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Learning from Peach Bacterial Spot Epidemics: Potential Strategies for Reducing Fruit Losses

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Bacterial spot of stone fruits is caused by the bacterium *Xanthomonas arboricola* pathovar *pruni*. The disease was first described in 1903 on Japanese plums in Michigan. Bacterial spot is favored by moist, warm environmental conditions. Moisture plays a critical role in the infection process particularly when it causes plant tissues to become water congested (Battilani, et al., 1999; Zehr and Shepard, 1996).

The incidence and severity of bacterial spot on peaches can vary greatly from year to year as shown in **Table 1**. It has been observed that in years when precipitation does not occur for several weeks before fruit ripening that the fruit still can be severely diseased. In other years, frequent periods of precipitation that should be favorable for bacterial spot development during this period prior to fruit ripening did not result in the expected disease severity on fruit. This suggested there is a period when fruit are very susceptible or bacterial inoculum is at an optimal level and that the environment at these times is critical for infection of fruit. Analysis of weather records showed an association with bacterial spot incidence and severity on peach fruit and occurrence of frequent periods of precipitation from mid-March to mid-May and particularly when precipitation occurred in April. In North Carolina where this research was conduced, this period coincides with petal-fall through pit-hardening. Fruit infections that occurred during this period usually caused lesions that extended deep (**Figure 1a**) into the fruit flesh. Lesions on fruit that developed from infections near or after pit-hardening were shallow or mostly limited to the fruit skin (**Figure 1b and c**).

Table 1. Yearly incidences and severity of bacterial spot caused by *Xanthomonas arboricola* pv. *pruni* on non-sprayed susceptible cultivars located at the North Carolina Sandhills Research Station, Jackson Springs, NC.

Year	Cultivar(s)*	Fruit with bacterial spot (%)	Fruit with only surface lesions (%)	Fruit with deep lesions (%)	Foliage with lesions and defoliated (%)
1997	O'Henry	95	15	80	75
1998	O'Henry	98	28	70	44
	Winblo	50	34	16	17
1999	O'Henry	15	13	2	30
	Winblo	4	4	0	3
2000	O'Henry	100	20	80	75
2001	O'Henry	58	32	20	40
	Winblo	1	<1	<1	10
2002	O'Henry	2	2	0	5
2003	O'Henry	100	50	50	83
2004	O'Henry	64	43	21	58
2005	O'Henry	76	49	27	78
2006	O'Henry	66	46	20	75
2007	O'Henry	No fruit	--	--	67
2008	O'Henry	67	53	14	90
2009	O'Henry	93	34	66	74
2010	O'Henry	36	35	1	71
2011	O'Henry	100	55	45	88

* cv. O'Henry is highly susceptible to bacterial spot while cv. Winblo is moderately susceptible (Werner, et al. 1986).

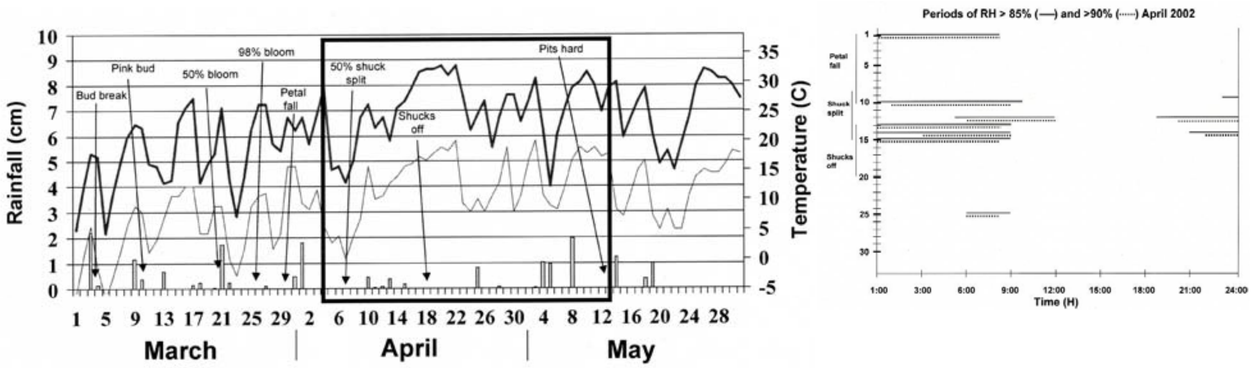
Figure 1a

Figure 1b

Figure 1c

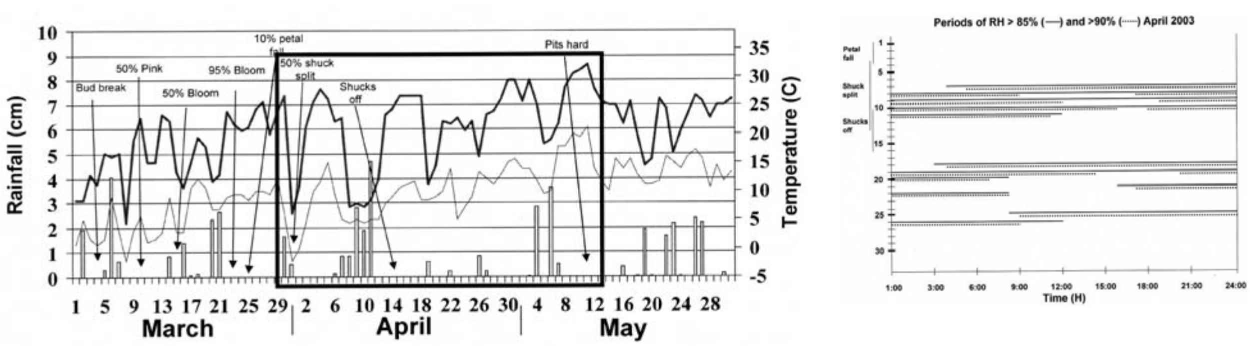
Data since 1984, a year of a severe bacterial spot epidemic (Werner, et al. 1986) in the southeastern U.S., have been analyzed. Years with low incidence of bacterial spot and more fruit with surface lesions than deep lesions were associated with fewer precipitation periods during the petal-fall through shuck-off period. Data that exemplify this precipitation pattern are shown for **April 2002**. Incidence of bacterial spot in 2002 on the highly susceptible cv. O'Henry averaged 2% diseased fruit and 5% diseased leaves at harvest (**Table 1**).

