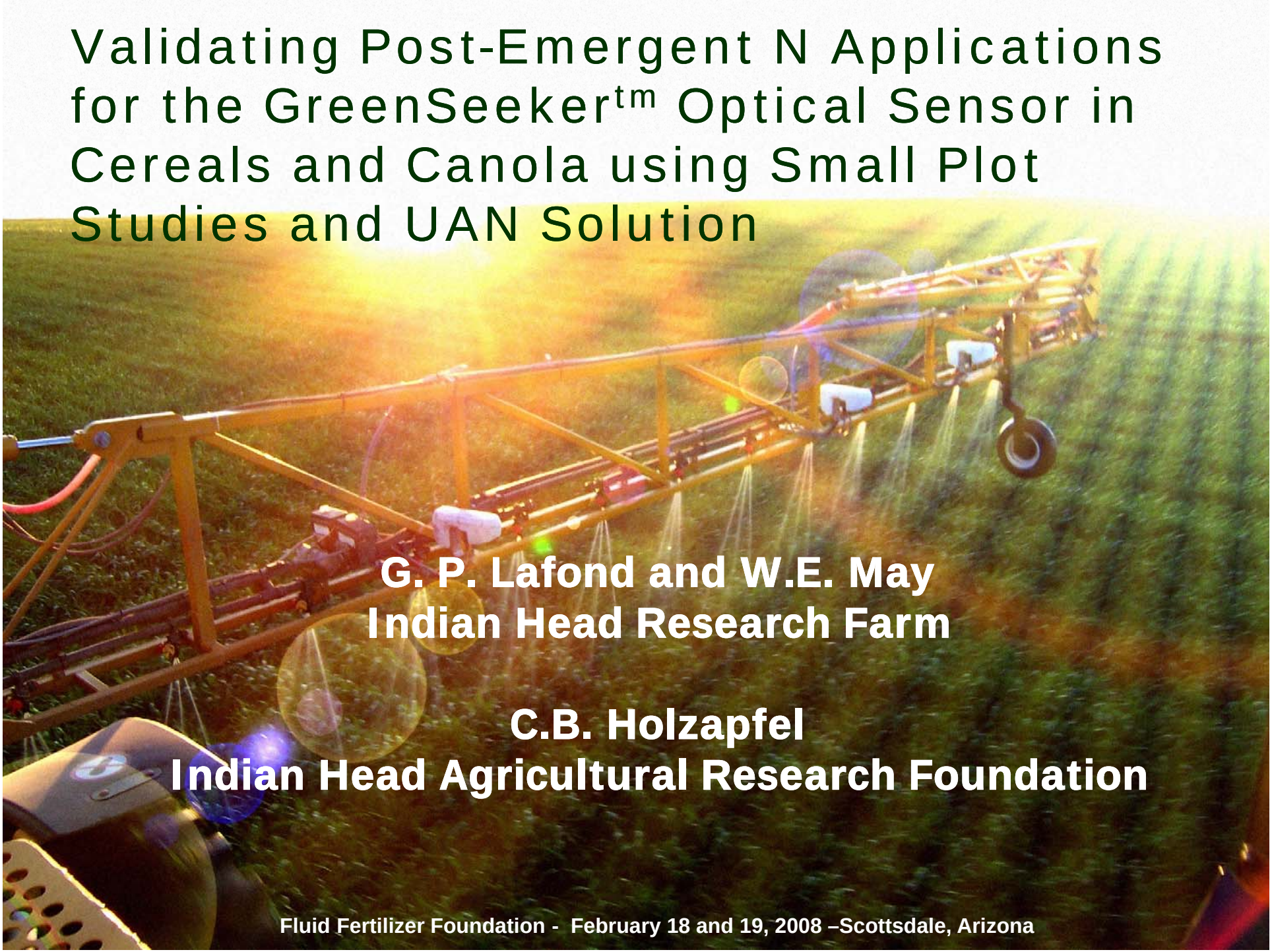
Validating Post-Emergent N Applications for the GreenSeeker^{tm} Optical Sensor in Cereals and Canola using Small Plot Studies and UAN Solution



