CROPPING CONCEPTS
FEEDING FARMER INNOVATIONS

PNW OILSEED & DIRECT SEED CONFERENCE

IMPLICATIONS OF CANOLA CROPPING ON NITROGEN CYCLING IN SOIL

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WASHINGTON STATE UNIVERSITY EXTENSION

PACIFIC NORTHWEST direct seed ASSOCIATION

Canola: A rotational break crop

Benefits:

- 20% wheat yield bump
- Disease suppression

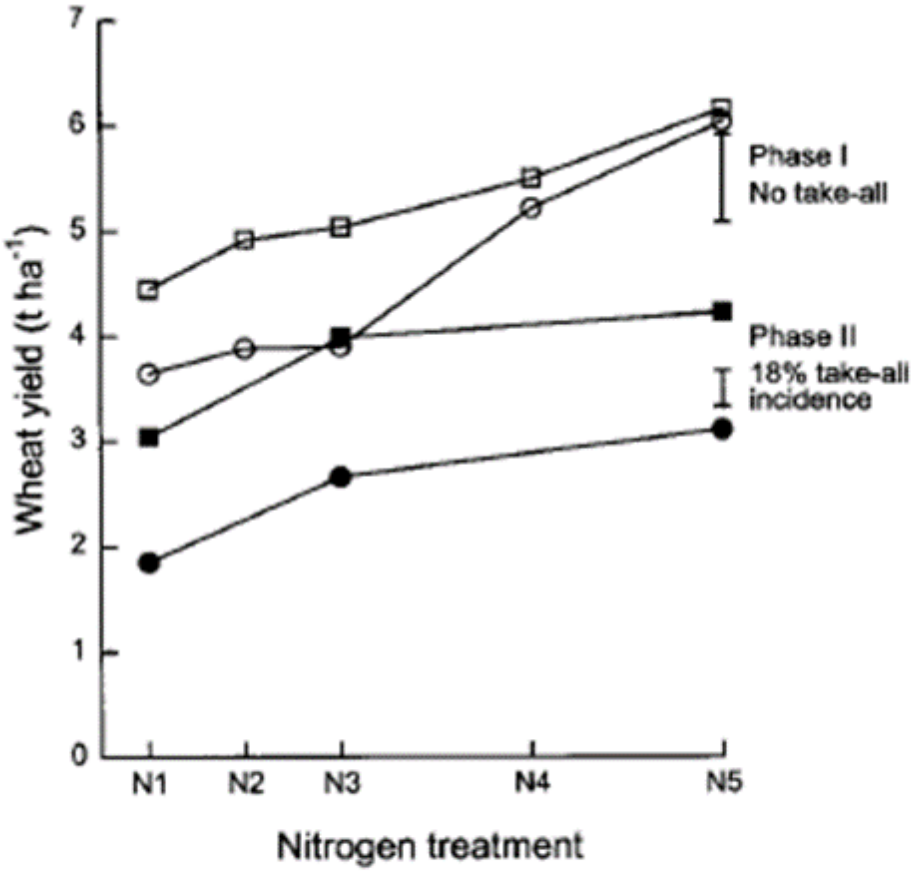

Fig. 3. Effect of increasing N availability (N1 to N5) at Dirnaseer on the grain yield of wheat following wheat (○) and canola (□) in phase I (absence of seedling root disease; open symbols) and phase 2 (in the presence of root disease; closed symbols). Vertical lines represent LSD for previous crop × N interactions.

Kirkegaard et al., 1997

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Canola root architecture

More soil water and N extracted from soil than wheat after wheat..

