Canola Soil Fertility Management

Image by Sophia Flikkema

Northeast Montana Pulse Plot Tour, June 30, 2017
Valley County Extension

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Why am I giving a CANOLA talk in a PULSE workshop?

- I've presented on pulse fertility at this Pulse Plot tour before
- Planned canola acreage increased this year
- Nutrient management of canola is quite distinct from both small grains and pulses
- Shel asked me to ☺

Question for you:
Why are there relatively few acres of canola in MT?

Objectives

We will discuss the following:

1. General soil preferences
2. How canola needs differ from small grain
3. Nutrient considerations for canola in rotation
4. Soil fertility management using the right rate, source, timing and placement

Optimum soil conditions for canola

1. Soils with adequate infiltration and aeration
2. Low to moderate sodium and salt content (up to 6 mmhos/cm before yields decline) = similar to small grains, far more tolerant than pulses
3. Minimal tillage, continuous and high diversity rotations to keep residue on surface preventing crusting, and interrupt disease cycles

Goal of soil fertility management

Synchronize nutrient supply (amount and timing) from soil and fertilizer, with plant nutrient demand. However there are:

Sources of variation

- Cultivars
- Soil variability
- Soil & tissue testing methods and labs
- Rate of nutrient supply from fertilizer & SOM
- Weather

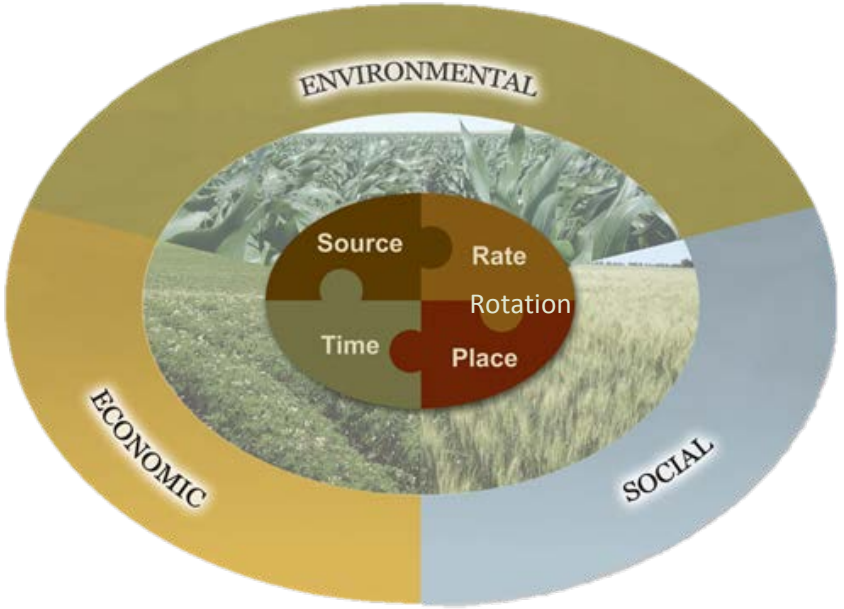
Additional unknowns

- Fertilizer use efficiency
- Nutrients lost to water, air and soil erosion

Use the 5 R's to aim for the best results

5 R's of fertilizer management

1. Rotation
2. Rate
3. Source
4. Timing
5. Placement



Soil nutrient considerations for crop rotations that include canola

Nutrient	Consideration
Nitrogen (N)	Can be provided by a legume
Phosphorus (P)	Canola and alfalfa are good P scavengers, deplete P for next crop
Potassium (K)	Canola leaves behind high K residue
Sulfur (S)	Canola is a good scavenger, depletes S for next crop
Other	Canola can reduce P, copper (Cu) and zinc (Zn) uptake by subsequent mycorrhizal crops (e.g., flax, legumes, small grains to a lesser extent)

Canola relative yields after other crops

Based on research at Mandan, ND, average over 4 rotations

	Crop to be grown			
Residue	SW, Barley	Pea, Lentil	Canola	Sunflower, Safflower
SW, Barley	1.00	1.19	1.09	1.81
Pea, Lentil	1.02	1.00	1.16	2.04
Canola	0.99	1.00	1.00	1.67
Sunflower, Safflower	0.95	0.99	1.00	1.00
Average	0.96	1.05	1.04	1.67

Adapted from Tanaka et al., 2005 and 2007, by K. McVay

Questions?

