Fewer spurs lead to a better and more reliable fruit set

By Stuart Tustin, Ken Breen, Ben van Hooijdonk, Sally Bound, Heidi Parkes, Osi Tabing, Simon Middleton, John Wilkie and Dugald Close

IN THIS ARTICLE, WE SEE HOW FRUIT SET RESPONDS TO DIFFERENT CROP MANAGEMENT APPROACHES AND HOW PRECISION CONTROL OF ANNUAL FRUITING CAN DELIVER PREDICTABLE YIELDS, HIGHER FRUIT QUALITY AND BETTER ORCHARD PROFITS.

The shift from conventional crop load management to one that uses artificial spur extinction (ASE) as the primary crop load method takes the process of regulating and setting crop load from 'approximation' to 'precision'.

In our previous Australian Fruitgrower articles we have described how precision cropping can be achieved by using simple metrics for branch number per tree (Manipulating apple tree structure to optimise fruit yield and quality, May 2014) and Artificial Spur Extinction (Artificial spur extinction – a new crop management tool, Jun 2014). This is compared with standard approaches that are frequently empirical and depend on multiple chemical and hand thinning strategies.

The productivity metrics for a full crop on mature dwarf apple trees planted at 2,000 trees per hectare are:

- 250 fruit per tree,
- average fruit size of 180-200g,
- equals 90-100 t/ha.

In the PIPS program, we have compared two methods for achieving such productivity:

1. **Conventional trees with no chemical thinning and with crop loading established by hand thinning.**
2. **Artificial spur extinction controlling floral bud density.**

We have compared every aspect of productivity and fruit quality from these two crop management approaches across sites in Tasmania, Victoria and Queensland using selections of 'Royal Gala' and 'Cripps Pink' apples over a minimum of three consecutive seasons.

The first significant step to optimising productivity is to achieve appropriate fruit set on the best quality buds throughout the canopy, so that a full crop of optimally sized fruit can be achieved every year.

Natural patterns of fruit set in apple in Australia

Conventional wisdom has been that most cultivars set up most of their floral spurs in clusters of 3-5 fruit per bud.

Whilst each cultivar will have a characteristic natural pattern of fruit set, many cultivars have a similar fruit set behaviour.

Did you know?

- 20-30% of flowering spurs fail to set any fruit at all.
- 25-40% of floral buds set just one fruit per bud.
- Fewer than 25% of all the floral buds ever set more than two fruit per bud.
- The patterns of fruit set are affected by the intensity of flowering.
- All these responses are without any chemical thinners and have been measured across three apple-growing regions in eastern Australia.

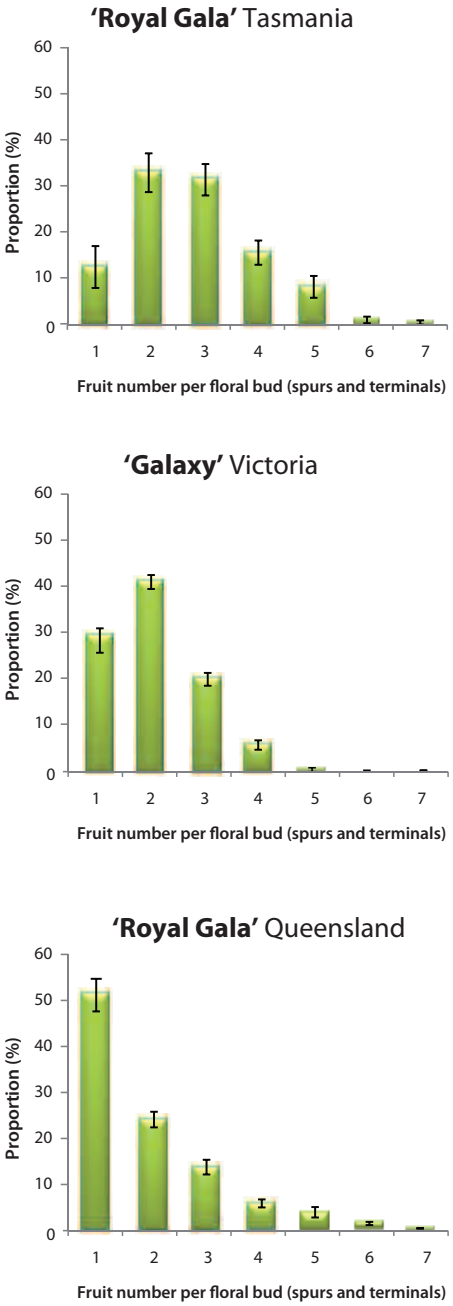

Figure 1: *The proportions of floral buds setting between 0 and 6 fruit per bud in unmodified 'Royal Gala' and 'Galaxy' apple orchards in Tasmania, Victoria and Queensland, where total floral bud density in each state was 4, 7 and 7 buds/ cm² BCA respectively.*

