

Cover Crops and Fertility- What the Research Shows

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Introduction

- Limited use of cover crops in corn/soybean/winter wheat rotations in Ontario
- Declining use of red clover as an underseed in winter wheat
- Use of cover crops is encouraged in Ontario following summer applied manure because it is assumed that:
 - potential for loss of nitrogen via leaching and/or denitrification during the fall and winter period is reduced
 - manure credit to next year's crop is increased.

Cover Crop/Manure Trial

- 29 on-farm sites in southern Ontario from 2003-2007.
- Strip block design
- Minimum 2 replicates
- Cover crops:
 - Oat
 - Oilseed radish
 - Field pea
 - Control
- Two manure rates
 - Farmers “typical” manure rate
 - No manure



- Manure applied following wheat harvest in August

Summary of type of manure applied, *average* application rates and manure-N applied and soil fertility in surface 15cm.

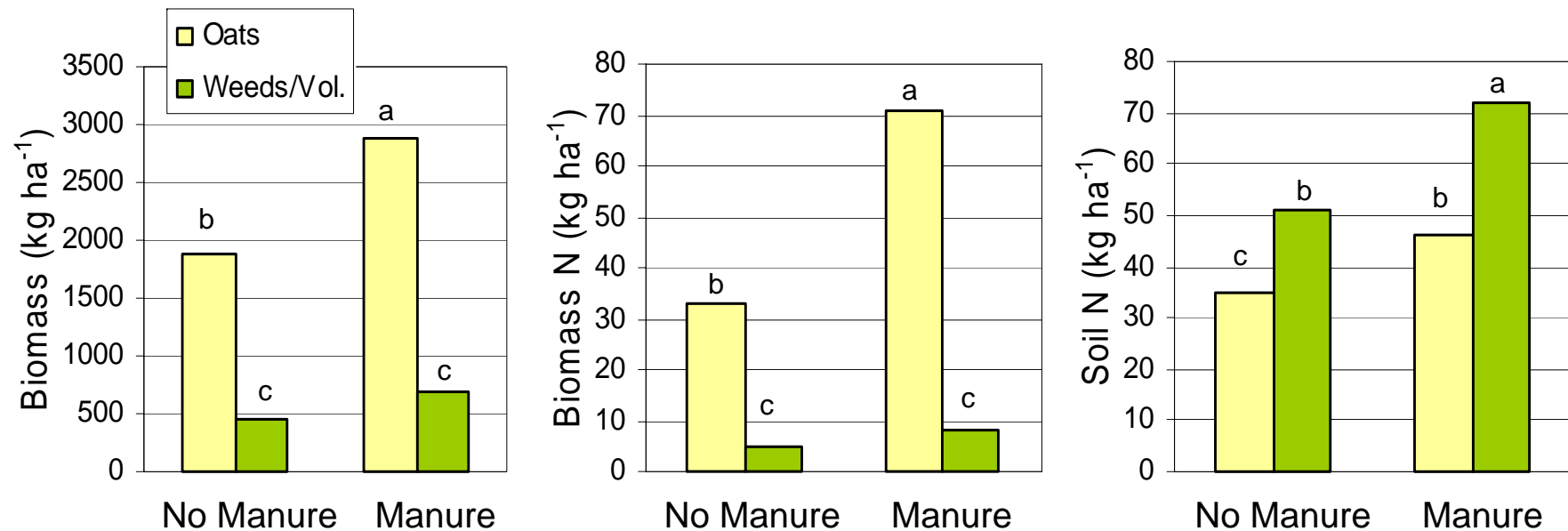
Manure Type	Sites	Corn Sites	Manure Properties			Soil Properties		
			Rate	NH ₄ ⁺ -N	Total-N	pH	P ₂ O ₅	K ₂ O
			kl / Mg ha ⁻¹	kg N ha ⁻¹	kg N ha ⁻¹		ppm	ppm
Liquid Cattle	5	5	74.3	125	234	6.8	34	124
Liquid Hog	11	8	46.4	139	185	7.1	38	146
Solid Cattle	7	4	48.3	61	304	7.3	26	142
Solid Poultry	7	5	10.3	56	283	7.2	39	150

- 22 sites evaluated for corn yield response
- All plots received the cooperator's starter N rate ranging from 0 to 30 kg-N ha⁻¹
- Cover crop/manure rate plots split
 - no nitrogen
 - 150 kg-N ha⁻¹ as sidedress UAN.



