Exploring Systems Management of Diseases and Insects on an Organic Vegetable Farm in California

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Introduction

A goal of an organic farming system is to suppress insect pests and diseases through ecological and systems management. The goal of this WSARE-supported project was to explore the strategies and outcomes of ecological systems management on 5 long term organic farms in California and Oregon. This poster describes this effort for Phil Foster Ranches, a 30-year-old diversified organic vegetable farm in San Juan Bautista and Hollister, CA.

PHIL FOSTER RANCHES
Farmers: Phil Foster, with Doug O'Brien Agricultural Consultants
Website: http://www.pinnacleorganic.com
Location: San Juan Bautista and Hollister, CA.
Crops: mixed vegetables, melons, and tree fruits
Markets: farmstand, regional farmers markets, wholesale
Years in organic management: 1985 to present
Total farm acreage: 300 acres
Certifications: CCOF and IFOAM

Data Collection

Farm-collected data: During the years 2013 - 2017 project staff aggregated farm records (scouting records, soil analyses, fertilizers/soil amendments, yield) and formatted data into tables/figures.

Farmer interviews: During that same period, staff iteratively interviewed Phil Foster and Doug O'Brien about their pest management practices and outcomes.

Farm System Descriptions (FSDs): FSDs focused on the farm's insect and disease management systems were drafted based on farm-collected data and farmer interviews. FSD sections were iteratively reviewed by farmers, OSU personnel, and topical experts.

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Systems Management Strategies

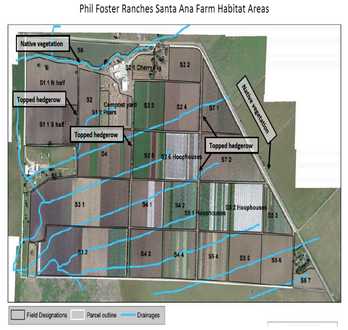
Systems disease management strategies

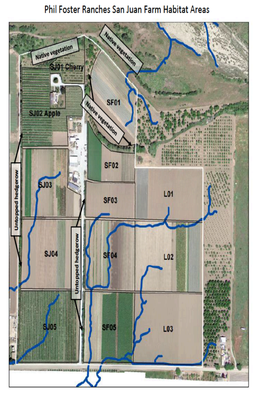
- Resistant varieties
- Crop rotation
- Soil building to improve soil quality and suppress damping-off
- Soil amendments to maintain balanced crop growth
- Irrigation management to reduce conditions favorable to pathogens
- Intensive, regular crop scouting to identify problems early
- Timely application of disease management materials
- Good record keeping to aid in management decisions

Systems insect management strategies

- Native habitat on field margins to enhance biological control organisms, such as birds and insect predators/parasites (maps).
- Increased in- and around-field plant diversity to enhance biological control organisms, such as birds and insect predators/parasites:
- Insectary plants as rows within the crop (normally 1 bed/12 beds of crop), or as individuals (one every 50 sq. ft.): white alyssum, Dhani-ya cilantro (a rapidly flowering coriander grown on-farm, not commercially available), regular cilantro, and white dill. PFR is experimenting with pelleted alyssum that could be direct seeded with lettuce or broccoli. Insectaries are planted in most crops except onions, shallots and garlic. Insectary plant species vary with crop and time of year to match insectary flowering with plant phenology.
- Hedgerows: native woody perennial shrubs and small trees planted along roads (see maps). These were installed in the 1990's and are trimmed with a tractor mounted hedgerow trimmer.
- Summer and winter cover crops.
- Compost tea applications to enhance or supplement *Pandora* entomopathic fungi for management of cabbage aphids
- Reduced tillage equipment (spader).
- Crop placement and timing, including spatial management (e.g. planting serial plantings upwind).
- Row cover to protect crops from root maggots, flea beetles, bagrada bugs, and cucumber beetles.
- Four-bed insect vacuum
- Regular field scouting and farm-developed action thresholds for insecticide applications
- Reduction in the use of insecticides and preferential use of materials with little or no impact on beneficial insects.

