Welcome to the webinar on field bindweed!

- We'll start soon, at the top of the hour!
- For questions, use the Q and A box on your control panel. We'll be reading the questions aloud after the c. 45-minute presentation.
- A recording will be available on the eOrganic YouTube channel within 1-2 weeks.
- Learn more about the USDA NIFA ORG bindweed research project at https://eorganic.info/node/26426
- Find all upcoming and archived eOrganic webinars at https://eorganic.org/node/4942

eOrganic

Organic Control of Field Bindweed in the Pacific Northwest

Oregon State University

USDA NIFA
United States Department of Agriculture
National Institute of Food and Agriculture

J. Green, M.L. Moretti, L. Brewer, A. Formiga, M.Y. Choi, R.E. Peachey

Funded by USDA NIFA Organic Transitions grant. 2017-51106-27004

Objectives of the Research

Oregon State University

- Evaluate the integration of multiple weed control methods in organic perennial fruit systems – using blueberry as model system
- Harness *Tyta luctuosa* as a biological control agent

Field bindweed covering blueberry at a commercial farm near Albany, OR.

Bindweed Control

Introduction

Weed control practices in planting row:

- Mulches - standard practice
  - Natural (saw dust)
  - Synthetic (weed-mat)
- Implications for plant nutrition, production costs, yield.
- Weed-mat can increase yield (8 to 20%) as compared to no mulches (Strik et al 2017).

Introduction

Weed escapes with mulches

1. Grows next to mulch
2. At plant base

Current options:

- Cultivation is limited
- Flaming is not compatible
- Hand-weeding is expensive

Research needs

- Methods compatible with current system
- Cost-effective option

New tools for weed management

Newer tools available on the market

- Saturated steam (Weed Technics SW900)
- Brush weeder (several manufacturers)
- Organic herbicides (e.g., capric + caprylic acid)

New tool for weed management

Saturated steam
Water use: 160 gal h^{-1} (10 $L.min^{-1}$)
Diesel burner: 2 gal h^{-1} (7.6 $L.h^{-1}$)
Gas pump: 0.5 gal h^{-1} (1.9 $L.h^{-1}$)
Temperature:

- boiler – 121 °C/250 °F
- nozzle ~ 87 °C/190 °F

Fast acting
Continuous flow (one or two applicators) -50 cm

Steamer

New tool for weed management

Brush weeder

Mounted on the 3-point hitch
Spinning shaft ~ 1100 rpm
Smooth cords
Hydraulic output: 6.5 to 8 GPM (one or two sided)
40 hp or greater tractor is recommended

Objectives

1. Evaluate performance of steam, brush weeder, and organic herbicides in blueberries
2. Compare saturated steam and organic herbicide for weed control at plant base.

METHODS

Methods – Obj 1.

Three field studies 2018-2019 (spring and summer)

Treatments:

1. *Saturated steam 0.5 mph 730 gallons/A (240 ~ 1/3rd of field)*
2. *Rotary brush 0.5 mph*
3. *Suppress 9 % v/v 80 GPA*
4. *Axxe 13 % v/v 80 GPA*
5. *Nontreated control*

Reapply treatments 4 weeks later
5 by 5 factorial – all possible combinations
Plots – 20 blueberry plants per plot (18 m)
RCBD four or six replicates

Methods

Weeds present

Spring study	Summer Study
Soft brome	Knotweed
Annual bluegrass	Sharppoint fluvellin
Willowherb	Field bindweed
Annual sowthistle	

Assessments: weed control, above ground biomass
Data analyzed and presented by season spring vs summer
4 or 8 weeks after treatment data presented

Methods – Obj 2. Targeted application

Two field studies 2019-2020

Study 1: Efficacy of steam and herbicides versus hand-weeding

Study 2: Blueberry Crop safety in response to repeated application of steam and organic herbicides

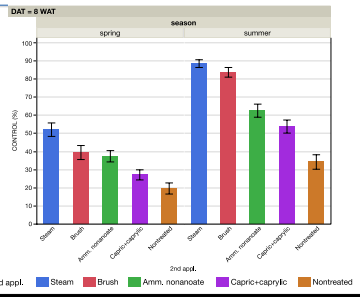
RESULTS
Obj. 1

Results – Weed Control

8 WAT

Better performance in summer

Steam was often best treatment
Followed by brush

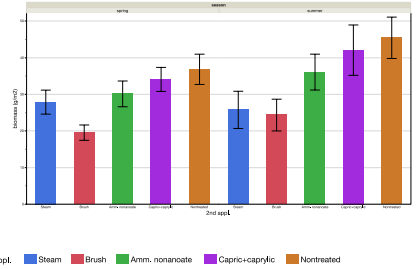


Results – Weed biomass

8 WAT

Better performance in summer

Steam was often best treatment
Followed by brush



Results – Cost comparison

Treatment	Cost band application (1/3 field)
Steamer	$43
Brush weeder	$32
Axxe (50 to 80 GPA 13 % v/v)	$170 - $252
Suppress (50 to 80 GPA 9 % v/v)	$121 - $187
*Hand-hoeing (estimated 6 h/A)	$64.5