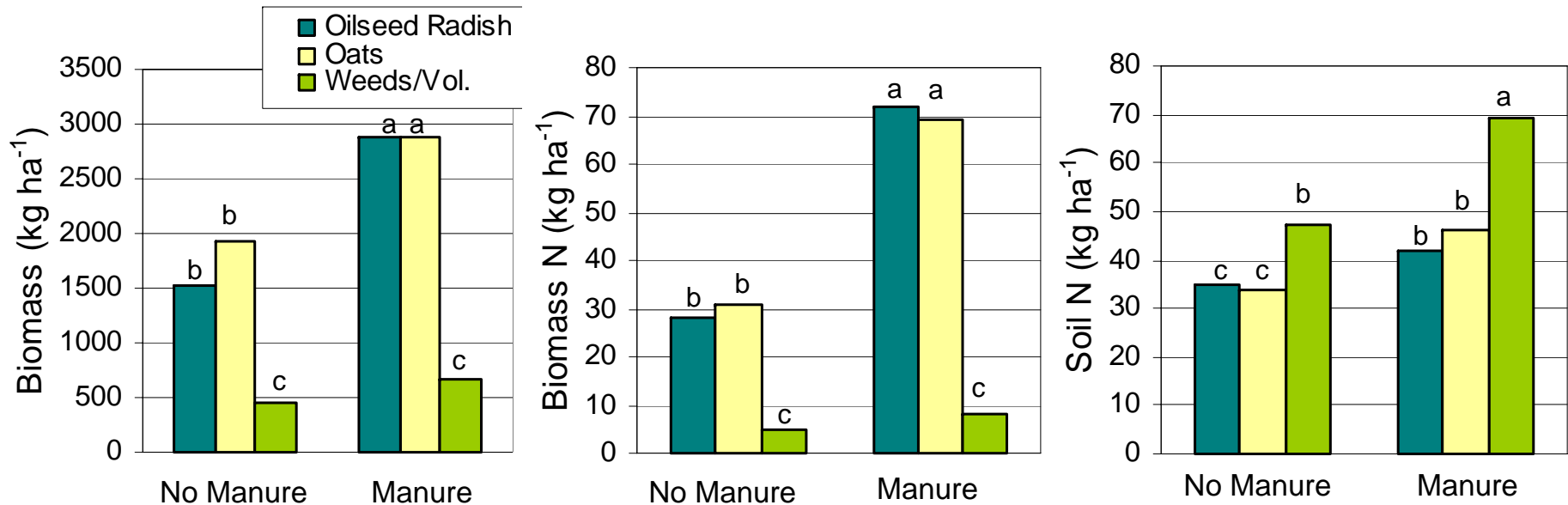
- Measurements
 - Cover crop biomass
 - End of season cover crop biomass N content
 - End of season soil N content
 - Corn yield
 - MERN estimation using delta yield approach similar to Lory and Scharf (2003)

Manure application and **oat** cover crop effect on biomass, biomass N, and soil N



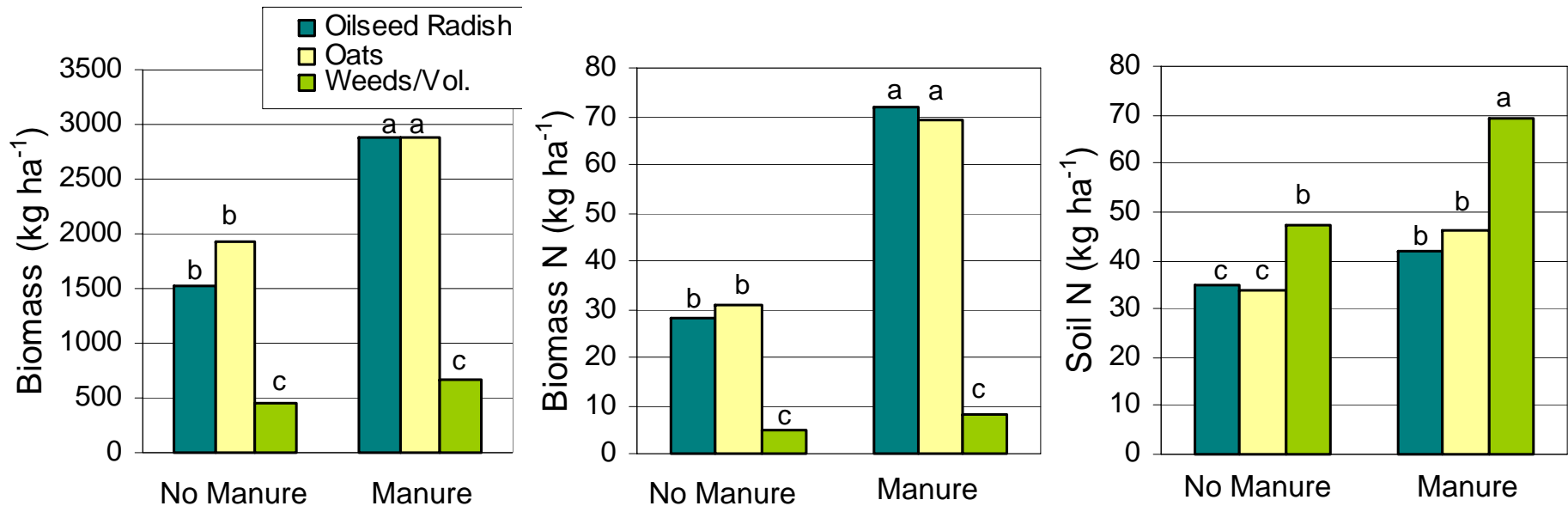
Biomass, biomass-N and soil N bars that contain the same letter are not different at the 5% level of probability. Statistical differences were identified using log(x+1) transformed data.

Manure application and **Oilseed Radish** cover crop effect on biomass, biomass N, and soil N



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Cover crop	C:N ratio	
	No Manure	Manure
Oilseed radish	24	18
Oats	28	19
Weed	19	16



