Cover crop mixtures for integrated weed and nitrogen management

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

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

	????
2008	0.59
2006	0.41
2003	0.29

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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

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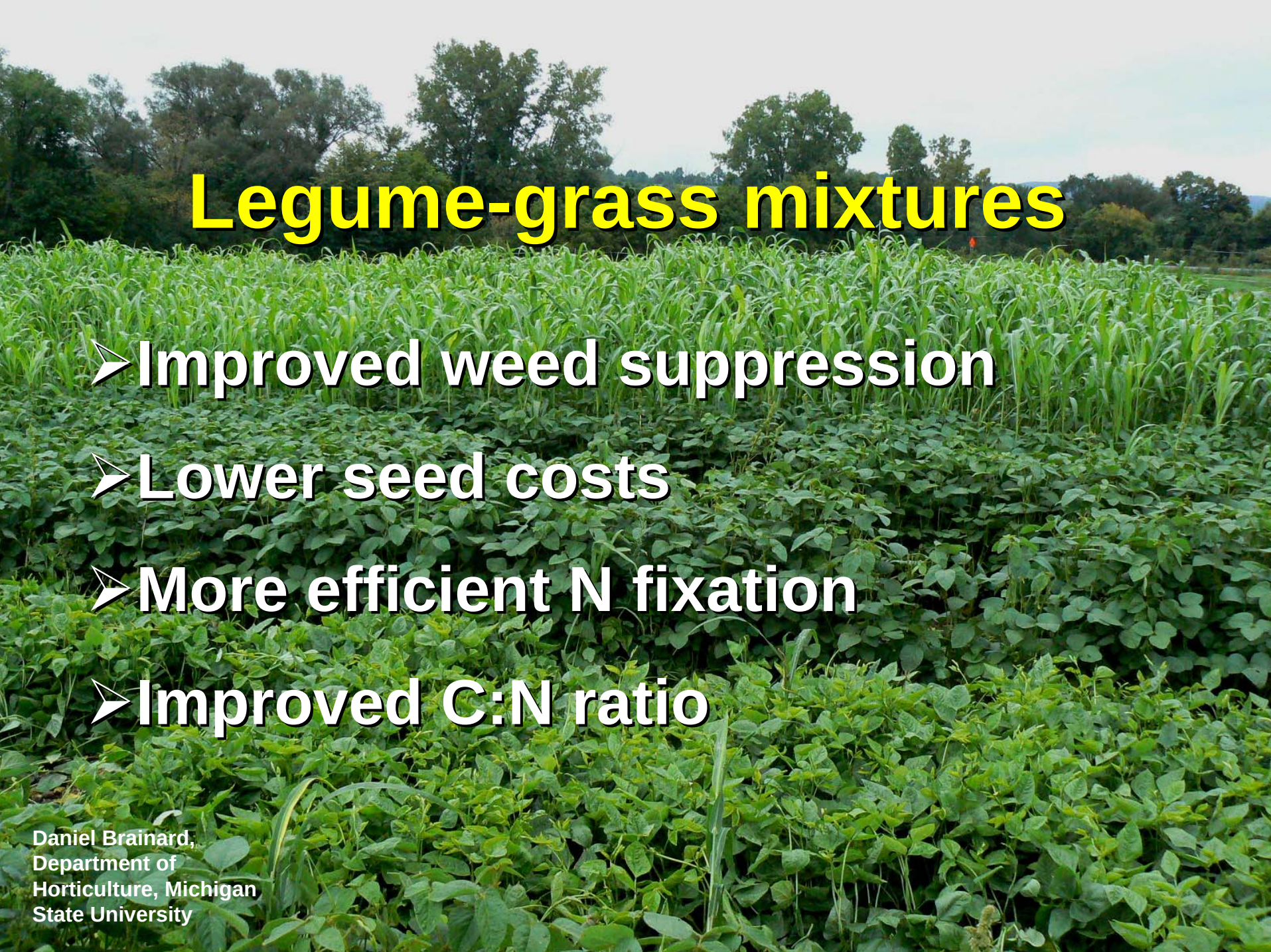

