Managing cover crops in vegetable systems

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Background

Tillage

Benefits

- Incorporate cover crops
- Warm soil
- Optimal seedbed

Drawbacks

- Disrupt soil biology

(Karlen et al., 2013; Pelosi et al., 2014; Roper et al., 2010)

- Reduce soil structure
- Erosion

Background

Plastic Mulches

Benefits (Lamont, 2005)

- Warms soil
- Retains soil moisture
- Controls weeds in row

Drawbacks

- Time (laying, disposal)
- Material waste (Hemphill, 1993)
- Requires tillage

➢ More economical than other materials (Cirujeda et al., 2012)

Background

Conservation Tillage

- At least 30% of soil covered by crop residue -

- Herbicide, mow, roll…
- No-till, strip-till...

ars.usda.gov

bighambrothers.com

Drawbacks

- Compaction issues during transition years (Vian et al, 2009)
- Residues lower soil temp (Teasdale and Mohler, 1993)

Previous research

Authors	Years	Vegetable crop	Cover crop(s)	Reduced tillage performance
Creamer et al., 1996	1991-2	Tomato	Hairy vetch/rye/ crimson clover/barley	Good
Delate et al., 2008	2002-3	Pepper	Rye/vetch	Good
Díaz-Pérez et al., 2008	2005	Pepper	Rye, rye/crimson clover, barley/crimson clover	Poor
Delate et al., 2011	2006-7	Tomato	Rye/vetch, wheat/winter pea	Good
Leavitt et al., 2011	2008-9	Tomato, zucchini, pepper	Rye, vetch, rye/vetch	Poor

Background

Rolled Cover Crops

Same yield as conventional tillage:

- Carrots (Brainard and Noyes, 2012) ST
- Pumpkins (Wyenandt et al., 2011) ST
- Peppers (Delate, 2008) ST
- Zucchini (Canali et al., 2013) NT

But sometimes lower yield:

- Tomato, zucchini, pepper (Leavitt et al., 2011) NT

➢ *What about when compared to black plastic mulch?*


Conservation tillage: Cover crops are key!

Seeding at the right time, depth, and rate is critical for such a system to work

- Seeding rate:
  - Rye: 100 lbs/acre
  - Hairy vetch: 25 lbs/acre
- Date: Rye/vetch
  - Late Aug. – late Sept.
  - The earlier the better
- Seed before a rain event, or irrigate.


Roller crimper


Thick mat of cereal rye in the spring


Hiniker 6000
Strip-tiller
WESTENDORF
JOHN DEE


Conventional tillage


Strip-tillage


No-tillage

Soil temperature (15 cm. depth)

Treatment[y]	Minimum			Mean			Maximum		
	Early	Mid	Late	Early	Mid	Late	Early	Mid	Late
				2014					
CT	20.3 a[x]	22.0 a	16.9	22.7 a	25.2 a	18.8 a	25.2 a	27.0 a	20.8 a
NT	18.9 b	20.5 b	16.7	20.7 c	23.1 c	18.1 b	22.6 c	23.6 c	19.7 b
ST	18.9 b	20.7 b	16.4	21.4 b	23.7 b	18.6 ab	24.2 b	25.6 b	21.5 a
Significance	***	***	NS	***	***	*	***	***	*
				2015					
CT	22.1 a	22.9 a	19.3	24.7 a	24.4 a	21.4 a	27.7 a	27.8 a	23.9 a
NT	20.6 b	21.7 b	19.3	22.3 c	22.0 c	20.5 b	24.1 b	24.7 b	22.0 b
ST	20.8 b	22.0 b	19.3	22.8 b	22.9 b	20.9 ab	25.1 b	25.6 b	22.7 b
Significance	***	***	NS	***	***	*	***	***	*

[z]Early: 14 June – 21 July 2014; 14 June – 17 July 2015. Mid: 22 July – 28 Aug. 2014; 18 July – 19 Aug. 2015. Late: 29 Aug. – 2 Oct. 2014; 20 Aug. – 22 Sept. 2015.