Select Results





Maps of Phil Foster Ranches and habitat elements

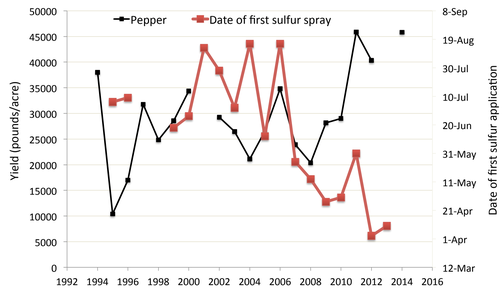


Fig. 1. Pepper yield and date of first sulfur spray for control of powdery mildew at Phil Foster Ranches, 1994-2014. Disease is successfully managed by early initiation of sulfur applications.

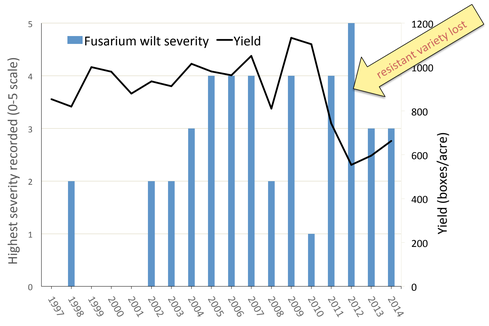


Fig 2. Yield and highest disease severity score recorded each year for Fusarium basal rot of onion. From yield and scouting records, Phil Foster Ranches, 1997-2014. Scoring scale ranged from 1 (very light damage, very few plants) to 5 (heavy damage, many plants). A less susceptible variety maintained yield until 2010 when that variety was no longer available.

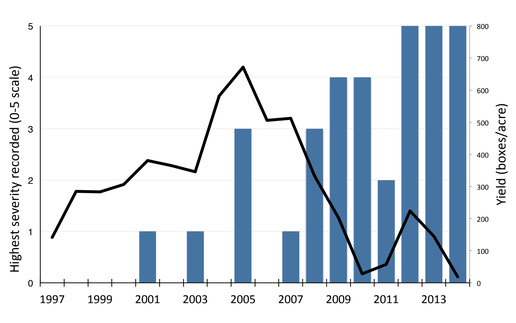


Figure 3. Severity of Verticillium wilt of watermelon and yield at Phil Foster Ranches, 1997-2014. PFR is now successfully grafting watermelons to control this disease, although resistant rootstocks are more attractive to cucumber beetle than susceptible rootstocks.

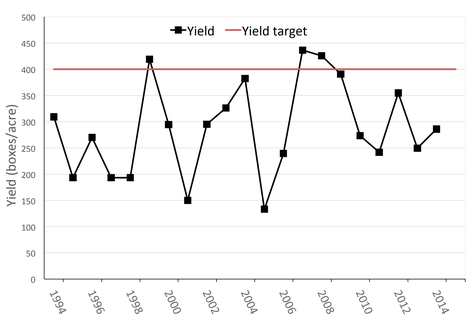


Fig. 4. Garlic yield at Phil Foster Ranches, 1994-2014. The yield target of 400 boxes per acre is rarely achieved as rust suppresses yield. There are currently no effective organic materials or rust resistant varieties.

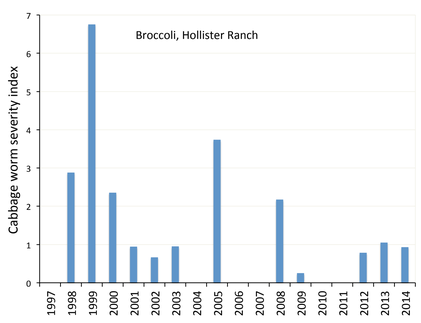


Fig. 5. The cabbage worm severity index for broccoli, calculated as 100*(1w+2x+3y +4z)/4, where w represents the percent of all observations of very low cabbage worm incidence/severity, x is the percent of all observations of low incidence/severity, y is percent of observations of moderate incidence/severity, and z is percent of high incidence/severity. From scouting records, Phil Foster Ranches, 1997-2014. PFR uses farm-derived action thresholds and Bt applications to manage CW.

