AHDB HORTICULTURE

Grower Summary

CP 091

Biology of the cabbage whitefly, Aleyrodes proletella

Annual 2014

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

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Project Number:	CP 091
Project Title:	Biology of the cabbage whitefly, Aleyrodes proletella
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Report:	Annual report 2014
Publication Date:	31 July 2015
Previous report/(s):	None
Start Date:	01 October 2012
End Date:	31 December 2015 (thesis completion)
Project Cost:	£67,650

GROWER SUMMARY

Headline

Field sampling, plot trials and laboratory experiments are providing information that is leading to an improved understanding of cabbage whitefly ecology**.**

Background

The cabbage whitefly, *Aleyrodes proletella,* has become an increasing problem for the Brassica industry in recent years, especially on Brussels sprout and kale. The reason for this is unknown, but it is believed to be due to a combination of climate change, removal of certain active ingredients from use and later harvest times of crops. Little research has focused on this species as, historically, it has been regarded as a minor pest. Knowledge about the biology of the cabbage whitefly is limited and most of what is currently understood about its ecology has been inferred from minimal anecdotal evidence.

The overall aim of this project is to understand population trends of *Aleyrodes proletella* in the most vulnerable crops, Brussels sprout and kale. This includes understanding the key times of population/generation increase and colonisation of a new crop.

Studies are focusing on periods of colonisation of crops, natural population increases within the field and the relationship between development rate and temperature. These investigations will build on previous knowledge and lead to the construction of a phenological model to help farmers develop targeted control methods that will maximize efficacy. An understanding of the weather conditions that impact on survivorship will also lead to an ability to forecast years that would support large numbers of whitefly, allowing growers to focus only on periods when treatments are absolutely necessary. Potential overwintering locations that may act as reservoir sources for the pest will be investigated, together with the dispersal potential of the species. It is hoped that through empirical study of this species we will gain an increased understanding of its ecology which can lead to an integrated management scheme to both prevent the development of large infestations within a crop and increase the efficacy of treatments applied to reduce whitefly infestations.

Summary

Experiment 1. Monitoring of whitefly on a newly-planted vulnerable field crop (Brussels sprout and kale) throughout the season.

Plots of Brussels sprout and kale were planted to investigate natural colonisation and population increase of the cabbage whitefly over a season. Plots consisted of 24 plants (3x8, 50cm spacing) of both kale (cv. Reflex) and Brussels sprout (cv. Revenge) (see Figure 1). Five replicated plots were planted in different locations on the Wellesbourne site. Plants were sown in 2x2cm modules and raised in glasshouse conditions for 7 weeks prior to planting out in the field. To determine date of colonisation to within a week, all plants and all leaves of all plots were surveyed weekly for a month after planting.

Kale and Brussels sprout plants supported differing numbers of whitefly of all life stages. However, this difference was only apparent after August, with the greatest difference occurring during the winter months. The presence of similar numbers of adults for the first few months suggests that there was no difference in the initial attractiveness of the two crops. In addition, the similarity in egg numbers at first suggests that, in the case of immigrating females, host plant quality was similar. This supports the results of laboratory work on egg-laying rate on kale and Brussels sprout plants which showed no significant difference between the two crops (Year 1 report, Experiment 1.4 (Collins, 2013)). As differences became more apparent after a full generation had developed on the plants, it is possible that females developing on the different crops emerge with different fecundities and future work will investigate this further. The extra physical protection provided by kale, in terms of plant structure, when compared to Brussels sprout plants may also have an effect. Adult whitefly may be less likely to be dislodged from kale by rain and wind. Future experiments will investigate whether this assumption is a valid one. When considering the crops separately, the 5 plots supported similar numbers of whitefly, with significant differences occurring on just a few occasions.

Experiment 2. Height at which adult whitefly disperse.

