Table 1. Characteristics of carambola cultivars.

Cultivar	Origin	Fruit size[x]	Color[y]	Flavor	
				Sugar	Acid
Arkin	Florida	med	yo-o	high	low
B-10	Malaysia	med	yo-o	high	low
Dah Pon	Thailand	sm-med	py	medium	low
Demak	Indonesia	med	o	medium	low
Fwang Tung	Thailand	lg	py	high	low
Golden Star	Florida	med	yo	medium	medium
Hew 1	Malaysia	med-lg	yo-o	high	medium
Kajang	Malaysia	med-lg	yo-o	high	medium
Kary	Hawaii	med	yo-o	high	medium
Maha	Malaysia	lg	py	medium	low
Sri Kembangan	Malaysia	med-lg	yo-o	high	medium
Tean Ma	Thailand	med	my	medium	low
Thai Knight	Florida	med	yo-o	high	medium

[x]Fruit size; sm = small, med = medium, lg = large.
[y]Color; py = pale yellow, my = medium yellow, y = yellow, yo = yellow-orange, o = orange.

of genetic characteristics in the existing cultivar collections and the relative lack of work of work done to date on selection within Florida.

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CONTROL OF POSTBLOOM FRUIT DROP ON 'TAHITI' LIME BY FOLIAR APPLICATIONS OF FOLICUR

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

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Abstract. **_Colletotrichum acutatum_, which causes postbloom fruit drop (PFD), continues to be a problem for lime growers in Dade county, Florida. The recommended treatment for _C. acutatum_ control remains a combination of Benlate and Carbamate at bloom and continued through petal drop. The fungus _C. acutatum_ is resistant to Benlate but still provides control when combined with Carbamate. Folicur at 4 and 6 oz alone, and combined with Carbamate at 1.5 lb per acre, when applied as a protective spray, reduced the number of buttons and provided significant control of PFD caused by the fungus _C. acutatum_.**

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; Fagan 1984, 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 health 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 stalk 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 acutatum* and subsequently identified in 1988 and genetically in 1991 and 1996 as a specific strain of *C. acutatum* (McMillan and Timmer, 1988; Liyanage et al., 1991; Brown et al., 1996).

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. In one lime grove which Moss and McMillan (1989) evaluated for PFD disease

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Table 1. Fungicide efficacy for PFD caused by *Colletotrichum acutatum* on 'Tahiti' lime in 1996 field trial.

Treatment	Rate/100 gal/ A	Disease Rating	Number of Calyx	% Disease Calyx
Control		8.62a[w]	39.88a[x]	38.09a[x]
Folicur	4 oz	3.62b	17.19b	23.55b
Folicur	6 oz	1.75c	10.81c	10.25c

[z]Mean separation by Duncans-Waller multiple range test at the 5% level.
[y]Calyx numbers made after 6 weeks from 8 single tree plots replicated 4 times.
[x]Percent disease calyx are means from 8 single tree plots replicated 4 times.
[w]Disease rating was rated on a 0 to 10 scale, with 0 = no calyx and 10 = 100% of the flowers having persistent calyx.

Table 2. Fungicide Efficacy for PFD caused by *Colletotrichum acutatum* on 'Tahiti' lime in 1997 field trial.

Treatment	Rate/100gal/A	Disease Rating	Number of Diseased Calyx	% Disease Free Calyx
Check		9.50a[w]	95a[x]	4.23g[x]
Benlate	1.5 lb	7.38b	28b	14.43f
Carbamate	1.5 lb	5.69d	12c	34.17e
Folicur	4 oz	6.94c	8de	49.60c
Folicur	6 oz	3.38e	7e	56.85b
Benlate + Carbamate	1.5 lb+1.5 lb	5.75d	9d	41.66d
Folicur + Carbamate	4 oz+1.5 lb	3.44e	7e	57.39b
Folicur + Carbamate	6 oz+1.5 lb	2.06f	5f	83.33a

