Correct Project Number: 95-K22

1995 Report for project 95-K21 (Noninfectious Bud-Failure)

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Introduction

Noninfectious bud-failure is a serious problem in almond particularly with 'Nonpareil' and 'Carmel'. Previous work under this project has achieved field control in Nonpareil through source selection but this has not yet been achieved with Carmel. Progress was made in 1993 in establishing the pattern of variability in BF-potential within Carmel and making selection for low BF-potential clonal sources. The number of clonal sources in 1990 and 1991 without some BF progeny have been reduced to 2, but 19 new selections have been propagated for field trials. An irrigation experiment conducted 1991 - 1994 showed that moisture stress had some effect on the severity of BF expression, and may have hastened the onset of BF symptoms, but did not substantially change the final percentage of BF affected trees, given the same source material. This was true for both Carmel and Nonpareil varieties. Flowering data collected in spring, 1993, indicated that flowering in Carmel was more strongly reduced by BF than in Nonpareil, suggesting that yield in Carmel may also be more sensitive to BF than yield in Nonpareil. This report covers data collected as of fall, 1995.

Materials and Methods

The established orchard plots of source progeny tests of Carmel which are growing in 3 locations in Kern and Fresno counties were examined and scored for BF symptoms in spring, 1995. Individual tree trunk growth and yield measurements were also made on representative trees in the Paramount orchard in the fall of 1995, and these data were analyzed to simulate how the removal of trees with different levels of BF severity in the first year of orchard life would effect orchard yield in the bearing years.

Results and Discussion

The research activities in the noninfectious bud-failure project can now be separated into four main areas.

1. Distribution of BF within the Carmel variety.

This study has been based upon annual inspections of 2700 progeny trees of 10 commercial nursery sources planted in 1989 in the Paramount Farming Co. orchard in northwest Kern Co. At the end of four years, significant differences existed among the 10 nursery sources ranging from 2 to 93% (Table 1). At the time of collection of budwood in 1989, no source tree of any nursery showed BF symptoms. This spring we reexamined the same trees and observed that symptoms had begun to appear among some of the source trees. In addition we began to trace the genealogy of each of these sources through nursery propagation records from the original seedling tree source to as many as 6 vegetative generations in some cases. Although BF potential clearly has increased in proportion to

Table 1. Percentage of BF-affected trees from different nursery sources.

Carmel Bud-failure Evaluation Plot: Nursery Sources
(Paramount Farms, CA)

		% of Trees With BF Symptoms			
		Year			
Nursery	(# TREES)	'92	'93	'94	'95
1	(210)	0	0	2	2
2	(150)	1	0	3	8
3	(240)	5	6	12	18
4	(300)	6	7	10	34
5	(240)	8	11	19	37
6	(80)	9	11	31	50
7	(410)	8	12	28	52
8	(240)	20	23	40	68
9	(320)	22	27	44	73
10	(290)	48	61	82	93

"age" of the `Carmel', other factors associated with individual orchards, including geographical location, soil conditions at the orchard, management and rootstock may be involved in affecting the pattern of general "deterioration" that appears to occur. An overall statistical analysis (Table 2) demonstrates however, that the greatest source of variation was the individual source trees within

Table 2. Statistical analysis describing the percent of variation due to the effects of source tree, budstick within source tree, and nursery.

% Of Bud-Failure Attributed to Various Sources

(CARMEL, PARAMOUNT FARMS)

SOURCE	YEAR			
	1992	1993	1994	1995
SOURCE TREE	44%	45%	42%	39%
BUDSTICK	24%	24%	17%	14%
NURSERY	11%	14%	25%	31%

nursery sources. Since each nursery uses it's own particular source trees, the percent variation due to nursery simply reflects the fact that the choice of those trees is not random for each nursery. We also found evidence that patterns of BF potential could be found within a source clone (Fig. 1), although it should be recognized that any clone whose progeny exhibit BF symptoms should be avoided. These results are consistent with previous recommendations that source selection must be

a key factor in the management of noninfectious bud-failure in almond. We expect to continue this analysis in spring, 1996.

2. Pattern of BF development within orchards.

Specific trends have been developing within the Paramount orchard. A range of severity extending from slight (rating = 1) to medium (2) to severe (3) to very severe (4) was apparent at the end of the first year (spring 1992). Two overall trends have occurred since then. One is the increase in percentage of affected trees over the four years from 12.5 > 16 > 26 >49. The other trend was the decrease in severity of BF expression with age. The overall trend of % severe trees of the "new cases" dropped from 77% to 7%. Thus the very large increase (almost double) in percent trees affected during the past year was produced by symptoms developing high in the tree with little effect on the tree overall. We need to follow this trend to see if these trees remain "mildly" affected, disappear, or worsen within the next few years.

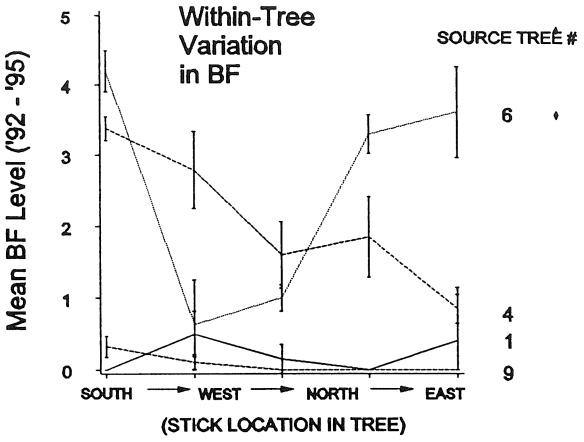

Figure 1. Pattern of the mean progeny BF score for buds taken from different locations on each of four representative source trees (tree 1, 4, 6, 9).