On to *tools to determine fertilizer needs and deficiencies*

Start with a realistic yield goal

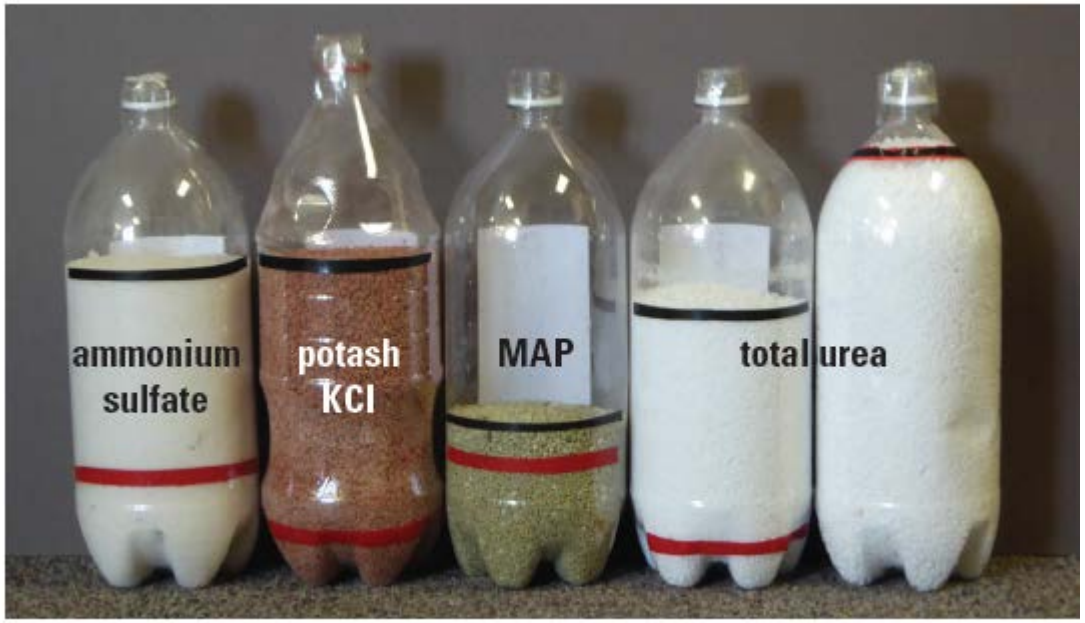
- Use MSU's NARC variety trials (http://agresearch.montana.edu/narc/varietytestingreports/variety_testing_reports_by_year.html), or successful local producers' experience
- Past yields indicate future performance
- Having ability for in-season N application allows conservative yield estimate for pre-plant rate
- Then look up how much is needed to produce a bushel of seed:

  (soil + in-season organic matter decomposition + fertilizer)

How much fertilizer is removed by canola plant and a bushel of canola seed?

Total in mature plant to produce one bushel seed.

Removed by one bushel seed.



	lb/bushel			
	S	K_2O	P_2O_5	N
Total uptake	0.9-1.2	4.1- 4.2	0.9-1.2	2.7-2.9
In seed	0.2-0.4	0.5-0.6	0.7-1.2	1.5-1.9
MSU Fert Guideline lb N/bu				~ 3.25
Canola Council of Canada lb N/bu				2.9-3.5

Next step: soil testing

- Help calculate fertilizer rates
- ID nutrient deficiency or imbalance
- Save on fertilizer cost
- Decrease environmental risks
- Take to 2 ft depth for N and S, 6” for P and K
- Consider sampling N to 3 ft if didn’t reach yield goal on previous crop or two

Ideally soil test in spring; fall soil tests can lead to over or under-fertilized fields

High N crop residue and/or high O.M.

Mineralization

Over fertilized

Over winter

High Precip

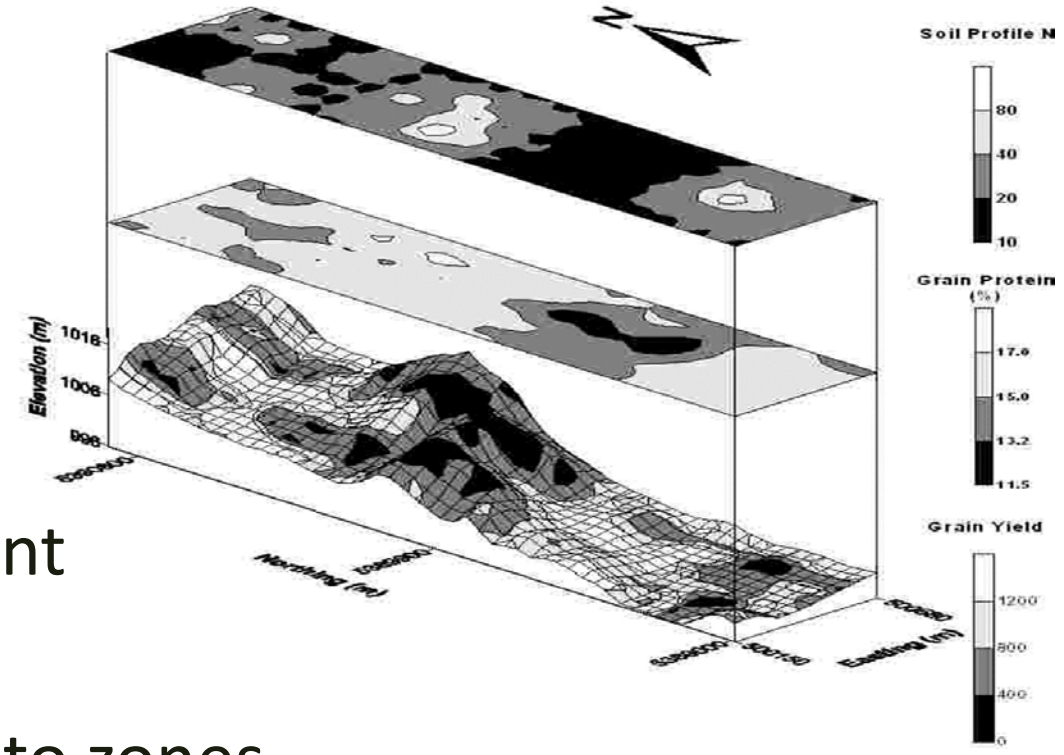
High N on shallow or coarse soil

Under fertilized

N leaching (or N_2 gas losses?)

