Alternative Cover Cropping Strategies

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Wisconsin's Central Sands

- Irrigated vegetable crop region
- 4th largest agricultural industry in the state behind dairy, corn, and soybeans

Crop	Acres	Gate Receipts	National Rank
Potatoes	66,000	$232 Million	# 3
Snap Beans	70,900	$36.6 Million	# 1
Sweet Corn	83,000	$38.3 Million	# 3

Central Sands Characteristics

- Coarse, sandy loam soils
- Low OM content < 2%
- Center pivot irrigation
- Highly erodible and prone to leaching
  - Wind erosion
  - Nitrate contamination of groundwater
- High water table

Current System Problems

- Groundwater NO_3 contamination
- Increasing costs of fertilizer N
- Lack of N crediting information on green manure cover crops
- Lack of incentive to utilize cover crops
- Current management strategies for cover crops do not meet system goals

Cover Crop Benefits

- Erosion control
- Accumulation of excess N
- Production of N
- Rotational effect
- Weed control
- Increased soil structure & organic matter

Goals

- Develop management strategies for cover crops that will maximize benefits to a subsequent vegetable crop
  - Accumulate residual N
  - Produce N through fixation
  - Require minimal/no additional inputs of:
    - Labor
    - Tillage
    - Irrigation
    - Pesticides

Cover Crop Biomass and N

	Arlington		Hancock	
	5/23 - 6/22		4/12 - 6/14	
	Biomass	N	Biomass	N
	ton/a	lb/a	ton/a	lb/a
No cover crop	1.00	89.73	0.93	66.12
Pea	1.17	122.22	2.97	213.66
Hairy vetch	1.23	129.00	1.73	167.72
Oats	1.21	112.90	1.81	83.90
Oilseed rape	1.12	105.16	1.42	66.17
Oriental mustard	1.51	144.16	1.63	82.43
Sorghum X Sudan	1.33	105.30	1.11	74.84
Marigold	1.07	90.27	1.21	58.73
LSD (0.05)	0.14	1.03	0.33	2.00

Research Objectives

- Quantify N contribution of spring seeded cover crop
- Determine stage of cover crop development that provides most N when needed by subsequent crop
- Quantify residue persistence under vegetable crop
- Determine proper means of residue management to reduce harvest interference

Field Pea

Calliente Mustard

Bio-fumigant

- Mustard: inhibition of *Pythium* sp., *Rhizoctonia* sp. and *Aphanomyces* sp. through release of glucosinolates

Oat

Cover Crop Stage of Development

- ***Hypothesis***: Field pea cover crop will provide nitrogen for subsequent snap bean growth and decrease need for applied fertilizer N.
- ***Hypothesis***: Changes in stage of development will result in different total nitrogen and C:N for cover crops that results in varying effects on crop yield.

- Details
  - Species: Field Pea, Oat, 50:50 Mix, No Cover Crop
  - Incorporation: Vegetative, Pre-reproductive, Reproductive
  - N fertilization: 0 lbs N, 40 lbs N
- Measurements
  - Cover Crop: Biomass, C and N Content
  - Soil: Plant available nitrogen
  - Snap Bean: N uptake, Yield, Quality Grades

Results

Vegetative Stage - June 6

	Cover Crop	**Snap Bean**	
	Biomass	Yield (Tons/A)	
	(Tons/A)	0 N	40 N
Mix	0.37	2.71	3.57
Oat	0.34	2.59	2.99
Pea	0.37	2.68	3.02
No Cover	N/A	2.20	2.84
		b	a

Statistical difference in values denoted by different letters, values significant at $p < 0.05$ level

Results

Pre-Reproductive Stage - June 15

	Cover Crop	Snap Bean	
	Biomass (Tons/A)	Yield (Tons/A)	
		0 N	40 N
Mix	0.97 a	2.81	3.56
Oat	0.70 b	2.64	3.62
Pea	0.88 a	3.21	4.03
No Cover	N/A	2.56	3.87
		b	a

Statistical difference in values denoted by different letters, values significant at $p < 0.05$ level

Results

Reproductive Stage - July 5

	Cover Crop	Snap Bean	
	Biomass (Tons/A)	Yield (Tons/A)	
		0 N	40 N
Mix	2.94 a	1.27	1.44
Oat	2.28 b	1.26	1.50
Pea	1.03 c*	1.30	1.42
No Cover	N/A	1.28	1.62
		b	a

Statistical difference in values denoted by different letters, values significant at $p < 0.05$ level

Cover Crop Incorporation Technique

- ***Hypothesis***: Glyphosate can reduce need for tillage to manage residues of different cover crops.

