

Demonstrating N Fertilizer Options to Maximize Spring Wheat Yield and Protein

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Acknowledgements



Agriculture and
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Background

- In recent years, there has been an increase in wheat yields with a drop in protein levels as low as 10 %
 - leading to a drop in crop value by close to \$ 1.5/bu
- Application of more N fertilizer at seeding
 - Increased lodging, yield loss and/or difficulty during harvest
 - Leaching
 - Volatilization

Wheat Yield and Lodging vs N

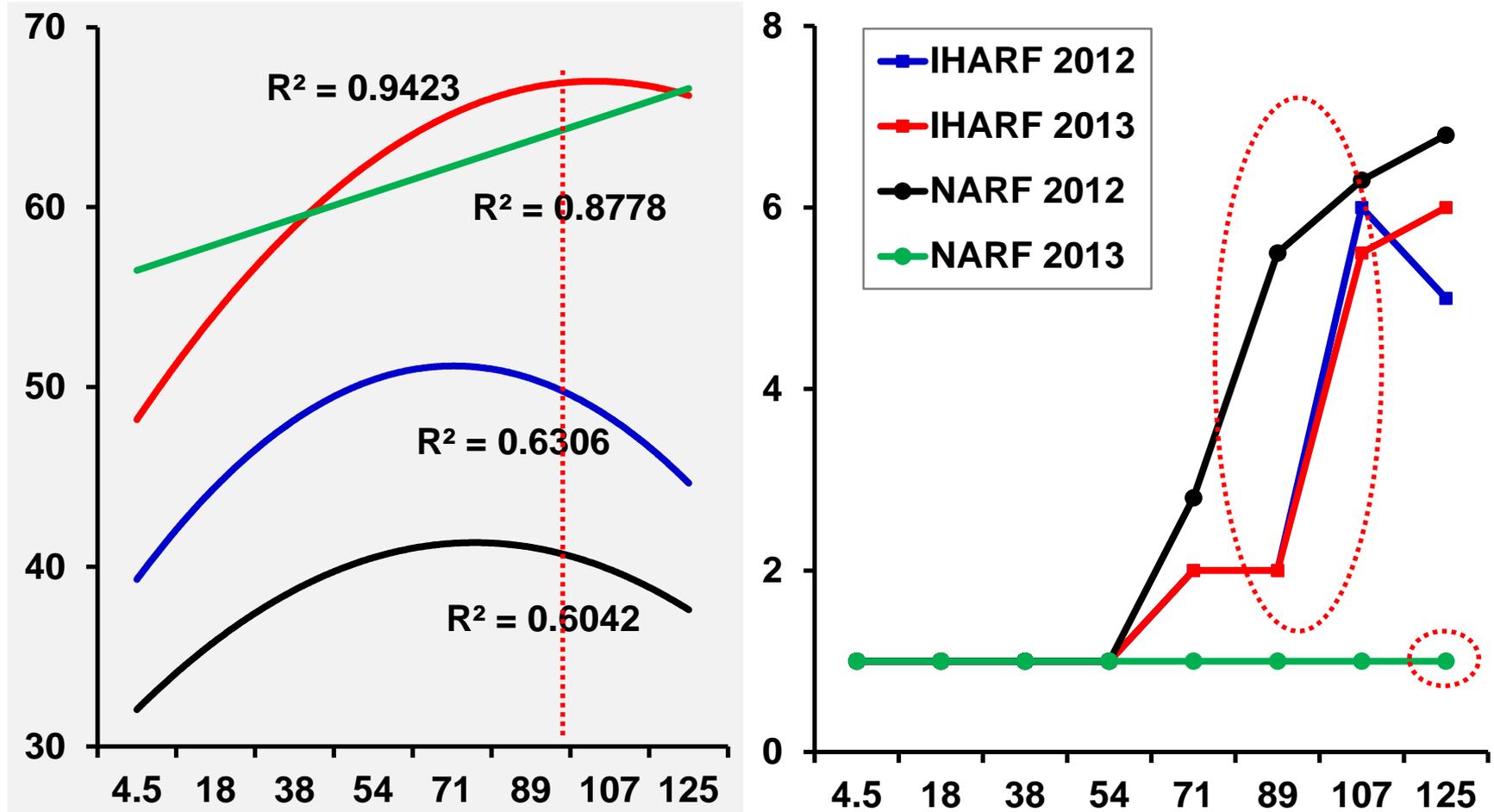


Figure 1: Relationship between wheat yield (bu/ac) (left) and Lodging (1-10) (right)

Strategies

- Strategies to address drop in protein%
 - Use of several controlled release nitrogen (CRN) fertilizers
 - Grow lodging resistant varieties
 - Grow varieties with higher inherent % protein

