Non-random distribution of cabbage aphids in canola

Dusty Severtson, UWA/DAFWA**; Christian Nansen,** UWA

Key messages

- Initial detection of cabbage aphids in canola should focus on inspection of the underside of lower canopy leaves on the primary stem, while racemes should be inspected where cabbage aphids have established.
- In paddocks, cabbage aphids were shown to be distributed along crop edges, and current sampling methods, which assume random distribution, do not account for this.
- Infestations by cabbage aphids inwards into canola fields appear to be associated with occurrence of 'non-crop' areas (such as tree lines and contour banks), which may harbour alternative hosts such as wild radish.

Aims

Improved knowledge about mechanisms driving host plant selection and aphid colonisation in late season canola can be used to improve both accuracy and efficiency of aphid sampling. It may also lead to increased insight into the feasibility of precision-applications of pesticides. Glasshouse trials and field assessments were conducted to investigate the within and between plant colonisation patterns of cabbage aphids on canola.

Method

Glasshouse trials

In 4-choice studies in a glasshouse, we investigated preference by alate (winged) cabbage aphids to four different growth stages of canola (4-8 leaf, stem elongation, budding and flowering). Cabbage aphids were released into tents containing canola plants and the position of cabbage aphids on each plant was assessed after one week. We also conducted no-choice studies with single plants in cages using 3 growth stages (4-7 leaf, stem elongation and budding). No-choice trials were analysed using one-way analysis of variance; choice trials were analysed using Wilcoxon signed rank test.

Field assessments

In two commercial canola crops, we sampled 10 adjacent plants at 60 and 100 sampling points at York (28-31 August 2013) and New Norcia (15-21 August 2013) respectively and assessed the total cabbage aphids per 10 plants. These paddocks were chosen because of their differing environmental characteristics: tree patches (New Norcia) and contour banks (York). Both crops contained plants which ranged from budding to podding growth stages. Based on initial analyses of field-wide spatial distribution pattern, two high-resolution sampling grids per site were established. Both York (5 September 2013) and New Norcia (4 September 2013) grids were sampled every m^2 within a quadrat of 400 m^2 (i.e. 10 m along the crop edge by 40 m inwards). Regression techniques were used to analyse aphid counts (colony lengths on racemes) in relation to distance from crop edges.

Results

Glasshouse trials

Cabbage aphids showed a significant colonisation preference for plants at stem elongation, budding and flowering to plants in 4-8 leaf stage ($p<0.05$, N=10). Out of 100 aphids released, 50 aphids colonised plants; growth stage categories are displayed in Fig. 1. Also, cabbage aphids colonised 100% of plants in the no-choice study with no significant difference between aphid counts ($p=0.70$, N=7). Aphids consistently colonised the lower portion of the canopy (Fig. 2), even when racemes were present. For both choice and no-choice trials, all aphids were found on the underside of leaves.

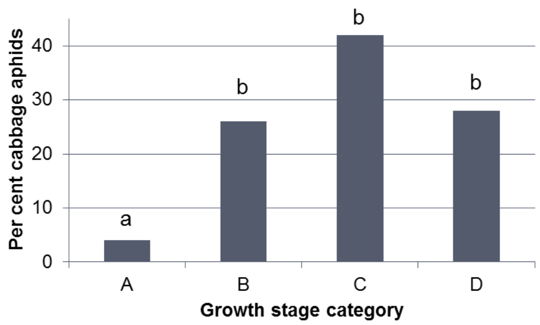

Figure 1 Choice experiment showing per cent of cabbage aphids which colonised plants in four growth stage categories: 4-8 leaf (A), stem elongation (B), budding (C) and flowering (D). Lower-case letters on bars indicate like means for like letters.

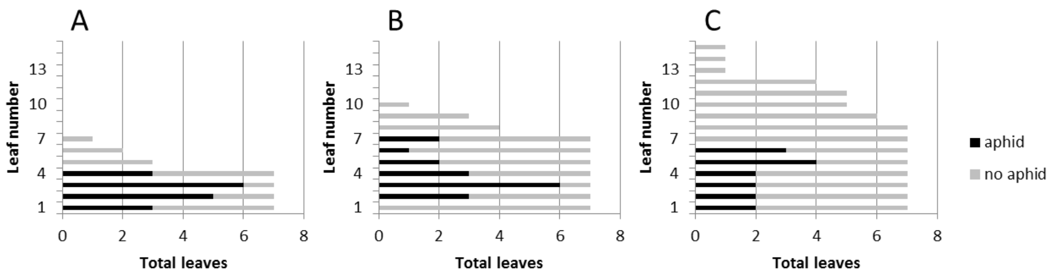

Figure 2 No-choice experiment showing cabbage aphid-colonised leaves (black) and non-colonised (grey) within 3 growth stages of canola: 4-7 leaf (A), stem elongation (B) and budding (C). Leaves on y-axis are numbered from bottom (one) to top leaf.

Field assessments

Cabbage aphid infestation showed an ‘edge effect’ for both York and New Norcia canola crops in which cabbage aphids were most commonly found within 20-30 m of the crop edge and rarely detected further inwards (Fig 3a, b). Where significant infestation of cabbage aphids was detected further into the crop it was noted that the locations were either near a tree line or contour bank. Furthermore, the infestation detected >400 m into the crop at New Norcia (Fig. 3b) most likely originated from the cabbage aphid populations visually present on wild radish within the nearby tree line at the time of sampling.