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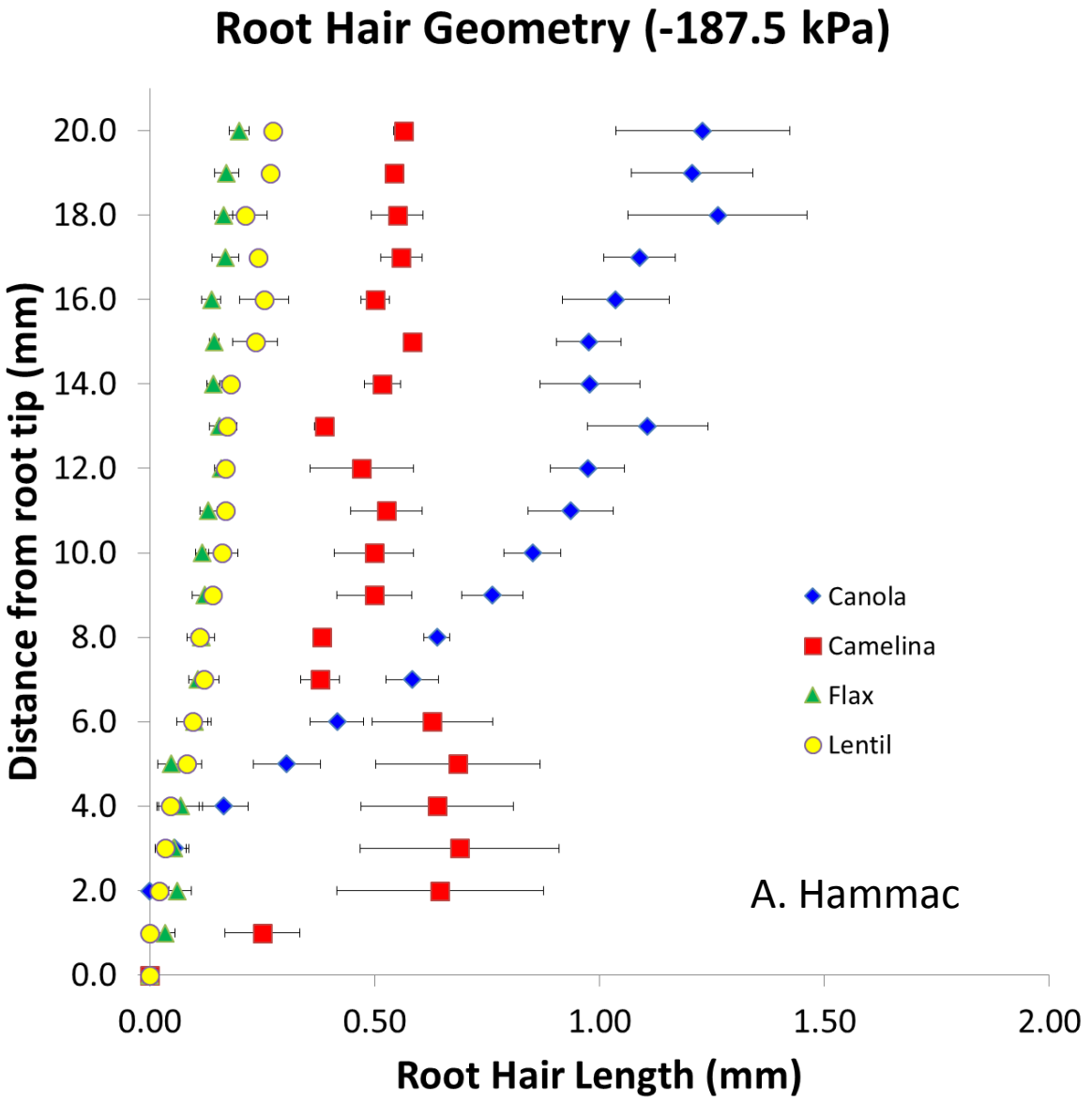

Potential shifts in nutrient management:

Canola Nitrogen (N) Use

	Canola	Soft white wheat (9% protein)	Dark northern spring wheat (14% protein)
	---------- Pounds of nitrogen [N] per 100 lbs of seed ----------		
Uptake by the plant	5.8	2.3 (1.35 lb/bushel)	3.2 (1.8 lb/bushel)
Removal in the seed	3.4	1.6 (1.0 lb/bushel)	2.5 (1.5 lb/bushel)
Difference *(left in field)*	2.4	0.7	0.7
Recommendation*	5 to 11	4.5 (2.7 lb/bushel)	6.0 (3.6 lb/bushel)