Compare fall with spring a few times to see patterns of loss or gain for given pastures/rotation

Variable rate N application (Zone or site specific farming)



- At this time economic advantage is inconsistent (and hard to study)
- Is best to divide field into zones of low, med, high productivity
- NDSU has bulletin series on Zone farming SF1176 series at www.ag.ndsu. edu/publications

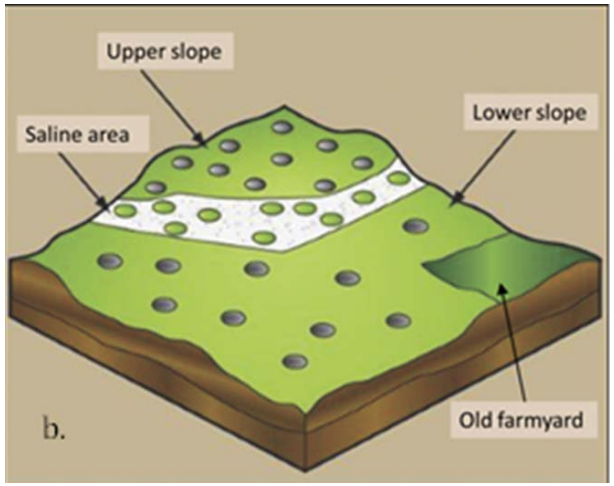


Image adapted from IPNI 2012

Tissue tests and optical sensors

Tissue sufficiency: levels are published, but too much variation in cultivars, plant growth stage, time of day to make reliable nutrient management decisions based solely on tissue testing.

Optical sensors: the technology is here, the correlations between sensor readings and N fertilization recommendations not yet for MT

Plant symptoms – once symptoms appear, yield may already be compromised

Boron

R. Karamanos

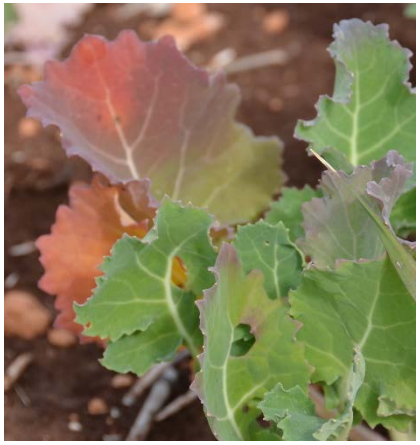
Nitrogen

GRDC Canola Guide

Sulfur

Gov. W. Aust., T. Potter

Phosphorus



IPNI, El Gharous

Potassium

IPNI, Roberts

Sulfur

R. Karamanos

Questions?

On to *calculating fertilizer rates*

N rate adjustments

- Stubble: small grains stubble high carbon to N (C:N). Adjust fertilizer N up or down?

  10 lb N/1000 lb stubble up to 40 lb N
- Fallow: assume ½ of stubble has decomposed over previous year when adjusting
- SOM: 15 – 20 lb N credit per % >2%
- After legume rotation:

  Adjust fert up or down?

