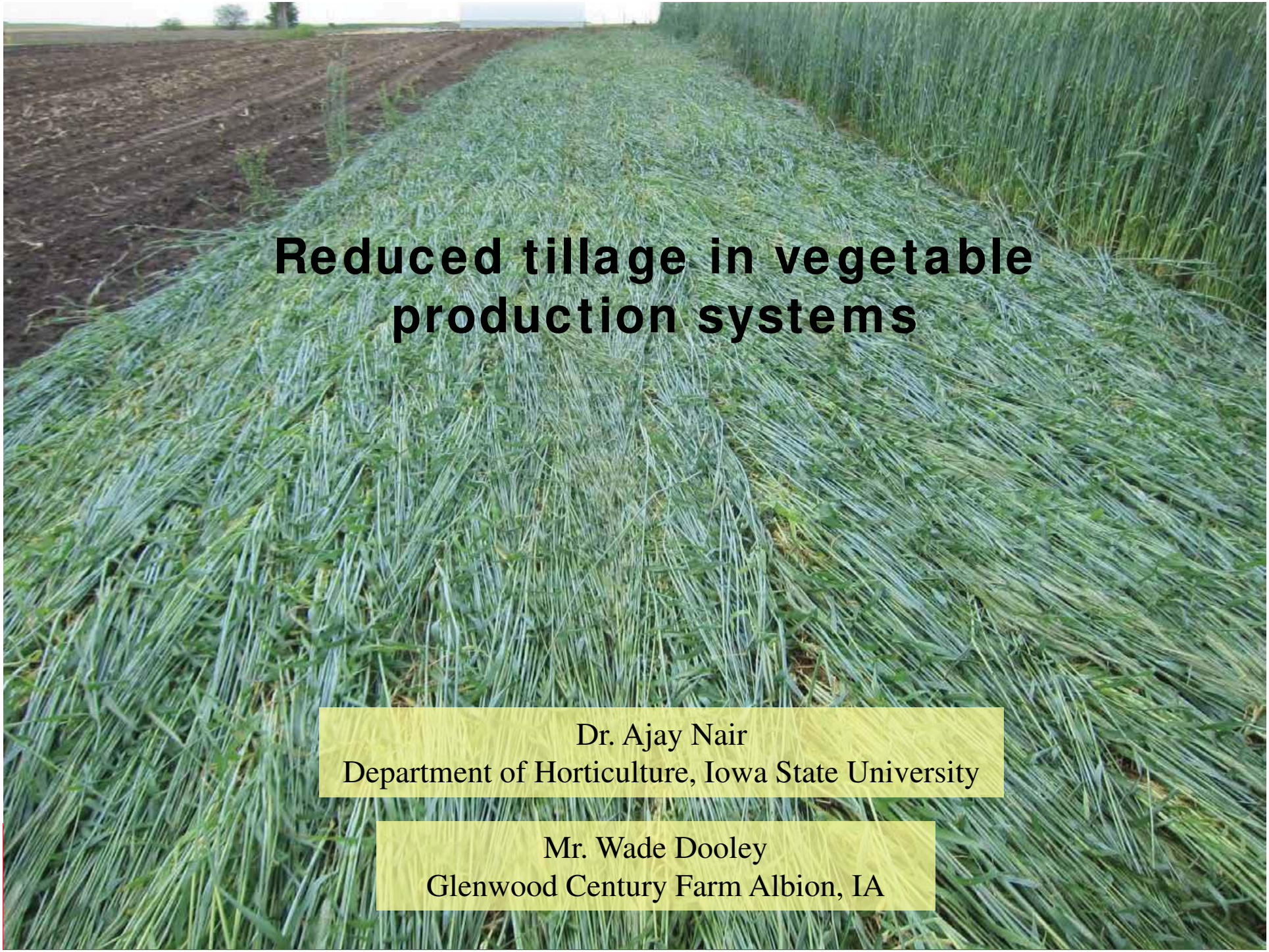
