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Tree Fruit Diseases

Comparison of Capture of Ascospores of *Venturia pirina* with the Temperature of Wetness of Rain in Mendocino County, California 2006

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Abstract: Ascospores of *Venturia pirina* were trapped during rain periods using rotor rod samplers as part of a disease management program in Mendocino County pear orchards. Data of spores trapped for the season vs. degree days above 0°C were compared. It was possible to judge the effect of wetness temperature on apparent pseudothecial productivity as measured by ascospore capture. There were captures with rain periods of 6 hour wetness at least 7°C (45°F). Capture often rose with increasing temperature. Rains beginning at night or early AM were judged to have spore discharge started at 7AM the next morning for the beginning of the 6 hours unless a warmer 6 hour period occurred later. Rains occurring before 5% and after 95% of the seasonal spore total had been captured were categorized separately, since a shortage of ascospores in the pseudothecia would lower productivity as measured by spore capture data. Regression analyses of rainfall temperature vs. the square root of the fraction of the seasonal spore total captured during the wetness yielded R squared values of 0.24 (P=0.11) for total wetness period temperature, for example. Thus approximately 24% of the variation in the data may be attributable to the rainfall temperature differences. As degree days (0°C) increased since the last rainfall episode, the spore captures during a succeeding rainfall event diminished (R squared = 0.29, P=0.02). Thus approximately 29% of the variation in the data may be due to the separation of rain events in time. This and the absence of capture data for dew periods may help explain deviations in discharge from maturation curve models for pear scab ascospores.

Introduction

Beginning at the period of early bud swell on February 25, 2006, there were 30 rainfall events on 37 days in the next 52 day period in Mendocino County pear orchards (Table 1). The rainfall events were not all equally productive in *Venturia pirina* ascospore capture. It was possible to judge the effect of temperature of wetness on apparent pseudothecial activity as measured by ascospore capture to compare with previously reported similar studies after another high rainfall year 1998 (7).

Methods

Ascospores were trapped during rain periods using rotor rod samplers (Model 20, Sampling Technologies Inc., Minnetonka, MN 55305) as part of a disease management program in 2006. The four samplers were located 45 cm above the ground in commercial Bartlett pear orchards,

and were baited with a 1 m diameter pile of random leaf litter 10 cm deep beneath the samplers in late winter. Remote sensing equipment (Adcon Telemetry, Inc., Boca Raton, FL) located in pear orchards in Hopland, CA and Ukiah, CA was used to determine the average temperature of wetness events. Accumulated degree day readings were maintained at Hopland, CA, using a digital biophenometer (Model TA51, Omnidata International, Logan,UT 84321) which made temperature readings at 10 minute intervals and converted the data to a degree day readout. Data of the percent of spores trapped for the season were compared with similar plots for percent of mature asci vs. degree days above 0^{o}C (4). Percent capture for the season was also compared by regression analysis using Sigmastat statistical software (Jandel Scientific, San Rafael, CA), with degree days since the beginning of the previous Mills Table rainfall event (3) and with the temperature of the wetness event's warmest 6 hour period. (Commencing 7 AM-7 PM, these periods were usually about 8-9 AM to 2-3 PM.). Percent capture for the season was also compared with the temperature of Mills Table wetness of the rainfall infection period.

Results and Discussion

Capture of ascospores proceeded with 11 rainfall events in 2 weeks (100 degree days) in which only 5% of spores were trapped. This was followed by 12 rainfall events, March 11 –April 1, in which the next 90% of spores were trapped, and 5 rainfall events, April 2-16, in which the last 5% of spores were trapped (Figures 1-2). Three additional rain events above 0.075cm (0.03") occurred April 22, May 19 and May 21, but were not monitored for spore release. The approximate 100 degree day lag in capture is similar to one suggested for apple scab, *Venturia inaequalis* (1) but differs from the Spotts and Cervantes model for maturation of ascospores of pear scab, *Venturia pirina* (4). Other spore trapping efforts in California have also suggested a maturation lag for pear scab in some seasons (2, 6).

