Welcome to the webinar!

- The webinar will start the top of the hour.
- To type in a question, use the q and a box on your control panel. We'll read the questions aloud after the presentation for 30 minutes.
- A recording will be available in our archive (see below) and on the eOrganic YouTube channel within 1-2 weeks
- Find more upcoming and archived webinars at https://articles.extension.org/pages/25242
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eOrganic

Ecological Weed Management *Research-based Practical Guidance for the Western Region*

Mark Schonbeck, PhD.

Organic Farming Research Foundation

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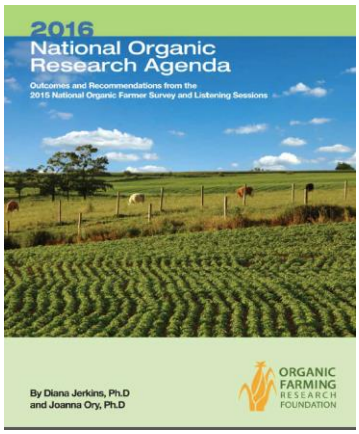
Research Priorities Identified by Western Region Organic Farmers



63% - weed management

71% - soil health

Download full report at http://ofrf.org/

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The Organic Farmer's Dilemma: How to Control Weeds and Protect Soil Health

Non-use of synthetic herbicides:

- Protects soil life and water quality.
- Allows flexibility in crop rotation.

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The Organic Farmer's Dilemma: How to Control Weeds and Protect Soil Health

Non-use of synthetic herbicides:

- Protects soil life and water quality.
- Allows flexibility in crop rotation.

Greater dependence on cultivation can:

- Stimulate weed seed germination.
- Consume soil organic matter.
- Hurt soil life.
- Increase soil crusting and erosion.

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Western Weed Research Priorities

- Managing invasive weeds
- Crop rotations to decrease annual weed pressure
- Effects of tillage regimes, and plant and animal rotations on soil health and weeds
- Managing weeds through grazing and crop-livestock integration
- Managing weeds through grazing and crop-livestock integration
- Cost-effective organic weed control methods and products
- Optical weeding technology

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Problem Weeds for Western Region Organic Farmers

Field Bindweed



Yellow Nutsedge


Canada Thistle


Lambsquarters


Cocklebur

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Weed Ecology 101

How Human Activities "Make Weeds Happen"

Weeds are Pioneer Plants that Fill Open Niches Created by Disturbance



Weeds are trouble, but the alternative is worse



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Cropland Weeds are Pioneer Plants that:

- Adapt to disturbance.
- Germinate quickly.
- Grow and develop rapidly.
- Accumulate and respond to abundant nutrients.
- Reproduce prolifically.

Common ragweed and jimsonweed in tomato

Spotted knapweed

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Exotic (Non-native) Plant Species often become Aggressive, Invasive Weeds

European and Asian

"Canada" thistle

Field bindweed

Yellow nutsedge

European

Lambsquarters

Johnsongrass

North American

Pigweed

Cocklebur

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Weeds are Nature's Cover Crop

NRCS Soil Health Principles

Keep soil covered

Diversify crops

Maintain living roots

Minimize disturbance

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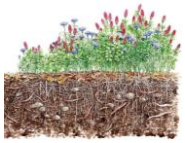
Weeds are Nature's Cover Crop

NRCS Soil Health Principles

Keep soil covered

Diversify crops



Maintain living roots

Minimize disturbance

Benefits

Weeds restore cover and living roots, protect and restore soil after tillage, and absorb excess nutrients.

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Weeds are Nature's Cover Crop

NRCS Soil Health Principles

Keep soil covered

Diversify crops

Maintain living roots

Minimize disturbance

Benefits

Weeds restore cover and living roots, protect and restore soil after tillage, and absorb excess nutrients.

Drawbacks

Invasive, exotic weeds displace native plants, consume soil moisture, and disrupt indigenous soil biota, thus reducing biodiversity.

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Integrated Weed and Soil Management

Getting the Most Weed Control with the Least Soil Damage

The "Many Little Hammers" of Organic Weed Management

"Achieving the two-fold goal of weed management and soil conservation requires an ecological approach to weed management that combines multiple weed control tactics with knowledge of the ecology of crop-weed competition and an understanding of the economic threshold for control."
(Menalled et al., 2012. Montana Extension)

The cabbage crop is way ahead of the small weeds. Skip hoeing to save the soil and reduce labor costs.

