FACTORS WHICH INFLUENCE FRUIT SIZE

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"He who pays the piper calls the tune." We are moving into an era where the returns for each fruit size will be reflected in grower pay out, rather than be hidden in a common pool of all sizes. In this way, growers will receive direct market signals in their payments. Those growers who produce high percentages of market preferred sizes will receive the better payments.

Fruit size is important, and is becoming even more important. There are many factors that affect fruit size, and management practices must be conducive to production of fruit in the preferred size range for maximum returns to be achieved.

In this paper we will be discussing some of the important factors that influence fruit size.

One of the most important factors affecting fruit size is genetics, the inherited characteristics for good size.

The Hayward variety became the favoured variety because of its size, and certain other characteristics, as compared to other varieties such as Abbott, Monty and Bruno. This size factor is a genetically controlled factor. In the same way it has become apparent that there are different strains of Hayward, which have probably arisen by chance mutation and some of these seem to have a generally good size fruit, other factors being satisfactory. The Kramer strain of Hayward for example is reputed to have good characteristics, including size, and the Gordon's Large entry in the Wrightson's Super Kiwi Contest is certainly a Hayward strain with exceptionally good size.

A fundamental principle of propagation is to get planting material from the best parent source, and this is also an important aspect of achieving the best size in kiwifruit.

However good the genetics of the variety, the plant must be grown under favourable environmental conditions for good fruit size to be made manifest.

The over-riding factor affecting kiwifruit growth and performance in New Zealand is wind. In unsheltered or badly sheltered blocks wind will so adversely affect kiwifruit, that growth, yield, and fruit size will be seriously affected. Wind continually buffeting a kiwifruit plant will increase water loss, cause a serious reduction in leaf efficiency, greatly reduce the chances of good pollination, and cause considerable scarring of the fruit, all of which will reduce the eventual fruit size potential. Good shelter in the orchard is therefore essential.

However, particularly shaded areas will also have a reduced leaf efficiency due to restricted photosynthesis, and a reduced chance of good pollination, with subsequent adverse effect on fruit size. Hence good shelter management to prevent excess shading is vitally important, especially on the narrower blocks of up to six rows in width.

An unseasonal frost at around fruit set can distort fruit, and adversely affect eventual fruit size.

Given good genetics, and environmental conditions, there must still be an efficient plant to produce good yields of good sized fruit. This factor I term good vine tone.

The roots exert a controlling effect on the whole plant, and roots must be healthy, and in a satisfactory soil environment for the plant to be operating efficiently. From the grower's point of view this is the area of soil management. Kiwifruit roots must have air, but anaerobic or water-logged soils will be unsatisfactory for good kiwifruit performance. Where soils are not naturally free draining, a suitable drainage system must be installed to get excess water away quickly and prevent anaerobic conditions developing around the roots. This is particularly important when the vine is in full leaf, and carrying a full crop.

In January 1986 there was heavy rain, and some of the less well drained soils around Auckland and South Auckland became waterlogged for a period of 48 hours or more. The result was some very sick vines that did not

size the fruit properly because of this serious debility. Such water logging can often lead on to the roots becoming infected with Phytophthora root rot.

On the other side of the coin, the vines must be supplied with adequate supplies of water through the heat of the summer when they are in full leaf, and carrying a crop, or they will wilt, and fruit size can be very seriously affected. I first saw this aspect dramatically demonstrated on some seams of gravel soil on the Opotiki river flats during a particularly hot dry spell one summer. If the soil does not have a good moisture holding capacity, the answer is to have an irrigation system, and equally important to operate it properly. The period of first dramatic fruit sizing in the early weeks after fruit set, has been identified as a critical period in which to avoid any shortage of water if full fruit size potential is to be achieved.

The roots then are of vital importance in vine tone, but so also are the leaves. The leaves are the food factory of the plant where the organic compounds, such as sugars, are produced within the plant.

For the plant to be at its most efficient there must be large, green, fully active leaves. The efficiency of the roots affects leaf size, but where the roots are healthy and there is a good general environment, the major factors affecting leaf size are nutrition and water supply. Research has revealed much about the nutrition of kiwifruit over the last few years, and we now know what the desirable levels are for a plant, and that it is important the plant is not short of nutrients in the early season. The production of large healthy leaves early in the season will enhance the prospects of a good yield of good sized fruit.

The seasonal variation to be expected in nitrogen and potassium levels between early and mid/late season could be as follows:

TIME AFTER LEAF EMERGENCE	*N*	*K*
4 weeks (October)	*3.70*	*2.70*
20 weeks (February	*2.12*	*1.80*

In addition recent work at Levin has shown a direct relationship between nitrogen levels and fruit size, with the lower levels of nitrogen being

associated with higher percentages of small sized fruit. It is pointed out, however, that heavy late season nitrogen applications are likely to increase fruit softness.