Release of ascospores appeared to have reached a low plateau after 300 degree days since initial captures at early budswell, although the Spotts and Cervantes model suggested that additional captures could be expected (Figure 3), and later captures have resulted in other years of our studies. However, 2006 had similarities with another wet year, 1993, in reaching this plateau of low discharge early in the season (6). A 300 degree day time until 95% of spore maturation is near the lower 90% confidence limit of the apple scab maturation model and perhaps is to be expected, occasionally (1).

With the many rains occurring in 2006, it was possible to judge the effect of temperature of wetness on apparent pseudothecial productivity as measured by ascospore capture. There were increases with rain periods whose warmest 6 hours were at least 7^{o}C. However, statistical validity was lacking ($P=0.46$, $R^2=0.06$) in these studies compared with a similar comparison made in 1999 (Table 2, Figure 4) (7). A stronger statistical basis was seen in comparisons of spore capture with the temperature of the infection period ($P=0.11$, $R^2=0.24$), as warmer temperatures measured in the entire period of wetness resulted in increasing capture (Table 2, Figure 5). Lower temperatures of wetness have been shown to delay the release of apple scab ascospores (5). There was a hint ($P=0.35$, $R^2=0.10$) that increased rainfall amounts in the early lag period of 0-5% spore capture were resulting in lower spore capture (Table 2, Figure 6). There was strong indication ($P= 0.02$, $R^2=0.29$) that an increased interval between rainfall events resulted in lower spore capture, suggesting perhaps that a period of re-conditioning of the asci after drying could be necessary to result in expected captures (Table 2, Figure 7). Rainfall

temperature and the interval between rains thus may help explain lags and deviations in discharge from the predictions of maturation models.

Summary

The highest correlations were of spore capture vs. the number of degree days since the beginning of the previous Mills table event ($Y = 2.88 – 0.0633X$, $P = 0.02$, $R^2 = 0.29$); and vs. the temperature of the current Mills table event ($Y = 0.329X – 0.430$, $P = 0.11$, $R^2 = 0.24$). Thus, a re-conditioning rain may be necessary when rain events become separated in time before expected captures predicted by maturation models are attained; and rainfall temperatures also influence the magnitude of spore capture during a given event.

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Table 1. Rainfall amounts, Ukiah, CA 2006

CAPTURE PERIOD	ALL DAYS	RAIN DAYS	TOTAL CM	CM / RAIN DAY
0-5% of Spores	15	12	20.7	1.7
5-95% of Spores	22	17	16.5	1.0
95-100% of Spores	15	8	9.5	1.2
TOTAL	52	37	46.7	1.3

Table 2. Regression analyses of spore capture vs temperature, rainfall, degree days (0°C)

		P	R^2
TEMPERATURE, WARMEST 6 HOURS of WETNESS			
5-95% of Spores	Y = 0.200X + 0.552	0.46	0.06
TEMPERATURE, MILLS TABLE EVENT			
5-95% of Spores	Y = 0.329X - 0.430	0.11	0.24
RAINFALL AMOUNT			
0-5% of Spores	Y = 2.82 - 0.633X	0.35	0.1
DEGREE DAYS SINCE PREVIOUS EVENT'S BEGINNING			
5-100% of Spores	Y = 2.88 - 0.0633X	0.02	0.29

