GROWING EXPORT KIWIFRUIT

by NORRIE LEES
TE PUKE

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GROWING FLOWERS AND POLLINATING THEM

1. We bought an orchard 13 years ago. It had three blocks of kiwifruit; two were on T bars, one in full production, the other nearly producing. A third newly planted block had alternate male and female lines of vines, and had been planned for pergola support. Many orchards were beginning to bring in a few hives of bees at flowering time to help pollination. But fruit set was very variable. With hives at one to the acre or less, and some orchards with none, this wasn't surprising.

2. The crop we harvested was heavy and fruit sizes were excellent. The next crop - the one that we grew - was a surprise. The lovely looking wood, beautifully spaced and tied down, and approved by experienced growers, bore few flowers, and later carried a lot of small poorly pollinated fruit. Yield was down by half. Clearly there was room for a vast improvement, and new approaches.

3. We began by looking at as many orchards as possible, to see what circumstances combined to produce large quantities of big fruit! Nearness to a male vine was obvious for big fruit sizes. What was not so obvious, but was nevertheless true, was that the heaviest concentrations of fruit were borne on self-terminating laterals from the previous year, which in turn were borne on self terminating canes of the year before that. Or put in another way, at winter pruning an untipped two year old cane with self terminating laterals bears very well if it has developed in full light. These findings - nearness to male flowers, whole two year old canes with self terminating laterals and full summer sun, formed the basis for a successful change in system.

4. Long canes could not be carried on the T bars then in use, unless their ends were cut off. We were not prepared to go against our observations. Therefore we changed from T bars to pergolas, to carry these long (pioneer) canes in one year, and the same cane with its self-terminating laterals in year two. With full light this practice ensured heavy female flowering. The annual addition of one year canes from above, and the winter pruning of the now spent three year canes from below, ensures continuity of crop by an annual succession of canes and laterals.

5. So much for this change to fruitfulness. But it had a major unlooked for bonus. By giving the vine, width to spread a full cane length sideways over a pergola structure, its vigour was spent on a large fruit crop, (instead of an excessive vegetative growth) and thus laterals self-terminated at a convenient length. With these circumstances, the less you prune, the less you need to prune.

6. Hand in hand with this change to a pergola structure, and the use of full length female canes, had come the realisation that alternate lines of male and female vines would place female flowers no more than 12 ft, and an average of only 6 ft, from male flowers - surely a highly desirable circumstance for pollination.

7. But when the pergola canopy first closed with development of the system, a significant proportion of fruit was found to be poorly pollinated. This was seen to be due to restricted bee access through the canopy to the flowers, especially where the canopy was dense. The removal of all canopy growth at winter pruning, between the male leader and the first wire out to one side, thus forming a slot, gives the necessary bee access for full, and completely satisfactory pollination of female flowers. We used then, and still use now nine years later, 3 hives/acre in average years, and 4 hives/acre when female flowering is abundant.

8. For several seasons after the initial use of this bee access slot, we were still apprehensive about pollination, when cold, wet weather was adverse for bee activity. Accordingly on the third successive day of adverse weather, we hand pollinated female flowers by brushing males across them. However, as we could never hand pollinate as fast or as much as we wished, and as fruit set was always uniformly good over the orchard, we slowly abandoned this practice, and came to rely entirely on bee pollination - even when weather was adverse. By this time the male vines had joined up to form lines of flowers down the whole length of each avenue. We still rely only on bees to give us excellent pollination. It appears from our experience that female flower stigmas remain receptive to pollen for periods longer than adverse weather periods, and it is because of this we think, that satisfactory fruit set is achieved. It is certainly a common occurrence to see bees landing on female flowers after their petals have dropped, and when the stigmas have each exuded and bear, a tiny drop of liquid.

9. It is also worth recording that while our Matua type male has many excellent attributes: - when kept dense it coincides well with female flowering, has large flowers throughout the whole flowering season, and has abundant pollen of high viability -, nevertheless it has one very serious drawback. Dr Murray Hopping has shown that about twice as many of its pollen grains are needed to fertilise one ovule, as are M Series pollen grains. But despite this very serious drawback, we obtain excellent pollination through the use of of alternate lines of male and female vines, an access slot down one side of each male line, and 3-4 hives/acre.

10. In these circumstances I consider it would be prudent to take full advantage of Dr Hopping's discovery and selection of the M Series males, and to slowly work over my existing Matua type males and substitue his new ones.