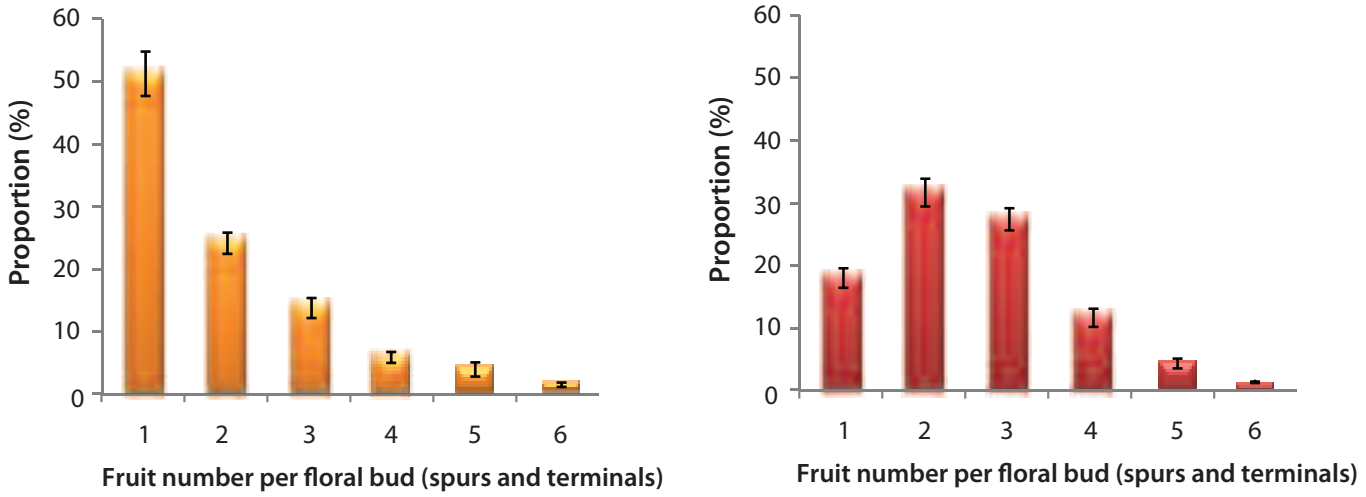

Figure 2: *Patterns of fruit set in 'Gala' apple trees at the Queensland PIPS site, in the absence (left) and in the presence (right) of adequate donor pollen supply.*

The natural patterns of fruit set for 'Royal Gala' orchards in the three regions provide some interesting comparisons *(Figure 1)*:

- The patterns shown in Tasmania and Victoria are reasonably similar.
- Tasmanian 'Royal Gala' had a lower proportion of buds setting zero fruit. This is because this block had a low floral bud density of only 4 buds/cm^2 of branch cross-sectional area (BCA), was mildly biennial, and had fewer than half the floral buds normally expected.
- In Victorian 'Galaxy', floral bud density was 7 buds/cm^2 BCA, and 30% of floral buds failed to set.
- 'Royal Gala' in Queensland had a different natural pattern of fruit set despite having a normal floral bud density of 7 buds/cm^2 BCA, where more than 50% of buds failed to set.

Knowing what natural fruit set patterns look like is very valuable in understanding the fruit set behaviour on individual orchard blocks. An analysis of responses in *Figure 1* demonstrates this.

The patterns of fruit set in Tasmania and Victoria are similar to patterns for New Zealand 'Gala' orchards. The slight variance in fruit set pattern in Tasmania is explained by the low flowering intensity in that year.

The different and atypical pattern for Queensland immediately warned us that there was some factor affecting fruit set, unrelated to flowering intensity. Analysis of the particular circumstances of the block suggested a lack of any polleniser cultivar, which was corrected using donor bouquets in the next spring. The pattern of fruit set response when donor pollen was supplied conformed to the typical 'Gala' fruit set behaviour *(Figure 2)*.

Fruit set behaviour in apple with artificial spur extinction

Artificial spur extinction systematically reduces the number and density of spurs and terminal floral buds on tree limbs. This method of precision crop load control is done before bud break, effectively partially thinning the tree before flowering and also markedly reducing the tree total floral bud load (typically by 50% or more) compared with that of unmodified trees.

Reduction in floral bud numbers occurs in two ways:

- Hand-thinning spur and terminal buds to a pre-determined density on each limb, systematically selecting and spacing out only the largest and strongest buds.
- Stripping off all axillary floral buds just after bud break when they are quickly and easily stripped between thumb and forefinger.

By these methods, all retained floral buds on the tree are derived from the strongest of the most preferred bud types, terminals of short shoots and spurs.

Once spur extinction is completed, the major annual thinning effort for the crop is already done – before bud break!

Because artificial spur extinction reduces floral bud numbers, it is vital that a high success rate of fruit set is achieved on the retained buds because:

- From a fruit set perspective, the total bud load has been significantly reduced.
- From natural fruit set studies, we expect that reduced floral bud numbers will enhance fruit set in the retained floral buds.

Fruit set responses to artificial spur extinction for 'Gala' and Cripps Pink' cultivars show that fruit set, on an individual bud basis, progressively increases when the floral bud load is reduced by artificial spur extinction to 5 buds per cm^2 BCA (a commercial crop density), and even further to 3 buds per cm^2 BCA (a lower, non-commercial crop load) *(Figures 3 and 4)*.

