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ScienceDirect
Agriculture, Ecosystems and Environment 117 (2006) 171–177
Agriculture Ecosystems & Environment
www.elsevier.com/locate/agee

# Intercropping sunflower in organic vegetables to augment bird predators of arthropods

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Received 27 May 2005; received in revised form 9 March 2006; accepted 21 March 2006
Available online 3 May 2006

**Abstract**

Field experiments were used to test whether intercropping sunflower (*Helianthus annuus*) in organic vegetables would (1) attract insect-eating birds and encourage them to (2) forage in greater numbers and (3) for more time in cropped fields. Cropped areas with sunflower treatments of one or two rows per 0.4 ha exhibited significantly greater mean abundance of insectivorous birds than did control plots, across a variety of crop types. Additionally, both mean numbers of individual birds foraging on insect prey and mean insect-foraging time per hour in crops were significantly greater in plots with sunflower rows than without. Birds actively pursuing prey in study plots consumed economically important pest species and did not damage crops during the study. The addition of sunflower intercrops proved to be an effective habitat modification for augmenting avian insectivore numbers and insect-foraging time in organic vegetables.


*Keywords:* Predator augmentation; Avian insectivory; Farmland birds; *Helianthus annuus*; Intercrops

## 1. Introduction

Innovative crop protection through enhancement of predator–prey relationships characteristic of natural systems has a pivotal role to play in the evolution of agriculture towards environmentally sustainable systems (Atkinson and McKinlay, 1997). Mechanisms underlying habitat-based improvements of predator effectiveness in controlling pests include facilitation of dispersal, colonization, daily foraging movements, and improved prey-capture success of predator species (Helenius, 1998). Modifications that create predator habitats that serve ecological functions on farms (i.e., predator refugia) frequently take the form of within-field strips (intercrops), cover crops, field margins, hedgerows, fencerows, windbreaks, irrigation and drainage ditches, and roadside margins (Nentwig, 1998). The importance of predator refugia in farmland mosaics has long been recognized for fostering invertebrate predators, but creation of on-farm refugia for native vertebrate predators of pest insects, e.g., insectivorous birds, has received much less attention (Picket and Bugg, 1998).

On North-central Florida farmlands insectivorous bird activity is higher in polyculture crops than in monoculture, in both organic and conventional operations (Jones et al., 2005). One of the most effective polyculture plantings for attracting birds into cropped areas appeared to be cut flowers. In this study, therefore, the primary goal was to test the hypothesis that sunflowers (*Helianthus annuus* L.) planted as intercrops would significantly increase avian predatory activity in vegetable crops. It was predicted that if sunflower intercrops serve as avian predator refugia then crops planted with interspersed sunflower rows would have significantly greater abundance and foraging activity of insectivorous birds.

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doi:10.1016/j.agee.2006.03.026

## 2. Methods

Four certified organic growers in Alachua County, Florida, agreed to incorporate rows of multi-branched open-pollinating varieties of sunflowers into their cropped acreage at the earliest planting dates during their spring and summer growing seasons of 2002 and 2003. Farm size ranged from 8 to 80 ha and field sizes from 4.5 to 55.8 ha. Vegetable crops grown in fields containing our experimental plots included either polycultures or monocultures of kale or collard greens (*Brassica oleracea* L.), melons (*Cucumis melo* L.), yellow and zucchini squash (*Cucurbita spp.*), tomatoes (*Lycopersicon esculentum* Mill.), beans (*Phaseolus spp.*), okra (*Abelmoschus esculentus* L.), cucumbers (*Cucumis sativus* L.), strawberries (*Fragaria ananassa* Duch.), and sweet corn (*Zea mays* L.; see Table 1)).

