PROJECT SUMMARY
CALIFORNIA LETTUCE RESEARCH BOARD
April 1, 2007 to March 31, 2008

# Supporting aphid predators through intercrops with alternative prey

Project investigators:

**Kent M. Daane**
**Nick J. Mills**
**Erik H. Nelson**
Department of Environmental Science, Policy, and Management
University of California, Berkeley

## Summary

Growers that use beneficial insects to help control the lettuce aphid (*Nasonovia ribis-nigri*) and other pest aphids have focused their attention on syrphid flies, also known as hover flies. Syrphid fly larvae consume dozens of aphids as they develop. To attract syrphids into lettuce fields, growers have used intercroppings of flowering plants such as sweet alyssum. Flowers provide food to adult syrphid flies, but not to syrphid larvae. Therefore, syrphid populations can increase only when aphids are present. It may be possible to increase local syrphid populations before pest aphids arrive by providing an alternative source of aphid prey. Our long-range goal is to assess the feasibility of using intercrops and alternative prey to enhance infield syrphid populations.

Nine prospective intercrop plant species were screened for colonization by aphids and syrphids, and for any associated pest risks. The intercrops were grown in plots embedded in fields of commercial organic romaine lettuce and were sampled for aphids, syrphid flies, and other insects. The observed populations of aphids and syrphid flies indicate that bell beans, common vetch, and barley have the greatest potential to provide alternative aphid prey to in-field populations of syrphid flies and thereby reduce the numbers of pest aphids in the adjacent lettuce crop. Our next step is to plant these three plant species as intercrops in field trials that will test the movement of syrphid flies from the intercrop into the lettuce, and their impact on pest aphids in the crop.

PROJECT REPORT
CALIFORNIA LETTUCE RESEARCH BOARD
April 1, 2007 to March 31, 2008

# Supporting aphid predators through intercrops with alternative prey

Project investigators:

**Kent M. Daane**
**Nick J. Mills**
**Erik H. Nelson**
Department of Environmental Science, Policy, and Management
University of California, Berkeley

## Objective:

**Screen prospective intercrops to evaluate (i) their potential to cause problems for the lettuce crop and (ii) their potential to benefit the lettuce crop by encouraging syrphid populations.**

## Procedures

Nine species of potential intercrop plants (see list below) were grown in romaine lettuce fields owned and managed by a commercial organic lettuce grower near Watsonville, California. A bed dedicated to the experiment was divided into 45 plots (5 blocks of 9 plots). Each plot was the width of the bed (60 inches) and 5.5 meters in length, and each plot was planted to one of the intercrop plants. There were five replicates for each plant species. This screening experiment was repeated three times during the 2007 growing season, in fields that were first irrigated on May 4, June 19, and August 2.

| Intercrop plant species | |
|---|---|
| 1 | Common vetch, *Vicia sativa* |
| 2 | Lightning Persian clover, *Trifolium resupinatum* |
| 3 | Bell beans, *Vicia faba* |
| 4 | Cilantro, *Coriandrum sativum* |
| 5 | Spring barley, *Hordeum vulgare* cv. UC 603 |
| 6 | Winter barley, *Hordeum vulgare* cv. Sprinter |
| 7 | Showy evening primrose, *Oenothera speciosa* |
| 8 | Shasta daisy, *Chrysanthemum maximum*, cv. Alaska |
| 9 | Sweet alyssum, *Lobularia maritima* |

During each trial of the experiment, the intercrop plants were sampled periodically for aphids, syrphids, and other insects. Plant material was clipped from a 762 $cm^2$ area, placed into plastic bags, and then washed to separate the insects from the plants. Insects were then sorted and counted through a dissecting microscope. The three trials were sampled with different frequencies: the May 4, June 19, and August 2 trials were sampled six, five, and two times, respectively. In all three trials, the final sample date was immediately before harvest. For each trial, we summed the aphids collected across all sample dates to calculate the cumulative total number of aphids, syrphids, and other insects observed in

each plot. Insect abundances were $\log_{10}$-transformed and compared by ANOVA with block and intercrop species as independent variables.

The aphids, syrphid fly larvae, and other insects in the field plots were sampled by collecting plant material into plastic bags.

The plant material was washed over a fine mesh filter, and the insects were then sorted and counted.

