# Field-scale interactions between weeds and *Aphis fabae* Scop. (homoptera: aphididae) in conventional and low-input sugarbeet.

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## Introduction

Low-input cropping systems are often related to higher weed species diversity and density. Crop pest species have been reported to decrease in fields with a higher vegetational diversity caused by a reduction of crop appearance and nutritional quality (Pimentel, 1961). For *Aphis fabae* Scop. the decision to form a colony and the possibilities to develop large colonies depends on the nitrate level in the plant phloem (Kennedy *et al*., 1950). If host nutritional quality becomes low, this affects aphid fecundity and they start to develop more winged forms for dispersal. It can therefore be expected that competition with weeds has a negative impact on crop nutrition and susceptibility to aphids. In fields with a higher weed density there is also a higher diversity of possible alternative host plants for aphids.
This study was therefore designed to establish differences in *Aphis fabae* Scop.– crop - weed interactions in two cropping systems differing in tillage technique, fertilization level and weed and pest management. The experimental hypothesis was that, due to their polymorphism aphids are able to optimise resource use through changing infestation dynamics as a response to differences in crop-weed competition in differently managed cropping systems.

## Materials and methods

The study was carried out at the Interdepartmental Centre for Agro-environmental Research 'E. Avanzi' of the University of Pisa in a long-term field scale trial started in 1993 (average field size 6000 $m^2$). The sugarbeet crop was included in a 6-year rotation (sugarbeet, durum wheat, grain sorghum, sunflower, durum wheat and set-aside) managed according to a conventional (CS) or a low-input system (LIS) differing in tillage technique, fertilisation level, pest, weed and set-aside management.
Data sampling was carried out in 2001 and 2002 in two adjacent fields at three times: three weeks after crop emergence, two weeks after post-emergence herbicide application and one month later. Data on weed species and sugarbeet density and aphids infestation were collected in 35 fixed plots of 1 x 1 m per field arranged in a regular grid. In CS in 2002, a total of 40 plots were sampled because this field was longer. Aphid infestation was estimated applying various abundance and damage classes described in the literature (Banks, 1954; www.ipm.ucdavis.edu), and weed presence was determined by density at the first two sampling dates and by the Braun-Blanquet method at the third sampling date.
For measurement of aphid response to crop – weed interaction, an index expressing relative density of sugarbeet with respect to total vegetation density (Sugarbeet/vTot) was used. Data were analysed with nonparametric correlation tests and spatial data analysis was performed with semivariogram analysis and with cross-correlation to test the interpolation model for spatial representation.

## Results and discussion

Sugarbeet density was not different between the two cropping systems and varied around 6 plants $m^{-2}$ in both years. Weed species richness varied between 1.6 and 8.1 species $m^{-2}$, was higher in the LIS than in the CS and decreased during the crop growing period. Weed density decreased after the post-emergence herbicide treatment in both systems although density levels were always higher in LIS than in CS. Dominant weed species were similar in both years, but species composition differed more between the two systems in 2002 than in 2001.

Data showed a positive correlation ($P \leq 0.01$) between number of winged forms and total vegetation density during sugarbeet emergence in 2001. In 2002 this correlation could not be verified because sugarbeet was sown earlier and aphid arrival did not coincide with sugarbeet emergence. After herbicide spraying in 2001, there were more dispersal forms in the LIS, especially in those areas where Sugarbeet/vTot was low and competition was high (Fig. 1a). At the same time, in the CS, there were bigger colonies than in the LIS, especially in those areas where Sugarbeet/vTot was high (Fig 1b). Since the development of dispersal forms indicates lower nutritional crop quality, these results indicate that the general crop quality was higher in CS than in LIS, probably due to the higher N fertilization level. The differences within the fields were likely due to weed competition with the crop, which negatively affected crop nutritional quality and thus resulted in the development of more dispersal forms.
After post-emergence weed control in 2002 weed composition in CS was dominated by wild beet (3.9 plants $m^{-2}$), whereas in LIS weed species composition was dominated by *Ammi majus* (2.5 plants $m^{-2}$), *Equisetum arvense* (4.6 plants $m^{-2}$) and *Polygonum aviculare* (3.7 plants $m^{-2}$). Aphid infestation severity on sugarbeet was higher ($P \leq 0.05$) in CS than in LIS. In CS there was a correlation ($P \leq 0.05$) between colony size on sugarbeet and on wild beet and between colony number on sugarbeet and on wild beet ($r = 0.39$ and 0.34 respectively; d.f. = 38). It can be hypothesized that aphids are attracted by the inflorescence of wild beet and that they colonize sugarbeet from wild beet.