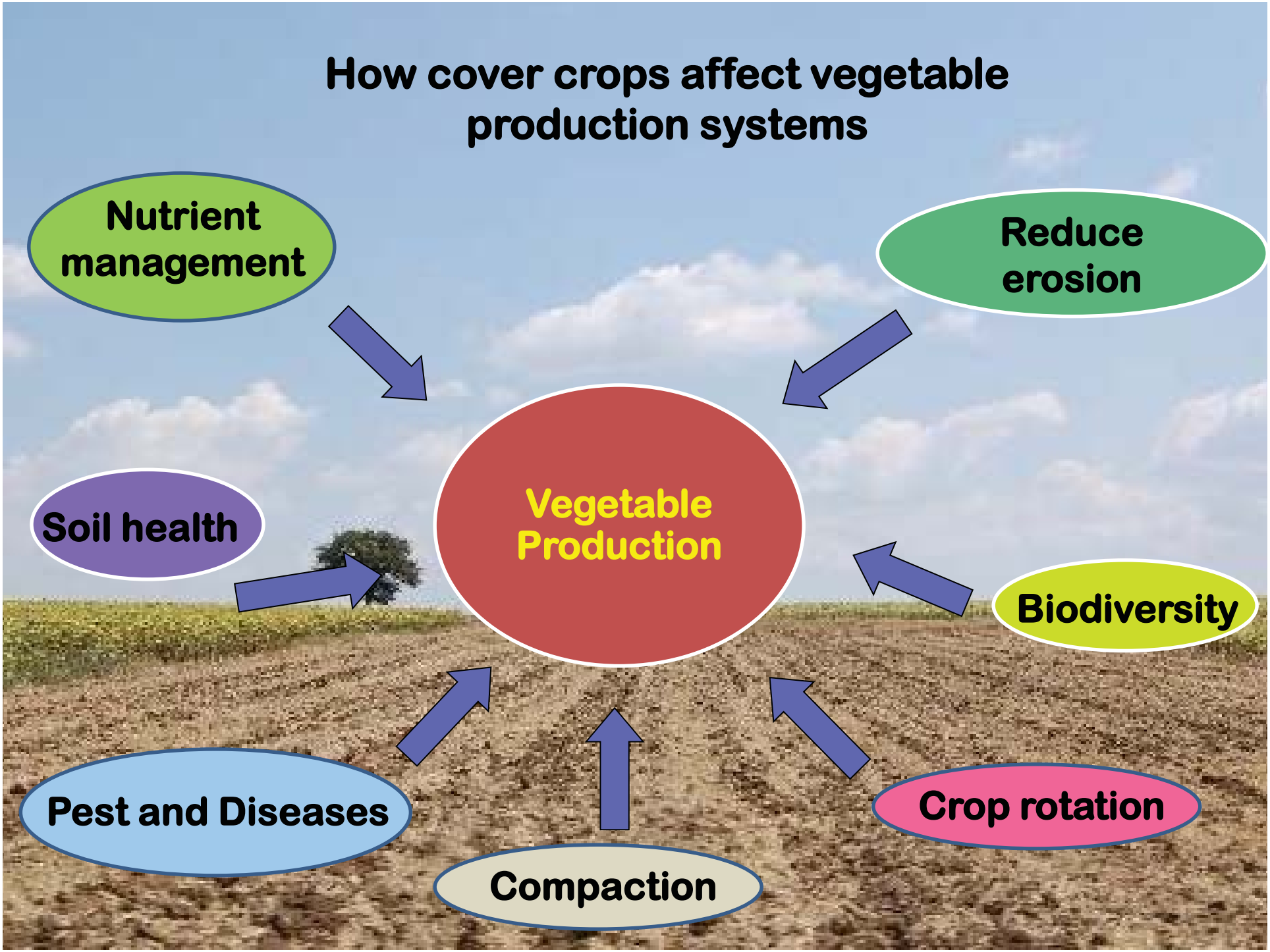