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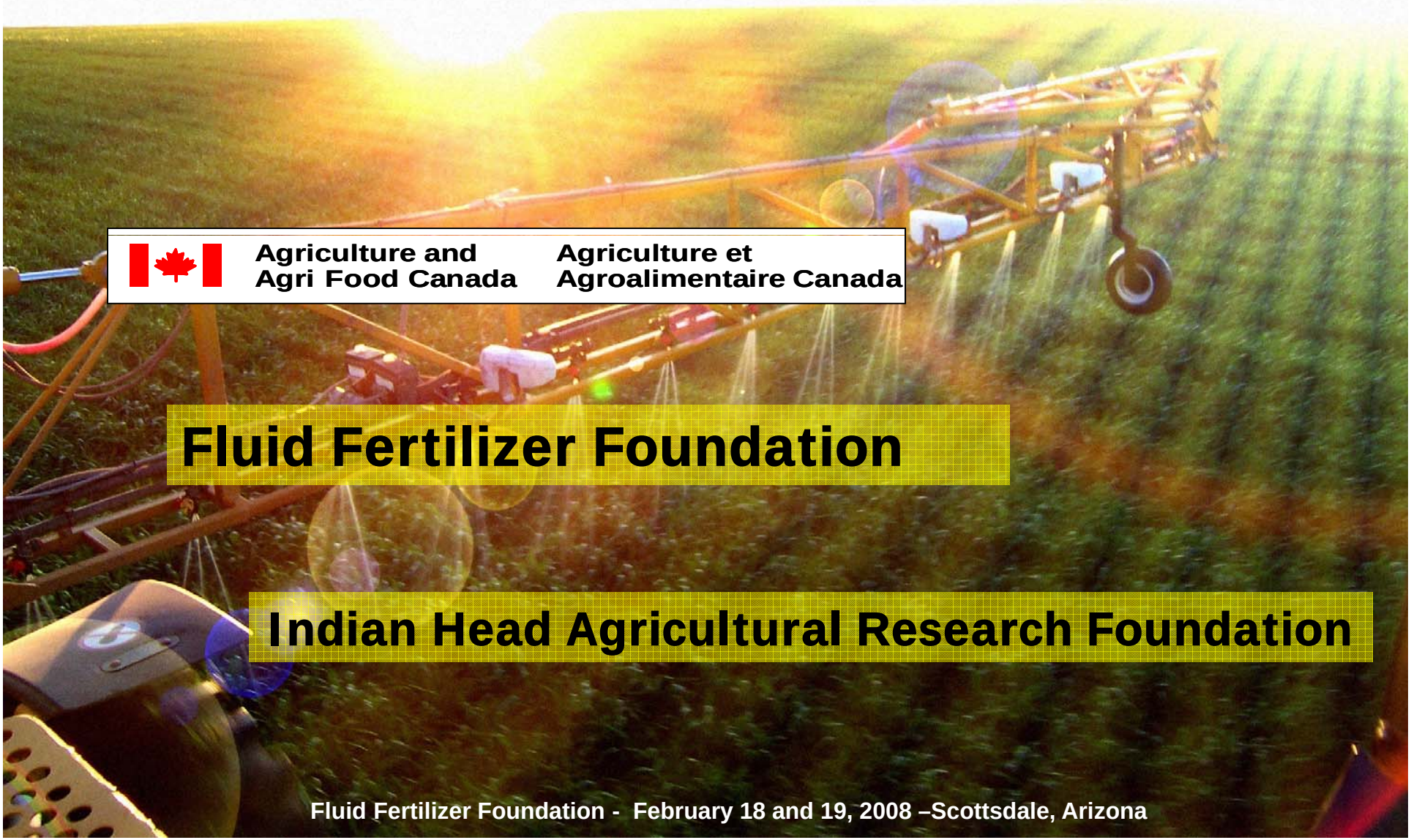
Fluid Fertilizer Foundation - February 18 and 19, 2008 –Scottsdale, Arizona

ACKNOWLEDGEMENTS



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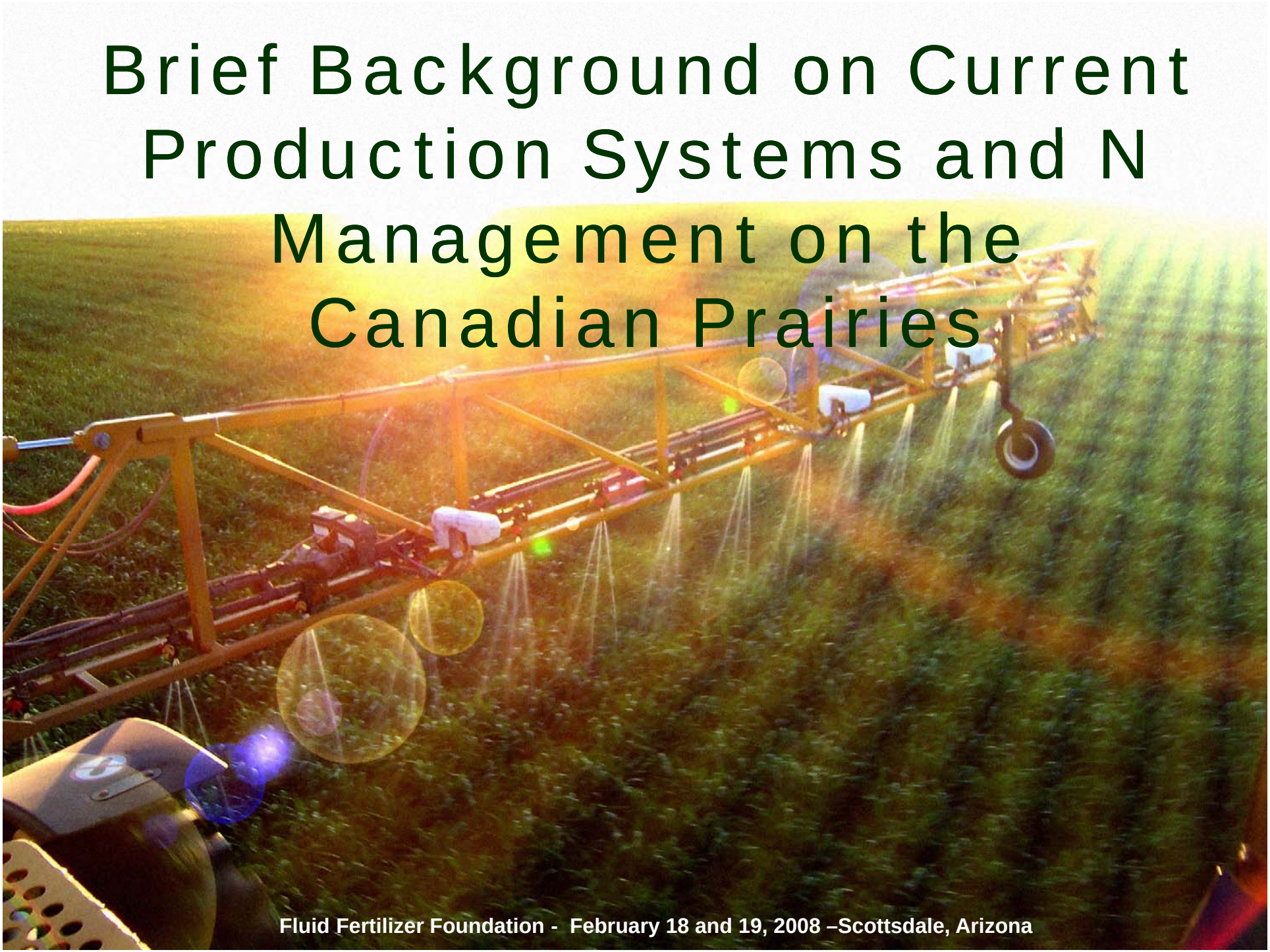
Brief Background on Current Production Systems and N Management on the Canadian Prairies



