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Growing For Your Market

Setting up the Optimum Crop

One key observation we have made during Future Orchards 2012 Orchard Walks is that many Australian orchards are failing to reach potential production levels and are therefore under cropping. This has a profound adverse effect on their production costs and competitiveness.

Undoubtedly the harsh and variable Australian climate is a contributing factor to these cropping problems, but it is possible to manage the climate problems and mitigate much of the climate related risk.

Understand the Yield Capability of your Block

The Future Orchards 2012 website has gross yield and Class 1 yield for all of the blocks in the project. There is also data on tree size expressed as both tree row volume (TRV) and trunk cross sectional area (TCA) with average and upper quartile curves by tree age and planting density shown.

Comparing your own orchard TRV and TCA measurements by block against this data enables your orchard blocks to be evaluated for assessment of their yield potential. Before the orchard canopy becomes fully developed, specific crop expressed as fruit number per cm^2 TCA is the usual parameter for setting up crop load. While trees are small, optimum crop load is in the range of 8 – 12 fruit per cm^2 TCA. As the trees mature, optimum fruit number per cm^2 TCA falls because TCA grows at a faster rate than the productive capacity of the tree increases.

Once full canopy is reached, historical crop history or fruit per cm^2 branch cross sectional area (BCA) becomes more appropriate than TCA for determining crop loads. Depending on branch size BCA crop loads of 4-5 fruit per cm^2 are about optimum for small efficient fruiting units up to 2 or possibly 3cm in diameter, then as branch size increases their productive capacity expressed as fruit per cm^2 BCA drops off rapidly.

The Future Orchards 2012 notes on Crop Loading prepared for the November 2007 Orchard Walks gives further details on setting up crop load targets.

Getting the Crop to Set Fruit

From what we have observed of Australian pomefruit orchard cropping, many orchard blocks experience difficulty in getting fruit to set. Because of the huge range of growing conditions in Australia the reasons for poor crop loads are many and varied. These range from inadequate flowering caused by biennial bearing or animal damage, particularly birds, destroying the buds, to weak flower due to shade or nutrient deficiency, lack of suitable pollination or direct loss of setting fruit by frost or cold weather inhibiting satisfactory pollination.

Previous articles in this series have already discussed aspects of biennial bearing, as well as the role excess vigour has on fruit set, so we will not go into it in any depth other then point out that you need to understand the role biennial bearing and excess tree vigour have on cropping.

This month we will assume the flower numbers are adequate to ensure a full crop, providing there is satisfactory fruit set.

Adverse Weather for Fruit Set

In southern fruit growing districts, such as Tasmania and higher altitude orchards, particularly Batlow, cold weather over the blossom period can markedly reduce pollination and fruit set.

Pipfruit pollination tends to be temperature driven, which means that when day temperatures fall to around 12°C or less, there is not much pollination going on. At these temperatures bee activity is very low and pollen tube growth very slow. Inhibition of pollen tube growth is the main mechanism of self infertility in apples. While a few cultivars, notably Red Delicious types and Triploid varieties such as Gravenstein and Jonagold are completely self unfruitful, many varieties show partial self fertility and if the temperatures over blossom are high enough and flower is strong, usually set commercial crops in the absence of good cross pollination. However, the general consensus of opinion is that for regular full cropping, adequate cross pollination is required.

There is also an interaction between blossom period temperatures and flower strength in regard to fruit set. Strong flowers on regular or “on” cropping trees have well developed flower parts, so pollinate better under marginal conditions than weak flower on trees which had heavy crop the previous season. For varieties that show a tendency towards self set “on” crop flower is more likely to self set, than weak flower of “off” crop trees. This is because there is less, impediment to pollen tube growth in strong “on” crop flower. Likewise strong flower is going to pollinate better under low temperature conditions.

Effective pollination period, which is the period from flower opening until the unpollinated ovule aborts, determines how well the fruit will set under marginal conditions. The longer this period the more time the pollen tube has to grow from the stigma down to the ovule.

Scientific studies made on fruit set by Dr. Hill-Cottingham at Long Ashton Research Station in England, some 40 years ago, showed that flowering and particularly fruit set was very dependent on ample nitrogen reserves accumulated in the latter part of the previous growing season.