Objectives

The objectives of this study were to demonstrate:

- ❑ the effects of CRN fertilizers on grain yield and % protein of three spring wheat varieties
- ❑ which option or combination of options would be most effective to adopt

Study Sites

Study sites: Scott and Melfort

Study year: 2015

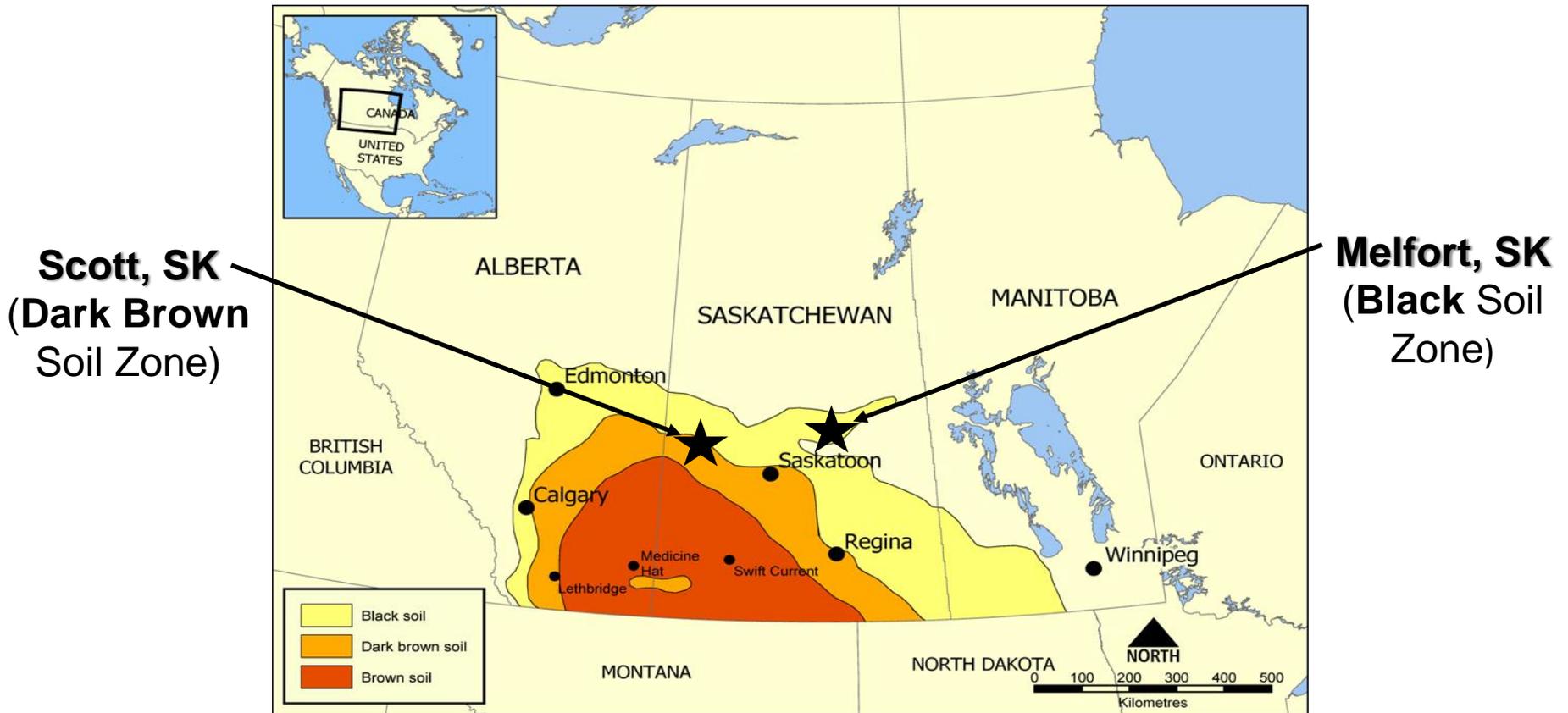


Figure 1: Study site characteristics

Weather Conditions

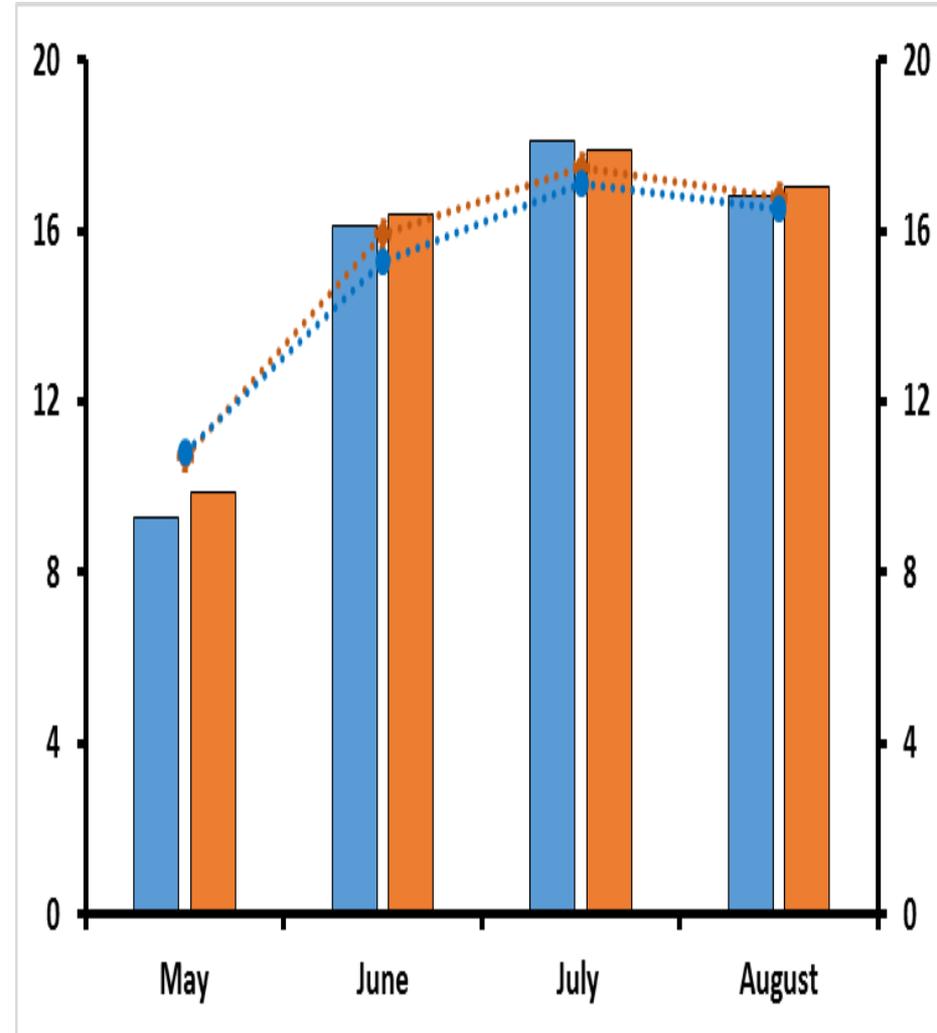
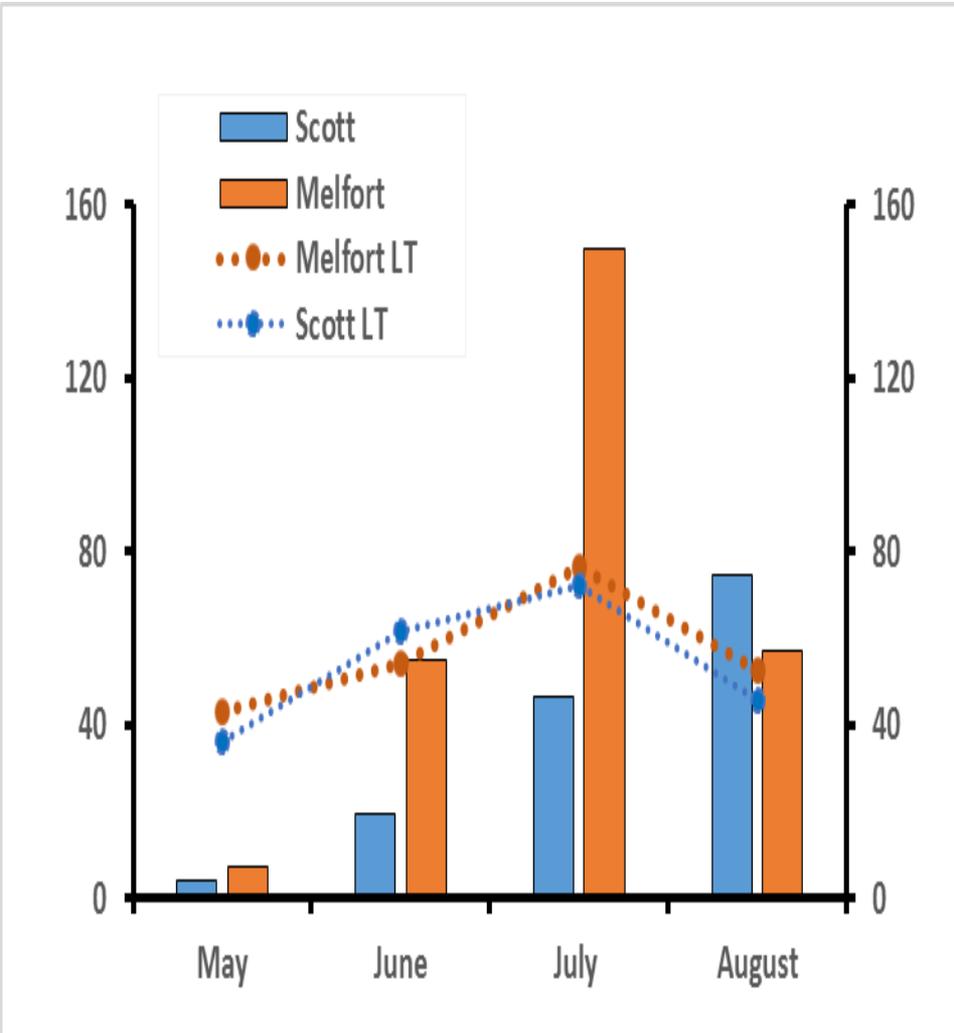