[y]CT= conventional tillage; ST=strip tillage; NT=no tillage.

[x]Means within the same column and year followed by the same letter are not significantly different; Fisher's protected LSD ($P \leq 0.05$).

*P < 0.05; **P < 0.01; ***P < 0.001; NS nonsignificant.

Weed data

Treatment[y]	2014		2015	
	Dry weight	Density	Dry weight	Density
Tillage (T)				
CT	2.0 a[x]	232 a	32.0 a	113 a
ST	0.5 b	92 b	5.0 b	54 b
NT	0.2 b	42 b	4.8 b	48 b
Significance	*	**	***	**
Region (R)				
IR	1.1 a	162 a	16.7 a	72 a
BR	0.7 b	82 b	11.2 a	71 a
Significance	*	*	NS	NS
T × R	NS	NS	NS	*

[z]Weeds were sampled on 2 July 2014 and 8 July 2015.
[y]CT= conventional tillage; ST=strip tillage; NT=no tillage; IR=in-row; BR=between- row.
[x]Means within a column and treatment followed by the same letter are not significantly different; Fisher's protected LSD ($P \leq 0.05$).
*P < 0.05; **P < 0.01; ***P < 0.001; NS nonsignificant.

Marketable yield

Treatment[z]	2014 Marketable Yield (Mg·ha^{-1})	2014 Marketable No. of fruits (1000s/ha)	2015 Marketable Yield (Mg·ha^{-1})	2015 Marketable No. of fruits (1000s/ha)
Tillage (T)				
CT	17.9	107	37.7 a	202 a
NT	16.0	96	21.8 b	143 b
ST	16.6	102	23.4 b	139 b
Significance	NS	NS	**	**
Fertility (F)				
Preplant	18.9 a	114 a	26.1	153 b
Split	14.7 b	90 b	29.2	169 a
Significance	**	**	NS	*
T × F	NS	NS	NS	NS

[z]CT= Conventional tillage; ST=strip tillage; NT=no tillage; Preplant = only preplant fertilizer; Split = 2/3 of N from preplant fertilizer and 1/3 from fertigation.

[y]Means in a column within the same column and treatment followed by the same letter are not significantly different according to Fisher's protected LSD ($P \leq 0.05$).

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$; NS nonsignificant.

Marketable yield

Treatment[z]	2014		2015	
	Marketable yield ($t \cdot ha^{-1}$)	Head diam (cm)	Marketable yield ($t \cdot ha^{-1}$)	Head diam (cm)
Tillage (T)				
CT	5.9 a[y]	8.6	20.6	11.3
ST	3.2 b	7.7	19.0	10.7
NT	4.1 b	8.5	20.4	11.1
Significance	***	NS	NS	NS
Fertility (F)				
Preplant	6.4	9.1	22.6	11.7
Split	5.8	8.6	22.5	11.5
Significance	NS	NS	NS	NS
T × F	NS	NS	NS	NS

[z]CT= Conventional tillage; ST=strip tillage; NT=no tillage; Preplant = only preplant fertilizer; Split = 2/3 of N from preplant fertilizer and 1/3 from fertigation; No fert = unfertilized control.