[z]Mean separation by Duncans-Waller multiple range test at the 5% level.
[y]Calyx numbers made after 6 weeks from 8 single tree plots replicated 4 times.
[x]Percent disease calyx are means from 8 single tree plots replicated 4 times.
[w]Disease rating was rated on a 0 to 10 scale, with 0 = no calyx and 10 = 100% of the flowers having persistent calyx.

incidence, the fruit drop loss due to *C. acutatum* 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 and Difolatan, 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. acutatum* on 'Tahiti' limes was confirmed in greenhouse tests at TREC, Homestead. This was an encouraging find since these two chemicals were approved for use on citrus in Florida. However, Difolatan was removed from the market soon after and is no longer available to the lime growers. Recent PFD disease control studies on 'Tahiti' limes by McMillan in 1991showed that Benlate and Carbamate alone and in combination provided good control of *C. acutatum* (Table 1). In another field study McMillan (1991) showed that the fungicide, Biocide, which is 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 inhibited the growth of *C. acutatum.* Copper fungicides applied during the bloom were not effective for the control of PFD, and even aggravates the disease problem (Fagan 1984; McMillan unpublished data; Sonda unpublished data). 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 three to four fungicide applications were needed throughout the bloom to provide good control. Since most *C. acutatum* infection occurs during wet weather at bloom time, fungicide applications should be made prior to peak bloom, especially if rain is forecast.

The purpose of this field study was to evaluate efficacy of Folicur at 4 and 6 oz and Folicur at 4 and 6 oz plus Carbamate at 1.5 lb per acre for *C. acutatum.*

Materials and Methods

The two field trials were conducted in a 5-year-old, commercially grown, 5 acre Tahiti lime grove planted in Rockdale fine sandy loam-limestone complex. The lime grove had a history of PFD. The lime grove was irrigated with over head rainbird ¼ in per hour nozzles which provided an excellent environment for *C. acutatum.* The treatments in the two field trials were applied to four single tree plots commencing at the first sign of flower buds and continued for 4 applications coinciding with petal fall. The fungicides were applied with a 4 gallon spray Doc, Model 100HDP, Professional Service Sprayer. The first trial commenced on 23 Mar. 1996 and ended on 12 Apr. 1996. The second trial commenced on 22 Mar. 1997 and ended on 12 Apr. 1997.

The treatments in the first trial were Folicur at 4 and 6 oz per acre and an untreated control. The treatments in the second field trial were Folicur at 4 and 6 oz per acre, Folicur at 4 and 6 oz plus Carbamate at 1.5 lb per acre, Benlate at 1.5 lb per acre, Carbamate at 1.5 lb per acre, Benlate at 1.5 lb plus Carbamate at 1.5 lb per acre and an untreated control. No adjuvants were used in any of the spray mixes. The number of persistent calyxes for each tree were counted 6 weeks after petal fall.

Results and Discussion

All fungicide treatments in both field trials provided significantly better PFD control than the untreated check (Table 1 and 2). In the first field trial Folicur at 6 oz per acre provided 10 percent control better than Folicur at 4 oz per acre at 24 percent control (Table 1).

In the second field trail the combination of Folicur at 4 and 6 oz plus Carbamate at 1.5 lb and Benlate at 1.5 lb plus Carbamate at 1.5 lb was significantly better than Folicur at both rates, Benlate at 1.5 lb, and Carbamate at 1.5 lb (Table 2). Both rates of Folicur plus Carbamate were significantly better for calyx control than Benlate plus Carbamate. Also, Folicur at both rates was significantly better for calyx control than Benlate or Carbamate. Folicur at 4 to 6 oz rates in both field trials provided similar calyx control results (Table 1 and 2). The results of Benlate plus Carbamate, Benlate and Carbamate alone was similar to that described by McMillan in 1991.

Mention of a trademark, warranty, proprietary, products, or vendor does not constitute a guarantee by the University of Florida and does not imply its approval to the exclusion of other products or vendors that may also be suitable. This study also does not in any way imply that the chemicals used can be applied without EPA use labels.

