2.5 cm or larger counted. The fruit were measured so that only fruit that had set within 2 weeks after the last spray would be included as the grower applied 2 more benomyl sprays beginning 2 weeks after the last experimental spray application.

Analysis of variance (ANOVA) was performed on all measured data. Percent clusters with infected blossoms was transformed to square root arcsine prior to conducting ANOVA. Fewer open blossoms on marked clusters were affected by PFD in trees treated with the combination of benomyl and ferbam than on trees treated with benomyl alone (Table 2). Fewer of the marked clusters had diseased blossoms in trees treated with the combination of benomyl and ferbam than on trees treated with benomyl alone (Table 2). No significant difference was observed in number of fruit set on the marked clusters. On the clusters marked on the one row of untreated trees, an average of 31% of the blossoms had PFD lesions and an average of 81% of the clusters had infected blossoms. There was no fruit set on any of the marked clusters in unsprayed trees.

In this and other experiments (Sonoda et al., In press; Sonoda, unpublished), the combination of benomyl plus ferbam has been consistently more effective than benomyl alone in reducing blossom infection. However, further study is needed to determine if the increase in disease control with applications of the combination is enough to provide an increase in yield as compared to applications of benomyl only.

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AN UPDATE ON THE INCIDENCE OF POSTBLOOM FRUIT DROP ON 'TAHITI' LIMES IN SOUTH FLORIDA

R. T. McMillan, Jr.
University of Florida
Tropical Research and Education Center
Homestead, FL 33031

Abstract. **'Tahiti' lime Postbloom fruit drop (PFD) was first noted in Dade and Lee Counties in 1983. The symptoms of PFD in limes are small reddish-brown necrotic spots on the open petals which coalesce, with the petals becoming hard and dry and persist several days. The young fruit, 0.5 cm or less in diameter, first show a yellowish discoloration and rapidly abscise, leaving the calyxes and pedicel intact. Early studies found Benlate and Difolatan to be effective for the control of PFD. However, the registration of Difolatan was removed from the market and is no longer available to citrus growers. Recent PFD studies have shown that Carbamate, Biocide, and Tilt, alone or in combination provided disease control. 'Tahiti' lime production groves in Brazil and Mexico are reporting that PFD is seriously affecting yields.**

Postbloom fruit drop (PFD) was first noted on 'Tahiti' lime, *Citrus aurantifolia* (Christm) Sw., in Dade and Lee Counties, Florida in 1983 (McMillan and Timmer, 1989). The disease is known to occur in Argentina, Belize, Brazil, Colombia, Dominica, Panama, Venezuela, Peru, Ecuador, Guatemala, Costa Rica, El Salvador, Mexico, and Trinidad (Denham, 1988 and personal observations by the author). Until PFD occurred in Florida, most of the studies concerning this disease were conducted in Belieze. In 1971, Fagan (1971) mentioned that PFD had been observed in Florida, but there is no other documentation of those observations. The only disease similar to PFD, noted for the first time in 1960 by C. W. Campbell, TREC, Homestead, was the persistence and enlargement of the calyxes in limequat. To date, the disease occurs in limes, as well as on other citrus in Dade, Lee and other citrus growing counties in Florida (McMillan and Timmer, 1989; Timmer, 1990).

The first symptoms of PFD in 'Tahiti' limes are small reddish-brown necrotic spots on the open petals. These necrotic spots coalesce, with the petals becoming hard and dry and persist several days beyond normal petal fall for healthy flowers.

Young 'Tahiti' lime fruit, 0.5 cm or less in diameter, first show a faint yellowish discoloration and rapidly abscise, leaving the calyxes and pedicel intact. The calyx, instead of abscising may remain green for a year or more. The young diseased fruit are also distinguished by the persistence of the stigmas and styles. Profuse fungal growth is noted along the persisting styles. Dissected young fruit show a faint brownish internal discoloration at the stem end.

The fungus most consistently isolated from the petals, styles and young fruit from Dade and Lee Counties was *Colletotrichum gloeosporioides* Penz. and subsequently identified in 1988 and genetically in 1991 as a specific strain of *C. gloeosporioides* (McMillan and Timmer, 1988; Liyanage et al., 1991).

Under moist conditions the fungus produces a saucer-shaped acervulus that is lined with dark setae and short colorless stalks, on which are borne minute spores. These

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collect in a salmon to orange mucilaginous mass until water dissolves the mucilage and frees the spores to be disseminated by splashing rains, irrigation, equipment, and/or insects (Pena and Duncan, 1989).

Spores of *C. gloeosporioides* can germinate and infect blossoms in 8 to 12 hrs when conditions are moist and temperatures are in the range of 65 to 80 F.

