

Cover crop mixtures for integrated weed and nitrogen management



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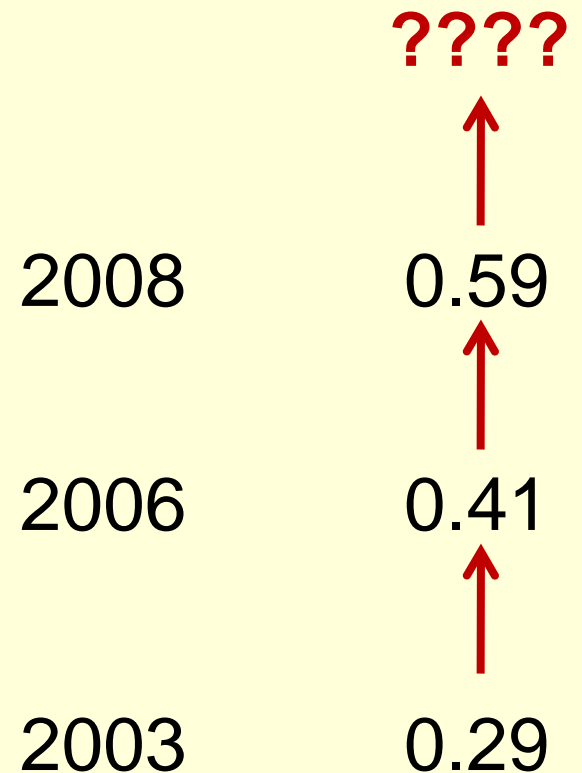
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<http://brucefong.files.wordpress.com/2008/03/gas-prices.jpg>

Cost of N (from urea) (\$/lb)



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Grow your own N with legumes?