- Details
  - Species: Field Pea, Oat, Mustard
  - Incorporation Stage: Vegetative, Reproductive
  - Tillage Method: Conventional Tillage, Conventional Tillage + Glyphosate Burndown, No-Till (Glyphosate Burndown)
- Measurements
  - Cover Crop: Biomass, C and N content
  - Crop Residue Persistence: At snap bean planting, harvest, contamination of harvested snap beans
  - Snap Bean: Yield and Quality Grades

Aboveground Biomass

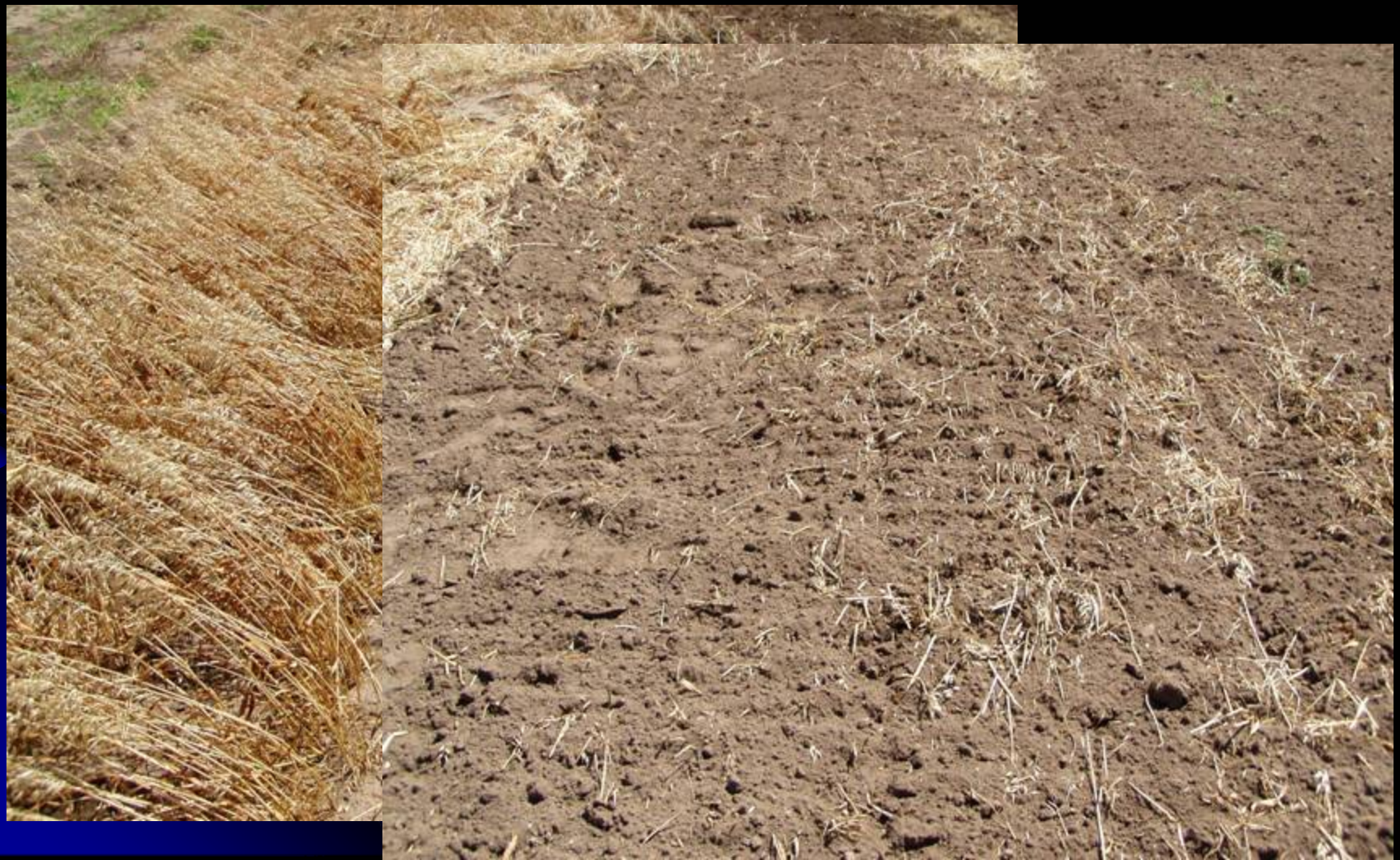
	Developmental Stage	
Cover Crop	Vegetative (Tons/A)	Reproductive (Tons/A)
Oat	0.28 b	1.81 b
Mustard	0.48 a	2.24 a
Pea	0.22 c	1.90 b

