Colletotrichum crown rot: Measures to take in the early spring and considerations for sustainability of the industry with regard to the Colletotrichum crown rot problem

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Current Situation: Colletotrichum crown rot incidence, caused by *Colletotrichum gloeosporioides* (C.glo) occurred on numerous farms in the fall of 2007. Problems included collapsed or stunted plants soon after field setting and a declining loss of plants with the onset of winter. From Sept 15 to February 20, the Plant Disease and Insect Clinic (PDIC) managed 64 strawberry samples. We identified 14 growers in NC and 1 out-of-state grower (n=15) with *Colletotrichum* problems. Thirteen samples were confirmed to have C.glo, 2 farms probably have C.glo but isolations attempts did not verify the presence of the pathogen, and 3 farms were confirmed or suspected to have *C. acutatum* (the anthracnose ripe fruit rot pathogen) in addition to C.glo. Affected growers suffered moderate to severe losses. Although it is dangerous to provide specific numbers of plant mortality since systematic surveys were not done, the numbers are also helpful. Field observations and grower estimations range from less than 5% up to 60% of the plants died within fields planted to infected plant sources. A rough estimation would put the average plant death at 5-15% with the majority of plants dying in October-November. A second related problem is the planting of non-symptomatic plants (mainly "Treasure") in Florida from NC-sources. Discussions with clinicians, growers and agents in Florida (again without actual surveys) offers numbers ranging from a low percentage (less than 3%) up to 40% incidence, with an average estimated problem of 15% or less collapsed plants. Although the problem could be related to specific plant sources in most cases, the correlation was not always straight forward, making room for the hypothesis that plant infection from other sources is possible at any stage of the production cycle. Other strawberry problems have been diagnosed. With the dry hot fall weather some fields had low moisture levels in the bed and plants were stunted from drought injury. Three additional NC samples were confirmed to have *Phytophthora* crown rot and three had angular leaf spot. Both of these diseases could cause stunting and *Phytophthora* will cause plant collapse.

What Should I do? Problem sources were identified and if you are aware of a potential plant source infestation, you may have to be extra vigilant in the early spring in spite of no noticeable

plant collapse yet. In many cases plants with lower levels of infection are stunted even though crown tissues do not show any characteristic reddish brown discoloration. In our research and diagnosis, we were able to isolate *C. gloeosporioides* from crowns of stunted plants with no typical symptoms. With the onset of increasing temperatures in the spring, some of these plants may start showing typical symptoms followed by plant collapse. Correct diagnosis is important and this is the best time to send stunted/collapsing plants to your local clinic for further diagnostics. These plants may be distributed randomly in the field in an otherwise vigorous healthy looking strawberry field.

For growers with confirmed problems: If you have been dealing with the problem from late fall or early winter, there is enough reason to be extra careful with the spray program to effectively manage crown rot together with other diseases that may be prevalent at this time. When it comes to fungicidal control of the disease, resistance management or use of effective doses becomes an essential consideration for disease management. Experience in Florida has demonstrated regular applications of captan prevent spread within the field and Topsin-M has shown good systemic activity to reduce disease levels. In our most recent work, highly preliminary at this time, *C. gloeosporioides* isolates collected from a few strawberry farms were used for fungicide tolerance studies in the lab with Topsin-M. Results from this study indicated a high tolerance of two isolates out of four to Topsin –M. However, these four isolates when tested against a QoI fungicide (such as Cabrio) with a combination of captan, better growth inhibition was obtained. These observations and results suggest affected growers will need to rely on captan and the QoI fungicides (Group 11 fungicides = Abound, Cabrio or Pristine) in between captan+Topsin-M applications or to start use of QoI fungicides earlier in the fields where crown rot has been detected. There is a danger to use the QoI fungicides too much and resistance could develop in the pathogen population. Therefore, use the following rules to develop a spray program: Where QoI fungicide products are applied solo, do not exceed 33% of the total number of sprays or a maximum of 4. Where mixtures (co-formulations or tank mixes) are used do not exceed 50% of the total number of sprays (should be a maximum of about 5 for strawberries). Use a maximum of 1 QoI fungicide spray out of every 3 fungicide applications. Therefore, in our current situation, the best strategy is to include captan when applying a QoI product. Alternate sprays should rely on captan plus other products as needed. Growers with Botrytis pressure may

elect to use Pristine, especially during bloom, since it has a QoI component and a good botryticide component. The QoI products also have fairly good activity on powdery mildew.

In our nursery trial at a research station, we have seen the dispersal of inoculum from the source diminishes rapidly over short distances despite overhead sprinkler use, unlike the quick spread of ripe fruit rot caused by *C. acutatum*. This observation indicates that removal of symptomatic plants (collapsing or stunted looking and diagnosed to have C.glo infection) together with a few neighboring ones should limit the spread of the crown rot fungus in the field. A fungicide program as outlined above should also help in minimizing spread of inoculum in the field. Plants already infected will continue to collapse and will produce many spores so rouging and/or fungicides will be an important IPM strategy. Our research with the bare root plants from the research station nursery trial, where mother plants were spray inoculated with *C. glo*, showed low plant mortality in the fruiting field after a strobilurin dip (Quadris/Abound) before planting. This data also suggests the QoI fungicides will be an important and effective part of a spring fungicide program. Based on our preliminary research findings and existing situation in the field, especially fields with suspected *C. glo* infestation our recommendations are to:

1) Include Qoi fungicides earlier in the spray program (no later than 10% bloom) and follow the rules above
2) Use nitrate sources for nitrogen in the fertility management program
3) Finish diagnosis of suspected plants in your field
4) Scout your field and rogue suspected plants

What does the future hold? Crown rot problems may not be a recurrent major problem every year with high severity index. However, in the strawberry plant business, it is not a question "if" but "when" will these types of diseases show up. The C.glo is a problem of an enduring nature due to the presence of wild inoculum sources. For the future of the strawberry industry and keeping the impact of this problem to its minimum, the following points need to be considered.

a) Growing strawberry transplants in a safe distance from the wild inoculum source. This will require identification of wild alternate hosts in North Carolina and determining the "safe" distance of inoculum dispersal experimentally from the source.

b) Introduction of drip irrigation systems for nursery production instead of overhead sprinkler. This would help in drier years but if we get regular rains the impact will be low.

c) Do not overwater plugs using overhead sprinklers and minimize sprinkler irrigation for plant establishment in the fruiting field

d) Development of effective sampling methods followed by sensitive diagnostic protocols to detect latently infected plants at every stage including assaying tips before entering into the plug production facility and plugs/bare root plants before entering into fruit production fields.

e) If problems are suspected and growers need to use the plants, then discard suspected plants at each step or keep problem plants separate to follow highly stringent production protocol such as

   i) Use of fungicide drenches of a registered QoI fungicide that is known to have systemic activity through the xylem

   ii) Revising fungicide spray programs based on population structure in North Carolina and their sensitivity to fungicides

   These points do not replace the priority of developing resistant/tolerant varieties, nor the continued need to grow plants under strict production protocols (e.g. certification-type standards) to be included in the integrated disease management program for the sustainability of the strawberry industry in North Carolina.

   When growers get the problem one year and want to use the same piece of land for growing strawberries in the next year, a common concern is the carryover of the inoculum to the next crop. This is not a soilborne pathogen and research in Florida has shown that pathogen does not survive in stubbles until the next crop. It is highly unlikely for the same pathogen to go to the next crop although North Carolina soil type and weather conditions are slightly different from Florida and empirical assessment of this issue is warranted. However, in such situations, fumigation of the land before the second strawberry crop will be important.