11. The following are some observations and practices that I consider important.

11.1 It has been my experience that the outside avenues of blocks are considerably better pollinated if the outside lane of vines are males. This arrangement also helps to shelter fruit in the outer avenues from wind damage.

11.2 Pollination hives are placed centrally in the orchard in groups of 2-3 amongst avocado trees. Shelter from wind, and exposure to full sun throughout the day, and especially in the morning and evening, are the main considerations. Hives 2-3 ft above the ground on boxes or bins, on some mornings can raise the hives above a layer of cold air, and let the bees work up to an hour earlier.

11.3 Orchard ground cover with its wild flowers, is mown before pre-blossom insecticides are applied. This practice has the merit of protecting the wild bee population for pollination duty before hives are brought in.

11.4 Ground cover is mown during kiwifruit flowering, only when it is about to compete strongly with kiwifruit roots.

11.5 During the dry flowering periods water for bees is provided by dribbling it onto a convenient concrete slab and its surrounding weed area.

11.6 We rent strong, well prepared hives, and have always enjoyed excellent relations with our beekeeper.

11.7 Pollen traps in previous years have shown that hives have worked mainly kiwifruit, but that at times significant quantities of pollen from avocado, clover, oxalis, and citrus, have also occurred.

11.8 Hives are brought in at several different times during the flowering period, starting at about 5-10% flowering. This is achieved by orchards purposely bringing in their hives at different times to their neighbours.

11.9 Our experience has been (para 7) that to get good pollination in pergolas, it was necessary to provide a bee access slot in the canopy down one side of male lines. I offer the suggestion that in pergola situations where males are scattered throughout blocks, better bee pollination would be achieved, if each male was surrounded by a gap in the canopy 3/4 metre (2-3ft) wide, to give similarly good bee access. A dense female canopy also restricts bee access, this is particularly apparent towards the end of the flowering period. I believe that too much canopy leads to poor pollination, and hence to a smaller instead of a bigger crop. This seems particularly important now that price differentials will obtain for different fruit counts. My canopy is more open this year then ever before.

11.10 By design, I have left until the end of this first section, mention of a practice which I am sure, increases the size of the flower crop. Since we started the practice some ten years ago, we have always had abundant flower crops. Indeed we have usually had too many flowers, resulting in too many fruit for the vines to size up. Immediately after harvest we put on a nutrient foliar spray, and sometimes a second spray just as leaf fall is beginning. At first we used urea, but now I prefer a more balanced mixture of nutrients, including trace elements. It may be that variation in this practice could exercise a measure of control on the size of the following year's flower crop. Perhaps it has helped to reduce biennial cropping.

11.11 With such heavy crops of flowers, obtained, managed and pollinted as previously described, it has seemed to me unnecessary to increase canopy area above 100% of ground area by new structures of raised arms or folds; nor indeed to incrase the flower crop by the use of such chemicals as hydrogen cyanamide. To my mind, the crucial problem has been and still is, how to size up heavy crops of fruit. Until we can achieve this, the production of still more fruit per vine seems counter-productive.

THE SMALL FRUIT PROBLEM

12. Poor bee pollination has been blamed for small fruit many times. There are other causes too, such as bud rot preventing, or allowing only partial, pollination; when fruit is set and develops in heavy shade, size seems to remain small; drought, too much rain, and low spring temperatures keep fruit small; fungal attacks to fruit stalks, shoots and leaves seem able to do the same; and also severe wind damage to leaves.

13. My own approach to improving fruit size of the overall crop, has been to concentrate on plant nutrition, irrigation and physical soil properties. The 1986 harvest may at last have seen some progress. In an adverse season, average fruit size was about 40, and undersize rejects from the grader and from selective picking totalled about 8% - which meant that most bays were fairly cleanly picked.

NUTRITION

14. For years I have been removing heavy kiwifruit crops, without adequately replacing those resulting very heavy mineral losses, that in recent years have been highlighted by Drs G Smith, R Ferguson, N Turner and their colleagues and associates. I am finding that several successive annual heavy applications of mineral fertilizers are necessary to restore mineral fertility. Last year 1.25 tonnes/ha (9 cwt/acre of muriate of potash, in a total of 6 applications from August to February, went a long way - but not all the way - to restoring potassium levels in the leaf. Nor has it been possible to supply all potassium needs, by a heavy weekly balanced fertigation

programme, using micro-sprinklers covering respectively 50% or even 70% of area covered by the female vine canopy. From these findings I deduce that kiwifruit vines depend on their deeper roots, as well as on surface feeder roots, for adequate supplies of minerals. I also deduce that fertigation is a supplement to, and not a substitute for, adequate broadcast applications for fertilizer. Mineral status is monitored monthly by leaf analysis, and appropriate corrections are made through variations in the fertigation programme. I also use suitably adjusted levels of nutrient foliar spray to correct mineral deficits in leaves. Again these have helped, but they have not been able to keep mineral levels quite high enough.