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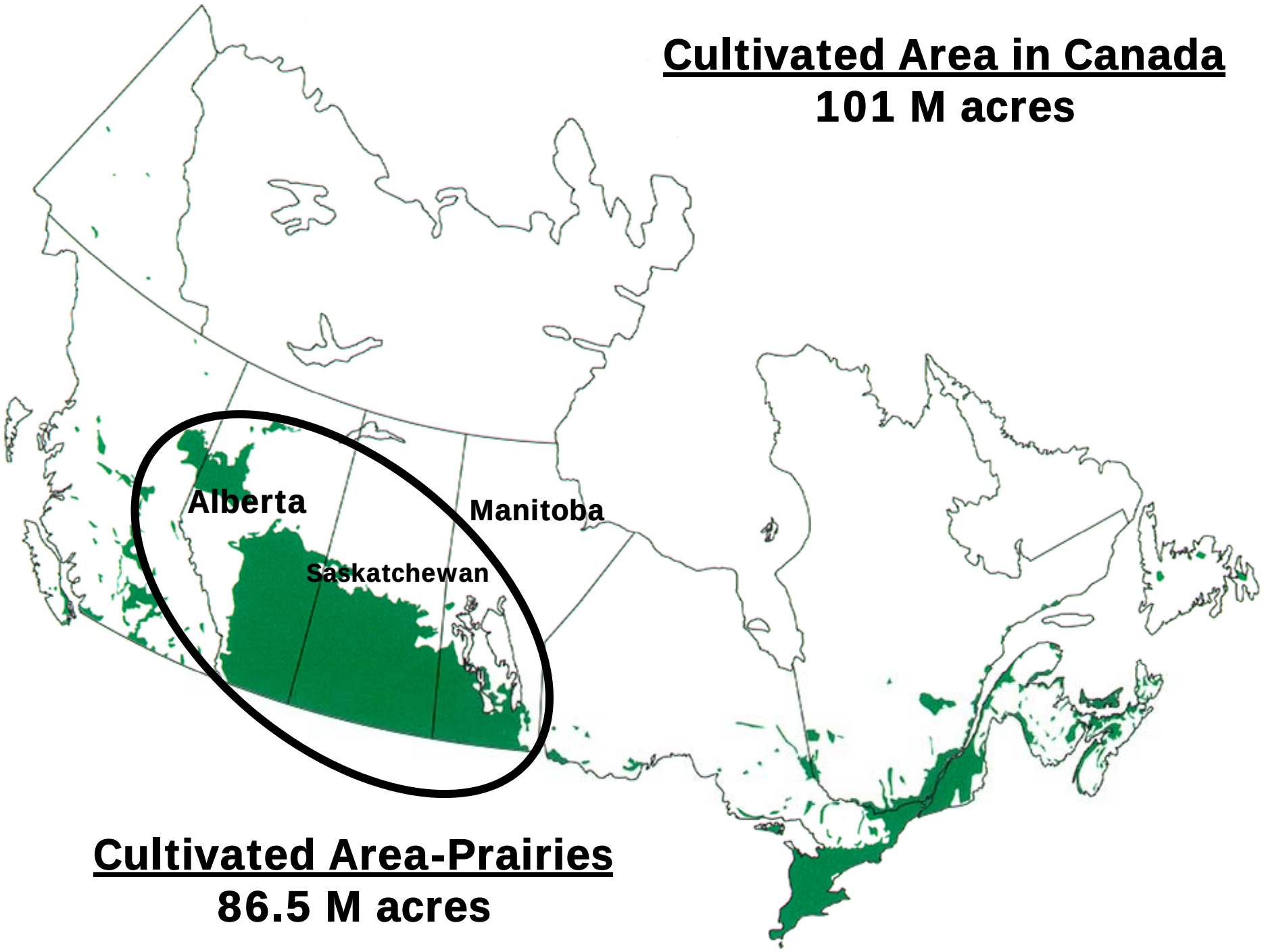

Cultivated Area in Canada
101 M acres
Alberta
Manitoba
Saskatchewan
Cultivated Area-Prairies
86.5 M acres

