BUGS FOR BUGS

Berry Bulletin

July 2017

Queensland strawberry season

Plant health and berry production

Owing to the difficult weather conditions experienced by runner growers during the critical digging period this season, runner supply was generally delayed. As a result, except for some early Aussie Gem, a lot of planting occurred 1-3 weeks later than planned.

Later planting dates combined with consistently mild weather has meant that plant establishment and development was quite slow. Consequentially, plants have come into production later than in previous seasons and there have not been the same volumes of early fruit that growers have come to expect.

Figure 1: A nice looking Aussie Gem berry (above) and signs of good production coming on (below).

However, there have been upsides – plant health has generally been very good and fruit quality has been excellent. Also, the winter lull that is usual with early varieties looks as though it will be less pronounced than in previous years, resulting in steadier production throughout the season.

Most varieties are now looking set for some very solid late winter and spring production. At this point weather will be the main determinant in how quickly production ramps up. If South East Queensland does get some real winter weather during the next month this will delay the build in production. However, if the weather continues to remain as mild as it has been, or gets warmer, growers can expect volumes to increase significantly over the next 3-5 weeks.

Pests and diseases

The mild and generally dry conditions during Autumn meant that early season disease pressure was relatively low. There were generally low numbers of wilt deaths across all varieties except Fortuna. There was some early season powdery mildew pressure but most growers have been able to get control of this reasonably quickly. Until recent rain events there was very little grey mould pressure.

With respect to wilt deaths, growers have had significant losses in many Fortuna blocks. Testing by DAF has identified phytophthora as the main cause of these deaths. Unfortunately, this is an indication of how vulnerable Fortuna is to this disease given the low levels of wilt disease observed in other varieties this season. However, there has been a lot of variability in Fortuna establishment with some

blocks establishing well and producing some excellent fruit.

Recent rain events have resulted in significant grey mould outbreaks. Growers are advised to follow established best practices for grey mould control. This involves maintaining a comprehensive fungicide program based on the recommendations developed by Apollo Gomez from DAF (if any growers do not have copies of these guidelines please contact Apollo or myself and we can forward a copy of these guidelines to you), and fast and affective hygiene practices to reduce disease load following rain events.

Mild temperatures throughout autumn and early winter have meant that pest pressure has also been generally low. Mite levels have remained very low on most farms until quite recently. Pressure from Heliothis and Cluster caterpillars has also been generally low. There was some early aphid pressure, with many growers having to spray, but there have been increasing levels of parasitism by wasps over the last month and now aphid levels are generally very low across most farms.

Unusually, owing to the mild winter so far, there have been higher levels of pests such as Rutherglen bug and thrips that are normally not a concern until much later in the season. Some growers have already decided to spray for both Rutherglen bug and thrips. Though thrips pressure is not a widespread issue in South East Queensland at the moment, there may be greater than normal pressure from both Rutherglen bug and thrips later in the season if there is not a significant period of cold weather before spring. Growers can also expect mite pressure to increase significantly over the coming month.

Growers should be vigilant regarding the presence of pests over the coming weeks and should follow good IPM practices to achieve the best outcome. In the case of Rutherglen bug this means prioritising control of weeds that attract and harbour this insect. For good Two-spotted mite control growers should be following practices that will facilitate establishment of predatory mites. With regard to thrips, the June 2016 Berry Bulletin provided a comprehensive discussion of thrips management and growers are encouraged to review that issue. However, I will take this opportunity to address some key points regarding thrips control.

Key points on thrips management

Though thrips are generally not a widespread issue in the area at present, unless there is a solid cold spell before spring there is a risk that there may be increased levels of thrips activity later in the season.

It is important to remember that a large proportion of thrips species are harmless or even beneficial to crops. Many types of thrips act as pollinators and some act as predators of various pest species.

Of the thrips species recognized as harmful, Western flower thrips (*Frankliniella occidentalis,* WTF) is most consistently linked to crop damage. It is very difficult to differentiate between WFT and plague thrips (*Thrips imagines*) or onion thrips (*Thrips tabaci*), which are also commonly found in South East Queensland. Plague thrips and onion thrips can be tolerated at much higher levels than WFT before crop damage is likely.

