

A tractor is plowing a field, with a large tree in the background. The image is used as a background for the presentation.

COVER CROPS IN VEGETABLES AND STRAWBERRIES

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My research



Overview: Cover crops

- Why cover crops?
- Choosing a cover crop
- Cover crop management
- Ongoing research



Why cover crops?

- Potentially provide a variety of beneficial services to cropping systems:
 - ▣ Nitrogen fixation
 - ▣ Plant biomass to soil and improved soil quality
 - ▣ Prevention of nutrient and soil loss
 - ▣ Weed suppression
 - ▣ Rotational effects
 - ▣ Habitat for beneficial organisms
 - ▣ Protection of water quality
 - ▣ Provision of mulch material
 - ▣ And more...

What are potential drawbacks?

- ❑ Slowed soil warming in spring
- ❑ Direct, indirect, & opportunity costs
- ❑ Immobilization of nitrogen
- ❑ Potential to increase pest issues

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Choosing a cover crop

- **Step 1**: Identify what function is needed from the cover crop
 - ▣ What is limiting production in a given system? (e.g. low fertility? poor soil structure? erosion? weed or pathogen populations?)
 - ▣ What functions can cover crops serve for vegetable and small fruit systems?

Choosing a cover crop

- **Step 2**: Identify the cover crop planting niche
 - ▣ Where does the cover crop fit in the crop rotation?
 - Short or long warm-season niches
 - Short or long cool-season niches
 - With cash crop
 - ▣ Define timing of critical cash crop operations, so that cover crop management does not conflict

Choosing a cover crop

- **Step 3**: Select cover crop that meets goals and requirements of steps 1 & 2
 - ▣ Consider benefits and drawbacks (perfect fit is unlikely)
 - ▣ Consider cost and availability of seed
 - ▣ Consider management costs (field operations needed to plant, kill, etc.) for specific species or mixture

Cover crop costs

- Direct costs
 - ▣ Seed
 - ▣ Establishment (tillage, drilling)
 - ▣ Termination (mowing, tillage, rolling, spraying)
- Indirect costs
 - ▣ Interference with following cash crop
 - Soil temperature, nitrogen release, pests, etc.
 - ▣ Management issues
 - Difficult termination, weediness, disease pressure
- Opportunity costs
 - ▣ Cost of forfeit income if a cash crop alternative was feasible

Cover crops for vegetables/strawberries

- Cool-season annuals
 - ▣ Legumes
 - ▣ Non-legumes
 - Grasses
 - Broadleaves
- Warm-season annuals
 - ▣ Legumes
 - ▣ Non-legumes
 - Grasses
 - Broadleaves



Cool-season annual legumes

- Crimson clover (*Trifolium incarnatum*)
 - ▣ Total N contribution 70 to 150 lbs/acre
 - ▣ Planted in mid-fall in TN, rapid spring growth
 - ▣ Grows well mixed with small grains (e.g., rye, triticale, wheat)
 - ▣ Good pollen source, ~April flowering
 - ▣ “Disease bridge” with many vegetables?
 - ▣ ‘Dixie’ most common cultivar
- Others include hairy vetch, winter pea



Cool-season non-legumes

- Rye (*Secale cereale*)
 - ▣ Should not be confused with ryegrasses (*Lolium spp.*)
 - ▣ Very cold hardy
 - ▣ Good nutrient scavenger
 - ▣ High early & late season biomass
 - ▣ Allelopathic
 - ▣ 'Wrens Abruzzi', 'Wheeler', 'Elbon' and other forage varieties



Cool-season non-legumes

- Other cereal grains
 - ▣ Wheat (*Triticum spp.*), barley (*Hordeum vulgare*), triticale (× *Triticosecale*)
 - ▣ Common oat (*Avena sativa*) or black oat (*A. strigosa*) can be used for late winter or early fall planting (hardiness varies)
 - ▣ Select forage rather than grain cultivars