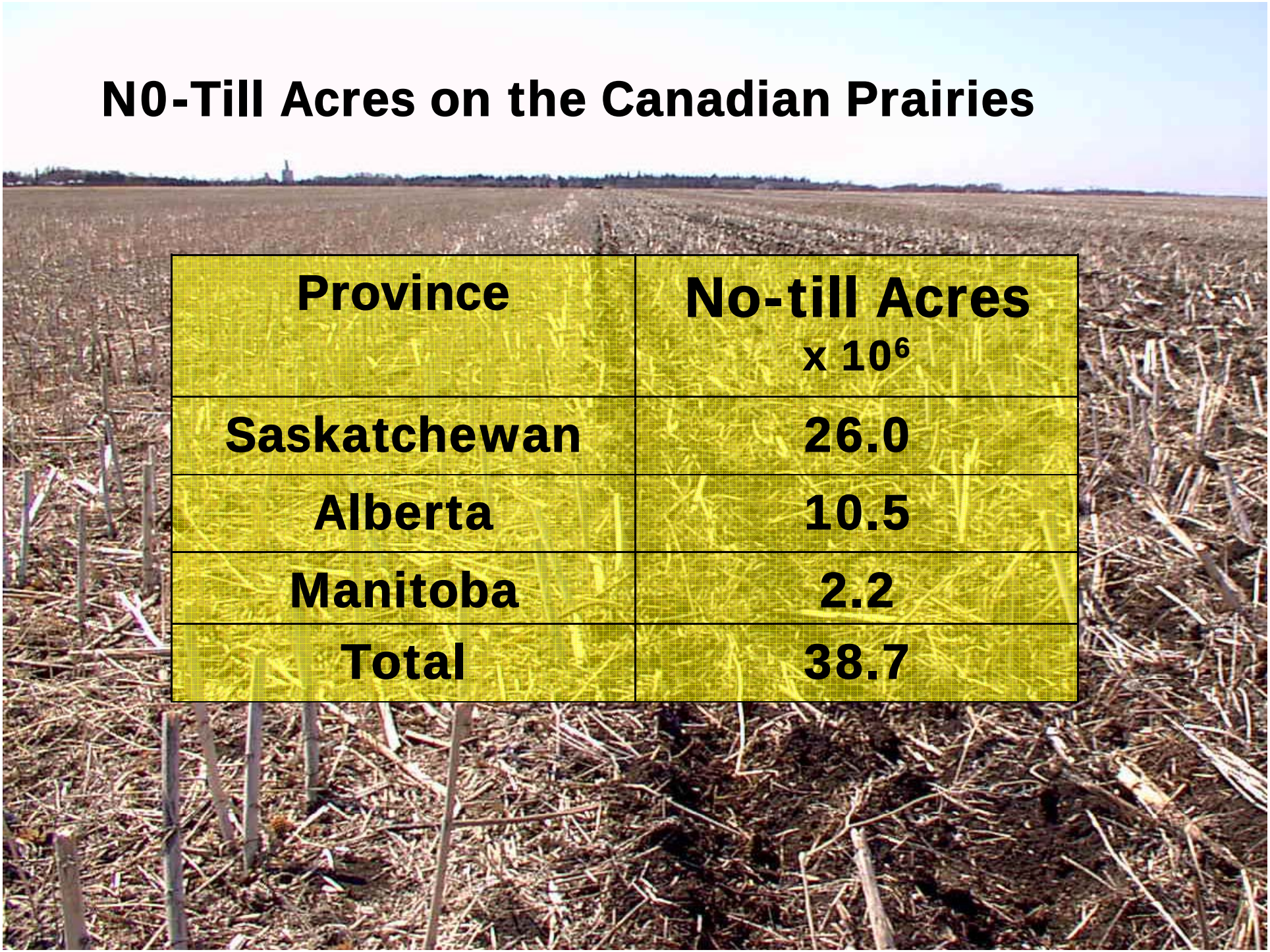
No-Till Area on the Canadian Prairies (% of cultivated acres)

Year	Saskatchewan	Alberta	Manitoba
1991			
1996			
2001			
2006			

NO-Till Area on the Canadian Prairies (% of cultivated acres)

Year	Saskatchewan	Alberta	Manitoba
1991	10	3	7
1996	19	10	15
2001	39	27	13
2006	60	48	21

N0-Till Acres on the Canadian Prairies



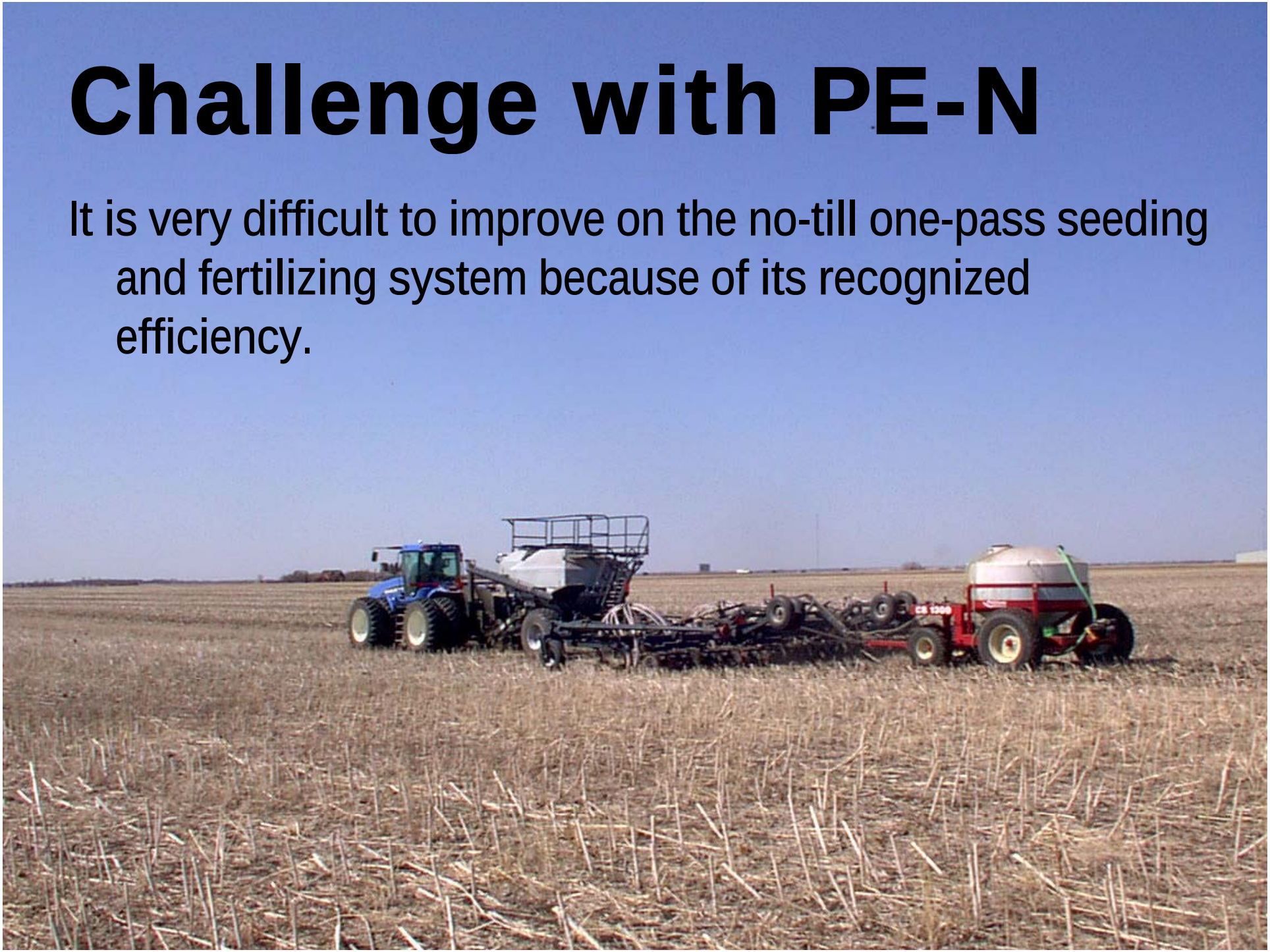
Province	No-till Acres x 10^6
Saskatchewan	26.0
Alberta	10.5
Manitoba	2.2
Total	38.7

