Investigating the Effects of Hedgerows to Enhance Natural Biological Control

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Project Number: GW06-016

Title: Investigating the Effects of Hedgerows to Enhance Natural Biological Control

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Tara Pisani Gareau collects insects on yarrow (*Achillea millefolium*) with a vacuum sampler.

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SARE Grant: $10,000

This hedgerow is near Hollister, CA

Situation:

Hedgerows are linear assemblages of perennial shrubs, trees, grasses, and forbs. Their value to the conservation of biodiversity, including insects, is well documented in Europe, where hedgerows have a long history.

California producers are establishing hedgerows along field borders for beneficial insect, habitat, soil and water conservation, weed suppression, wildlife habitat, and windbreaks. These hedgerows, typically with 10 to 40 managed species, have the potential to protect biodiversity by:

- Increasing both botanical and arthropod diversity in the farmscape
- Catching agricultural runoff (nutrients, pesticides, and soil particles)
- Reducing the need for pesticides that can negatively affect biodiversity

Widespread hedgerow adoption, however, requires better understanding of the conditions that foster beneficial arthropods and quantifying the biological services gained.

Objectives:

- Investigate the effectiveness of hedgerows in the Central Coast of California for biological control in vegetable systems
- Make practical recommendations on semi-natural habitat management for pest control in mixed vegetable systems

Actions:

The study focused on three areas:

1. **Monitored** key arthropod natural enemies and pests attracted to hedgerows

This entailed taking vacuum samples to monitor insect abundance at six hedgerow plants within four different hedgerows sites. Insects were sampled eight times in 2005 and 10 times in 2006. Additionally, each plant's floral resources were measured.

2. **Traced** the movement of indicator insects into adjacent vegetable fields

Insects foraging on hedgerow plants were marked with a fluorescent pigment sprayed on hedgerow vegetation. Traps were placed in the adjacent vegetable fields at 25 and 100 meters from the hedgerows.

3. **Measured** the rate of parasitism in the vegetable fields

First and second instar larvae of *Trichoplusia ni* (Lepidoptera: Noctuidae) were set out on 20 potted collard plants in eight vegetable fields (four with hedgerows, four without). Pots were placed 10-25 meters ('near') and 50-100 meters ('far') from the hedgerow or field margin.

Eriogonum fasciculatum

Eriogonum giganteum, close up

Results:

Insects and natural enemies attracted to hedgerow plants

Numerous natural enemies, including lacewings, minute pirate bugs, lady beetles, syrphid flies, and parasitic wasps, were found in Central Coast hedgerows. Wasp parasitoids were consistently more abundant on hedgerow plants than generalist predators or herbivore pests and were strongly associated with *Baccharis pilularis* (coyote brush).

Key pests of vegetable and fruit crops were also present, cumulatively representing 10% of indicator insects in 2005 and 14% in 2006. The most abundant pests were the western spotted and striped cucumber beetles.

Dispersal of indicator insects from hedgerows into adjacent crop fields

The fluorescent mark was found on all insect taxa at 25 and 100 meters, except for lady beetles and flea beetles, which were found only at 25 meters. Predators as a functional group had a higher mean rate of movement than both parasitoids and pests. Pest taxa generally had lower rates of movement into crop fields than natural enemies.

Effect of hedgerows on parasitism rates of a sentinel pest

The crop matrix was found to influence parasitism rates. In 2006 at a hedgerow field, parasitism rates ranged from 70% in the brassica stand (50m from the hedgerow) to 0% on bare ground. In a control field planted entirely in brassica, parasitism rates declined from 80% at 10 meters to 20% at 100 meters, indicating that parasitoids may have been more abundant or active at the edges. In 2007, parasitism rates were higher amongst control fields than fields with hedgerows. However, the variability in crop matrix among fields makes these results inconclusive

Sticky traps were placed in fields adjacent to hedgerows.

Hedgerows were sprayed with a fluorescent pigment to mark insects.

Potential Benefits:

This research provides evidence to producers in the Central Coast region that:

- Diverse hedgerows are providing stable habitat for natural enemies important in biological control
- These insects not only reside within the hedgerow, they actively move into adjacent crop fields
- Insect pest usage of hedgerow plants was relatively low compared with natural enemies

Providing beneficial insect refuge is important because annual vegetable systems are highly disturbed environments, which can destabilize natural enemy communities. At the same time, hedgerows are less likely to harbor high numbers of pests, which should reassure producers that hedgerows will not exacerbate pest problems. While hedgerows are clearly supporting insect natural enemies, more research needs to be done to determine the biocontrol services these insect parasitoids and predators are providing.

Table 2. Descriptions of four sites with hedgerows selected for plant comparisons.

Characteristics	Site A	Site B	Site C	Site D
Location	Watsonville	Watsonville	Hollister	San Juan Bautista
Management	Organic	Organic	Organic	Organic
Crops in adjacent field	Salad greens	Cole crops, cucurbits, lettuce, onions, flowers	Cucurbits, peppers, onions, leeks	Cole crops, cucurbits, lettuce, onions, leeks
Year hedgerow was established	2000	2002	2001	1999
Hedgerow direction	E→W	NE→SW	N→S	N→S
Wind direction	SW→NE	W→E	W→E	W→E
Hedgerow length (m)	972	150	318	366
Hedgerow width (m)	3	4	3	3
Plants studied	*A. millefolium* *B. pilularis* *C. grinnse* *C. 'Ray Hartman'* *H. arbutifolia* *R. californica*	*A. millefolium* *B. pilularis* *C. grinnse* *C. 'Ray Hartman'* *E. giganteum* *R. californica*	*A. millefolium* *B. pilularis* *C. 'Ray Hartman'* *H. arbutifolia* *R. californica*	*A. millefolium* *B. pilularis* *C. grinnse* *C. 'Ray Hartman'* *E. giganteum* *H. arbutifolia* *R. californica*
Total number of hedgerow species	15	35	15	17
% Gaps	<10%	30-31%	30-10%	30-10%
Picture				