Reduced tillage in vegetable production systems

Dr. Ajay Nair
Department of Horticulture, Iowa State University

Mr. Wade Dooley
Glenwood Century Farm Albion, IA


MARCH MADNESS
WINTER
WINTER
WINTER
WINTER
WINTER
WINTER
WINTER
WINTER
WINTER
WINTER
WINTER
WINTER
WINTER
WINTER
AW, C'MON!!
KOTERBA
OMAHA WORLD-HERALD


How cover crops affect vegetable production systems
Nutrient management
Reduce erosion
Soil health
Vegetable Production
Biodiversity
Pest and Diseases
Compaction
Crop rotation

Effects of Cover Crops and Strip-tillage on Muskmelon Production and Food Safety

IOWA STATE UNIVERSITY

MICHIGAN STATE UNIVERSITY

NORTH CENTRAL SARE
Sustainable Agriculture Research & Education

Funded by a grant from USDA NC-SARE

Background

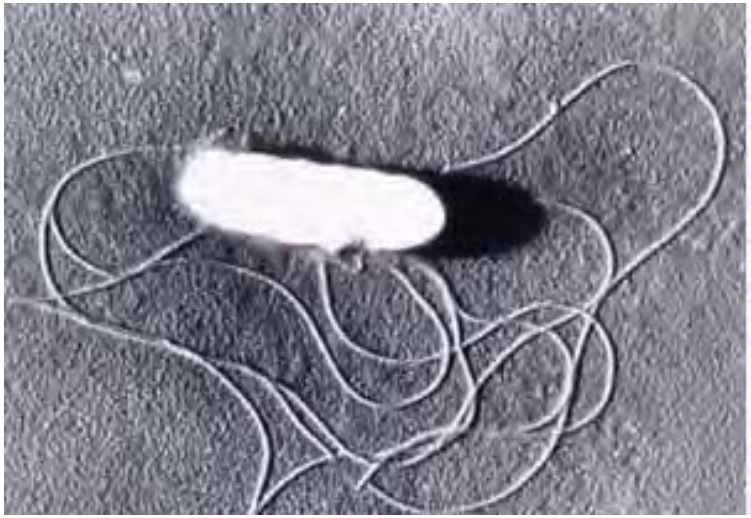
Food Safety Risks of Muskmelon

- **Textured Surface is difficult to wash and sanitize**
- **Edible portion is ideal for microbial growth**
- **Fruits are in contact with the soil**
- **Eaten raw**
- **Rarely washed by consumers**

