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Fungicide use and *Colletotrichum acutatum* levels over the past two years - a grower survey

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Fungicide Use and *Colletotrichum acutatum* Levels Over the Past Two Years – A Grower Survey

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Abstract
Current New Jersey recommendations for anthracnose *Colletotrichum acutatum* control in highbush blueberry call for several fungicide applications starting at the beginning of bloom and continuing afterwards on more susceptible varieties such as Bluecrop. Chemistries are rotated for a resistance management program. Numerous growers are having problems with anthracnose infection control in New Jersey blueberry production. The objective of this study was to survey grower fungicide programs and anthracnose levels over 2 years to see if there was a weakness in commercial fungicide programs. Commercial packed pints of ripe blueberries, cv. Bluecrop, were collected along with grower spray records. Fruit was stored at room temperature (24^{o} C) for 10 days and read for percent infection. The timing for bloom infection periods was identified and compared to fungicide application records. In 2016, berries ranged from 1 to 72% infected, and in 2017, ranged from 0 to 63% infected. Data analyses attempted to correlate grower fungicide use and timing of fungicide applications with resulting anthracnose infections. Observations show that there is a more complex picture to anthracnose control other than starting fungicide cover sprays during bloom, and rotating chemistries. Some growers who are following current recommendations for anthracnose control still produce fruit with high infection rates, while others obtain excellent control. Further work will include looking at sprayer type and spray coverage.

Additional Index Words: anthracnose, *Colletotrichum*, fungicide use

Introduction:
Anthracnose fruit rot, caused by *Colletotrichum acutatum*, is a serious problem in most blueberry-growing regions, such as New Jersey (NJ) (Milholland, 1995). The fungus overwinters as mycelium in the bud scales and on dead wood from the previous season. Spores are dispersed from the overwintering sites onto flower clusters and developing fruit either aerially or through precipitation events. The level of resulting disease depends mainly on: inoculum availability, cultivar susceptibility and weather conditions (Polashock et al., 2017). Since anthracnose is such a serious pest in New Jersey, most growers focus their fungicide program around this disease. Because it overwinters on bud scales, the most critical sprays are applied during bloom, often on a weekly basis. This spray timing is supported by research (Oudemans et al., 2018), and reflected in the current New Jersey State Blueberry Management Guide (Oudemans, 2018), used by most New Jersey commercial blueberry growers. We also recommend that fungicide materials be rotated by mode of action for resistance management. Actual grower use of rotations can vary in effectiveness, with example programs shown in Table 1.

Even while observing optimal spray timing, excessive levels of anthracnose are still present in a number of commercial NJ fields. Our objective was to survey grower fungicide programs to see if there were weaknesses in the anthracnose spray program.

Table 1. Pest Control Recommendations forNew Jersey (Oudemans, 2018).

Spray 1	Spray2	Spray 3	Spray 4	Assessment
azoxystrobin	pyraclostrobin & boscalid	azoxystrobin	pyraclostrobin & boscalid	Very Bad all high risk with the same mode of action
azoxystrobin	pyraclostrobin & boscalid	ziram	azoxystrobin	Better, but still heavy emphasis on high risk materials
azoxystrobin	ziram	azoxystrobin	ziram	Best, high risk materials separated by low-risk

Material and Methods

Data that was analyzed came from 2016 and 2017 seasons. In 2016, 28 pints of highbush blueberries were surveyed for anthracnose symptoms, and pints were obtained from 28 separate blueberry fields out of 23 growers that are part of the Integrated Pest Management (IPM) Program. In 2017, 45 pints were surveyed from 45 separate blueberry fields out of 33 growers that are part of the IPM program. Our samples were packed pints, randomly selected from growers on the dates when grower farms were scouted. All pints that were collected were produced from mature Bluecrop plants ranging from 3 to 30 years old. Pints were second picking, which was harvested manually, and placed through the sorting machine. Samples were immediately incubated on a lab bench at room temperature (24^{o} C) with a range of 45-55% relative humidity for 10 days to encourage visible disease symptoms. Berries were then counted and converted to percent of berries infested with anthracnose. This is our standard practice in the IPM program used to advise growers for their general anthracnose levels.

Grower pesticide use records were collected for those fields from which fruit samples were obtained. Fungicide use during bloom and for 2 weeks after, was compared to percent disease incidence in the collected samples. Bloom timing was observed in the field, but standardized for each year with a degree day model on the Rutgers University blueberry website: http://benedick.rutgers.edu/Blueberryweather/. In 2016, bloom started April 13th and in 2017, it started on April 18th. Precipitation during 2016 and 2017 bloom timing (Table 2 and 3) was also recorded, since some fungicides are known to vary in their rain fast properties (Schilder, 2010).

Table 2. 2016 Precipitation of over 0.1 centimeters of rainfall starting at bloom, through the month of May. Data generated from: www.usclimatedata.com for the Hammonton, NJ area.