Yield records of affected trees in both 1994 and 1995 showed that when symptoms and yields are both evaluated in the same season, lower yields were only associated with relatively severe BF symptoms (Fig. 2A). However, when current season yield is compared to the symptoms expressed in the first year of orchard growth, then even mild symptoms are clearly associated with yield reductions (Fig. 2B). This suggests that early (first season) evaluation and removal of BF affected trees may ultimately benefit overall orchard production. In order to test what effect different levels of tree removal in the first year would have on orchard yield in subsequent years, we reanalyzed the 1994 and 1995 yield data, assuming that removal of BF trees

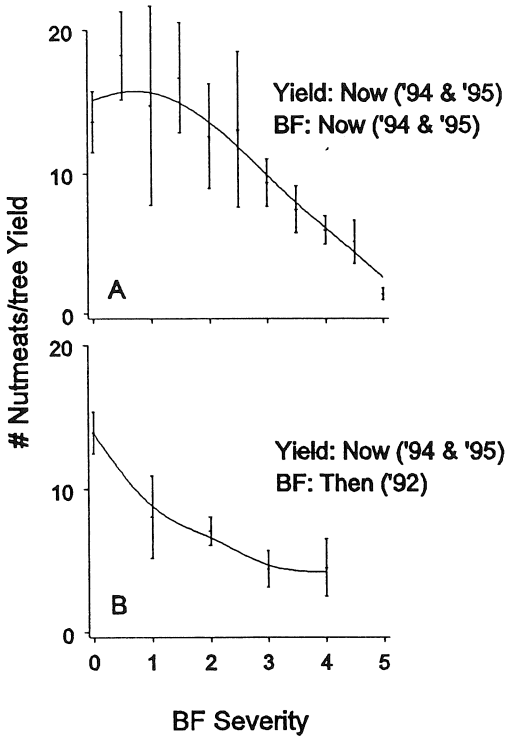

Figure 2. (A) Average '94 and '95 yield as a function of average BF severity over the same period of time. (B) Average '94 and '95 yield as a function of BF severity expressed in the first year.

in the first year would delay yield in those trees by one year, but that those trees would be replaced by the higher yielding non-BF trees shown in figure 2B. This analysis (Fig. 3) showed that the predicted yield loss due to tree removal in 1994 was regained by 1995 for all possible scenarios of tree removal, and that perhaps an intermediate level of removal was best. Since tree growth and yield will increase over time, a number of additional years of data will be required to obtain a more accurate picture of the economic effects that different levels of BF tree removal will have.

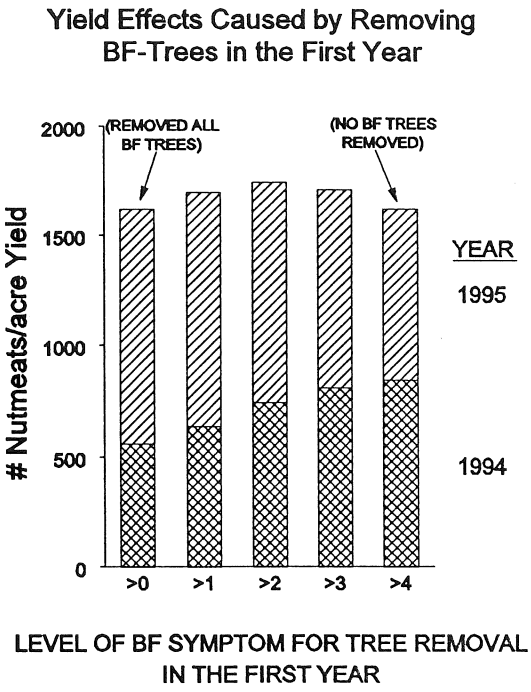

Figure 3. Predicted yield in 1994 and 1995 using different levels of BF symptoms to determine tree removal.

3. Selection of single tree sources with low BF potential.

Two primary types of low BF potential sources have been emerging. One is the individual trees in the separate nursery source blocks whose progeny have remained free of BF symptoms in the Paramount test. The number of these has been decreasing each year but it should be noted from the previous comments that many of these "new" cases have very low BF expression and their value is difficult to assess. It should be noted that the Paramount test orchard is located in one of the hottest sites in the San Joaquin valley and levels of BF are being expressed that may be greater than in other parts of California.

On the other hand, 3 out of eleven single tree sources of Carmel have remained free of BF symptoms in five and six year tests. Two of these have been established as Foundation Clones in the Foundation Plant Materials Service at UCD and distribution has begun to nurseries for commercial distribution. One other Foundation Clone is available which originated with one nursery where BF progeny trees were low.

Seventeen additional single tree selections have been made from the same source (Manteca RVT) and another commercial orchard in San Joaquin Co. All have remained with no BF after one year. These efforts of selection described under this project are matched by individual tree selections of commercial nurseries. The number of commercial trees available from all of these selected sources will probably be too low to fill the immediate demand and commercial experience with them is limited. Consequently growers should probably expect to see some BF incidence in orchards and should plan to follow the recommendation of early visual inspections for BF and early removal.

4. Rootstock effects.

The relative trends of numbers of BF symptomatic Carmel trees on different rootstocks after two years was Nemared > Nemaguard > Marianna 2624 > Hansen PA = Lovell. The test was started in 1993 at West Side Field Station (Fresno Co.) and Wolfskill Expt. Orchard (Winters, CA, Solano CO.)