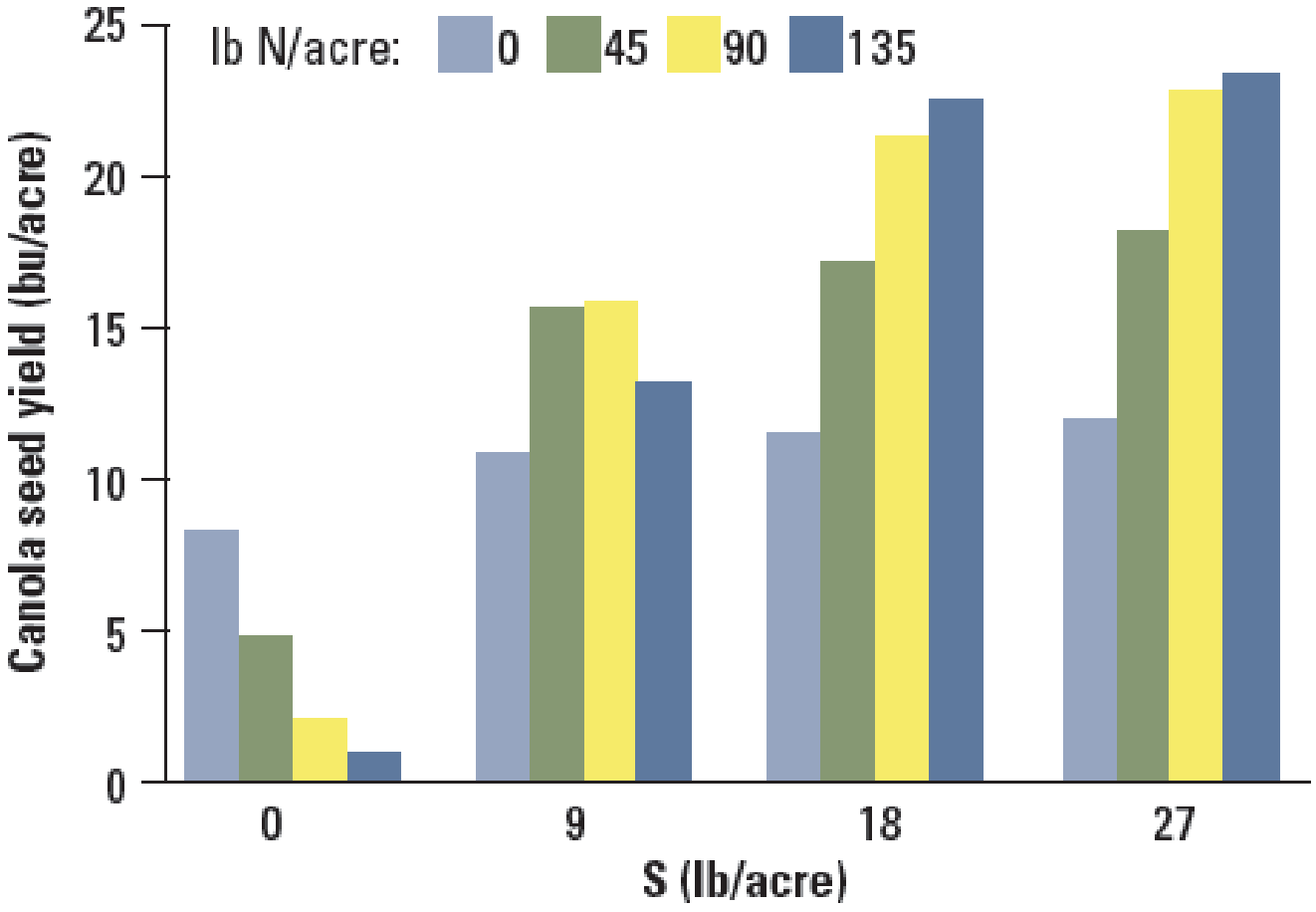
  Legumes credit (add) N

Crop	N credit (lb N/acre)
Pulse grain 1-2 x	~10
Pulse grain ≥ 3 x	~20
Pulse cover 1-2 x	20-30
Pulse cover ≥ 3 x	30-50
Alfalfa	40

Example N rate calculations depending on previous crop

	Spring wheat	Grain pulse grown 1x	Legume cover crop grown 1x
Canola yield goal (bu/ac)	18	20	23
Total soil N recommended (bu/ac x 3.25 lb/bu)	58	65	75
Spring soil N (lb/ac)	20	35	50
N credit (lb/ac)	0	10	25
Fertilizer N (lb/ac)	**38**	**20**	**0**

Canola can only respond to N if S is not limiting; S helps most when N is sufficient



N:S of 7:1 only helpful if both are deficient, otherwise irrelevant

(Karamanos et al., 2007)

Open pollinated variety, N and S broadcast and incorporated just prior to seeding. Malhi et al., 2007

S for canola

S deficiency image by R. Karamanos

- Base S rate on field history, crop appearance, response to test strips, tissue & soil testing.
- S varies greatly across a field – but if <20 lb S/acre (to 2 ft. depth) then likely limiting
- 18-20 lb S broadcast at seeding or 9 lb S/acre w/seed (BEWARE – very sensitive to seed placed fertilizer)
- 0.5 lb S/bu yield potential as 8-0-0-9, 21-0-0-24, or 12-0-0-26 (amm thiosulfate) as an in-season rescue through rosette (Janzen and Bettany, 1984)

P and K guidelines depend on soil test levels and do not vary with yield potential

Banded P and K fertilizer guidelines

Olsen P (ppm)	P_2O_5 (lb/acre)
0	45
4	40
8	35
12	30
16	25
>16	0.9 lb P_2O_5/bu or 10 lb/ac w/seed