Background

Listeria monocytogenes

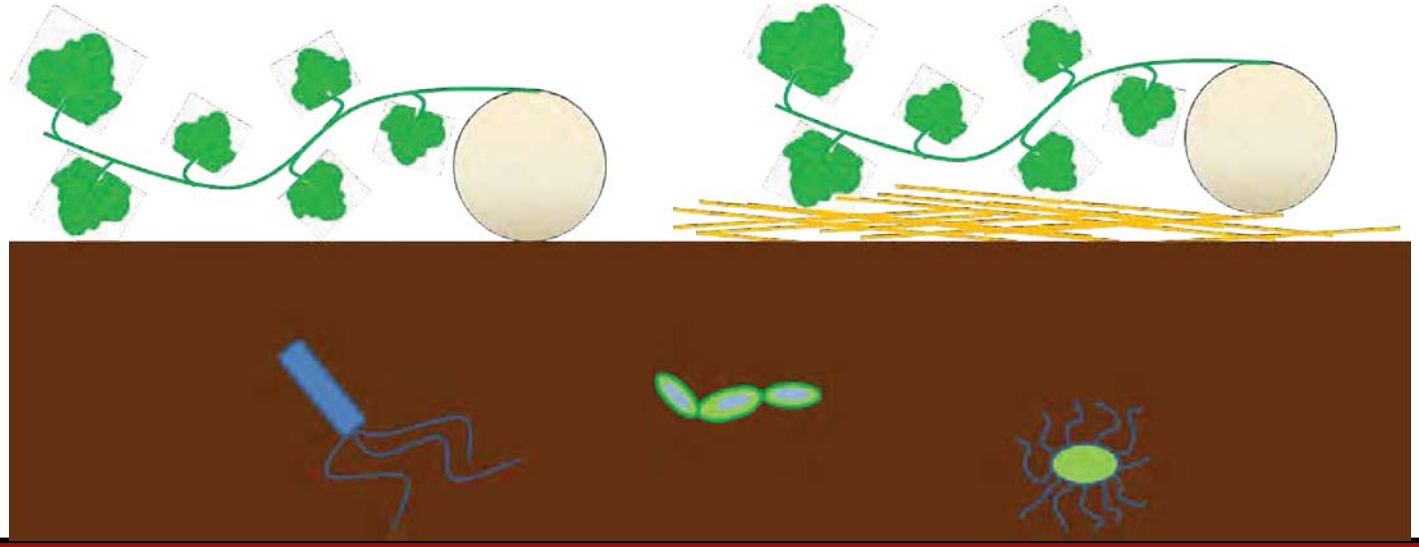
- **Facultative anaerobe, can grow -0.4-50 °C**
- **Pathogen and saprophyte**
- **Thrives in cool, damp environments**
- **20-30% mortality rate upon infection**
- **Very similar to non-pathogenic *Listeria innocua***



SEM image of *L. monocytogenes* with flagella
https://web.mst.edu/~microbio/BIO221_2010/L_monocytogenes.html

Hypotheses

- **Cover crop based strip-tillage systems can produce comparable yields as plasticulture-based systems**
- **Plant growth and marketable yield will be similar among Strip-tillage and cover crops will increase microbial measures of soil health**
- **Cover crop based strip-tillage will prevent contamination of fruit**



Methods

Experimental Design

- **Trials conducted at ISU Horticulture Research Station in 2014-15 and 2015-16**
- **Split-split-plot design, 4 replications**
  - **Whole plot factor: cover crop**
  - **1° split-plot factor: tillage**

Terminate cereal rye at anthesis

Methods

Conventional-tillage: Mow Cover Crop

Methods

Conventional Tillage

Roller crimper

Rhodale Institute


Hiniker 6000
Strip-tiller
WESTENDORF

Methods

Strip-Tillage

Results

Plant Growth

Table 8. Measurements of plant health and vigor (vine length, SPAD and petiole sap) as affected by cover crops and tillage in 2015 and 2016 in Ames, IA.

Treatment	2015[z]		2016[y]			
					Petiole Sap	
	Vine Length (cm)	SPAD[x]	Vine Length (cm)	SPAD[x]	NO_3^--N ($mg \cdot kg^{-1}$)	K^+ ($mg \cdot kg^{-1}$)
Cover Crop						
None	262.8	51.8	356.6	46.6	771.5 A[w]	2111.2 B
Rye	265.6	44.3	327.7	45.5	339.2 B	3572.2 A
Rye + Vetch	243.1	51.0	316.9	47.9	318.0 B	3755.7 A
Tillage[x]						
CT	282.4 a	46.3 b	356.9 a	48.2 a	566.3 a	2711.1 b
ST	231.9 b	51.8 a	301.6 b	45.1 b	386.1 b	3581.6 a
Significance						
Cover Crop	ns	ns	ns	ns	0.0008	0.0005
Tillage	0.0015	0.0231	0.0005	0.0412	0.0003	0.0001
*Cover*Tillage*	ns	ns	ns	ns	0.0023	ns

[z] In 2015 SPAD and vine length were measured on 25 Aug.

[y] In 2016 SPAD and vine length were measured on 19 Aug.. Petiole Sap measurements were taken on 17 Aug.

