Grower Summary

PE 020

Macrolophus as a biocontrol agent: Optimising release and feeding strategies

Final 2014

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GROWER SUMMARY

Headline

Provision of supplementary food can improve establishment of *Macrolophus pygmaeus* in tomato crops but further fine tuning is required to determine how that food should be presented to the predators.

Background

In 2013, HDC-funded project PC 302d developed a *Macrolophus*-based IPM strategy for the control of *Tuta absoluta.* Where the predator established well, the programme was highly successful but delays elsewhere resulted in additional interventions with chemical pesticides. *Macrolophus pygmaeus* population growth appeared to be improved when the predator was provided with supplementary food in the form of *Artemia* (brine shrimp) eggs. However, further investigation of the optimum rates of release and the true benefits of providing supplementary food were beyond the scope of that project. The Tomato Growers' Association Technical Committee requested that the project team continue studies on this subject starting from the beginning of the 2014 growing season.

Summary

The overall aim of the project was to improve the reliability of *Macrolophus pygmaeus* as a biocontrol agent on UK tomato crops. Specific technical objectives were to:

- To evaluate a range of release rates and approaches to the provision of supplementary food.
- Draft a Factsheet for UK growers describing in detail the new strategy.
- Convey results to tomato industry.

The approach

This project was designed to evaluate the speed of *M. pygmaeus* population growth from six combinations of release rate and feeding strategies on two types of cultivars. The trials work was done in commercial tomato crops following the general approach that was successfully developed in HDC project PC 240 and more recently used in HDC projects PC 251, PC 295 and PC 302/b/d. This approach has immediately identified any important interactions with current agronomic practice and thereby eliminated the need for an additional exploitation phase to transfer the technology to the commercial situation. In all examples provided above, the results of the research were implemented by growers within the duration of the

projects.

The main trial utilised four identical glasshouses with each divided into two halves by a central roadway. The basic treatment comprised an application of one *M. pygmaeus* / m^2, released on tomato cv Mecano (a classic round tomato type) three weeks after the plants arrived and fed with *Artemia* cysts at four week intervals. There was a sub-division of this treatment with *Artemia* cysts either applied at distinct feeding stations or broadcast more generally from a Koppert dispenser. There were three variations of the basic treatment:

1. with the *M. pygmaeus* release rate halved
2. the *M. pygmaeus* release made earlier
3. the cultivar changed to cv Angelle (a baby plum tomato type)

In each case, the sub-divisions with *Artemia* eggs applied at feeding stations or broadcast was retained.

Additional treatments were introduced in three similar sized crops of cv Angelle. In all cases, *M. pygmaeus* was released at the rate of 1 / m^2 three weeks after the plants arrived. One crop received no supplementary food while the other two received more frequent applications of decapsulated *Artemia* eggs either at feeding stations or broadcast.

The findings

The main outcome from this trial was that *M. pygmaeus* population growth was markedly greater on cv Angelle than on cv Mecano with 40% more predators on cv Angelle at the end of the trial. This was broadly consistent with results from previous projects which have explored the susceptibility of speciality tomato cultivars to a range of insect pests. At some stage, it may become important to fine tune IPM programmes by categorising the performance of pests and beneficial insects on each type of tomato currently grown. However, in the short term there are other factors to address which could have greater immediate impact across all tomato types.

The results from this project reinforced the observations from PC 302d which indicated that *M. pygmaeus* population growth was greater when the predators were provided with supplementary food. However, we were unable to demonstrate any significant difference between the six combinations of *M. pygmaeus* release rate and feeding strategies, and were therefore unable to further refine the use of this predator.

Subjective in-crop observations indicated that there was a high level of natural mortality of *M. pygmaeus* immediately after release in the crop. This was based on the presence of large

numbers of dead *M. pygmaeus* on plants within 48 hours of release. The observations were supported by survival tests done in the laboratory. The actual percentage mortality could not be quantified in the crop because it was impossible to track all the predators after release. However, the concern was such that independent laboratory-based studies were instigated to investigate the issue. The results of these studies are beyond the scope of this report but they indicate that the impact of the natural mortality could have masked smaller differences between *M. pygmaeus* release rate and feeding strategies within this project.

In parallel to the main trial, the team undertook a more in depth study of *Artemia*-based food materials. *Artemia* are collected in bulk from the surface of salt lakes in various parts of the world. They are usually in an encysted form which is able to resist extreme adverse conditions for long periods of time. They are used by the fish farming industry either in the collected form or in a 'decapsulated' state which has the outer coating removed by an industrial process. The quality of the material apparently varies according to the geographical origin and the extent of the industrial processing.

Upon delivery, the *Artemia* material is dehydrated but rapidly rehydrates if placed upon a damp pad. Our experience indicates that there is insufficient moisture in the crop canopy to hydrate the material and retain it in that state. Given that *M. pygmaeus* have 'piercing and sucking', rather than 'chewing', mouthparts we believe that this is a serious impediment to successful feeding.

In the light of knowledge gained this growing season, we believe that *M. pygmaeus* population growth could be significantly improved by hydrating the *Artemia*-based food during use. This will require a completely new and novel feeder system which will keep the *Artemia* in a suitable state of hydration for sufficient time to influence *M. pygmaeus* feeding and population growth.

Financial Benefits

- *Macrolophus pygmaeus* is potentially one of the most useful biological control agents available to tomato growers but, at £70 - £80 / 1,000, it also one of the most expensive. Hence, it must be used to best effect. A saving in release of only 0.25 *M. pygmaeus* / m^2 across 66% of the UK tomato industry would equate to a saving of over £24k thus giving immediate payback on this project in one season.
- *Liriomyza* leafminers are currently the most expensive pests to control with biological control agents in tomato crops. Improved use of *M. pygmaeus* could provide savings of £400-£800 per hectare for growers who suffer this problem.
- *Tuta absoluta* is one of the most important pests of tomato crops in the UK. For example, at one nursery in 2012, 30% of fruit were damaged by the pest and graded out during June and July. This represented losses of approx £50k per hectare to that grower for that period alone. Where successful, the *Macrolophus*-based control strategy has prevented such damage. Hence, avoiding the situation described in this example alone would provide an immediate x2 payback on the cost of this project.

Action Points

- The provision of supplementary food can enhance population growth of *M. pygmaeus* in commercial crops.
- *Macolophus pygmaeus* population growth varies significantly between tomato cultivars. In the present case, there were 40% more predators on tomato cv Angelle than on cv Mecano at the end of the trial.
- *Macolophus pygmaeus* are vulnerable to stresses associated with short-term storage, packaging and transport which we believe led to high levels of natural mortality of the material supplied to this trial. Growers must take this into account when receiving and handling deliveries of *M. pygmaeus*.
- Parallel studies have shed more light on the importance of the type of supplementary food provided to *M. pygmaeus*. In particular, it seems that the state of hydration of *Artemia* cysts / eggs could be critical to their value as a food material. This requires further investigation and potentially the development of a feeding unit that maintains the supplementary food in an optimal state for the predators.