*from various university fertilizer guides for canola and WSU guides for wheat

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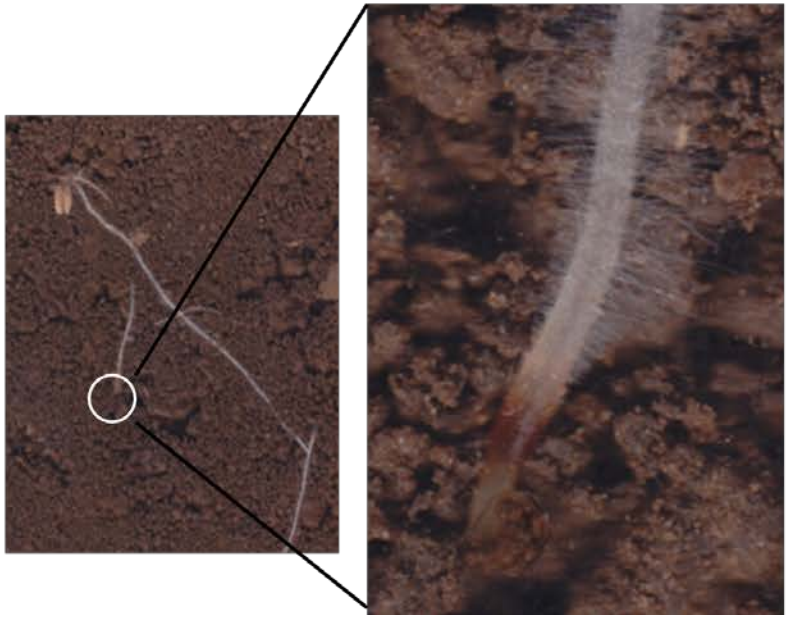
Potential shifts in nutrient management

Test	Garbanzos	Lentils	Peas	Spring canola	Soft white spring wheat
Bray 1 (ppm)	P_2O_5 (lb/ac)				
0-20	60	50	60	60	60
20-30	40	30	40	40	40
30-40	20	10	20	20	20
>40	0	0	0	0	0
K test ppm	K_2O (lb/ac)				
0-50	90	70	80	80	80*
50-75	60	40	60	60	60
>75	0	0	0	0	0
SO_4-S (ppm)	S (lb/ac)				
0-10	20	5	20	25	20
>10	0	0	0	0	0
Boron	B (lb/ac)				
<0.5 ppm	1	1	1	1-1.5	NA
Molybdenum	Mo (ounce/ac)				
Seed treatment	1	0.50	0.50	NA	NA

* 0-35 ppm of K test; Source: Various fertilizer guides by Mahler and Guy, University of Idaho Extension