Statistical difference in values denoted by different letters, values significant at $p < 0.05$ level

Reproductive Stage Oat

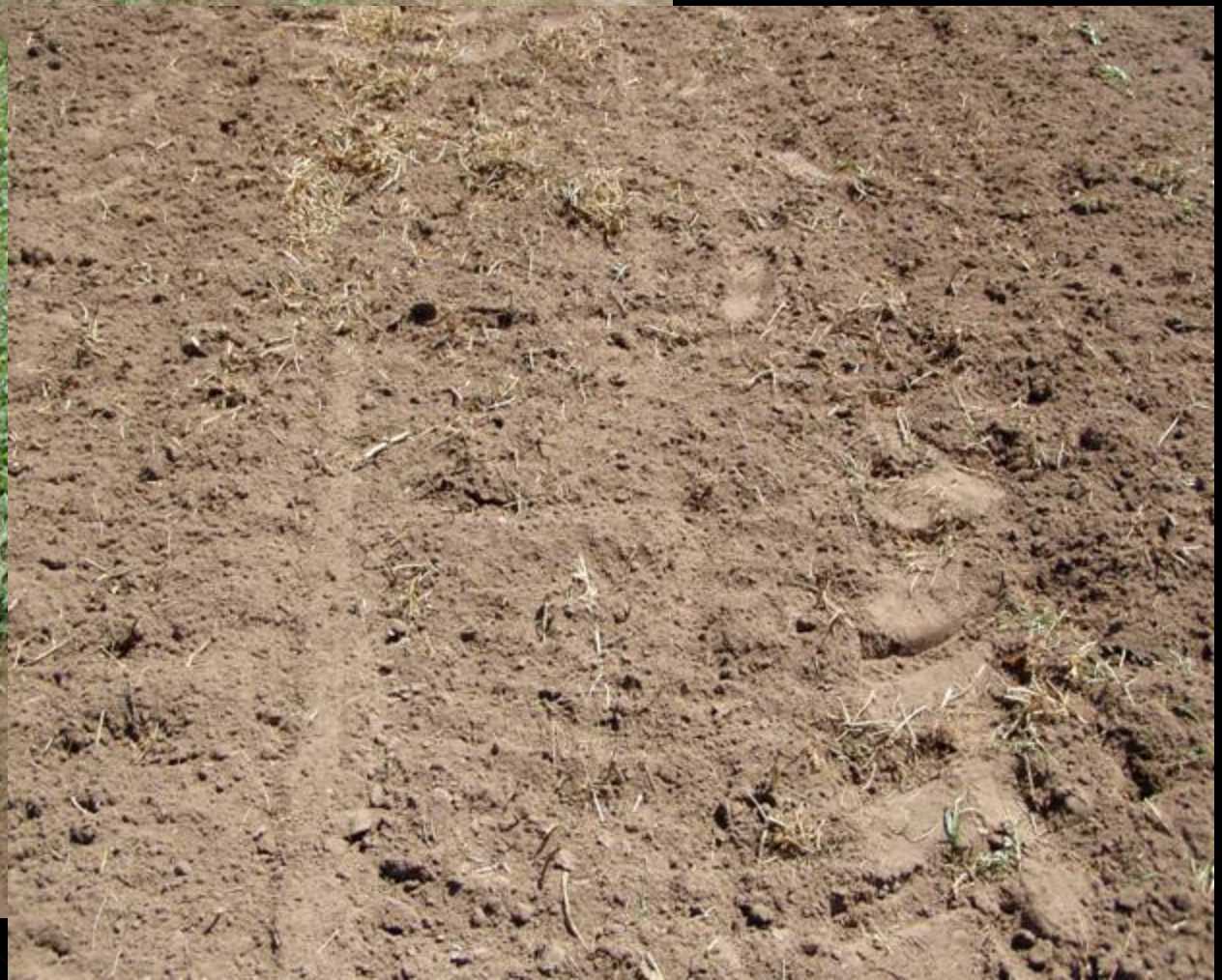
Reproductive Oats: Green Manure Incorporation