➤ Major Benefits

- Reduce fertilizer costs
- Improve soil health

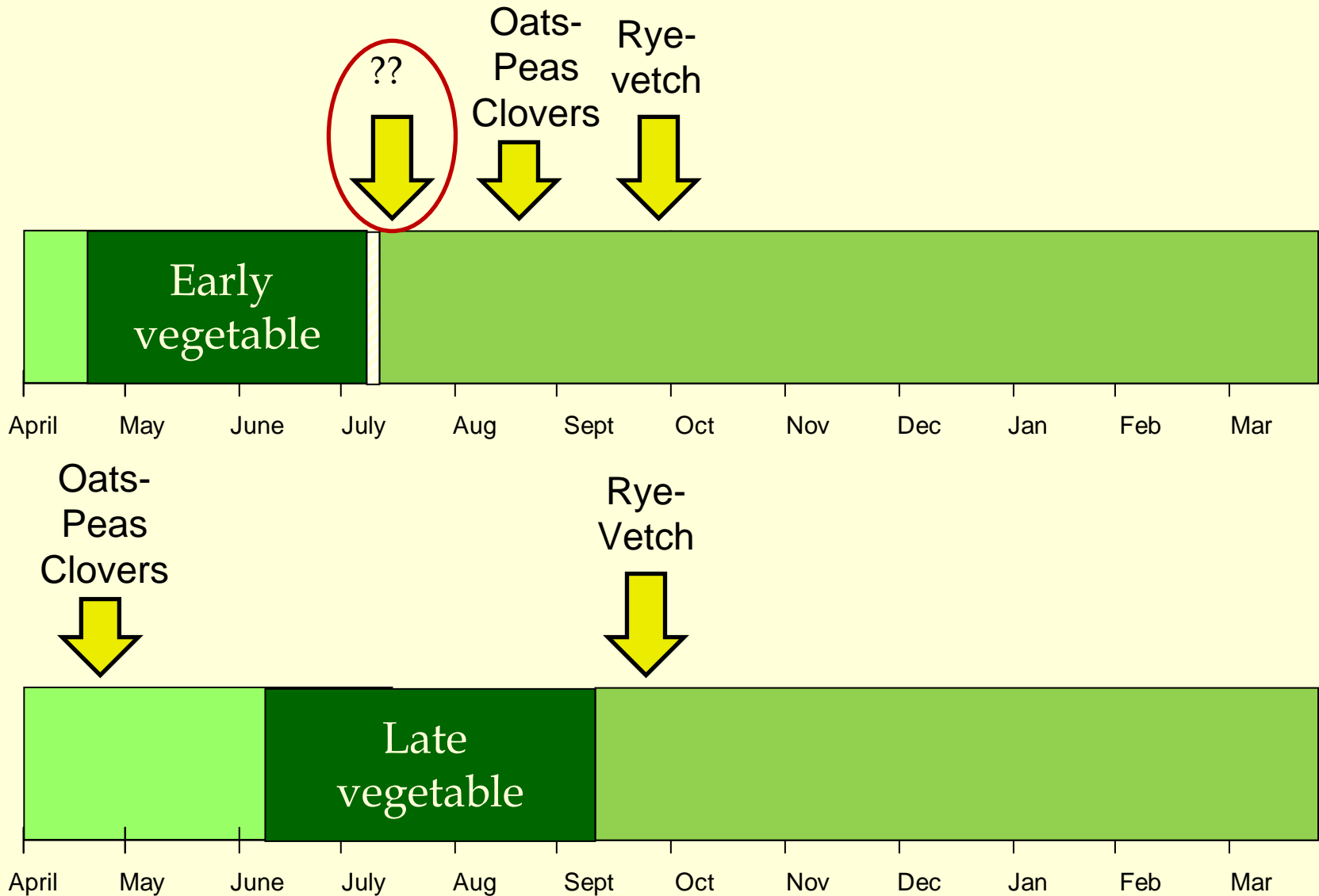
➤ Potential Problems

- Seed and maintenance costs
- Weed suppression

Legume-grass mixtures

- Improved weed suppression
- Lower seed costs
- More efficient N fixation
- Improved C:N ratio

Cover crops in vegetable systems



Objectives

- Identify potentially valuable cover crop species or mixtures for use following early harvested vegetables
- Evaluate effects grass-legume cover crop mixtures on:
 - Weed suppression
 - N-fixation

Methods

- Cover crops evaluated
 - Sorghum sudangrass (Sweetleaf II; 50 lb/A)
 - Japanese millet (12 lb/A)—one yr only
 - Cowpea (Red Ripper; 150 lb/A)
 - Soybean (Tyrone; 150 lb/A)
 - No cover crop
- Alone and in 50:50 mixtures
- Drilled in mid July
- Evaluated in mid September (60 days later)

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Sorghum-sudangrass

A photograph of a field of Sorghum-sudangrass plants. The plants are tall, green, and have long, narrow leaves. They are arranged in rows, with a gravel path running through the field. In the background, there are other plants and a dense line of trees under a cloudy sky.

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Japanese millet

A wide-angle photograph of a research garden. The foreground and middle ground are dominated by rows of Japanese millet plants, which are tall and green with long, narrow leaves. The plants are planted in a field with a gravel path or border in the immediate foreground. In the background, there are other garden beds, some with different types of plants, and a dense line of trees under a cloudy sky.

