# Non-infectious Bud Failure Effects and Management

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This year is shaping up to be a bad one for the expression of Non-infectious bud failure (BF) symptoms. Anyone who has followed BF for awhile recognizes that some years are much worse than others.

It's well known that non-infectious bud failure is a genetic disorder that occurs in many almond varieties in California. Nonpareil or any variety with Nonpareil parentage in its genetic background can be affected by the disorder. The problem is usually more severe in warmer areas of the state and in a spring following a hot June the previous year.

BF does not affect the flower buds. Flowers form and bloom normally although the bloom time is usually delayed by four to seven days. It is the vegetative shoot buds that actually fail.

Yield losses occur because fruit wood development is reduced and possibly because more limited leaf surface reduces carbohydrate production. On individual shoots affected by BF the basal or terminal buds are more likely to survive since they grow during cooler times of the season. Pruning won't eliminate the problem. Re-growth that occurs following pruning has at least the same potential to develop BF that the tree had prior to pruning.

Various sources of a variety have differences in BF potential. The key element of control is the selection of single-tree sources whose low BF potential is determined by growing progeny trees under orchard conditions in a high temperature area. If BF is initially expressed in trees early in their training stage (up to 4 years), expression is severe because a large part of the tree is affected. If symptoms are initiated later, lesser expression results and affected parts are confined to smaller areas in the top or periphery of the tree. This is the basis of recommending BF trees be removed if symptoms develop during the early orchard development period.

***Options***. There are three options for dealing with a BF problem in your orchard. First, you can simply continue to maintain the BF trees (this is usually the best option in older trees). Second, it's possible to top work the affected trees by budding or grafting using wood with a lower BF potential. This takes considerable attention to detail but may be a good choice if the trees are noticed in the second to fifth leaf. Finally, replacing the tree by replanting is another option. This is reasonable between the second and fifth leaf (the sooner the better). Once trees are mature, replacing the tree should be done only if there is sufficient time left in the orchard's life to recoup the cost of the new tree and the yield lost from the BF tree while the replacement tree is coming into bearing.

In a study done in the early 1970's by Gerdts,et.al., Nonpareil yields from normal trees were compared to yields of both mildly affected BF trees and severely affected trees. Mild BF was defined as BF found only in several secondary branches. After three years of data collection, the average Nonpareil yield on mildly affected BF trees was 91% of normal. Such trees actually out produced normal trees in one orchard in some years due to later bloom and better pollination weather. Severe BF trees displayed BF in at least one major scaffold with other symptoms showing throughout tree. In these trees, the three-year average Nonpareil yield was 64% of normal. The researchers found decreases in kernel weight and in kernel numbers and they also observed a trend toward more double kernels.

In a companion study by Browne, et al., a UC agricultural economist calculated the break-even point for replacing BF trees by replanting or top working assuming hypothetical yield curves representing 90, 60, and 40 percent of a normal 1500 pound per acre orchard yield. Break even occurs when the increased returns of grafted or replanted trees finally offset the increased cost and loss of income from having the BF tree out of production.

At the 90% yield level, replacing a BF tree didn't result in breaking even until after more than 50

years had passed! At the 60% yield level, the break-even point occurred at 14 years (this level of yield reduction is typical for severely affected BF trees). If BF reduced the yield to 40% of normal it still took 9 years to break even by replanting. At all yield levels, top working a BF tree provided a one-year advantage compared to replanting assuming that top working was successful.

Overall, the severity of BF is the major factor in determining when the break-even point occurs. Orchard yield and price per pound are minor factors since different yield levels require a similar time to reach the break-even point. Generally, the orchard must have more than 10 years of life remaining to justify replacing a BF tree.

Shackel, et al. studied BF effects on yield of young Carmel almonds in a Kern County orchard planted in 1991. Yields for three years, 1994 through 1996 (4th-6th leaf) were collected from normal trees, from very mildly affected BF trees, from trees with moderate BF, from trees with severe BF, and from trees with very severe BF. Three year average yields from the very mildly affected trees were scarcely different from the normal trees and in some cases were actually greater. Moderately affected BF trees produced a 3-year average yield that was about 89% of normal. Trees severely affected by BF yielded 62% on average of what was produced by normal healthy trees. These results are similar to the findings on Nonpareil that were discussed earlier. Carmel yields from very severely affected trees were reduced even further to 50% of normal.

Early BF diagnosis is critical in reducing the time to a break-even yield. The first opportunity to observe BF in a new orchard is the spring of the second leaf. Observations must be made in March or April when symptoms are clearly visible since new growth from the surviving buds can mask BF later in the season. Replanting or top working any tree showing even mild symptoms at that time should have beneficial yield effects in four to five years. Mild BF symptom expression after the fourth leaf may not warrant tree replacement. Severe BF may continue to warrant replacement until about the eighth or ninth leaf.

***What to do*.** BF has the greatest impact on future productivity when second through fourth leaf trees are affected. **Make a major effort to detect BF in the second to fourth leaf** and replant as soon as possible or top work affected trees using bud wood with low BF potential.

For trees five to six years old, replace the trees only if BF is affecting the main framework of the tree. If you find trees like this it means you probably overlooked them when they first showed subtle signs of the disorder in their second or third leaf. Mild BF affecting only the upper canopy may not seriously affect yield.

When older trees become affected, do nothing. The cost of replacement and the yield loss following tree removal will not be offset by increased production before the orchard is removed. When BF is restricted to upper portions of the canopy there's less impact on productivity.

Avoid any stress in the orchard that can raise canopy temperatures. Anything that can cause defoliation such as water stress, mites, scab, or leaf rust could contribute to higher canopy temperatures and possibly aggravate BF.

***Sources:***

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Shackel, Ken, Tom Gradziel, Dale Kester, Mario Viveros, Warren Micke, Mike Cunningham. Non-infectious bud-failure, 1996 Annual Report to the Almond Board, Project No. 96-K23, Spring 1997, 7 pgs.