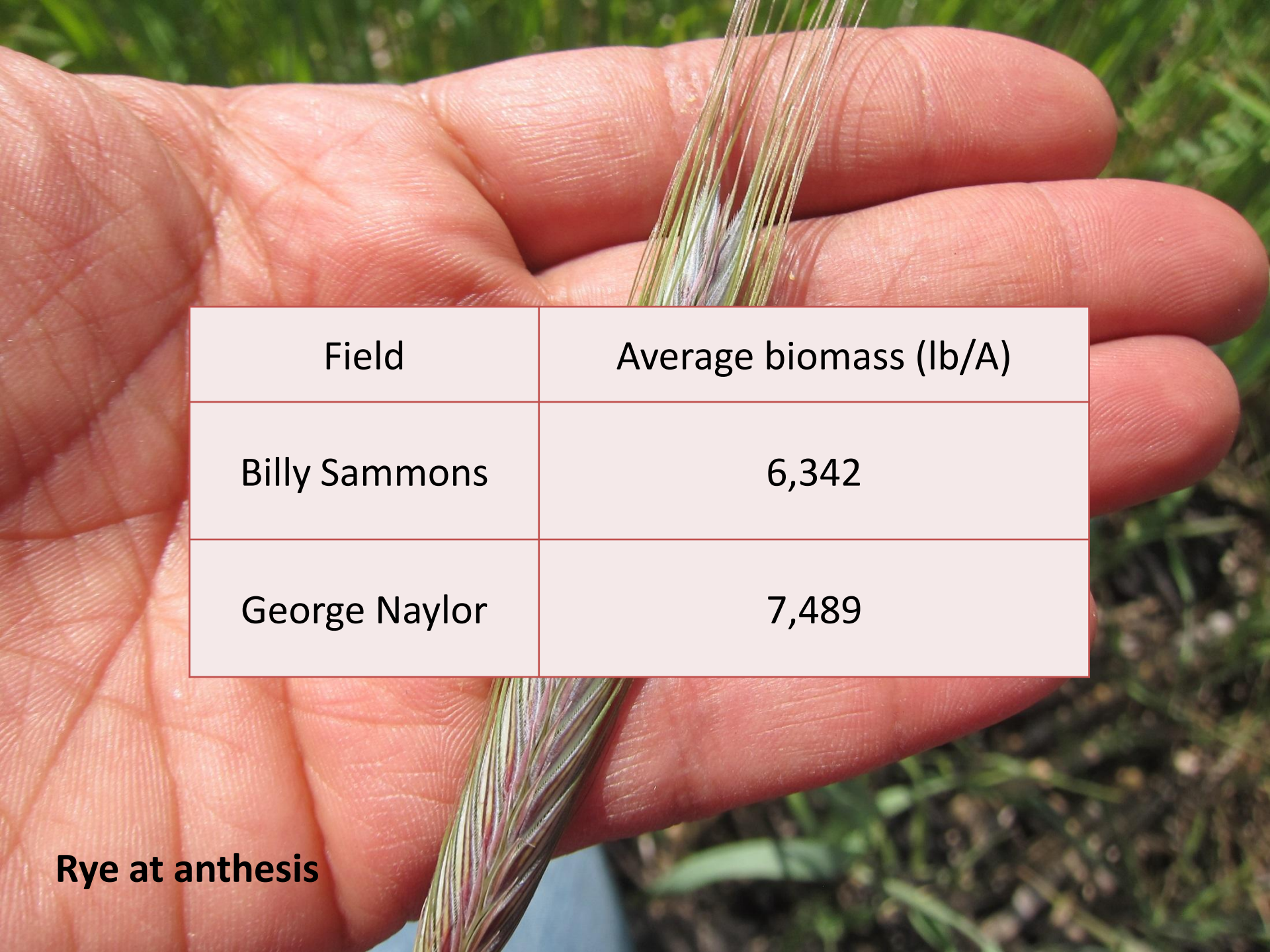
[y]Means in a column within the same column and treatment followed by the same letter are not significantly different according to Fisher's protected LSD ($P \leq 0.05$).

*P < 0.05; **P < 0.01; ***P < 0.001; NS nonsignificant.

Conclusions

- Lower soil temperatures in conservation tillage systems
- Broccoli and pepper yield similar between conservation vs conventional tillage
- Significant weed suppression by cover crops but late-season weed management could be a challenge

Cover crop biomass (5/18/16)



Field	Average biomass (lb/A)
Billy Sammons	6,342
George Naylor	7,489

Rye at anthesis

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SMART
TRIPS