Impacts of BMSB on kiwifruit

Research update: August 2020

This is an update on the research programme that has been commissioned by KVH and Zespri to help improve our understanding of the impacts caused by Brown Marmorated Stink Bug (BMSB) in kiwifruit orchards.

Summary: Impacts of BMSB on kiwifruit

If BMSB were to establish in New Zealand, what are the likely impacts to kiwifruit growers? While we know that BMSB is likely to have a significant impact on fruit production, the magnitude of this impact is somewhat uncertain and likely to be variable between production systems and regions, as well as between seasons. However, the best indication is to summarise what we have observed on kiwifruit offshore, both anecdotally and through specific research projects. Anecdotal reports out of Italy, China and Korea suggest kiwifruit growers could expect fruit loss of up to 30% on badly affected orchards because of feeding damage and subsequent storage rot. KVH and Zespri (through the Biosecurity Innovation portfolio) have commissioned several research projects offshore to quantify these reports, and aid our industry preparedness by better understanding the impacts of BMSB. Key findings from the research can be found below:

- ✓ Damage reported from Italian and Chinese trials is significantly higher than that reported from overseas growers (see more details in box below). Anecdotal reports suggest up to 30% damage in the most severely impacted orchards, whereas experimental results suggest much higher damage incidence with most reports suggesting over 50% damage if BMSB is not managed.
- ✓ There is no evidence of varietal preference during BMSB feeding.
- ✓ Damage can be difficult to see on the exterior of fruit, but the interior shows white corking at the area of feeding.
- ✓ Hayward tends to hang on the vine and wither, whereas BMSB damage will cause early fruit drop in Gold3.
- ✓ Gold varieties appear to have lower damage severity. As gold tends to drop from the vine, damage was not assessed in most of these trials and this may contribute to the lower reported severity.

Background

BMSB is considered one of the most significant biosecurity threats to the New Zealand kiwifruit industry, as pressures at our borders remain high. The risk of this pest entering New Zealand is considered high and if it were to arrive eradication would be a significant challenge. While there is a large programme of work underway looking to refine our response tools, both at a national level through the BMSB Council and at an industry level through KVH, we need to be prepared for the scenario where eradication fails and we enter into long-term management of this pest. Understanding the impacts and lifecycle on kiwifruit from BMSB is an important part of this industry preparedness.

Image: *Damage caused by BMSB in kiwifruit. From left, going clockwise: fruit injured by stink bug in most cases did not show any evidence of damage. In the lab, different levels of the damage could be seen overtime (Ref: BS1821: The interaction between kiwifruit and BMSB lifecycle and potential parasitoid and predator control).*

Supporting research

Research trials in China

Although BMSB is native to China, information on the types and level of damage it does to kiwifruit during the growing season is lacking. Several projects have been commissioned to increase our knowledge.

English sourced references about BMSB impacts in kiwifruit were sparse, likely due to its relatively recent invasion outside of Asia into other kiwifruit growing regions. As such, it made sense to scour Chinese literature for reports of BMSB damage to better understand its impacts to kiwifruit within its native range. A report on the translated literature highlighted that BMSB is indeed a major pest of kiwifruit in China, indicating on average 7-10% damage, but up to 25-30% damage in heavily infected orchards.

To help quantify these reports, further experimental research was undertaken on kiwifruit orchards in China. These recent field experiments (partially funded through Zespri/KVH) assessed feeding damage of BMSB on three kiwifruit cultivars (two green and one gold variety) using exclusion mesh cages. Results published in early 2020 indicate both nymphs and adults caused damage. The amount of fruit damage was not significantly different among the cultivars with Hayward having 76.9%, “other green” having 82.5%, and the gold variety having 73.5% damage incidence within the mesh cages. BMSB densities were tested against damage severity to help understand the potential impacts of population pressure. Not surprisingly, the results highlighted that the intensity of fruit damage significantly increased when the fruit : insect ratios increased (i.e. when four or more insects were introduced to cages when compared with two), suggesting that higher populations of BMSB will result in higher damage.

A KVH/Zespri commissioned three-year project looking into potential impacts on-orchard has recently reported on its second year of trials. This project is looking at both conventional and organic Hayward orchards. Direct sampling of 30 fruit per week highlighted that significant damage was seen. Preliminary results show that although slightly lower than other reports, damage was still significantly higher than anecdotal reports, with an average of 40% damage in conventional orchards and 55% damage in organic orchards. Two generations per year were observed during these trials and population peaks (i.e. periods where nymphs and adults are present together in significant numbers) correlated with the highest damage periods. This reiterates the point above that both nymphs and adults are responsible for causing damage to kiwifruit.