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Soybean

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Cowpea

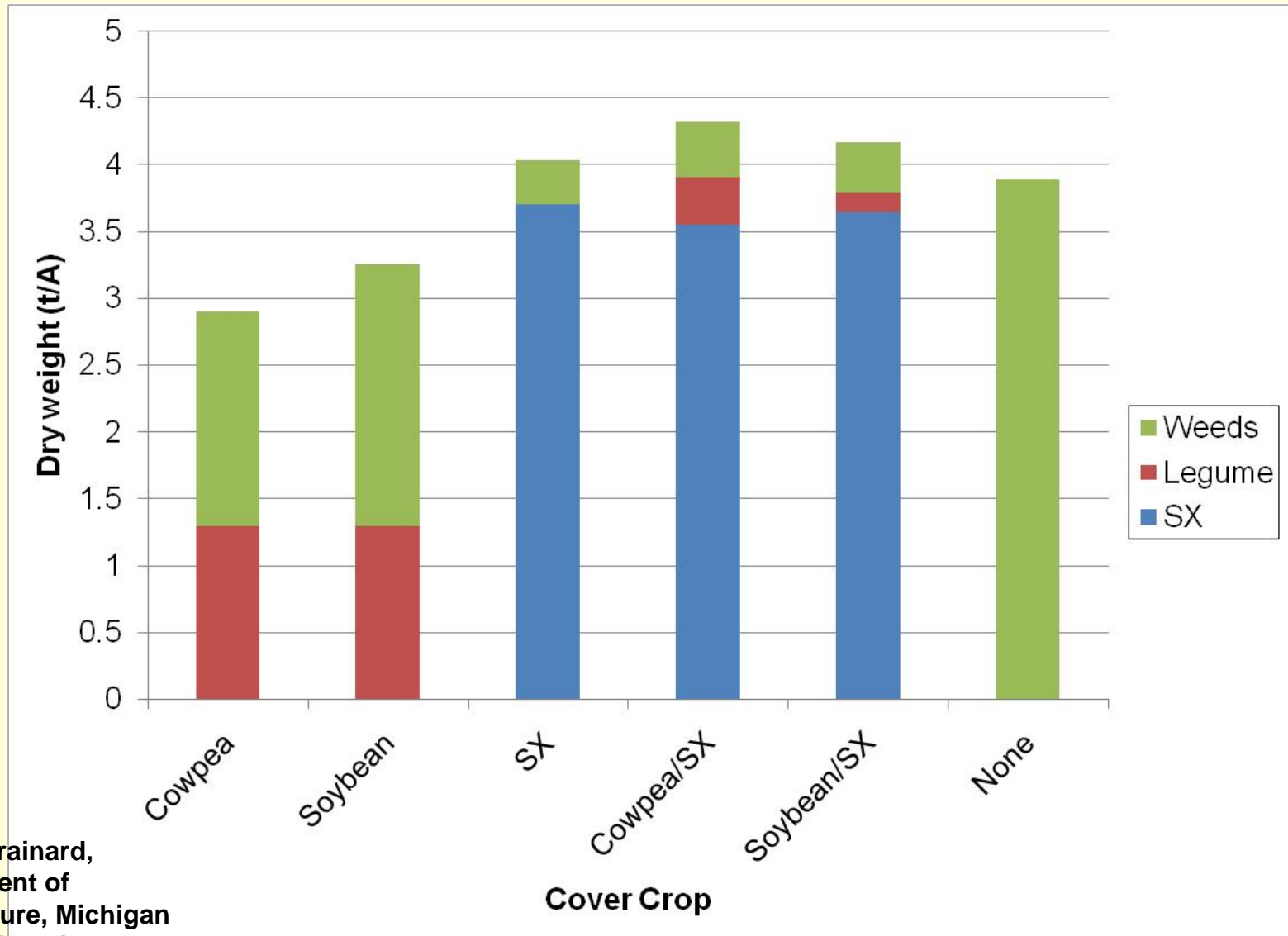


Grass-legume Mixtures

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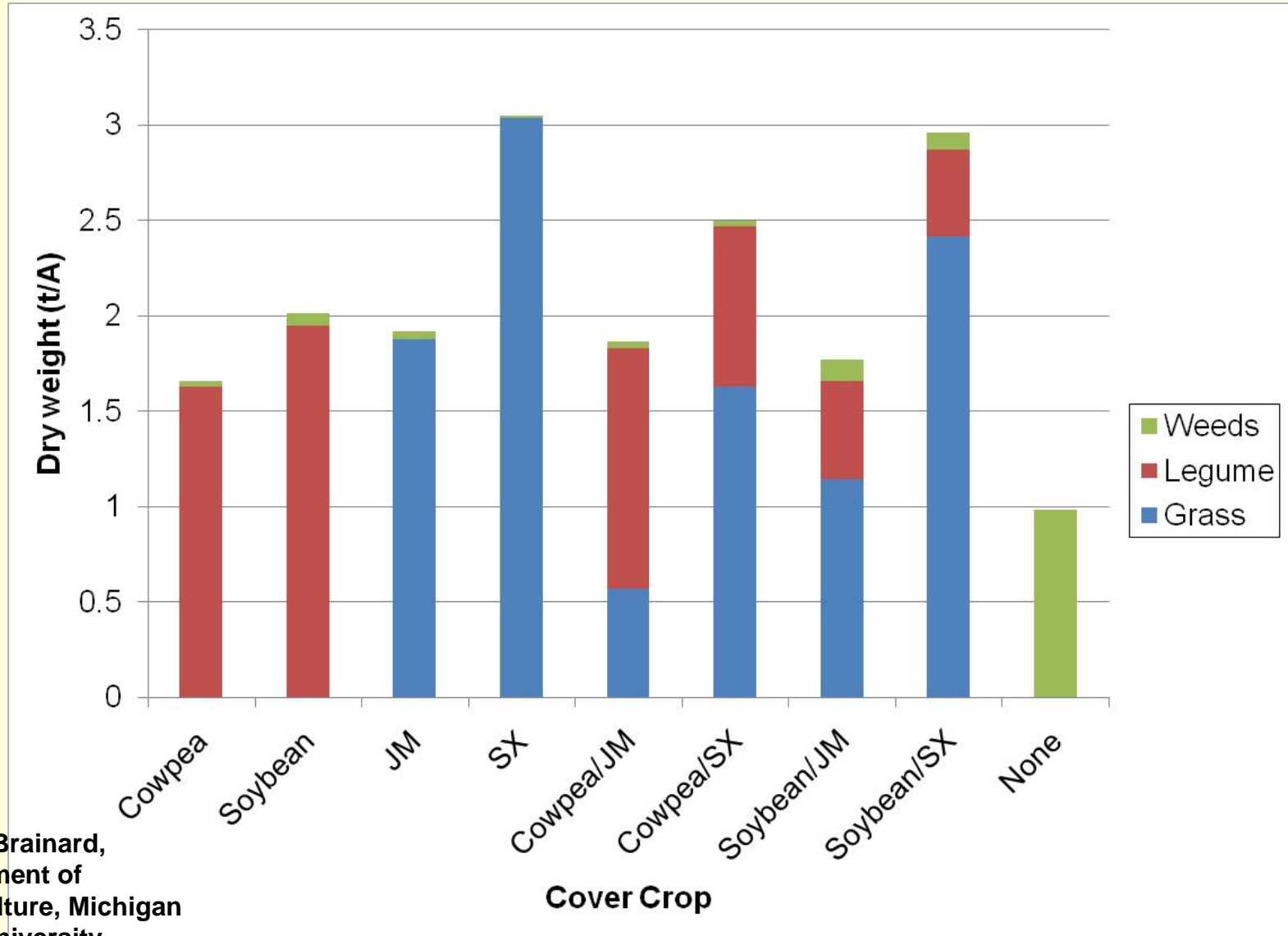