Root Apex NH_3 Toxicity



Canola

Wheat

Pan, 2013

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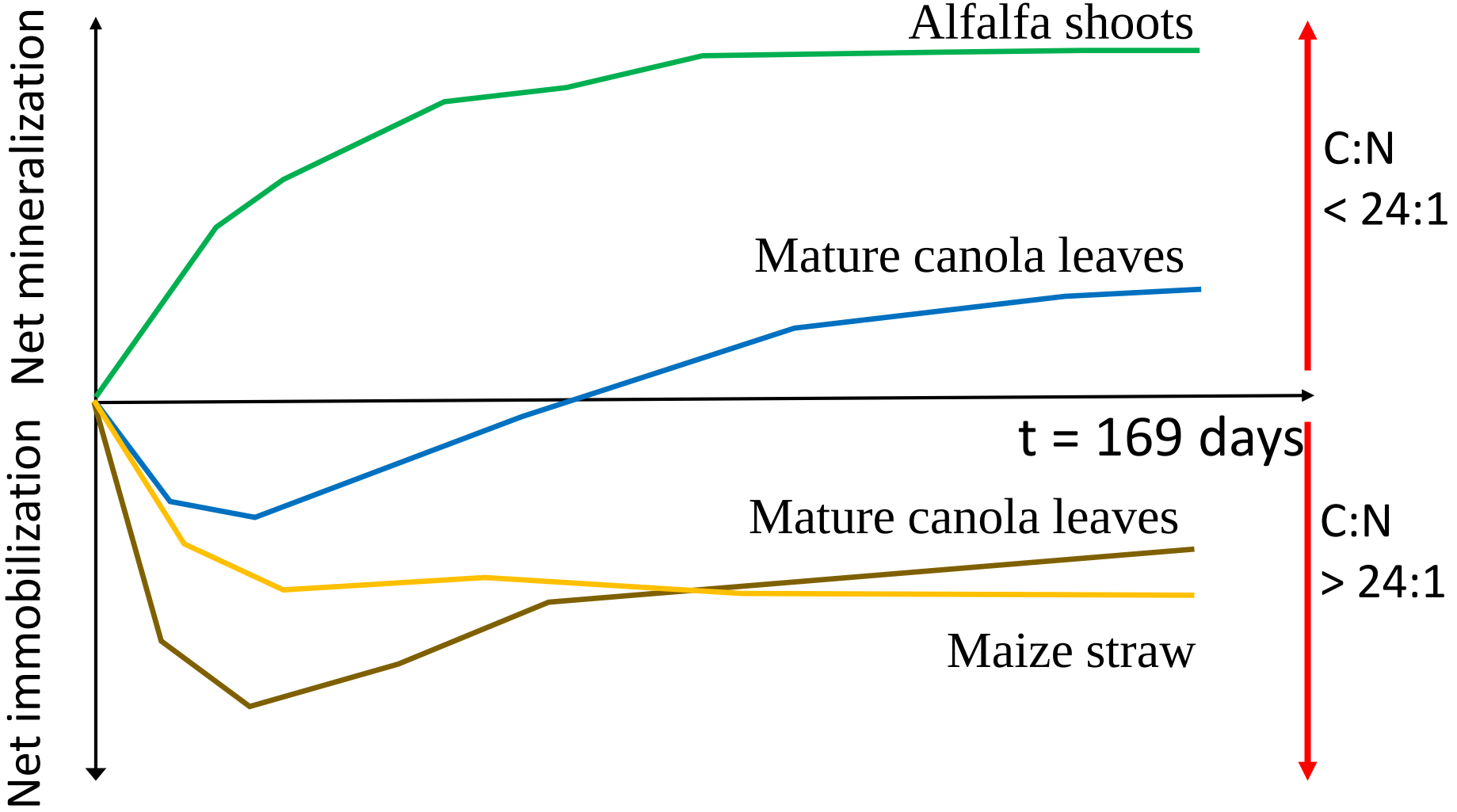
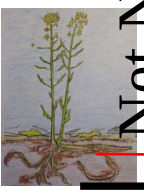
N dynamics following canola…..

Crop residues and N dynamics



Trinsoutrot et al., 2000

N cycling in cropping sequence with canola



Net N mineralization

Net N immobilization

(Turnover of canola residue after more than 1 year)

C:N 50:1

(Short-run < 1 year)