Legume-grass mixtures

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

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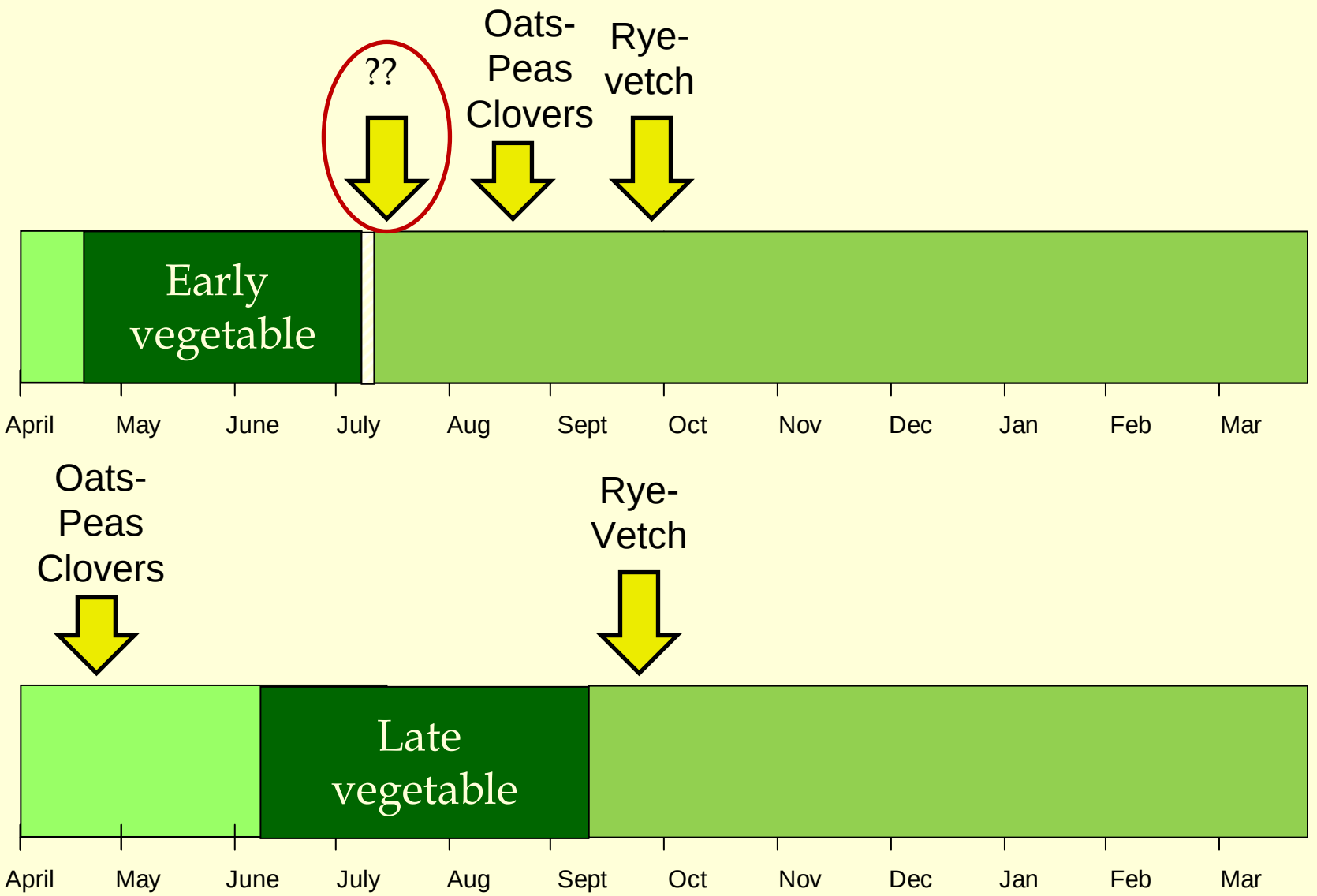
Cover crops in vegetable systems



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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

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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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Cowpea