April	**Rainfall**	**May**	**Rainfall**
13th	0.762	2nd	1.80
23rd	0.254	3rd	2.134
24th	0.457	5th	0.356
26th	0.965	6th	0.838
27th	1.016	7th	2.108
29th	0.356	14th	1.245
		18th	0.559
		22nd	0.889

Table 3. 2017 Precipitation of over 0.1 centimeters of rainfall starting at bloom, through the month of May. Data generated from: www.usclimatedata.com for the Hammonton, NJ area.

April	**Rainfall**	**May**	**Rainfall**
18th	0.305	2nd	0.279
23rd	0.330	6th	4.495
26th	2.768	13th	2.134
		14th	2.54
		22nd	2.667
		23rd	5.283
		24th	0.381
		25th	1.117
		26th	1.808
		31st	0.110

Results

In 2016, anthracnose infection ranged from 1 to 72%. Grower's that showed 1% infested berries had a fungicide program that incorporated applications that either were on time or 2 days late after bloom had started, had good fungicide rotations, and continuous fruit maturation sprays. When we analyzed spray records from a grower that only sprayed twice: one application at bloom and the 2nd two months later, it resulted in 45% infested fruit. We would assume that these high disease levels were due to not enough applications and no fruit maturation sprays. When we analyzed the spray records for a sample that had 72% infested berries, we found that the grower was 14 days late at bloom timing, and did not spray during fruit maturation. Regression analysis produced a very low r^2 value and no significant correlation. This was a non-replicated survey with more variables then just numbers of fungicide used versus percent anthracnose. A number of growers who were using 4 or more fungicide sprays during bloom were still obtaining high levels of infested berries (Figure 1). Rainfall also may be a factor in that there were 12 days of rainfall of greater than 0.25 cm in 2016 during bloom (Table 2). Various degrees of wash-off are known to occur by some fungicides with over 0.254 centimeters of rain (Schilder, 2010).n 2017 we saw similar results as seen during 2016. The anthracnose infections ranged from 0 to 63% infested berries. When we analyzed spray records from 2017 we observed similar spray patterns. Growers who were applying on time during the bloom period and rotating fungicide chemistries showed little to no infested berries. Some growers who were late in bloom sprays and did not show good effective fungicide rotations, or not using fruit maturation applications showed a significant amount of infested fruit.

However, much of the fungicide use and disease incidence were similar to 2016 (Figure 2). We had numerous growers who were incorporating 4 to 6 fungicide sprays during bloom and still generated high levels of anthracnose on their berries. In 2017, there were 12 days of rainfall greater than 0.25 cm during bloom (Table 3).

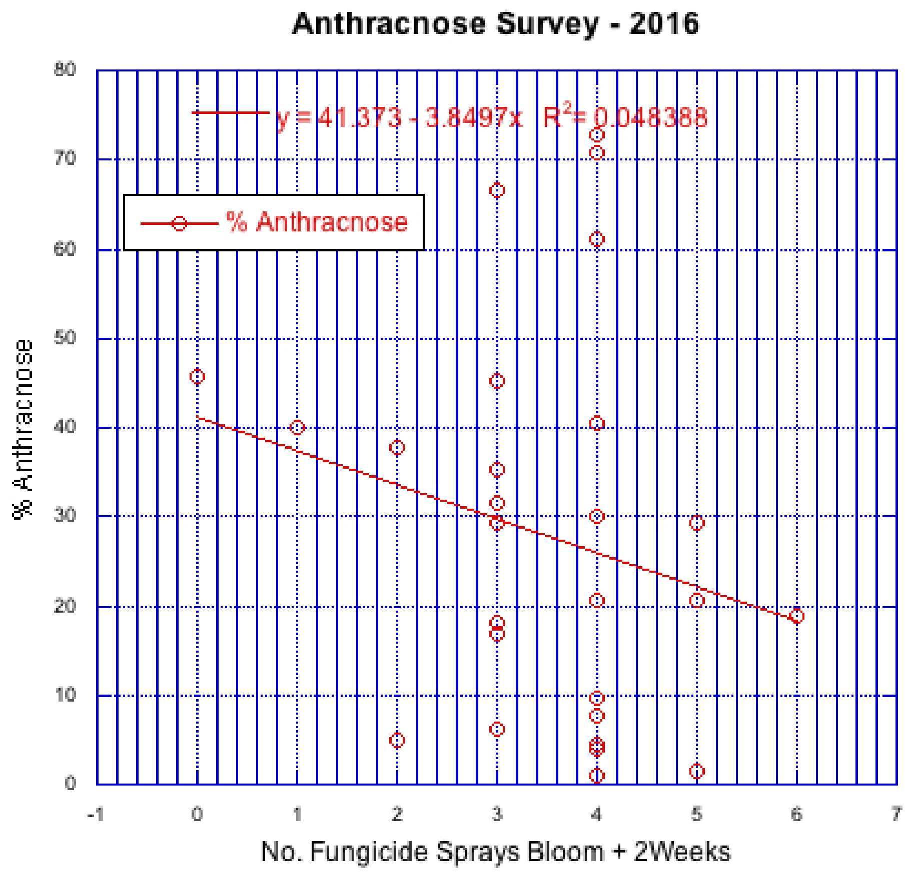

Figure 1. 2016 regression analysis of number of fungicide applications used during bloom and 2 weeks after versus percent anthracnose. The R^2 value was very low, with no significant correlation.