Figure 2: Precipitation (*left*) and Temperature (*right*) relative to long-term

Experimental Setup

- **Experimental Design**
 - 3 x 7 factorial in RCBD with four replications
- **Seeding rate: 350 seeds/m²**
- **N application method**
 - All N blends applied mid-row/side-band at seeding, UAN dribble-band at late flag to early heading
- **Herbicide and fungicides**
 - applied according to site operations
- **Plot sizes: 2 x 10 m (Scott), 2 x 7 m (Melfort)**

Factors

Factor A (Wheat varieties)

1. Lillian

- Yield (lower)
- Protein (higher)

2. Goodeve VB

- Yield (moderate)
- Protein (moderate)

3. Shaw VB

- Yield (higher)
- Protein (lower)

Factor B (N type)

1. Check

2. Urea (100)

3. Urea + ESN (50/50)

4. Urea + ESN (25/75)

5. Urea + Super U (50/50)

6. Urea + Super U (25/75)

7. Urea + UAN (80/20 @ early heading)

- At 90 kg/ha

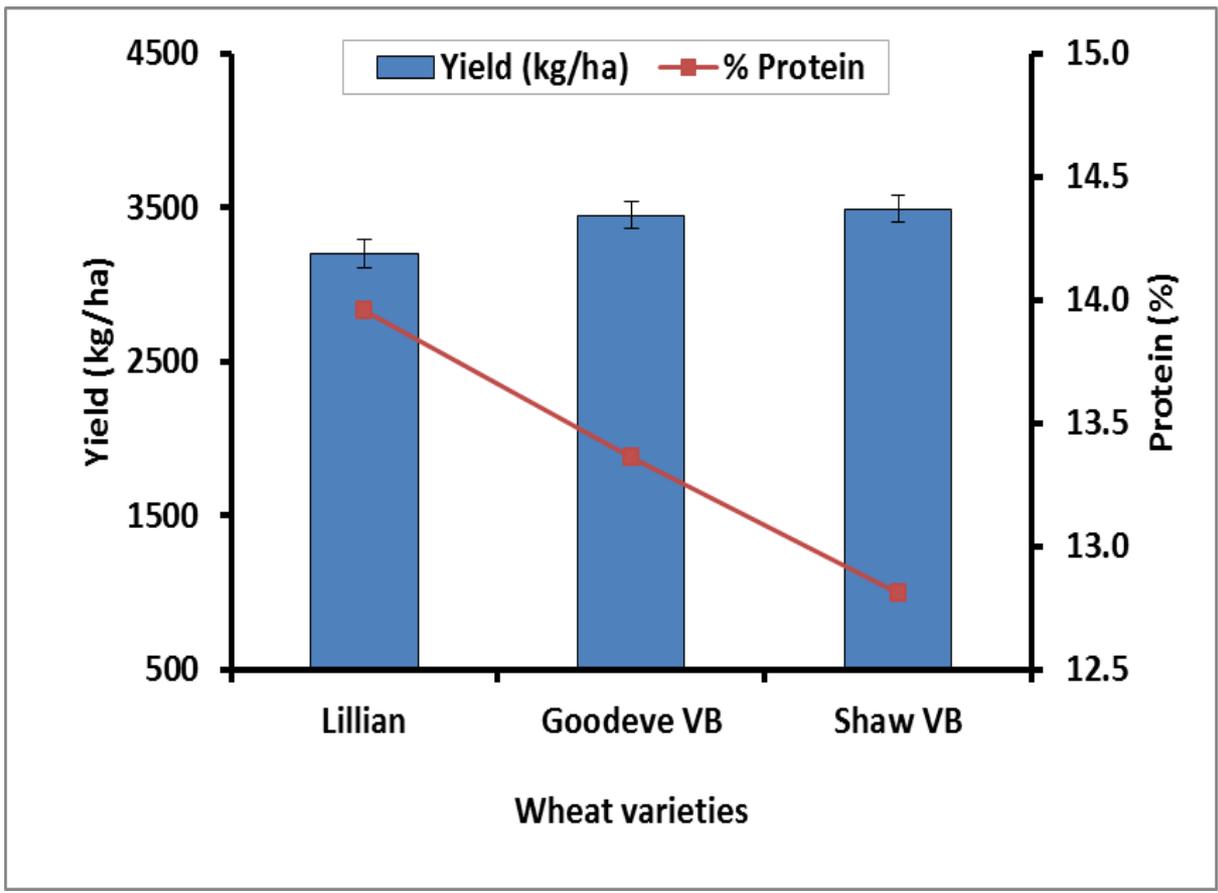
Data & Analysis

- Data was collected on
 - Days to Maturity (DTM)
 - Thousand Kernel Weight (TKW)
 - Bushel weight
 - Yield
 - Protein %
- *Combined* data was analysed using PROC MIXED in SAS 9.3
- Treatment means were separated according to Tukey's HSD and considered significant at $P < 0.05$

Results and Discussion

- Bushel weight, DTM and TKW were all affected by only wheat variety
- Bushel weight
 - Shaw VB > Goodeve VB > Lillian
- DTM
 - Shaw VB > Lillian > Goodeve VB
- TKW
 - Goodeve VB > Lillian = Shaw VB

Yield and Protein vs Variety



Both yield ($P = 0.0023$) and protein ($P < .0001$) were significantly effected by wheat variety.

