

APPLE GROWING IN EAST JAVA: THE SCOPE FOR IMPROVEMENTS

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Summary

Starting around 1960 apple growing in East Java developed from a few straggling trees into an industry of some 2 million trees. Production per year is estimated at approx. 15 000 ton. Unique features are that the apples are grown at lower elevations (700 - 1 200 m) than elsewhere in the tropics and that trees produce 2 crops per year (amounting to 3 ton/ha/year in good orchards), through manipulation of the growth rhythm by defoliation and pruning, in the young trees supplemented by bending.

Intensive husbandry is essential for sustained growth; as this leaves much to be desired the majority of the trees hardly contributes to apple production in the region. Short-term improvements have to come mainly from:

- balancing growth and yield through stimulation of growth and harder pruning and fruit thinning;
- improved disease control, based less on spraying and more on orchard hygiene;
- delaying harvest till fruit matures on the tree.

Long-term improvements:

- good fruit set in the rainy season through cross-pollination;
- propagation and distribution of virus-free trees;
- widening the basis of the industry with other cultivars.

The apple example suggests that the field is wide open for similar developments in respect of pear, plum, peach and nectarine.

1. Introduction

Starting around 1960, apple growing in East Java developed from a few straggling trees into an important industry of some 2 million trees. Annual production is estimated at approx. 15 000 ton. Several authors have described the success story and the unique features of apple growing in the area (Janick, 1974; Kusumo, 1974; Notodimedjo et al, 1981a & 1981b; Saure, 1973). The apples are grown at lower elevations (700 - 1 200 m) than elsewhere in the tropics. Moreover the trees produce two crops per year. This is achieved by strict regulation of the growth rhythm through defoliation and pruning, in young orchards supplemented by bending of the shoots to a horizontal position in order to induce lateral bud-break. Good growers attain yields of about 30 ton per ha per year, based on 1 000 - 1 500 trees per ha. The trees remain so small that no steps or ladders are needed for pruning and harvesting; simple knapsack sprayers are used for crop protection.

Apple growing in East Java shows all the characteristics of a young industry, it is expansive, dynamic, speculative. Profits can be very high but success does not come easily. Intensive crop care is required to sustain growth, but many trees have been planted on land

which cannot be irrigated and in many instances manuring and crop protection leave much to be desired. It is probably correct to say that the majority of the trees does not produce substantial crops. Moreover, trees age quickly in a 6-month crop cycle and problems increase with age. While the crop is still spreading into new areas, production in the original centre around Batu appears to be declining, probably also because many trees are ageing.

Another problematic feature is the narrow basis of the industry; only one rootstock is used and of the three cultivars grown, 'Rome Beauty' is by far the most important one; 'Manalagi' (a local name) and 'Princess Noble' play only a modest role. Here attention should also be drawn to the fact that other temperate fruits, such as pear, plum and peach are hardly grown at all. This is remarkable because elsewhere in the tropics pear or plum and peach are important highland crops and apple takes the last place, it being considered a much more difficult fruit to grow. This suggests that there is still much scope for the development of the other temperate fruits in East Java.

The above points indicate that for the success story of apple growing in East Java to be continued, a hard look at the current cultivation methods is appropriate. In this paper, based on field observations and reports by others rather than on personal experimental work, recommendations are made to overcome constraints mentioned by growers. Improvements which can be implemented in existing orchards are discussed in section 2, more long-term improvements in section 3.

2. Suggested improvements in existing orchards

2.1 Balancing growth and yield

In East Java, the apple bears profusely. A large majority of the terminal buds are flower buds. Since few lateral buds break, flowering is heavy in relation to the number of leaves. In the dry season nearly all flowers set fruit. This tendency to overbear is not adequately corrected by early fruit drop. As a result trees respond very well to intensive husbandry: clean cultivation under the trees, irrigation, manuring, crop protection. These measures encourage vegetative growth which is essential to support the heavy crop and to maintain tree vigour for subsequent crops.