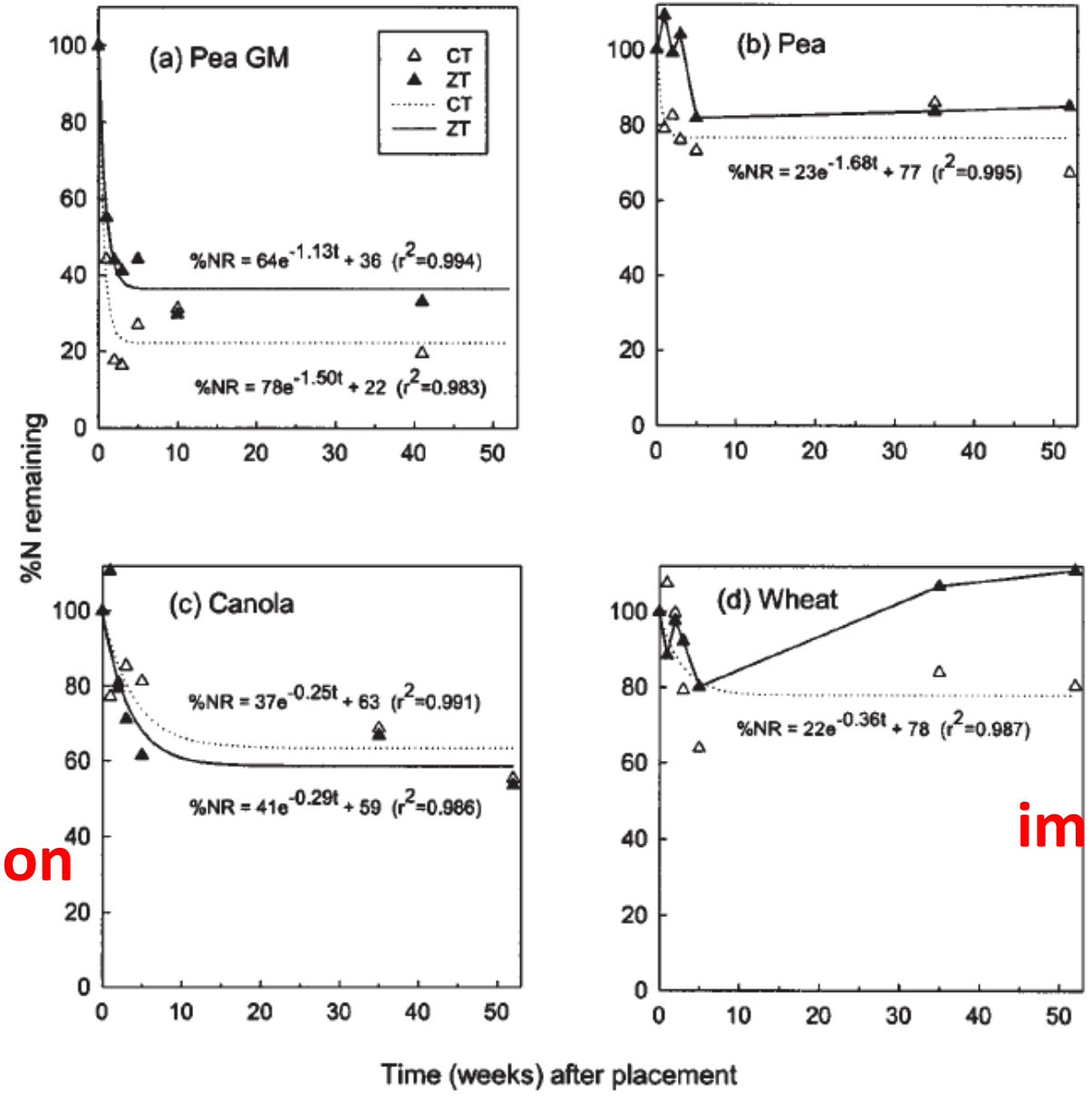
Time

(Long-run > 1 year)

C:N 90:1

(Engstrom, 2010; Lupwayi et al., 2006, Sieling et al., 2006, Sieling et al., 1999, Soon and Arshad, 2004; Jensen et al., 1997; Lupwayi et al., 2006; Trinsoutrot et al., 2000ab, Singh et al., 2006)

… N-sequestration???