Yield

- Shaw VB
- Goodeve VB
- Lillian



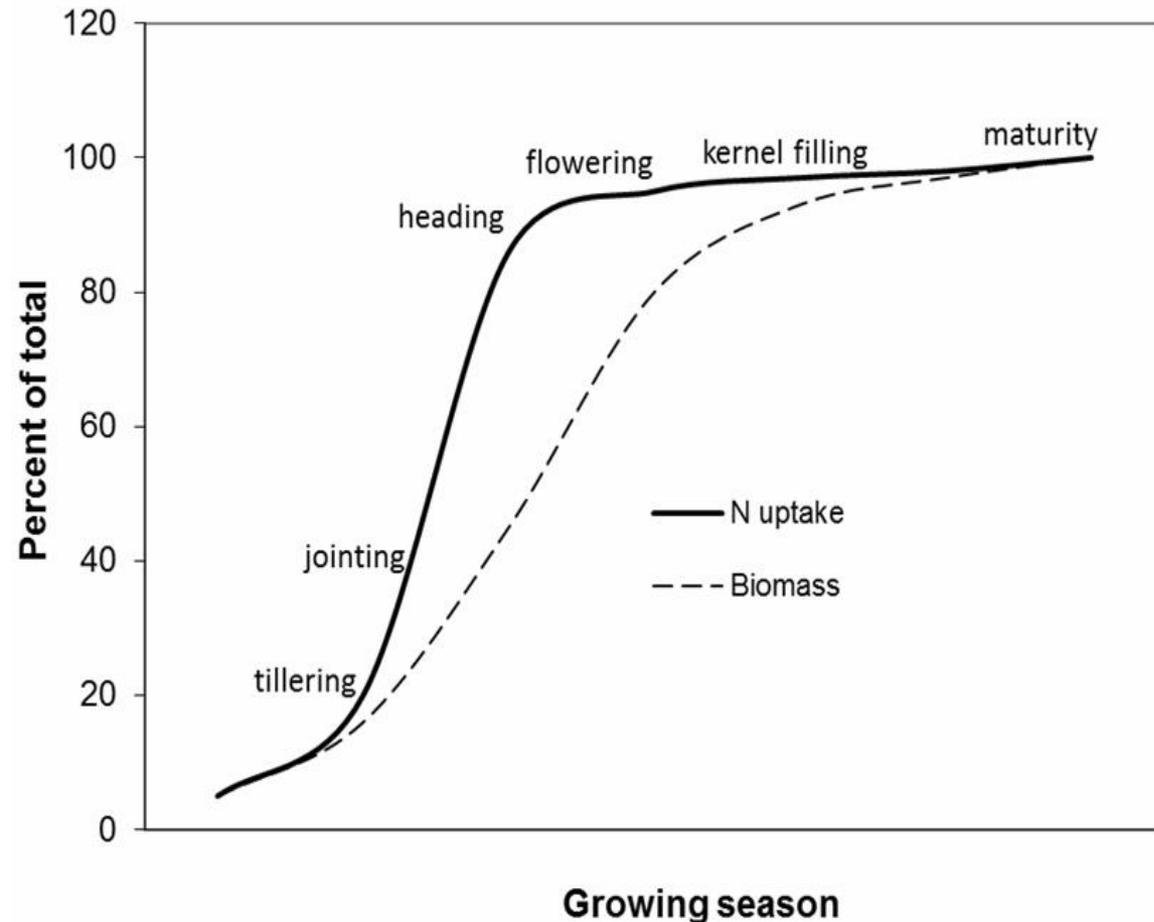
Protein

- Shaw VB
- Goodeve VB
- Lillian



Figure 3: Effects of wheat varieties on grain yield and protein

N uptake vs Biomass



Biomass lags behind N uptake and accumulation

Early-season (prior to the boot stage) N uptake affects

- Breakdown residue from previous crop
- Yield (number of head-bearing tillers/unit area, number of kernels/head and size of individual kernels)
- ***But has minimal effect on grain protein.***

Late-season N has minimal impact on yield because

- Tiller density and kernel number have already been established
- Can improve yield slightly in deficient plants
- ***However, it can have a significant impact on protein concentrations.***

Figure 4: Percent of total biomass and N uptake during the growing season at various wheat growth stages.
From: *Nitrogen Management for Hard Wheat Protein Enhancement*