Results: Biomass 2005



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Results: Biomass 2006



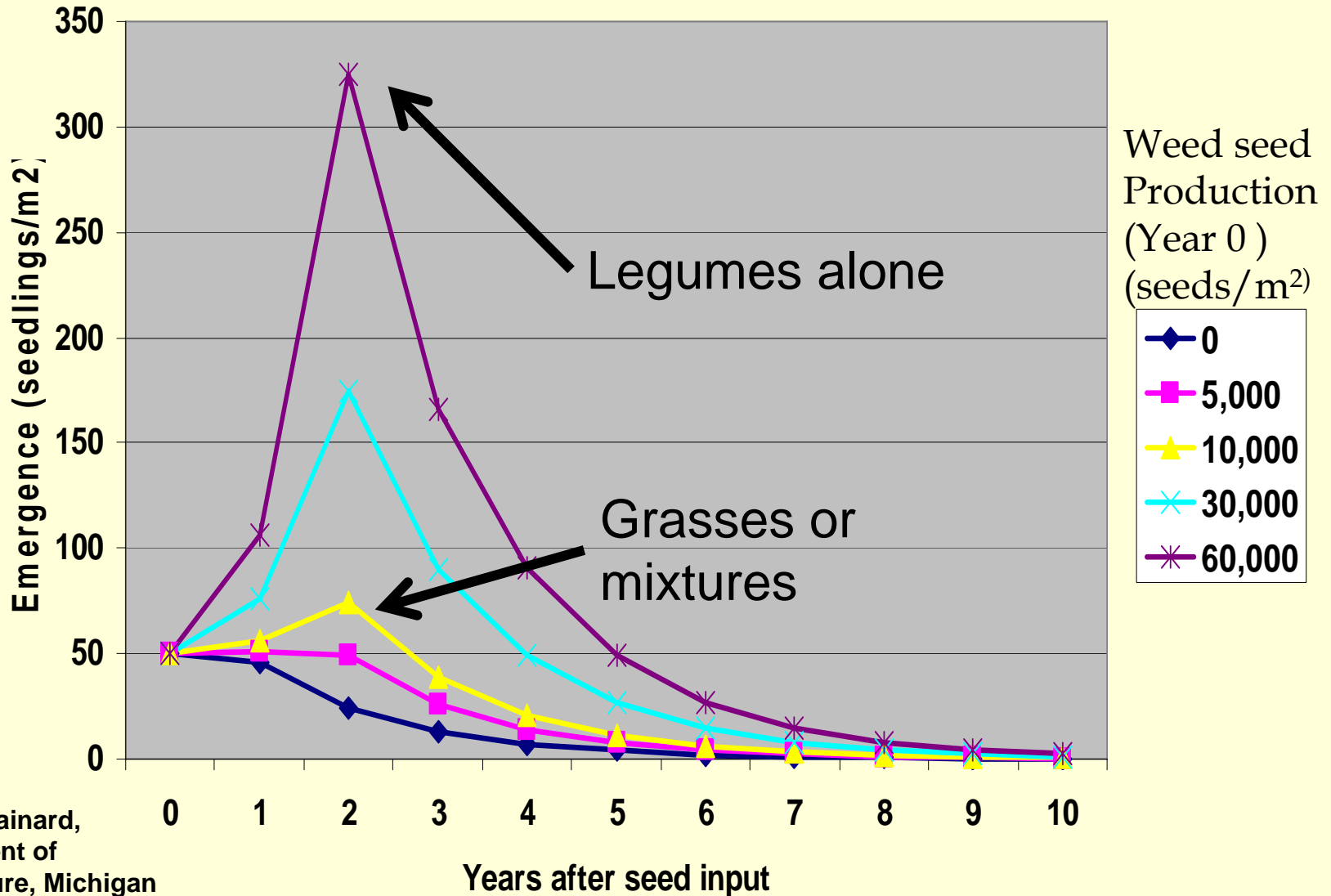
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Results: Weed seed production

