (Figure 12.26) are trained into two planar canopies inclined at an angle of 60º from the horizontal, and held by a trellis system of posts and wires. The system is designed to

encourage precocity by using 2000 trees per hectare and rapidly ?lling the trellis structure with fruiting branches. Within each arm, the canopy itself is shallow to encourage good light penetration. Summer pruning of unwanted, upright vegetative growth is practised to maintain a high, uniform light environment along each arm. Vegetative growth has also been successfully controlled in the dry environment of Tatura by regulated de?cit irrigation. The Tatura trellis is also designed for mechanical picking. A rigid and shallow canopy ensures that fruit can fall onto the catching frame with minimal chance of damage. As peaches bear fruit on one-year-old wood, yields of Golden Queen on Tatura trellis in year two have reached 28 t ha^{-1} rising to a maximum of 86 t ha^{-1} by year four (van den Ende *et al*. 1987). Other stonefruit and pomefruit (pipfruit) have also been grown successfully with this management system.

(c)??Grapes

Traditional pruning of grapevines was aimed at producing a limited number of moderate-sized clusters of berries to facilitate hand picking. Consequently, pruning removed large amounts of young wood so that growth of vigorous shoots was stimulated. With the advent of mechanical picking for wine grapes, however, this constraint has been removed as the harvesters are capable of efficiently removing the berries from large and small grape bunches. This has consequently brought about new grapevine pruning and training techniques (Possingham 1994), particularly in regions with long growing seasons, irrigation and high vigour such as Australia, Chile and California. Minimal pruning of cordon-trained vines (MPCT) is one such example from Australia. Each vine is initially developed conventionally with two or four permanent horizontal arms or cordons. From year three, vines are minimally pruned — low hanging canes are removed. Consequently MPCT vines carry far more buds over from one year to the next, but competition between these growing points results in shorter shoots, with shorter internodes, and higher yields made up of a large number of small clusters of berries well exposed to the light. The resulting wine quality is high and comparable with that from conventionally pruned vines.