Discussion

Limitations (steamer):
- Contact action – above ground control
- Water consumption
- Operational capacity vs weight
- Equipment maintenance

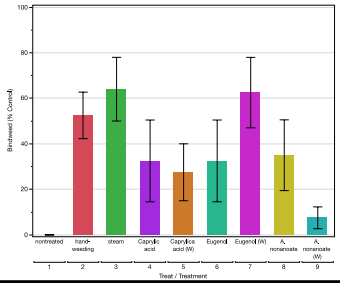
Limitations (brush):
- Dust
- Long-term impact on weed mat
- Incompatible with sawdust

Plot treated with saturated steam at 730 gallon per A.

RESULTS Obj. 2

Efficacy

- Steam was as effective as hand weeding
- Eugenol – not approved by OMRI

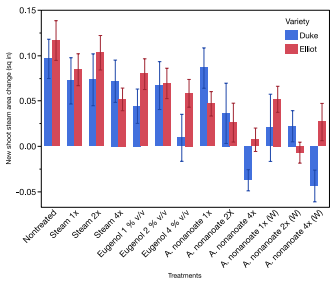


Saturated Steam applied to field bindweed

- Steam was as effective as hand weeding

Crop safety

New shoot growth after two consecutive treatments over two years



Examples of crop injury

Steam 4X

AXXE (wiper)

Eugenol (wiper) not approve by OMRI

Is saturated steam a viable alternative in blueberry?

Crop
- Safe to the crop
- Compatible with mulches
- Effective weed control

Economics
- Lower costs than hand weeding
- Less labor demand

Technology
- Operational capacity
- High maintenance
- Parts availability
- High water use

Not yet, it needs refinement

2021 Research

Research on Electric Weed Control

Tyta luctuosa

Acknowledgements

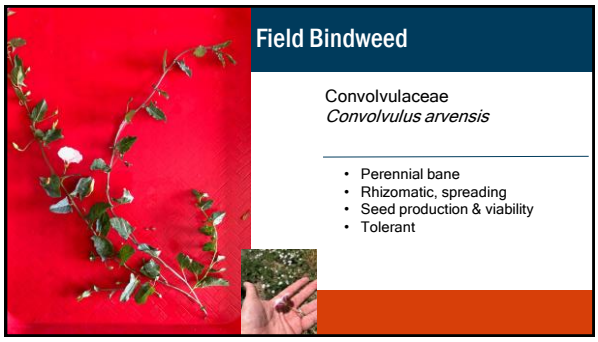
This work was funded by
USDA NIFA Organic Transitions Grant #2017-51106-27004

Collaborators:
AGRICARE
Matt Borg and Cyndee Ross, Matt-Cyn Farms
Leonard Foltz, Dancing Oaks Nursery
Doug Kramer, Berries Northwest
Chris O'Brien, Big Leaf Farm

Organic Control of Field Bindweed in the Pacific Northwest

Jessica Green, SFRA 1
DEPT. OF HORTICULTURE
OREGON STATE UNIVERSITY

eOrganic webinar
Oct 20th, 2021



Field Bindweed

Convolvulaceae
Convolvulus arvensis

- Perennial bane
- Rhizomatic, spreading
- Seed production & viability
- Tolerant

Management Tactics ≠ Control

Focus efforts on:

- Prevention
- Competition
- Disturbance

Avoid:

- **Contaminated compost**
- Moving contaminated soil and equipment into clean fields
- Feeding the weed
- Shallow cultivation in moist soil

"constant vigilance"

'5 year plan'

Till in FBW at bloom; plant sweet clover and oat → 3" disc in sweet clover + sweep plow FBW as it emerges → spring wheat to harvest, chisel plow to encourage FBW, then sweep → Sweep plow FBW at bloom, plant buckwheat, harvest, then plant rye → harvest rye, then chisel plow to encourage FBW and sweep plow mid-Oct

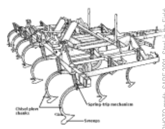


PHOTO credit: SARE 2001. Steel in the Field;

Kirschenmann, F. 1992. Eradicating field bindweed; tillage, rotation knock out weed. Northern Plains Sustainable Agriculture Society Newsletter, Jan. pg. 5

Biotypes

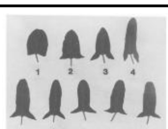


Figure 1. Variation in leaf shape between nine clones of field bindweed.