No Manure

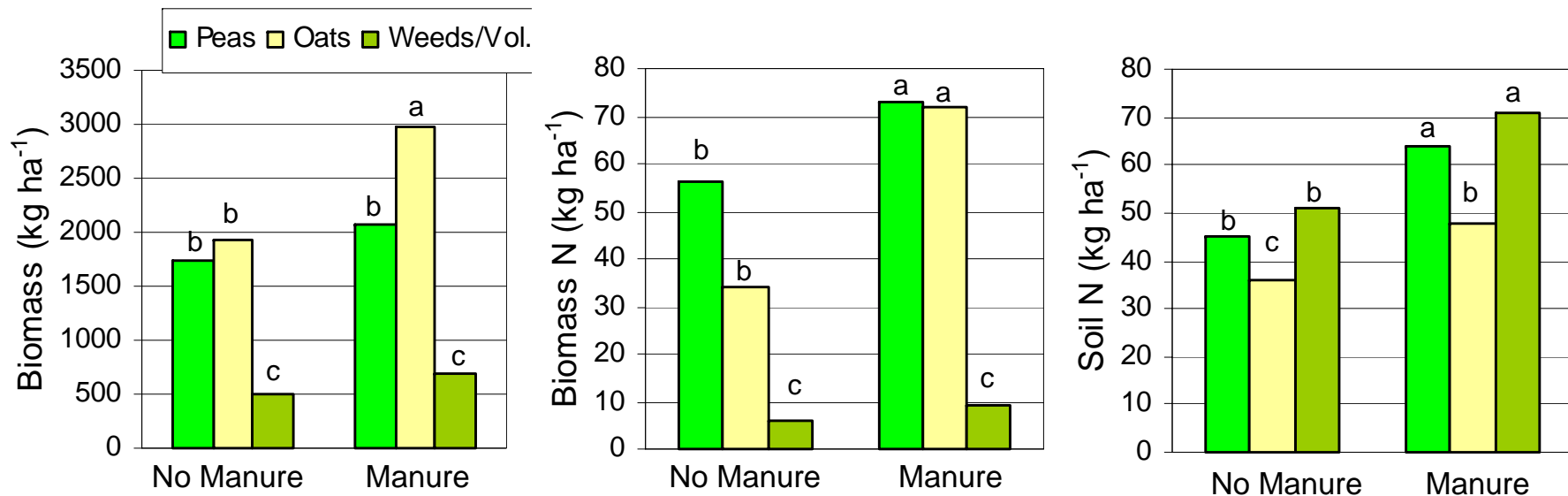
Manure

Manure application and **Field Pea** cover crop effect on biomass, biomass N, and soil N



