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PLANT GROWTH REGULATORS (PGRs) IN SPRING WHEAT

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PLANT GROWTH HORMONES

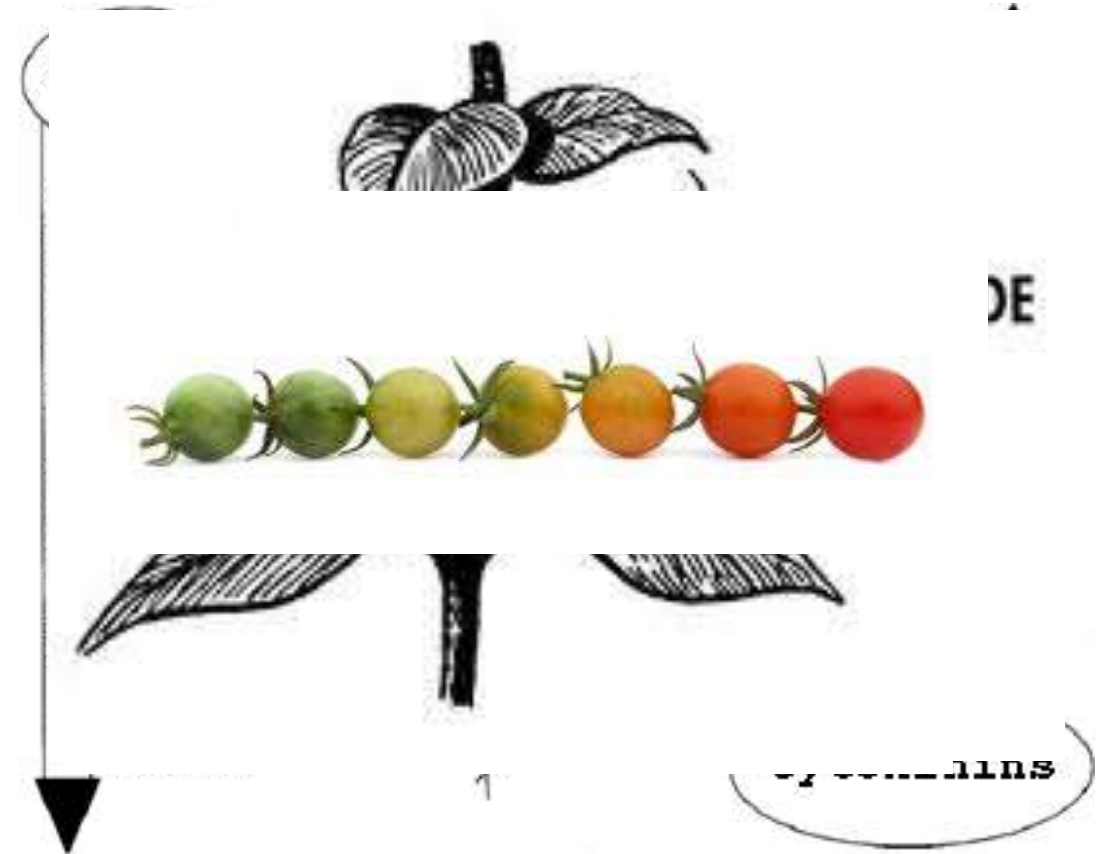
Auxin – primary cell elongation

Cytokinins – cell division

Abscisic Acid – germination, protein stores, and water stress

Gibberellins – longitudinal growth

Ethylene – stress and ripening



PLANT GROWTH REGULATORS (PGRs)

- Synthetic compounds to modify growth and development.
- Intended to reduced lodging and increase yields in high input cereal production.
 - Shortens the crop – leaving more resources available for seed filling
- Help create more uniform crop by out levelling tillering.



PGRs are NOT new!

- Used throughout the horticultural industry and golf course grass care world wide.
- Used extensively in UK winter cereal crops for over 30 years
- Research in Canada started in the 80s
- Not on the market till now because:
 - Some products caused crop injury
 - Narrow application windows
 - Falling cereal prices



ETHREL

BY: BAYER CROPSCIENCE

- **Chemical Name:** Ethephon
- Works using the plant hormone ethylene
- Used in Wheat and Barley

- **Not highly promoted for use in Western Canada yet.**
 - Due to short application window



MANIPULATOR

BY ENGAGE AGRO

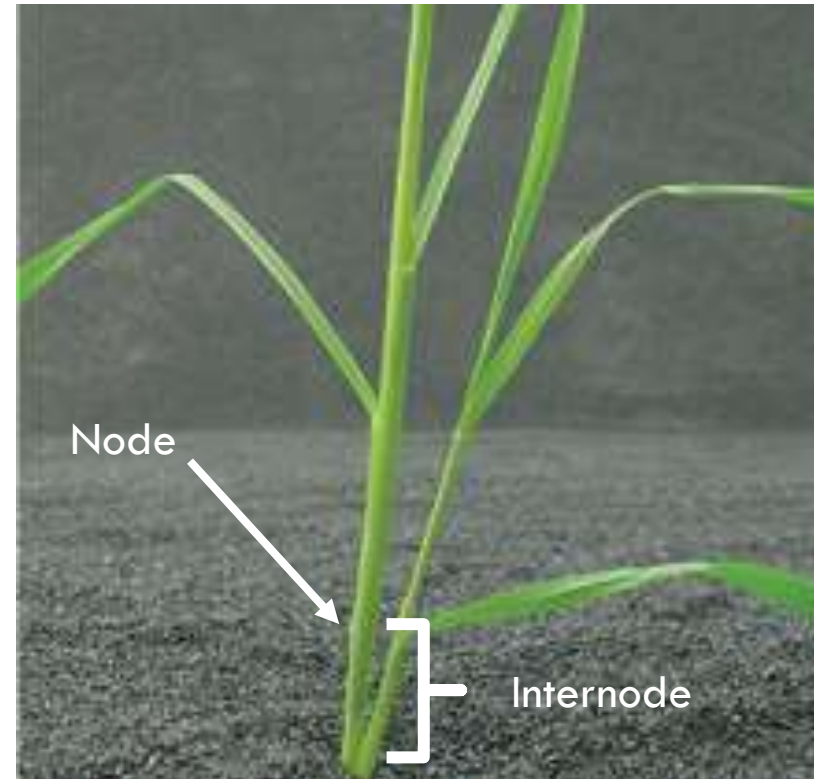
ENGAGE AGRO

- **Better. Stronger. Shorter.**
 - yield was increased, with and without lodging, 93% of the time.
 - producing stronger stems to reduce lodging
 - 94% of the time application resulted in shorter plants.
- **Flexible:** can be first applied at the 2-3 leaf stage up to early flag leaf.
 - Can be applied at temperatures just above freezing.
- **Optimal:** best results when applied at 1-2 node stage (Z31) at 1.8 L/ha
- **Cost:** \$10 - \$15 per acre.