Amaranthus powellii

Cover crop(s)	2005	2006
	-----000 seeds/m ² -----	
Cowpea	130 b	0.6 b
Soybean	166 b	1.3 b
Japanese millet (JM)	NA	0.7 b
Sorghum-sudangrass (SX)	20 c	0.2 b
Cowpea/JM	NA	0.6 b
Cowpea/SX	27 c	0.3 b
Soybean/JM	NA	3.4 b
Soybean/SX	24 c	2.0 b
None	386 a	48.7 a

Impact of weed seed production on future Weed density



Results: Nitrogen fixation



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Results: Approximate nitrogen fixed, 2006

	Cowpea	Soybean
	-----lbs/ A-----	
Alone	45.0	105.0
With Japanese Millet	71.8	41.8
With Sorghum-sudangrass	31.1	33.2

Results: Approximate cost per lb N

(includes seed and establishment costs only)

	Cowpea	Soybean
	-----\$/lbN-----	
Alone	1.56	0.38
With Japanese Millet	0.63	0.72
With Sorghum-sudangrass	1.45	0.90

Summary

- Mixtures of legumes with Sorghum-sudangrass
 - Reduced risk of weed seed production
 - But suppressed legume N fixation

—————→ not recommended
- Mixtures of legumes with Japanese millet
 - Provided adequate weed suppression
 - Improved N fixation of cowpea
 - Reduced N fixation of soybean