Growers should seek advice on what species of thrips they have on their farm before making management decisions. A guide to identifying thrips of concern in Queensland can be found at: http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/177330/strawberry-thrips.pdf

Even with WFT there is a lot of variation regarding what is considered an acceptable level before crop damage is likely. Suggested economic injury levels (EIL) range from less than 5 adult thrips per flower to more than 15 adult thrips per flower. The tolerance for thrips has tended to increase over time as researchers have been able to differentiate more between crop damage that is caused by thrips and damage resulting from other factors such as environmental conditions.

An approach suggested by researchers for growers in Israel is to have multiple thresholds based on market conditions. During winter production, when fruit is of high value, an EIL of 10 adult WFT thrips per flower has been recommended whereas in spring and summer when the value of the fruit declines it has been suggested that the EIL should be increased to 24 adult WFT per flower. This type of approach makes a lot of sense for Queensland winter production where prices can decline rapidly in the latter half of the season.

Regardless of what EILs growers decide upon, they must consider cultural, biological and chemical factors when planning a management strategy.

In terms of cultural practices, it is recognized that Thrips levels and the damage associated with their activity tends to increase when conditions are hot and dry. It has been shown that use of overhead irrigation during these conditions discourages thrips activity and can reduce crop damage.

It has also been observed that healthy plants are better able to tolerate thrips. For example, fruit damage occurs more readily on plants that are also exposed to high Two-spotted mite pressure. For this reason, it is very important to prioritise mite control. Growers should also apply good all-round agronomic practices to minimize plant stress.

It is well understood that there is a limit to how effective chemical control for thrips will be, particularly when the pest is WFT. Chemicals registered for control of WFT in Queensland are the soil fumigant Ethyl Formate, Spinetoram and Abamectin. From experience, growers can only expect suppression from these products at best. These chemicals will also kill a wide range of naturally occurring beneficial insects that are predating on thrips and assisting with overall control. Wiping out these beneficial tends to result in a poorer outcome overall. Regular use of such chemicals will also impede Two-spotted mite control.

From the biological perspective augmenting beneficial insect populations has been shown to be valuable in managing thrips. Research indicates that a good population of established predators will effectively reduce thrips populations and can also increase a given EIL by as much as 50-100%.

Bugs for Bugs can supply the predatory mite *Typhlodromips montdorensis* (Monties) for WFT control. Research and field trials have shown this predator to be at least as effective as other thrips predators such as *Neoseiulus cucumeris*. Trials indicate that if *T. montdorensis* is used in conjunction with the soil based predatory mite *Hypoaspis miles* efficacy can be improved further.

A review of fruit bronzing

This season many growers and agronomists have been finding higher than normal levels of bronzed fruit and there is concern that this bronzing is the result of thrips activity. However, on the farms that Bugs for Bugs crop scouts visit regularly thrips numbers are much lower than what is normally associated with the levels of bronzing being observed. A proportion of this early season bronzing may be attributed to aphids. However, it is difficult to associate most of this bronzing to either thrips or aphids and we believe that environmental conditions have been the main contributing factor.

A considerable amount of research has been conducted in the United States on the causes of bronzing in strawberries. Researchers conducted an extensive study into bronzing in California, where it was being attributed to thrips. They found that only a small proportion of the damage was due to thrips and the majority was a result of environmental conditions. A separate study conducted in Iowa attributed less than 1% of fruit bronzing to thrips despite thrips levels exceeding recognized EILs.

Three distinct types of bronzing have been identified as affecting strawberry fruit, and they are termed Type I, Type II and Type III bronzing.

Type I bronzing

Type I bronzing is the only form of bronzing that is associated with insect pests, primarily thrips. It is localized to areas of the fruit that have been directly feed upon by the pest. This is usually the area under the calyx and the areas outside the indentations formed in the fruit tissue around the seed (**Figure 2**).

Type II bronzing

Type II bronzing is attributed to chemical burn and is normally associated with the use of pesticides containing sulphur, or other caustic compounds in unfavorable weather conditions. This damage is also localized in nature and is confined to the area directly contacted by the chemical (**Figure 3**).

Figure 2: Type I bronzing resulting from feeding of insect pests such as thrips (photo: Koike, Zalom, and Larson, 2009).

Figure 3: Type II bronzing resulting from chemical applications, often with pesticides containing sulphur or other caustic compounds (photo: Koike, Zalom, and Larson, 2009).