Registered for use on spring, winter, and durum
wheat for 2015

HOW IT WORKS

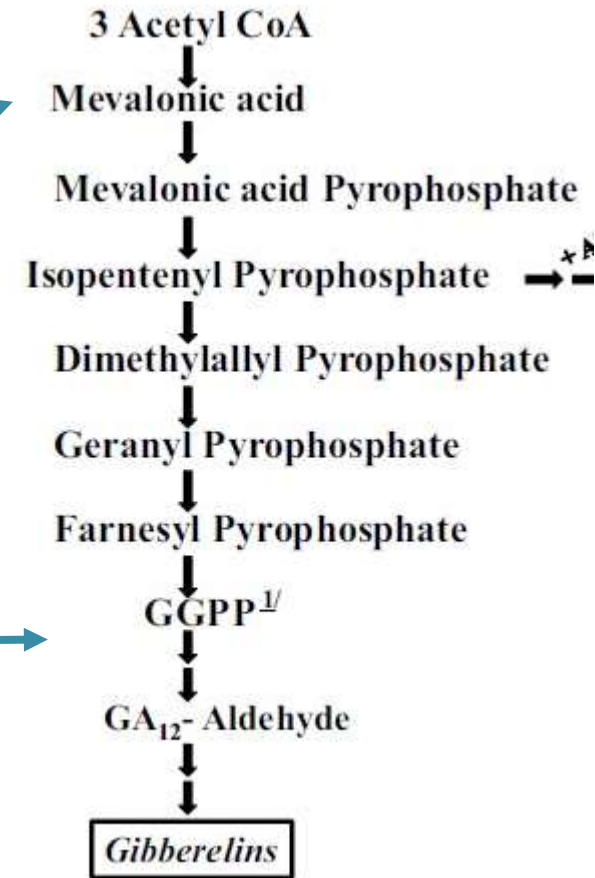
- Acts on the plant growth hormone responsible for stem elongation: gibberellin
- Prevents hormone biosynthesis
- Reduced internode length



HOW IT WORKS

○ **Chlormequat Chloride:**
blocks metabolism early in
pathway

○ **Trinexapac – ethyl
(Syngenta):** blocks enzymes
late in pathway



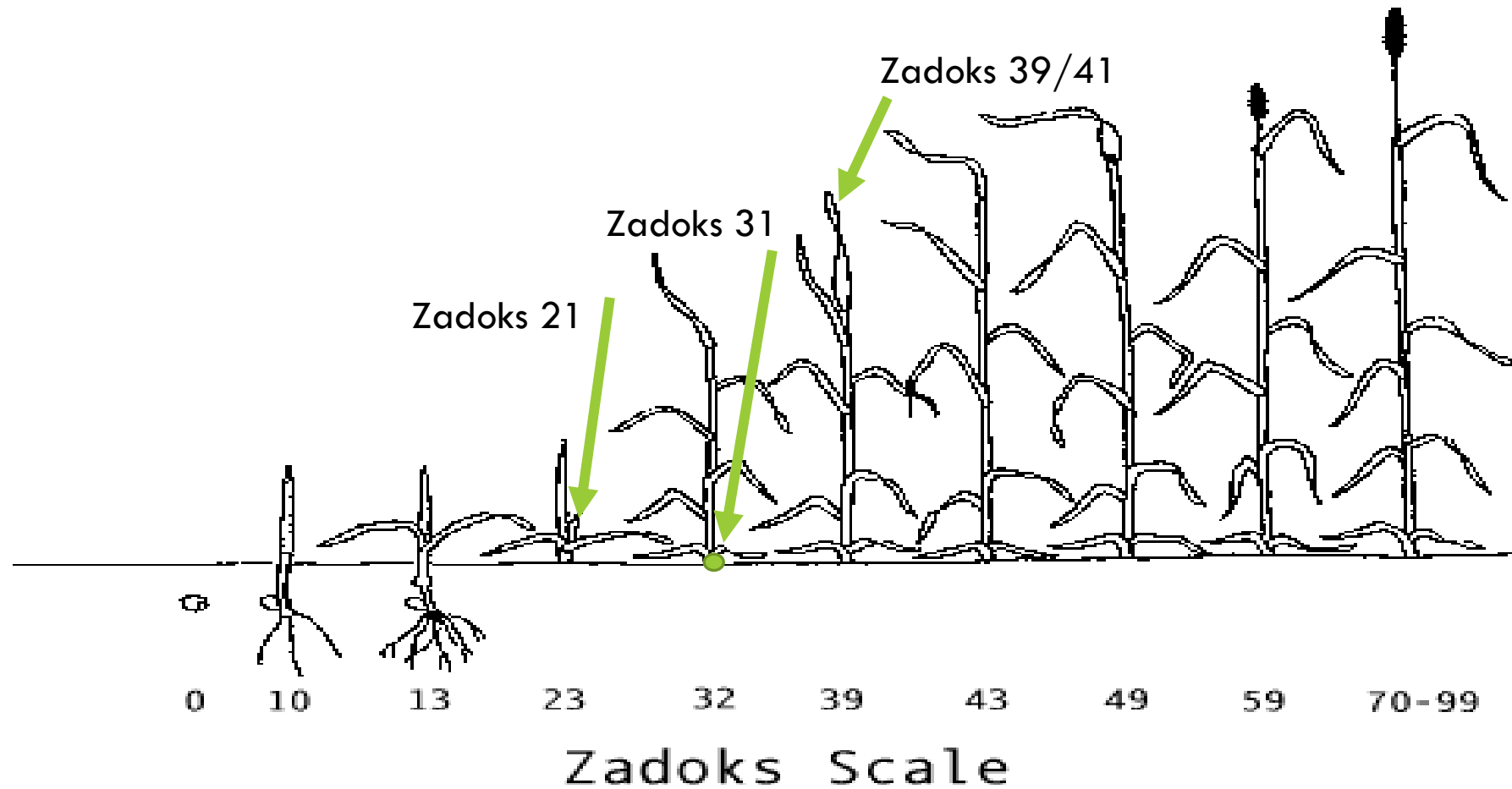
GROWER QUESTIONS

- 1) How consistent is crop shortening and lodging prevention?
- 2) How big are yield responses?
- 3) How consistent are yield responses?
- 4) Will PGR application economically pay off?

APPLICATION TIMING AND FERTILITY EFFECTS ON SPRING WHEAT RESPONSE TO PLANT GROWTH REGULATOR

- **In Melfort (NARF) and Indian Head (IHARF) in 2013 and 2014**
- **Used Unity VB at 275 seeds/m²**
- **Fertility rate was based on 112-34-14-17 kg/ha of NPKS**
 - Use 100, 125, and 150 %
- **PGR Timing – applied Manipulator at 1.8 L/ha**
 - Zadoks 21 – first tiller (herbicide timing)
 - Zadoks 31- first node detectable
 - Zadoks 21 + 31 – first tiller and first node (split application) – 2013 only
 - Zadoks 39/41 – flag leaf present (fungicide timing) – 2014 only

PLANT GROWTH STAGES



1. HOW CONSISTENT IS CROP SHORTENING AND LODGING PREVENTION??

Small plot:

- 4 of 4 cases of shortening.
- There was a dramatic reduction or no lodging recorded in 4 of 4 trials.