- Self-incompatible
- Leaf shape
- Flower color
- Vegetative reproduction
- Susceptibility to herbicide

Adaptive Ability

Degennaro, F. and S. Weller. 1992. Growth and Reproductive Characteristics of Field Bindweed. *Weed Sci.* (32)

Biological Control

Using selected natural enemies to reduce density and competitive ability of a targeted weed.

- IOBC → USDA-APHIS → Release
- Host specific

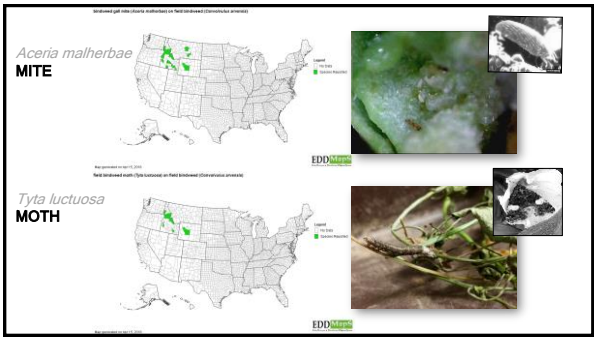
"silver bullet"

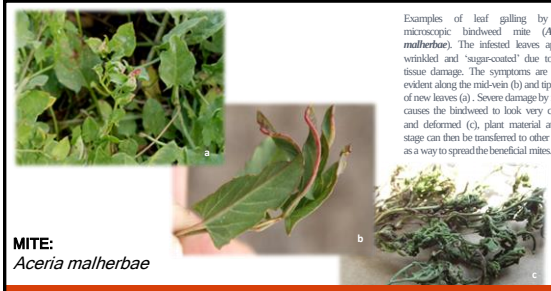
Biological Control

Best for:
Undisturbed areas
Low agronomic inputs
Perennial crops

- IOBC → USDA-APHIS → Release
- Host specific
- Challenges
- Opportunities

Biocontrol is NOT a **"silver bullet"**





Examples of leaf galling by the microscopic bindweed mite (***Aceria malherbae***). The infested leaves appear wrinkled and 'sugar-coated' due to cell tissue damage. The symptoms are most evident along the mid-vein (b) and tips and of new leaves (a) . Severe damage by mites causes the bindweed to look very curled and deformed (c), plant material at this stage can then be transferred to other areas as a way to spread the beneficial mites.

MITE:
Aceria malherbae

Oregon State University

Aceria malherbae
ACMA

Managing *Aceria malherbae* gall mites for control of field bindweed

Cooperative Extension Service • Circular 600

Lauriault et al. - New Mexico State University – 2004 - Circular 600

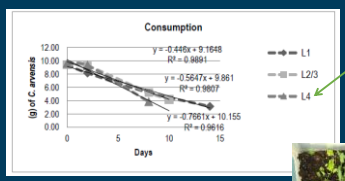
Green, J. (in prep). Arthropod-Plant Interactions. "Unexpected performance of field bindweed (*Convolvulus arvensis*) in response to gall formation by *Aceria malherbae*"

Examples of herbivory by the defoliating caterpillar (***Tyta luctuosa***). Larvae are released (a) and begin feeding immediately. Leaves are stripped completely in lab settings (b). Larvae feed at night and rest at the base of plants during the day. Visual sightings of larvae after release are rare, and herbivory is quantified by scouting for evidence of characteristic feeding (from leaf edges inward and petiole clipping (c)).

MOTH:
Tyta luctuosa

Oregon State University

How much do they eat?



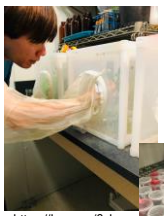
Large larvae

64% in 8 days

Extrapolate!

"very hungry caterpillars"

Rearing & Redistribution



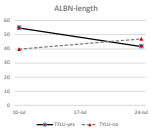
https://beav.es/3yb

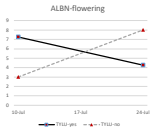
- Lab colony → Field release
- Diet
- Augment with wild-caught
- Success F6+

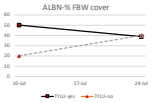
"time, skill, and patience"

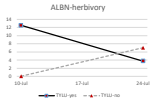
On-farm releases


ALBN	Organic, diversified veg	5 patches in unused compost area
13-Jun	Release	10 TYLU per; no bags; no attractants
10-Jul	Eval	More flowers and longer stems vs. untreated; herbivory evident
24-Jul	Eval	Less flowers and signs of herbivory; stem length similar

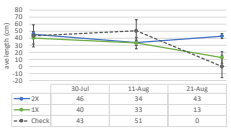




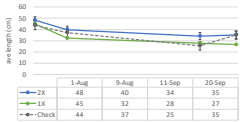




DVRC	Transition, large scale commercial	3 patches below bushes
20-Jul	Release	0-5-10 TYLU per; no bags; no attractants
No difference 30DAT; shoot length greater at 61DAT in 2X		



