Stressed High Density Apples are Subject to Collapse

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Editor's note: *All new high density apple plantings, especially tall spindle should be planned with trickle irrigation. The water needs to go on the day the trees are planted. Stressed trees are predisposed to insect damage. I have seen several blocks of trees in both PA and NJ that are in the same situation as Peter describes below, Collapse and tree death. Peter and I had several conversations as he was developing the article below, both before and after it was published. Please take all the suggestions to heart. This article was reprinted with permission from Peter Jentsch's blog from October 16, 2015:* https://blogs.cornell.edu/jentsch/ *with the title,* Fuji & Zestar Collapse: The 'Perfect Storm' for Tree Stress at Harvest.

In the world of fruit growing there are few sights more disheartening for a grower then the loss of fruit just days before harvest. Whether its hurricane winds and flooding, hail storms, tall spindle trees upended in a failed support structure from a heavy crop load or herbicide injury during drought years leading to tree decline. Without a doubt, late season fruit damage is costly.

Only a few of these scenarios might be prevented by careful planning and continued critical assessments of each block through the season. Prevention will often be needed years before these events occur. In the case we describe here, it may be a 'perfect storm' of multiple causes, interacting together within specific varieties and rootstock to cause severe decline.

During the past few seasons we've seen both early and late season environmental stress affecting newly planted and young well established trees. Stress can be caused by both sever rain (Hurricanes Irene and Sandy in 2011-12) and this seasons drought (2015).

In eastern and western NY, growers are seeing an increasing infestation from black stem borer (BSB), *Xylosandrus germanus* that are attracted to stress induced trees. To date, we have not seen BSB infestation of 'healthy trees' exhibiting 1mm holes in the trunk or tell tale 'tooth pick' frass. However, in stressed trees, we are increasing seeing the presence of BSB infested trees with trap captures of BSB from Essex to Orange Counties.

This week we observed two Hudson Valley orchards with severe tree decline leading to tree loss. The first, a block of Fuji on M.9 rootstock in Ulster County with varying degrees of rootstock, union and scion injury just above ground level up to the graft union and well into the scion wood. The second, a block of Zestar, also on M.9 rootstock in Columbia County had near identical injury. Both blocks showed yellowing foliage of weakened trees with near perfect crop load, standing

Evidence of black stem borer near graft union.

Adult black stem borer.

in contrast to the dark green of neighboring trees. Both blocks had the same herbicide active ingredient in weed management programs over the past two years.

In Fuji we assessed 121 trees, inspecting three rows in the block and finding over 58% of the trees with varying degrees of yellowing. As we dug into the rootstock and base of the scion we found 30% of the trees had lost 100% of their bark just below and above the rootstock graft union. Only 9% of the trees in the block had complete or undamaged bark, the majority without burr knots. Evidence of dogwood borer feeding, frass and or live larva were found in 52% of the trees while 1mm holes, galleries and sawdust frass indicated BSB in 26% of Fuji trees.

A very confusing aspect of this sampling showed many of these severely damaged trees had little to no live bark around the perimeter of the trunk, yet they were still completely green, and with a full crop. Over the past weeks many of these trees had transitioned from a 'completely healthy appearance' to yellow, then brown, in just a matter of a few days. To date the grower had removed 73 trees in these Fuji rows with increasing numbers of trees showing severe symptoms of decline over time.

Adjacent rows with Cameo, Golden Delicious and HoneyCrisp, also on M.9, and on the same herbicide schedule, showed no yellowing or decline. However, in Cameo there is flaking bark and cracking but no signs of cambium decline or bark separation from the wood. The Golden Delicious and Honeycrisp were without any signs of damage to the trunk save the 'normal' growth cracking and healing that comes with age.

In the Columbia County Zestar block we observed pockets of decline, initially thought to be only from black stem borer. Similar herbicide schedules and active ingredients were used over the past two years, identical to the Ulster County Fuji block. Dogwood borer has also been a perennial problem with live larva present and significant DWB feeding injury found throughout the block. Bark separation from the trunk near the base of the tree of

Black Stem Borer entry hole and frass, Dogwood Borer Frass and bark flaking.

Canker and peeling bark on Fuji / M.9.

both rootstock and scion was also present.

We know that rootstocks, which produce a high number of rooting initials that appear above ground when the graft union is up, such as the M.9 rootstock, are very prone to dogwood borer infestations in the Northeast. The loss of vascular cambium tissue restricts the flow of nutrients and water to the tree causing tree stress as nutrient flow slows within the tree.