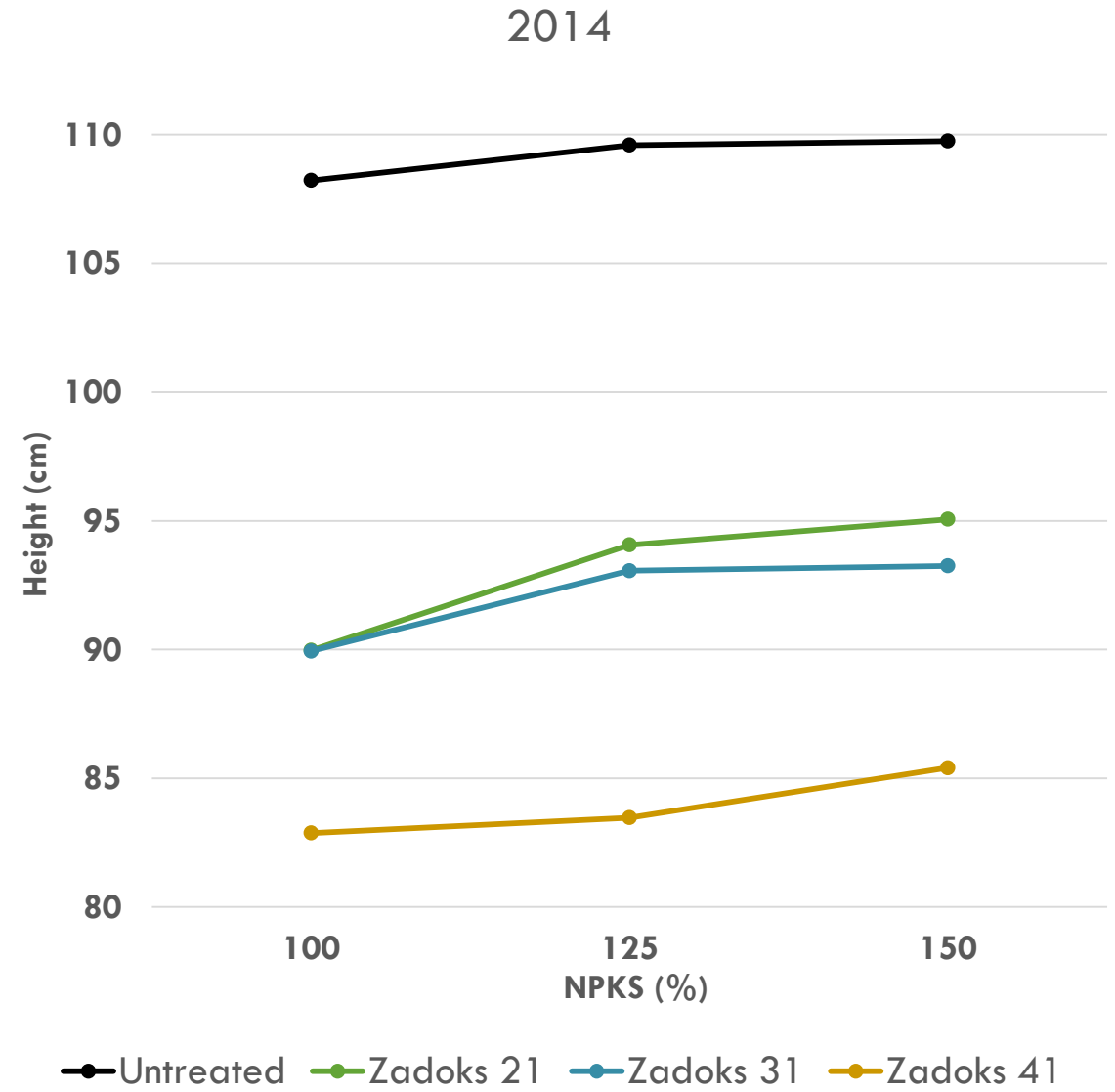
IHARF HEIGHT

Factor	Pr > F
PGR	<0.0001***
Fertility	0.0222 *
PGR * Fertility	0.8808

*** highly significant

* significant

- Only PGR had a highly significant statistical effect on plant height.
- Plant height decreased at every fertility rate and timing compared to the untreated check.
- Z41 timing resulted in the shortest plants regardless of fertility rate.