Study plots in cultivated fields were 0.4 ha in area, comprised of a semicircle extending 50 m into production rows from the field border (Fig. 1). A total of 18 study plots were used (8 control, 5 single and 5 double rows of sunflower treatments in 2002; 8 control, 7 single and 3 double rows of sunflower treatments in 2003; Table 1). Study plots were placed at least 200 m apart, but every treatment plot was paired in the same field and/or in the same crop type on the same farm with a control plot. Treatment plots were planted with one or two rows of sunflowers interspersed with, and parallel to, production rows (Fig. 1). One-meter wide sunflower rows were planted at a density of nine plants per m$^2$. Sunflower rows were approximately 100 m in length, extended outside of study plots, and were centered in roughly rectangular fields. Study plots were established in standardized locations – at field edges adjacent to hedges and/or trees – near features likely to serve as sources of insectivorous birds (Jones et al., 2005).

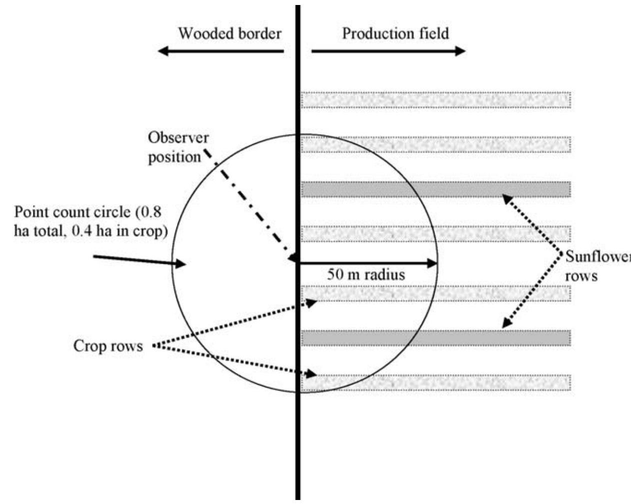


Fig. 1. A representative study plot showing placement of the 50 m radius point count circle and two rows of *Helianthus* in relation to farm field edge, observer station, and the orientation of crop rows.

Sunflower rows were planted early (in February or March) and maintained throughout the spring growing season (April–June) as other crops were planted, harvested, and rotated through each farm's production area. Only two of the farm sites had fields dedicated to a single crop type (sweet corn). In the other fields, two or more plantings of

Table 1
Experimental plots were established on five certified organic farm sites

| Farm site[a] | Field size (ha) | Plots | Crop types[b] | Treatments[c] | |
|---|---|---|---|---|---|
| | | | | 2002 | 2003 |
| Hammock hollow | 4.5 | 1 | Mixed | 2 | 2 |
| | | 2 | Mixed | 0 | 0 |
| Bellview 1 | 60.7 | 1 | Watermelon and corn | 0 | 0 |
| | | 2 | Watermelon and corn | 1 | 1 |
| | | 3 | Squash and corn | 1 | 1 |
| | | 4 | Squash and corn | 0 | 0 |
| Bellview 2 | 55.8 | 1 | Watermelon, squash and corn | 1 | 1 |
| | | 2 | Watermelon, squash and corn | 0 | 0 |
| | | 3 | Watermelon, squash and corn | 0 | 0 |
| | | 4 | Watermelon, squash and corn | 1 | 1 |
| Govinda's gardens | 16.2 | 1 | Mixed | 2 | 2 |
| | | 2 | Mixed | 0 | 0 |
| | | 3 | Mixed | 1 | 1 |
| | | 4 | Mixed | 2 | 1 |
| Phoenix rising | 16.1 | 1 | Kale and collards | 0 | 1 |
| | | 2 | Kale and collards | 2 | 2 |
| | | 3 | Squash and cucumber | 0 | 0 |
| | | 4 | Squash and cucumber | 2 | 0 |

[a] The 14 plots not including Bellview 2 were used in the first 2 years of the study (2000–2001) for quantifying bird abundances only.
[b] Mixed-crop fields included varieties of greens such as kale, tomatoes, beans, or okra in addition to corn, melons, squash, or strawberries.
[c] Plots received 1 or 2 (treatment) or 0 (control) rows of sunflowers. Note that 3 plots received different treatments in 2003 than in 2002; Govinda 4, and Phoenix 1 and 4.