Reproductive Oats: Glyphosate Treatment

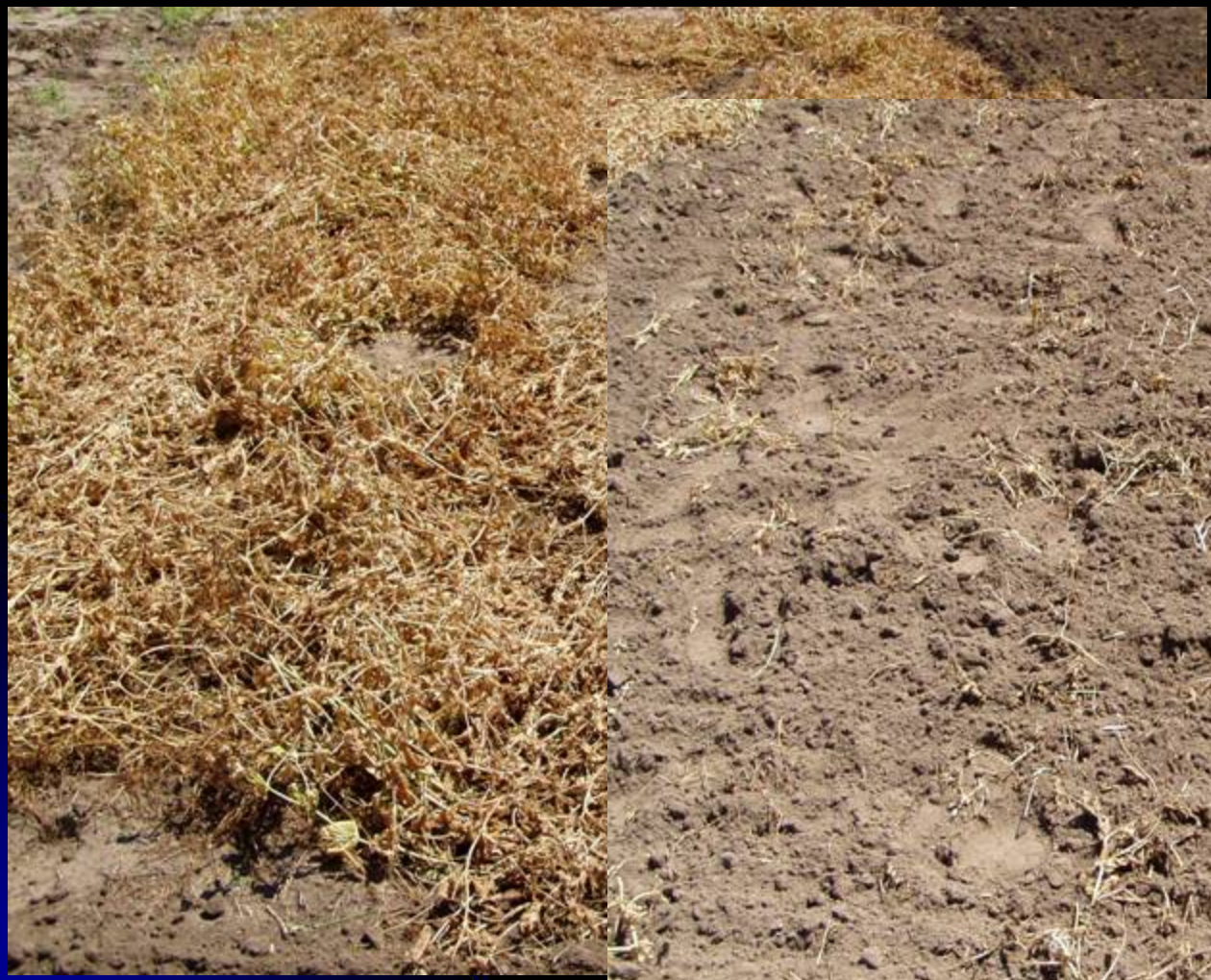


Reproductive Stage Field Pea

Reproductive Field Pea: Green Manure Incorporation

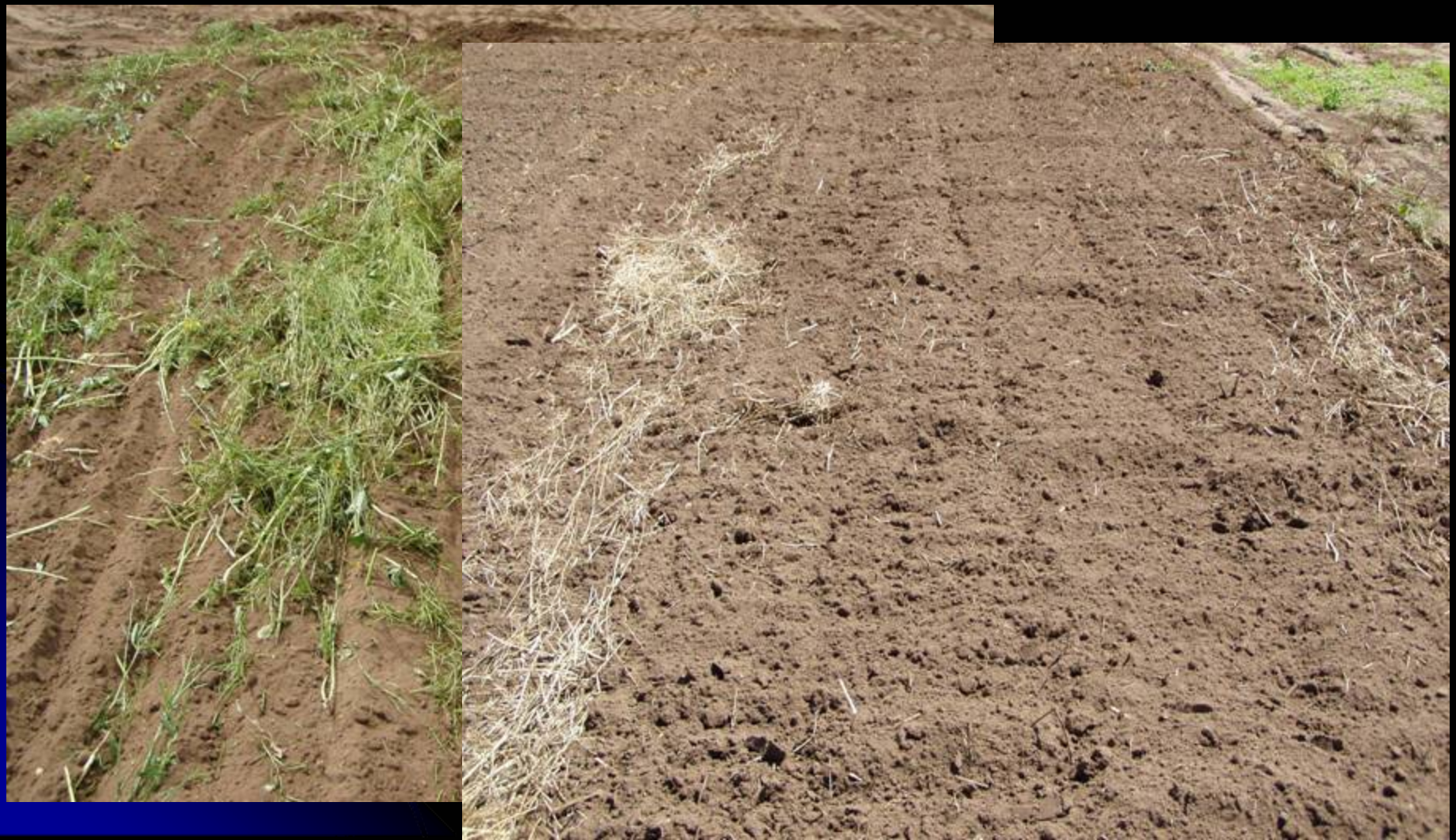


Reproductive Field Pea: Glyphosate Treatment

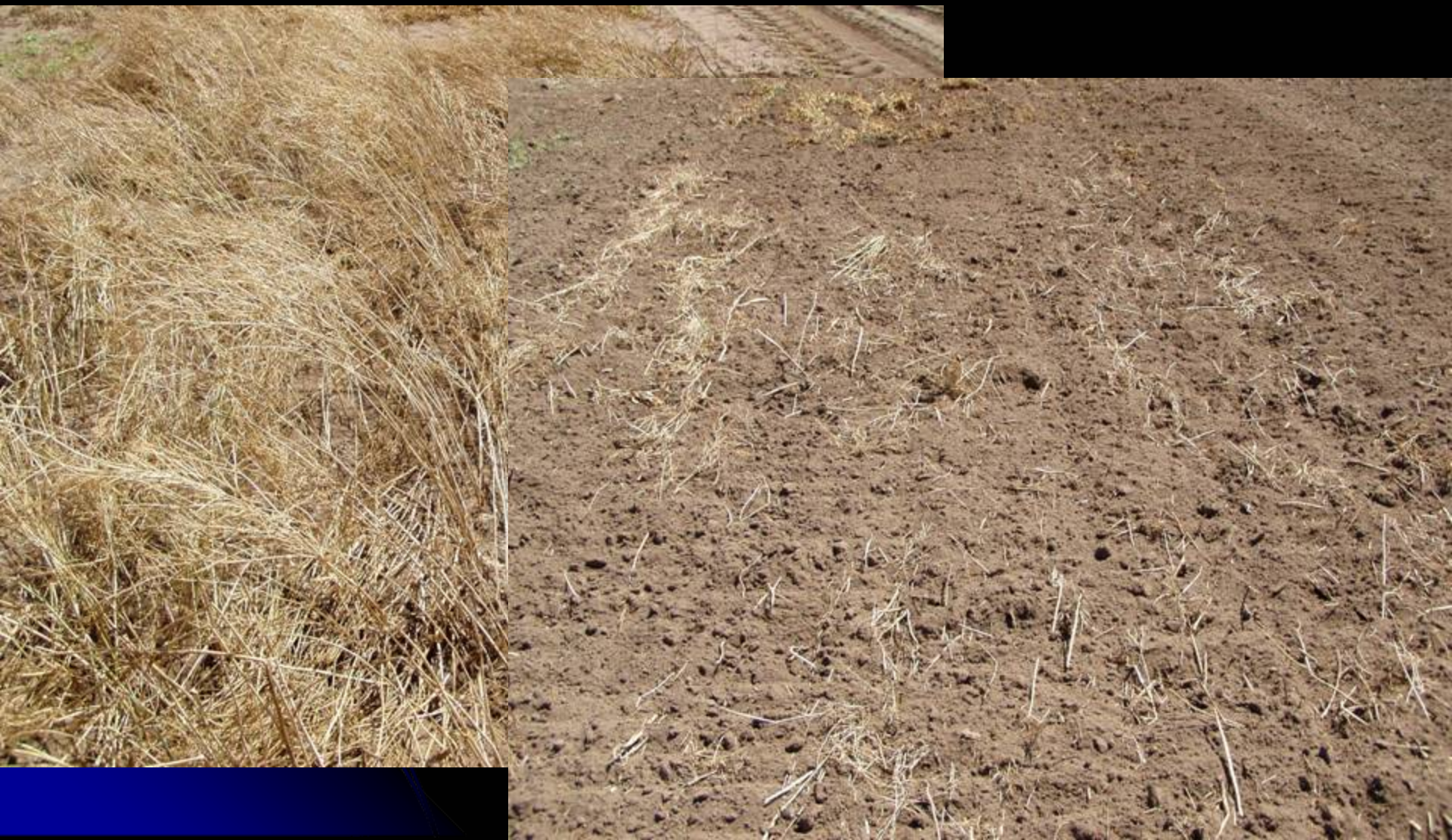


Reproductive Stage Mustard

Reproductive Mustard: Green Manure Incorporation



Reproductive Mustard: Glyphosate Treatment



Vegetative Stage Yield

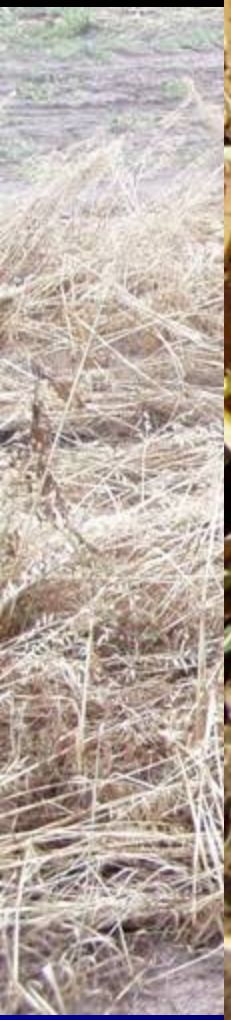
	Incorporation Method		
	No-Tillage	Tillage	Tillage + Glyphosate
Cover Crop	**Yield (Tons/A)**		
Oat	2.58	2.91	3.45
Mustard	2.65	2.98	3.91
Field Pea	2.06	2.92	3.45