Growers are aware of the need to boost growth, but do not always have the means (e.g. irrigation water, knowledge of crop protection) to sustain vigorous growth. Hence most trees decline within a few years after coming into full bearing.

The problem is so serious that it should be tackled both ways:
- promote leaf growth by intensive husbandry;
- reduce the demand for photosynthates by fruit thinning and pruning.
This latter approach requires some explanation:

When everything has been done to promote growth, fruit thinning is the only way to correct the remaining imbalance between growth and yield. Bourse shoots at the base of the inflorescence are not common in East Java. This means that the cluster of fruitlets depends largely on the subtending leaves, which were formed in the same bud. During fruit set one can already see how many leaves are present; further events (damage by pests and diseases, early leaf fall) can only reduce the available leaf area, it cannot be increased. That is

why irrigation, manuring and crop protection are essential to promote leaf area and leaf duration. Research work is needed to establish the number of leaves needed per fruit and shortly after fruit set the cluster should be thinned accordingly. In the temperate zones bourse shoots have a balancing influence, because initially they reduce fruit retention through competition and after the leaves have expanded the bourse shoot feeds the fruits which have been retained.

As for pruning it should be pointed out that the leaves have to support the living tissues in branches and roots as well as the fruit. Long bare branches with only a few leaves at the tip may in fact weaken the tree instead of strengthening it; such branches should therefore be cut out. Intensive husbandry will produce enough vigorous shoots to replace these branches; these should be bent horizontally and tipped before dormancy precludes good lateral bud-break. Current practice is to stop bending and tipping after the trees come into full bearing. Consequently bud-break is largely limited to terminal buds, which inevitably results in extended bare branches.

Thus fruit thinning and replacement pruning are recommended, in addition to all practices which stimulate growth, in order to balance growth and fruiting. This will become even more important if fruit set in the wet season is improved. At present, a very light second crop, following poor fruit set during the rainy season, gives the trees a chance to recuperate, at least in orchards with adequate crop protection.

2.2 Improved disease control through orchard hygiene

A large number of pests may attack the apple trees at any time, but there are only a few important diseases and their occurrence is more predictable. In well-kept orchards very frequent spraying is common practice and crop protection is usually the biggest item in the cost of production. It is felt that with more attention to orchard hygiene chemical treatments against diseases can be greatly reduced, to the benefit of both producers and consumers!

The three main diseases are:

- powdery mildew (*P o d o s p h a e r a l e u c o t r i c h a*)
- necrotic leaf spot (*M a r s s o n i n a* sp.)
- canker (*C o r t i c i u m s a l m o n i c o l o r*).

The control of each of these diseases may be simplified through appropriate cultural practices.

Powdery mildew affects buds and leaves. If defoliation is carried out carefully, only bud infections remain on the tree. Infected buds give rise to mildew-covered shoots which can be recognized at a glance. These stunted shoots are useless; worse, they are the source at infection of leaves on healthy shoots. Therefore, breaking out the infected shoots once or twice a week during the period of bud-break eliminates the source of infection. This is a very effective way to simplify control of powdery mildew.

M a r s s o n i n a is a rampant disease which attacks the mature leaves in the wet season and can quickly give an orchard a blighted appearance. Defoliation at the start of a new crop cycle offers an opportunity to eliminate the disease. To this end complete removal of all mature leaves is needed. Thereafter, during budburst and early shoot growth, there is no need for spraying. When spraying is resumed, thorough coverage of the trees is important to slow down the

build-up of the disease.

Canker is wide-spread and infections can usually be recognized by their sooty mould cover. Infection occurs in moist conditions through wounds. Narrow crotches in the tree frame are most prone to infection because thickening of the joint causes fissures and these spots lead to amputation of big branches if not death of the tree. Therefore growers protect the tree framework by painting it with a fungicidal paste. This practice is sound but the risk of infection can be minimized by shaping the young tree with wide-angled branches. In existing orchards a further good practice is to cut out and treat all canker wounds thoroughly at the end of the dry season, so as to enter the wet season with low level of infection.