HEIGHT BY PGR TIMING



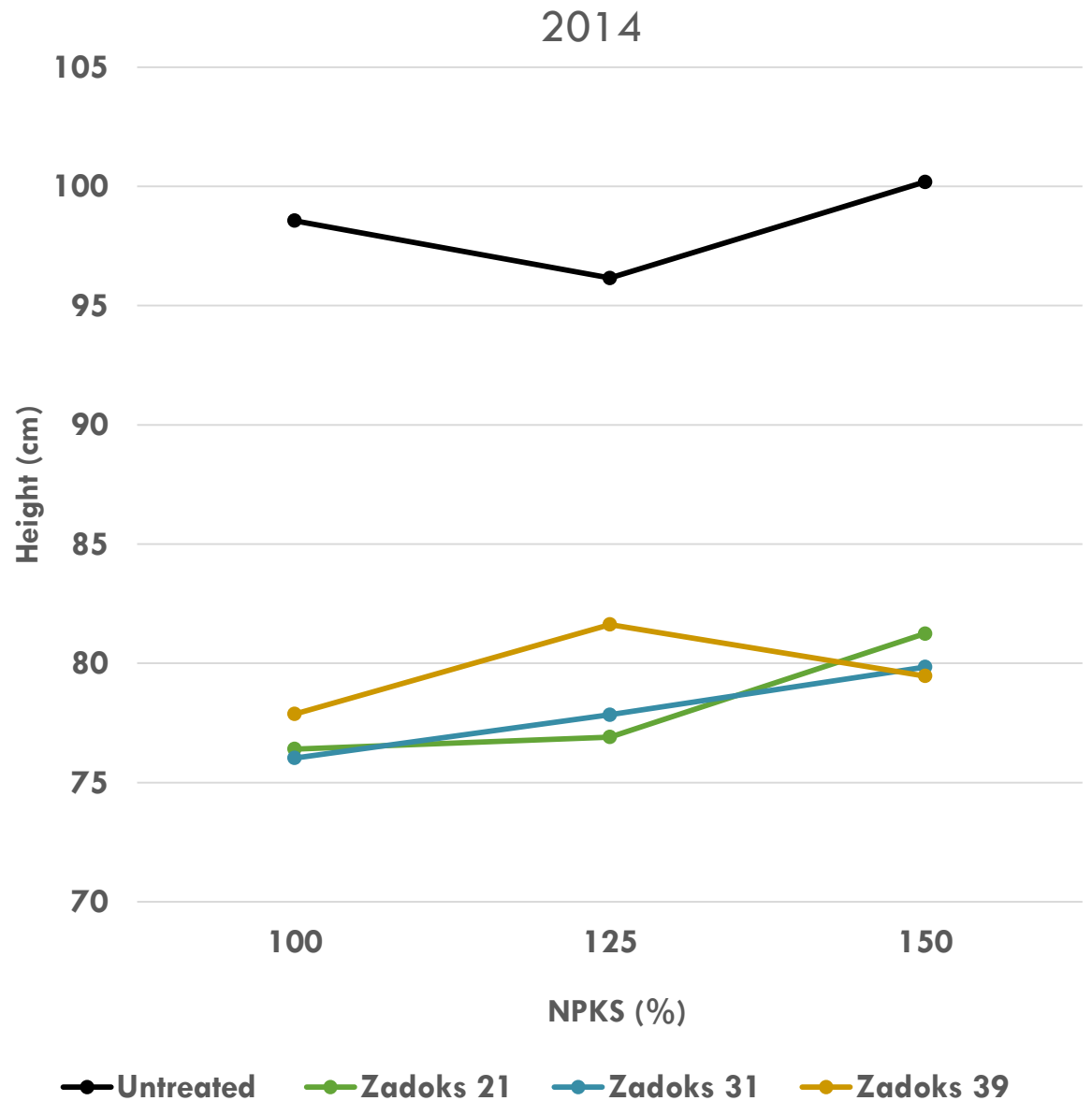
NARF HEIGHT

Factor	Pr > F
PGR	<0.0001 ***
Fertility	0.0264*
PGR * Fertility	0.2531

*** highly significant

* significant

- PGR timing had a highly significant statistical effect on height.
- Height at all fertility levels was reduced from the untreated check at all timings.
- Overall, application at Z31 produced the largest decrease in height.



JULY 25, 2014

No PGR @ 150%



Z31 @ 150%



Courtesy of C. Holzapfel

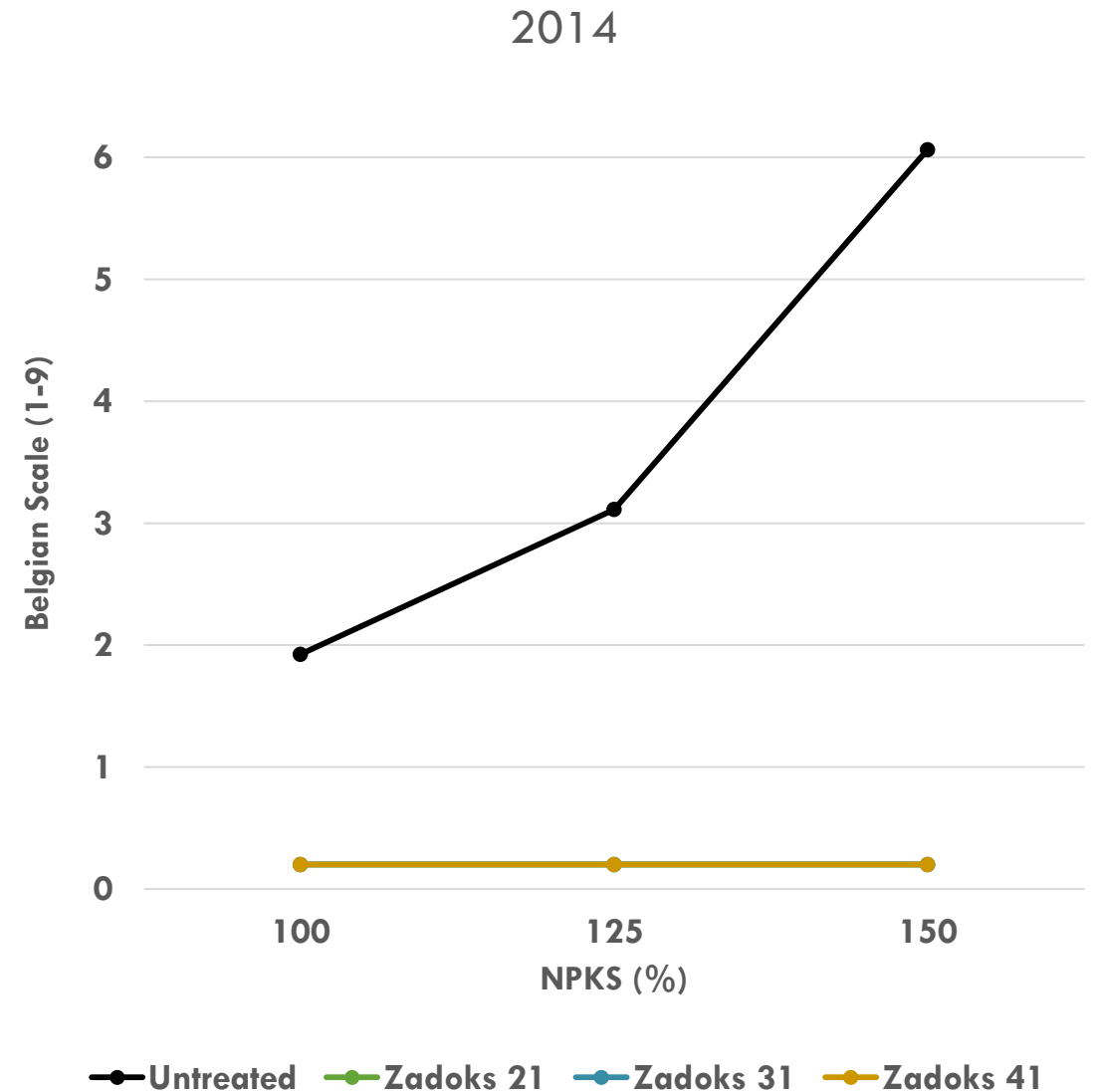
IHARF LODGING

Factor	Pr > F
PGR	<0.0001***
Fertility	0.0352 *
PGR * Fertility	0.0063

*** highly significant

* significant

- Only PGR had a highly significant statistical effect on lodging.
- Lodging increased with fertility rate without PGR application as expected.
- PGR application was able to reduce lodging to minimal levels at all timings and fertility levels.