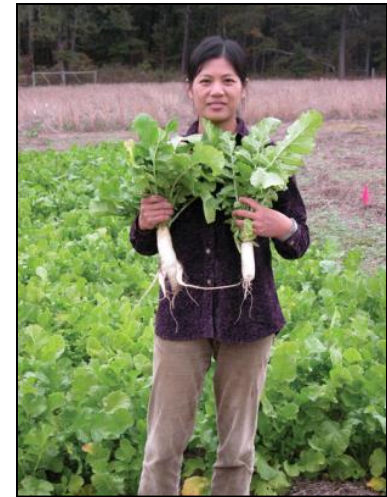
Cool-season non-legumes

- Annual ryegrass (*Lolium multiflorum*)
 - ▣ Good nutrient scavenging
 - ▣ Good biomass production with sufficient N and moisture
 - ▣ Residue does not persist as long as cereal grains
 - ▣ Excellent for row middles with plastic beds
 - ▣ Can become weedy without herbicides, limiting it's use in organic systems



Cool-season non-legumes

- Brassicas
 - ▣ Mustards
 - ▣ Rapeseed & canola
 - ▣ Radish (forage, oilseed, 'tillage' types)
 - ▣ Arugula (cover crop types)
 - ▣ Pest suppression (in non-brassica rotations!)
 - ▣ Good nutrient scavenging ability
 - ▣ Winter hardiness varies; many work well in brief fallow periods



Warm-season legumes

- Sunn hemp (*Crotalaria juncea*)
 - ▣ Rapid biomass and N production (120 lbs N/acre in 9 weeks)
 - ▣ Does best in very warm conditions
 - ▣ Limited by seed cost
 - ▣ Suppressive to root-knot and reniform nematodes
- Others: cowpea, soybean



Warm-season non-legumes

- Sorghum-sudangrass hybrid (*Sorghum bicolor* x *S. bicolor* var. *sudanense*)
 - ▣ Very high biomass production, good for building soil organic matter
 - ▣ High allelopathy and very competitive with weeds
 - ▣ Suppressive against pathogens and nematodes
- Others: millets



Warm-season non-legumes

- Buckwheat (*Fagopyrum esculentum*)
 - ▣ Good for brief fallow (maturity in 30-45 days)
 - ▣ Good smother crop
 - ▣ Attracts pollinators
 - ▣ Can seed easily and become weedy if not well-managed



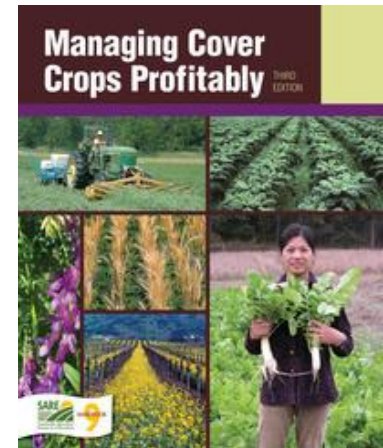
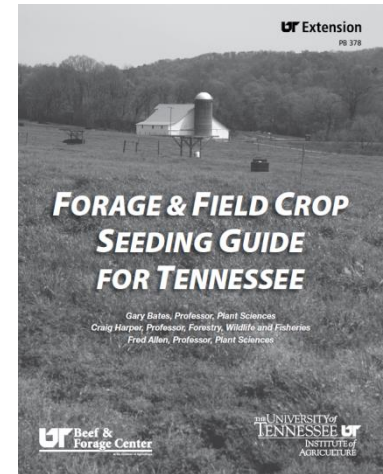
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Cover crop management

- Plant at the appropriate time
- Plant with good seed to soil contact
- For information on planting rates, dates, methods, see:
 - Forage & Field Crop Seeding Guide for Tennessee, UT Extension PB378, www.utextension.tennessee.edu/publications/documents/pb378.pdf
 - Managing Cover Crops Profitably, USDA-SARE, www.sare.org
 - Southern cover crops council, <https://southerncovercrops.org/>





(Photo: D. Butler)



(Photo: D. Butler)



(Photo: Lancaster Farming)

Now what?

□ How will crop be planted?

- ▣ Tillage, plastic
- ▣ Tillage, no plastic
- ▣ Reduced-tillage
- ▣ Strip or zone tillage

□ How will cover crop residue be managed?

- ▣ Removed from field
- ▣ Incorporated with tillage
- ▣ Left at soil surface

Reducing opportunity costs...