Growth stage vs timing of application

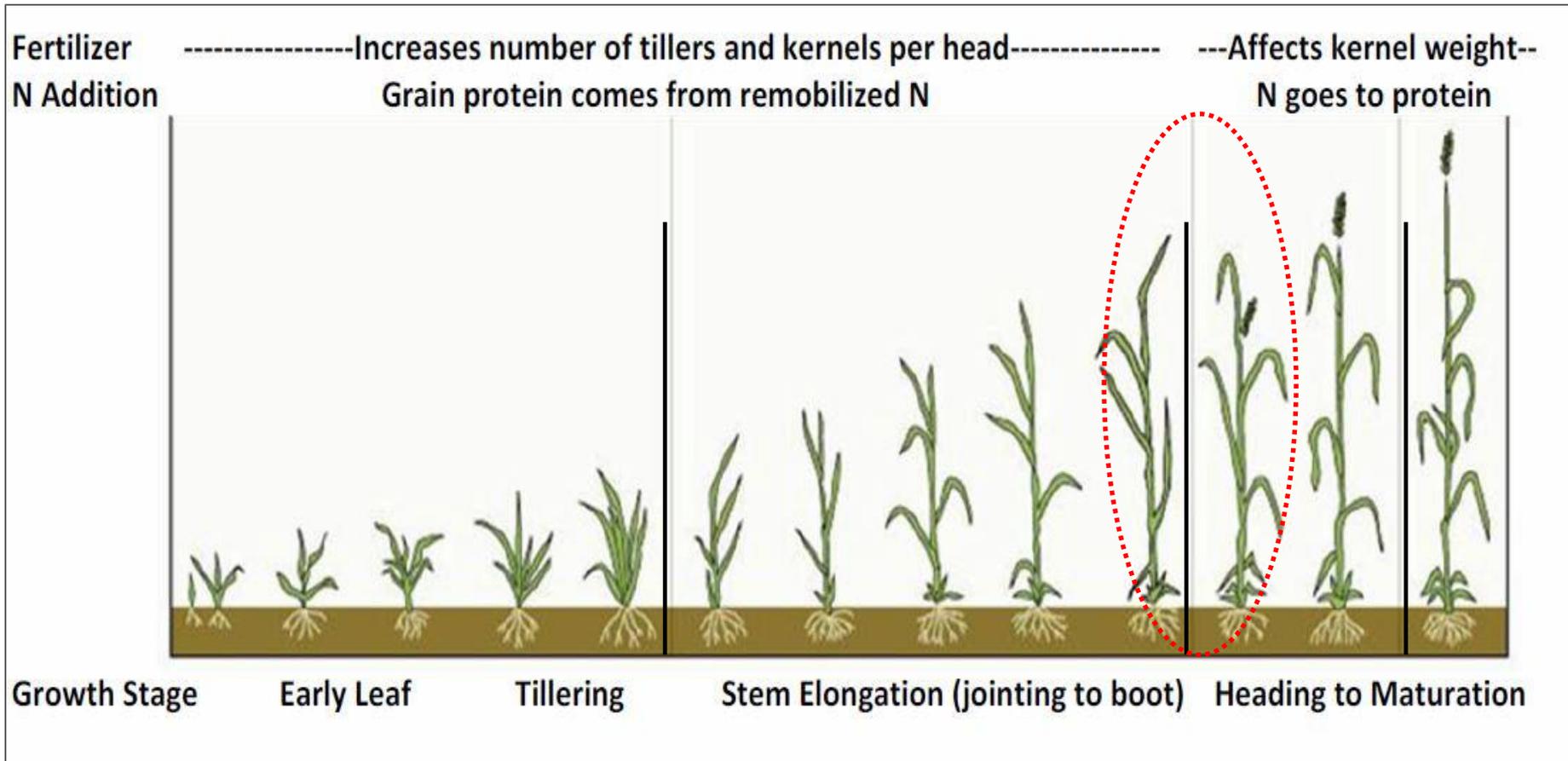
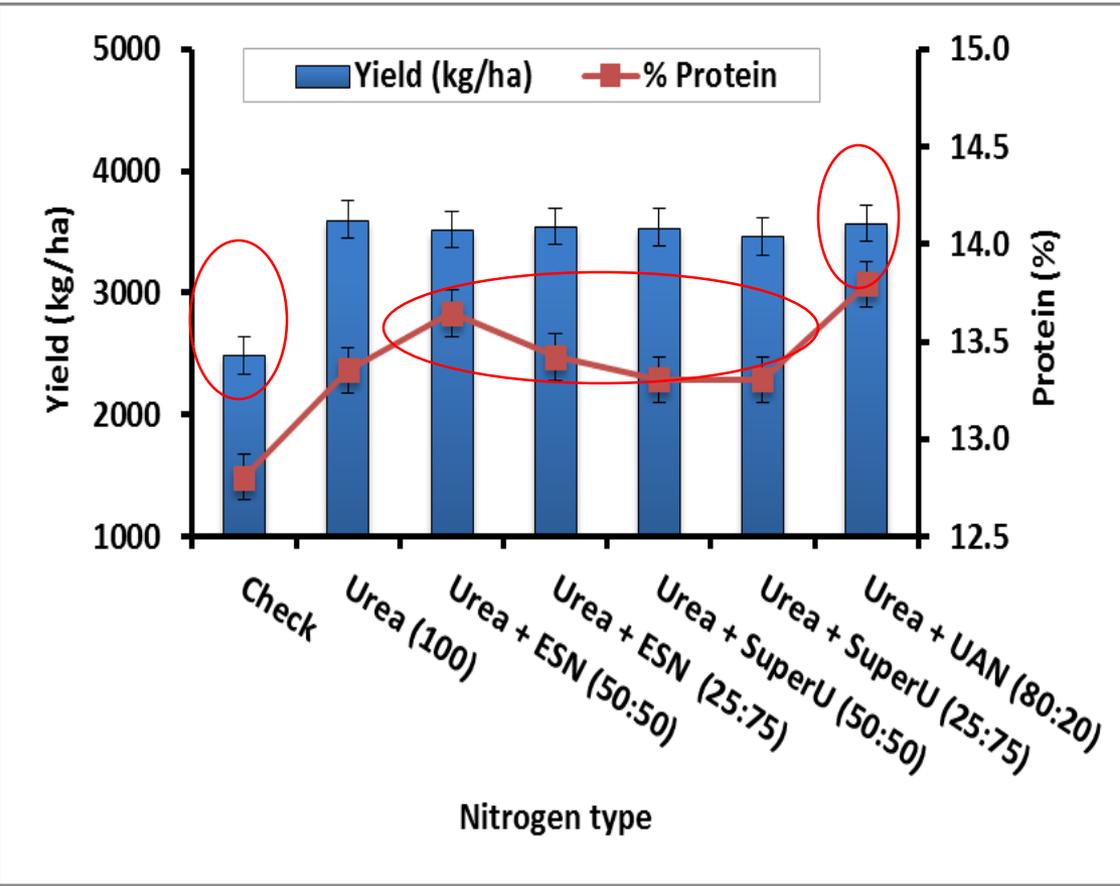


Figure 5: Appropriate cereal growth stages and N application timing effects on yield and protein. (From: *Practices to Increase Wheat Grain Protein*)

Yield and Protein vs N type



Both yield ($P < .0001$) and protein ($P < .0001$) were significantly effected by N type.