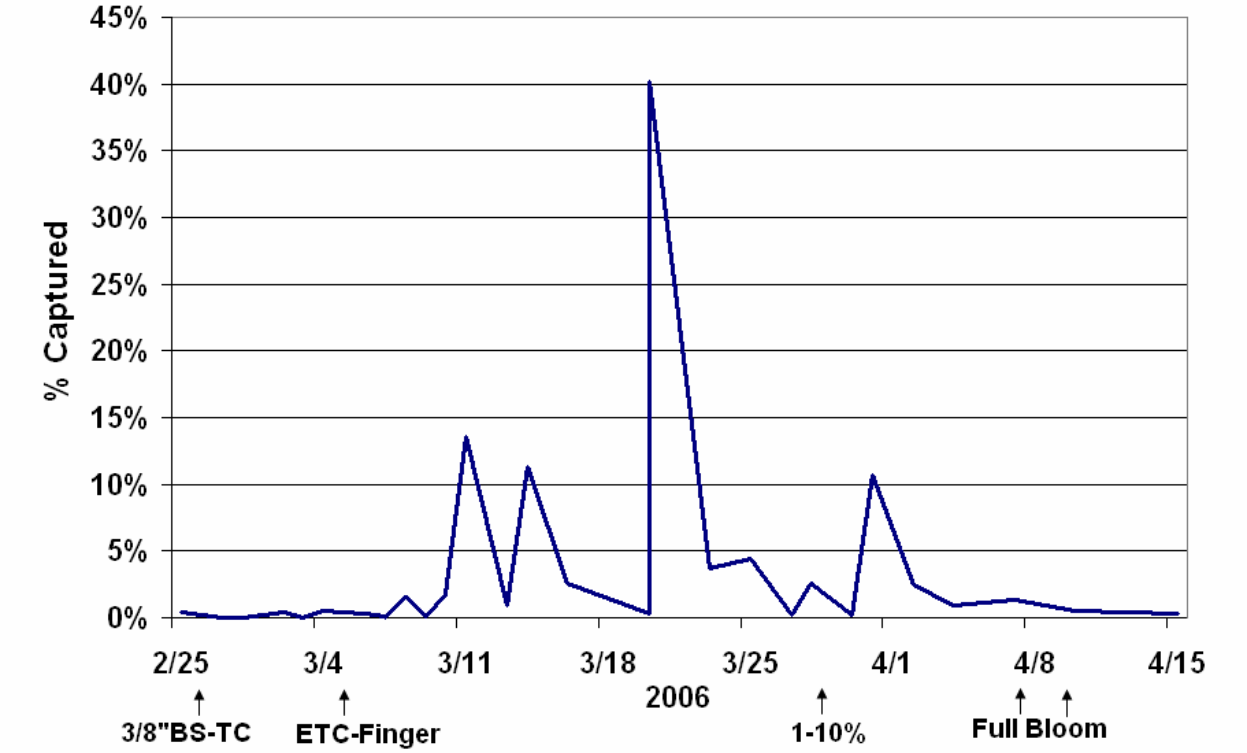

Figure 1. Ascospore capture vs date and tree phenology.