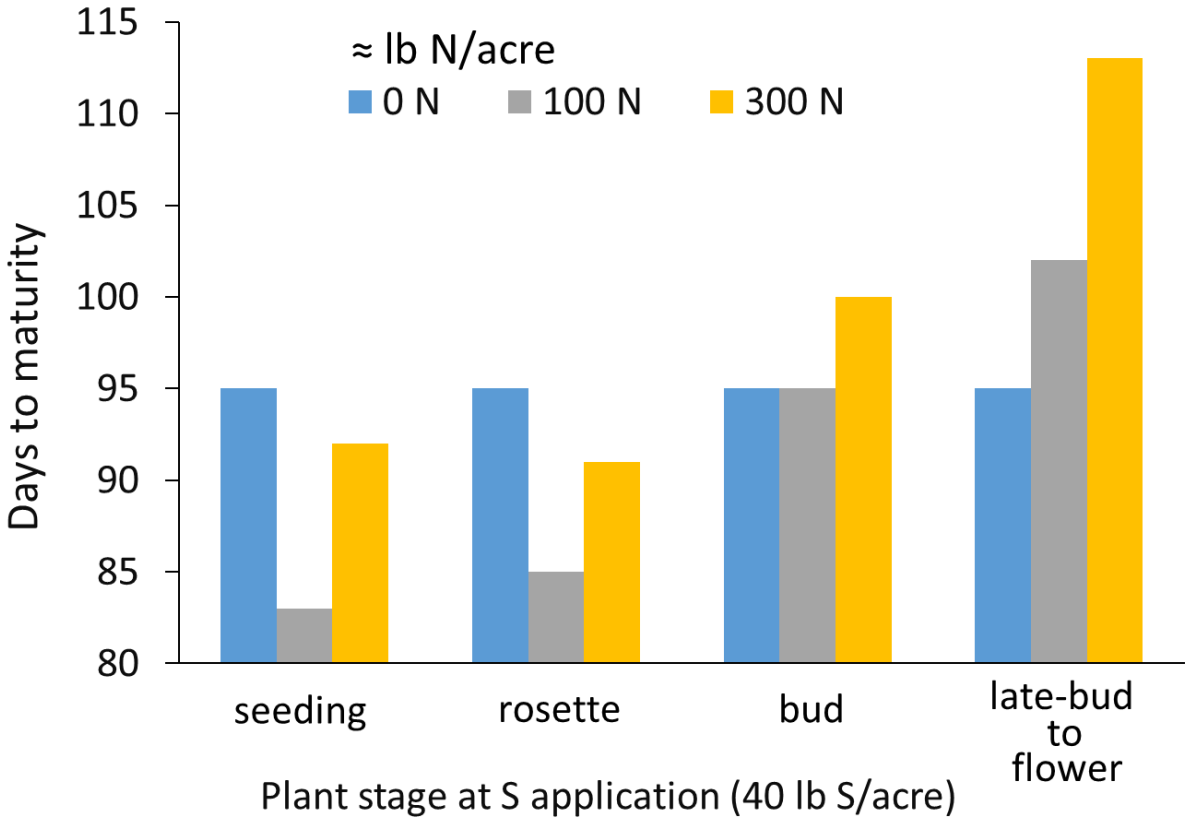
K (ppm)	K_2O (lb/acre)
0	45
50	40
100	35
150	30
200	25
250	20
> 250	0.5 lb K_2O/bu

More if surface broadcast, especially at low soil levels

Application rates depend on source, placement and timing (coming later)

Can soil fertility affect canola maturity?

- Starter P important for an early start
- Excess N slows maturity, especially in dry years or with delayed seeding



- Sufficient S needed before elongation stage for earlier maturity, insufficient S extends flowering period

(Janzen & Bettany, 1984, greenhouse study)

Questions?