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Strategy 1 – Get to Know the Weeds

- Life cycle, season
- Growth needs
- Germination cues
- **Weak points**

Broadleaf seedlings (left) are susceptible to flame; grass seedlings (right) less so.

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Strategy 1 – Get to Know the Weeds

- Life cycle, season
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Broadleaf seedlings (left) are susceptible to flame; grass seedlings (right) less so.

Common purslane succumbs to shade from tall crops.

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Strategy 1 – Get to Know the Weeds

- Life cycle, season
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- **Weak points**

Broadleaf seedlings (left) are susceptible to flame; grass seedlings (right) less so.

Common purslane succumbs to shade from tall crops.

When perennial weeds regrow after tillage, hit them at the 3 – 4 leaf stage to deplete underground reserves.

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Strategy 2 – Pre-empt the Weeds

Cover crops do the weeds' work.

Intercrop occupies the whole space.

Strip tillage leaves alleys in rye cover, maintained by mowing.

Relay interplanted clover is ready to cover the soil after vegetable harvest.

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Cover Cropping for Effective Weed Control

- Aim for **rapid early growth** and **canopy closure**.
- Include at least one such cover crop in mixes.
- Combine complementary growth habits.
- Use best seeding rate, method, and planting date for your region.
- Provide fertility or water as needed.

Buckwheat, 14 DAP

Rye, vetch, and peas

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Strategy 3 – Keep the Weeds Guessing

- Rotate and diversify crops:
  - Cool and warm season
  - Deep- and shallow-rooted
  - Different growth habits
  - Heavy and light feeders
  - Perennial and annual
- Vary timing of tillage, planting, and harvest.
- Vary method and depth of tillage.
- Vary weed control tactics.

Perennial “sod break” in intensive annual crop rotation reduces weed seed banks and restores soil health.

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Crop Rotation

"Crop rotation is at the core of organic weed management. Establishing crops with different phenologies and morphologies creates unstable environments that discourage weed establishment. It is critical to vary crop growth periods (e.g., winter vs. spring crops; early vs. late spring planting) to keep weed communities off balance."

(Menalled, F., C. Jones, D. Buschena, and P. Miller. 2012. *From Conventional to Organic Cropping: What to Expect During the Transition Years.* Montana State U Extension, MontGuide)