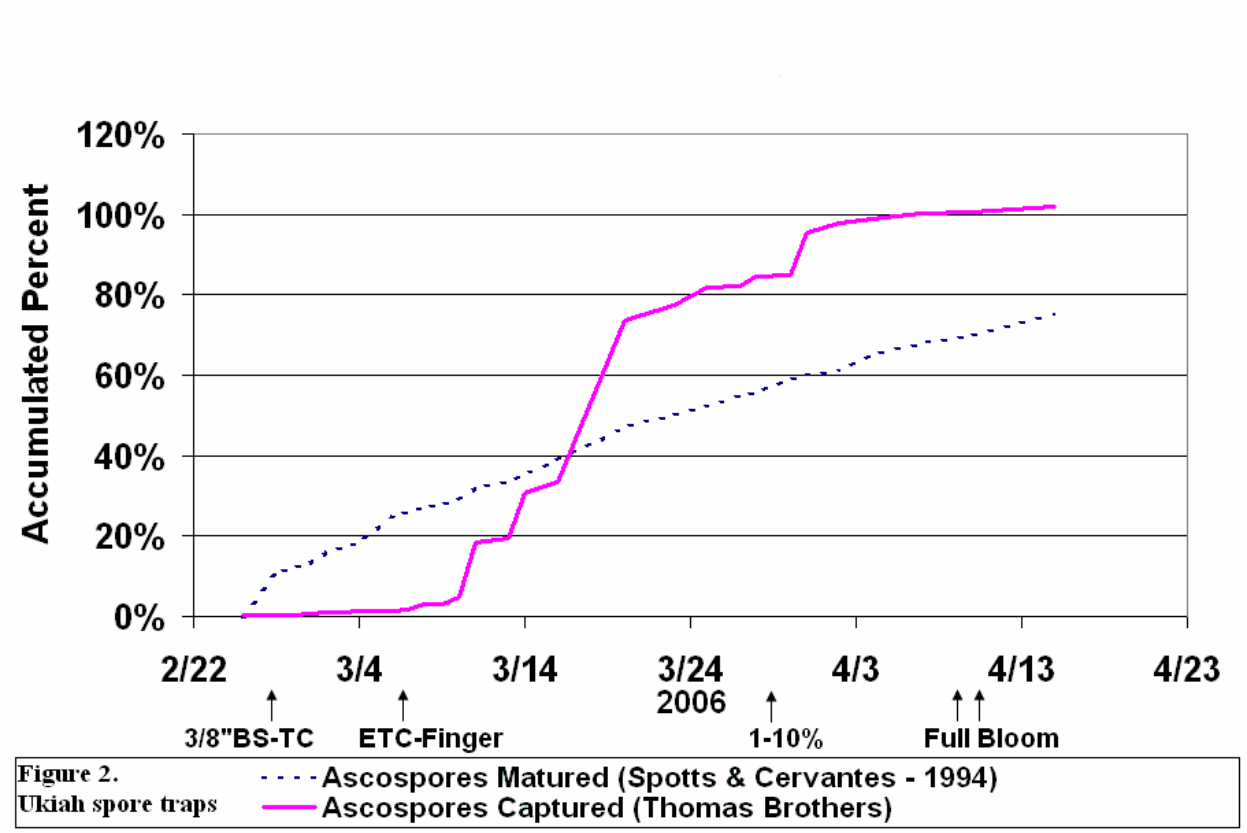

Figure 2.
Ukiah spore traps

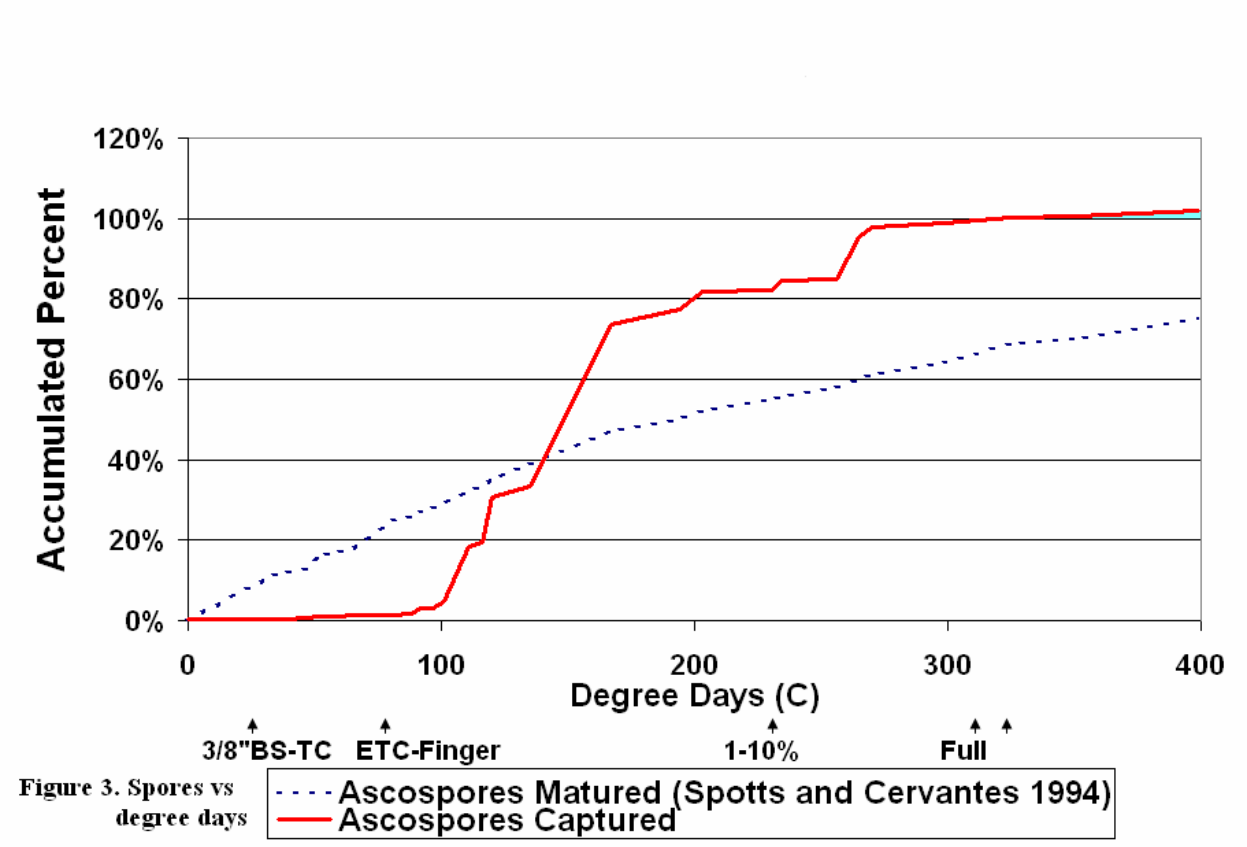

Figure 3. Spores vs degree days