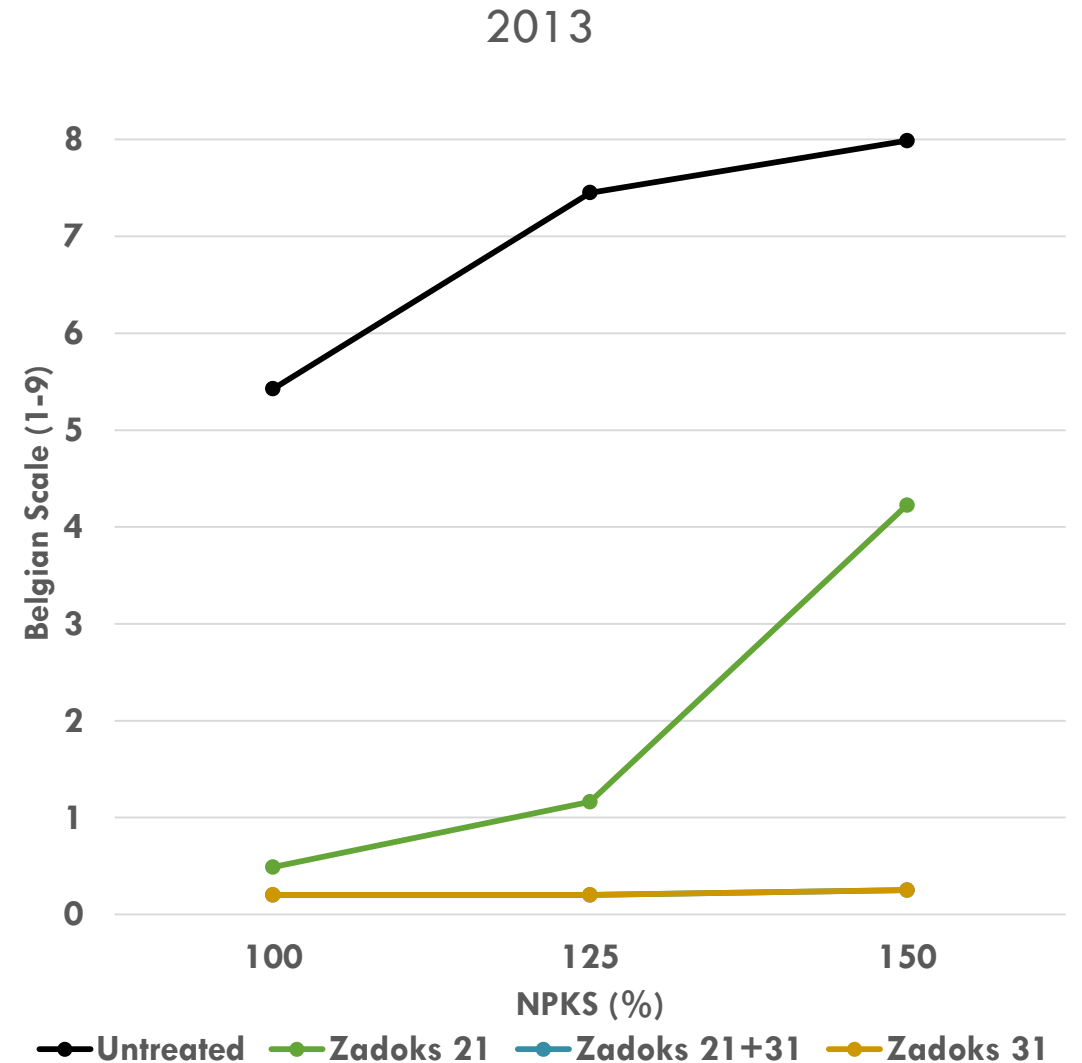


IHARF LODGING

Factor	Pr > F
PGR	<0.0001 ***
Fertility	<0.0001 ***
PGR * Fertility	<0.0001 ***

*** highly significant

- In 2013, PGR timing, fertility, and the interaction had a significant effect on lodging.
- Early application timing was unable to fully reduce lodging at any fertility rate, most notable at 150%
- However, it was still 47 – 91% reduced from the untreated check.



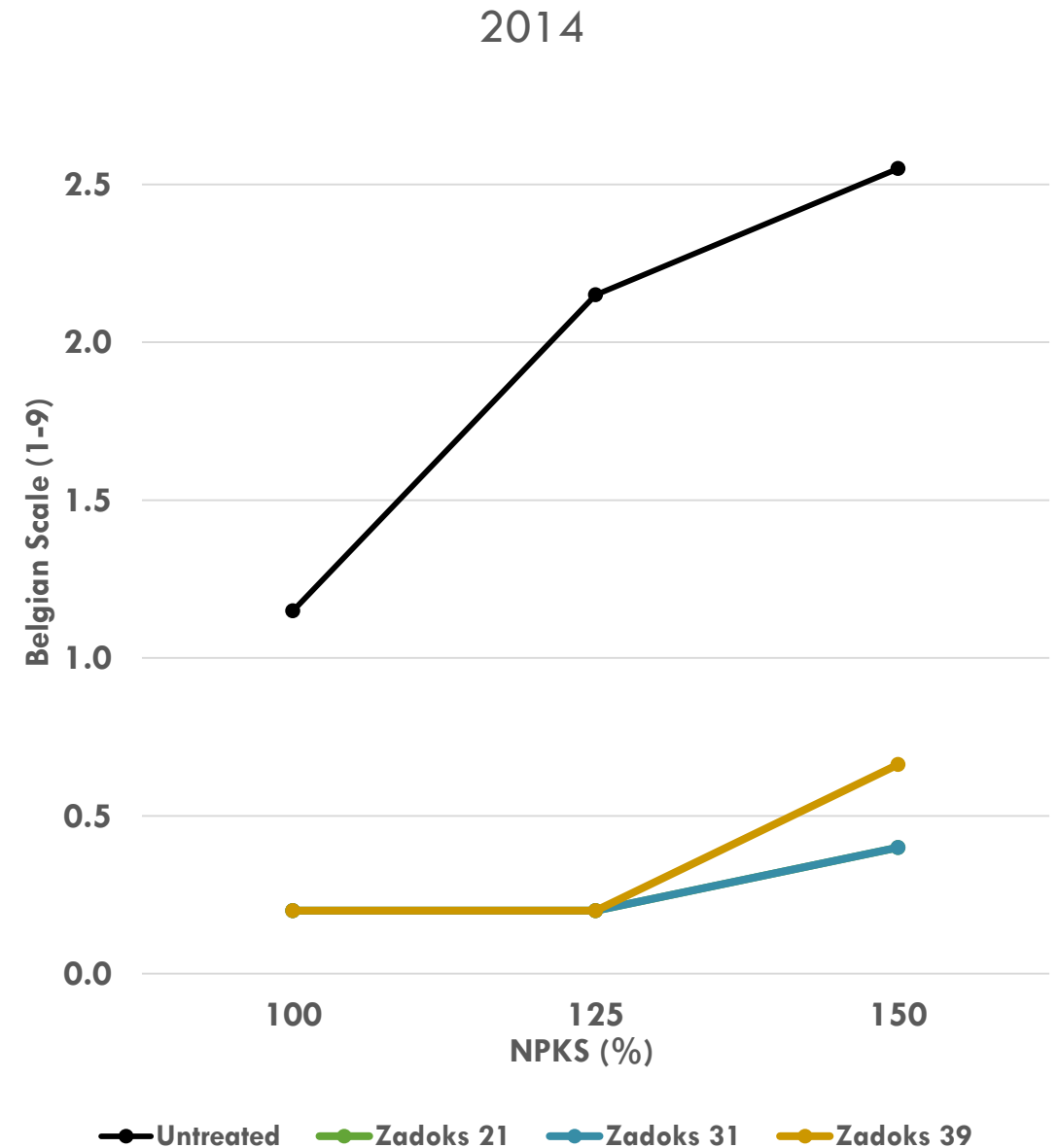
NARF LODGING

Factor	Pr > F
PGR	<0.0001***
Fertility	0.0245*
PGR * Fertility	0.2938

*** highly significant

* significant

- PGR had a highly significant effect on lodging.
- All PGR application treatments were able to reduce severity or incidence of lodging.
- Application at Z21 and Z31 produced the best results.