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CONTROL OF LYCHEE ANTHRACNOSE BY FOLIAR APPLICATIONS OF TEBUCONAZOLE, MANCOZEB, AND COPPER HYDROXIDE ON 'MAURITIUS' LYCHEE FRUIT UNDER SOUTH FLORIDA CONDITIONS

JONATHAN H. CRANE, ROBERT E. SANFORD AND ROBERT T. MCMILLAN, JR.
University of Florida, IFAS
Tropical Research and Education Center
18905 S.W. 280 St.
Homestead, FL 33031-3314

Additional index words. *Colletotrichum gloeosporioides* (Penz.) Sacc., *Litchi chinensis*, fungicide, fruit disease, phytotoxicity, storage.

Abstract. **Anthracnose is the major fungal disease of 'Mauritius' lychee (*Litchi chinensis* Sonn) in Florida and may reduce crop yields up to 100% in some years. Foliar applications of tebuconazole, mancozeb, and copper hydroxide were made to 'Mauritius' lychee trees from flowering (Feb.) to harvest (late May) in two commercial orchards. Tebuconazole was applied eight times at two rates in Orchard 1 and at one rate in Orchard 2. Ten mancozeb and copper hydroxide applications were made in both Orchard 1 and 2. Temperatures ranged from 52°F to 94°F and 13.0 inches of rainfall occurred during the test period Feb. to late May. The percentage of anthracnose infected fruit was determined on three dates in May, phytotoxicity ratings and yields were estimated once during May. Crop yields were estimated by counting total number of fruit per tree. Postharvest anthracnose infection was determined from a sample of fruit from each treatment in Orchard 2. Fruit was stored at a mean of 40 ± 2°F and 89 ± 5% RH and rated 4, 6, and 10 days after harvest. In general, tebuconazole and mancozeb treatments had a lower percentage of diseased fruit than copper hydroxide and non-treated control fruit. Phytotoxicity ratings on the fruit were low for all treatments. Mean fruit number per tree was significantly greater for trees treated with tebuconazole (1.56 oz ai acre^{-1}) compared to mancozeb, copper hydroxide, and non-treated control trees in Orchard 1. There was no significant difference in fruit number per tree among treatments in Orchard 2. There was no significant difference among the percentage of diseased fruit for any treatment after 4, 6 and 10 days of cold storage.**

Lychee was introduced to Florida around 1880 (Westgate and Ledin, 1953) and, during the 1940s and 1950s, went from a landscape fruit tree to a commercial crop encompassing about 350 acres (Knight, 1994; Young, 1966). During this period, 'Brewster' made up at least 95% of the commercial acreage. 'Brewster' produces a bright red-colored, good-flavored fruit that is resistant to anthracnose; however, the tree has an unreliable bearing habit. A number of freezing events from the winter of 1957 through 1989 and Hurricane Andrew (1992) reduced the lychee acreage in Florida to about 100 acres by 1993 (Knight, 1994; J. H. Crane, personal communication).

Today, Florida has about 611 acres of lychee with Dade County accounting for about 84% of the total State acreage (J. H. Crane, personal communication). The remaining acreage is distributed among Palm Beach, Broward, Lee, Martin, Sarasota, and Indian River Counties. 'Mauritius' is the predominant cultivar, comprising about 90% of the current acreage. About 6% of the acreage is planted to 'Brewster' and the remaining 4% is planted to various minor cultivars (e.g., 'Hak Ip', 'Bosworth 3').

'Mauritius' lychee was introduced into Florida from South Africa in 1951 (Ledin, 1957). It first fruited in 1957 and the fruit was noted to be affected by anthracnose, caused by *Colletotrichum gloeosporioides* (Penz.) Sacc.

Anthracnose is the major disease problem for lychee production in Florida at the present time (McMillan, 1994a) and in some years, crop losses from this disease may reach 100% if left uncontrolled. This is due to the predominance of 'Mau-

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