New Strawberry Powdery Mildew control strategy

writes Malcolm Withnall

In a unique collaboration that could be an example for all growers, berry growers Harriet and Henry Duncalfe have created a synergy between themselves and a research scientist. They have been collaborating with plant pathologist, Dr Avice Hall from the School of Life and Medical Sciences at the University of Hertfordshire at Hatfield, to address the ever-present problem of strawberry mildew, a plant disease of major economic importance to growers of berry crops.

Based at Maltmas Farm, Friday Bridge near Wisbech, the Duncalfes built up a substantial berry-growing business on a Cambridgeshire County Council holding, starting in 1988, and later arriving at the 120ha unit at nearby Maltmas Farm. "Although we now have 300 acres, we have concentrated on soft fruit, and grow long season crops intensively on 60 acres using protected growing systems", explained Harriet. "We are split roughly equally between strawberries and raspberries. The remaining land is used for spring barley, wheat and oilseed rape."

Maltmas Farm is a member of Berry Gardens, and Driscoll varieties feature strongly in its production. "We are growing varieties that we have found from experience particularly suited to our growing location, including Driscoll Jubilee, Sonata, Vibrant and Fenella, and also Driscoll Amesti, to acheive the longest season possible," she added. "We grow both floricane and primocane raspberries, using Octavia, Driscoll Maravilla and Driscoll Cardinal in our long-season supply programme".

Harriet was quick to reveal the devastating consequences of Strawberry Powdery Mildew (Podosphaera aphanis), explaining that annual losses can range from 20% to 70%, and Harriet has heard of 100% crop losses from this pernicious disease. At 20%, as it was estimated to be in 2008, the loss was equivalent to 12,800 tonnes of berries valued at £25m.

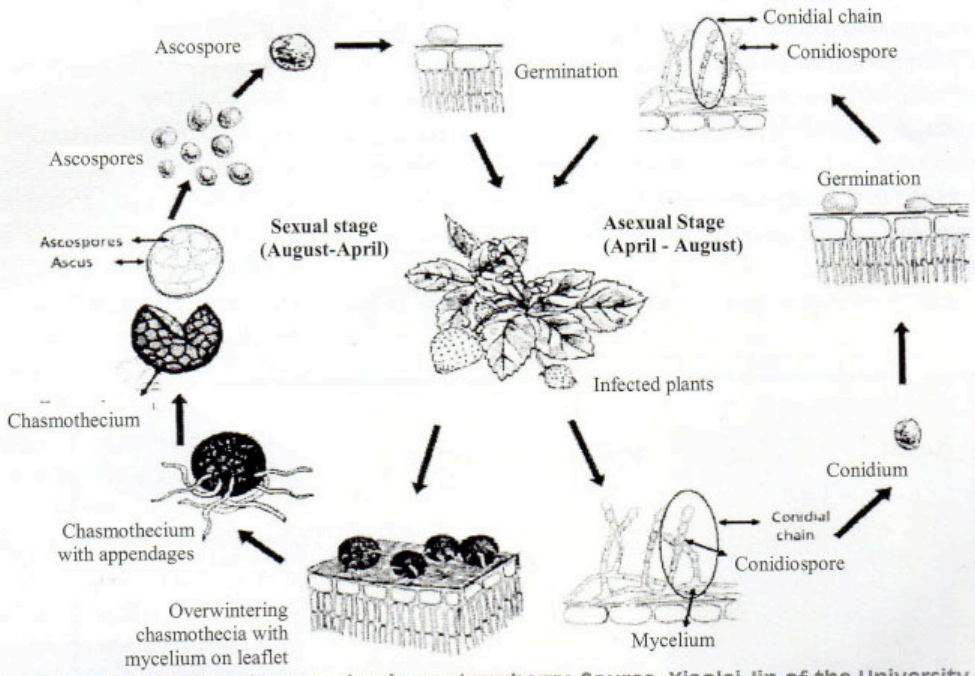
Harriet began her collaboration with Dr Avice Hall ten years ago with an HDC project initially looking at the source of the epidemic, and in 2008 looking at the effectiveness of a potassium bicarbonate and a silicon-based product as part of a postgraduate/grower trial. Additionally, a prediction system for Strawberry Powdery Mildew was developed to control the disease with reduced fungicide use. "Conducting field trials with

An infected leaf shows the devastating impact of Strawberry Powdery Mildew on plant performance.

growers on their holdings heightens the relevance of scientific research," said Dr Avice Hall. "This decade of unique collaboration has generated a special synergy within us all by facilitating new solutions to a serious commercial problem".