Grass-legume Mixtures

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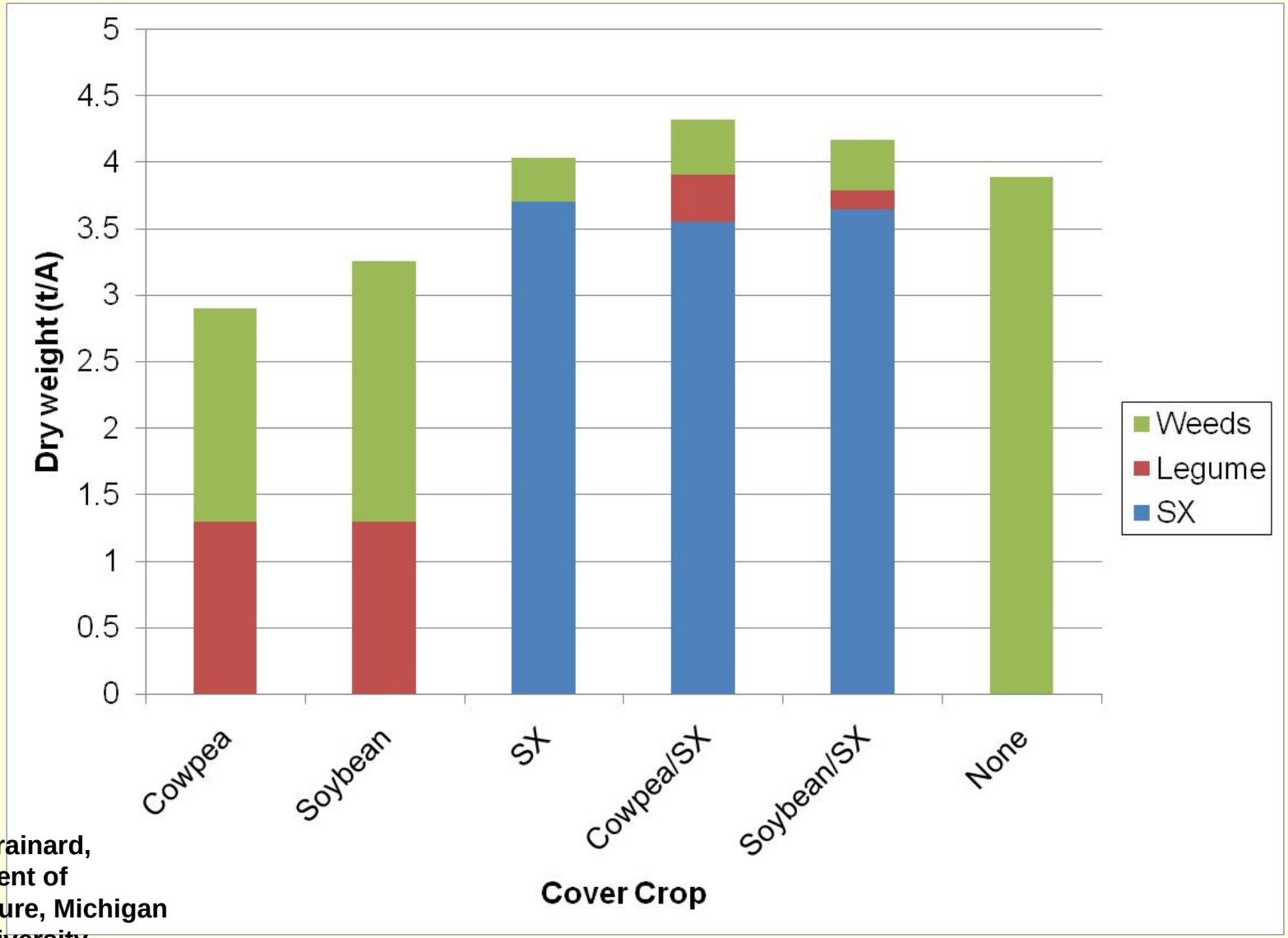
Results: Biomass 2005