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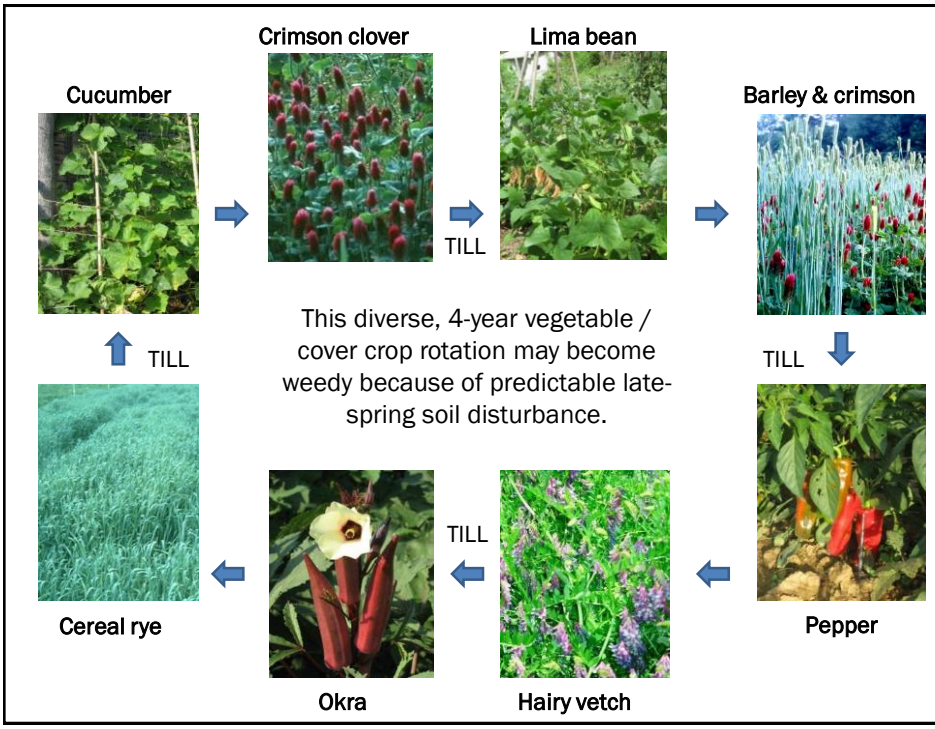
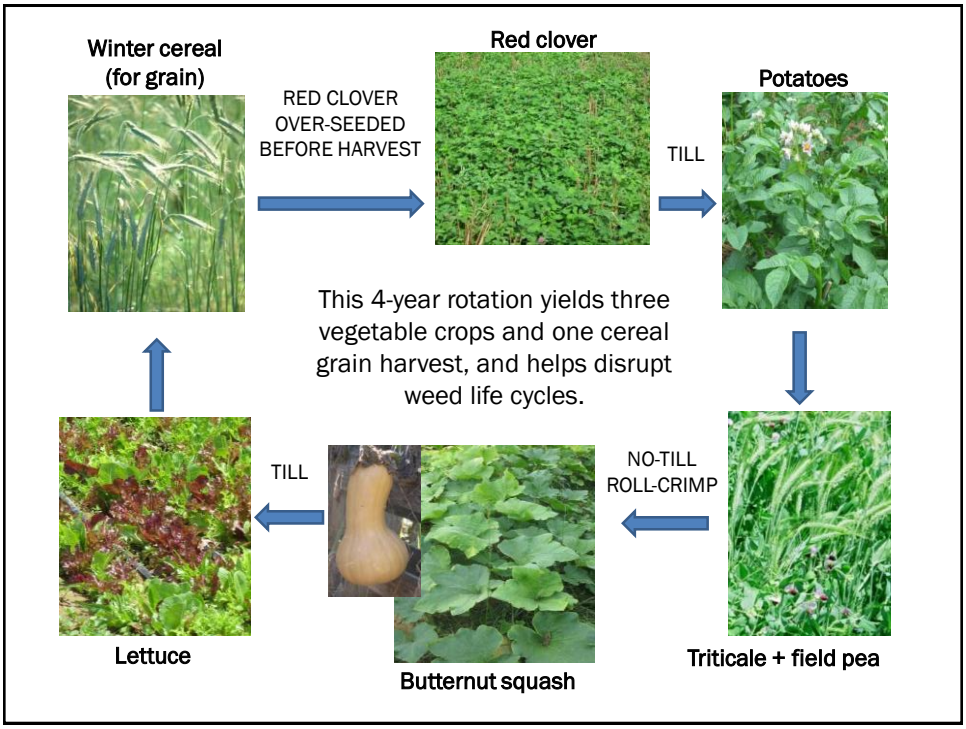
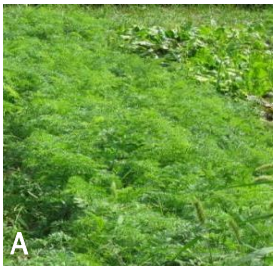




Strategy 4 – Grow Competitive Crops



Give crops an edge over the weeds:

- Maintain healthy, fertile soil.
- Choose vigorous cultivars that rapidly cover the ground (A, B).
- Use season extension to optimize environment for the crop (C).
- Transplant vegetable “starts” (D).

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Healthy Soil Favors Crops over Weeds

- Poor soil structure or slow drainage can favor certain weeds.
- Good soil structure can reduce many of these weeds.
- Healthy, biologically active soil grows vigorous, competitive crops.

Yellow nutsedge came up in wet, compacted field edge.

Pigweed emerged in footprints where soil was compacted.

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Strategy 5 – Feed the Crop, not the Weeds

In-row drip irrigation and fertigation (A, B) delivers moisture and nutrients to crops, leaving between-row weeds dry and unfed. Composting organic materials at 140°F kills weed seed. Use nutrient-rich compost in moderation, band near crop row to avoid feeding weeds.

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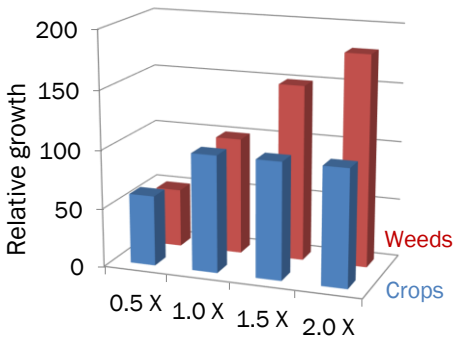
Managing Nutrients to Favor Crops

- Avoid over-application of N, P, and K, including organic forms.
- Encourage mycorrhizal fungi.
- For strong N fixers, maintain low soluble soil N levels with higher C:N cover crops or amendments.