N Management under No-till on the Canadian Prairies

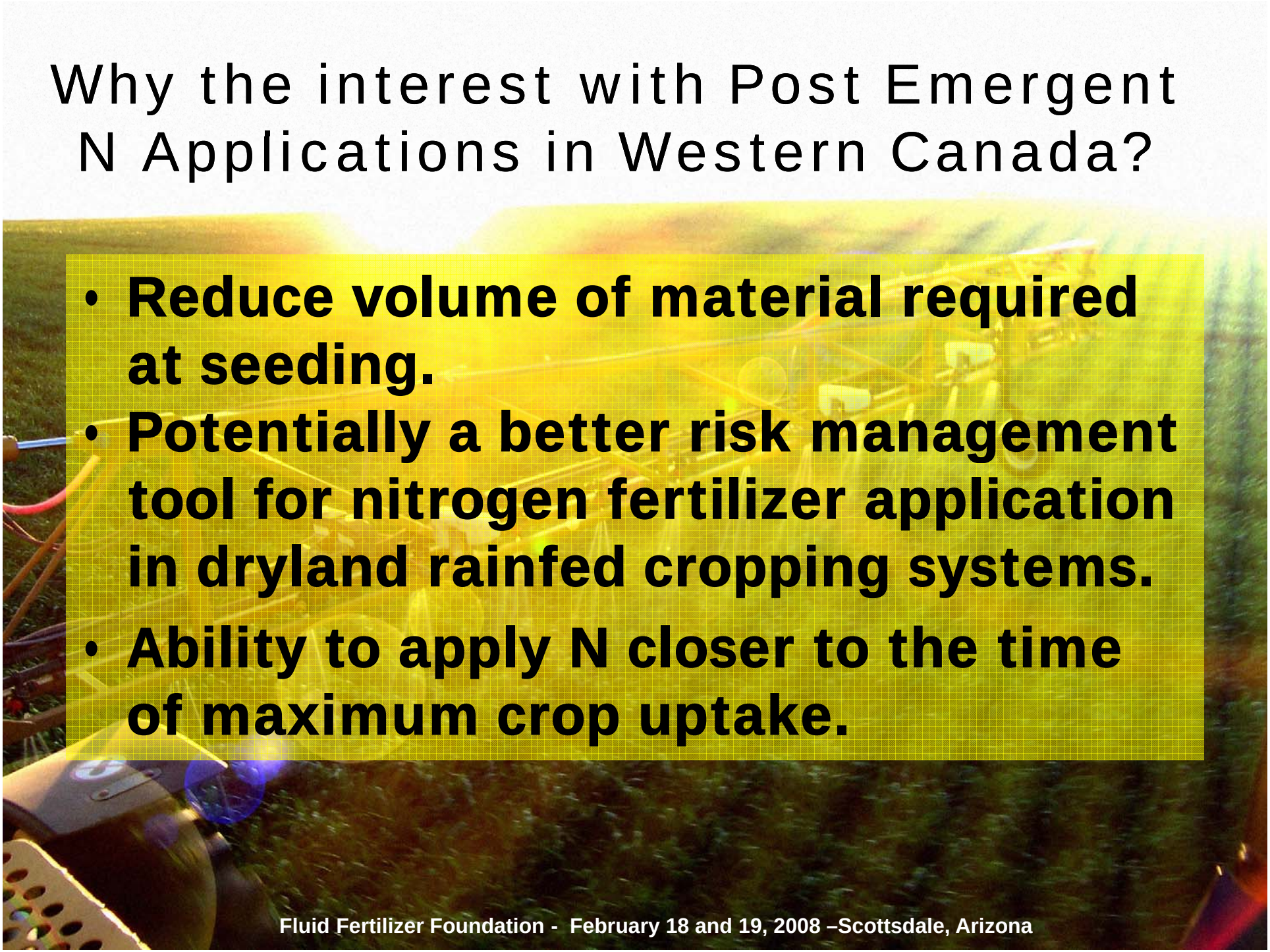
- Majority of N is applied in the soil at time of seeding using a one-pass seeding and fertilizing system

Challenge with PE-N

It is very difficult to improve on the no-till one-pass seeding and fertilizing system because of its recognized efficiency.



Why the interest with Post Emergent N Applications in Western Canada?