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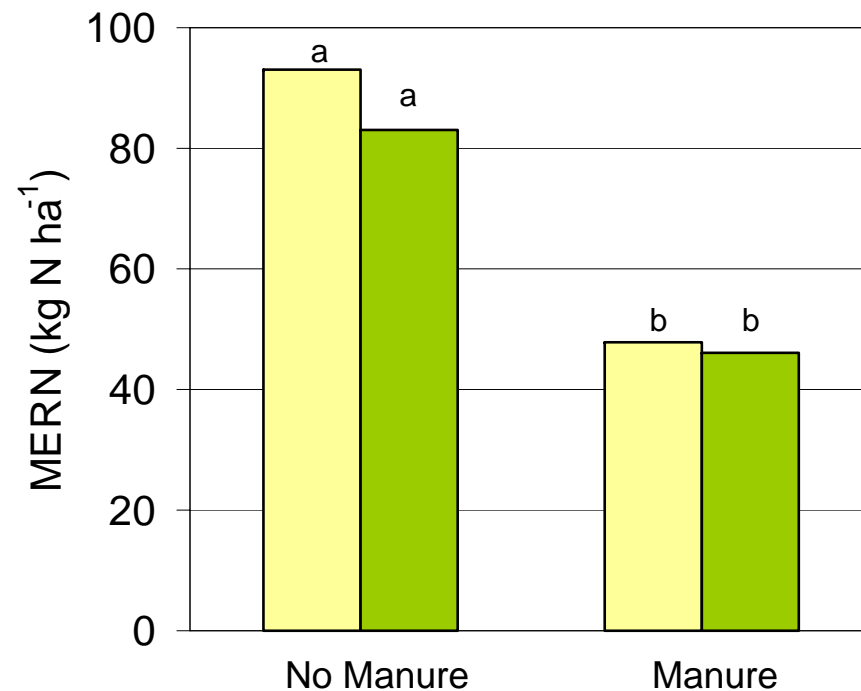
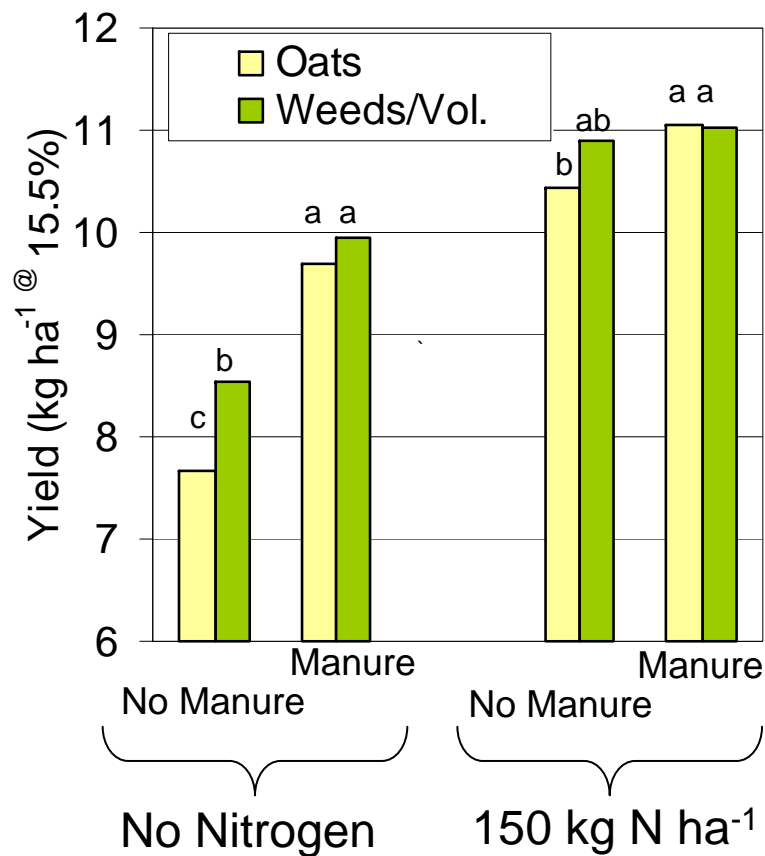
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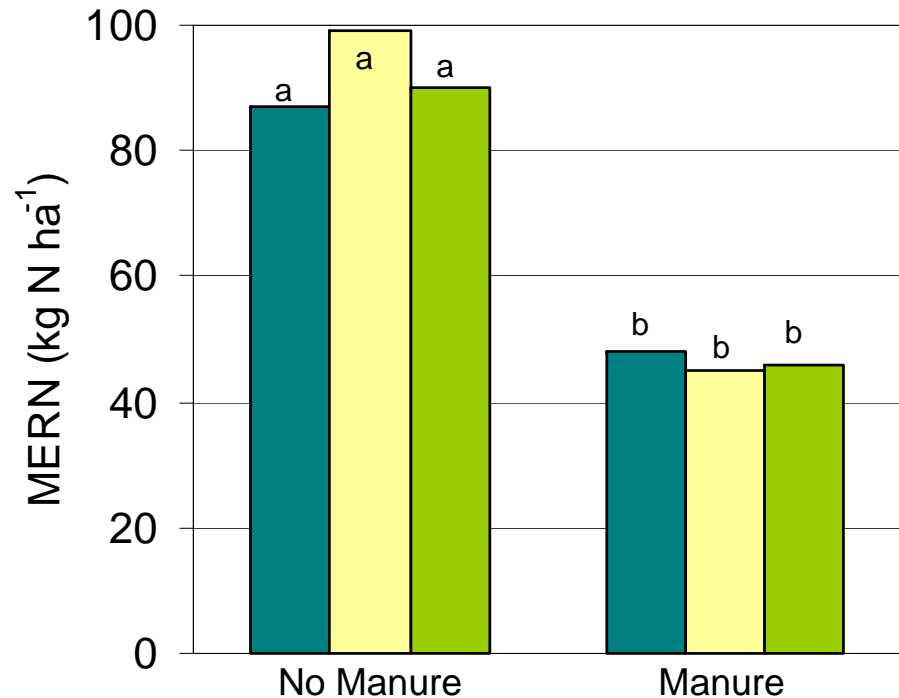
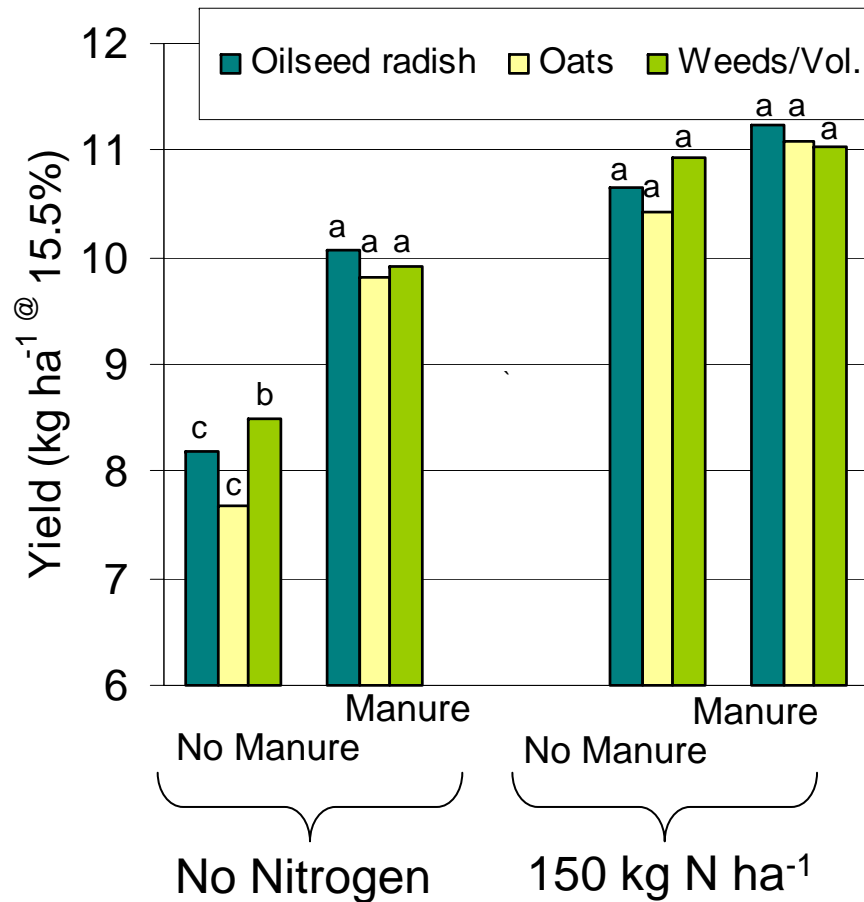
Cover crop	C:N ratio	
	No Manure	Manure
Peas	13	12
Oats	26	19
Weed	18	15

Manure application, **Oat** cover crop and nitrogen effect on corn yield and MERN



