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EFFECT OF REMOVAL OF PERSISTENT CALYXES FROM NAVEL ORANGE TREES AFFECTED BY POSTBLOOM FRUIT DROP

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Abstract. **Symptoms of postbloom fruit drop (PFD) on citrus, caused by *Colletotrichum gloeosporioides* Penz., in the Indian River area of Florida include lesions on petals, abscission of young fruit, persistence of calyxes from which fruit have abscised and leaf curling around clusters of persistent calyxes. Some trees retain several thousand persistent calyxes long after normal fruit drop has occurred. Navel orange has been one of the most severely affected cultivars. The effect these persistent calyxes have on PFD-affected Navel orange trees was studied in three severely affected groves in Indian River County. Treatments consisted of the persistent calyxes' removal at different times of the year. The trees were monitored and data taken on blossom production, new petal infections by the PFD fungus, and fruit production. The results obtained from the three test sites are reported in this paper.**

Postbloom fruit drop (PFD) was first detected in the Indian River area of Florida (4). The causal agent is *Colletotrichum gloeosporioides* Penz. Several countries in South and Central America have also reported existence of the disease (1). Evidence of the disease was also detected in several groves in the Indian River area of Florida in the springs of 1988 and 1989 (2). PFD has also been found in South Florida groves (3).

Symptoms observed include infected blossoms with reddish brown lesions, fruit abscission, persistent calyxes, and slight distortion and discoloration of leaves within blossom clusters. When the fruit from an infected blossom aborts, it leaves a calyx which can persist for a year or more. These calyxes usually enlarge. Several growers have expressed concern that these persistent calyxes may have an effect on subsequent bloom and yield. They also have asked if there would be any benefit to removing the persistent calyxes. The following studies were initiated to determine the effect of removing the persistent calyxes from PFD affected trees.

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Materials and Methods

Three groves in the southern part of Indian River County were selected for the experiments. All three groves were planted with Navel oranges, and each grove was under different management. Grove #1 had trees that varied in age from 4 to 8 years planted on double-row beds at a 18 x 25 foot (5.5 x 7.6 m) spacing with a drip irrigation system. Grove #2 had trees about 6 years old planted on double row beds that varied in measurement from 16 feet (4.88 m) to 22 feet (6.71 m) between the rows. These trees were set 12 feet (3.66 m) apart in the rows with a low volume micro-sprinkler irrigation system. Grove #3 had double row beds of 8 year old trees spaced 16.5 x 30 feet (5.03 x 9.15 m) with a low volume irrigation system. Trees in the three groves varied in height from 4.5 feet (1.37 m) to 7.75 feet (2.4 m).

Persistent calyxes (buttons) were removed from the trees with hand-held scissor-action clipping shears. All visible buttons were removed from eight randomly selected trees representing a treatment at each experimental site at each clipping date. Often, whole clusters of buttons were removed together. Frequently, leaves adjacent to buttons were unavoidably removed. The first treatment occurred on 21 Aug. 1988, the second on 24 Oct. 1988, and the third on 19 Apr. 1989. Persistent calyxes were left on one set of eight trees at each site and represent the fourth treatment or control group. Bloom intensity estimates were made on 27 Feb. 1989, and 19 Mar. 1989. The rating system used to indicate the intensity of bloom is shown in Table 1.

Weekly observations were also made from 15 May to 10 Aug. 1989, to determine blooming periods for the summer or June bloom time period.

Fruit counts were made on trees at all three test sites on 21 Aug. 1989. The number of fruit in the northeast quadrant of each tree was counted each time. All data collected were statistically analyzed.

Results and Discussion

The observations and data gathered from the various test plots (Table 1) show that removal of the persistent calyxes caused by PFD infection produced no effect on blossom production. Also, as shown in the fruit count (Table 2), yield was not significantly affected. A small amount of summer blossoms was observed in the plots following the heavy rains from 23 Aug. 1989, through 1 Sep. 1989, at the end of a summer that was unusually dry for this area. No blossoms to very few blossoms were observed in any of the three blocks from 19 May 1989, through 1 Aug. 1989, which was unusual considering the light bloom that occurred in the spring of 1989. A few infected petals were observed in Grove #3 in Nov. and Dec. of 1988 and Feb. of 1989, which indicated that disease pressure was present. Blossom intensity estimates for 27 Feb. 1989, and 19 Mar. 1989, are shown in Table 1. The major bloom period for each of the three sites varied.