Conclusion

We know that bloom timing is a key factor in starting an anthracnose spray program. We found several spray program deficiencies largely due to sprays being applied too late after the start of bloom, and in some cases stopping too early. Other reasons for failure may be due to wash off from rain and not reapplying fungicides. Reapplications are very important if heavy rainfall occurs shortly after the initial application (Schilder, 2010). Chemistry rotations are also a key component in a spray program (Oudemans, 2018). However, there were a few growers that showed an excellent spray program, but still obtained high levels of diseased fruit. Some growers may have fields with greater amounts of overwintering inoculum, poorly pruned bushes and dead wood. It is also possible that some growers are obtaining poor spray coverage, or their equipment is not calibrated correctly. Blueberry anthracnose remains one of the most challenging diseases in the mid-Atlantic area.

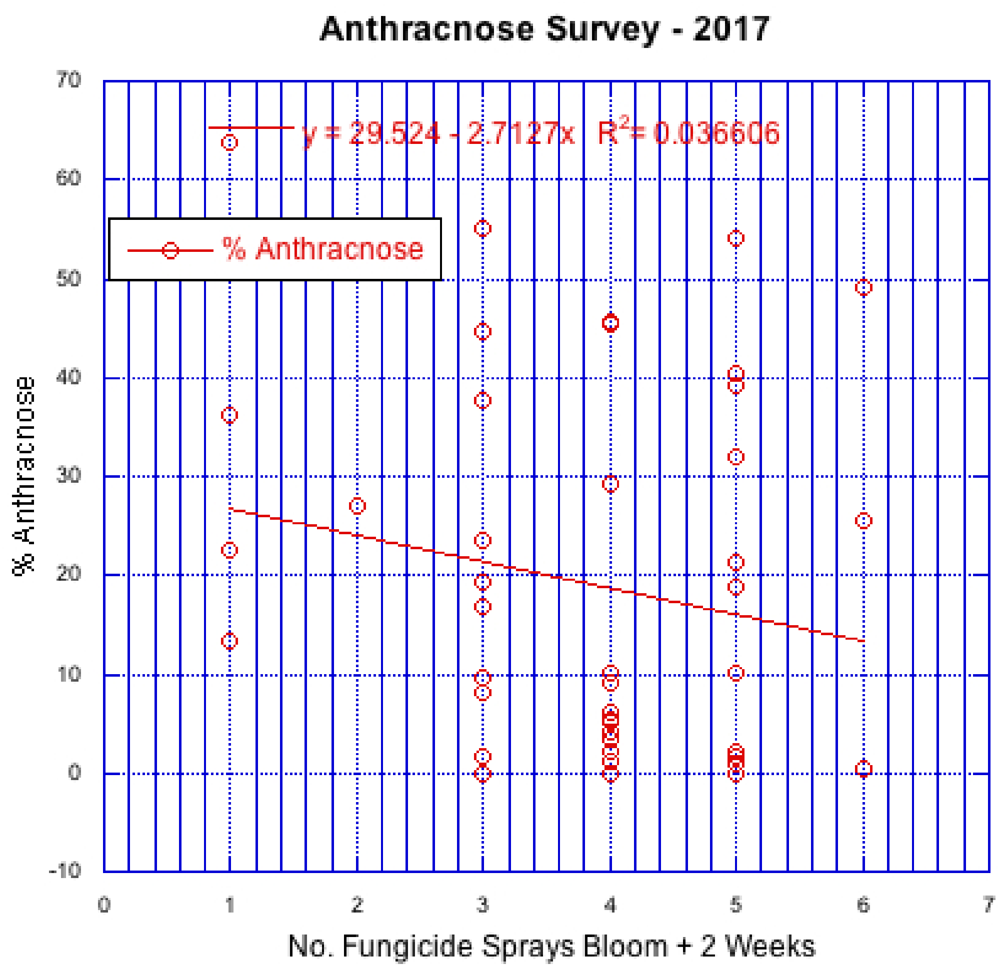

Figure 2. 2017 regression analysis on number of fungicide applications used during bloom and 2 weeks after versus percent anthracnose. The R^2 value was very low, with no significant correlation.

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