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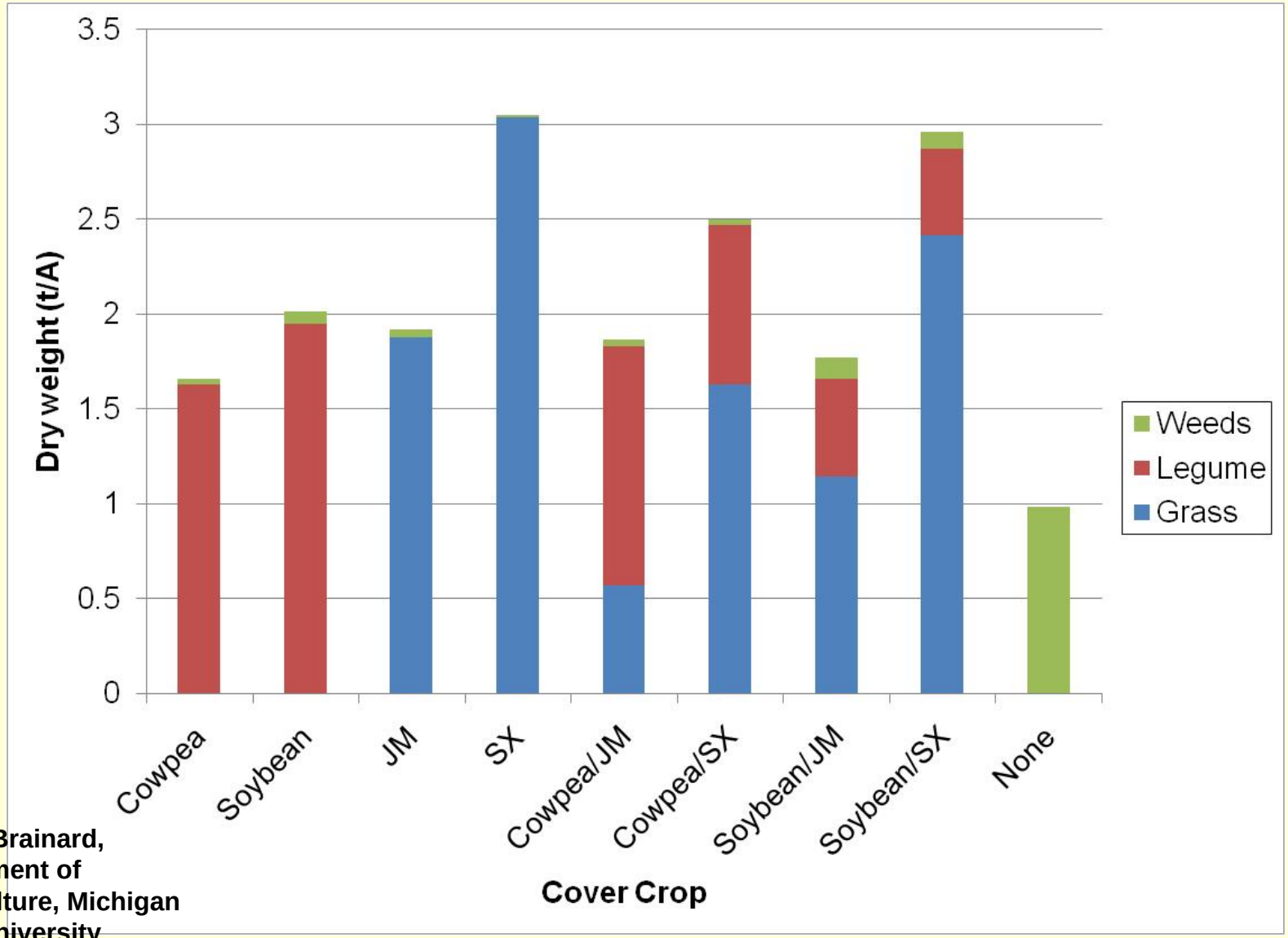
Results: Biomass 2006



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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