On to *Source*

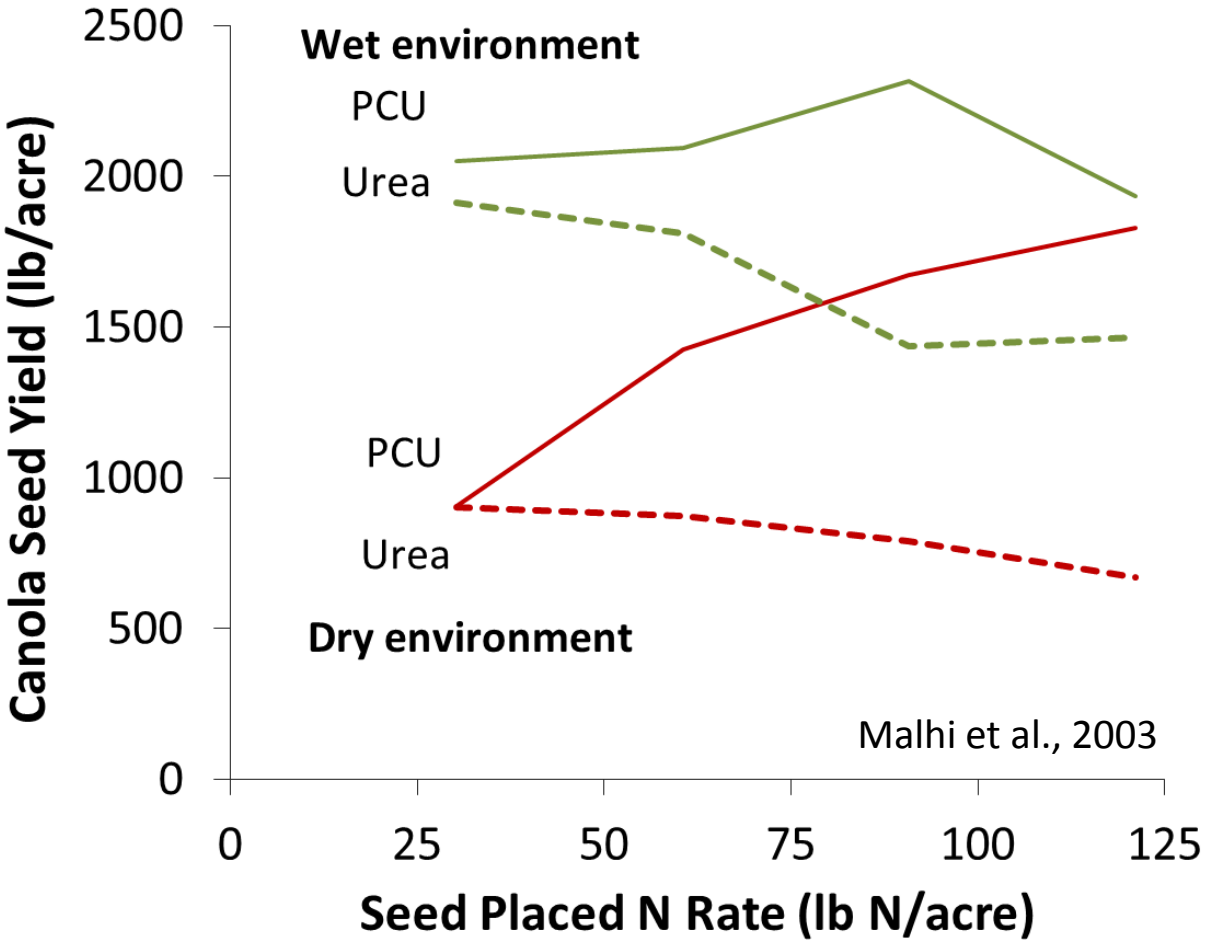
N source

Select readily available N, e.g., urea (46-0-0) vs. 28-0-0 or 32-0-0 based on:

- $/lb N
- ease of application
- leaf burn potential
- seed-placed safety
- potential leaching or volatilization loss to the air

	***POTENTIAL* loss compared to urea**	
Source*	Volat.	Leaching
AN, CAN, AS	less	≈
UAN	less	≈
+NBPT (Agrotain, ContaiN, Arborite Ag)	less	≈
+nitrification inhibitor (Nserve, Instinct)	≈	less
Combo (SuperU)	less	less
Polymer coated (ESN)	less	less
Slow release (Nitamin)	≈	less?
* Examples given do not imply endorsement		

See *Crop and Fertilizer Management Practices to Minimize Nitrate Leaching* (MT201103AG) *Management to Minimize Nitrogen Fertilizer Volatilization* (EB0209)



Other N sources

- Polymer coated
- Legumes

- Polymer coated are safer seed-placed than urea
- PCU release is too slow in cool, dry conditions to provide enough N early on – consider blending

S source and timing to benefit seed yield

	2-plus years prior	Prior crop	Fall	Spring, before or at seeding
Sulfate – on soil surface or incorporated				
Elemental-S incorporated				
Rapid release elemental-S				

 ideal  not ideal but may benefit yield  not recommended

P source

- MAP vs DAP (11-52-0 vs. 18-46-0) base on: $/lb P_2O_5, ease of application, seed-placed safety
- Specialty P: inconsistent results, higher safe seed-row rates, simplifies application and saves time
- Specialized bacteria/amendments: may increase nutrient availability, inconsistent yield response. Use on-farm strip trials and common sense to evaluate.
- Animal manure: excellent source of P, K, micros. More P and K relative to N than plants need. Concentrations vary, beware of herbicide residue.

Phosphorus source for seed row placement

- MAP < 5-20 lb P_2O_5/acre seed placed
- DAP use CAUTION = toxic to seedlings
- Liquids – equally potent as MAP, but close proximity of band to seed = higher risk to seed (Grenkow et al., 2013).

- Coated specialty P – 2x safe seed placed rate, unsure on ability to provide needed P (Qian and Schoenau, 2010; Grenkow et al., 2013, SK)

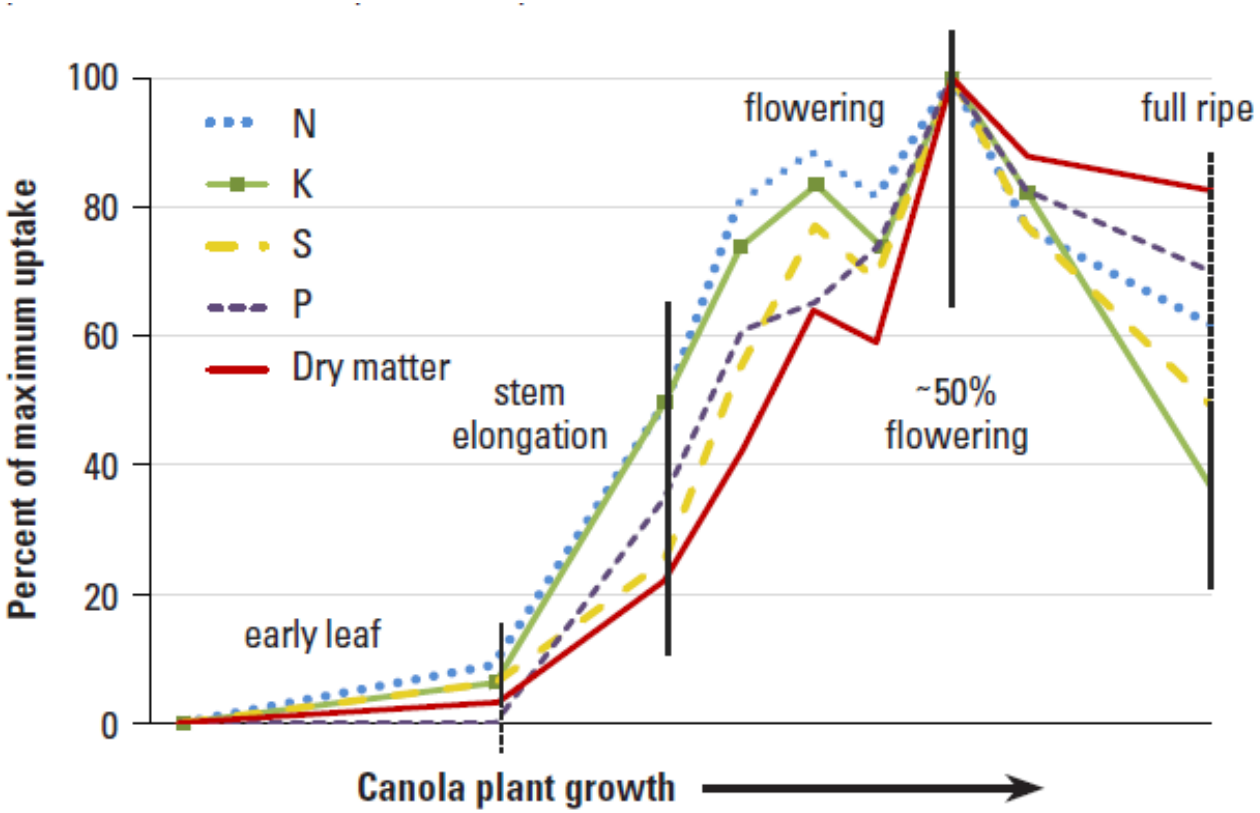
Questions?

