Sudden Apple Decline (SAD): the situation in New York

Introduction

In the summer of 2016, several growers in the apple-producing regions of New York State reported cases of what has been termed Sudden (or Rapid) Apple Decline (SAD/RAD), in which affected trees exhibited yellowing leaves and stunted growth, followed by progressively worsening decline and eventual death.

Last year, this syndrome was also seen in Pennsylvania, Ontario and North Carolina. In all cases, the reported symptoms were very similar, but no causative agent could be identified. Not knowing the underlying cause makes it hard to provide meaningful advice to growers, or to effectively target research efforts. As a first step, therefore, fruit workers in both Pennsylvania and New York initiated grower surveys in 2017 with the aim of identifying any underlying factors common to decline-affected blocks.

New York Grower Survey

With funding from the New York State Apple Research and Development Program (ARDP), members of Cornell University's Eastern New York Commercial Horticulture Program and Lake Ontario Fruit Team developed an on-line and mail-in survey that was released to growers in the summer of 2017. Questions included location, acreage and planting history of declining blocks, affected cultivars and rootstocks, planting date(s), symptoms, herbicide use and any past or present history of weather-related problems, diseases and insect pests.

At the time of writing (December, 2017), the responses are still being collated and analyzed. However, we have enough data from more than 20 declining blocks covering 8 different counties to draw some preliminary conclusions.

So far, Sudden Apple Decline has been reported in 13 cultivars on 9 different rootstocks, with affected blocks representing various ages/planting dates. All survey respondents reported leaf yellowing in declining trees (the only symptom common to all sites), and a high proportion (approx. 70-80%) also reported rough, flaking or splitting bark either above or below the graft union. Discoloration of the bark was also commonly observed.

Most respondents reported an apparently random occurrence of declining trees within affected blocks, with about one-third of growers reporting small clusters of affected trees within rows or (less commonly) in adjacent rows (approx. 10% of responses). About 30% of growers reported that their declining blocks had suffered winter injury at some point, about 15% reported no winter injury, and the remaining respondents were uncertain on this point. Similarly, about half of the affected blocks had irrigation, and half did not.

A wide variety of different herbicides were used by survey respondents, and most growers indicated that root suckers had been present at least some of the time when herbicides were applied. However, it is not unusual to see dead trees with apparently healthy root suckers present in declining blocks.

Questions concerning other possible contributing factors (including waterlogging, fireblight, *Phytophthora*, stem borers, etc.) showed no clear or consistent patterns in responses. We have not so far considered soil conditions/soil health (including compaction), root competition, the possible role of viruses and their vectors, or the possibility of pathogen transfer between adjacent trees by natural root grafting. These are all targets for further investigation.

However, it is possible that Sudden Apple Decline may be similar to honeybee Colony Collapse Disorder, in that it may be the result of a complex combination of stressors rather than a single causative agent. For example, bark damage due to winter injury or herbicide applications might provide entry points for insect pests or various pathogens. Additional environmental pressures such as flooding, prolonged drought, or heavy crop loads may then be enough for affected trees to reach 'tipping point'. At present, however, this remains unclear.

Field observations

Our own field observations are in agreement with grower reports that the initial distribution of declining trees in affected blocks appears to be random, usually with no obvious 'edge effects'. As the decline spreads, however, it is not unusual to find small groups of 3–4 trees consisting of dead, dying and healthy individuals adjacent to each other within a row.

In general, declining trees appear to set relatively few fruit. However, those that are produced are not aborted but are strongly retained by the tree and persist as small but perfectly formed fruit until the end of the season. There also appear to be some cultivar-specific symptoms, with Honeycrisp (for example) showing a pronounced downward curling of the 'tip half' of the leaves, particularly on branches near the top of the tree. In 2017, affected NY-1 trees tended to develop a thickening of the leaves towards the end of the season, giving them a 'plastic' or 'leathery' feel; often, the leaves also showed either a red-purple discoloration on the upper surface or darkened blotches on the lower surface. However, it remains to be seen how consistent these symptoms are in the same varieties in different regions and in different years.

As Figure 1 (below) illustrates, regular monitoring of several declining blocks over the 2017 growing season generally showed both a progressive worsening of trees that were showing symptoms at the start of the monitoring period, and a steady increase in the proportion of new trees showing symptoms. What usually did <u>not</u> increase, however, was the number of dead trees in the block: trees that were unhealthy at the start of the summer gradually worsened, but were usually still alive at the end of the season. It seems reasonable to assume, however, that these weakened trees will be less likely to survive the winter than their more vigorous neighbors. This will be assessed in spring, 2018.