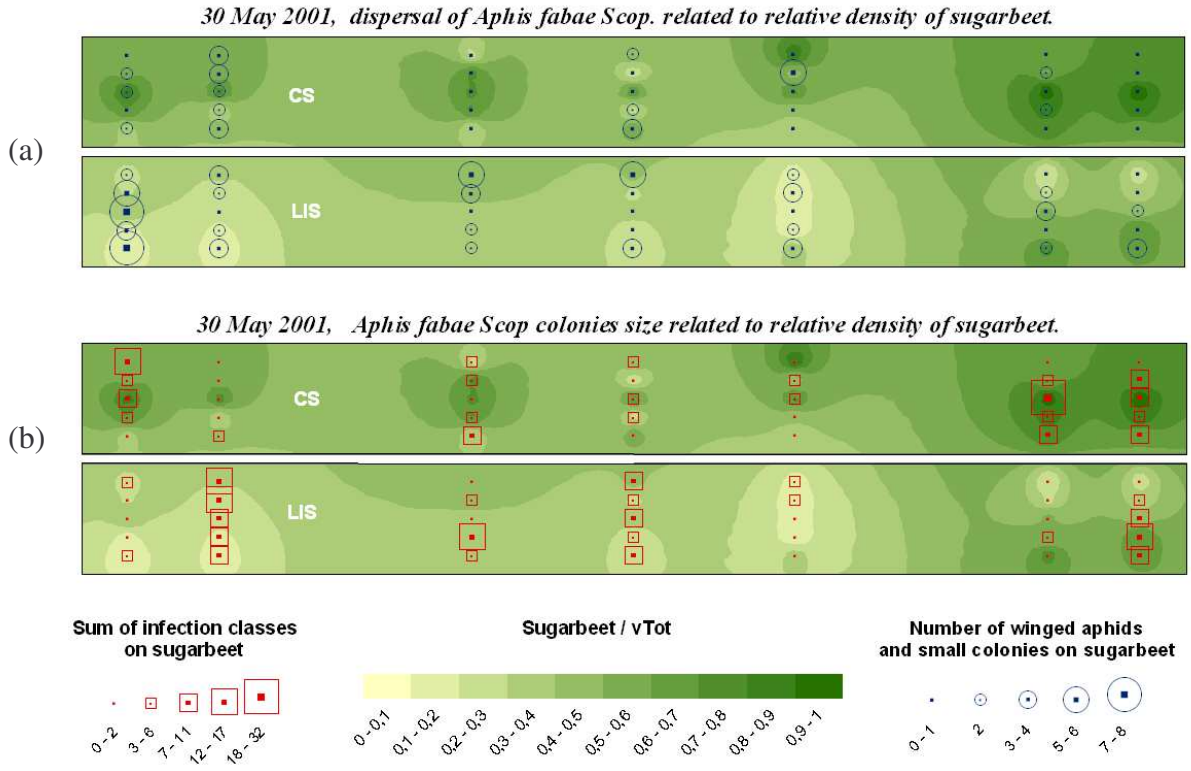



Figure 1. Relationship between (a) winged forms after post-emergence weed control and sugarbeet relative density and (b) colony size and sugarbeet relative density.

**References**

Banks, C.J., 1954. Bull. Ent. Res. 45, 751 – 756.
Kennedy, J.S. et al., 1950. Ann. Appl, Biol. 37, 651 – 679.
Pimentel, D., 1961. Ann. Entomol. Soc. Amer. 54, 76 – 86.