



Strategies for improved litchi production

Part 1: Flowering to harvest

Productivity of litchi depends on a series of developmental phases and is determined by both tree status and environmental factors. In general, litchi tree growth in South Africa includes one or more flushes after harvest, followed by a short dormancy period in autumn and early winter, flower induction under cold temperatures in late autumn and winter, flower panicle emergence during early winter leading to flowering (pollination and fertilisation) in late winter/early spring and fruit set and development during summer.

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The productivity of litchi trees is related to the fitness of each mentioned developmental phase, which needs proper management. Figure 1 describes the details of vegetative and reproductive growth cycles in litchi with reference to necessary management practices during the reproductive cycle for improved production. Management strategies to improve litchi fruit production and quality will be discussed in two parts. The current part will deal with management practices during flowering and fruit growth.

IMPROVING FLOWER QUALITY

With inductive chill temperatures in late autumn and winter, litchi trees will exit the vegetative growth cycle and enter the reproductive growth cycle, including flower panicle growth, flowering and fruit growth. These processes are very nutritionally costly.

Optimum fertiliser and water supply are essential for strong and healthy flower panicles and fertile flowers. Early flower panicle emergence causes long flower panicles. Long flower panicles and a large quantity of flowers tend to bear less fruit than short flower panicles due to depletion of starch reserves. This is especially the case for the cultivar Fay Zee Siu. Poor flower quality in Fay Zee Siu is reflected by low pollen fertility in male flowers and weakly developed embryo sac of the female flowers. Therefore, flower panicle pruning is routinely used in China to reduce panicle size of Fay Zee Siu by panicle shortening at the end of panicle elongation to increased flower quality and improve fruit set. The following strategies are recommended for improved flowering:

Applying sufficient fertiliser and water

Availability of ample water and nutrients during flower panicle development and flower opening will ensure strong and healthy flower

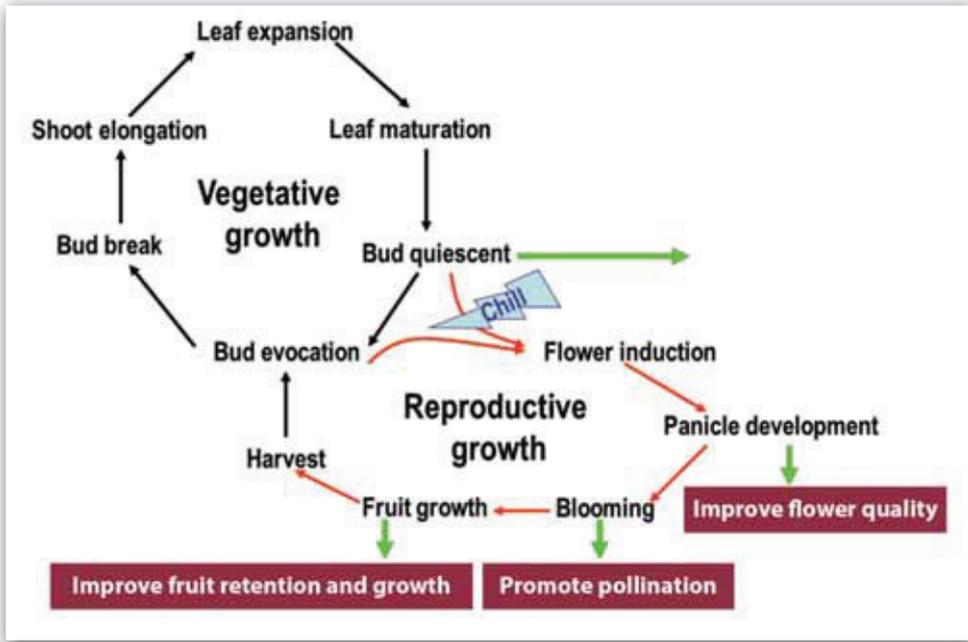


Figure 1. Vegetative and reproductive growth cycles in litchi and necessary management practices (maroon blocks) to improve litchi production in the reproductive phase.

SOURCE: X.M. HUANG, KEYNOTE PRESENTATION AT THE 4TH INTERNATIONAL LITCHI AND LONGAN SYMPOSIUM, DEC 2012; ADAPTED

panicles and fertile flowers. Fertilisers should be applied according to soil and leaf analysis during flower panicle development. During flowering, often hot winds occur. In order to prevent unnecessary flower drop, sufficient water according to tree requirement should be supplied.

IMPROVING FRUIT SET

Although litchi often flowers profusely, only 1 to 5% of the female flowers set fruit depending on tree, cultivar, year and environment. Fruit abscission is a normal physiological process so that limited resources are supplied to a limited number of fruit and a quality crop can be produced. This self-regulating mechanism is, however, greatly influenced by external factors such as adverse climatic conditions (too warm or too cold, low humidity, strong winds, prolonged rain), water stress, lack of nutrients (especially boron and zinc) and competition with vegetative growth, which can lead to excessive fruit drop and production loss. Strong bearing shoots with plenty of functional leaves are the basis of good fruit set. To improve fruit set the following strategies are recommended:

Improving pollination

Pollination and fertilisation are the preconditions for sufficient initial fruit set and plenty of bee colonies

(4 per hectare) should be introduced to the orchard before flowering. Sufficient initial fruit set is the best way to suppress summer flush, which competes with the fruit for carbohydrates and can cause heavy fruit drop (Fig. 2).

Applying micronutrients

Zinc and boron are important micro nutrients for pollination and fertilisation. Foliar applications of zinc and boron should be applied to first male flowers.