[x] Data were log-transformed for analysis and converted to original values for presentation.

[w] Within each year mean separation of cover crop(uppercase letters) and tillage (lowercase letters) in columns is based on least significant difference at P≤0.05.

Results

Plant Growth: Petiole Sap

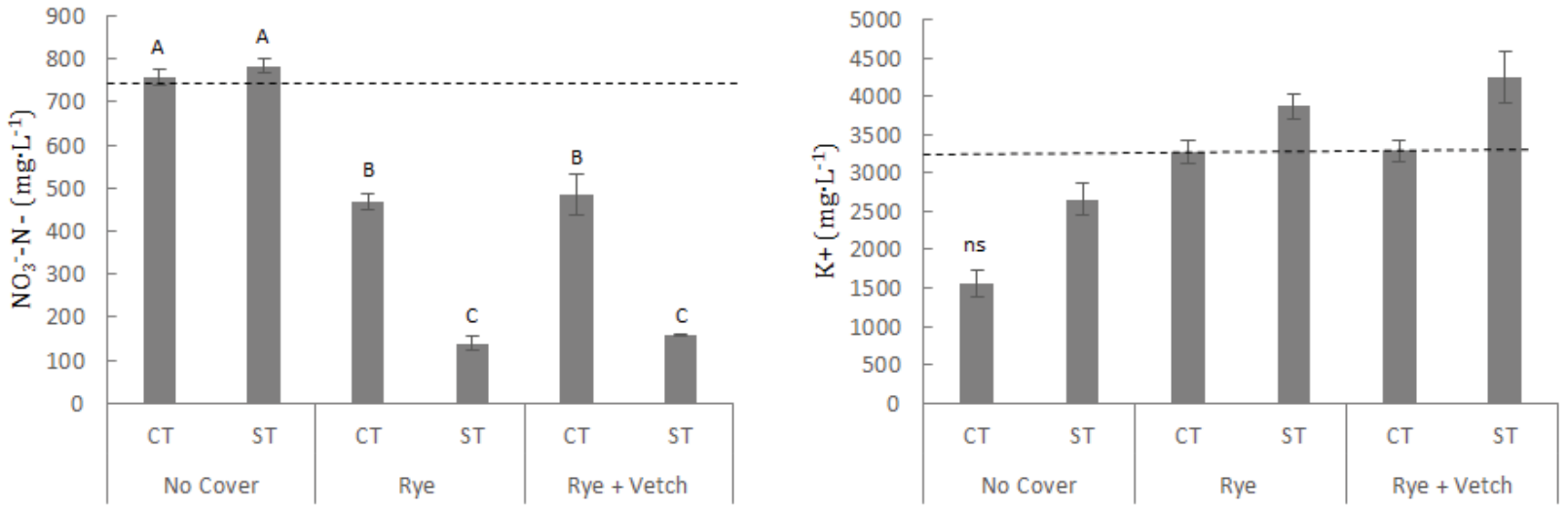


Fig. 3. Interaction effects of nitrate-nitrogen (left) and potassium ion (right) concentrations in muskmelon petiole sap of as affected by cover crops and tillage (CT=conventional tillage, ST=strip tillage) sampled on 18 Aug. 2016 in Ames, IA. Mean separation of N-NO_3 (uppercase letters) and K+ (lowercase letters) based on least significant difference at $p \leq 0.05$. Error bars represent standard error of the mean. Horizontal dashed line represents the median of the sufficiency ranges for N-NO_3^- (700-800 mg·L^{-1}) and K^+ (3000-3500 mg·L^{-1}) as recommended by Hochmuth et al. (1991).

Results

Muskmelon Yield

Yield (weight and number of fruit) of muskmelon fruit as affected by cover crop and tillage treatments in Ames, Iowa in 2014-15 and 2015-16.