On to *Timing and Placement*

Application timing – depends on source. Fertilizer needs to become 'plant available' but not be lost from system.

N: Ideally split application, 50 to 65% of N at seeding, remainder adjusted to current production potential by 5- to 6-leaf stage.

S: Rescue broadcast or foliar up to early flowering, followed by rain/irrigation. Foliar after 5th leaf emergence to minimize leaf burn.

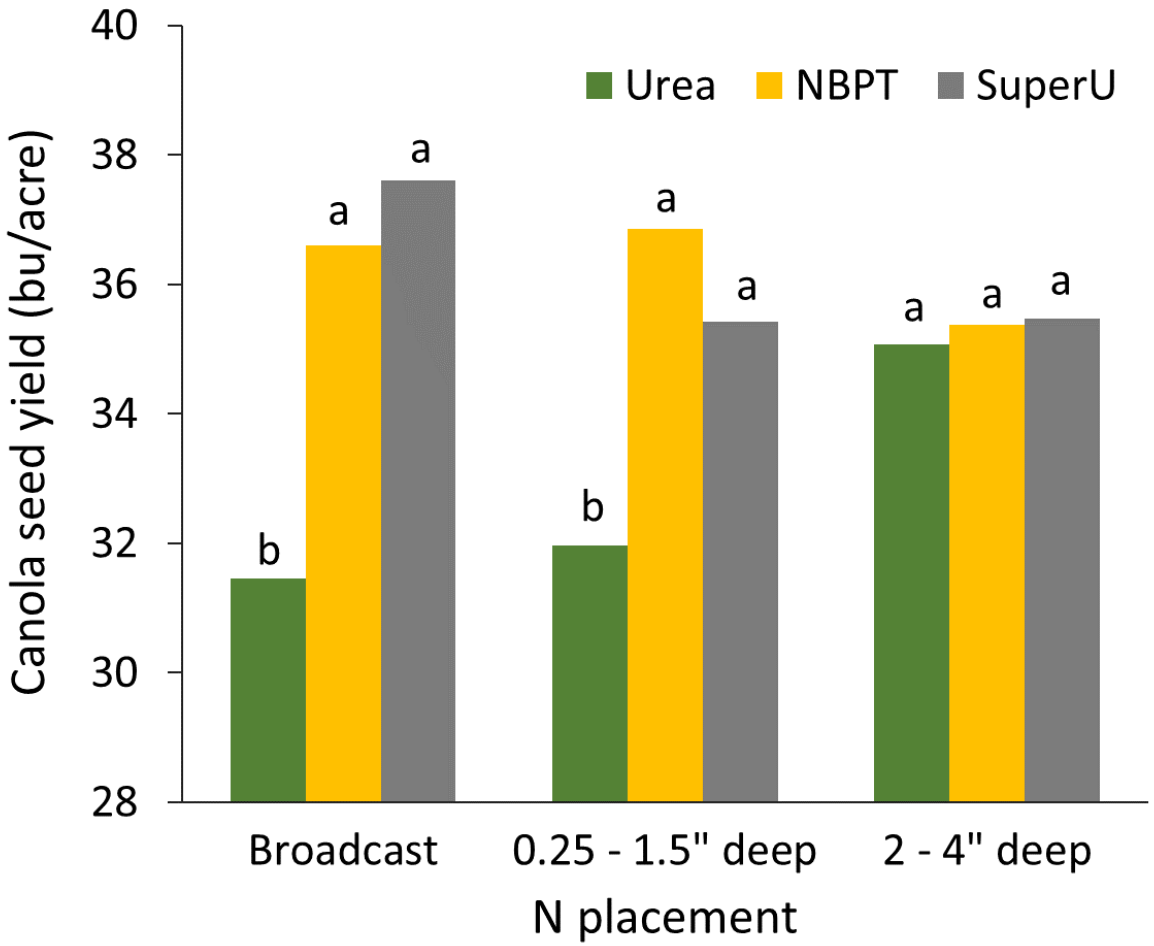


P and K: before or at seeding

Karamanos 2013

Placement: N

- side or pre-plant band >2” deep prior to packing
- early-spring broadcast with incorporation
- if seeder can’t place N deep, consider NBPT (e.g., Agrotain®)
- 28-0-0, 32-0-0 better subsurface than surface band