Nutritional deficiencies, or toxicities that adversely affect leaf size, or the greenness of the leaf will adversely affect both yield and fruit size potential, especially if they progress to the point of partial defoliation.

Leaves must be functioning in good light to be fully efficient. Where the canopy is allowed to become too dense, or multi layered, the efficiency of the underneath leaves is adversely affected with the consequences being seen in the yield and size of the fruit. A good pruning regime is the answer to this, making particularly sure that there is only one layer of shoots at the winter pruning, and then maintaining order and light penetration of the canopy in the summer pruning.

Pollination is of vital importance in achieving a good fruit size.

It has often been stated that at least 1100 seeds are required to get a really good sized Hayward fruit. This requires a lot of pollination. The key factors in a good pollination are to have a good supply of high quality male pollen, at the same time as the female flowers are open, and to get it transferred to the stigmas of those female flowers. There are various ways in which this can be achieved such as hand pollination, bees, or artificial methods such as Pollenaid. The important thing is to get it achieved, as without it there will be a very poor fruit size.

Most kiwifruit flowers have the potential to set good fruit, but the lateral flowers, of doubles and triples will nearly always produce smaller fruit than the 'king flower'. Thus flower thinning by removing these lateral flowers before they are fully open is a useful management practice in governing fruit size, especially where high percentages of doubles and triples are propduced.

Last season we had the phenomenon of a very extended blossom period with the early set fruit being set 3-3½ weeks, or even longer, before the last

set fruit. The early set fruit was of some significant size by the time the last fruit was set, and created a very unbalanced situation. It appeared that the latest set fruit, even where properly pollinated, with a good seed number, could not compete satisfactorily with the early set fruit, and was predisposed to be significantly smaller in size. In contrast to this in some of the cyanamide trial blocks the blossom occurred over a 3-4 day period, and the fruit developed very evenly with a high degree of uniformity in size.

With all fruit crops, crop load tends to have a significant effect on fruit size.

This is dramatically exhibited in some of the more acutely biennial crops such as some citrus varieties. Kiwifruit, although not dramatically biennial, is no exception in that crop load affects fruit size. Very heavy crops with a high fruit number always tend to have high percentages of smallish fruit. This was not too serious 10-15 years ago when we packed Haywards down to 54 count size, and got the same return as for a tray of 25 count. Since then we've seen the removal of 54s, and then 49s from export, and the pressure is now on 46s in that we've had the penalty on that count for the last 2 seasons. From next season on however, we are moving to payment by fruit size, and it was stated this season that 46s were returning $5.00/tray less than the larger sizes. There is a demand for 46s, but perhaps only a maximum of about 8% of our exportable crop. We are now in a new ball game and management practices must be geared to producing an adequate yield of the preferred size fruit. This may require some modification of pruning, but almost certainly a more prominent role of thinning. It would be nice to give you a neat formula for thinning that would be applicable in all cases, but unfortunately it is not that simple. The question of vine tone, as discussed earlier, will control how much fruit can be carried and adequately sized, assuming a good pollination. Vines can look quite o.k. but there may be limiting levels of nutrition, minor shortages of water, or minor debilities of the plant that will limit the potential. However, for an efficiently functioning vine the optimum crop load to produce the majority of fruit in the preferred sizes, 30-39s, would be in the range of 40-50 fruit/m^2. Where thinning is carried out, it must be completed by 2-3 weeks after fruit set to get the fruit size increment

on the fruit remaining on the vine. This will cause considerable pressure on labour as it comes at a time when summer pruning of the female vines is in full swing, and there is also pressure to get the major pruning of the males completed as quickly as possible. However some flower thinning can be undertaken prior to this stage, as doubles, triples, flats and fans can be thinned off even before flowering.

Plant diseases can also have a dramatic effect on fruit size. They may affect vine tone via the roots or leaves, or as a direct effect on the fruit itself.

Phytophthora root rot can debilitate roots, adversely affect vine tone and consequently fruit size.

Where it gets established leaf spot can seriously affect leaf function, even to the point of defoliation with adverse effect on fruit size.

Blossom blight infection of flower parts can lead to small fruit although many of these will fall off the vine, some will remain as small rather misshapen fruit.

The new problem of fruit stalk withering is also appearing to have an effect on fruit size, presumably by way of interfering with the sap supply to the fruit.

There are also other factors which can adversely affect fruit size, by way of affecting vine tone.

An obvious example would be herbicide damage which affects the leaf, or causes a distortion of the fruit with a consequent effect on its overall sizing, such as with Roundup, or hormone contamination.

Fruit size is important, and going to be even more important in the future in supplying the market with the fruit it wants. It is a complex issue, but should be tackled by getting the best planting material, from the best parent sources, growing under good environmental conditions, and maintaining a healthy plant with good vine tone, by good orchard management, and ensuring the best possible pollination is achieved.