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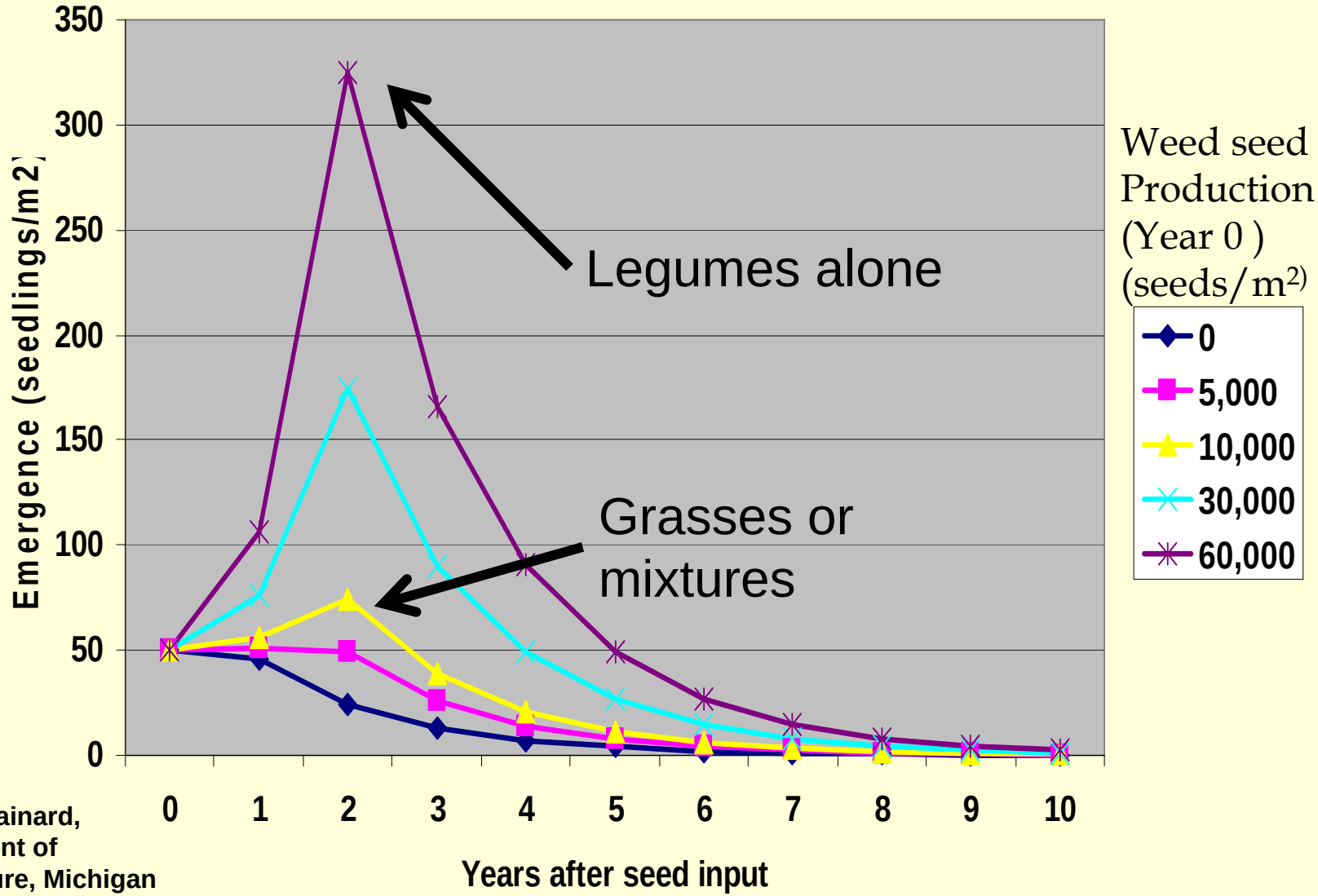
Impact of weed seed production on future Weed density



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Brainard 2002

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

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Drinkwater and Brainard, unpublished

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

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Drinkwater and Brainard, unpublished

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

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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.

