Exploring Mature Plant Resistance in sugar beet to avoid Virus Yellows infection in the field

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Background

In sugar beet a natural resistance mechanism against aphids is present called "Mature Plant Resistance" (MPR). When sugar beet plants reach their 10 to 12 leaf stage, aphid mortality is increased (Kift et al., 1998). Prior to the aphid's death, a black stomach deposit is formed, which appears to be directly related to their death. Interestingly, reduced aphid mortality is observed on plants that are infected by yellowing viruses (Kift et al., 1996) possibly linking reduced MPR to yellowing virus infections.

MPR is a potential aid in IPM strategies. However, to further exploit this trait, a better understanding of the mechanism of MPR in sugar beet in relation to aphids is needed, and what roles the phenological plant stage and the environment play.

Kift, N. et al. (1996). Ann. Appl.Bbiol. 129: 371-378

Kift, N. et al. (1998). Entomol. Exp. Appl 88: 155-161

Objectives

- Unravel the toxicity effects of MPR in aphids
- Quantify the levels of MPR to aphids in sugar beet
- Identify whether there is variation in MPR between different genotypes of sugar beet

Methodology

Aphids were reared on sugar beets in climate-controlled rooms. For the climate-controlled experiments aphids were taken from young leaves and confined on the second oldest leaves of 6 wk-old sugar beet plants. Subsequently, mortality and formation of the black deposit was counted every 3-4 days.

Results

MPR significantly increases black stomach deposit and decreases aphid survival rate and fecundity

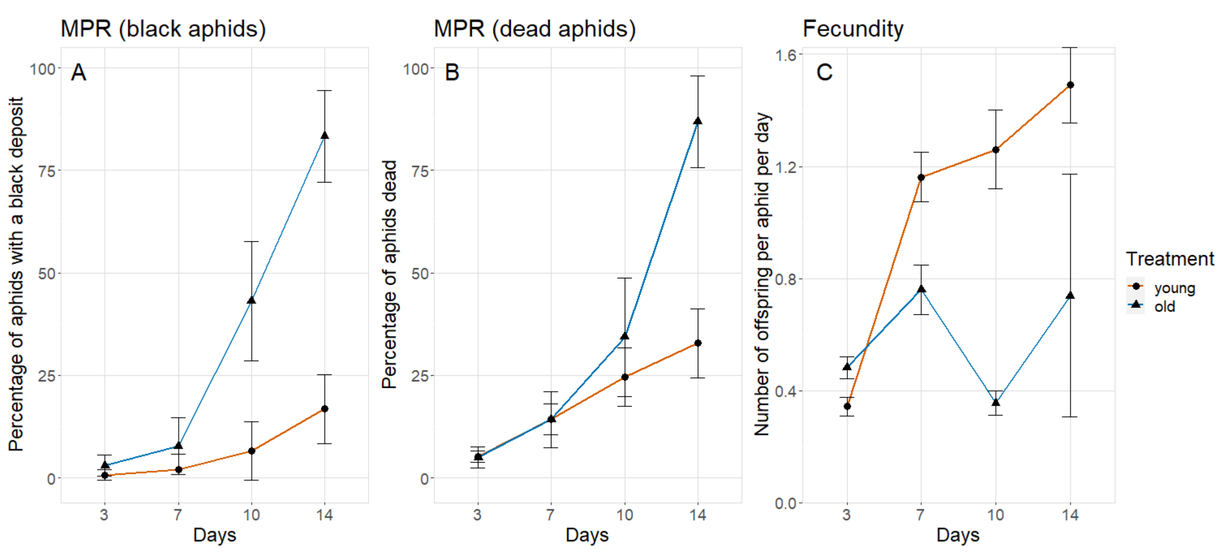

Figure 1: The negative effect of mature plant resistance on *Myzus persicae* on young (orange) and old (blue) leaves of 6-weeks-old sugar beet plants in a climate-controlled experiment.

Significant differences in mortality, formation of black deposits and fecundity were observed between aphids that were confined on young and old sugar beet leaves (Fig. 1). The percentage of aphids that had died within 14 days was 86.8% and 32.8% on old and young leaves, respectively. Aphid mortality and the presence of a black deposit were significantly correlated (P-value < 2.2e-16, r=0.8, Pearson correlation test, n=111)

Variation in MPR between six genotypes

Climate controlled experiments revealed variation in MPR between sugar beet genotypes (Fig. 2). Aphids on genotype 4 suffered from the highest proportion of black deposits (92%), while for genotype 2 only 58% percent of the aphids had formed a black deposit 14 DPI.

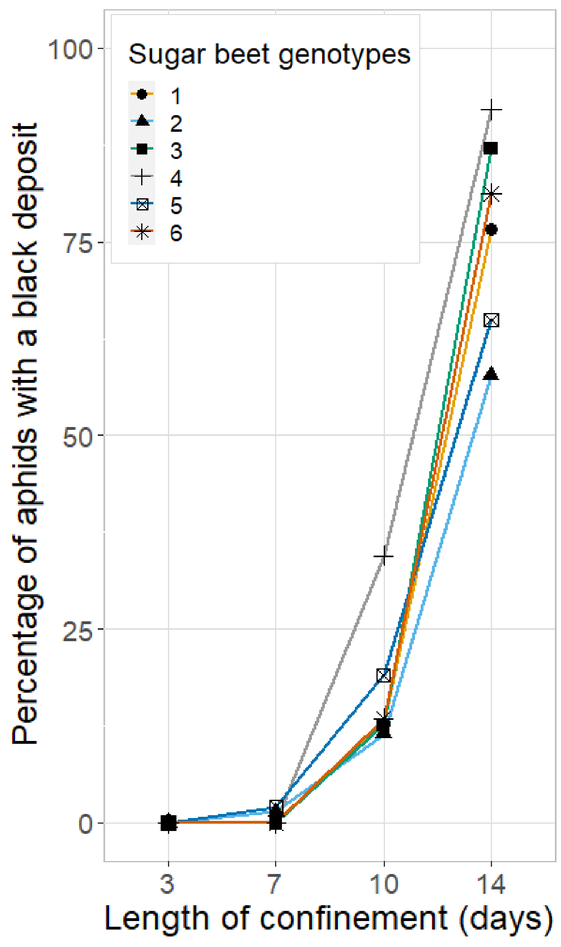

Figure 2 (left): Variation in the levels of MPR (% of black deposits in *Myzus persicae* stomachs) between six genotypes.

In a field trial however, the levels of MPR were different from those in the climate-controlled experiment. Levels of MPR seemed to be related to environmental effects such as temperatures. Further information on these findings is given in our paper (Schop et al, 2022). A QR-code to the website is given in Fig. 3.

Figure 3: QR-code to the paper Schop et al., 2022

Conclusions

MPR leads to increased black deposit formation and negatively affects survival rate and fecundity of aphids. We observed significant differences in levels of MPR between genotypes of sugar beet. Environmental factors, such as high temperatures, apparently play a role in the levels of MPR as observed under field conditions.

Acknowledgements

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