—————→ JM/cowpea potentially good

Take-home messages

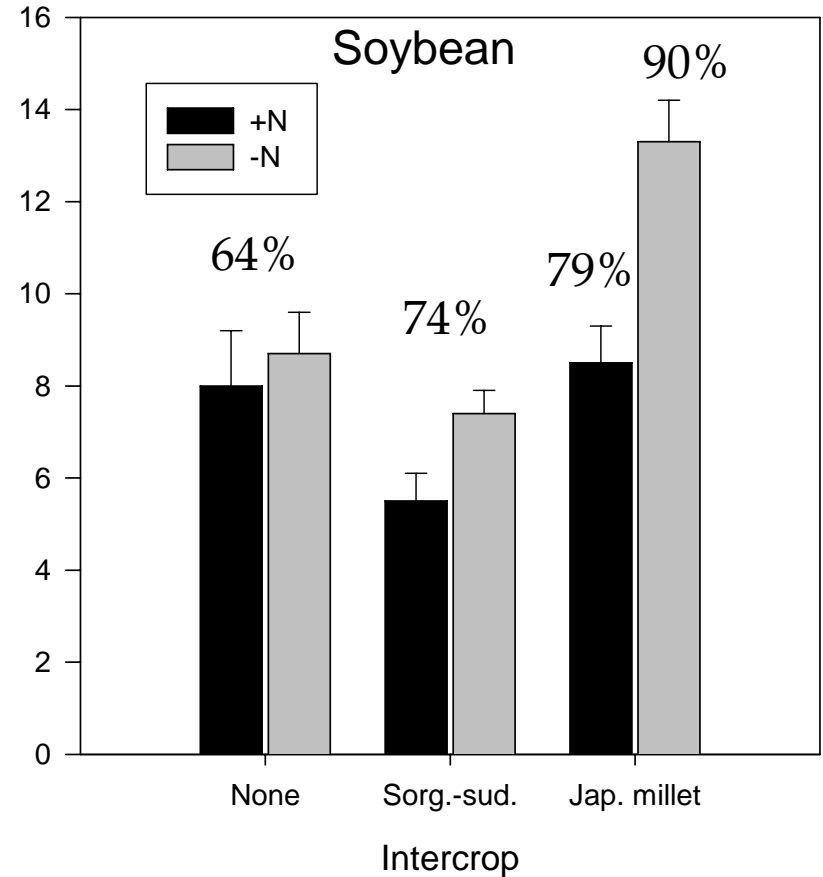
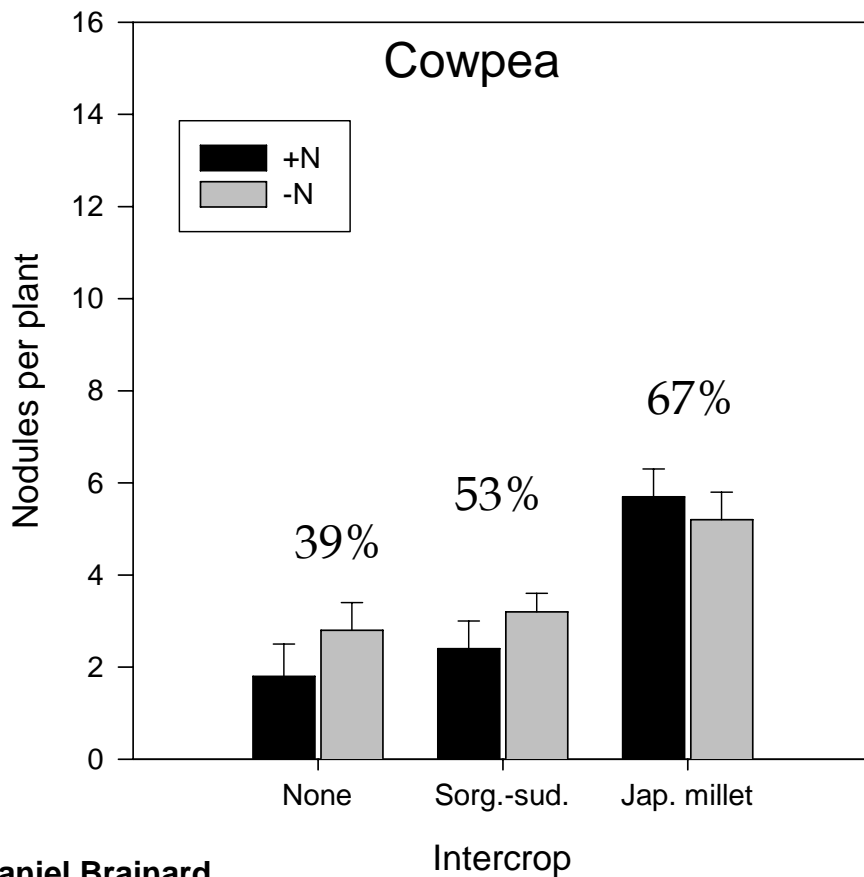
- Cost of fertilizer makes use of legumes more attractive.
- Legumes grown in mixture with grasses may reduce costs, improve N-fixation efficiency and improve weed suppression....but not always.
- More research is needed to identify compatible mixtures and optimize their use.