JFRSN	Organic, large scale commercial	3 patches along weedmat
19-Jun	Release	0-5-10 TYLU per; no bags; no attractants
Possible reduction in shoot length 21 and 63DAT but only in 1X		



Behavioral Modification

Push-Pull
Attractants-Repellents
Perennial Crops

- Host recognition
- Host acceptance
- Semiochemicals (NOP-ok)
- Natural products
- M / F

Oregon State University

Investigation - HIPVs

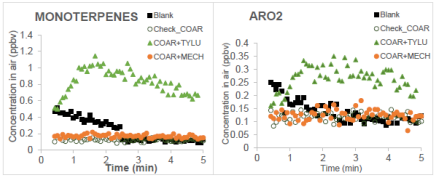
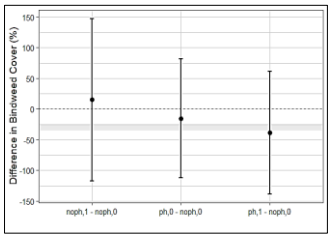


Figure 3 – Monoterpenes and one specific aromatic compound were detected from field bindweed plant tissue (COAR) that had been damaged by T. luctuosa caterpillars (TYLU), but not mechanical damage (MECH) nor mites.

Attractant Field Trial (ongoing)



Integrated Weed Mgmt.

Research
Cooperation
Discovery

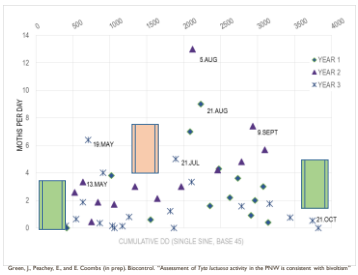
- **Timing**
  - BCA lifecycles
  - Crop production (INS)
  - Weed management (MECH)

"many little hammers"

OMRI-LISTED INSECTICIDES

BLUEBERRY

	APHIDS	SWD	LFROLLER	BVWEEVIL	NTO-TYLU
Azadirachtin (Neemix)	X	X	X	X	?
Bt var. kurstaki			X		?
Beuveria bassiana (Mycotrol)				X	?
Insecticidal soap (M-Pede)	X				?
Kaolin clay	X		X		?
Pyrethrins (PyGanic)	X	X	X	X	?
Spinosad (Entrust)		X	X		?
Azadirachtin (Neemix)		X	X		?



Green, J., Peachey, E., and E. Coombs (in prep). Biocontrol. "Assessment of *Tyta luctuosa* activity in the PNW is consistent with bivoltism"

Bivoltine – 2 activity peaks

Oregon State University

United States Department of Agriculture
Agricultural Marketing Service
National Organic Program

1400 Independence Avenue S.W.
Room 2648 South Building
Washington, DC 20250

NOP 5020
Effective Date: 1/15/16
Page 1 of 9

Guidance
Natural Resources and Biodiversity Conservation

2. Background

The conservation of natural resources and biodiversity is a primary tenet of organic production. For instance, native vegetation interspersed throughout a certified organic operation provides food, cover, and corridors for beneficial organisms such as pollinators, slows water down for erosion control and groundwater recharge, and filters pollution. Using practices that attract or introduce beneficial insects, provide habitat for birds and mammals, and provide conditions that increase soil biotic diversity serve to supply vital ecological services to organic production systems. Advantages to certified organic operations that implement these types of production practices include: 1) decreased dependence on outside fertility inputs; 2) reduced pest management costs; 3) more reliable sources of clean water; and 4) better pollination.

Guidance
Decision Tree for Classification of Materials as Synthetic or Nonsynthetic

NOP Guidance 5020 / 5033

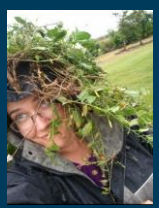
- **Non-synthetic**
- **Beneficial insect**
- **Ecosystem services**
- **Self-sustaining**

Augmentative / Conservation Biocontrol

Establishment Habitat

Pollinator Habitat

Edge Habitat



Thank you for your interest!

Jessica Green
Sr. FRA I / PhDc
jessica.green@oregonstate.edu
https://beav.es/3yb

Oregon State University

USDA

USDA-NIFA-Organic Transitions grant #2017-51106-27004

Thank you for coming!

- A recording will be available on the eOrganic YouTube channel within 1-2 weeks.
- Learn more about the USDA NIFA ORG bindweed project at https://eorganic.info/node/26426
- Find all upcoming and archived eOrganic webinars at https://eorganic.org/node/4942
- Please fill out our evaluation survey which you will receive by email!

eOrganic