

Thwarting the Low-spray Plan: Marssonina Throws a Curve Ball

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Marssonina coronaria, the fungal organism known to cause Marssonina leaf blotch (MLB) on apple, is an emerging disease in the Northeast. The pathogen was first documented in the United States in 1903 (Davis 1903). At the time, it was listed under a different name: *Ascochyta coronaria*, and has since undergone several changes in its taxonomic name before arriving at today's *M. coronaria*. Until recently, the disease has been considered minor in the US, compared to other diseases caused by fungi, notably apple scab, powdery mildew, rusts and fruit rots.

Over the last 20 years, *M. coronaria* has become a commercially significant pathogen in organic apple growing regions in Europe. It caused significant damage on 'sustainably grown' apples in northern Italy in 2002 and 2003 (Tamietti and Matta 2003). It now causes losses in southern Germany, southern Austria and Switzerland as well. (Persen et al. 2012; Wöhner and Emeriewen 2019). In China, India and other Asian countries, MLB has caused huge losses over the past 30 years, and is considered one of the most important diseases in apple production over that region (Verma and Sharma 2004; Lee et al. 2011; Dang et al. 2017).

M. coronaria has been observed in commercial orchards in the north-eastern United States in recent years, and is becoming especially problematic in organic and low-spray orchards. It is also being seen in conventional orchards. Symptoms first begin as discreet dark brownish-purple spots. These spots develop acervuli, a fungal fruiting body that produces spores (Figure 1). These spots expand into yellowed chlorotic regions which then coalesce into a mottled yellow "blotch" of the leaf. If infections are

severe enough, trees defoliate prematurely. Over a few years, this can lead to a decline in tree health, and cause a reduction in fruit production and quality. *M. coronaria* can also cause spots on fruit, decreasing value or even making them largely unmarketable. Fruit symptoms are less common than foliar symptoms.

Currently, there are no fungicides labeled in the United States for use in managing *M. coronaria*. Other regions that have been struggling with MLB in commercial orchards report that there are materials that are effective in preventing infection. For example, in India broad-spectrum protectant fungicides including mancozeb, ziram, dodine, chlorothalonil and thiophanate-methyl controlled MLB, but sterol inhibitors (DMIs) were not effective (Verma and Sharma 2003). Dang

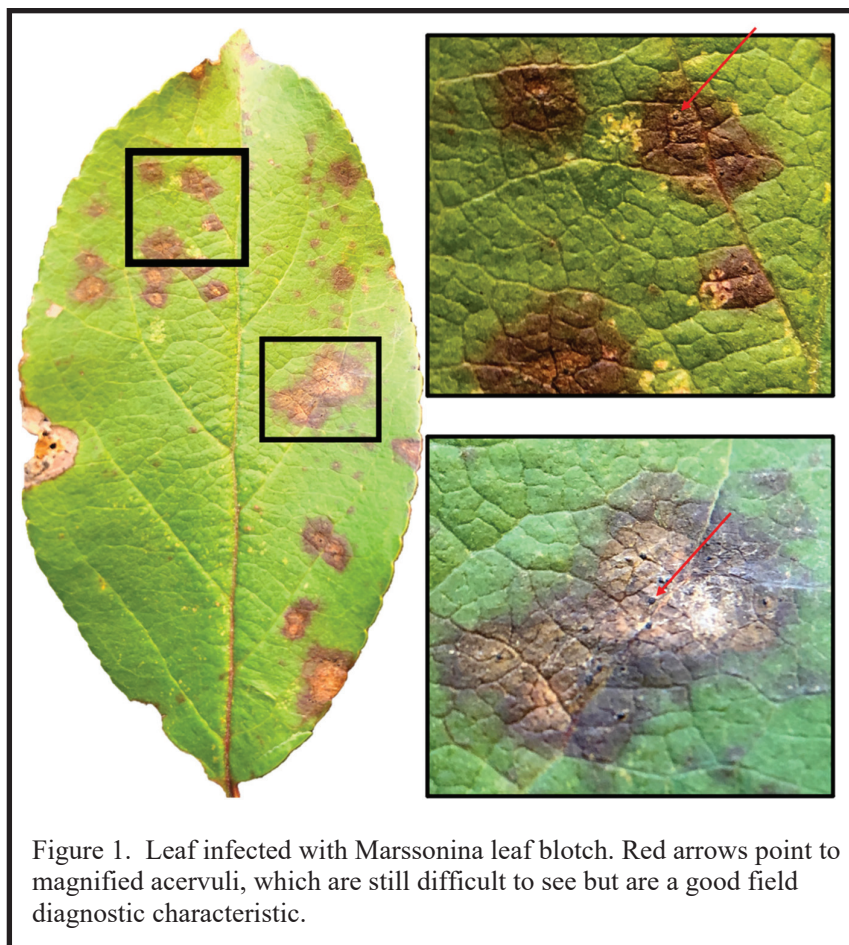


Figure 1. Leaf infected with Marssonina leaf blotch. Red arrows point to magnified acervuli, which are still difficult to see but are a good field diagnostic characteristic.

et. al. (2017) in China tested the strobilurin kresoxim-methyl (Sovran), DMI fungicides (tebuconazole = Tebuzole, myclobutanil = Rally, difenoconazole = one a.i. in Inspire Super, and two others not sold in the US), and Bordeaux mix. Sovran was effective, but performance of the DMIs and Bordeaux were erratic, with tank-mixes of different DMIs or with Bordeaux more effective. This work also recommended an early summer application of mancozeb in addition to DMI fungicides is effective in preventing disease in the field.