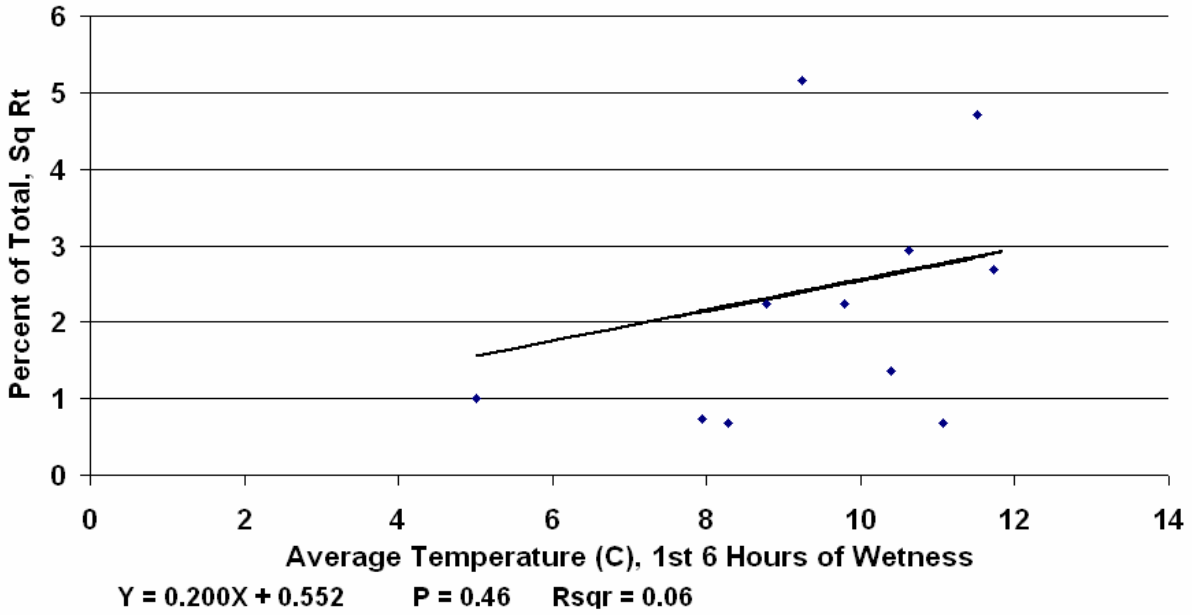

Figure 4. Spores captured vs temperature of warmest 6 hour period of wetness; 5-95% of spores, 2006.