April 2002:



Years with a greater incidence of diseased fruit and fruit with deep lesions, had frequent and extended periods of precipitation occurring in April during the period of petal-fall through shucks off and often extending to at least pit-hardening. Data that exemplify precipitation conditions associated with this pattern are shown for **April 2003**. In contrast to 2002, 100% of fruit and 83% of leaves at harvest for cv. O'Henry had bacterial spot (**Table 1**).

April 2003:



In addition to frequency and time of precipitation relative to seasonal tree development, the duration of wetness is important as reported by Zehr and Shepard (1996) using potted trees and dew chambers. In 2002, a year having very little bacterial spot, the duration of wetness as measured by periods of relative humidity at minima of 85% and 90% support the dew chamber results. The precipitation periods in April 2002 mostly occurred in early morning and seldom extended more than 9 hours. In contrast, the precipitation periods for April 2003 were more frequent and much more extended, with some exceeding 24 hours. Bacterial infection seems to be independent of temperature; however, temperature can influence the rate of bacterial multiplication and thus bacterial inoculum levels and the rate of symptom development as also reported by Zehr and Shepard (1996).

Management of bacterial spot on peaches should start with host resistance when available for cultivars adapted to the growing area. Spray options are very limited to chemicals (Horton, et al., 2011) such as copper-containing materials and the antibiotic oxytetracycline (eg, FireLine 17WP, Mycoshield 17WP).

Other materials evaluated have provided at best minimal disease control (Ritchie, 2005a, 2005b, 2006, 2007). The strategy for using copper is to place a bacterial-killing barrier on the surface of the tree before the bacteria emerge from over-wintering sites. The bacterial pathogen over-winters in the tree in leaf scars, buds, and other protected sites on the tree surface. When the bacteria over-winter in leaf scars and buds, these areas can be killed and form necrotic areas (**spring cankers**) at terminal or lateral buds. These cankers are normally first visible at bloom and are a major source of the season's first bacteria that can infect emerging leaves. Recently, spring cankers have been observed as early as time of bud-break.

Spring canker

Peaches and other stone fruits are **very sensitive to copper**, thus extreme care must be taken when copper is used during the growing season. Sprayers should be properly calibrated, the correct rate of copper used in the appropriate volume of spray water, and **foliage monitored before subsequent sprays** are applied to determine if unacceptable injury is occurring or likely to occur with another spray. Also, copper can accumulate on the trees if adequate rainfall fails to occur between applications. Oxytetracyline can be tank-mixed with low rates of copper in sprays starting at petal-fall to <5% shuck-split.

In orchards having bacterial spot, avoid applying any sprays when foliage is wet as this can readily "blast" the bacteria throughout the trees.

It is difficult to present a spray program for bacterial spot that fits every orchard. Variables include growers' management styles, environmental conditions at orchard locations, cultivar susceptibility, and changes in yearly weather conditions. Below is an **illustration** of a spray schedule (based on using 100 gal water per acre with a range of 75-125 gal) for a moderately to highly susceptible cultivar in an orchard where bacterial spot occurs. Rates of copper vary depending on the product, thus rates are presented based on **M**etallic **C**opper **E**quivalent (MCE). Some injury to leaves present as reddish spots and shot-holes with some very mild defoliation is expected if an effective rate of copper is being used. Because of risk for foliar injury most copper materials are not registered for use post-bloom or in more than two (2) applications post-bloom and then to be used only at low rates (always read and following instructions on the label).

-- Dormant bud to bud-swell: copper 1.0 – 2.5 lb MCE per acre.

-- Bud-burst (top of buds have opened) to ¼" green: 0.75 – 1.25 lb MCE per acre.

-- Pink to 25% bloom: 0.5 – 1.0 lb MCE per acre.

-- First petal-fall to 50% petal fall: 0.25 – 0.75 lb MCE per acre.

GROWTH STAGE AT WHICH INJURY FROM COPPER BECOMES HIGH RISK

-- First shuck-split to 50% shuck-split: FireLine 17WP or Mycoshield 0.75 – 1.0 lb may be tank-mixed with 0.10 – 0.20 lb MCE per acre.

-- Shucks off: FireLine 17WP or Mycoshield 0.75 lb may be tank-mixed with 0.10 – 0.20 lb MCE per acre.

-- Additional sprays as needed based on weather and disease conditions. **Discontinue copper if unacceptable injury occurs**. Antibacterial activity of oxytetracycline has a short period of a few days and is readily washed off with rainfall (Christiano, et al., 2010).

Selected References:

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