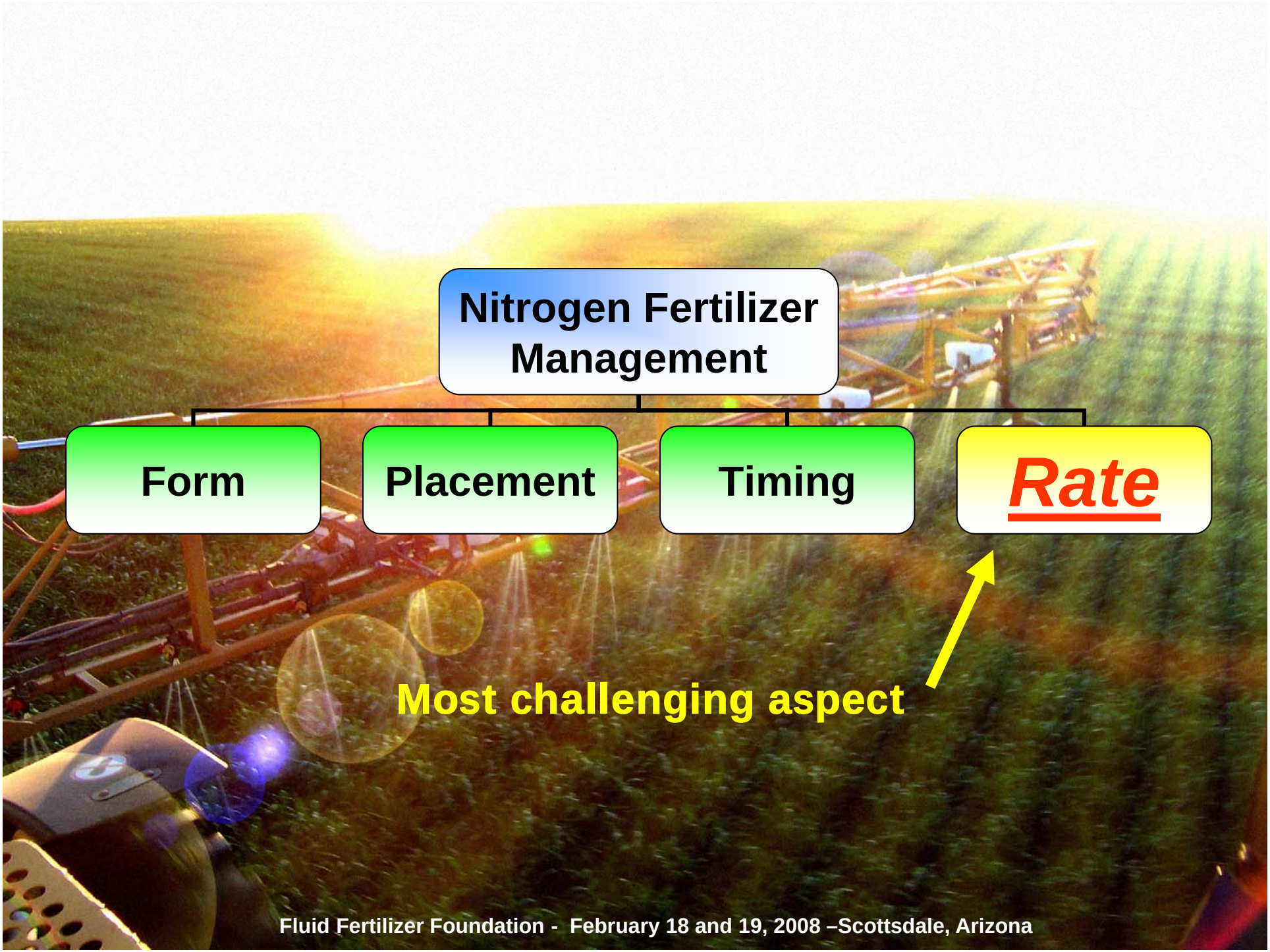
- **Reduce volume of material required at seeding.**
- **Potentially a better risk management tool for nitrogen fertilizer application in dryland rainfed cropping systems.**
- **Ability to apply N closer to the time of maximum crop uptake.**

Where are we at with this concept-Part 1?

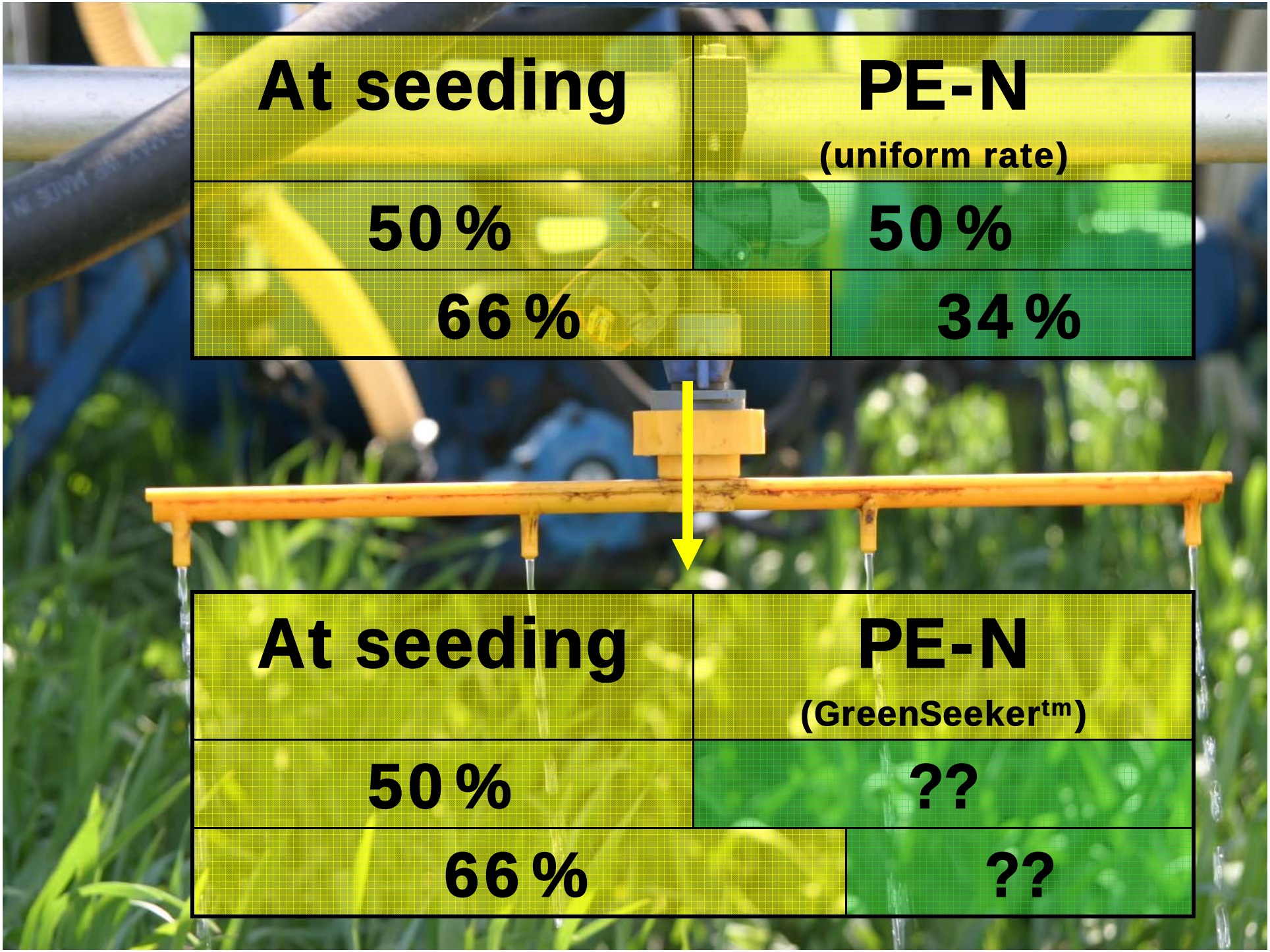
- **Test Crop: Spring wheat and canola**
- **PE-N application: 1, 10, 20 & 30 days after planting**
- **Post-emergent N applications are not without risks.**
- **Biggest risk is delay in receiving significant rainfall after application.**
- **Coulter injection reduces but does eliminate the risks associated with PE-N**
- **Adding ATS to the solution did not improve the performance of PE-N**
- **Need to consider some N at time of seeding**