Characteristic fruit set responses to artificial spur extinction crop load setting include:

- The proportion of buds that fail to set any fruit is reduced by 30-60%.
- Associated with this response is an increase in the proportion of floral buds that set two or more fruit per bud.
- At commercial crop densities, the greatest proportion of buds always set just one fruit per bud.

After the use of artificial spur extinction at commercial crop loads (5-6 buds per cm^2 BCA), only 10-25% of the floral buds

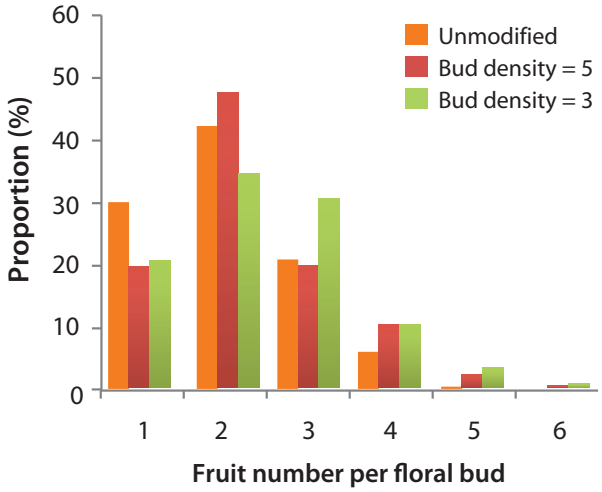

Figure 3: *The proportions of floral buds (spurs and terminals) setting between 0 and 6 fruit per bud in unmodified 'Galaxy' apple trees in Victoria, compared with trees in which artificial spur extinction was applied at bud densities of 5 and 3 floral buds/cm² branch cross-sectional area.*

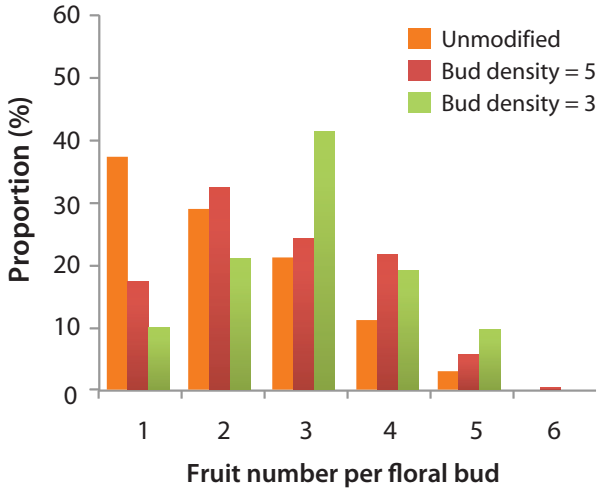

Figure 4: *The proportions of floral buds (spurs and terminals) setting between 0 and 6 fruit per bud in unmodified 'Cripps Pink' apple trees in Victoria, compared with trees in which artificial bud extinction was applied at densities of 5 and 3 floral buds/cm² branch cross-sectional area.*

set more than two fruit per bud *(Figures 3 and 4)*. These are the only buds on the tree that require any hand thinning.

The proportion of buds setting two fruit generally compensates for the proportion of buds that fail to set (compare columns 0 and 2 in *Figures 3 and 4*), thereby ensuring the target fruit number per tree is achievable with minimal further input.

But wait ... there is more!

A correctly structured dwarf tree using artificial spur extinction to achieve 5 buds per cm² BCA will have only 275-300 floral buds per tree, for an intended final crop load of around 270 fruit per tree.

A very useful physiological phenomenon occurs as a result of this reduced flower load. Because of the reduction in flower numbers, the total number of fruit set on the tree is also markedly lower than that on 'normal' trees.

Trees set up using artificial spur extinction DO NOT express December drop. This is because there is no excessive fruit set that invokes the fruit-shedding phenomenon.

Why is this important?

With no need to wait for final fruit drop, the final crop load adjustments by hand thinning the small proportion of buds with more than two fruit can be completed much earlier than usual. We recommend thinning at around 25-30 days after bloom once the initial set is completed, which is still early enough to improve fruit size responses. At this time, the fruit are also very easily visible within the young developing leaf canopy, and because spurs are well spaced by artificial spur extinction, with redundant spurs removed.

Summary

The behaviour and patterns of fruit set in apple demonstrate that controlling tree structure and bud population using precision methods (based on measurements and metrics) can make accurate crop load setting simpler, and provide better control of both productivity and fruit quality. Using artificial spur extinction maximises cropping on the best buds in the tree and spatially distributes buds so that fruit develops optimally at development stages that enable optimum fruit size responses to crop load.

By using these crop management methods, chemical thinning is not required and biennial bearing is controlled, as long as there are no other unrelated factors affecting apple tree development. These combined responses are fundamentally regulated by the effect of artificial spur extinction on reducing and controlling the floral bud load of trees, and the associated regulation of fruit set and fruit growth which arises from early-season control of crop load. :afg

Acknowledgements

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