Trees with adequate nitrogen reserves are less prone to biennial bearing and will set crops more readily. It’s our impression that on some Australian orchards nitrogen levels are allowed to fall into the range where flower strength and fruit set are adversely affected, because of the need to restrict nitrogen to improve fruit colour development in difficult to colour varieties, such as Cripp’s Pink. We have seen the problem with Fuji too. Trees suffering low nitrogen reserves often show late and irregular bud break, pale spring foliage and poor fruit set. Pale foliage is also the symptom of chill injury, so early season leaf analysis maybe required to determine whether or not low nitrogen is part of the problem. Optimum early season nitrogen leaf levels are generally about half a percentage point higher than the standard recommended mid-

summer level, ie, early spring nitrogen levels need to be approaching 3% to be sure of good fruit set under marginal conditions.

Figure 1: Good fruit set where leaves were dark green and well supplied with nitrogen – spring leaf N approaching 3%.

Figure 2: Poor fruit set, note pale green leaves compared to Fig. 1. Spring leaf nitrogen here about 2.4%

The June '09 Future Orchards 2012 Walk had very good notes on Orchard Nutrition prepared by Kevin Manning and Ross Wilson, which explain the role of nutrition in fruit set in more depth.

Low boron levels have also been implicated in poor fruit set problems particularly in pears, so pre-bloom boron sprays may help lift fruit set, where levels are marginal or deficient.

European Measures to Improve Fruit Set

Jan Peeters from Fruitconsult, a European Consultancy company, who took part in the Future Orchards 2012 orchard walk programme several years ago, has sent us information on the strategies they use to improve fruit set under marginal spring weather conditions.

For orchards with a history of poor fruit set, they place heavy emphasis on foliar nutrient sprays over the period from pink bud through to about 10% flowering. Sprays are applied at weekly intervals or sometimes twice a week, if conditions are bad or flowering and leaf quality particularly weak. The rates are Urea 3-5kg/ha plus Boron (eg. Solubor or Bortrac at 1kg/ha) plus fungicide. Magnesium Sulphate at 5kg/ha may also be added to the balloon blossom stage.

Phosphorous acid sprays are often applied where flowering is weak and fruit set conditions poor. If primary spur cluster leaves are very small, early application of GA 4/7 is made during pink bud and balloon blossom stage, provided temperatures exceed 16℃ to improve leaf size. Cytolin is another tool that is sometimes used over blossom to assist set.
Note – GA sprays cannot be mixed with foliar boron sprays.

They also have a programme based on average daily temperature, which tracks pollen tube growth. Their data shows that for diploid varieties the pollen tube needs to reach the ovule in 6 days or less and this means that you need several days in that period average daily temperatures in the 12-15℃ range. Pollen tube growth rates increase 2.5 times between average temperature lift from 12 to 15℃, and double between average temperatures of 7 to 12℃.

Frost

Frost over the spring can be a major thief of good crops and its true impact on orchard performance often slips below the radar, because trees compensate for reduced fruit set in the earlier flower by setting their crop on the later weaker flower sites. You still end up with a crop, but it does not have the potential fruit size or quality of the earlier set fruit that was lost through frost.

There is some evidence that hail netting may give a little frost protection, but it is unlikely to give enough protection to save the crop in more severe frost events and I have certainly seen situations where crops have been lost under hail nets due to frost.

In districts prone to spring frost, protection against frost needs to be included in any intensive orchard development plan. Options for frost protection include some form of heat source, the most cost effective being water sprinkling. Under tree will give protection against mild to medium strength frosts, but for heavier frosts over tree sprinkling is necessary. Water availability is a real issue on many Australian orchards, so it may not always be possible to use scarce water resources required to get the crop through summer for spring frost protection.

Orchard heating by oil or gas has become uneconomic due to high oil prices, but may still be a back-up option for very heavy frosts, that exceed to the capability of more economic frost protection methods such as frost fans.