2.3 Harvest ripe fruit

Premature harvesting is a problem the world over; in East Java apples are picked extremely green. This reduces yield, market acceptance and price level. The need for cash and the risk of leaving a valuable crop 4-6 weeks longer on the tree are important reasons to harvest early. In fact one never sees ripe fruit on the tree. It is not even sure that the fruit will ripen properly on the tree; unless enough foliage persists, fruits will not further grow out and may as well be after-ripened in storage. In establishing criteria for the best stage of maturity to pick apples, the consequences of a 4-6 week longer crop cycle for the cropping schedule also needs to be considered.

3. Recommendations for long-term improvements

3.1 Fruit set in the wet season

Of the two crops per year one largely fails because of poor fruit set during the rainy season. This is in sharp contrast with the very heavy fruit set during the dry season. Pollinator trees are absent in most orchards in East Java. Since apple generally sets much better with cross-pollination, poor fruit set is to be expected; in fact the heavy set during the dry season is the surprising phenomenon!

Yuda (1983) has investigated fruit set during the dry season in East Java. His main findings are that 'Rome Beauty' is self-compatible and that pollination can already take place before the flowers open. In three orchards without pollinators 'Rome Beauty' fruits contained only 2-3 seeds on average and 12.5 -18% of the fruit were parthenocarpic. With pollinators average seed numbers per fruit increased to 3.90 and 6.70 in the two orchards sampled and no parthenocarpic fruits were found. Yuda noted a significant increase in 'Rome Beauty' fruit size with increasing seed number (in all samples with sufficient variation in number of seeds per fruit); growth rate and final size of seedless fruits were lagging behind considerably.

In discussing his results, Yuda suggests that strong sunlight and high temperature favour self-pollination. This is in keeping with the experience that cross-pollination is less important when weather during bloom is warm and sunny. The implication is that in the far less favourable weather conditions during the rainy season, cross-pollination is indeed needed. Incidentally, observations in other

tropical highland areas suggest that cultivars which are poorly adapted tend to become more self-fruitful in those environments than well-adapted cultivars. The low-chilling cv 'Anna' for instance requires cross-pollination even in the dry season.

To improve fruit set in the wet season introduction of pollinator cultivars is strongly recommended. If these cultivars produce a good crop themselves, they also constitute a most welcome widening of the basis of the apple industry in East Java.

3.2 Elimination of virus diseases

As a result of indiscriminate use of rootstock and scion material, virus diseases are wide-spread. It must be presumed that all the trees in East Java suffer from one or several virus diseases. Although apple viruses are less debilitating than citrus viruses, virus-free trees do grow and yield better. They are uniform, grow more vigorously and produce more top grade fruit. Experience in other countries shows that apple viruses spread mainly through propagation of diseased material in the nursery. Insect vectors do not play an important role; if virus-free trees are planted, the orchard is likely to stay virus-free for a long time.

Therefore it is recommended to establish a collection of virus-free mother trees to supply nurseries with healthy root-stocks and budwood. The first and most important step has already been taken: the local rootstock is being treated in the Netherlands to eliminate virus infection. Virus-free budwood of 'Rome Beauty' and other cultivars is readily available in several countries. When the rootstock is returned to Indonesia, imported healthy budwood can be propagated to build up a virus-free mother tree collection. With a certification scheme the supply of healthy trees through bona-fide nurseries can be guaranteed.

4. Conclusion

The apple industry in East Java has developed by leaps and bounds. Now the emphasis is shifting from expansion to making the best of existing orchards. As shown in this paper recommendations are rather general and to some extent speculative, but with the support of research work it will not take long to work out specific recommendations, e.g. on replacement pruning, fruit thinning, fruit maturity, pollination, etc.

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