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Strategy 6 – Cultivate Effectively

- Cultivate shallowly (<1 in) when weeds are small.
- Select tools to remove between- and within-row weeds, considering:
  - Crop stage of growth
  - Weed species and size
  - Soil conditions
- Use high residue cultivators in minimum till systems.

Finger weeders, UCCE Sonoma County, CA

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Strategy 7 – Use Alternatives to Cultivation when Practical

See video demos at:
http://articles.extension.org/pages/61887/weed-management-topics

- Mowing between crop rows
- Flame weeding
- Directed hot water or steam
- Mulch
- Solarization (clear plastic)
- Occultation (opaque tarp)
- NOP allowed herbicides
- Livestock grazing after harvest

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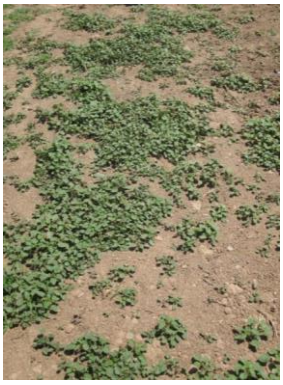
Challenge#1: the Weed Seed Bank

Early season cultivation …



can fail to give season-long weed control …

if last year's weeds were allowed to make a big "bank deposit!"

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Challenge #2: Creeping Perennials



Yellow nutsedge forms underground rhizomes long before it reaches full height and flowering (left). Early in the season, rhizomes give rise to daughter plants (center); later, rhizome tips form tubers (right) that regenerate the weed the next year.

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Strategy 8 – Bait the Weeds with Stale Seedbed



Prepare seedbed as if to plant (left). Let weeds emerge (center), then till shallowly or flame. A similar strategy can be used to reduce weed populations before seeding a cover crop. The rototiller (right) has been set to work one inch deep, to remove sprouting weeds and incorporate cover crop seed in one pass.

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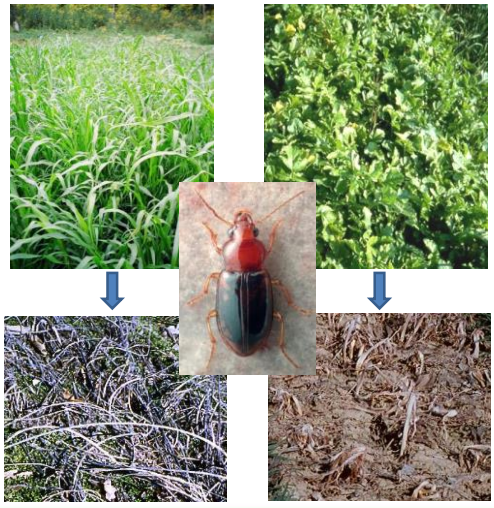
Strategy 9 – Let the Cleanup Crew do its Job



- Leaving frost-killed cover crop residues on on the surface over winter maintains habitat for ground beetles and other weed seed consumers.
- Delaying tillage improves soil health and can increase yield of the next crop.

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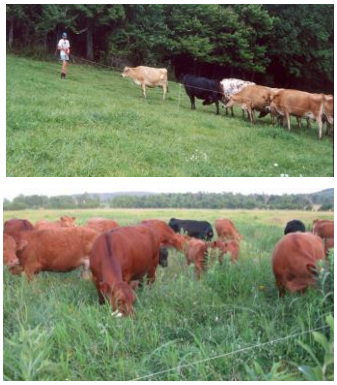
Strategy 10 – Turn Weeds into Organic Meat, Dairy, and Eggs

Graze livestock and poultry on:

- Crop residues and late season weeds after harvest.
- Cover crops.
- Perennial sod phase of a crop rotation.



Rotationally grazed dairy (top) and beef cattle (bottom)

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Strategy 10 – Turn Weeds into Organic Meat, Dairy, and Eggs

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- Perennial sod phase of a crop rotation.

Management intensive rotational grazing:

- Reduces pasture weeds.
- Improves soil health and forage quality.