15. By measuring the conductivity levels of soil moisture solution, and comparing them against fruit swell data, I found that a steadily dilute fertigation solution, promotes greater fruit swelling than does a concentrated solution. Conductivity factors of 3-6 promoted greater fruit swelling than C.F. values over 6, (taken at depths of 20 and 40 cms). I also found that fruit swell is greater when the soil at 30, 40 and 70 cms depth, is slightly wetter than field capacity, than when it is slightly drier than field capacity. Perhaps this is to be expected, but after a hot 7-10 day dry spell with high winds, irrigation that wets the soil down to at least 70 cms produced a very well worthwhile increase in fruit size, using micro-sprinklers, and circumferential fruit measurements for comparison. These findings relate specifically to the Bay of Plenty soils on my orchard.

PHYSICAL SOIL PROPERTIES

16. On long established orchards digging with a spade between herbicide strips shows severe compaction where tractor (and trailer) wheels traverse the avenues. Roots are far less frequent here than in herbicide strips. Worms are infrequent. When it rains water is very slow to percolate, and run-off is considerable. These are very different characteristics from those found on pasture land, or on newly established kiwifruit orchards.

17. Nor should this be surprising. By my count a tractor, with or without a trailer, is driven along an avenue about 50 times a year. Nor is it always possible to let the soil dry out before driving on the land. A heavy single axle sprayer, or bin trailer, with a loading of 1/2-3/4 tonne per wheel may be useful for compacting a new road base, but I think that remedial action is necessary on the orchard. Also my observations lead me to believe that a flail mower pounds debris onto the surface of the soil, creating a hard crust that further reduces aeration and percolation. To overcome these compaction problems, it is now my practice to spike avenues with a ground hog at least once a year. Also I like to mow as high above the soil and as infrequently as reasonably possible, and to sow grass and clover seed, to promote vigorous sward to restore soil structure. It seems likely to me, that the main value of a vigorous sward under the vines, lies not in indicating that the canopy is nicely open, but in the fact that soil structure, percolation and aeration are being maintained at a satisfactory level.

CROP LOADING

18. Paragraph 4 outlined a system for carrying a mixture of 1 and 2 year old full length canes on pergolas. The next objective has been to carry the "right" size of fruit crop. I offer the following as a useful approach.

19. A one year cane averages 2.8 metres on my orchard. The bearing laterals on a two year cane, total roughly three times this, say 8.4 metres. At winter pruning if I keep

	8 x 1 year canes of 2.8 m	=	22.4 m
and	5 x 2 year canes of 8.4 m	=	42.0 m

then I have kept a total length of fruit bearing wood for next season of 64.5 metres

If the area of female canopy in a bay is 17 square metres, then I carry 1 metre of wood to approximately 1/4 square metre of canopy, and the bearing lengths of wood are spaced about 25 cm (10 inches) apart. This seems a very reasonable framework for bearing fruit, and should make for easy pruning. You can tell your pruners, "Leave 8 one year canes and 5 two year canes spread evenly over each bay," and know that you will carry an average of about 65 metres of bearing wood. You can set your own standard length of bearing wood, and achieve it by specifying the required numbers of 1 and 2 year canes.

20. That is the first step, the setting of the framework- the last step comes from the knowledge that if you carry the **"RIGHT"** number of fruit per metre of one year bearing wood, then you will achieve an excellent distribution (mix) of fruit sizes for your crop; for example 85% in the 30-39 counts, 15% in the 42-46 counts, and only a tray/bay of undersize fruit. Mr Ripley, perhaps? I have not the time to present the evidence, but I have data from 12 orchards to prove it. I hope you can believe it.

21, As an example that might apply to a Bay of Plenty soil, suppose the "RIGHT" number of fruit per metre of bearing wood is 12. Then 65 metres times 12 fruit = 780 fruit/bay, less 15% reject = 663 fruit, at 36/tray = 18.4 trays/bay, times 450 bays = 8287 trays/hectare (3315 trays/acre). Obtaining the optimum fruit size distribution (mix) seems to be largely independent of the number of metres of bearing wood that is carried per bay. Number of fruit per metre of bearing wood seems to be the vital factor in determining the mix of fruit sizes.