Acknowledgements

- Towards Sustainability Fund
- Robin Bellinder
- Andrew Leed
- Laurie Drinkwater
- Virender Kumar
- Meagan Schipanski
- Ann Piombino
- Chris Benedict
- Steve McKay



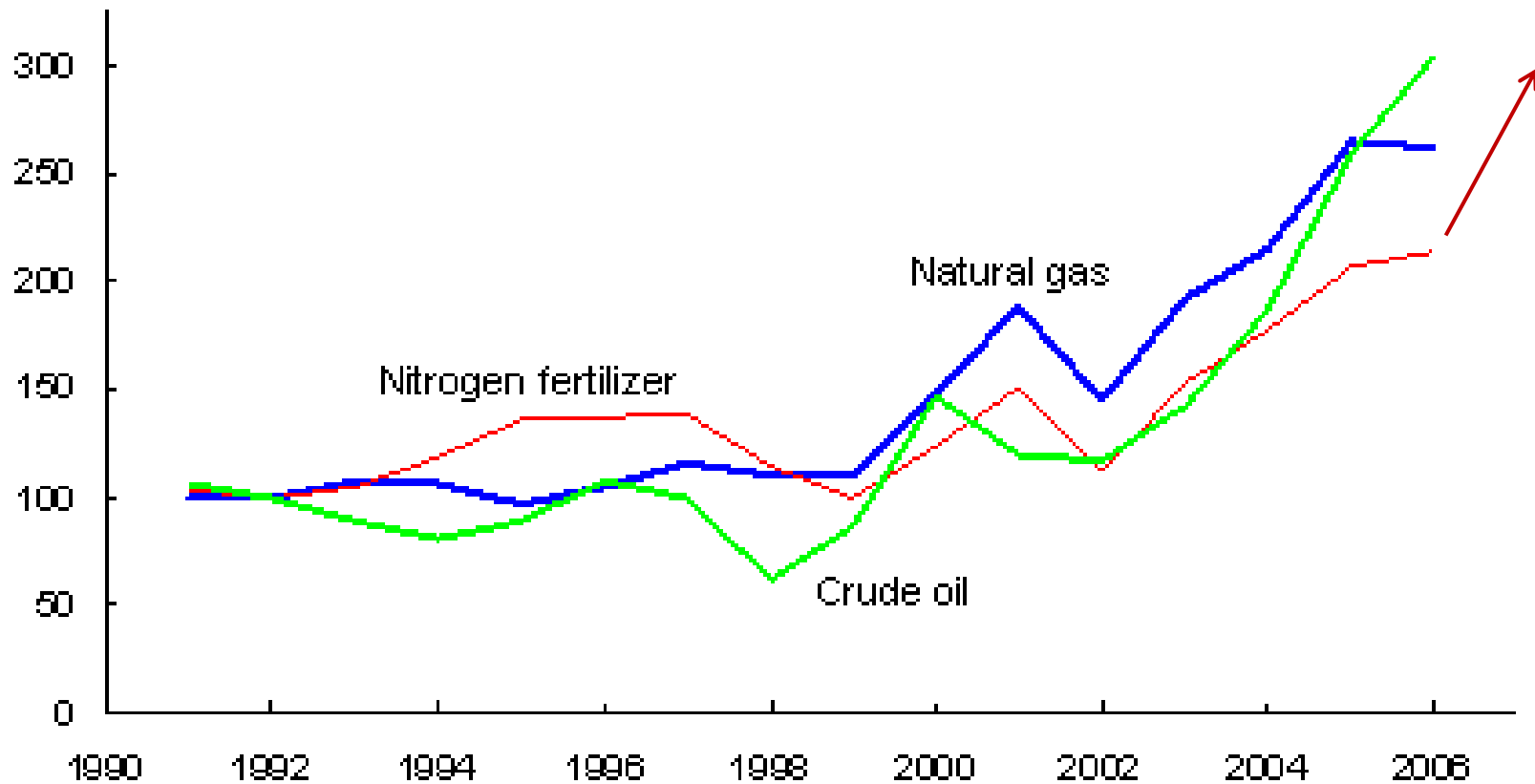
Results: Legume nodulation and percent N fixed, 2006



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U.S. crude oil, natural gas, and nitrogen-based fertilizer prices move together

Producer Price Indexes, 1992=100



Sources: *USDA Agricultural Projections to 2017*, February 2008.