By combining an acutely inquisitive mind, and enthusing young postgraduates at the University, Avice Hall has brought together, with her grower host, a greater understanding of the fungus, its mode of activity, and strategies to ameliorate its commercial impact. This collaboration has brought together scientists from different disciplines and commercial crop management to create genuine applied research.

The real benefits of having Dr Hall's plant pathology team addressing the problem is that the fungus is now far better understood than before. "At the onset we incorporated predictive



The lifecycle of Podosphaera aphanis on strawberry. Source: Xiaolei Jin of the University of Hertfordshire.

Strawberry grower Harriet Duncalfe (third from left), Dr Avice Hall of the University of Hertfordshire (third from right) and other members of the team involved in developing new strategies to control Strawberry Powdery Mildew.

systems to track the relationship between the prevailing meteorological and growing conditions surrounding the protected crops – 'Strawberry Powdery Mildew Periods' - and established a viable, colour-coded risk assessment scale for mildew," she said. "We have quickly identified that strawberry mildew is a serious biogenic pathogen, and is a disease with an important overwintering phase in its lifecycle. This has shifted our thinking regarding controls from being seasonal to a more holistic, year-round control strategy".

Dr Hall was also clear in her belief that the dynamics of plant disease and varietal resistance did not appear to have generated a clear solution through plant breeding, given that the pathogen rapidly mutates through new generations. "Because of the pathogen's ability to change, I have more confidence in a more durable, non race-specific, resistance which does not exert the same selection pressure on the pathogen," she added.

For some years the Duncalfes were incorporating potassium bicarbonate into their crop protection programmes, it being recognised as a powerful mildew eradicant. However, an Orion agronomist suggested a silicon-based product which could enhance the defence mechanism of the plant. "In plant science silicon as a nutrient is not fully understood, but it is beginning to be recognised as a valuable contributor," commented Dr Hall. "The coming together with a like-minded grower such as Harriet Duncalfe catalysed a collaboration that has generated results beyond our initial expectations".

Just as with her professional relationship with the grower, Dr Hall quickly recognised that the two compounds enhanced one another. This was the hypothesis behind the first trial. Academic literature established that the element Silicon is omnipresent in plants, though some species have enhanced levels of silicon. Rice is a high accumulator of silicon whereas strawberry is listed as a non-accumulator. However, this investigation by researchers at the University of Hertfordshire has shown that when strawberries are given silicon, the plants absorb additional silicon, and this is associated with morphological changes in the plant, including an increase in the number and length of leaf hairs, a thicker cuticle and a modification of the wax layer of the leaf. Silicon also appears to be located in the vascular system of the plant, namely the xylem and phloem tissues.

Additionally, the use of the silicon nutrient delays the build-up of an epidemic of Strawberry Powdery Mildew. "It is perfectly feasible that a silicon-strengthened epidermis will present a barrier to fungal infection, and when silicon is combined with the eradicant properties of potassium bicarbonate, experiments show that disease levels are reduced," observed Dr Hall.

In addition, the researchers identified that powdery mildew had an overwintering stage (ascospores) which became active as chasmothecia, releasing infective spores whenever present, and peaking at times when the climatic conditions favoured the fungus. These conducive conditions are prevalent in current growing systems, placing modern varieties under enormous pressure to remain free from disease.

From the established development stages of the crop, and directly from experience, the Duncalfes programmed their regular fungicidal applications using the Strawberry Powdery Mildew period prediction system to ameliorate powdery mildew infection. "A combination of fungicidal treatments and Sirius, a silicon-based product from Orion, in a mix, and following the prediction system, gave improved disease control," said Harriet.

Dr Hall described the management of the disease as a 'holistic approach', encouraging growers to view this pathogen as a year-round foe that should never drop from their sights. Regular use of the silicon nutrient through the fertigation system delayed the build-up of the epidemic by 8-10 days.

"We have also concluded from our 2013 trials that early applications of silicon via the fertigation systems are desirable, as the growing plant requires a regular supply," she said. "But I have to emphasise that the Strawberry Powdery Mildew period prediction system is a rule-based system, not a model, and requires further software updates to make it truly grower-friendly. All methods of disease reduction and control require constant year-round vigilance to enable satisfactory control"

The work undertaken by the team from the School of Life Sciences is well documented in the Aspects of Applied Biology in 2011, 2012 and 2013 and in HDC Factsheet 17/2008. The results of the 2014 work will be published and the programme will continue in 2015. ◆