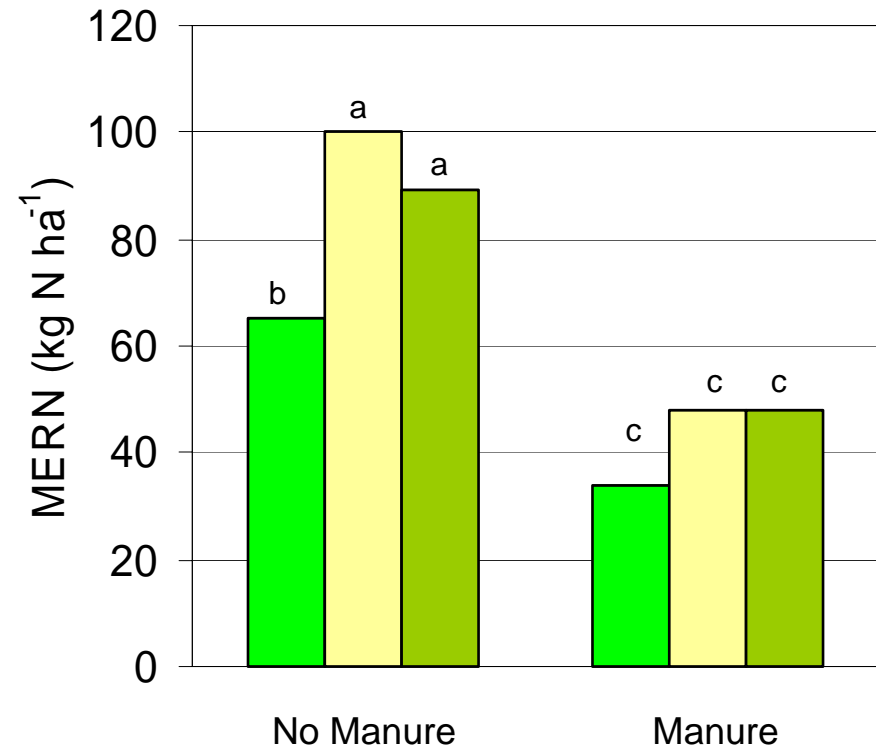
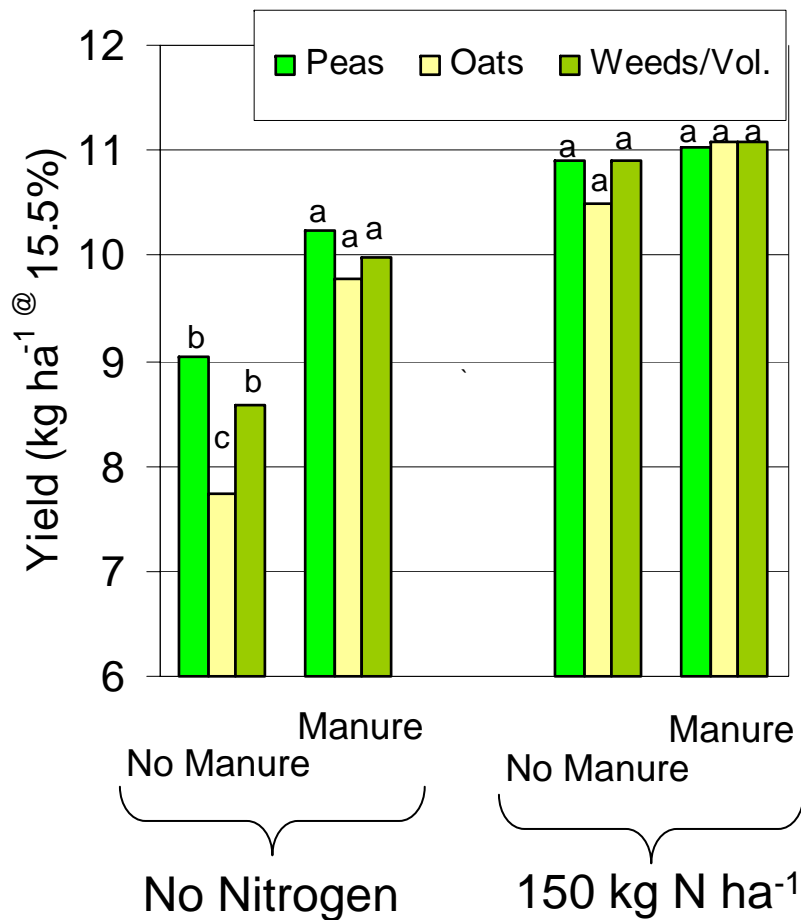
Yield and MERN bars that contain the same letter are not different at the 5% level of probability.

Manure application, **Oilseed Radish** cover crop and nitrogen effect on corn yield and MERN



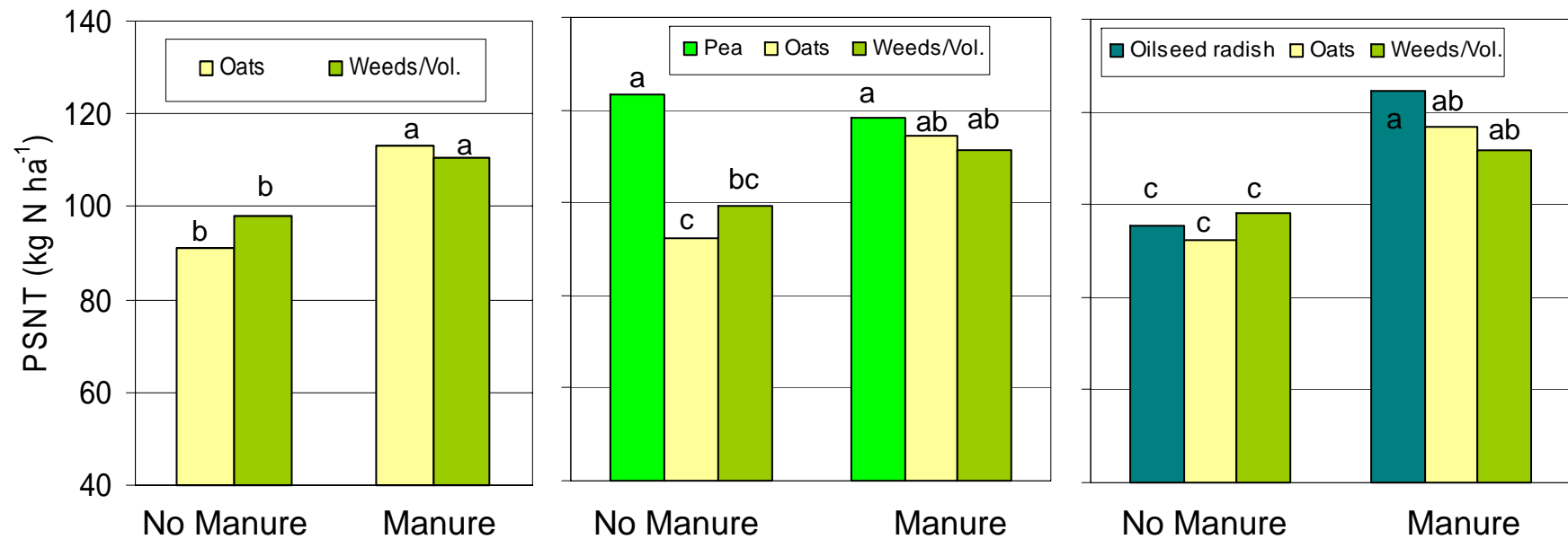
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Manure application, **Field Pea** cover crop and nitrogen effect on corn yield and MERN



Yield and MERN bars that contain the same letter are not different at the 5% level of probability.