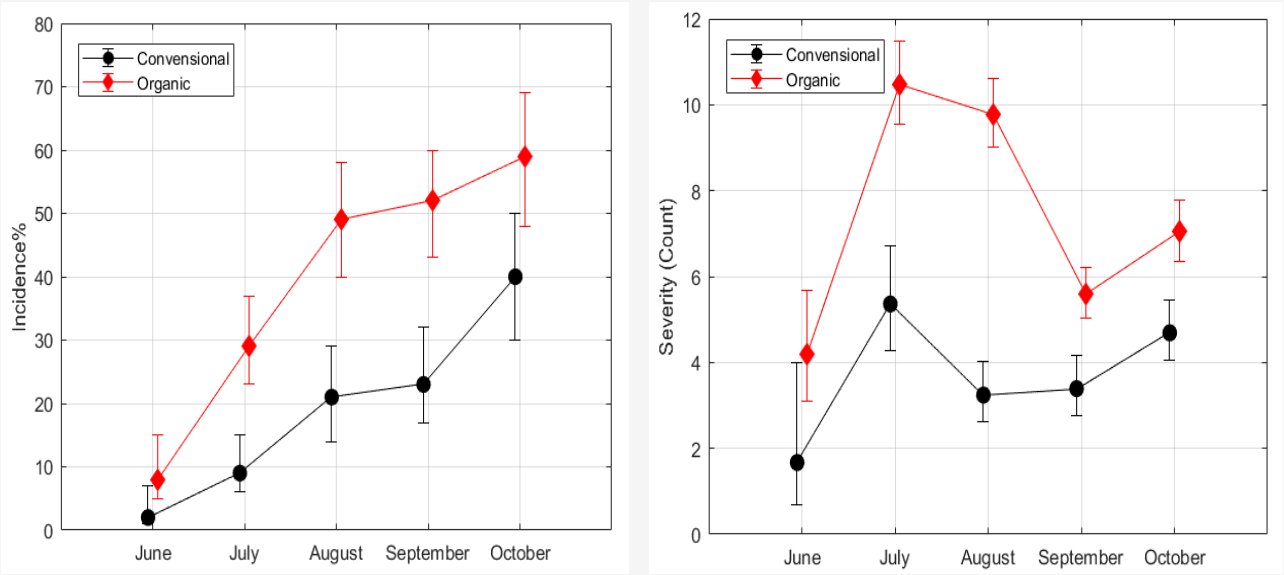


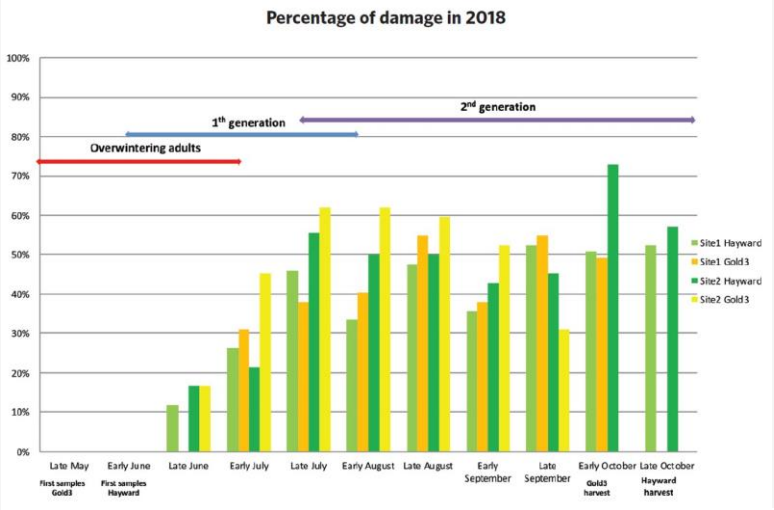
Figure 1: *Left: Level of damage incidence; Right: Severity of damage (Note: drop in severity for August/September likely due to fruit falling from vine due to early season damage and not being assessed) (Ref: BS1913: Optimising biocontrol for BMSB in kiwifruit: Preliminary results - year 2 update).*

Research trials in Italy

In northern Italy, BMSB is causing significant damage in the horticultural regions, including to kiwifruit. Although kiwifruit is reported as a host of BMSB, both in its native range and in introduced areas, little was known about its actual impacts and damage on kiwifruit. To address this, a trial was commissioned to run over two Italian seasons (2018 and 2019) to provide an understanding of the BMSB lifecycle on kiwifruit orchards, and the timing of damage caused, to help inform management practices here in New Zealand. To do this, the orchards were not sprayed with insecticides and BMSB was not managed. Two different sites were selected; Site 1 was a kiwifruit orchard surrounded by peach, persimmon, and broad beans. Site 2 was in the middle of kiwifruit orchards. This could help inform whether surrounding environments would have an impact on the level of damage seen in kiwifruit.