High resolution ‘edge’ grids also showed edge effects at all locations with cabbage aphid populations decreasing considerably after 10-20 m into the crop. Significant ($p<0.01$) logarithmic regression curves were achieved for all grid-sampled locations (Fig 3c, d, e and f).

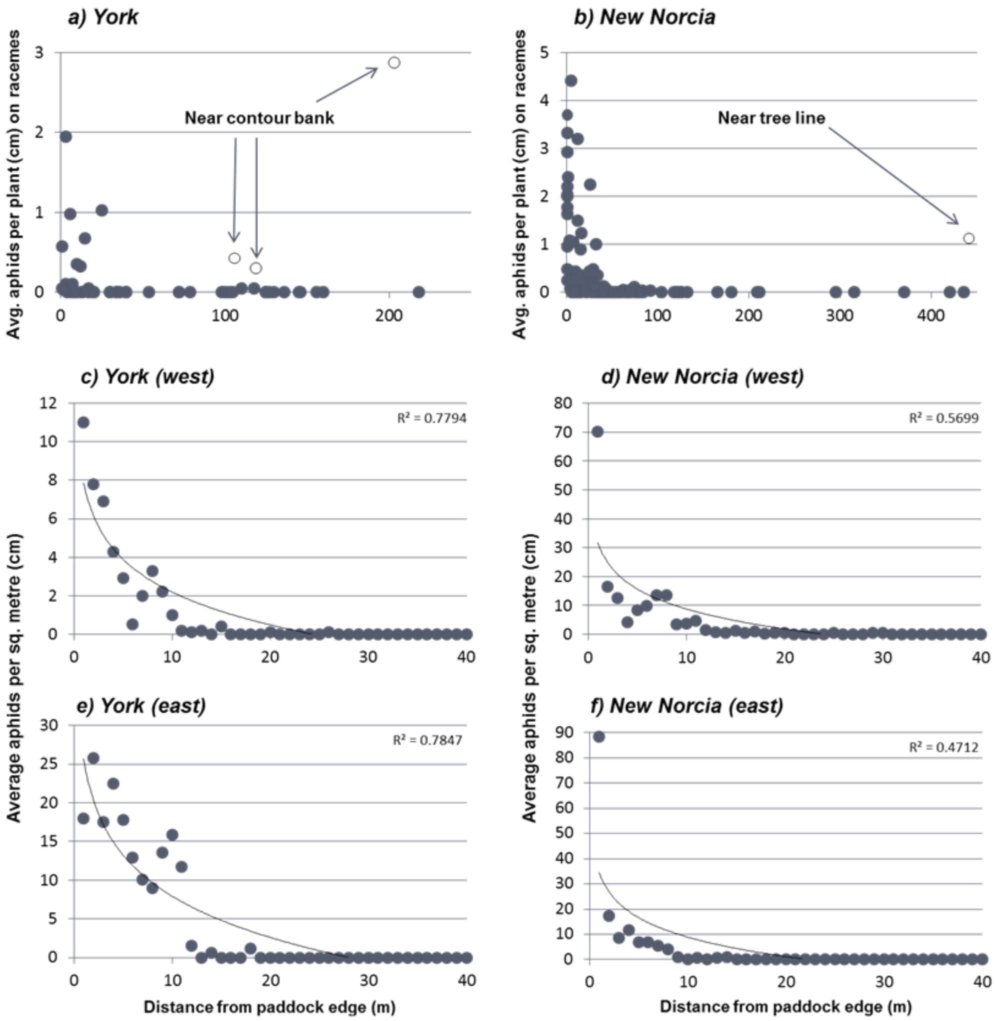

Figure 3 Scatterplots of average cabbage aphids per plant (cm colony lengths on racemes) for whole paddocks sampled at York (a) and New Norcia (b); average aphids per m^2 of high resolution grid sampling for York west (c) and east (e) and New Norcia west (d) and east (f). All regression curves are logarithmic ($p<0.01$).

Conclusion

- When given a choice, cabbage aphids preferred plants at stem elongation, budding and flowering over plants in 4-8 leaf stage.
- When given no choice, cabbage aphids colonised the underside of leaves within the lower portion of the canopy for all 3 growth stages: 4-7 leaf, stem elongation, and budding.
- Spatial distribution analyses revealed significant edge effects. Infestation by cabbage aphids inwards into canola fields appeared to be associated with occurrence of non-crop areas (such as tree lines and contour banks), which may harbour alternative hosts such as wild radish. This highlights the importance of weed control in reducing within-crop sources of aphids.

Although the two canola crops showed consistent edge effect patterns, it is evident that they differed in curve steepness (Fig 3c, d, e and f). Aphid infestation was greater within the first 1 m of the New Norcia crop edge than at York. Knowledge about the mechanisms driving the edge effect of cabbage aphids in canola would aid in gaining understanding of between-paddock variability.

Combining the identified vertical preference and edge-effect characteristics listed above may be used to increase detection and reduce sampling effort needed to identify emerging infestations of cabbage aphids in canola. In addition, the identified spatial patterns of cabbage aphid infestations may be used to optimise and precision-target insecticide applications. Further studies are required to modify current sampling methods for cabbage aphids in canola to increase accuracy and optimise time efforts required.

Key words

Cabbage aphids, *Brevicoryne brassicae*, canola aphids, spatial distribution, canola

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