The Role of Cover Crops in Organic Transitions

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http://www.extension.org/organic_production







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Outline

- Resources on cover crops (CC) and their use in organic agriculture
- Benefits during transition to certified status
- Risks during transition to certified status
- Recent studies at Ohio State University





Key Book Resources on CC

http://www.sare.org/Learning-Center/Books



Chart 4A POTENTIAL ADVANTAGES

		Soil Impact			1	Soil E	Ecology	Other			
	Species	subsolier	free P&K	loosen topsoil	nematodes	disease	allelopathic	choke weeds	attract beneficials	bears traffic	short windows
	Annual ryegrass p. 74	0	•	•	•	•	•	٠	٠	•	•
	Barley p. 77	•	0	•	٠	•	•	9	•	•	•
N	Oats <i>p. 93</i>	0	٠	•	0	0	•	•	0	0	•
5	Ryc <i>p. 98</i>	O	9	•	•	9	•	٠	٠	•	•
N N	Wheat p. 111	•	9	J	٠	٠	٠	J	٠	0	0
z	Buckwheat p. 90	0	٠	•	٠	0	•	٠	•	0	٠
	Sorghum-sudangrass p. 106	•	0	0	•	•	•	•	•	•	•
A G	Mustards p.81	O	0	•	•	•	•	•	0	0	•
SSIC	Radish p. 81	•	•	•	•	•	•	•	٠	٥	•
	Rapeseed p. 81	•	٠	•	•	•	•	•	0	٠	•
	Berseem clover p. 118	O	•	•	0	0	O	•	•	O	•
	Cowpeas p. 125	•	0	•	0	0	0	•	•	0	•
	Crimson clover p. 130	٠	0	0	٠	0	٠	0	•	٠	0

Chart 4B **POTENTIAL DISADVANTAGES** Note change in symbols O = problem • = not a proble

		Increa	Increase Pest Risks			Manage	ment Ch	allenges		1		
	Species	and all	11	P.M	A.D.	and the second s	the state	and a start	and the	Comments Pro/Con		
	Annual ryegrass	0'	•	9	•	•	•	•	0	If mowing, leave 3-4" to ensure regrowth.		
•	Barley	٠	٠	٠	0	•	•	•	0	Can be harder than rye to incorporate when mature.		
Ĭ	Oats	•	0	•	0	•	•	0	0	Cleaned, bin-run seed will suffice.		
LEGL	Rye	O	0	•	۰	•	•	•	0	Can become a weed if tilled at wrong stage.		
NON	Wheat	0	۰	٠	0	٠	•	•	0	Absorbs N and H20 heavily during stem growth, so kill before then.		
	Buckwheat	0	9	•	•	•	•	•	•	Buckwheat sets seed quickly.		
	Sorghum-sudangrass	0	9	•	٠	٠	9	9	٠	Mature, frost-killed plants become quite woody.		
84	Mustards	O	•	•	0	٠	•	C	•	Great biofumigation potential; winterkills at 25° E		
ASSIC	Radish	0	9	•	•	٠	•	•	•	Winter kills at 25° F; cultivars vary widely.		
8	Rapeseed	O	۰	•	•	٠	0	٥	•	Canola has less biotoxic activity than rape.		
	Berseem clover	•	0	9	•	•	0	O	•	Multiple cuttings needed to achieve maximum N.		
	Cowpeas	•	0	9	•	•	•	•	•	Some cultivars, nematode resistant.		
	Crimson clover	0	0	9	•	•	9	9	•	Good for underseeding, easy to kill by tillage or mowing.		

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Cover Crops Benefits During Transition

- Building and Balancing Soil Fertility
 - Balanced fertility is good for cash crops AND bad for weeds
 - CC legumes provide additional N
 - CC roots may stimulate greater availability of P



SAREP UC Davis

Cover Crops Benefits During Transition

- Building and Balancing Soil Fertility
 - TEST FIRST TO ASSESS NEEDS
 - Spring (pre plant) or Fall (post harvest) testing
 - Macronutrients: P, K, Ca:Mg,
 - Soil organic matter
 - pH
 - Micronutrients
 - Invest in an expert testing service
 - Local Land Grant College of Agriculture
 Local testing service recommended by County Extension

http://ohioline.osu.edu/hyg-fact/1000/pdf/1133.pdf



Cover Crops Benefits During Transition

- · Weed suppression
 - CC compete with weeds for soil water, nutrients and light
 - Killed CC mulches can suppress weeds through allelopathy
 - Rolling can be used with good stands of rye or rye+vetch to suppress annual weeds



Photo credit: John Cardina Ohio State University

Cover Crops Benefits During Transition

- · Pest and pathogen suppression
 - CC "rotation" effect reduces pest and pathogen levels in absence of natural hosts
 - Mulch effect (if crimped and rolled) prevents splash dispersal of soilborne pathogens
 - Biofumigation is a short-lived toxic effect especially of *Brassica* spp.
 - Microbial suppression occurs as a consequence of CC decomposition



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Cover Crops Risks

- Advanced planning required
 - Timing of CC planting relative to cash crop harvest
 - Be sure rotation fits into your growing season
 - Avoid late harvest/CC planting which can give low stand establishment
 - Avoid early harvest/CC planting which can limit cash crop yields



Cover Crops Risks

- Advanced planning
 - Timing of CC kill relative to cash crop planting/transplanting
 - Accumulate sufficient CC biomass needed to attain desired benefits (e.g. 4 tons/A rye if rolled)
 - Destroy "green bridge" for pathogens (e.g. use 4 to 6 week rule between plow down and planting)
 - Avoid CC going to seed in most cases (e.g. buckwheat and rye)