Results from this trial highlighted that damage on both Hayward and Gold3 was significant at an average of 60% and 50% respectively across the years. Hayward fruit tended to have all over damage and wither on the vine, while Gold3 tended to be punctured at the stem end and drop early. Damage to fruit increased throughout summer and peaked in autumn. The first signs of damage appeared just before the fruit had reached a third of development. The percentage of damaged fruit was the highest when the fruit reached maximum size (at harvest). The significant difference in percentage damage between the two years directly correlated to the higher stink bug presence in 2019 resulting in higher damage. It is thought that the milder winters and warmer summers likely contribute to the higher populations and subsequent higher damage found in the 2019 season.

The overall number of individual BMSB captured was much higher in Site 2 (surrounded by other kiwifruit orchards) than in Site 1 in both years, possibly due to the position of the two sites. The variety of possible hosts in Site 1 may have been a more preferred host and lured the BMSB away from kiwifruit, something that would not occur in Site 2 where kiwifruit was the only host option. It should be noted that the high levels of damage occurred regardless of whether the orchards were netted or not, as the nets were not closed until after pollination and after BMSB had come out of overwintering. This led to a trapped population of BMSB in the netted orchards, which produced two generations per year, highlighting that kiwifruit is both a feeding and breeding host for BMSB.



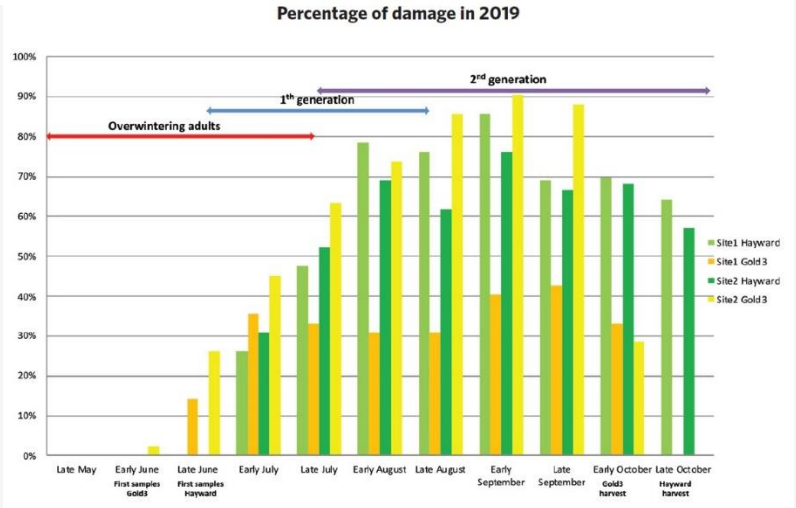


Figure 2: *Percentage of damaged fruit for the 2018 and 2019 monitoring rounds across the different sites and cultivars (Ref: BS1821: The interaction between kiwifruit and BMSB lifecycle in northern Italy).*

Research trials in Italy continued…

Another trial has recently been completed in Italy looking at evaluating the timing and type of damage to kiwifruit by BMSB. Exclusion netting was used to bag a single kiwifruit (see Figure 3 below). A single BMSB adult was then introduced to the bagged fruit at different intervals during the season. Every week, each was assessed for external damage, whether fruit had fallen or clung to vine and insect mortality.

The percentage loss throughout the season was on average higher in Gold3 than in Hayward. In the aforementioned trials, fallen Gold3 was not assessed for damage which resulted in less damage severity in Gold3 being reported. However, in this trial fallen Gold3 was assessed as it was contained within a bag and this indicated Gold3 had higher damage severity than Hayward throughout the season.

Significant weather data was collected throughout the trial to assess whether weather would have an impact due to its effect on BMSB. The only correlation with weather data and damage was related to increased BMSB mortality in hot and dry conditions, which subsequently resulted in less damage. Note that BMSB were confined to a mesh bag so were unable to escape the heat and therefore mortality was likely higher in this experiment than we would see outside an experimental trial.

As well as timing of damage, a portion of Hayward was assessed at harvest and after 12 weeks cold storage to understand the impact of BMSB damage on storage ability of the fruit. This highlighted that BMSB damaged Hayward held in 12 weeks post-harvest cold storage had no impact on fruit quality and had no effect on percentage of post-harvest rots.