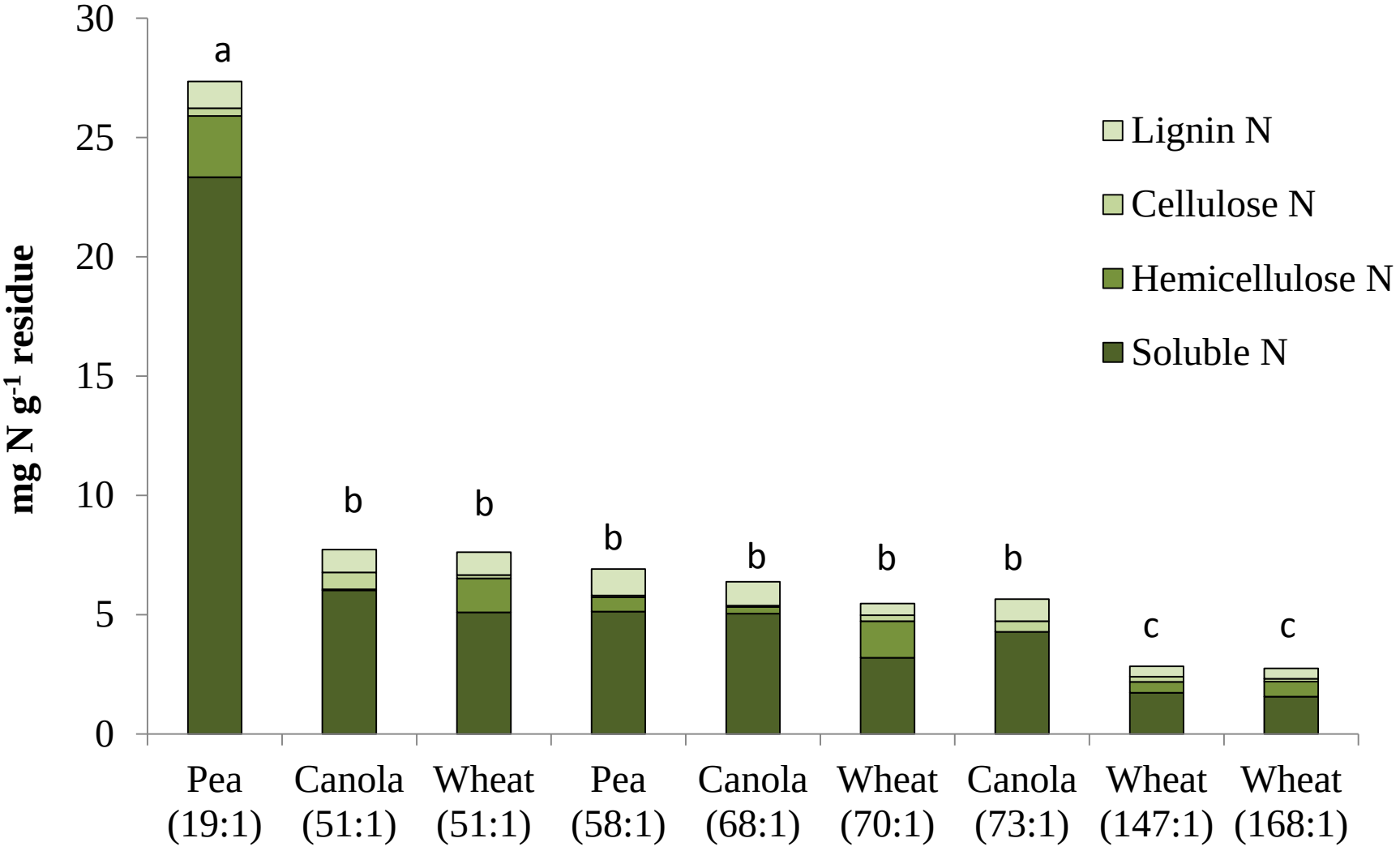


Release then stabilization

Release then stabilization