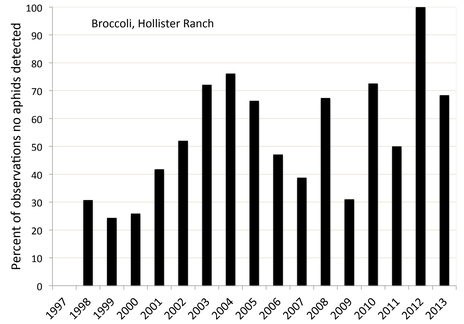


Fig. 6. The The percent of all scouting observations in which no aphids were present. From scouting records, Phil Foster Ranches, 1997-2014. Compost tea is applied regularly to control cabbage aphid. Doug and Phil think that the tea enhances control by *Pandora neoaphidis*, a fungus that parasitizes aphids.

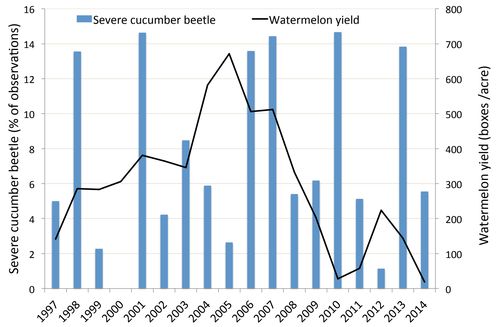


Fig. 7. Severe cucumber beetle damage (percent of total observations) and yield of watermelon. From scouting and yield records, Phil Foster Ranches, 1997-2014. Cucumber beetles kill young plants and scar fruit, making them unmarketable. PFR uses row cover to prevent damage early in crop development. Surround is applied to fruit two weeks before harvest to deter feeding; it must be washed off before sale.

Outcomes

RELATED TO THE FARMING SYSTEM

Disease outcomes: PFR's disease management system has been mostly effective.

1. Many diseases common to the Monterey Bay area do not occur, or are sporadic and inconsequential.
2. Several diseases are effectively managed, such as powdery mildew of pepper (Fig. 1).
3. Four diseases remain chronic problems: Fusarium basal rot of onion, garlic and shallot (Fig. 2); Verticillium wilt of watermelon (Fig. 3); garlic rust (Fig. 4); and downy mildew of cucumber.

Insect pest outcomes:

1. Many insects common to the Monterey Bay area were never, or are no longer, significant (eg. wire worm (Family Elateridae), root maggots (*Delia* spp.), turnip aphid (*Lipaphis erysimi*), squash bugs (*Anasa tristis*), potato aphid (*Macrosiphum euphorbiae*), and lettuce aphid (*Nasonovia ribis-nigri*)).
2. Others are now managed successfully so damage almost always falls within economically tolerable levels, such as tuber moth (*Phthorimaea operculella*), tarnished plant bug (*Lygus hesperus*), black bean aphid (*Aphis fabae*), onion thrips (*Thrips tabaci*), and cabbage worms [Imported Cabbage Worm (*Pieris rapae*), Diamondback Moth (*Plutella xylostella*) and cabbage looper (*Trichoplusia ni*); Fig. 5].
3. A few cause yield losses most years, occasionally with a very significant economic impact: corn earworm (*Helicoverpa zea),* cabbage aphid (*Brevicoryne brassicae; Fig. 6*), spotted cucumber beetle (*Diabrotica undecimpunctata*), striped cucumber beetle (*Acalymma vitatum; Fig. 7*), and brassica flea beetles (*Phyllotreta* spp. and/or *Systena blanda*).

RELATED TO THE APPROACH

1. Interviews and data collection revealed significant successes in ecological insect suppression as well as critically and chronically damaging pests. Successful management strategies can be adapted by other farmers. Intractable and serious pests are identified as critical organic research priorities.
2. FSDs and FSAs (published to eOrganic), including data sets, are useful resources for formal and informal educational experiences with farmers, agricultural professionals, researchers and students. Alex Stone is using FSDs in Oregon State University organic management courses.