Optimising irrigation

Flowering and fruit set periods are very

sensitive to water / drought stress and lack thereof can cause excessive fruit drop. During fruit set and initial fruit growth, cell division takes place and any stress during this period reduces the amount of cells formed in the fruit and thus can limit final fruit size. Tensiometer readings for the root zone should not go below -30 kPa. Frequency and duration of irrigation cycles should be adjusted according to tree water requirement, soil type and irrigation system. Use of soil moisture probes is advisable to avoid under- or over irrigation.

TO PAGE 62



Figure 2. Sufficient initial fruit set suppresses summer flush (A), whereas shoots with poor fruit initial set tend to produce a summer flush (B).

PHOTOS: X.M. HUANG

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FROM PAGE 61

Applying plant growth regulators

Abscission of plant organs is regulated by the balance between auxin and ethylene at the abscission zone. Ethylene triggers abscission of organs, including fruit, while auxin suppresses it. Abiotic stresses such as cold, high temperature and mechanical wounds, induce ethylene production that can induce excessive fruit drop. Under such circumstances, application of auxin-like regulators such as Maxim® (3, 5, 6-TPA) or naphthaleneacetic acid (NAA) can help the fruit to pass the "harsh" period and are useful for fruit retention. Maxim® is registered on litchi for fruit retention (40 ppm, applied at 2 g fruit mass stage).

The application of cytokinins at female flower (e.g. Kelpak®) helps to increase cell division for improved fruit size.

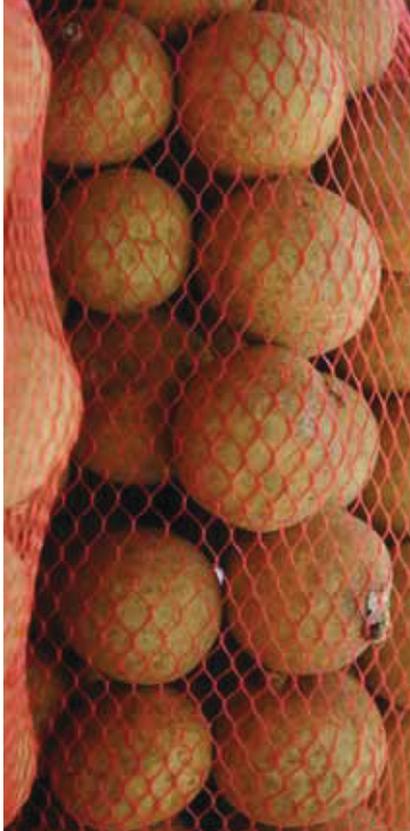
Girdling

Girdling is an effective measure to suppress summer flush and root growth and significantly improves fruit set. Girdling for fruit set is done during female flower bloom in a spiral around the trunk (Fig. 3). Although very effective, girdling has not been widely used in South Africa.



Figure 3. Spiral girdling applied on a litchi tree trunk to promote fruit set and growth or suppress winter flush.

PHOTO: XM HUANG



Pest control

Damage by pests and diseases induces ethylene production and thus massive fruit drop. Fortunately, litchi has few pests and diseases in South Africa. However, the coconut bug (*Pseudotheraptus wayi*) was found to be the cause of significant fruit drop in the Nelspruit area, where it also has a range of other hosts. Although litchi trees may possibly compensate for early fruit loss, the effect of fruit drop caused by the coconut bug on production has not been quantified yet. It is advisable to examine dropped fruit for coconut bug feeding damage.

IMPROVING FRUIT QUALITY

Carbohydrates are the basis for good fruit yield and quality and are mostly supplied by the leaves behind the fruit cluster, but also by the main reserves in the bigger branches. Therefore, fostering strong bearing shoots after harvest and supplying the trees with sufficient water and nutrients at critical developmental stages is crucial for optimum photosynthesis and carbohydrate build-up and thus for a quality crop. Water stress and lack of nutrients during the fruit growth period can lead to small fruit, premature fruit drop and cracking. The following strategies are recommended for improved fruit growth:

Optimising irrigation

Irrigation to maintain soil moisture is necessary throughout fruit growth. This

ensures sufficient cell enlargement for big fruit. Tensiometer readings for the root zone should not go below -30 kPa. Frequency and duration of irrigation cycles should be adjusted according to tree water requirement, soil type and irrigation system. Use of soil moisture probes is advisable to avoid under- or over irrigation.

Applying nutrients

About 30%, 50% and 50% of annual applications of N, P and K, respectively, are recommended for fruit development depending on soil and leaf analysis. No more nitrogen should be applied after the 2nd fruit drop as this can delay fruit colouration during maturation time. Calcium is an essential element for cell wall construction and very important for fruit growth and cracking resistance. Supply of calcium with foliar sprays should be carried during the early fruit development stage (within 6 weeks after female flower) in one to two applications. Liming should be done earlier during or before flowering in the winter. Monopotassium phosphate (MKP) can be applied at the 8 to 10 g fruit mass stage for improved fruit colour.

Applying plant growth regulators

Auxin-like plant growth regulators can increase fruit size when applied at the correct time. Maxim®, a synthetic auxin, is registered for litchi for increase of fruit size (40 ppm, applied at 3 to 4 g stage; after 2nd fruit drop period).

Pest control

Fruit flies (*Ceratitis* spp.), litchi moth (*Cryptophlebia peltastica*) and false codling moth (*Thaumotobia leucotreta*) can do considerable damage to the litchi crop if left uncontrolled and in certain areas and years. Monitoring for these pests should start early in the season and recommended control measures be applied to protect the crop.

Bagging of fruit clusters can prevent pest damage, save on pesticide sprays and improve fruit colour, especially for the green-coloured cultivar Fay Zee Siu, but it is very labour intensive. **ST**