A trial looking at fungicide performance against apple fruit rots in Pennsylvania also proved useful in evaluating fungicide efficacy against MLB, and showed that several fungicides were very effective against the

personal communication).

Selecting disease resistant apple varieties might mitigate the impact of *M. coronaria*. Little is known about the relative susceptibility of apple cultivars to MLB, including the susceptibility of cultivars resistant to scab, and in some cases, other diseases. Commercially available cultivars selected for disease resistance were not screened for tolerance to MLB, as they were bred well before *M. coronaria* was observed on commercial apple trees in the U.S. Additionally, recent breeding has focused less on disease resistance and more on consumer sensory appeal (Peace et. al. 2019). In order to manage MLB, it is important to determine which cultivars currently on the market, or in the ground, are resistant to *M. coronaria*. In this article, two scab-resistant apple cultivars, GoldRush and Enterprise, grown under a low-spray, organic program are assessed for susceptibility to MLB during the 2020 season.

GoldRush is a commercially available scab resistant apple variety bred by the Purdue-Rutgers-Illinois (PRI) apple disease resistant breeding program (Janick 2006). In addition to field immunity to apple scab, GoldRush exhibits high resistance to powdery mildew and is moderately resistant to fireblight. It also stores extremely well, (Crosby et. al. 1994a). Goldrush develops optimum flavor/sugars after 4-6 weeks in cold storage. It maintains its flavor and texture for 10-11 months. Quality



Figure 2. Enterprise (foreground) exhibits resistance to Marssonina compared to GoldRush (background).

disease if applied from pink through the summer (K. Peter). Captan, mancozeb, Luna Sensation, Luna Tranquility and Merivon all provided excellent control. Topsin, Flint Extra, sulfur and the SDHI fungicides (Aprovia, Fontelis and others) gave good to excellent control. Again, these materials are not labeled specifically for use against MLB in the US. However, they may be used to manage other summer diseases such as sooty blotch/flyspeck, bitter rot and black rot. Mancozeb applications made early in the apple growing season targeting apple scab and rusts can also manage early season *M. coronaria* infections in conventional orchards. But mancozeb has a 77-day preharvest interval, so other fungicides or methods need to be used during the summer against MLB. For organic growers, the situation is difficult, as organically approved fungicides, except for sulfur, are not very effective against MLB (K. Peter,

can be enhanced for the longer storage times if treated with Smartfresh (personal communication, Win Cowgill, Professor Emeritus, Rutgers Univ.). Goldrush makes excellent hard cider as tested by Duane Green in his UMass hard cider apple trial. It is utilized commercially for hard cider production both in NJ and PA cideries. It is also planted extensively in NJ, PA, and OH, as it has developed a retail sales and PYO following due to its high dessert quality. Goldrush ripens 3-3.5 weeks after Delicious and after Fuji but before Pink Lady. Because of its long maturity development and late harvest, there was concern by northern growers that it would not ripen in some years. Dr. Ian Merwin found that several nights of below 32F will trigger ripening, and it could be harvested in good condition. Because of this, Goldrush can usually be harvested in Geneva, NY before it is ready for harvest in Northern

NJ. (personal communication, Ian Merwin, Professor Emeritus, Cornell Univ.). Generally, GoldRush is not prone to premature drop.