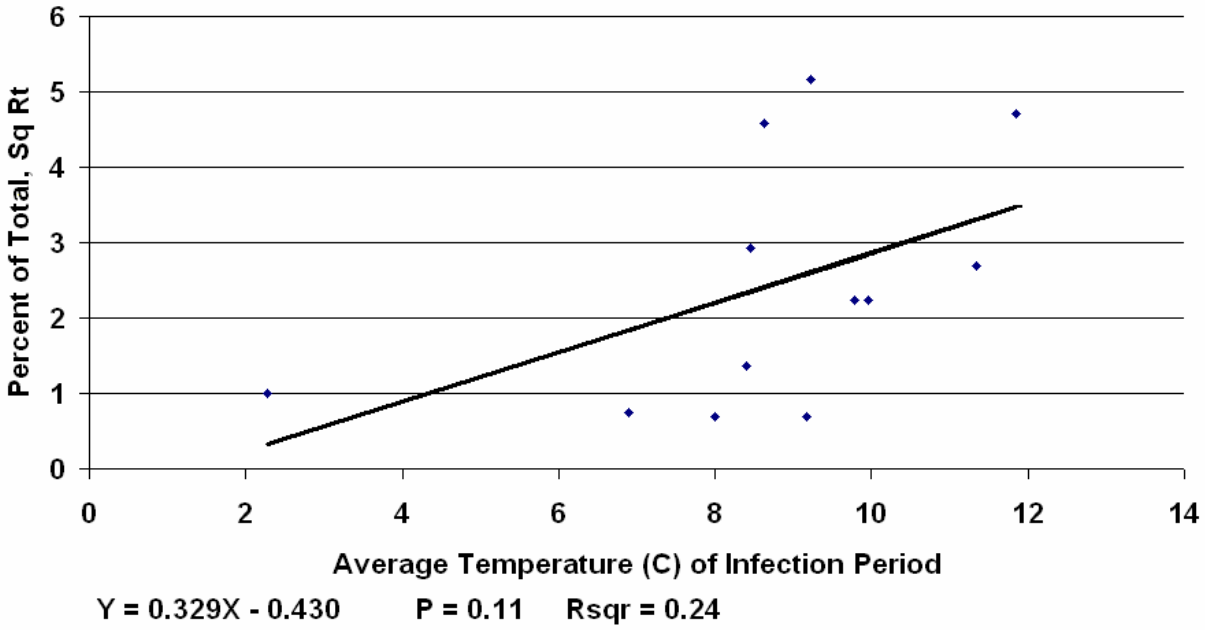

Figure 5. Ascospores captured vs temperature of infection period; 5-95% of spores 2006.