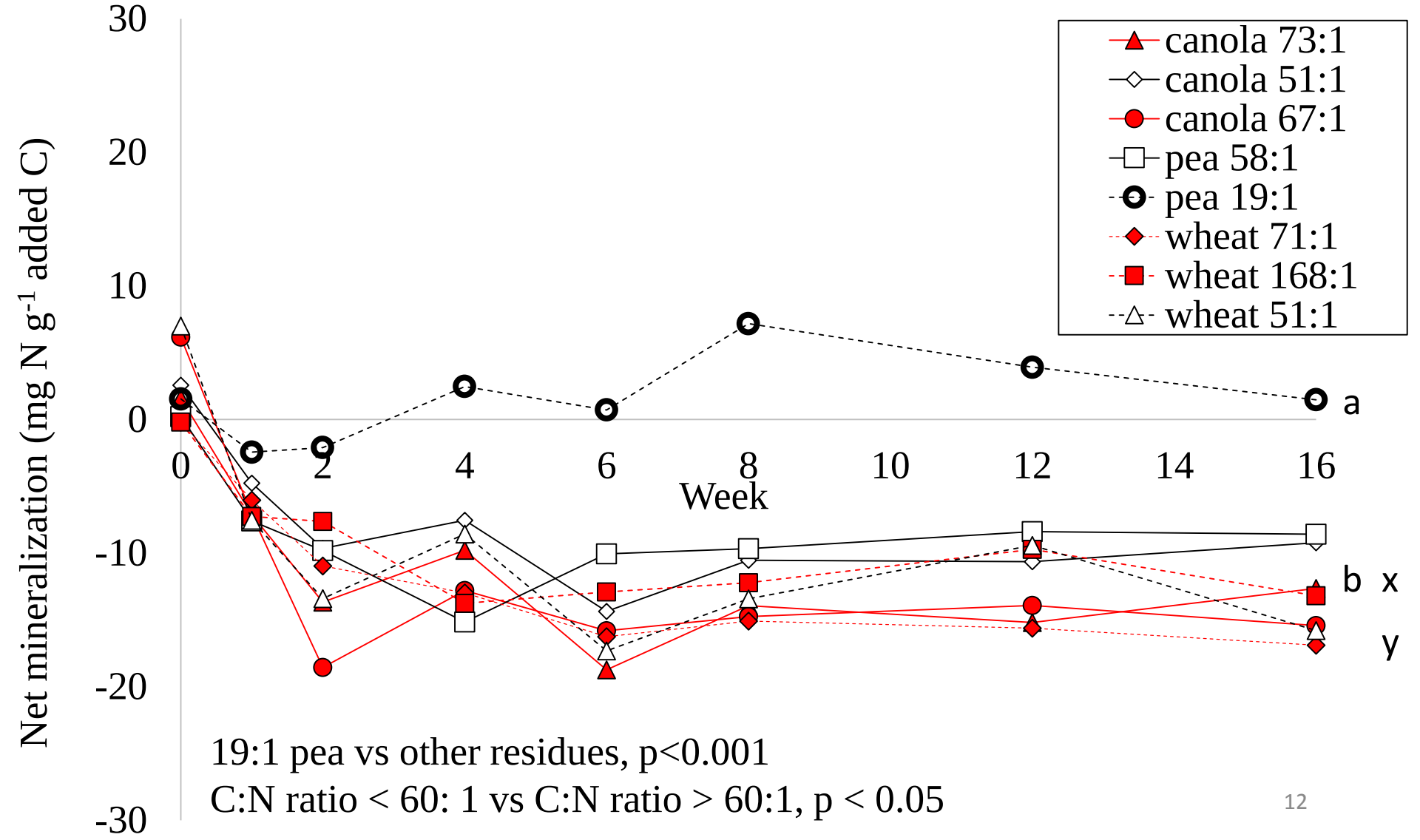
Net N immobilization

N partitioning (McClellan Maaz, 2014)