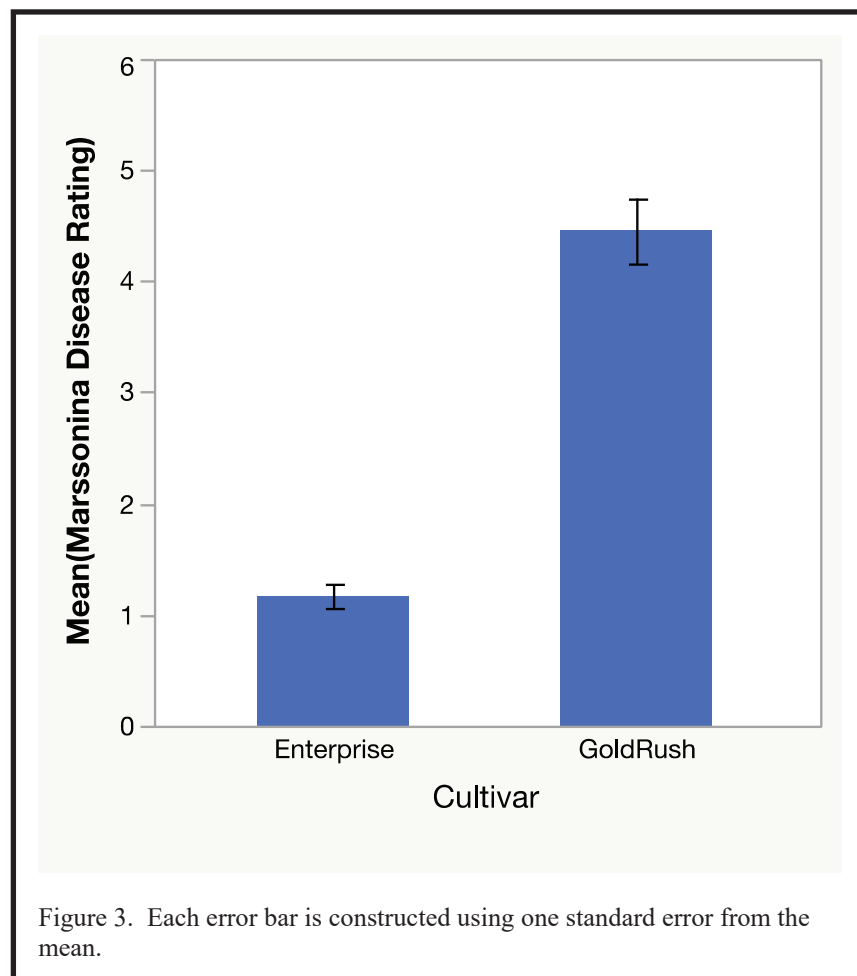
Enterprise is another commercially-available apple variety developed in the PRI program. This late maturing, approximately three weeks after 'Delicious', apple. Enterprise was extensively tested in greenhouse conditions and proved resistant to apple scab. It is also highly resistant to cedar apple rust and fireblight and moderately resistant to powdery mildew. This apple is reported to keep well, maintaining "excellent" quality up to six months in storage. Enterprise has a severe calcium disorder "Mystery Spot" that limits its commercial acceptance. (Tietjen et.al 1994, Tietjent et. al.1995). While Enterprise has excelent flavor and large size, it also has tough skin. These two issues limit it from being adopted as a retail apple cultivar (Cowgill et. al. 1994). Note that Enterprise is one of the parents of Washington States new club variety Cosmic Crisp tested as 'WA 38', the other parent being Honeycrisp. Of interest is that after 2 years of commercial production Cosmic Crisp is having a calcium disorder problem they coined 'green spot' (Courtney, 2018).

The original Enterprise seedling was planted out in 1982 at the Purdue University Horticultural Farm. The first GoldRush seedling was planted in 1973(Crosby et. al. 1994b). Both cultivars attribute their apple scab resistance to the V_f gene derived from *Malus floribunda* parentage.

Differences in the parentage of Enterprise and Goldrush suggest there may be differences in MLB susceptibility. Two varieties common in the parentage of these varieties have shown susceptibility to MLB, Golden Delicious and Rome Beauty (Li et al. 2012; K. Peter, personal communication, October 9, 2020). Golden Delicious is a direct parent of GoldRush. While Enterprise also has both Golden Delicious and Rome Beauty in its background, it is a direct result of a "sibling cross", where two plants

grown from seed of the same fruit are bred together to create the new cultivar, in this case, Enterprise. Enterprise is three generations removed from Golden Delicious and four from Rome beauty. GoldRush has no generational separation from Golden Delicious though it is five generations removed from Rome Beauty, but with fewer intervening crosses than Enterprise. These sibling and other intervening crosses in the parentage of Enterprise as compared to GoldRush make it less directly descended from cultivars known to be susceptible to MLB, suggesting it may be less susceptible to MLB. It appears as though the gene deck is stacked against GoldRush when it comes to Marssonina.

In the comparison of MLB susceptibility of GoldRush and Enterprise, a rating scale of 0 to 9 was used to quantify disease severity, with 0 having "no visible lesions", and 9 showing "tree almost completely bare, only few leaves left on top or side branches" (Bohr et. al. 2018). Four trees were selected at random from each of six rows from each cultivar providing 24 trees as-



essed per cultivar and a total of 48 trees assessed. All trees assessed had symptoms of MLB. The severity of MLB on GoldRush was significantly higher than that of Enterprise (Figure 1). MLB can also cause premature fruit drop in GoldRush, which appears to be more susceptible than Enterprise (Figure 2).

MLB apparently is becoming established in our region, and when traditional fungicide applications are stretched, or in the case of some low-spray or organic orchards, eliminated altogether, significant damage can occur. As MLB becomes more prevalent it is increasingly important to understand which varieties are more or less susceptible. Some evaluations of commercial cultivars in China (Li et al. 2012) show there are significant differences. Wöhner and Emeriewen (2019) identified differences in cultivar susceptibility drawing on several sources in their review of MLB. However, they rate Honeycrisp as resistant, while experience in the Northeast indicates it is quite susceptible. More research on resistance is needed. Unfortunately, it appears that available disease resistant varieties may not fare any better than many commercial varieties against MLB. Identifying which varieties are tolerant and which susceptible to the disease is a critical first step in managing this emerging disease.

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