USDA, Economic Research Service.

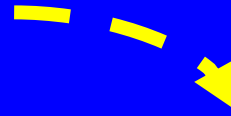
Producer Price Indexes, U.S. Department of Labor, Bureau of Labor Statistics.

Related research

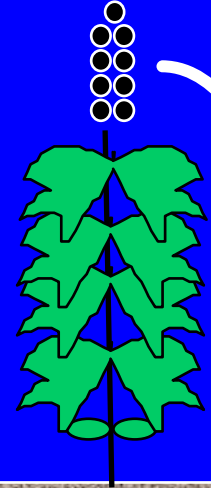
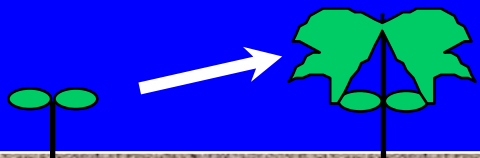
- Rye-vetch mixtures
 - How much N for subsequent vegetables?
 - Which varieties best in mixture?
 - Impact of tillage on N, and weed management in subsequent crops



Cover crops



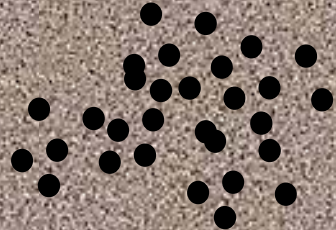
Seedling mortality



Seed production



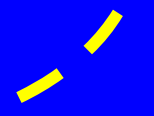
Seed mortality



Seed Germination



Seed predation
Seed decay



Cover crops

Allelochemicals
Mulch effects
Nutrient effects



Seeding rates

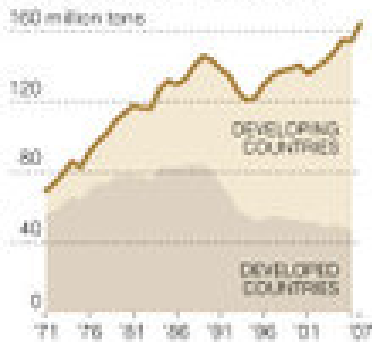


Seed rate (lbs/A)	100	200	300
Cost (\$/A)	30	60	90
Weed seeds (#/m ²)	20,000	4,260	1,522

Worldwide Growth in Fertilizer Use

Fertilizer use has been growing faster in developing countries than in the industrialized world in recent years. But rising demand has produced a big price jump. Increased fertilizer runoff is expected to worsen the problem of dead zones along ocean shores.

Worldwide fertilizer consumption



Canada
-12%

United States
+3%

"Dead zones"
Areas in which fertilizer runoff has created algae blooms that suck oxygen from the water.

European Union
-25%

Poland
+22%

Eastern Europe
Central Asia*
+2%

China
+55%

India
+54%

Pakistan
+45%

Bangladesh
+40%

Japan
+75%

Thailand
+11%

Philippines
+3%

Malaysia
+55%

Indonesia
+31%

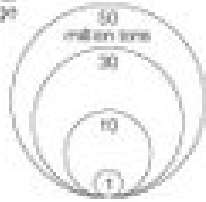
Australia and New Zealand*
+27%

Brazil
+81%

Argentina
+61%

Africa*
+14%

Fertilizer use compared with 10 years ago



*Data for these regions are for 2005-6 and the 10-year change is from 1995-6

Source: International Fertilizer Industry Association; "Eutrophication and Hypoxia in Coastal Areas: A Global Assessment of the State of Knowledge," Nancy Selman, Suzie Greenhalgh, Robert Diaz and Jeremy Sugg (Blackwell-Parsons published).

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McHUMOR by T. McCracken



"So, Jack, did you use
compost or chemical fertilizers?"

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How much can legumes reduce fertilizer use?

Previous Crop	N Credits (LBS./ACRE)
corn and most other crops	0
soybeans *	0 to 40*
grass (low level of management)	40
grass(intensively managed)	70
2-yr stand red or white clover	70
3-yr alfalfa stand (20-60% legume)	70
3-yr alfalfa stand (>60% legume)	120
hairy vetch cover crop excellent growth	110

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Magdoff and van Es, Building Soils for Better Crops