Frost fans have become the principal frost protection tool in New Zealand for orchards and vineyards. In principal they rely on good inversion layers of warm air, which they can pull down to replace cold air at lower levels. In some parts of Australia, severe advection frosts, with weak or nil warm air inversion layers are responsible for the damaging frosts, leading to doubts about the effectiveness of frost fans. Our experience is that while frost fans do not work as well in the absence of warm air inversion layers, they still offer protection, albeit over a reduced area. Their effectiveness under these conditions can be markedly improved when they are combined with an alternative heat source, such as limited orchard heaters, or under tree sprinklers on the upwind side so they can capture the rising heat from this source and drag it back down into the orchard to be used again.

Figure 3: Frost fans have become the principal frost protection tool in New Zealand Orchards. In absence of good warm air inversion layers, their effectiveness can be boosted by supplementary orchard heating.

Figure 4: The fruitlets in this cluster have been damaged by frost; note the brown dead tissue at the base of the stamens.

Figure 5: The ovule and stigma of this flower have been killed by frost.

Figure 6: This is a healthy flower with no frost damage..

Where very mild frosts are involved, some fruit growers claim benefit from application of 500g/100 l of low biuret urea at 1,000l/ha which is usually applied as a dilute spray to alternate rows immediately prior to the forecast frost event.

Site selection is also very important for managing frost risk and can be a very effective passive form of frost protection. Long term weather station data give information on the probability of frost occurring over the sensitive period and the likely severity. Within a district there are often relatively constant relationships among different sites and the severity of the frost, so if there is good weather station data available, calibrating minimum temperatures across your property during frost events against the weather station data for those events, will give a picture of the level of frost risk your sites may have. Cold air is denser than warm air, so will flow to the lowest parts of the orchard and if it cannot escape will pond there. Avoid dense shelter at the bottom of cold air ponding areas that prevents the cold air escaping. Conversely where cold air drifts down onto an orchard, dense shelter on the upper sides of the orchard will tend to divert the cold air around the orchard rather than into it.

Pollination

Even though some cultivars maybe partially self fruitful, good provision for cross pollination is essential to ensure regular pomefruit crops under all conditions.

The Future Orchards 2012 website has notes on Pipfruit Pollination that were prepared for the June ’09 Orchard Walks.

Modern intensive orchards are planted in hedgerows, which means that most bee foraging in them is along the row, rather than across rows, so pollinators need to be in every row to be fully effective. Under net this becomes even more critical, because unless there is several metres clearance between tree top and net there is little bee movement from one row to the next. In row pollinators need to be at 15 – 20m intervals.

Australian orchards are often isolated from other orchards and our experience has been that pollination problems occur more frequently in isolated orchards, than on orchards in locations

where there is high concentration of similar orchards also being foraged by the same bee population. This is because significant pollen transfer occurs within the hive and if the whole hive works pomefruit across a number of orchards, there is bound to be pollen present from a number of cultivars.

The Water Problem

Water availability is a limiting factor for many Australian orchards. Excess water can also be a limiting factor to fruit set. Water logged root systems through the sensitive fruit set period increase the aggressiveness of chemical thinning sprays, notably those the involve ethylene release, eg. NAA, ethephon. Be very careful with chemical thinners if soil conditions are wet.

Farming for the drought is another factor in low orchard performance. If the orchard has grown beyond its sustainable irrigation supply, lower performing orchard blocks maybe best removed so that their water ration can be diverted to the better performing areas of the orchard. Pulling out low or non-performing orchard blocks will also release about $10,000/ha of working capital that can be spent elsewhere in the business.

There is a lot of data in the scientific literature on water management and the effect of water stress on fruit behaviour. Also many of you have become very skilled in managing scarce water by using mulches, efficient drip irrigation systems and pulsed water application. With good fruit size and soil moisture monitoring through the growing season, there is the ability to identify the onset of water stress that may influence fruit sizing.

The published data of irrigation response shows that it is possible to grow marketable fruit with limited water supply, by paying attention to crop load in times of water stress. So rather than set the crop up in spring for the drought that may not occur, set normal full crops and then, if the water supply becomes limiting, adjust crop loads downwards with aggressive hand thinning to remove smaller and damaged fruit.