Where are we at with this concept-Part 2?

- **Test Crops: Spring wheat and Canola**
- **Adding some N at seeding significantly reduces the risks of post-emergent N applications.**
- **Recommend a minimum of 50% of total fertilizer N requirements as starter N**
- **Spring wheat: PE-N up to 5-6 leaf stage**
- **Canola: PE-N up to appearance of first flowers**


Nitrogen Fertilizer Management
Form
Placement
Timing
Rate
Most challenging aspect


The next step...


At seeding
PE-N
(uniform rate)
50 %
50 %
66 %
34 %
At seeding
PE-N
(GreenSeeker™)
50 %
??
66 %
??

Objective

To validate the application algorithms developed for the GreenSeeker™ sensor in cereals and canola using small plots and to continue with the evaluation of the merits of PE-N.

List of Crops

- **Durum wheat**
- **Spring wheat**
- **Winter wheat**
- **Malting Barley**
- **Oat**
- **Canola**

List of Treatments

- 1. Check (no nitrogen)
- 2. N rich (NR)
- 3. Farmer Practice (FP)
- 4. 66% of FP (RR)
- 5. 50% at seeding + 50% PE-N
- 6. 66% at seeding + 34% PE-N
- 7. 50% at seeding + PE-N with GS
- 8. 66% at seeding + PE-N with GS

Timing of PE-N

- **Cereals: ~ 6 leaf stage**
- **Canola: mid-bolting stage**

Total N Applied for the Various Treatments
(kg N/ha)

Treatments	Durum	Spring wheat	Barley	Oat
1. Check	0	0	0	0
2. N Rich	130	130	160	120
3. Farmer Practice (FP)	90	90	105	60
4. 66% of FP (RR)	59	59	69	40
5. 50% N at Seeding + 50% PE	90	90	105	60
6. 66% N at Seeding + 34% PE	90	90	105	60
7. 50% N at Seeding + PE GreenSeeker				
8. 66% N at Seeding + PE GreenSeeker				

Total N Applied for the Various Treatments
(kg N/ha)

Treatments	Durum	Spring wheat	Barley	Oat
1. Check	0	0	0	0
2. N Rich	130	130	160	120
3. Farmer Practice (FP)	90	90	105	60
4. 66% of FP (RR)	59	59	69	40
5. 50% N at Seeding + 50% PE	90	90	105	60
6. 66% N at Seeding + 34% PE	90	90	105	60
7. 50% N at Seeding + PE GreenSeeker	52	52	64	38
8. 66% N at Seeding + PE GreenSeeker	62	68	95	49

Total N Applied for Various Treatments
(kg N/ha)

Treatments	Winter wheat	Canola
1. Check	0	0
2. N Rich	206	150
3. Farmer Practice (FP)	118	100
4. 66% of FP (RR)	78	66
5. 66% N at Seeding + 34% PE	118	100
6. 66% N at Seeding + PE GreenSeeker		
7. 34% N at Seeding + PE 66%	118	-
8. 34% N at Seeding + PE GreenSeeker		-

Total N Applied for Various Treatments
(kg N/ha)

Treatments	Winter wheat	Canola
1. Check	0	0
2. N Rich	206	150
3. Farmer Practice (FP)	118	100
4. 66% of FP (RR)	78	66
5. 66% N at Seeding + 34% PE	118	100
6. 66% N at Seeding + PE GreenSeeker	90	67
7. 34% N at Seeding + PE 66%	118	-
8. 34% N at Seeding + PE GreenSeeker	62	-

Grain Yields (bus/acre)

Treatments	Durum	Spring wheat	Barley	Oat
1. Check				
2. N Rich				
3. Farmer Practice (FP)				
4. 66% of FP (RR)				
5. 50% N at Seeding + 50% PE				
6. 66% N at Seeding + 34% PE				
7. 50% N at Seeding + PE GreenSeeker				
8. 66% N at Seeding + PE GreenSeeker				

Grain Yields (bus/acre)

Check vs rest

Treatments	Durum	Spring wheat	Barley	Oat
1. Check	20.8	22.3	37.7	93.4
2. N Rich	50.3	39.1	76.9	104.5
3. Farmer Practice (FP)	46.8	36.4	76.1	103.5
4. 66% of FP (RR)	42.7	31.8	63.4	103.3
5. 50% N at Seeding + 50% PE	38.5	36.1	73.0	104.4
6. 66% N at Seeding + 34% PE	43.9	35.4	71.8	105.7
7. 50% N at Seeding + PE GreenSeeker	36.9	37.9	66.4	101.6
8. 66% N at Seeding + PE GreenSeeker	42.8	38.8	69.9	106.0