Untreated

Treated



LARGE PLOT TRIALS

Height Reduction	Occurrence of Trials with Height Reduction		
	CWRS (35 Trials)	CPS (12 Trials)	CWAD (5 Trials)
5% +	95%	100%	80%
10% +	83%	67%	
15% +	53%	33%	60%
20% +	20%	8%	

*Trials from 2011 to 2014 – provided by Engage Agro

- **Consistent shortening: all classes have a height reduction to date.**
 - At least 5% in 95, 100, and 80% of trials
 - And at least 15% in 53, 33, and 60% of trials

2. HOW BIG ARE YIELD RESPONSES??

Small plot:

- **Yield increases of 11.3 bu/ac with normal fertility practices.**
- **Gains of 19.6 bu/ac under increased NPKS levels.**
- **In 1 case there was a 4.4 bu/ac decrease – maybe due environmental factors**



Increased
yields

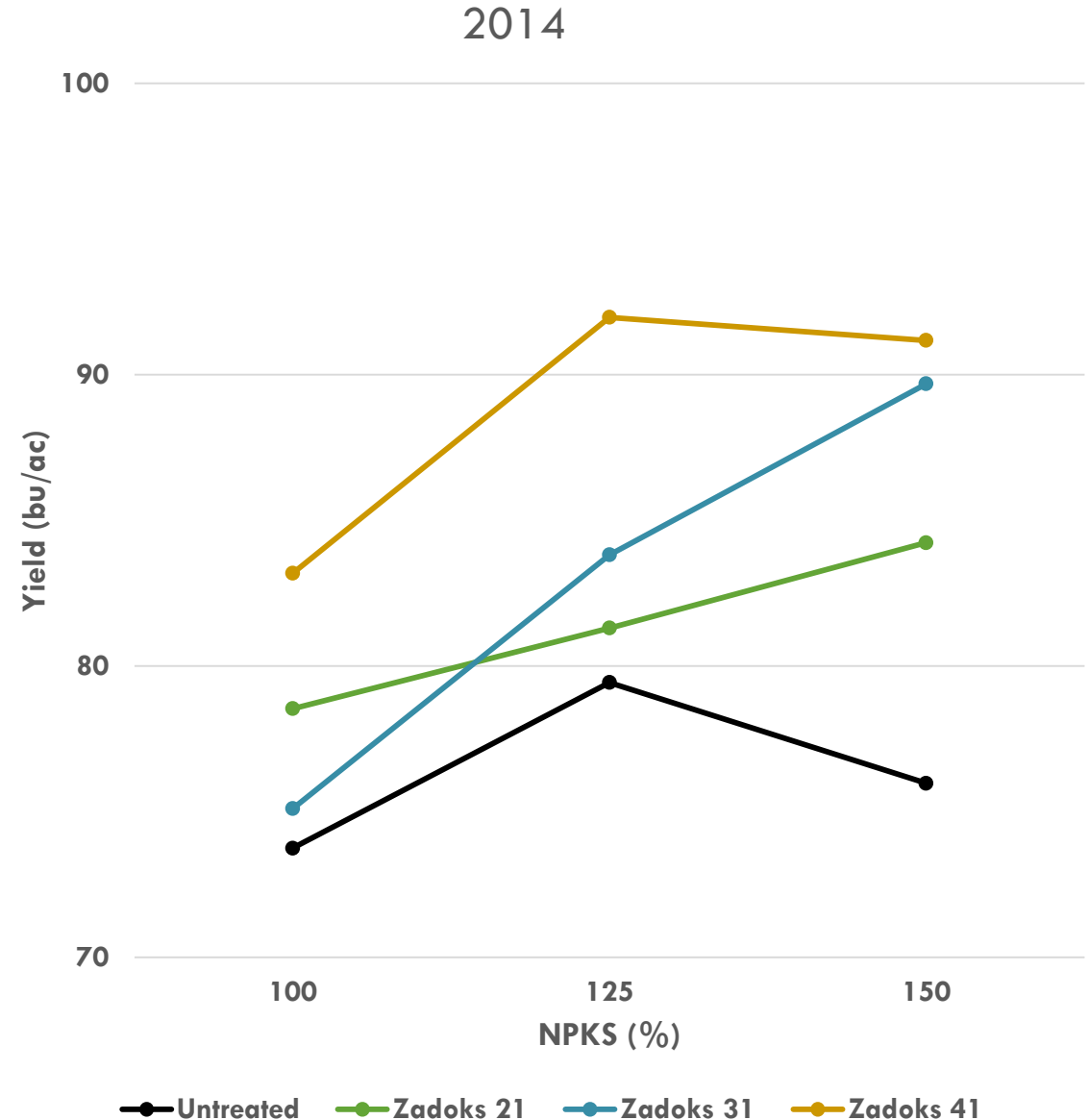


IHARF YIELD

Factor	Pr > F
PGR	<0.0001***
Fertility	<0.0001***
PGR * Fertility	0.1343

*** highly significant

- PGR and Fertility rate were each statistically different, but not together
- Yields at each application timing and fertility rate were above the untreated check.
- Late application timing (Z41) produced the highest yields at each fertility rate.