Table 1. Estimates of bloom intensity on Navel orange trees at three test sites in Indian River County.

Dates Buttons Removed	Mean bloom intensity[z]		
	Grove #1	Grove #2	Grove #3
	27 Feb. 1989		
21 Aug. 1988	0.6	0.3	2.1
24 Oct. 1988	0.5	0.4	2.1
19 Apr. 1989	0.6	0.3	2.8
Control group	0.6	0.6	2.1
	19 Mar. 1989		
21 Aug. 1988	1.9	0.5	0.9
24 Oct. 1988	1.6	0.8	0.9
19 Apr. 1989	0.6	0.3	0.9
Control group	1.3	0.3	1.3

[z]Rating system:
0 = 1-25% tree in bloom
1 = 26-50% tree in bloom
3 = 51-75% tree in bloom
4 = 76-100% tree in bloom
Eight single-tree replicates for each treatment at each site.

Tests or experiments which would refine this study could include observations of trees which have buttons removed soon after they are formed, which is usually during the major bloom period from Feb. to Apr. In addition, a longer term study may be appropriate.

This experiment indicates that any effort to remove persistent calyxes will probably have little or no effect on either blossom production or fruit yield.

Table 2. Number of fruit present on Navel orange trees at three test sites in Indian River County on 21 Aug. 1989.

Dates Buttons Removed	Mean number of fruit[z]		
	Grove #1	Grove #2	Grove #3
21 Aug. 1988	30.6	18.1	36.4
24 Oct. 1988	35.1	19.1	28.4
19 Apr. 1989	33.9	20.9	32.6
Control group	28.8	16.5	33.5

[z]Mean number of fruit in northeast quarter of canopy of each treated tree.

Whether the PFD pathogen survives when blossoms are unavailable has not yet been determined. Further studies are needed to determine if the persistent calyxes are significant factors in the survival of the pathogen between bloom periods. If calyxes are of survival value to the fungus, the effect of removal of calyxes on disease development will have to be evaluated.

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PHYTOPHTHORA FEEDER ROOT ROT OF BEARING CITRUS: FUNGICIDE EFFECTS ON SOIL POPULATIONS OF *PHYTOPHTHORA PARASITICA* AND CITRUS TREE PRODUCTIVITY

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Abstract. **Fungicide treatments for control of feeder root rot of mature citrus caused by *Phytophthora parasitica* were made for 4 yr in 4 Florida orchards. Foliar applications of fosetyl-Al at high (FOS-H) and low (FOS-L) frequency and soil applications of metalaxyl (MET) were compared to untreated controls. When propagule densities of *P. parasitica* were expressed on a soil volume basis, MET treatments usually reduced fungal populations, but when propagule densities were expressed on a root weight basis, all treatments reduced fungal populations in most locations. The FOS-H, FOS-L, and MET treatments increased feeder root densities by averages of 26.8, 9.4, and 47.8%, respectively, above the untreated controls in the 4 orchards over all 4 yr. Feeder root loss in citrus due to infection by *P. parasitica* appears to be substantial and is corrected by applications of fosetyl-Al or metalaxyl. Tree appearance was improved by fungicide treatments in 3 of the 4 orchards. Average fruit weight was increased by all treatments in the grapefruit orchard, but not by any treatment in the 3 orange orchards. The percent juice in the fruit was consistently increased by fungicide treatments, but the sugar-acid ratio was affected only occasionally by fungicide applications. Total fruit and juice yields were increased by the FOS-H and MET treatments in one orchard and by the MET treatment in another orchard. Since large, consistent tree responses to treatment were not observed, orchards to be treated should be selected carefully.**

Phytophthora diseases of citrus are major problems in citrus orchards worldwide (12, 13). Foot rot, which occurs when *Phytophthora* spp. infect the base of the tree, is a commonly observed problem of citrus in Florida. The disease occurs primarily on young trees and occasionally losses can be severe. Foot rot can be controlled effectively by proper orchard management and use of fungicides (2, 3, 9, 11, 15). Feeder root rot, caused by *Phytophthora* spp., is a com-

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