**Results**

All but two of the intercrop species grew readily under the grower's production practices; the exceptions were evening primrose and Shasta daisy. The intercrops did not

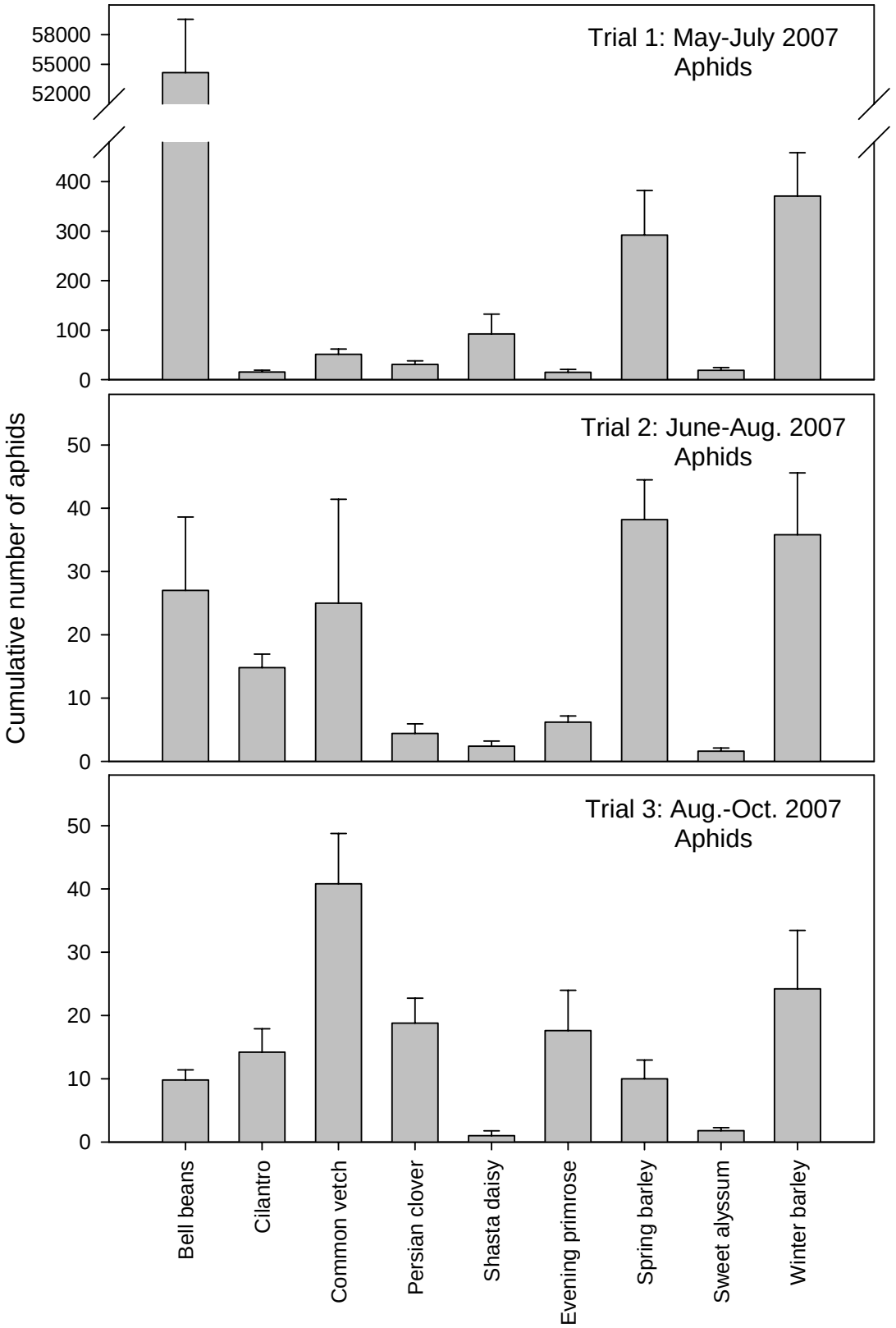
produce mature seed before harvest, except for sweet alyssum. The aphids present on the intercrops were not recognized as pests of lettuce or cole crops.