Using a telescopic flagpole, sticky traps were deployed at various heights from the ground (ground-420cm, 60cm intervals) to monitor adult whitefly and determine the vertical distribution of flight. The sticky traps (22cm x 10cm) were either yellow or blue (BHGS Ltd, UK) and were rolled into a cylinder (10cm tall, 8cm diameter) to provide a coloured sticky surface that covered 360°. After deployment for 7 days, the traps were collected and the numbers of whitefly counted using a microscope. The trapping periods began on 28th May, 14th June and 28th June 2014. Yellow sticky traps at ground level caught significantly more

adult whitefly than any other trap colour/height combination, catching on average ~50 individuals per trap during the study period. The next highest catch rate was by yellow traps at 60cm and here the average catch rate fell to only ~5 individuals per trap. Yellow traps caught significantly more whitefly than blue traps but this was only apparent up to 120cm, when numbers captured were too low to distinguish between them. These results show the importance of trap height in terms of the efficacy of yellow sticky traps for monitoring the cabbage whitefly. A difference of 60cm can reduce catch rates of whitefly by ten-fold. Any sticky traps used for monitoring cabbage whitefly are likely be much more effective at ground level. Data shown in this report only represents the behaviour of reproductively-active whitefly. However, previous studies have suggested that female cabbage whitefly entering reproductive diapause show stronger migratory behaviours (Iheagwam, 1977b). The current study will be replicated at times when females in diapause are present; during September and October, for example.

Experiment 3. Distribution of whitefly in a commercial crop of kale.

Adult whitefly were counted on individual plants within a commercially-grown field of kale, cv. Reflex, in Lincolnshire. Transects were taken from each side of the four field edges (North, South, East and West). Whitefly were counted at distances of 0 (edge plants), 5, 15, 35, 75 and 155 plants into the field, plant spacing was ~60cm. Four plants at each distance were sampled for whitefly using a similar approach to Experiment 1. As the numbers of whitefly in each transect seemed to differ, each field edge was sampled in more detail. Plants were sampled in five randomised locations on each field edge. Sampling was conducted on 18th August 2014. Average numbers of whitefly on plants at the edge were approximately 4 times greater than those at a distance of 45m into the field, showing a clear edge effect in numbers of cabbage whitefly. Comparing numbers of adults between each of the field edges (North, South, East and West) showed that numbers of adult whitefly differed between them. The most pronounced difference was between the northern and southern edges where there was an approximately five-fold difference in numbers of adult whitefly. This information is very important for growers who are surveying fields for cabbage whitefly. If counts are always made from the same edge of the field, growers are unlikely to get a true representation of the field as a whole. Further research will be needed on multiple fields and at multiple times of year, to see if this type of distribution applies to all field situations.

Experiment 4. Estimating the abundance of adult whitefly at different distances from a field infestation.

Yellow sticky traps and 'trap plants' were deployed in 'transects' at a range of distances from plots infested with whitefly, which were those used in Experiment 1. Each sticky trap was placed horizontally on a plastic tray ~1 cm above the ground. For the approach using 'trap plants', groups of three cauliflower plants (7^{th} true leaf stage) were placed at the required distances along the hedge line adjacent to the infested plot. Both the sticky traps and trap plants were left for 7 days, after which all adults on the plants were counted by eye. The sticky traps were taken into the laboratory where the whitefly were counted using a microscope. The sticky trap method was used in each of 3 locations on 3^{rd} and 30^{th} April, 2014. The trap plant method was used in each of 3 locations on 24^{th} April and 9^{th} June 2014.

Trap plants

There was a significant decrease in the number of adult whitefly found between 0 and 5 metres from the plots, but the numbers found on plants placed at distances of 5 and 15 metres did not differ. At 25 metres, the number of whitely was nearly 5 times less than that at 5 metres.

Yellow sticky traps

The number of whitefly caught on yellow sticky traps at distances of 0 and 5 metres from the population source differed significantly from each other and from all other traps within the transect. The numbers captured on traps located at the remaining distances of 10m, 20m and 30m caught very similar numbers of whitefly and did not catch significantly different numbers from each other.

Experiment 5. Monitoring whitefly activity using yellow sticky traps on the ground.