Figure 4: Type III bronzing resulting from specific weather conditions, primarily high temperatures, low humidity and high light levels (photo: Koike, Zalom, and Larson, 2009).

Type III bronzing

Type III bronzing is caused by certain environmental conditions, primarily high temperatures, low humidity and high levels of solar radiation. Unlike other types of bronzing, it affects the whole fruit (**Figure 4**). It is thought to begin in early fruit development when epidermal cells are damaged, resulting in a loss of integrity in the cuticle and epidermis. As the fruit develops and ripens, the bronzing may become less pronounced but the fruit has a dull appearance, texture can become rubbery, and shelf life is reduced. There appear to be differences in susceptibility amongst verities, with lighter coloured fruit being more susceptible than darker fruit. Thrips are often mistakenly blamed, but researchers have found no link between thrips activity and Type III bronzing. At times, this type of bronzing will result in significant reductions in marketable yield.

Researchers have identified environmental conditions and production practices that will have an influence on incidence levels. In California, lower levels of bronzing occur in coastal regions, where regular sea fogs moderate temperature, humidity and light levels. When misters or micro sprinklers are used during peak periods of the day incidence is reduced again due to moderation of temperature and humidity. Pesticides (fungicides or insecticides) applied shortly before periods of high risk also reduce incidence. This is thought to be a result of the sulphinated lignins contained in many pesticides, which are known to provide protection against solar radiation.

Researchers see this type of bronzing as primarily a problem from spring to mid-summer in California and attribute this to a lack of canopy development at this stage of the season. Later in the season a more developed canopy will provide greater moderation of the micro-climate. Increased incidence has also been noted with later plantings, and this has been attributed to reduced canopy development.

Given the generally mild conditions that South East Queensland has experienced so far this season, it is reasonable to question why Type III bronzing would be such an issue. However, during the 2000-2001 strawberry season in the Central Coast region of California there was a significant outbreak of bronzing while researchers were investigating its causes.

During this period temperatures at harvest were generally between 15-25 °C with only two days over 30 °C, and peak day solar radiation levels that are comparable to those experienced in South East Queensland this season. It is possible that the combination of a relatively warm and dry autumn, late planting and generally slow plant development early in the season has contributed to an increased incidence of Type III bronzing in South East Queensland this season.

According to crop scouts, levels of bronzing observed in the field have declined over the last week, and we hope that this decline will continue.

Figure 5: The elevated nature of tabletops may make them a more attractive target for fruit fly.

Queensland fruit fly

The time of the season when Queensland fruit fly becomes an issue is fast approaching. Growers with ICA 34 requirements should have MAT traps in place and be conducting regular perimeter bait spraying. They should also be planning for the first of the required cover sprays in a few weeks' time. Growers that do not have ICA 34 requirements should also be planning a fruit fly management strategy.

Bugs for Bugs recommends the use of MAT traps and perimeter bait sprays as the first line of defence for all growers. If growers then only make spray applications when fruit fly is scouted in the crop this will reduce, or potentially remove the need for cover sprays entirely.

With some growers exploring tabletop production this year, there is a concern that these systems may present an increased risk of fruit fly infestation. An understanding of fruit fly behaviour indicates that there is a chance that the elevated nature of the tabletops may make them a more attractive target for fruit fly, and growers are urged to be particularly vigilant in these blocks.

As tabletop production is relatively new in Queensland it is not known how best to apply bait solutions in this system. Initial suggestions would be to drip rather than spray the solution directly onto strawberry foliage from above the crop. Care should be taken to ensure that the bait solution is not being applied to fruit. An alternative may be to apply directly to the table gutters themselves, possibly on the underside. To improve adhesion and retention it may be worth fixing patches of material, such as carpet, at regular intervals throughout the block. The bait solution could be applied to these patches.

Whichever way growers decide to apply the bait solution the use of a Fruit Fly Thickener is highly recommend to aid adhesion and retention. In the case of MAT traps, it should be relatively simple to suspend these from the tabletop structures, being careful that they are not going to come into contact with fruit.

Bugs for Bugs can supply bait solution and thickener. We can now also supply cardboard, biodegradable MAT traps, which is a much better option in terms of waste management than existing plastic products. We are also more than happy to provide growers with any assistance they may require to achieve the best results from their fruit fly management strategy.