Mean separation by Tukey HSD, n =4

N dynamics



19:1 pea vs other residues, $p<0.001$

C:N ratio < 60: 1 vs C:N ratio > 60:1, $p < 0.05$

Predicting N release

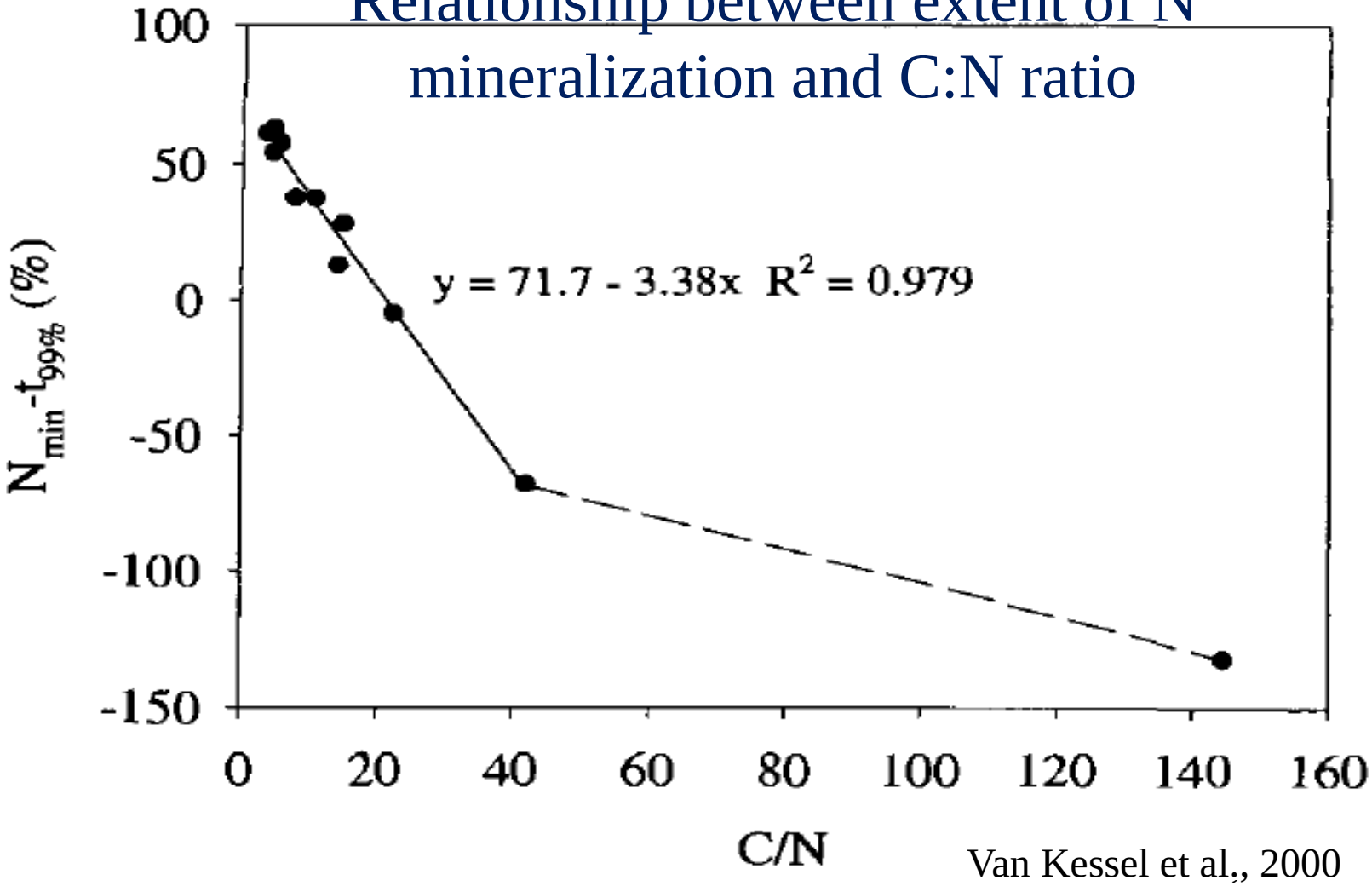
N tie up correlated with:

- Water extractable N
- Dissolved organic N
- Soluble N
- Total N

Not C:N ratio

How to predict N tied-up during residue decomposition?

Relationship between extent of N mineralization and C:N ratio



Van Kessel et al., 2000

Predicted differences in net N immobilization

Citation	Crop	Residue (kg ha^{-1})	%N	%C	Predicted N debit (kg N ha^{-1})
	canola	2900	0.66	43.9	16.1
Lupwayi et	pea	2290	0.95	42.1	10.1
al., 2004	wheat	1620	0.61	45.4	9.6
	canola	2300	0.70	49.7	14.1
	pea	5830	0.71	46.9	33.5
	wheat	4750	0.50	48.5	32.0
Soon and	canola	3290	0.59	47.5	20.6
Arshad,	pea	4340	0.72	38.8	20.6
2002	wheat	4230	0.40	42.0	26.0
Malhi and	canola	5339	0.55	44.8	32.3
Lemke,	pea	2636	1.38	41.9	7.9
2007	wheat	7426	1.02	44.2	32.4

Calculated from y= -7.6652%N+17.711

Conclusions

- All residue types resulted in initial N immobilization
- Extent of N immobilization was related to N partitioning into fiber fractions
- Interaction between quantity and quality of N fractions in crop residues affects soil N cycling

Questions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