The Lee County 'Tahiti' lime groves in which PFD was first reported totaled 270 acres. Two hundred and three acres of these groves had trees that were estimated to be 90 to 100% infected.

The amount of fruit loss due directly to PFD is not known, however, there were estimates of losses of 200 to 300 boxes per acre per year.

In Dade County the groves near the East Everglades were found to have high incidence of PFD. At no time since PFD was recognized as a problem in 'Tahiti' limes has the incidence of disease been as high in Dade County as it was observed to be in Lee County. In one lime grove which Moss and McMillan (1989) evaluated for PFD disease incidence, the fruit drop loss due to *C. gloeosporioides* fell within the range of normal physiological fruit drop.

Premature fruit drop is a difficult disease to control. Since infection and spread are favored by moisture, overhead irrigation for extended periods should be avoided.

Two fungicides, Benlate-DuPont and Difolatan-Chevron, were reported to be effective for the control of PFD on oranges in Belize during the 1970's (Fagan, 1971, 1979). The effectiveness of these fungicides for the control of *C. gloeosporioides* on 'Tahiti' limes was confirmed in greenhouse tests at TREC, Homestead. This was an encouraging find since these 2 chemicals were approved for use on citrus in Florida. However, Difolatan was removed from the market soon after and is no longer available to citrus growers. Recent PFD disease control studies on 'Tahiti' limes by McMillan in 1991 showed that Benlate and Carbamate-FMC alone and in combination provided good control of *C. gloeosporides* (Table 1). In another field study McMillan (1991) showed that the fungicide, Biocide-Suncoast, which is currently not registered by the Environmental Protection Agency, provided outstanding control of the fungus when applied alone or in combination with Benlate and/or Carbamate (Table 2). An in-vitro study by McMillan (1991) showed that the fungicide Tilt-Ciba-Geigy inhibited the growth of *C. gloeosporioides* (Table 3). Copper fungicides applied during the bloom were not effective for the control of PFD, and may even aggravate the disease problem (Fagan, 1984). Even though most of the fungicides are quite effective for the control of PFD, precise timing of applications or frequent applications are needed to obtain good disease control. Flower buds do not become susceptible to the fungus until they are about 1 cm long and there is no benefit gained by spraying after petal fall and fruit set. In Belize, it was shown that 3 to 4 fungicide applications were needed throughout the bloom to provide good control. Since most *C. gloeosporioides* infection occurs during wet weather at bloom time, fungicide applications should be made prior to peak bloom, especially if rain is forecast.

In 1992 hurricane Andrew reduced the 'Tahiti' lime acreage in Dade County from 6000 to 1000 or an 84% reduction. Even with the loss of foliage, PFD occurred on the new flower buds that were produced by the damaged trees in the fall of 1992.

Table 1. Combinations of fungicide sprays for PFD control on 'Tahiti' limes, 1989-90.

Treatment	Rate/Acre	Number of Buttons per Tree
Control (Water)		1087
Benomyl	1.5 lbs	290
Carbamate	1.5 lbs	189
Benomyl + Carbamate	1.5 + 1.5 lbs	104
Biocide	1.0 gals	32

Source: R. T. McMillan, Jr. 1991. Proc. Fla. State Hort. Soc.

Table 2. Combinations of fungicide sprays for PFD control on 'Tahiti' limes, 1990-91 season.

Treatment	Rate	% Reduction in Buttons
Control (Water)		00.0a
Benomyl	1.5 lbs	25.0 b
Carbamate	1.5 lbs	70.0 c
Biocide	1.0 gals	87.6 e
Benomyl + Carbamate	1.5 lbs + 1.5 lbs	84.1 e
Benomyl + Biocide	1.5 lbs + 1.0 gals	79.9 d
Carbamate + Biocide	1.5 lbs + 1.0 gals	86.8 e
Biocide + Benomyl + Carbamate	1.0 gals + 1.5 lbs + 1.5 lbs	88.5 e

Source: R. T. McMillan, Jr. 1991. Proc. Fla. State Hort. Soc.

Table 3. Effect of fungicides on *Colletotrichum gloeosporioides* (PFD) in vitro.

Treatment	Inhibition (mm)
Tilt 0.015 ml	4.2
Tilt 0.040 ml	11.2
Benomyl 0.23	0
Benomyl 0.4 6 g	0
Control	0

Source: R. T. McMillan, Jr. 1991. Proc. Fla. State Hort. Soc.

Brazil and Mexico are both becoming major producers of 'Tahiti' limes. Postbloom fruit drop is reported to be the most serious problem facing the lime industry in Brazil (Personal Communication with Dr. Aery). In the Veracruz region of Mexico PFD is causing serious production losses of 'Tahiti' lime. Both countries are currently seeking some PFD control with fungicides.

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