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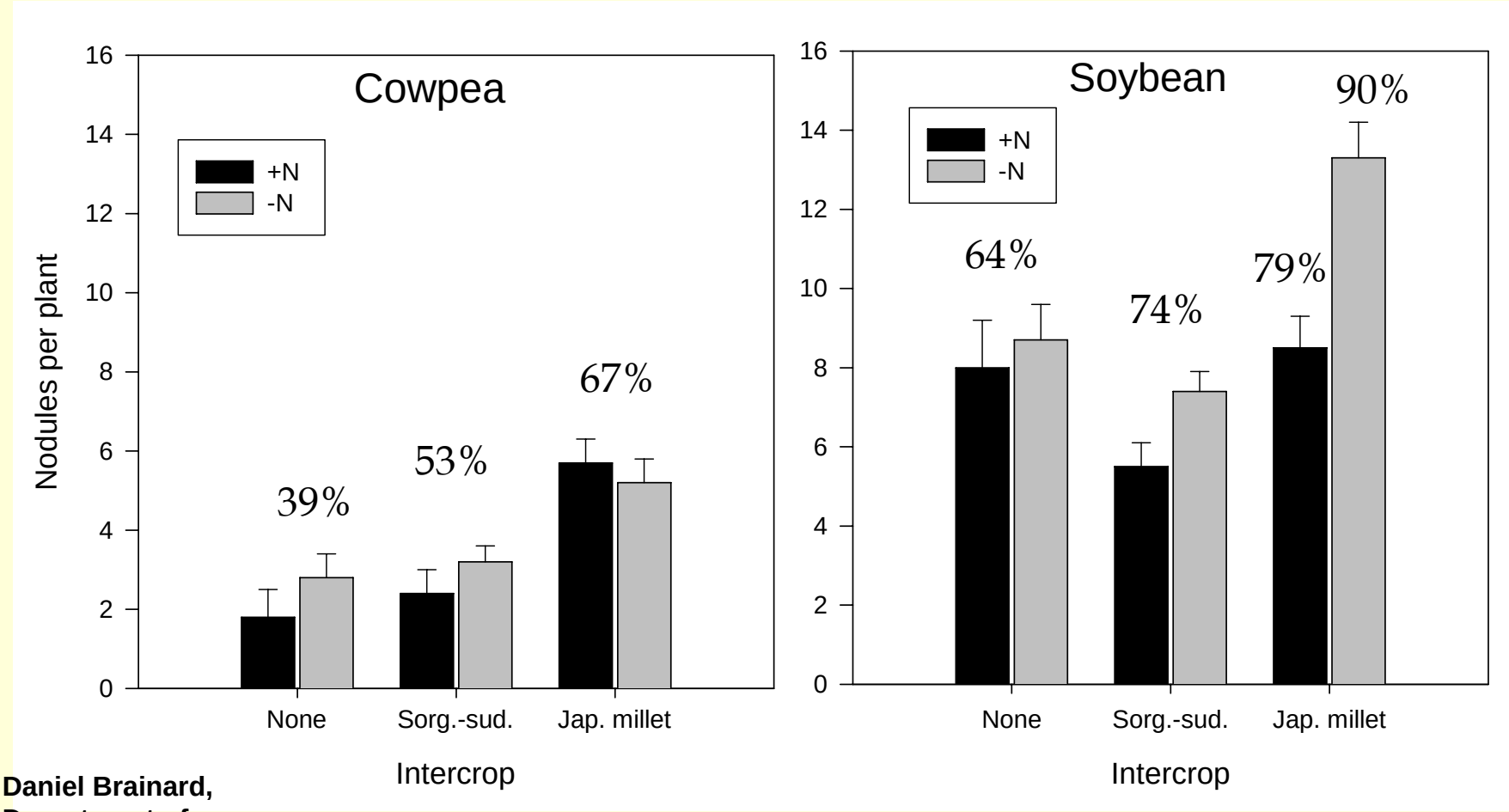
Results: Legume nodulation and percent N fixed, 2006