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Organic Transition Study

- Goal: Assess costs and benefits of different cropping strategies to manage transition to organic vegetable production
- Four main treatments: Tilled fallow (TF), Field vegetables (FV), Mixed hay cover cropping (H), High tunnel vegetables (HT)
- Focus today: Plant/soil health impacts of treatments
- Cooperators: M. Batte, P. Grewal, M. Kleinhenz, S. Miller, D. Stinner



Transition Strategies Differed in Soil "Building" Effects

- Main treatments did not vary significantly in soil chemistry after 3 years
 - HT exception (drip irrigated, less decomposition) with elevated pH and more extractable Ca & Mg and more residual SOM from compost additions
- But, compost addition to all main treatments led to dramatic changes in soil chemistry
 - Increased soil carbon (1 to 3 %)
 - Increased soil fertility (2x to 3x P, and 5x K!)

Soil Health Assessments

- Collect soils from all plots
- Assessed plant growth under controlled conditions and, subsequently, in the field on two test crops (soybean, tomato)
- Determined relative effects on soilborne disease potential on two test crops (soybean and tomato)





Identifying Suppressive Microorganisms





FV+C

FV

TF+C

TF

H H+C





M139-like isolates were found to be novel Mitsuaria sp.

Broad Spectrum Activities observed in planta



The *Mitsuaria* isolates reduced disease severity caused by *different* pathogens

Mixed vs. Single Cover Crops for Soilborne Disease Suppression

• Goal 1: Assess grower knowledge and fill gaps with essential information on cover crops, inoculants, and tomato disease suppression

• Goal2 :Evaluate and enhance the effects of mixed species green manures on productivity and plant disease suppression in tomato

Cooperators: S. Miller, M. Kleinhenz, C. Smart, K. Everts, S. Meyer, G. Norton



Summary: Organic Transition Study

- Mixed species cover cropping
 - Minimally affects soil fertility (unless legume is dominant)
 - Enhances suppressiveness of soil microbial communities (relative to cropping or tilled fallowing, and even compost additions)
- New microorganisms yet to be discovered and "farmed" as inoculants
 - Mitsuaria sp. are just one of many contributors yet to be discovered and tested

Defining Knowledge Gaps: Expert and Grower Model Development



2011 Grower Survey

- Survey designed to assess knowledge base and identify gaps in grower knowledge
 - Topical focus: Cover crops, disease management, inoculant/biopesticide use
 - ~100 respondents: 71% vegetable farms, with ~45% listing tomato as top crop in acreage and/or value, and 57% list tomato as crop with biggest disease problems
 - Diseases noted as significant factor in limiting production potential

Survey Results: Cover Crops

- Majority of growers (68%) use cover crops
 - Mixed species cover crops most commonly used
 - Perceived benefits varied by grower & CC choice
 - Significant limitations to effective use noted by growers
 - Seed and equipment cost, yield loss due to delayed planting and shortened growing season were most significant (>40% strongly agreed)
 - Fuel costs, limited growing options, and germination/establishment were also important (>25% strongly agreed)

Survey Results: Microbial Inoculants

- Nearly half of organic growers use microorganisms and/or biopesticides
 - 43% used inoculants and 49% used biopesticides
 Inoculants for legume crops, but rarely cover crops
 - Biopesticides used mainly for foliar diseases and pests
 - 51% thought cost justified use, but 74% waited until after symptom appearance to make application

Field Studies of Cover Crops and Disease Suppression

- Main treatments
 - Single vs. mixed cover crops followed by fresh market tomato cash crop
 - Rye, vetch, clover, tillage radish alone and in combination
 - 12 site years of data; 2 years x 6 fields (3 OH, 2 NY,



Field Studies : Cover Crop Establishment



a. Mixed species hay established in fall and spring



b. Tillage radish in late fall and the following spring

Field Studies of Cover Crops and Disease Suppression

- Results to date
 - Considerable year to year variation in field performance of CC at each location
 - Response of crop to CC additions dependent on timing of incorporation and soil type
 - Microbial responses have site-specific tendencies
 - Differences in root health and disease suppression tend to be of small magnitude and limited predictability
 - CC trend better than no CC
 - Mixed species CC trend better

Field Studies of Cover Crops and Disease Suppression

- Next steps
 - Quantify overall costs and benefits of mixed vs. single CC
 - Determine if CC can act as a vehicle for delivering microbial inoculants, temporarily boosting their populations and beneficial activities



Summary: CC for Disease Suppression

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Role of CC in Org. Transitions Summary

- Cover crops can be a useful tool for enhancing transitions to certified organic production
 - Farmers should way benefits and risks of CC to use them successfully
 - CC management requires planning and flexibility of timing operations
- New research is providing a better understanding of how to manage CC for maximum benefit
 - Mixed cover crops can provide multiple benefits, including better soil health, if used over the transition period
 - When comparing CC, differences in disease suppressive effects tend to be small when "reasonable" options are considered, but with good timing CC out performs no CC in most instances

Find the slides and recording of this presentation at http://www.extension.org/pages/62450

Register for upcoming webinars and view recorded eOrganic webinars at http://www.extension.org/pages/25242

Additional questions? Ask them at <u>http://www.extension.org/ask</u>

We need your feedback! Please fill out our follow-up email survey!





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