Grower Summary

CP 088

Enhancing the monitoring and trapping of protected crop pests by incorporating LED technology into existing traps

Final 2013

Disclaimer

The results and conclusions in this report may be based on an investigation conducted over one year. Therefore, care must be taken with the interpretation of the results.

Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.
Before using all pesticides check the approval status and conditions of use.
Read the label before use: use pesticides safely.

Further information

If you would like a copy of the full report, please email the AHDB Horticulture office (hort.info.@ahdb.org.uk), quoting your AHDB Horticulture number, alternatively contact AHDB Horticulture at the address below.

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Project title:	Enhancing the monitoring and trapping of protected crop pests by incorporating LED technology into existing traps
Project number:	CP 088
Project leader:	Dr Andy Evans, SRUC
Report:	Final report
Previous report:	
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Location of project:	SRUC Edinburgh
Industry Representative:	Alan Davis
Date project commenced:	3 October 2011
Date project completed (or expected completion date):	31 September 2014

GROWER SUMMARY

Headline

The potential for LEDs to enhance the monitoring of certain pests in protected crops without any effect on biological control agents has been demonstrated and warrants further development to make the use of LEDs with sticky traps more practical within protected cropping systems.

Background

Protected crops require significant pest management inputs in many cases, particularly with edible crops where insecticide use is discouraged where possible, and the use of biological control agents (BCA) is most often undertaken (e.g. tomatoes, cucumbers, peppers). To obtain the most efficient pest management using insecticides or BCAs (or in combination) requires precise timing of application to the crop and an assessment of their effectiveness post-application, to determine whether any further applications are required.

Currently, sticky traps (often coloured) are used to detect the presence of many pests (e.g. thrips, whitefly, various aphid species, leaf miners, sciarid flies) and a decision on whether to begin application of insecticides and/or introduction of BCAs is often taken based on whether pests are being found on the traps. The efficacy of traps relies on their attractiveness to these pests, and exploits the behavioural attraction of the pests to their colour. It has been known for many years that specific colours are attractive to specific pests, such as blue for thrips, yellow for whitefly, white for sciarid flies. Recent research has indicated that traps can be made more effective through the use of light emitting diodes (LEDs) incorporated with the trap. For example, the capture of tobacco whitefly (*Bemisia tabaci*) was enhanced by 100% through the addition of a lime-green LED (530 nm wavelength) to the trap. Similarly, a 250% increase in trapping efficiency for Western flower thrips (*Frankliniella occidentalis*) was obtained on blue sticky traps that had a blue LED (465 nm wavelength) incorporated with the trap.

Various researchers have looked at the use of LEDs to enhance the efficacy of insect trapping, particularly of biting pests such as mosquitoes, but there is relatively little work on exploiting this on a commercial scale to enable growers to incorporate these traps into their IPM programmes.

This project aimed to identify the light spectra that are most attractive to a range of protected crop pests and their biological control agents; screened LEDs of specific light wavelengths that can be used with traps to enhance the attractiveness of traps to pests; and evaluated the efficacy of LED/trap combinations for their use in trapping pests under protected crop conditions with a small group of growers.

Summary

A total of six relevant species were captured in sufficient number for statistical analyses (Table 1).

Table 1. Species captured across all trial sites.

Species	Common name	Relevance to crop growing
Bradysia difformis	dark-winged fungus gnat	Pest species
Frankliniella occidentalis	western flower thrips	Pest species
Trialeurodes vaporariorum	glasshouse whitefly	Pest species
Plutella xylostella	diamondback moth	Pest species
Encarsia formosa	No common name	Biological control agent (parasitoid of whitefly)
Kleidotoma psiloides	No common name	Biological control agent (parasitoid of shorefly)

Bradysia difformis

The main findings were a significant increase in the capture rate of *B. difformis* on yellow sticky traps equipped with green (540 nm) LEDs, and a small increase on those equipped with blue (480 nm) LEDs. This increase varied between the sites.

Overall green (540 nm) was the more effective colour, with a difference of +37.5% at site 1, +23% at site 2, and +350% at site 3 (Figure 1).