(Photo from: uvm.edu)



(Flail mower; photo from D.M. Butler)



(Photo from: morninggloryfarm.com)



(Spader; photo from puyallup.wsu.edu)



(Rotovator; photo from: farmingsweetbay.wordpress.com)

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(Flail mower & stalk chopper; photo from ucanr.edu)



(Roller-crimper; photo from northcentralsare.org)



(Flail mower as roller; photo from D.M. Butler)



(No-till pumpkin; photo from poltersberryfarm.com)

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(strip tillage; Photo from: www.butternutvalleyfarm.com)



(zone tillage; Photo from: uconn.edu)



(zone tillage; Photo from: www.fentonsproduce.com)

Ongoing cover crop research



Objectives

- Evaluate optimized non-fumigant soil treatment (anaerobic soil disinfestation, ASD) under varying rotation/cover crop systems
 - ▣ a) strawberry-cucurbit/wheat cover crop
 - ▣ b) strawberry-summer cover crop (sorghum-sudangrass)
 - ▣ c) continuous strawberry

a. Cucurbits/winter cover crop



Pumpkin
(*C. pepo* cv.
Baby boo)

A photograph showing a row of pumpkin plants in a field. The plants have large, green, lobed leaves and some small orange flowers. They are growing in a field with a dirt path and trees in the background.



Winter wheat
-Fallow

A photograph showing a field of winter wheat. The wheat is tall and green, with some yellowing at the tips. It is growing in a field with a dirt path and trees in the background.



ASD treatment mid-
August to mid-
September

A photograph showing a field with a long, straight, dark, reflective strip of material (likely a plastic mulch or a water treatment strip) running through it. The strip is surrounded by a dirt path and trees in the background.



Strawberry

A photograph showing a row of strawberry plants in a field. The plants have green leaves and small white flowers. They are growing in a field with a dirt path and trees in the background.

b. Summer cover crop

Sorghum-sudan
cover crop



Strawberry



Sorghum-sudan
cover crop



ASD treatment
mid-August to
mid- September



Strawberry



c. Fallow-Continuous strawberry

Fallow



Strawberry



Fallow



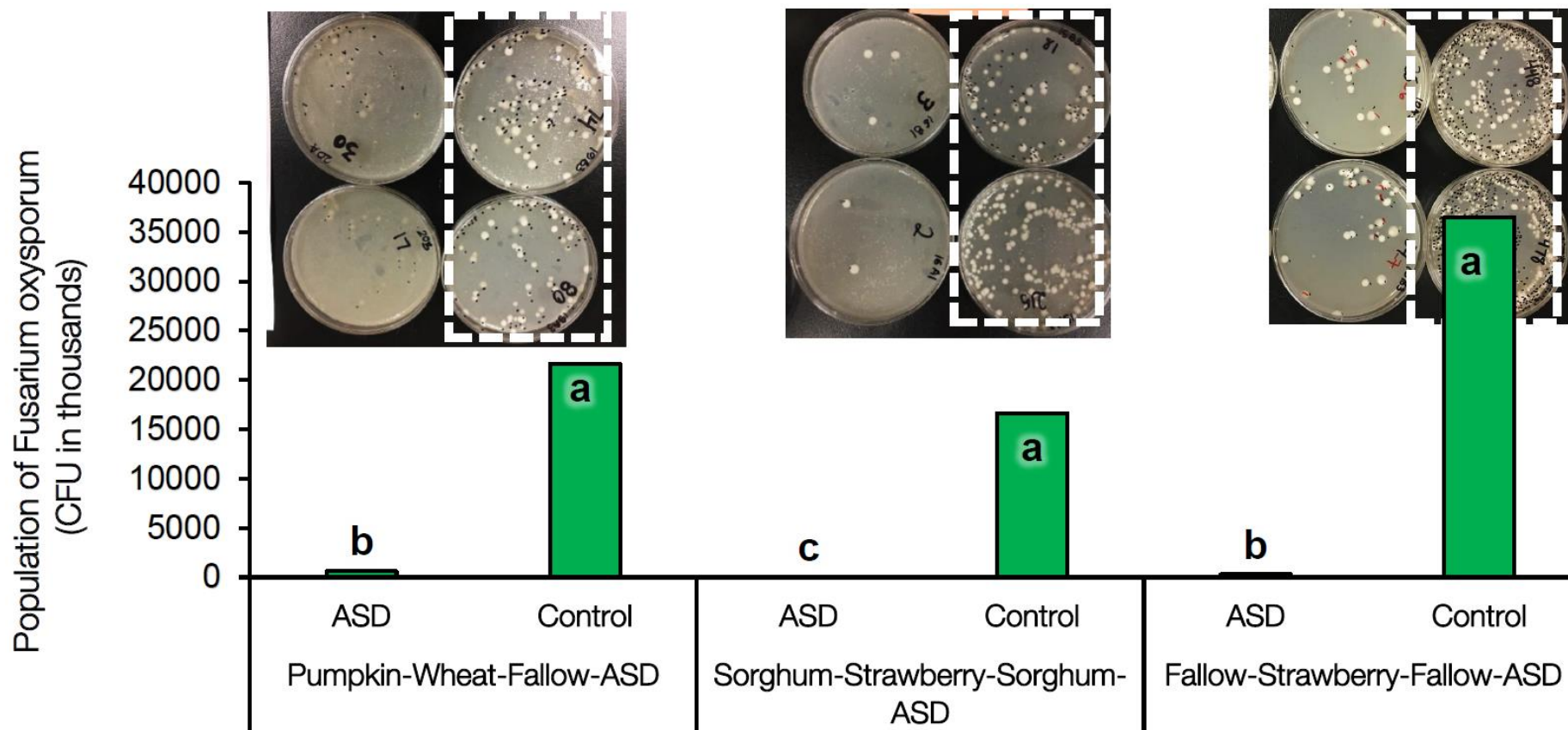
ASD treatment
mid-August to
mid-September