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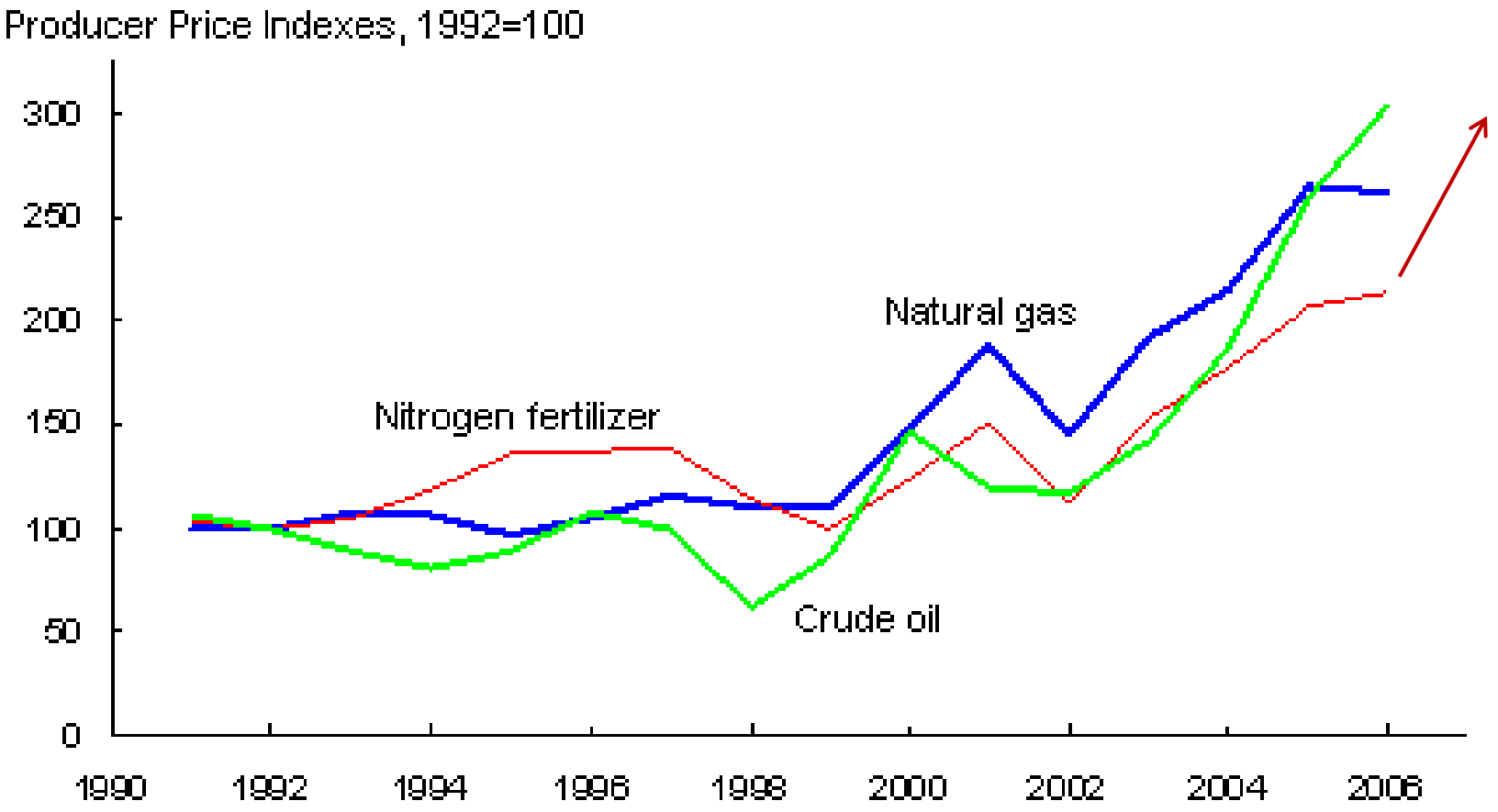
U.S. crude oil, natural gas, and nitrogen-based fertilizer prices move together



Sources: *USDA Agricultural Projections to 2017*, February 2008.
USDA, Economic Research Service.
Producer Price Indexes, U.S. Department of Labor, Bureau of Labor Statistics.

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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

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Seedling mortality

Seed production

Seed Germination

Seed mortality

Allelochemicals

Mulch effects

Nutrient effects

Seed predation

Seed decay

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Seeding rates

Seed rate (lbs/A)	100	200	300
Cost ($/A)	30	60	90
Weed seeds (#/m2)	20,000	4,260	1,522