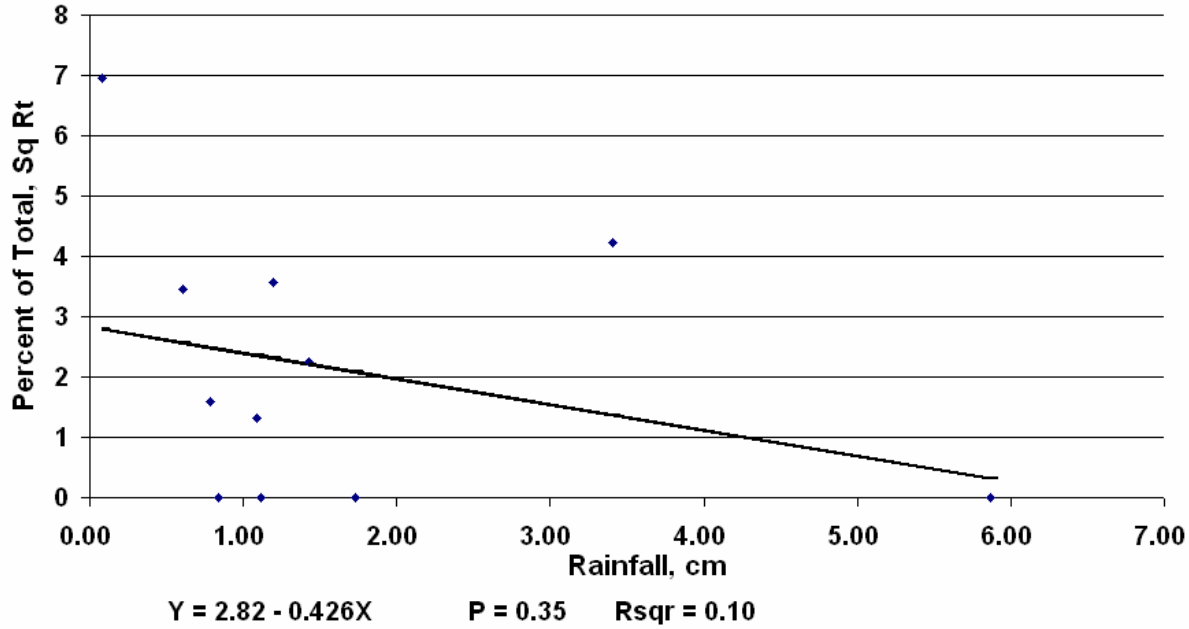

Figure 6. Spores captured vs rainfall amount; 0-5% of spores, 2006.

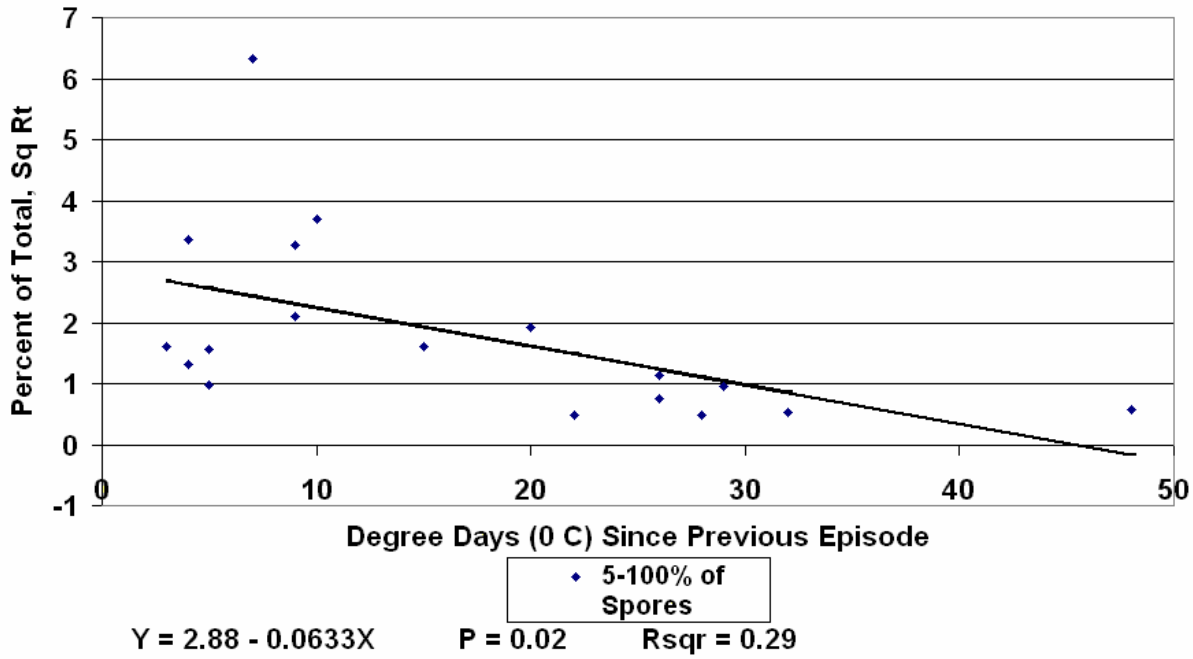

Figure 7. Spores captured vs degree days (0C) since beginning of previous Mills Table episode; 2006