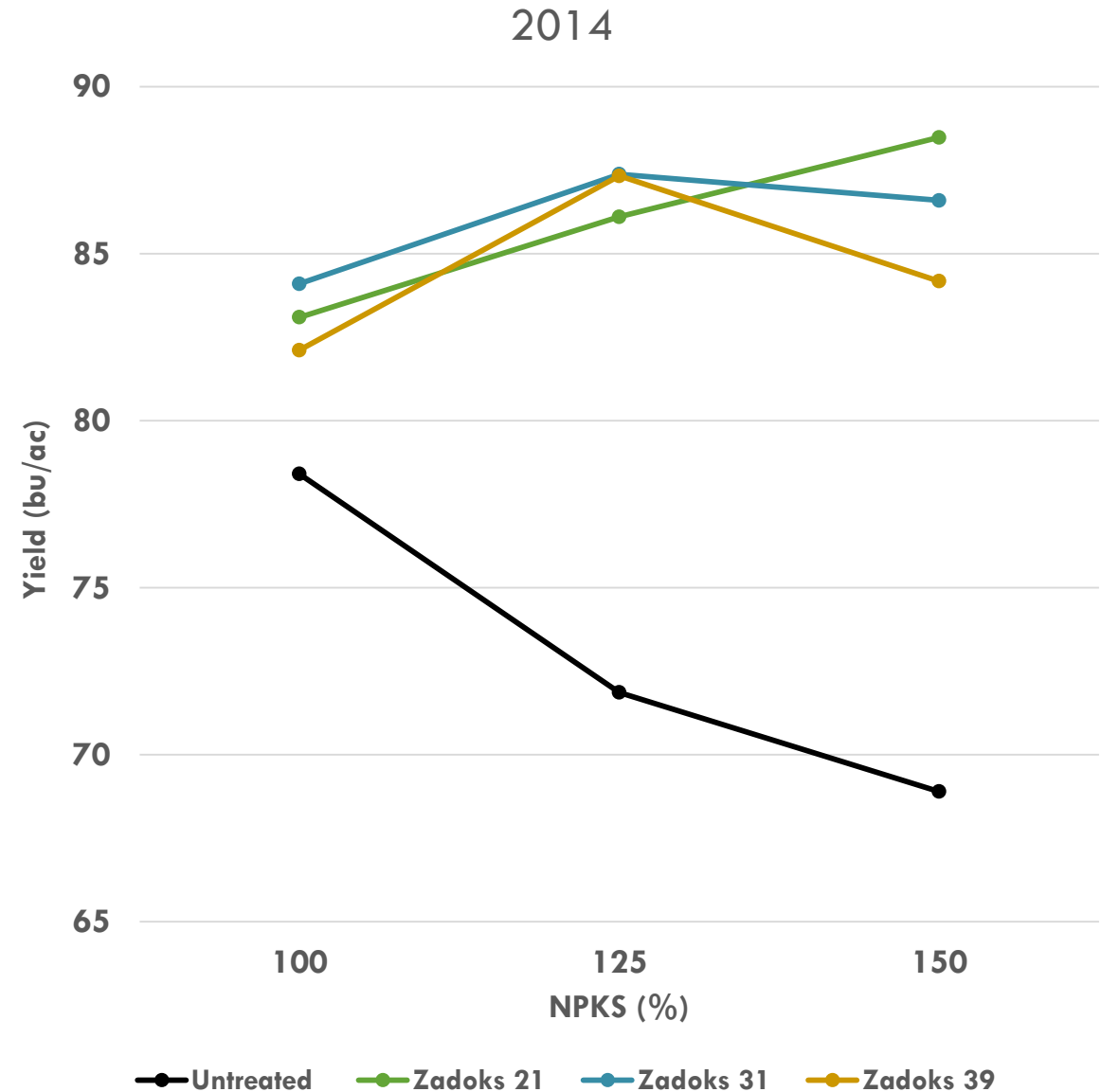
NARF YIELD

Factor	Pr > F
PGR	<0.0001***
Fertility	0.5204
PGR * Fertility	0.0018**

*** highly significant

** moderately significant

- PRG timing had an highly significant effect on yield.
- All fertility rates with PGR timings had higher yield than the untreated checks.
- Overall, application at Z31 produced the best yields.
- Decrease in yield due to lodging



2. HOW BIG ARE YIELD RESPONSES??

Yield Differences (bu/ac)	CWRS (35 Trials)	CPS (12 Trials)	CWAD (5 Trials)
Minimum	-0.2	-0.5	4.7
Maximum	17.0	7.2	12.0
Mean	6.41	1.85	8.88

*Trials from 2011 to 2014 – provided by Engage Agro

- **Classes act differently**
 - Durum was the only class to NOT experience a slight yield loss and had the largest overall mean increase
 - Red and Prairie Spring had slightly yield losses
 - There may be variation between varieties within classes as well

3. HOW CONSISTENT ARE YIELD RESPONSES??

Small plot:

- 31 of 36 cases there was a yield increase.
- 26 of 31 had an increase of 5% or more.
- And 18 of 31 had an increase of 10% or more.

CONSISTENCY
IS 

3. HOW CONSISTENT ARE YIELD RESPONSES??

Yield Increases	Occurrence with Yield Increases		
	CWRS (35 trials)	CPS (12 Trials)	CWAD (5 Trials)
5% +	85%	33%	80%
7.5% +	63%	25%	
10% +	55%	8%	60%

*Trials from 2011 to 2014 – provided by Engage Agro

All classes have yield increase to date

- Yield increases of at least 5% in 85, 33, and 80% trials
- And increases of 10% in 55, 8, and 60% of trials

However, classes respond differently!