Manure application, and cover crop effect on pre-sidedress soil nitrate



PSNT bars that contain the same letter are not different at the 5% level of probability.

Cover Crop/Manure Trial: Conclusions

- Oat pea and oilseed radish cover crops planted following fall manure application had increased biomass, sequestered nitrogen and reduced soil nitrogen
- Oat and oilseed radish did not reduce corn nitrogen fertilizer requirements
- Field pea reduced corn nitrogen fertilizer requirements by approximately 20 kg N ha⁻¹ when no manure was applied

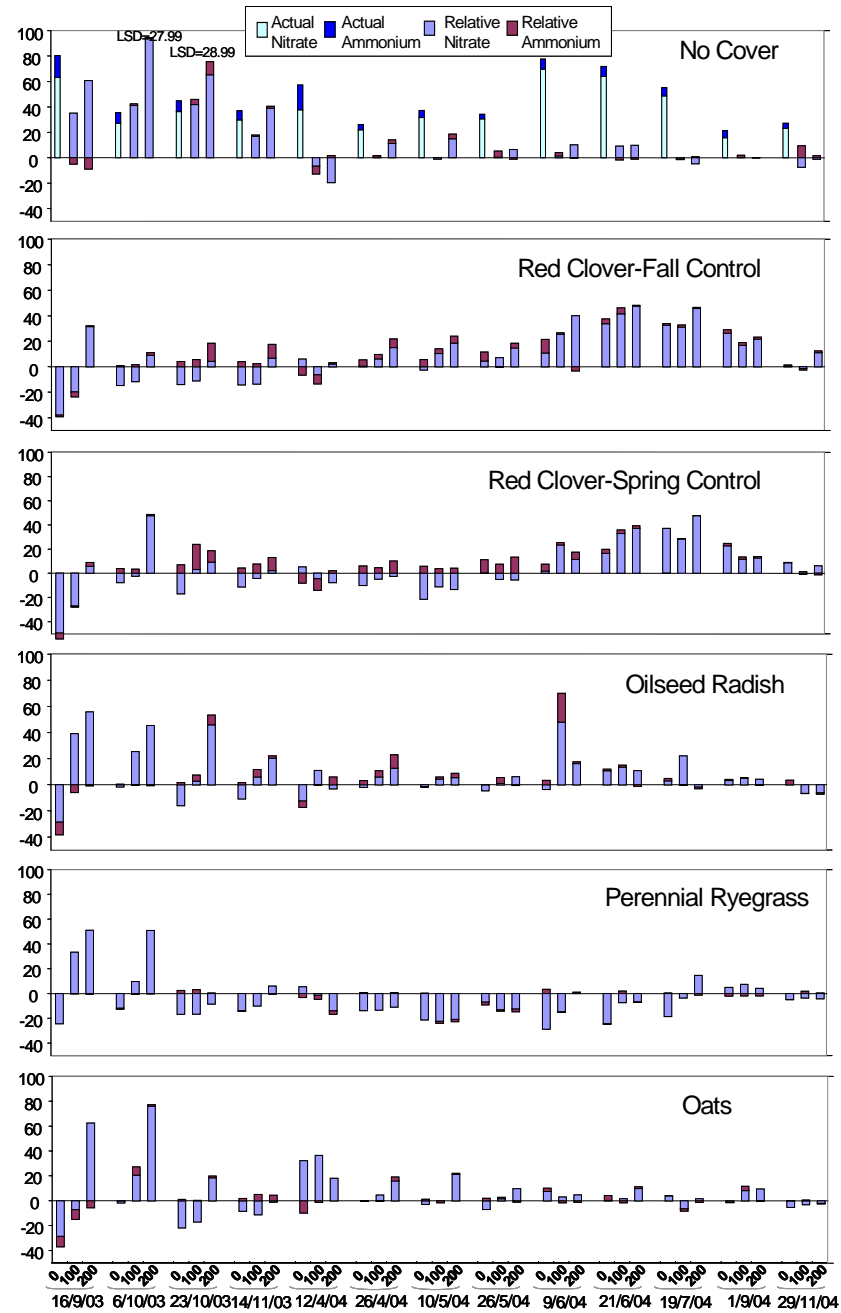
What About Red Clover?



Red Clover/Manure N



Impact of cover crops on PSNT soil nitrates.