On dwarfing rootstock orchard planting systems with considerably smaller trunk diameter and shallow rooting systems, trees are at greater risk to the impact of disease and insect pests and environmental stresses.

The underlying causes appear to be **a complex of factors**:

- the presence of **dogwood borer**, predominately along the southern side of the rootstock in rooting initials or burr knots below the graft union. The rootstock above ground peeled off, revealing dead wood, fresh frass from DWB feeding, and a high percentage of regions of dying trees with live larva present.
- the appearance of 1mm holds into the dead wood, believed to be that of **black stem borer** with fresh frass, tunneling and galleries within the heart wood.
- a defined region of **canker** radiating upward from the graft union on the north side of the tree. Beneath the bark of the canker was dead wood walled off by live tissue (see images below). We noted the Northwest band of bark to still be wet from the morning dew at noon. It may be that this area of moisture from dew in very dry years would have slower drying time post application of a spray AND act to 're-wet' the region for additional uptake of herbicide with long residual. The canker on a number of the dead trees had split open.
- herbicide strips in the two farms were impeccably clean, free of weed plants. There may be the possibility of residual herbicide injury causing cankers where overlap of high rates of spray and slow dry time causes re-wetting and re-absorption of the active ingredient. Was this exacerbated by the wounding by DWB and subsequent absorption and uptake of herbicide into these freshly wounded sites? In years of drought, super spindle trees without adequate irrigation will undergo increasing stress that may increase the risk of herbicide injury. This appeared to be the case in the use of Rely.

Brad Majek, weed scientist in New Jersey, recently published a warning about potential phytotoxicity to tree fruits from glufosinate herbicide (Rely and generics).

His short article appeared in the Rutgers Cooperative Extension Plant and Pest Advisory. One of the photos in Brad's article looks very similar to the damage seen in many Hudson Valley apple orchards. Desiccation from herbicide exposure combined with normal water stress during hot dry periods may predispose the trunks to invasion by *Botryosphaeria dothidea*, a canker pathogen that is incapable killing the cambium in healthy functioning trees, but which becomes very pathogenic in drought-stressed trees. Gramoxone can also contribute to similar trunk damage, especially on young trees (Observations from Dr. David Rosenberger).

Minimizing the use of herbicides that might injure the bark and cambium layer is yet another important factor in reducing tree stress. If injury from herbicide causes restriction in the cambium layer, reducing movement in phloem and xylem cells, the tree will be unable to transport nutrients and water. This in and of itself

may lead to BSB infestations.

The importance of **Dogwood borer management** played a role in the collapse of these trees and cannot be overstated. In new planting systems consider the Geneva rootstock series with the best match between rootstock and scion. They tend to throw fewer rooting initials above ground and will dramatically reduce the population of DWB.

Irrigation, especially in soils that drain quickly such as sandy loam, shale or alluvial till, is essential as the trees go into the ground. New plantings of high density fruit on well drained soils should be under regimented irrigation shortly after planting as root systems are developing. Establishing the rooting zone, pushing the extension leader and developing fruiting wood is critical to the productivity and longevity of a high density block.

A topic for future research will need to include the influence of DWB on the stress of young trees to produce ETOH leading to BSB infestation. Subsequently, do the fungal pathogens that are introduced to the tree by the adult to feed its young, give rise to cambium decline at the base of the tree? Secondarily, does the influence of herbicide on the trunk of trees play a role in cambium decline leading to bark death and separation. We hope to begin the process of answering these questions in small plots studies beginning in 2016.

Farming is Hard! The first eight to ten years in the life of a tall spindle system is one that requires unending attention to detail. Highly dwarfing rootstock, especially M.9, will hound even the stoutest of growers with a ruthless and unending barrage of tree stresses that are unforgiving in rehabilitation, leading to failure if left unattended. A single weak link in these systems can lead to rapid decline of entire blocks. As we commit to growing more fruit per acre, one's tenacity and commitment to effective diligence and detail in all areas of production also needs to flourish.

***Editor's note**: I have also observed numerous cankers and bark injury on apple in both PA and NJ that appear to be caused by glufosinate herbicide (Rely and generics).*

Cankers as the result of repeated applications of glufosinate herbicide (Rely and generics) on a block of Fuji/M.9. Win Cowgill photo.

Damage to Macoun trees from the herbicide Liberty(glufosinate) drift. Win Cowgill photo.

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