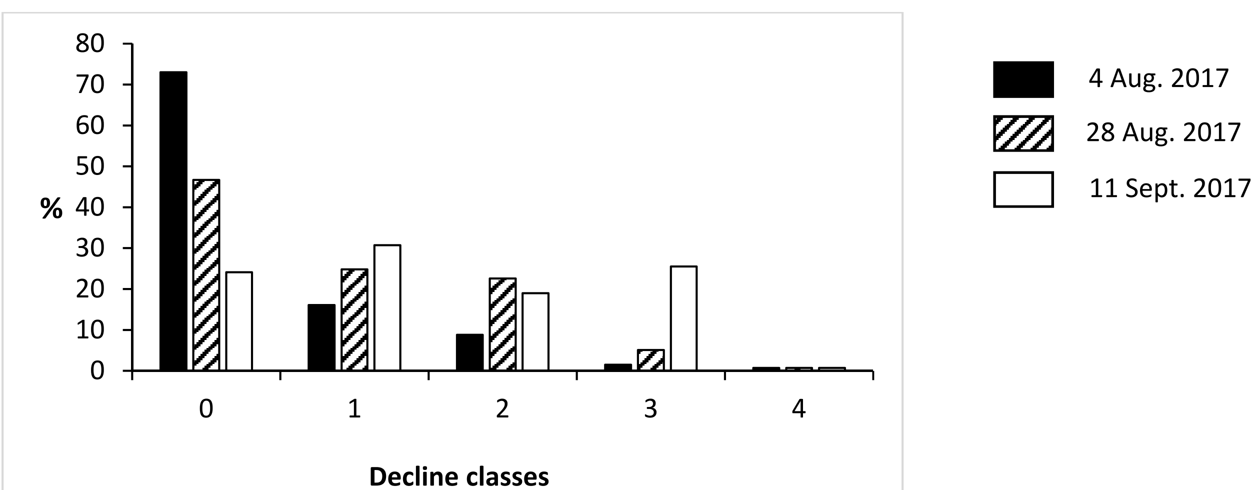

Fig. 1 Change in % trees in each decline class over a 6 week period. Class 0 = No visible symptoms, 1 = Slight signs of leaf chlorosis, 2 = Significant chlorosis/onset of decline 3 = Obvious decline, 4 = Death of tree. Data based on a total of 137 six-year old Fuji trees.

The way ahead: next steps

While we may not be able to pinpoint the definitive cause of SAD/RAD in all situations, we need to try to manage the situation. Can SAD/RAD be prevented in new plantings and can a declining block be saved? Is it cost-effective to try to save an affected block? Strawberry growers must contend with a similar complex called black root rot, which shares many of the same putative causal factors. It is also similar to the devastation caused by Armillaria root rot, which is endemic to the peach industry in the southeastern United States. Producers suffering from these plant declines were never successful at saving a planting or block to a level where they were satisfied with the results. In these systems, everything has been tried including different rootstocks, raised bed planting, root excavation, and individual tree injection. In many cases, decline was halted, but trees never recovered to a high level of productivity and the cost-effectiveness of the measures to halt the decline was questionable. Unfortunately, injured trees and trees with rots or cankers will not recover to the level of prior productivity. Whether or not it will be cost-effective to try to save a block with SAD/RAD will greatly depend on the level of decline and the importance of the block to the specific operation.

What are the options?

With decline that appears to be influenced by multiple and completely different causal factors at each location, what is one to do about the SAD/RAD problem? In all cases of plant decline, greater success will be achieved with preventative approaches instead of curative efforts which are typically less effective since the disease has had a head-start. Also, many of the environmental factors and potential abiotic causes are beyond our control. However, we can work to minimize potential abiotic injury by keeping the trees healthy. Since plant stress is a key component of many cases of SAD/RAD, it will be essential to keep plants healthy and minimize stress. Try to follow the best "safest" practices for growing healthy apples outlined by horticulturalists and physiologists. If blocks make it to year seven, they may escape the problem as it is observed that the period of highest susceptibility is within years three to six. Also, since a variety of pests and diseases can be involved, it will be important to implement general broad-spectrum tactics that can protect against several potential agents. The following is a list recommendations compiled from advice provided by previous specialists and practices that have been helpful in other decline systems. Adhering to these guidelines won't guarantee success in affected blocks, but at least you will know that you've given your planting the best chance of survival.

Guidelines for managing SAD/RAD

Production

1. Use and manage irrigation needs as defined by the current season's water availability. Implement gradual changes in the irrigation practices and avoid "burst" irrigation to deal with drought stress as it could lead to crown infections by wood-decay fungi in trees beginning to experience drought stress.

2. Invest in high quality, large caliper certified trees and spend extra time ensuring recommended planting depths for a healthy planting and to avoid infections near the graft union.

3. Thin, prune, and fertilize appropriately to balance vegetative growth and avoid weak, over-cropped trees.

4. Paint trunks with white latex paint to reduce positional winter injury. Painting may also impede uptake of herbicides by the bark at the crown if there was some slight drift or accidental coverage.

(Note: Organic growers should check with their certifying body before implementing this practice).

Pests

1. Manage trunk-boring insects by scouting and following season-specific insect management recommendations.

2. Manage weeds to reduce competition and tree stress, but take care to avoid trunk exposure to herbicides, which may be a considerable factor in SAD/RAD decline. Ensuring herbicide sprayer calibration and shielding is an excellent investment of your time and resources.

Diseases

1. Managing fire blight (particularly shoot blight) should be an essential component of a SAD/RAD management program, especially given the potential devastation of the pathogen to the planting and the potential for dead tissue to lead to opportunistic infections by wood-decay fungi such as *Botryosphaeria*, *Nectria,* or *Schizophyllum*. Wood-decay fungi have been reported in SAD/RAD samples throughout the eastern United States. However, it is hard to determine their role in decline and there is little one can do to manage them other than prevent their infection. When managing shoot blight in a block with (or at risk or getting) SAD/RAD, it might be important to implement a program of Systemic Acquired Resistance (SAR) (e.g. by using Actigard, Regalia or Lifeguard) with post-bloom applications of a copper fungicide. SAR is systemic and is a general means of activating plant defenses against all pathogens (including pathogens other than fire blight that might be involved in the SAD/RAD complex). Similarly, the copper used to protect against shoot blight infections would also protect against infection by wood-decay fungi.

2. Protect against *Phytophthora* infection with a program of phosphite fungicides at first leaf. Phosphite fungicides are one of the few fully systemic fungicides. They are absorbed by the foliage and will move to the roots and throughout the canopy. These fungicides are primarily active against *Phytophthora* and other oomycete pathogens, but can have a low level of activity against true fungal pathogens. Following the labeled guidelines for phosphite fungicides products would help minimize the risk of *Phytophthora* infection and potentially impede other wood decay and canker fungi.