Figure 3: *Left: Gold3 bagged with a single BMSB. Right: Gold3 fruit dropped from vine after exposure and BMSB damage (Ref: BS20076; Evaluating the timing and type of damage to kiwifruit by BMSB).*

Anecdotal versus experimental damage

Reports from Italy, Korea and China, and observations from other horticultural sectors in the USA suggest that if BMSB were to arrive in New Zealand, we could expect 5-10% loss on average with up to 30% fruit loss on heavily impacted blocks from fruit drop and storage rot. However, this figure is based on anecdotal reports of symptoms that are sometimes difficult to attribute to BMSB (i.e. fruit drop) and may contain a significant margin of error. Therefore, it was thought that conducting these on-orchard trials would provide more reliable insight. As the results suggest, we are seeing significantly more damage than we are hearing from offshore growers.

Why is this? One reason could be that we are seeing some experimental bias where feeding wounds measured in a scientific trial may not always result in fruit loss in an operational sense - i.e. damage in research is reported as a single sting in a fruit, and such small damage might not necessarily result in fruit loss on-orchard. Understanding the different supply chains will help to quantify whether this damage difference is significant in an operational sense. Another reason is that insecticides to control BMSB were not used in the Italian trials, whereas they are being used in the USA and Italy for example, resulting in the lower levels of damage. However, the high rates of insecticides required for control and subsequent residue issues are an ongoing concern.

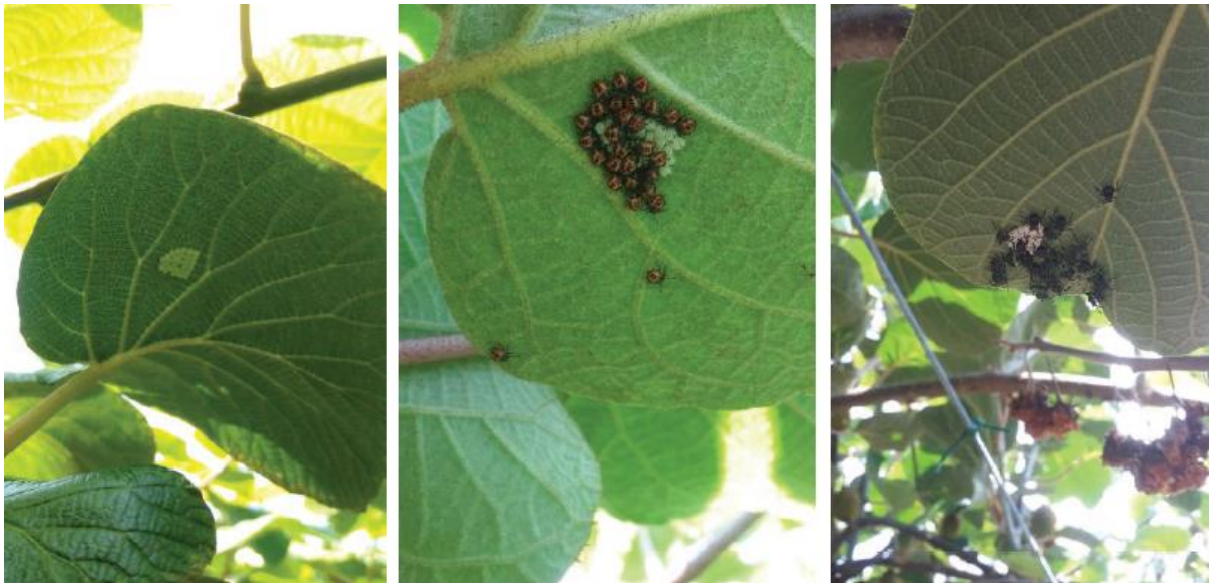


Image above: *Early stages of BMSB development: egg masses, first instar nymphs and second instar nymphs (Ref: BS1821: The interaction between kiwifruit and BMSB lifecycle in northern Italy).*

What's next?

- ✓ BMSB trials will be conducted for another season in China (on hold until 2021/22 season).
- ✓ KVH/Zespri will continue to refine our knowledge around BMSB damage through Biosecurity Innovation portfolio research.
- ✓ Conclusions from this research will be fed into long-term management plans to ensure that we are prepared and can look to reduce impacts and damage as much as possible on-orchard.
- ✓ For further information on BMSB long-term management, view the KVH grower guide at www.kvh.org.nz.

By proactively working together, we can protect your investment and manage risk