- Red Spring and Durum classes have a stronger, more consistent response

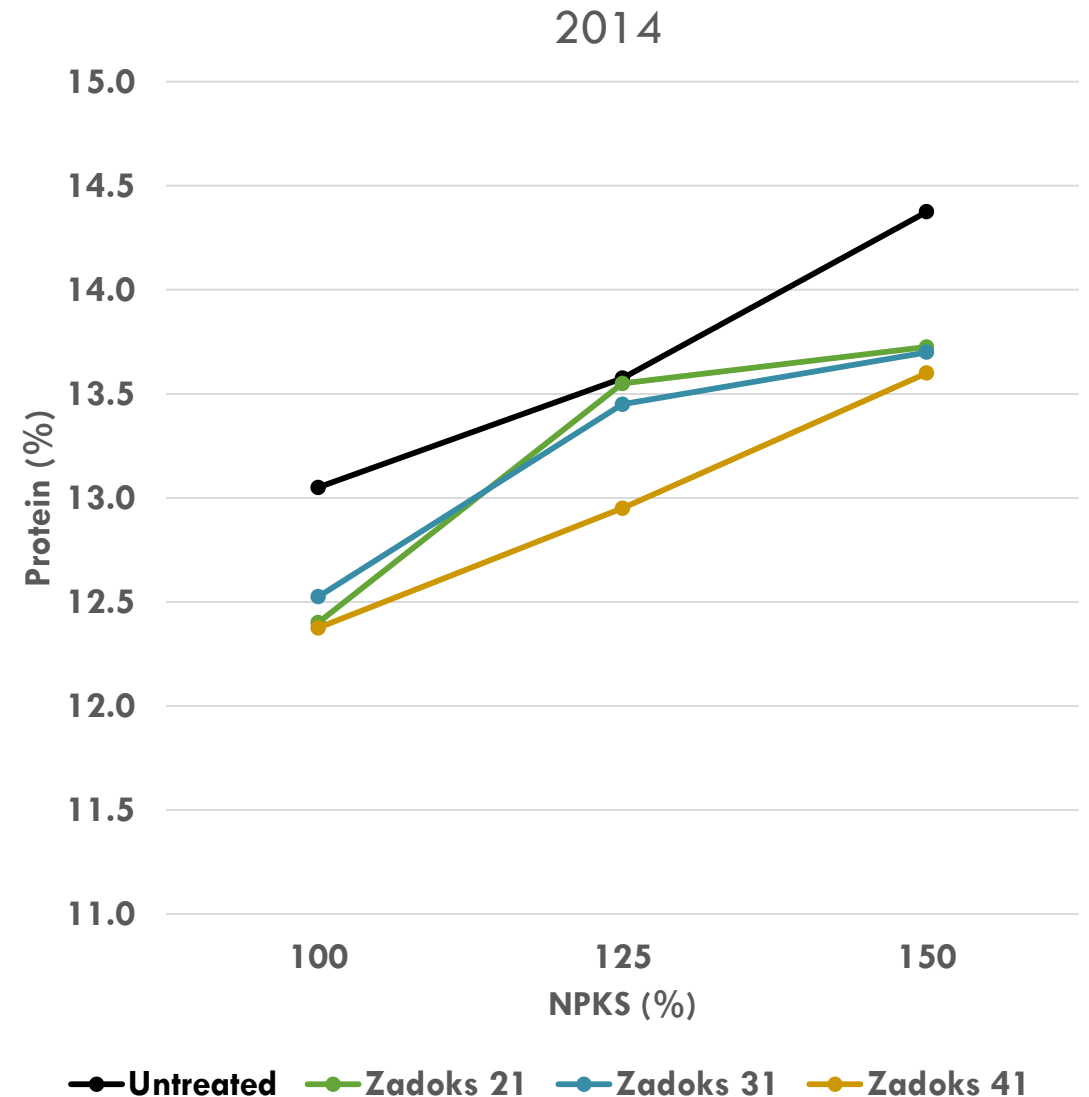
IHARF PROTEIN

Factor	Pr > F
PGR	0.0007**
Fertility	<0.0001***
PGR * Fertility	0.5037

*** highly significant

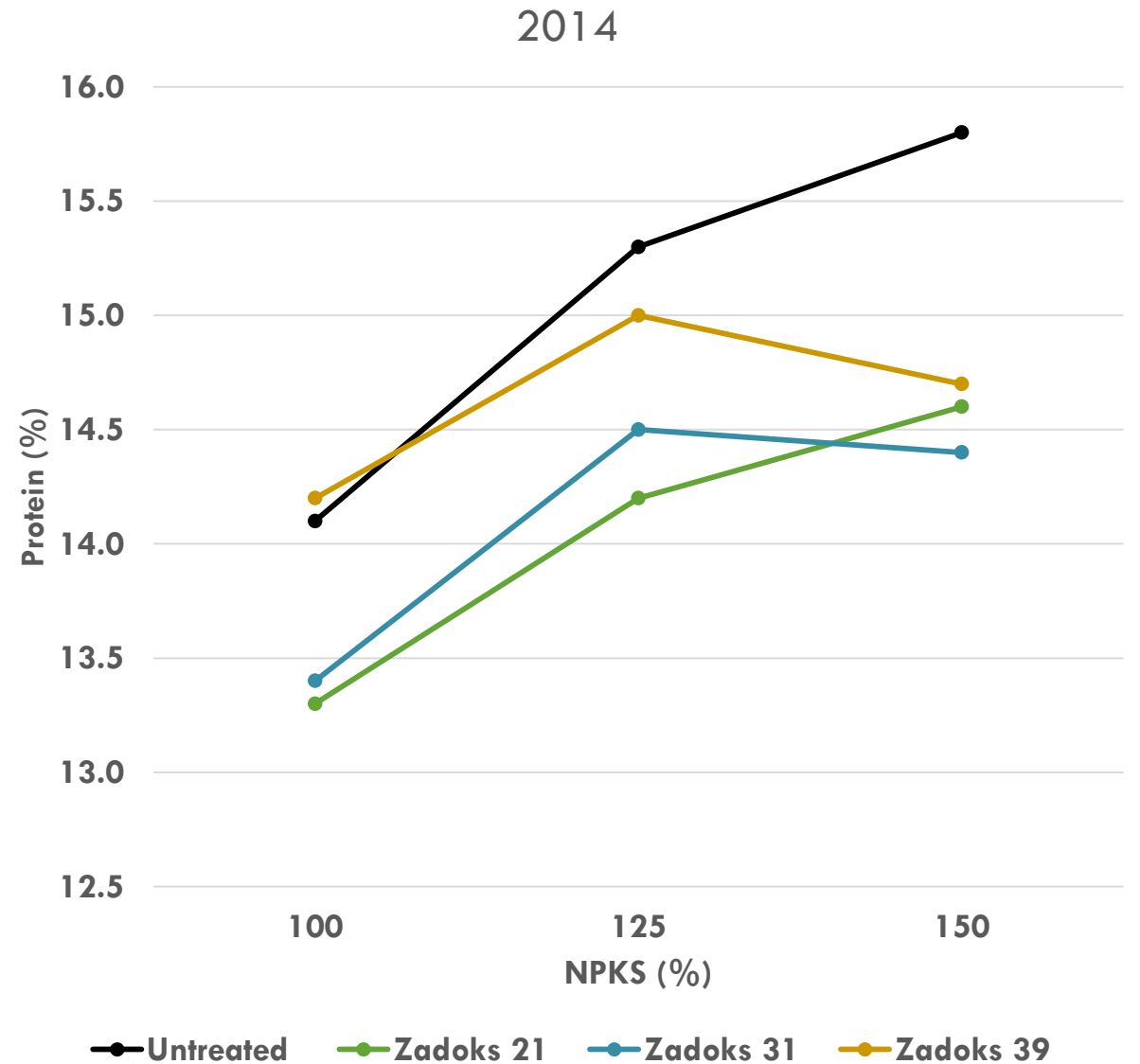
** moderately significant

- Fertility level had a highly significant effect on protein content.
- Protein content was less than the control for all fertility levels and application timings.
- Percentage protein in Zadoks 21 and 31 did not differ greatly from each other.
- Zadoks 41 had the least % protein overall, largely due to high yield.



NARF PROTEIN

- Percentage levels were less than the control for both Zadoks 21 and 31.
- Zadoks 39 had the best protein content of the application timings overall.
 - Slightly above the control at 100% fertility
- Overall, later application did not sacrifice yield as much as the earlier timings.



NOTE...

- PGR use in both cases was associated in decreased protein content compared to the control due to increased yield.
- PGR use should therefore not be used as a management tool for increasing protein content with and without lodging.
- Next step: look at Nitrogen levels that increase yield without sacrificing protein
- However, protein content was found to be high enough in all cases to still be considered a No. 1 CWRS and have a protein premium.

4. WILL PGR APPLICATION PAY OFF ECONOMICALLY??

Cost of PGR	Wheat Price	Avg. Input Costs/ac	Break even increase needed
\$10	\$5	\$220	2 bu/ac

- **Application pays off!**
 - Yield increases by 2+ bu/ac occurred in 3 of 4 small plot cases and 19 of 22 Engage Agro field scale trials of CWRS – costs are covered
 - Yield increases by 1+ bu/ac occur in 4 of 4 CWAD field trials – costs are covered
 - CPS yield responses weren't as promising because increases of 2.5+ bu/ac is needed however, still occurred in 4 of 10 trials – may not cover costs

DO THE MATH!

- **CWRS:** average increases of 7 – 12 bu/ac at \$5/bu that's:
 - \$35 to \$60 – \$10 cost of PGR = \$25 to \$50 net value!
- **CWAD:** average increase of 9 bu/ac at \$9/bu that's:
 - \$81 - \$10 cost of PGR = \$71 net value!

ALSO CONSIDER...

- **The value of:**
 - Ease of harvesting standing crop vs. a lodged crop
 - Decrease harvest time
 - Decrease labour/fuel costs
 - Less wear and tear on machinery
 - Better stubble management

IN THE FUTURE

- More PGR products created for spring and winter wheat use
- New PGR registration for barley, oats, and rye
- PGR Interactions with:
 - Fungicide application
 - Seeding rates
 - Root development
 - Water Use Efficiency

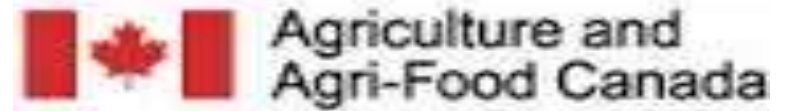
OVERALL

- PGRs are highly beneficial in lodging prevention and increasing yields.
- PGRs are another beneficial tool in high input cereal production.
- Try on a small scale first, then go big.

Thank You!



ENGAGE AGRO

The logo for ENGAGE AGRO consists of the word "ENGAGE" in a bold, italicized, red sans-serif font, followed by the word "AGRO" in a bold, black sans-serif font.



For More Information

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