Treatment	2015				2016			
	Marketable wt. (Mg·ha^{-1})	Total wt. (Mg·ha^{-1})	Marketable no. (no.·ha^{-1})	Total no. (no.·ha^{-1})	Marketable wt. (Mg·ha^{-1})	Total wt. (Mg·ha^{-1})	Marketable no. (no.·ha^{-1})	Total no. (no.·ha^{-1})
Cover Crop								
No Cover	17.4	44.4	2545	6770	40.2	58.3 A[z]	4831 AB	7146 A
Rye	23.7	46.2	3287	6871	34.5	44.3 B	4161 B	5408 B
Rye + Vetch	17.4	43.3	3093	6734	43.3	51.5 AB	5461 A	6598 A
Tillage[y]								
CT	23.8 a	48.6 a	3074	6755	42.5 a	59.3 a	5237 a	7484 a
ST	12.8 b	40.7 b	2876	6835	36.1 b	43.4 b	4398 b	5278 b
Significance								
Cover Crop	ns	ns	ns	ns	ns	0.0062	0.0080	0.0016
Tillage	0.0250	0.0051	ns	ns	0.0341	<0.0001	0.0125	<0.0001
*Cover*Tillage*	ns	ns	ns	ns	ns	ns	ns	ns

[z] Within each year mean separation of cover crop (uppercase letters) and tillage (lowercase letters) in columns is based on least significant difference at P≤0.05.

[y] CT=conventional tillage, ST= strip tillage.

Results

Soil Health: CLPP, Bacterial Diversity

http://www.biolog.com/pdf/mnit/00A_012_EcoPlate_Sell_Sheet.pdf

Results

Summer Survival of Soilborne *L. innocua*

Table 6. Frequency of detecting of *Listeria innocua* in soil samples as affected by cover crops irrespective of tillage treatments in Ames, IA in 2015.

Treatment	May[z]	June	July	August
	Positive	Positive	Positive	Positive
Cover Crop				
None	100%	100%	86%	75%
Rye-Vetch	100%	25%	0%	0%
Rye	100%	37%	0%	0%
Significance				
p value [y]	1.0000	0.0055	<0.0001	0.0003
Chi-squared	0.000	10.406	19.765	16.000

[z] Soil was inoculated with *L. innocua* on 14 May 2015 samples were taken on 17 May, 15 June , 15 July, and 18 August 2015.

[y] Chi-squared test of independence.

Results

Presence of *L. innocua* on Fruit

Table 3. Frequency of detecting *Listera innocua* on the exterior of muskmelon fruits in Ames, IA in 2015 and 2016. Treatment factors were cover crop, tillage, and the month soil was inoculated with *L. innocua*.

Treatment	2015 Positive	2016 Positive
Cover Crop		
None	18.8%[z]	25.0%
Rye+Vetch	12.5%	0%
Rye	12.5%	6.3%
Tillage		
CT[y]	10.4%	16.7%
ST	4.2%	4.2%
Inoculation Month		
October	8.3%	8.3%
May	6.3%	12.5%
Significance		
Cover		
p value	0.8460	0.0549
Chi-squared	0.3345	5.8047
Tillage		
p value	0.2199	0.1563
Chi-squared	1.5052	2.0093
Inoculation Month		
p value	0.6826	0.6366
Chi-squared	0.1672	0.2233

[z] Percentages represent the proportion of samples that were positive for *L. innocua*.
[y] CT= conventional-tillage, ST= strip-tillage

Conclusion

- **Cover crops and strip-tillage suppressed weeds**
- **Strip-tillage can reduce NO_3^--N leaching, though not consistently**
- **Conventional-tillage increases vine length**
- **Conventional -tillage increased marketable yield**
- **Conventional-tillage may increase MBC, only in presence of cover crop**
- **Cover crops have a positive impact on soil bacterial diversity**
- **Soilborne *L. innocua* can overwinter in Iowa**
- **Cover crops decreased populations of soilborne *L. innocua***
- **Cover crops and tillage had no effect of fruit contamination**

Many Thanks

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John Krzton-Presson

IFVGA
Iowa Fruit & Vegetable Growers Assn.