	c	b	a

Statistical difference in values denoted by different letters, values significant at $p < 0.05$ level

Reproductive Stage Yield

	Incorporation Method		
	No-Tillage	Tillage	Tillage + Glyphosate
Cover Crop	**Yield (Tons/A)**		
Oat	2.54	3.35	3.33
Mustard	2.14	3.21	3.59
Field Pea	2.4	3.39	3.35
	c	b	a

Statistical difference in values denoted by different letters, values significant at $p < 0.05$ level



Aboveground Residue

	Dried Residue (Tons/A)		
Cover Crop	No - Till	Tillage	Tillage + Glyphosate
Oat	1.60	0.28	0.18
Mustard	1.42	0.36	0.24
Field Pea	1.73	0.22	0.27
	a	b	b

Statistical difference in values denoted by different letters, values significant at $p < 0.05$ level

Residue at Harvest

	% Ground Cover by Cover Crop Residue		
Cover Crop	No - Till	Tillage	Tillage + Glyphosate
Oat	75.63	16.67	16.25
Mustard	78.54	22.50	22.92
Pea	79.38	20.83	11.25
	a	b	b

Statistical difference in values denoted by different letters, values significant at $p < 0.05$ level

Residue in Harvested Beans

	% Residue Contamination		
Cover Crop	No - Till	Tillage	Tillage + Glyphosate
Oat	0.75	1.01	0.97
Mustard	0.75	1.05	1.92
Pea	0.71	1.25	0.94
	a	b	b

Statistical difference in values denoted by different letters, values significant at $p < 0.05$ level

Summary

- Spring planted cover crops hold potential as nitrogen source for subsequent vegetable crops
  - Reduced inputs of fertilizer N
  - Reduced NO_3 loading to groundwater
  - Limited additional inputs or labor to existing system
  - Bio-fumigant properties of cover crops

Conclusions

- Reproductive stage cover crops show high potential for providing N to bean crop
- N contribution by cover crop evident when compared to unfertilized, no cover check
- Glyphosate holds potential for management of late stage cover crop residues
- Snap bean only one phase of the vegetable crop system
- Current studies are also incorporating perennial legumes into vegetable crop system