Red clover effects on N credit, yield and profit of conventional-till corn¹

Corn Price ²	N Cost	Cover crop	MERN ³	MEY ⁴	Profit ⁵
\$ Mg ⁻¹	\$ kg ⁻¹		kg N ha ⁻¹	kg ha ⁻¹	\$ ha ⁻¹
150	1	No-Red clover	143	9454	1293
		Red clover	79	9886	1382
		Difference	**	**	**
100	1	No-Red clover	129	9338	823
		Red clover	74	9841	889
		Difference	**	**	**
150	1.5	No-Red clover	129	9338	1234
		Red clover	74	9841	1353
		Difference	**	**	**
100	1.5	No-Red clover	107	9068	773
		Red clover	63	9713	863
		Difference	**	**	**

¹ Analysis conducted using 19 paired comparison of red clover-no-red clover

² Corn price after drying, handling and marketing

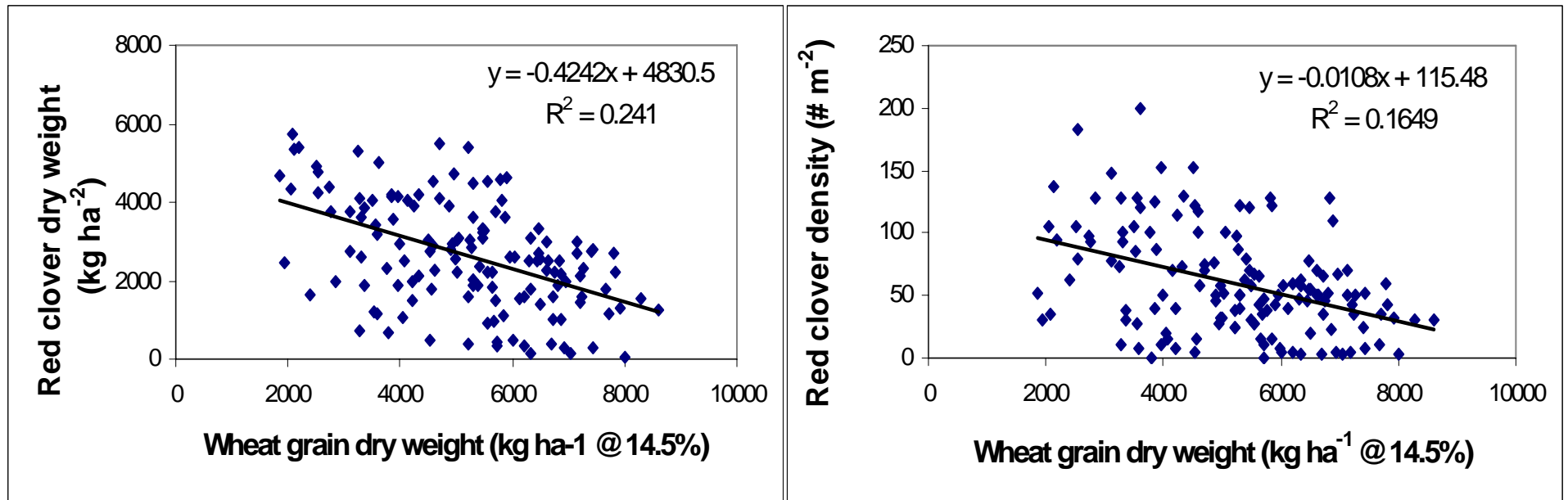
³ Maximum economic rate of nitrogen calculated using a quadratic function

⁴ Maximum economic yield at MERN

⁵ Profit based on nitrogen rate and corn yield at MERN and clover establishment cost of \$40 ha⁻¹