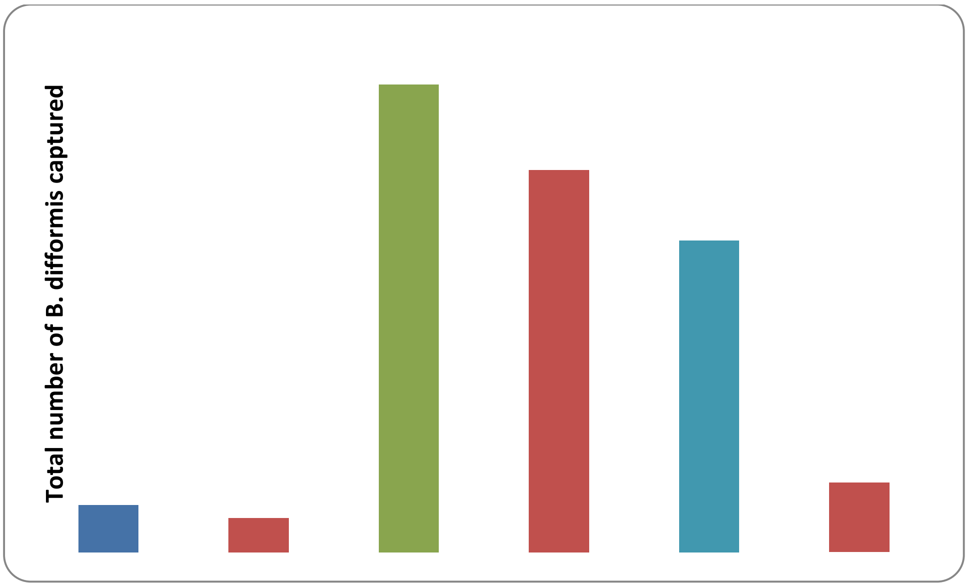

Figure 1: Total number of *B. difformis* captured on green (540 nm) LED equipped yellow sticky traps and standard yellow sticky traps at sites 1, 2 and 3 over the study period in 2012.

Frankliniella occidentalis

Laboratory behavioural experiments determined three wavelengths which may be effective for attracting this species; these are 360 nm (UV), 420 nm (violet/blue), and 480 nm (blue). When comparing yellow sticky traps to those equipped with green (540 nm) or blue (480 nm) LEDs, no significant differences were found. In the case of the blue LEDs this result is unexpected, and is likely due to the use of yellow sticky traps. Greater success may be had using blue sticky traps with the blue (480 nm) LEDs.

Trialeurodes vaporariorum

Laboratory behaviour experiments determined four wavelengths which may be effective for attracting this species; these are 320 nm (UV), 340 nm (UV), 380 nm (UV), and 480 nm (blue). Wavelengths in the green region were roughly equivalent in their level of attractiveness.

A small increase in capture rate was found in sites 5 and 7 for traps equipped with green (540 nm) LEDs, but no differences were found in comparisons using blue LEDs.

The combination of the field work and behaviour experiments suggests that either green (540 nm) or blue (480 nm) are effective at increasing the attractiveness of sticky traps to *T. vaporariorum*. Although a peak in relative spectral preference was seen at 480 nm, it should be noted that this is in comparison with 520 nm, a wavelength to which *T. vaporariorum* does not appear to exhibit a strong preference.

Plutella xylostella

The main findings were a significant increase in the capture rate of *P. xylostella* at site 3 for yellow sticky traps equipped with green (540 nm) or blue (480 nm) LEDs (Figure 2). It is unusual to capture *P. xylostella* using sticky traps, and the addition of either of these LEDs makes the yellow sticky trap more viable as a monitoring method for this species.

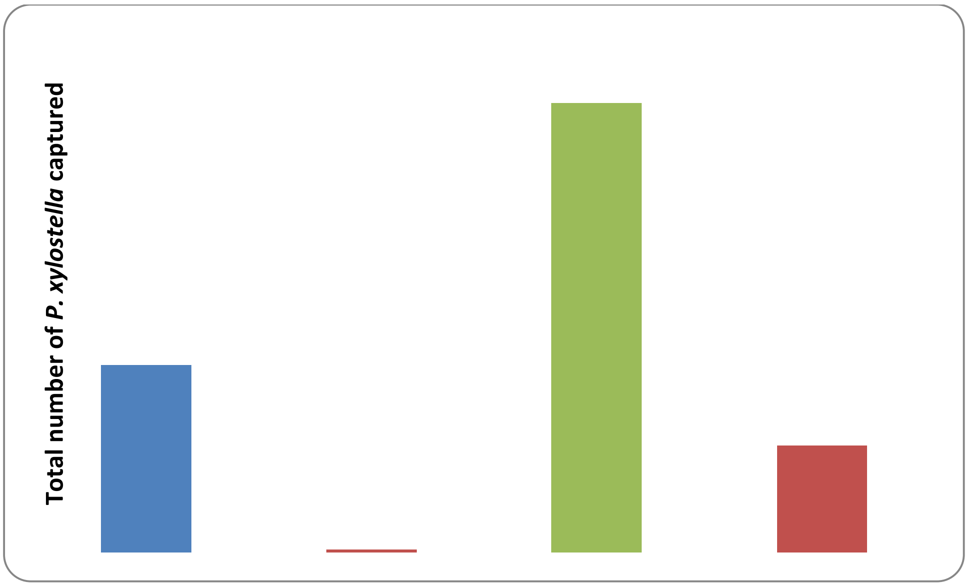

Figure 2. Total number of *P. xylostella* captured on green (540 nm) and blue (480 nm) LED equipped yellow sticky traps and standard yellow sticky traps at sites 3.