Yellow sticky traps were placed horizontally and 1cm above the ground on the North, South, East and West sides of the plots used in Experiment 1. Traps were deployed for a 7 day period prior to a sampling event within the plots. The whitefly on the traps were counted using a microscope. Weather data were collected for all days when traps were present in the field. To reduce the potential for dead whitefly to fall onto the traps, they were placed 30cm from the nearest plant, since the aim was to capture actively flying individuals. An 'activity index' was calculated, defined as the logged number of whitefly caught/mean number of adult whitefly per plant on the plot. An increase in activity in October by overwintering females supported the hypothesis that they are likely to show stronger migratory behaviour. As expected, the coldest months of December and January were also those showing the lowest levels of activity. Activity of overwintering females increased through March until May. A sharp increase in activity at the time of the emergence of the first generation in May-June supports the notion that first generation adults are likely to move onto new hosts and it signals a time when new crops are likely to be colonised. For the majority of the year, the direction in which the sticky trap was placed (i.e. northern, southern, eastern and western sides of the plot) had no effect on the catch rate. However, during December and January more whiteflies were captured on the traps placed to the North and the East. This also corresponds to the period when the whitefly had the lowest activity index. It is likely that trap captures at this time of year are whitefly that have been dislodged from their host rather than actively leaving the crop. The wind direction at Wellesbourne is predominantly south-westerly, this would cause any whitefly that are dislodged to be blown towards the northern and eastern traps more often.

Although a significant relationship between the numbers of whitefly caught on sticky traps and the numbers of whitefly per plant (both in log numbers) using sticky trap catches to monitor crop populations is unlikely to be reliable, it is likely that other factors contribute to catch rate, such as the reproductive condition of females and the ambient temperature. Using sticky traps to provide an estimate of adult whitefly populations on a crop is unlikely to be accurate and obviously this cannot be used estimate juvenile populations within the crop.

Experiment 6. Monitoring immigration and establishment of whitefly populations on spatially- and temporally- separated plantings of kale.

Plots of Kale (cv. Reflex) were planted in 5 locations at Warwick Crop Centre, Wellesbourne. Each plot consisted of 5 sub-plots of 6x6 kale plants separated by ~18m. A single sub-plot was planted at each location on 19th May, 17th June, 19th July, 15th August and 16th September. Plants were sown in modules and raised in glasshouse conditions for 5 weeks prior to transplanting in the field. For the first month, all leaves of all plants were surveyed for the presence of whitefly. When plant size increased, together with the size of the infestation, 10 randomly-selected plants were sampled completely. This experiment is on-going, and collection of data from all the sub-plots is not complete. Only data from the May plantings is included in this report. Whitefly numbers increased quickly in this study; the mean number of whitefly per plant in plot F exceeded 10 after only 36 days. In contrast, this did not happen in 2013 (in Experiment 1) until after 2 months. As the plots from 2013 (Experiment 1) were still present, there was a larger overwintering whitefly population at Wellesbourne in 2013-14 than in 2012-13. The closer a 2014 plot was to a plot planted in the previous year, the higher the rates of immigration it received. Doubling the distance from the source from 50m to

100m corresponded to a 75% reduction in the numbers of whitefly (after 13 days). This suggests, a very reasonable conclusion, that the rate of colonisation by whitefly onto new crops is highly influenced by the distance of the new crop from sources of overwintering females. Such locations are likely to be overwintered brassica crops such as kale, cauliflower and oilseed rape. This experiment is on-going and, for example, relationships between the colonisation rates and the time of planting will be investigated. Inter-plot differences will also be monitored to ascertain whether the differences observed between the May plantings continue throughout the season.

Financial Benefits

Brussels sprout crops constituted a £51 million ‘farm-gate’ value for the UK in 2012 (DEFRA, 2012) and the market for kale is increasing. Losses due to whitefly ‘damage’ are likely to be significant and can lead to product rejections. Brassicas constitute one of the largest users of insecticides within the outdoor-vegetable sector, 22 tonnes of active ingredients used in 2013 (Garthwaite *et al*. 2013). Any techniques that can reduce this insecticide cost will benefit the industry greatly.

Action Points

There are no action points for growers regarding this report.