Dick, Nebo, Holzapfel, Tenuta, unpub data courtesy Karamanos

Placement: P and K

P: critical close to seedling roots in first 2-6 weeks

- Especially in cool or dry soil even if Olsen P > 16 ppm, 10-15 lb P_2O_5/acre seed placed or side band
- If more P required – sub-surface side band next to seed, broadcast incorporate before seeding, build with prior crop

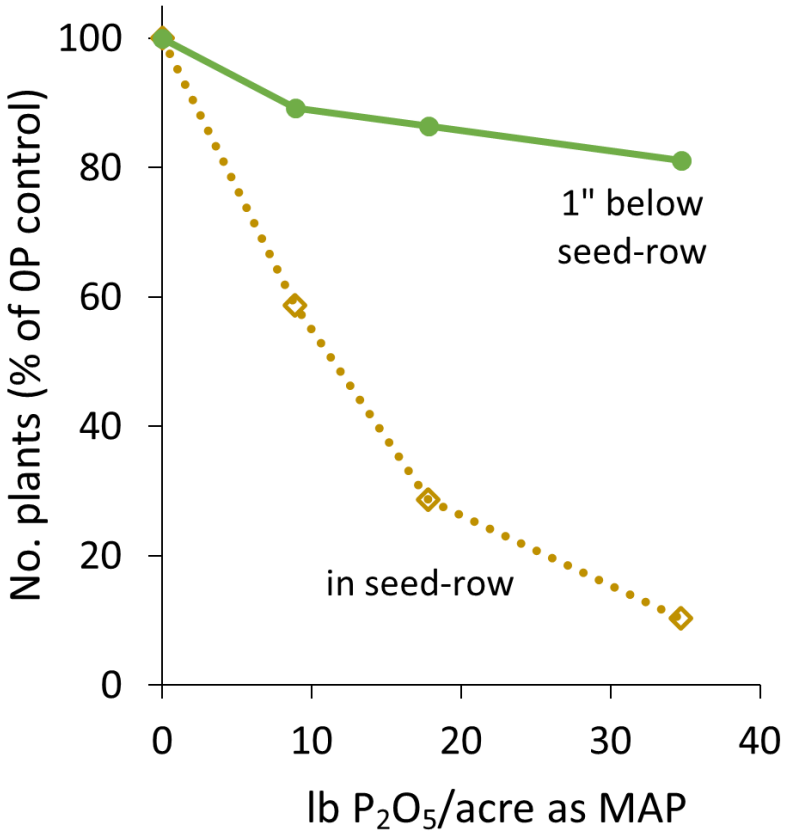
K: seed-placed K_2O + N **not** > 10 lb/acre (4 lb/acre in sandy soils) affects ability to seed-place P, since 10 lb P_2O_5 as 11-52-0 = 2 lb N

Ex: If 8 lb K_2O/acre seed-placed, only allows 10 lb P_2O_5/acre as 11-52-0 seed-placed. More important P close to the seed than K close to seed

Seed-placed guidelines

Seed row safe rates depend source and seed bed conditions

- heavy clay soil >> coarse
- high SOM >> low SOM
- high moisture >> dry soils
- low pH >> high pH



Nyborg & Henning 1969, AB and SK

Equipment

Use wide openers, or put fertilizer in knife and seed in fertilizer slot

Use SDSU/IPNI online safe seed-placed rate calculator

Micronutrients

- A combination of deficiency symptoms, soil testing, and tissue testing may be best approach at identifying deficiencies. This is NOT an exact science.
- Micronutrient deficiencies are exception, not rule
- Cool wet conditions cause deficiency – likely disappear when weather warms
- Too much of some micros can hurt yield more than not enough
- The main challenge is even distribution of a very small quantity – consider foliar options, but likely can't apply enough to correct severe deficiencies

Relative response to micronutrients

Response to micronutrient (Karamanos 2000)				
Boron	Copper	Iron	Manganese	Zinc
Medium	Medium	Medium	Low	Medium

Routine application is NOT suggested, focus on N and seeding rate before other amendments
(Harker & Harman, 2017, AB, SK)

Best test is field test strips and measured yield response

“Micronutrients should be used when there is an economic benefit to the farmer, ……” – R. Karamanos

Summary

- Use soil tests
- Ensure nutrients are available before stem elongation
- Adjust N in-season to reflect the growing season
- Need adequate S to ensure N response
- Low rates of seed-placed P and S promote a healthy start
- Select appropriate timing & placement for given fertilizer source
- Beware of seed-placed fertilizer toxicity
- Consider pulse crop rotation before canola

For more information and this presentation see MSU Soil Fertility Website
http://landresources.montana.edu/soilfertility/

Soil Nutrient Management for Canola (EB0224) – under 'Extension publications'

Canola: Nitrogen & Sulfur Management and *Canola: P, K, & Micronutrient Management* – both under 'Soil Scoop'

Canola Council of Canada *Canola Encyclopedia*
http://www.canolacouncil.org/canola-encyclopedia/

Safe seed-placed fertilizer rate calculator: SDSU and IPNI Online Fertilizer Damage Tool
http://seed-damage-calculator.herokuapp.com/

QUESTIONS?

Image by K. Olson-Rutz