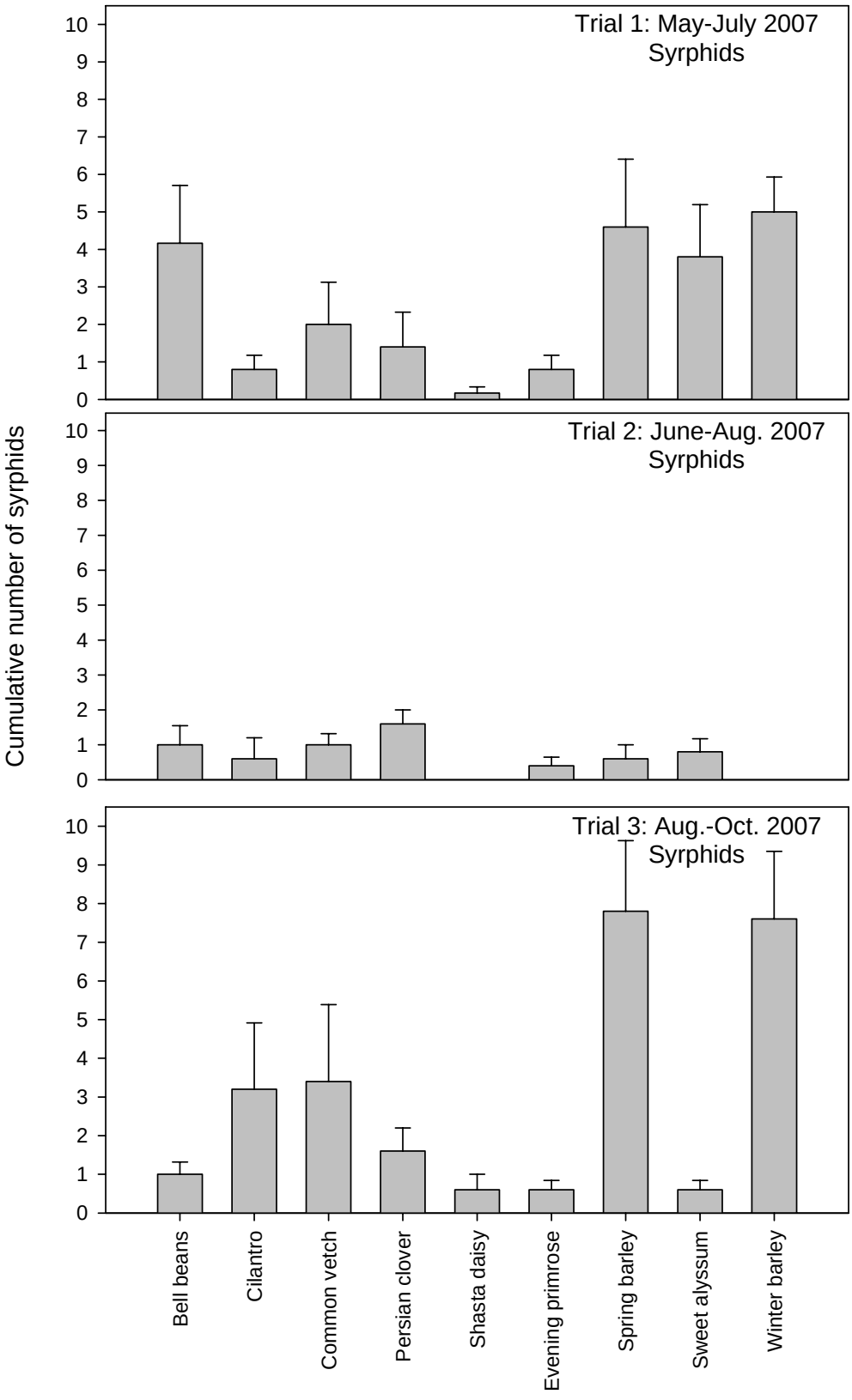
The intercrops with the greatest numbers of alternative aphids and syrphid larvae have the highest potential to attract and support syrphids in lettuce fields and aid in the suppression of pest aphids. Bell beans hosted extremely dense aphid populations during trial 1, and was also one of the top producers of syrphid larvae. Bell beans hosted fewer aphids and syrphids in trials 2 and 3. Spring and winter barley supported substantial numbers of aphids in all three trials, although the spring barley carried fewer aphids than the winter barley in trial 3. The two barleys were a reliable habitat for syrphid larvae, producing relatively high numbers of syrphids in trials 1 and 3. (Syrphids were generally at low densities during trial 2.)