Encarsia formosa

The main findings of this study were that there were, in general, no differences in the attraction of the whitefly parasite *E. formosa* to sticky traps equipped with green (520 nm or 540 nm) LEDs and standard yellow sticky traps. A significant effect was observed in the second batch of traps from site 1, where a greater number of *E. formosa* were captured on green (540 nm) LED equipped yellow sticky traps. This result was not replicated in the other batches of traps from this site, or results from site 3 where LED equipped traps captured fewer *E. formosa.* Given these results it is clear that the addition of LEDs to yellow sticky traps, are unlikely to have a negative impact on the use of *E. formosa* as a biological control agent.

Kleidotoma psiloides

The main findings of this study were that there was a significant decrease in the number of *K. psiloides* captured on yellow sticky traps equipped with green (540 nm) LEDs (Figure 3). This indicates that the addition of green (540 nm) LEDs at sites where *K. psiloides* are naturally present, may have a positive effect on their ability to control shore fly, when compared to using standard yellow sticky traps.

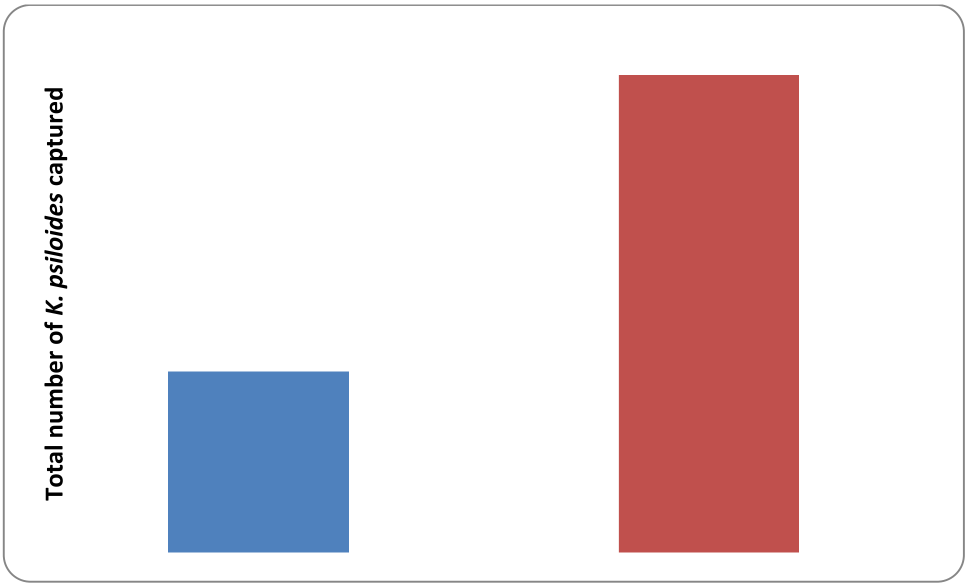

Figure 3. Total number of *K. psiloides* captured on green (540 nm) LED equipped yellow sticky traps and standard yellow sticky traps at sites 1.

Financial Benefits

LEDs are now relatively cheap (~£0.10 to £0.30 per unit, depending on wavelength and output) and have a very long life (>50,000 hours). If powered from the mains within a protected crop, the cost is estimated to be in the region of £0.08 per LED, per week, as the LEDs do not require much power to work. In the absence of mains power, LEDs can be powered by batteries, but this does increase the cost.

By using LEDs in conjunction with yellow sticky traps to enhance the monitoring and particularly the early detection of specific pests of protected crops, the improvement in timing of use of insecticides and/or release of biological control agents would be of economic benefit to the grower.

Action Points

1. Development of a simple method of attaching LEDs to yellow sticky traps, either by the grower or as a supplied product would facilitate the deployment of these traps for pest monitoring within protected cropping. The issue of power needs to be addressed – mains power is cheaper, but battery packs are possible but cumbersome and require waterproofing.
2. Individual LEDs such as the type used in this work are cheap to buy and power, and would be re-usable over several years, particularly if a simpler method of attachment/removal to/from traps can be developed.
3. The advantages of using LED enhanced traps would be evident in facilitating the improved timing of pest management within protected crops, and further testing/development is required to evaluate their role across a range of crop/pest situations, particularly where early detection and management of the pest is required.