All N treatments are significantly different from the check

- N fertilizer is essential to achieve acceptable yield

ESN had a slight % protein relative to Super U

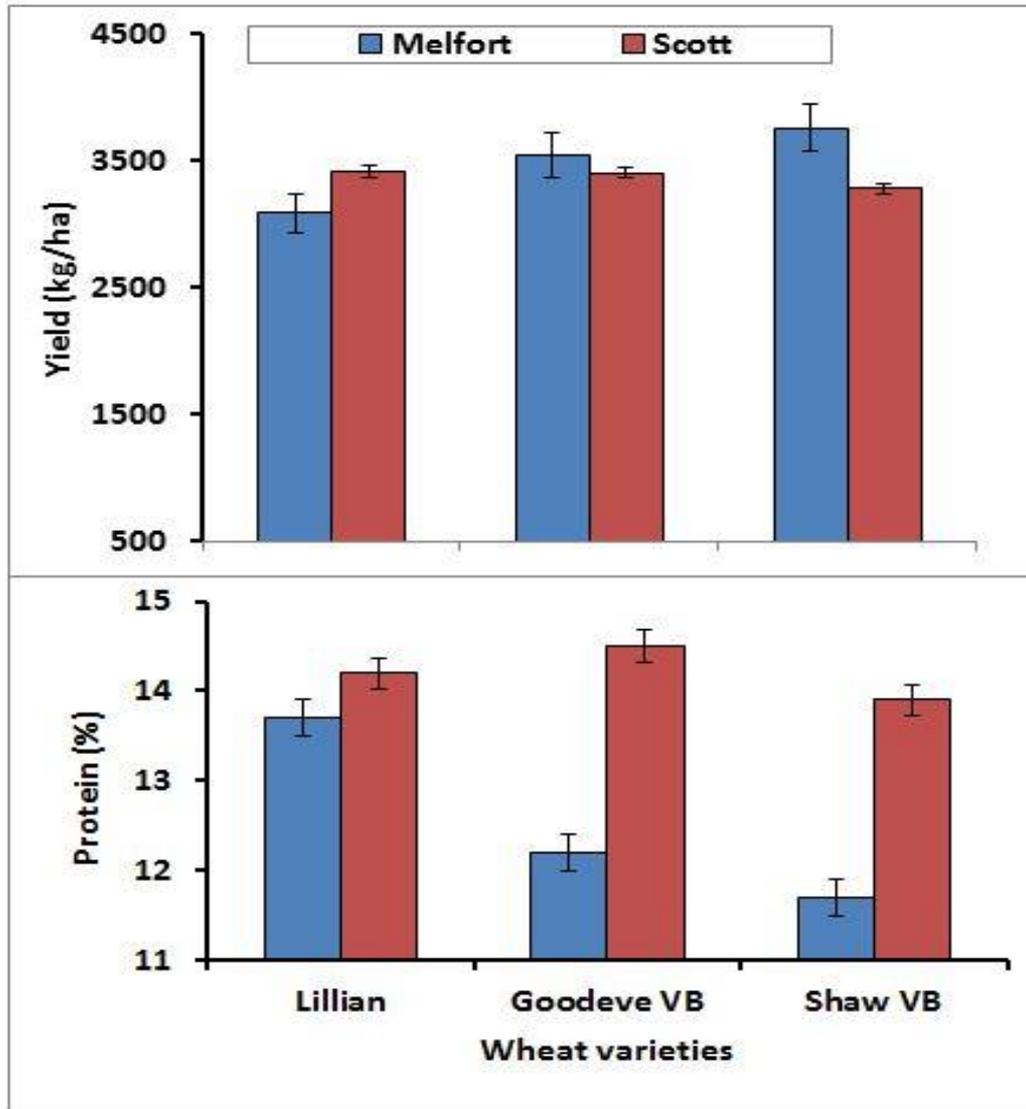
- In drought years, Super U could provide a quicker source of N to the plant compared to ESN (McDonald, 2010)

UAN blend had the highest % protein relative to the ESN and Super U

- 20% of the N was applied as liquid UAN at the flag leaf stage rather than at seeding

Figure 6: Effects of N type on grain yield and protein

Wheat variety vs site



- Both yield and protein were significantly effected by variety at Melfort but only protein was affected by variety in Scott.

- At Melfort

- Yield & protein

- Shaw VB
- Goodeve VB
- Lillian



- At Scott

- Protein

- Shaw VB
- Lillian
- Goodeve VB



Figure 8: Effects of wheat variety on grain yield and protein *by site*

Conclusions

- When considering only yield, we found no advantage for the CRN fertilizers
 - using untreated granular urea at seeding was as effective as any of the combinations
- The most effective strategy for increasing protein in wheat
 - choose low yielding but high protein varieties and fertilize them adequately with N fertilizer.
- To the grower wondering whether ESN, Super U or UAN pay?
 - UAN overall resulted in the greatest protein %, however, the grower must base their decision based on yield and/or price vs added costs and crop damage from application at flag leaf stage.
- Further trials over several years need to be conducted to see if the different blends of untreated and treated compared to untreated alone is profitable or not.

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Thank you!!!

**Questions and
Comments**

