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| <b>Project number:</b>          | HGCA RD-2008-3471  |
| <b>Project title:</b>           | Sustaining the effectiveness of new insecticides against aphid pests in the UK   |
| <b>Lead partner:</b>            | Rothamsted Research  |
| <b>Scientific partners:</b>     | ADAS and Plymouth University   |
| <b>Industry partners:</b>       | AHDB (Horticulture), AHDB-HGCA, AHDB (Potato Council Ltd), Bayer CropScience Ltd, Belchim Crop Protection Ltd, British Beet Research Organisation, Certis Europe BV, NuFarm (UK) Ltd and Syngenta Crop Protection (UK) Ltd |
| <b>Government sponsor:</b>      | Sponsored by Defra through the Sustainable Arable Link programme   |
| <b>Start date and duration:</b> | January 2009 for 36 months   |

**Project aim:** To strengthen and underpin the scientific framework for combating insecticide resistance in aphids, exemplified primarily by work on peach-potato aphids (*Myzus persicae*). It will take a broad perspective on the range of chemicals available for aphid control, and will focus on the cross-company and cross-commodity challenges posed by the stewardship of neonicotinoid insecticides. It builds on approaches already developed for monitoring changes in response to neonicotinoids and characterising the conditions under which resistance is most likely to be expressed and selected. The project includes: (i) the incorporation of new non-neonicotinoid insecticides (pymetrozine and flonicamid); (ii) analysis of possible fitness costs associated with neonicotinoid resistance; (iii) systematic evaluation of how neonicotinoid dose-rates, timing of exposure and mode of application (seed treatment vs. foliar) influence resistance risks; and (iv) pilot work on key aphid targets other than *M. persicae*. Strong emphasis is being placed on knowledge transfer and improved awareness of resistance threats in light of future agronomic developments including the greater use of neonicotinoids, particularly as foliar registrations.

**Key messages emerging from the project:**

- Significant resistance to neonicotinoids, pymetrozine and flonicamid (which belong to different chemical classes) has not been detected in *M. persicae* in the UK.
- Small and large scale assays show that resistance factors in *M. persicae* are much lower when neonicotinoids are applied systemically. This suggests that spray applications can impose greater selection pressures favouring resistant aphids.
- Significant resistance to imidacloprid, pymetrozine, lambda-cyhalothrin and pirimicarb has not been seen in UK samples of *Macrosiphum euphorbiae*.
- *M. persicae* carrying strong resistance to neonicotinoids capable of causing control failures are now present on peach in localised outbreaks in southern Europe.

**Summary of results from reporting year:**

- Some *M. persicae* with reduced sensitivity to neonicotinoids (Nic-R types) continued to be detected in UK samples collected in 2010 but there continues to be no directional trend towards an increase in their frequency over time. Bioassays suggest that this level of resistance is of little practical importance. Foliar applications may be imposing greater selection pressures. The majority of aphids continue to be fully neonicotinoid susceptible (Nic-S). Parallel screening of the UK *M. persicae* samples with pymetrozine and flonicamid disclosed no evidence of resistance to these compounds.
- As for recent years, the frequency of *M. persicae* with MACE (conferring resistance

to pirimicarb) remained high in 2010. In contrast, the frequency of *M. persicae* carrying *kdr* (conferring resistance to pyrethroids) continued to be relatively low.

- Monitoring of *M. persicae* for esterase resistance in the Rothamsted suction trap showed no R<sub>2</sub> and R<sub>3</sub> types (resistant primarily to OPs) since the few seen in 2007.
- Last winter (2009-2010) was one of the coldest for many years and would have imposed strong selection against *M. persicae* overwintering on crops and weeds as active forms. As a result the first flight dates in England occurred ~4 weeks later than average. A comparison between the frequency of *M. persicae* micro-satellite genotypes present in 2009 with those found in June 2010 showed very little change with O and P types (which carry MACE resistance) continuing to predominate (~80%). This shows that these two genotypes are well adapted for surviving British winters. *Kdr* aphids (carrying a C genotype) and aphids carrying *kdr* plus MACE (H genotypes) were less common. Fully susceptible aphids (I and J genotypes) remained very rare most probably because they are selected against by insecticides.
- Laboratory screening tests with imidacloprid on the current UK *M. persicae* genotypes (maintained as asexual clones at Rothamsted) show that they carry similar sensitivity to neonicotinoids as of the Nic-S and Nic-R types. This supports the findings of the imidacloprid monitoring on field and protected crops.
- Screening of UK samples of *M. euphorbiae* showed no evidence of significant resistance to imidacloprid, pymetrozine, lambda-cyhalothrin or pirimicarb.
- *M. persicae* with strong resistance to neonicotinoids (Nic-R<sup>++</sup>), i.e. capable of producing viable nymphs and surviving field applications, have been found locally in southern Europe but not the UK.

#### **Key issues to be addressed in the next year:**

- Continued monitoring for aphid response to neonicotinoids (including the highly resistant Nic-R<sup>++</sup> types) and response to pymetrozine and flonicamid in *M. persicae* collected from UK field and protected crops as well as samples from abroad.
- Measure the response of current UK *M. persicae* genotypes to screening doses of pymetrozine and flonicamid.
- Test the response of the Nic standards, including Nic-R<sup>++</sup>, to clothianidin, pymetrozine and flonicamid applied topically and clothianidin applied systemically.
- Characterise any new European/worldwide *M. persicae* samples particularly those associated with neonicotinoid failures.
- Measure the response of *M. persicae* from the UK and abroad to alarm pheromone to assess potential behavioural fitness costs associated with genotype/resistance.
- Measure the response of different *M. persicae* genotypes to sub-zero temperatures for periods that are realistic for UK winter conditions and compare the effects on fecundity.
- Measure the response of Nic standards, including Nic-R<sup>++</sup>, to foliar applications of acetamiprid and thiacloprid on whole plants (in field simulators).
- Screen UK *M. euphorbiae* samples for insecticide resistance and measure the response to imidacloprid, pymetrozine, lambda-cyhalothrin and pirimicarb of *Nasonovia ribisnigri* carrying resistance to an aphid-resistant cultivar of lettuce.

The results described in these summary reports are interim and relate to one year. In all cases, the reports refer to projects that extend over a number of years. The Home-Grown Cereals Authority (HGCA) has provided funding for this project but has not conducted the research or written this report. While the author has worked on the best information available to them, neither HGCA nor the author shall be liable for any loss, damage or injury howsoever suffered directly or indirectly in relation to the report or the research on which it is based. Reference herein to trade names and proprietary products without stating that they are protected does not imply that they may be regarded as unprotected and thus free for general use. No endorsement of named products is intended, nor is any criticism implied of other alternative, but unnamed products.