Rotationally grazed dairy (top) and beef cattle (bottom)

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Soil Health and Weed Management in the West

Challenges, Opportunities, and Strategies

Weed Management Challenges in Organic Grain Rotations in the Northern Great Plains

- Weeds consume precious soil moisture.
- Invasive perennial weeds are especially hard to control.
- Moisture use by cover crops can hurt grain yields.
- Thin, low-organic soils are easily degraded by cultivation.
- Organic reduced-till is more difficult than in wetter regions

Susan Tallman, NCAT

Lentil, sunflower, and wheat growing on 13" rain/yr at Bob Quinn's organic farm in Big Sandy, MT.

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Organic Weed Management Strategies for Northern Great Plains

- **Crop rotation and competitive crops**
- Nutrient management
- Flame weeding
- Cover crops, mulches
- Manage weed seed bank
- IWM for perennial weeds
- ~~Perennial forages in rotation:~~
  - Severely deplete soil moisture.
  - Can deplete nutrients (if forage is removed).
  - Allow severe weed infestation when sod is broken.

USDA NRCS

Perennial forages build soil, but can consume too much moisture.

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Creep Stop: A 2018 OREI Award

- Integrated organic weed management for creeping perennial weeds in Northern Great Plains and Pacific Northwest, testing combinations of:
  - Grazing
  - Rust fungus (against thistle) and bindweed gall mite
  - Changes in crop rotation
  - Mowing and tillage
- Four-year trials on 10 working farms, three experimental stations, and one student farm in WA, MT, and ND
- Grains, forages, and horticultural crops (two sites)

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Biocontrol and IPM for Field Bindweed in Perennial Horticultural Crops

- Field bindweed moth
  - "Voracious and specific"
  - Developing natural attractants
- Bindweed gall mite
- Farmer-participatory trials of IPM strategies
  - Steam outperformed brush weeder in field trials
- Project website: https://eorganic.info/bindweed

Tyta luctuosa, the field bindweed moth, shows promise as a biocontrol agent.

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Organic IPM for Canada Thistle

Colorado project on rust fungus as biocontrol for Canada thistle:

- Develop inoculation methods.
- Evaluate efficacy and interaction with farm management practices.
- Train producers.
- Disseminate methodology.
- Provide farmers with inoculum.

Canada thistle *Cirsium arvense*, heavily infected with the rust fungus *Puccinia punctiliformis*.

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Tackling Canada Thistle: Hints from Outside the Western Region

Sorghum-sudangrass (left) may help organic farmers fight Canada thistle (right).

- Canada thistle is suppressed by sorghum-sudangrass.
- Mowing thistle when tall but not yet flowering sets it back.
- Cutting sorghum-sudangrass at ~3 – 5' height stimulates top and root growth
- The cover crop gains the upper hand during regrowth.

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Crop-livestock Integration for Organic Management of Perennial Weeds

Grazing poultry on cover crop:

- Prevented weed seed production.
- Doubled cover crop biomass.
- Increased vegetable yields.

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Crop-livestock Integration for Organic Management of Perennial Weeds

Grazing poultry on cover crop:

- Prevented weed seed production.
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Grazing sheep on cover crop in 5-year grain rotation:

- Sharply increased weed levels.
- Shifted weed flora.
- Compacted soil in wet year.
- Reduced wheat and lentil yields.

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Suggested Improvements to the Rotation and Crop-livestock System

- Redesigning the crop rotation:
  - Higher diversity, intercrops
  - More competition against weeds
  - Less compaction during the grazing phase
- Blade plow to terminate covers
- Evaluate benefits and costs of grazing.

Intercrop of kamut (Khorasan wheat) and flax, at Vilicus Farms in Havre, MT. Photo by Doug Crabtree.

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Orchards and Vineyards: Managing Weeds during Tree/Vine Establishment

- Orchard floor soil health is far better under living cover than when kept bare.
- Newly-planted blueberry and bramble crops had best weed control and crop establishment with weed mat.
- Zipper arrangement of weed mat (right) facilitates fertility inputs.
- Living mulch works well for established crops.
- Orchards in UT had best soil health and tree growth with birdsfoot trefoil in alleys.

This farmer innovation suppresses weeds during establishment of fruit crops and allows access for soil amendments.

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- Have an organic farming question? Use the eXtension Ask an Expert service at https://ask.extension.org/groups/1668
- Please send your feedback! We will email you a survey about this webinar later today.
- Thank you for coming!

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