Wishing you all the best for the remainder of the season,

Sam Dunlop, Bugs for Bugs IPM Specialist

Bibliography

Atakan, E., Pehlivan, S. and Kiminsu, A. 2016. Pest status of western flower thrips, Frankliniella occidentalis (Pergande) (Thysanoptera: Thripidae), in tunnel-grown strawberry. Turk. Jour. of Ent. 40(1): 61-71.

Coll, M., Shkya, S., Shouster, I., Nenner, Y. & Steinberg, S. 2007. Decision-making tools for Frankliniella occidentalis management in strawberry: consideration of target markets. Entomologia Experimentalis et Applicata 122: 59-67.

Cluever, J. C., Smith, H. A., Nagle, C. A., Funderbuck, J. E. and Frantz, G. 2016. Effect of insecticide rotations on density and species composition of thrips (Thysanoptera) in Florida strawberry (Rosales: Rosacae). Florida entomologist 99(2): 203-209.

Clymans, R., Trekels, H., Boonen, M., Craeye, S., Hanssens, J., Smagghe, G., Vervoort, M., Melis, P., Bylemans, D. and Belien, T. 2017. Matching commercial thrips predating phytoseids with the highly diversified climatic conditions of different strawberry production systems. ActaHortic 1156.

Jay, C., and Fountain, M. 2015. New bio-control agents for western flower thrips on protected strawberry. Agriculture and horticulture development board annual report.

Larson, K. D. and T. M. Sjulin. 2001. Influence of polyethylene bed mulch, drip irrigation rate, and intermittent overhead sprinkling on strawberry fruit bronzing. HortScience 36:443 (abstr.).

Larson, K. D. Koike, S. T. and Zalom, F. G. 2004. Bed mulch treatment affects strawberry fruit bronzing and yield performance. HortScience 40(1): 72-75.

Koike, S. T., Zalom, F. G., and Larson, K. D., 2009. Bronzing of strawberry fruit as affected by production practises, environmental factors, and Thrips. HortScience 44(6): 1588-1593.

Mass, J. L. (ed.). 1998. Compendium of strawberry diseases. Amer. Phytopathol. Soc., St. Paul. Minn.

Matos, B. and Obrycki, J. J. 2004. Influence of Thrips on bronzing of strawberry fruit. HortScience 39(6): 1343-1345.

Mouden, S., Sarmiento, K. F., Klinkhamer, P. G. L., and Leiss, K. A. (2017). Integrated pest management in western flower thrips: past, present and future. Pest management science. 73: 813-822.

Rahman, T., Spafford, H. and Broughton, S. 2011. Single versus multiple releases of predatory mites combined with spinosad for the control of western flower thrips in strawberry. Crop protection (30): 468-475.

Sampson, C. 2014. Management of western flower thrips on strawberry (Unpublished doctoral thesis). Keele University, Newcastle, UK.

Steiner, M. Y. and Goodwin, S. (2005). Management of Thrips (Thysanoptera: Thripidae) in Australian strawberry crops: within plant distribution characteristics and action thresholds. Aust. Journ. Of Ent. 44: 175-185.

Steiner, M. Y., Goodwin, S., Wellham, T. M., Barchia, I. M. and Spohr, L. J. (2003). Biological studies of the Australian predatory mite Typhlodromips montdorensis (Schicha) (Acari: Phytoseiidae), a potential biocontrol agent for western flower thrips, Frankliniella occidentalis (Pergande) (Thysanoptera: Thripidae). Aust. Journ. Of Ent. 42: 124-130.

Shakya, S., Coll, M. and Weintraub, P. G. 2010. Incorporation of intraguild predation into pest management decision-making tool: the case of Thrips and two pollen-feeding predators in strawberry. J. Econ. Entomol. 103(4): 1086-1093.

Strzyzeweski, I. and Funderburk, J. 2015. UF/IFAS researchers evaluating flower thrips injury to strawberries. University of Florida Pan Handle Ag e-news. Retrieved July 18, 2017, from http://nwdistrict.ifas.ufl.edu/phag/2015/12/11/ufifas-researchers-evaluating-flower-thrips-damage-to-strawberries/

Vito, P. S., Larson, K. D. and Pinney, K. 2002. Anatomical and histochemical factors associated with bronzing development in strawberry fruit. Journ. Amer. Soc. Hort. Sci. 127(3):355-357. 2002.