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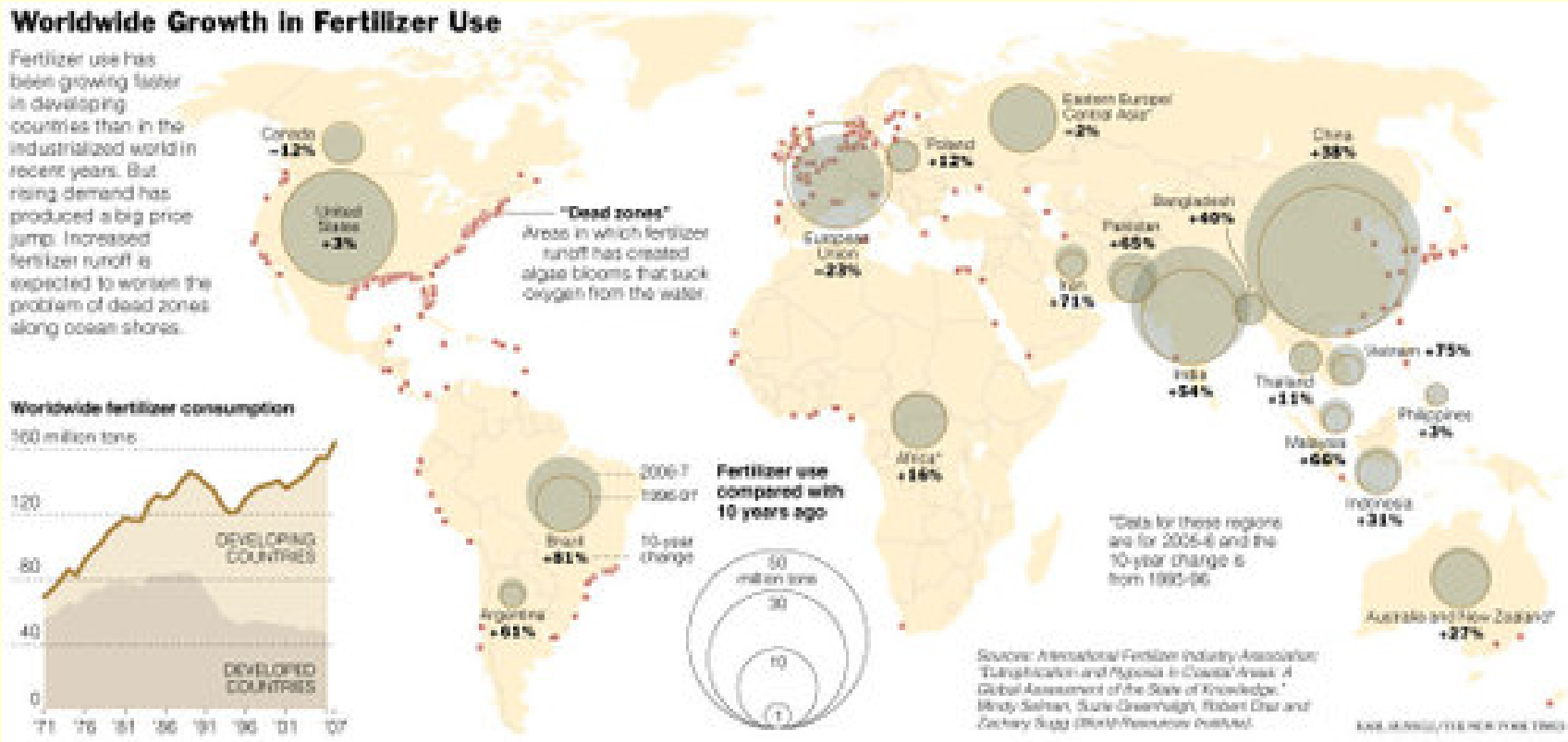

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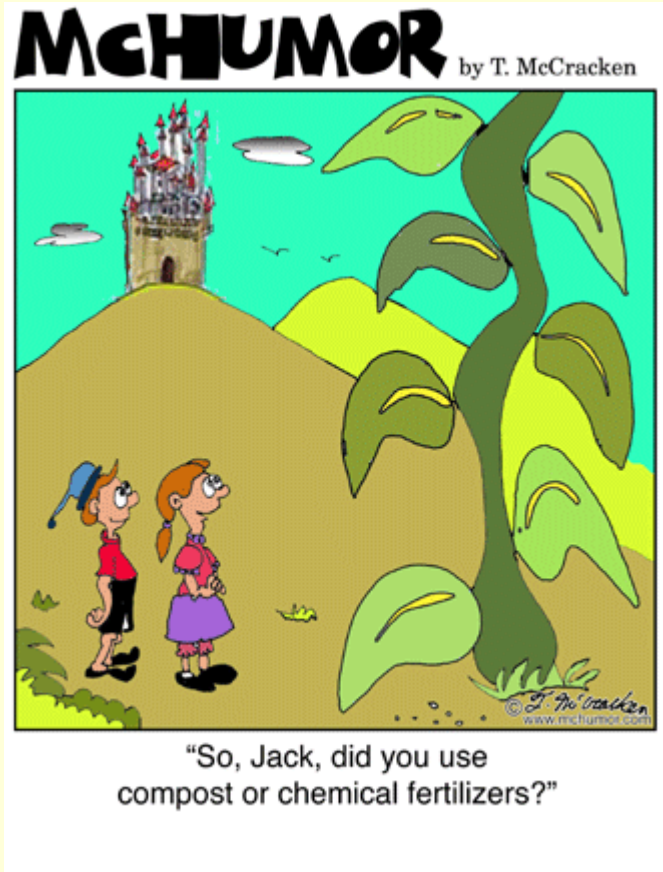

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How much can legumes reduce fertilizer use?

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