Practical Farmers of Iowa

IOWA DEPARTMENT OF AGRICULTURE AND LAND STEWARDSHIP

THE CERES TRUST

NORTH CENTRAL SARE
Sustainable Agriculture Research & Education

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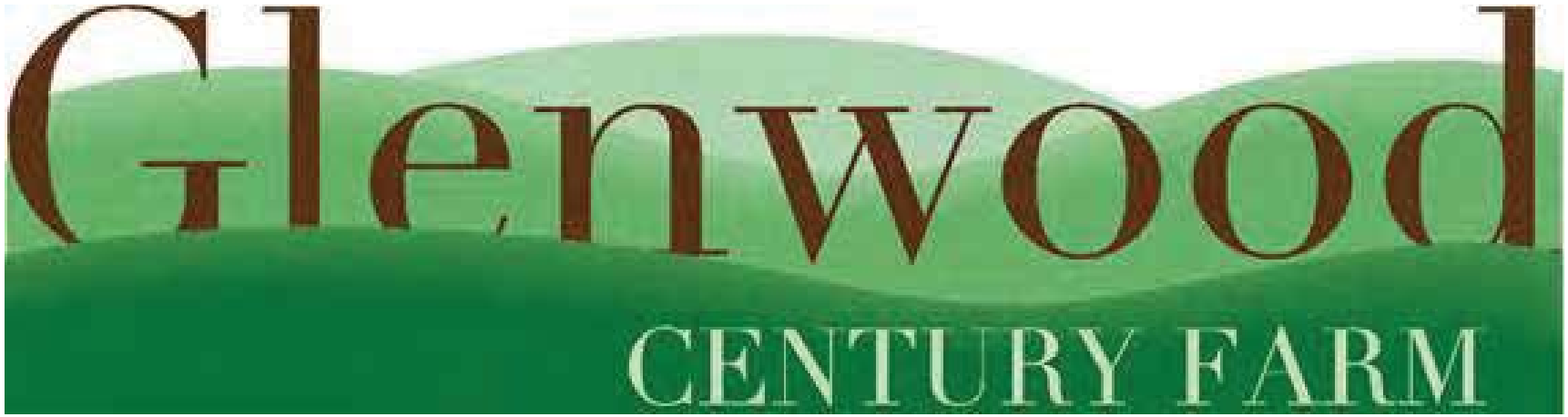
Extension and Outreach


On-farm trial
Wade Dooley, Glenwood Century Farm, Albion, IA

IOWA STATE UNIVERSITY
Extension and Outreach

Cover Crops and Conservation Tillage in Winter Squash Production



Wade Dooley

6th Generation

Albion, IA

Home Farm

Cattle

Row-crops

Produce

Small Grains

Hay

i'm an agronomist

- Heavy tillage
- Plasticulture
- Cornstalk mulch
- Cover-cropped alleyways

An easier way; a better way?

- Roller-crimped rye
- Strip-tilled squash

Weeds?

Remember, pictures don't always tell the whole story

- Plasticulture had multiple weedings
- Roller-crimped rye had almost none


3 October 2016

Good crews make the job go faster!

Winter squash growth

Treatment	SPAD	Vine length (cm)
Conventional	38.6	616 a
Strip-tillage	38.6	227 b

Winter squash yield

Treatment	Total count	Total wt (lb)	Average fruit wt (lb)
Conventional	541 a	1322 a	2.4 b
Strip-tillage	438 b	1118 b	2.6 a

Contact

Dr. Ajay Nair
Email: nairajay@iastate.edu
Phone: 515-294-7080

Wade Dooley
Glenwood Farm
glenwoodfarm@gmail.com

Updates:

http://iowavegetables.blogspot.com
www.extension.iastate.edu/vegetablelab