Poor red clover stands

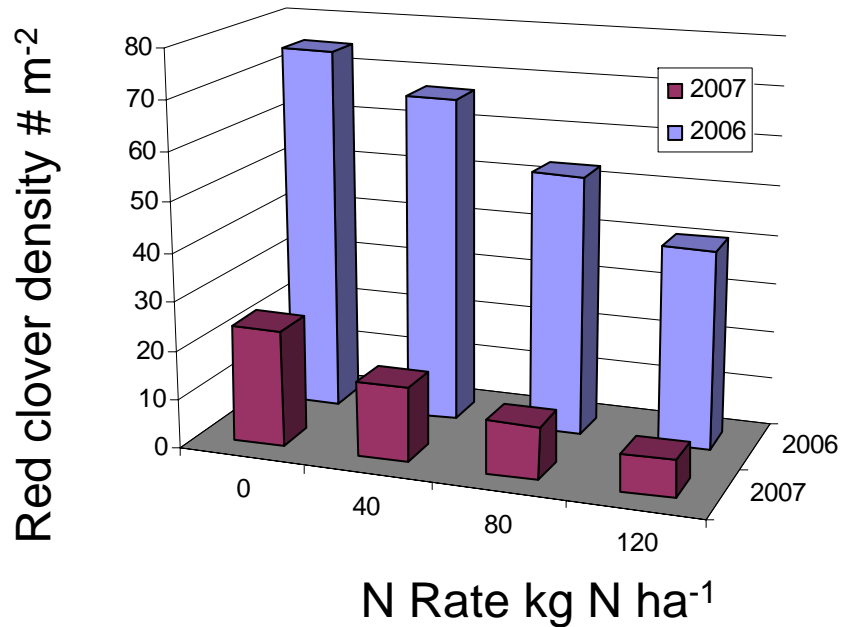




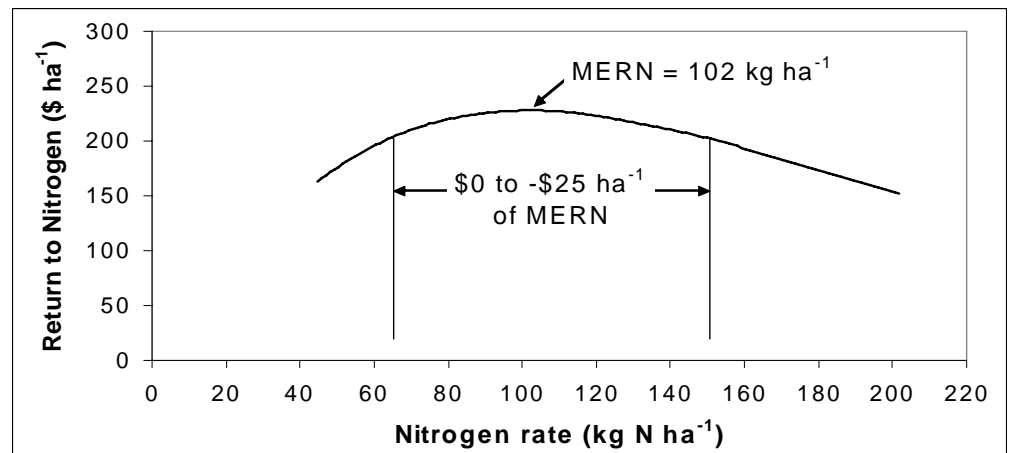
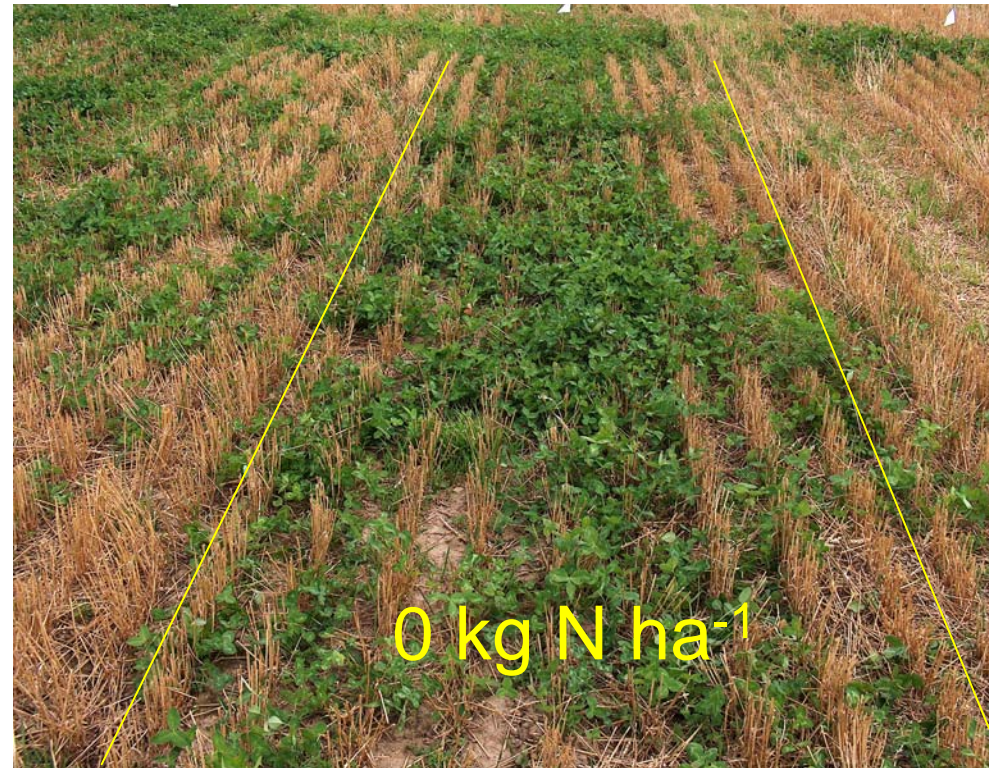
Effect of wheat yield on red clover stand and returns for winter wheat, 12 Ontario locations, 2006, 2007.

- Red clover application timing/frost tolerance
- Drilling versus broadcasting
- Wheat row configuration
- Wheat cultivar
- Wheat N rate
- Wheat tillage system
- Light versus drought competition

Nitrogen Effect on Red Clover



Effect of nitrogen rate red clover density, average of 12 Ontario locations, 2006, 2007.



Effect of nitrogen rate on returns for winter wheat, average of 12 Ontario locations, 2006, 2007. (N @ 1.00 \$Cdn kg⁻¹, wheat @ 114 \$Cdn t⁻¹)

Tillage Effect on Red Clover



Poor red clover stands – Variable N Application?

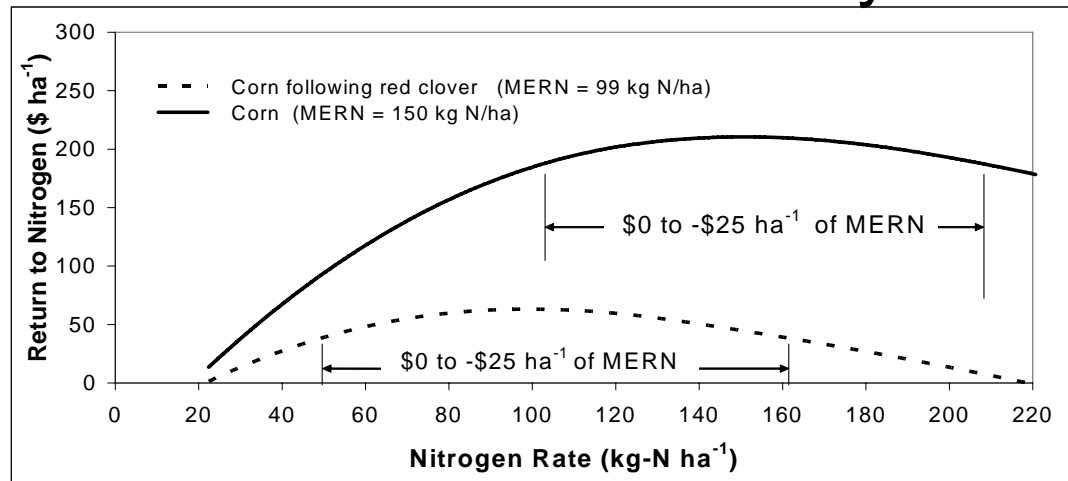


Key questions:

- What is the relationship between NDVI and N credit?
- What is the correlation between RC biomass and nitrogen credit?



Need for N credit accuracy?



Effect of nitrogen rate on returns for corn, average of 19 pair-wise comparisons between 1990-99. (N @ 1.00 \$Cdn kg⁻¹, corn @ 100 \$Cdn t⁻¹)

Questions?

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