Three intercrop species—cilantro, common vetch, and Persian clover—supported relatively high numbers of aphids and/or syrphids in one or two trials. Of these three, common vetch appeared to have the higher and more reliable numbers of aphids and syrphids. Two intercrops—Shasta daisy and evening primrose—grew too slowly to provide much habitat, and displayed low numbers of aphids and syrphids in all three trials. Sweet alyssum is a grower standard that provides nectar to adult syrphids, but is not considered a host for aphids. Although aphids were absent, syrphid larvae were unexpectedly observed on alyssum in trial 1.

Barley appears to host aphids and syrphids throughout the romaine lettuce growing season and is the most promising intercrop of this screening project. We tested two varieties of barley because we expected their phenology to differ (it did not). The primary aphid found on the barleys was *Rhopalosiphum maidis*, the corn leaf aphid. Two other intercrops are worth further investigation. Bell beans was an excellent source of aphids in the early and mid- season, and common vetch supplied aphids in the mid- and late season. (Bell beans hosted *Aphis fabae*, the black bean aphid, and common vetch hosted *Acyrthosiphon pisum*, the pea aphid.)

This work screened nine intercrops for their ability to host alternative, non-pest aphids as food for syrphid flies. Our future work will compare the three most promising intercrops—barley, bell beans, and common vetch—in terms of their effect on pest aphids in the neighboring crop.


Trial 1: May-July 2007
Aphids
58000
55000
52000
400
300
200
100
0
Trial 2: June-Aug. 2007
Aphids
50
40
30
20
10
0
Trial 3: Aug.-Oct. 2007
Aphids
50
40
30
20
10
0
Cumulative number of aphids
Bell beans
Cilantro
Common vetch
Persian clover
Shasta daisy
Evening primrose
Spring barley
Sweet alyssum
Winter barley
Intercrop plant species


Trial 1: May-July 2007
Syrphids
Trial 2: June-Aug. 2007
Syrphids
Trial 3: Aug.-Oct. 2007
Syrphids
Cumulative number of syrphids
0
1
2
3
4
5
6
7
8
9
10
Bell beans
Cilantro
Common vetch
Persian clover
Shasta daisy
Evening primrose
Spring barley
Sweet alyssum
Winter barley
Intercrop plant species

Summary of three trials of the intercrop screening experiment

| Trial | Wet date | Sample dates | Harvest | Highest-ranking intercrops for aphids | Highest-ranking intercrops for syrphids |
|---|---|---|---|---|---|
| 1<br>May-July | May 4 | 23 May<br>31 May<br>7 June<br>13 June<br>20 June<br>2 July | 9 July | Bell beans<br>Spring barley<br>Winter barley | Bell beans<br>Spring barley<br>Sweet alyssum<br>Winter barley |
| 2<br>June-August | June 19 | 16 July<br>23 July<br>31 July<br>6 Aug.<br>15 Aug. | 20 Aug. | Bell beans<br>Common vetch<br>Spring barley<br>Winter barley | None |
| 3<br>August-October | Aug. 2 | 28 Aug.<br>2 Oct. | 9 Oct. | Common vetch<br>Persian clover<br>Evening primrose<br>Winter barley | Cilantro<br>Common vetch<br>Spring barley<br>Winter barley |

Results of ANOVA testing for effects of intercrop species on $\log_{10}$-transformed counts of aphids and syrphid larvae.

| | | Source of variation | d.f. | F | P |
|---|---|---|---|---|---|
| Trial 1 | Aphids | Intercrop plant species | 8 | 70.8 | <0.001 |
| | | Block | 5 | 1.8 | 0.13 |
| | Syrphids | Intercrop plant species | 8 | 3.8 | 0.002 |
| | | Block | 5 | 0.6 | 0.70 |
| Trial 2 | Aphids | Intercrop plant species | 8 | 6.9 | <0.001 |
| | | Block | 4 | 0.72 | 0.58 |
| | Syrphids | Intercrop plant species | 8 | 2.5 | 0.03 |
| | | Block | 4 | 1.1 | 0.38 |
| Trial 3 | Aphids | Intercrop plant species | 8 | 10.1 | <0.001 |
| | | Block | 4 | 0.8 | 0.54 |
| | Syrphids | Intercrop plant species | 8 | 5.4 | <0.001 |
| | | Block | 4 | 1.3 | 0.27 |