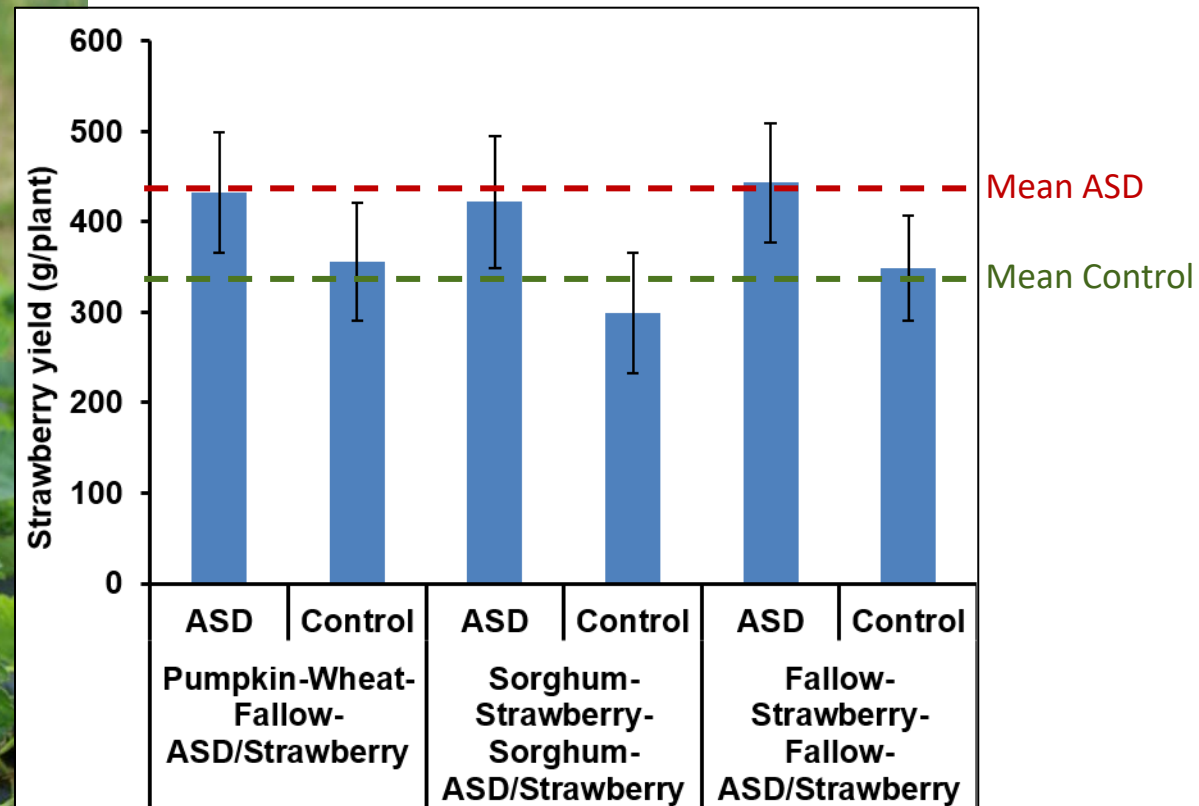
Strawberry



F. oxysporum mortality



ASD effect on strawberry yield



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