Grain Yields (bus/acre)
NR vs FP

Treatments	Durum	Spring wheat	Barley	Oat
1. Check	20.8	22.3	37.7	93.4
2. N Rich	50.3	39.1	76.9	104.5
3. Farmer Practice (FP)	46.8	36.4	76.1	103.5
4. 66% of FP (RR)	42.7	31.8	63.4	103.3
5. 50% N at Seeding + 50% PE	38.5	36.1	73.0	104.4
6. 66% N at Seeding + 34% PE	43.9	35.4	71.8	105.7
7. 50% N at Seeding + PE GreenSeeker	36.9	37.9	66.4	101.6
8. 66% N at Seeding + PE GreenSeeker	42.8	38.8	69.9	106.0

Grain Yields (bus/acre)
FP vs Split

Treatments	Durum	Spring wheat	Barley	Oat
1. Check	20.8	22.3	37.7	93.4
2. N Rich	50.3	39.1	76.9	104.5
3. Farmer Practice (FP)	46.8	36.4	76.1	103.5
4. 66% of FP (RR)	42.7	31.8	63.4	103.3
5. 50% N at Seeding + 50% PE	38.5	36.1	73.0	104.4
6. 66% N at Seeding + 34% PE	43.9	35.4	71.8	105.7
7. 50% N at Seeding + PE GreenSeeker	36.9	37.9	66.4	101.6
8. 66% N at Seeding + PE GreenSeeker	42.8	38.8	69.9	106.0

Grain Yields (bus/acre)
FP vs GreenSeeker

Treatments	Durum	Spring wheat	Barley	Oat
1. Check	20.8	22.3	37.7	93.4
2. N Rich	50.3	39.1	76.9	104.5
3. Farmer Practice (FP)	46.8	36.4	76.1	103.5
4. 66% of FP (RR)	42.7	31.8	63.4	103.3
5. 50% N at Seeding + 50% PE	38.5	36.1	73.0	104.4
6. 66% N at Seeding + 34% PE	43.9	35.4	71.8	105.7
7. 50% N at Seeding + PE GreenSeeker	36.9	37.9	66.4	101.6
8. 66% N at Seeding + PE GreenSeeker	42.8	38.8	69.9	106.0

Grain Protein (%)

Treatments	Durum	Spring wheat	Barley	Oat
1. Check				-
2. N Rich				-
3. Farmer Practice (FP)				-
4. 66% of FP (RR)				-
5. 50% N at Seeding + 50% PE				-
6. 66% N at Seeding + 34% PE				-
7. 50% N at Seeding + PE GreenSeeker				-
8. 66% N at Seeding + PE GreenSeeker				-

Grain Protein (%)

Check vs Rest

Treatments	Durum	Spring wheat	Barley	Oat
1. Check	12.8	14.7	12.3	-
2. N Rich	14.9	16.2	14.4	-
3. Farmer Practice (FP)	14.2	15.8	13.5	-
4. 66% of FP (RR)	12.6	14.8	13.2	-
5. 50% N at Seeding + 50% PE	13.3	15.7	13.6	-
6. 66% N at Seeding + 34% PE	13.9	15.5	13.7	-
7. 50% N at Seeding + PE GreenSeeker	12.6	15.5	12.8	-
8. 66% N at Seeding + PE GreenSeeker	12.8	15.4	13.5	-

Grain Protein (%)

NRich vs FP

Treatments	Durum	Spring wheat	Barley	Oat
1. Check	12.8	14.7	12.3	-
2. N Rich	14.9	16.2	14.4	-
3. Farmer Practice (FP)	14.2	15.8	13.5	-
4. 66% of FP (RR)	12.6	14.8	13.2	-
5. 50% N at Seeding + 50% PE	13.3	15.7	13.6	-
6. 66% N at Seeding + 34% PE	13.9	15.5	13.7	-
7. 50% N at Seeding + PE GreenSeeker	12.6	15.5	12.8	-
8. 66% N at Seeding + PE GreenSeeker	12.8	15.4	13.5	-

Grain Protein (%)

FP vs Split

Treatments	Durum	Spring wheat	Barley	Oat
1. Check	12.8	14.7	12.3	-
2. N Rich	14.9	16.2	14.4	-
3. Farmer Practice (FP)	14.2	15.8	13.5	-
4. 66% of FP (RR)	12.6	14.8	13.2	-
5. 50% N at Seeding + 50% PE	13.3	15.7	13.6	-
6. 66% N at Seeding + 34% PE	13.9	15.5	13.7	-
7. 50% N at Seeding + PE GreenSeeker	12.6	15.5	12.8	-
8. 66% N at Seeding + PE GreenSeeker	12.8	15.4	13.5	-

Grain Protein (%)

FP vs GreenSeeker

Treatments	Durum	Spring wheat	Barley	Oat
1. Check	12.8	14.7	12.3	-
2. N Rich	14.9	16.2	14.4	-
3. Farmer Practice (FP)	14.2	15.8	13.5	-
4. 66% of FP (RR)	12.6	14.8	13.2	-
5. 50% N at Seeding + 50% PE	13.3	15.7	13.6	-
6. 66% N at Seeding + 34% PE	13.9	15.5	13.7	-
7. 50% N at Seeding + PE GreenSeeker	12.6	15.5	12.8	-
8. 66% N at Seeding + PE GreenSeeker	12.8	15.4	13.5	-

Total N Applied for the Various Treatments
(kg N/ha)

Treatments	Durum	Spring wheat	Barley	Oat
1. Check	0	0	0	0
2. N Rich	130	130	160	120
3. Farmer Practice (FP)	90	90	105	60
4. 66% of FP (RR)	59	59	69	40
5. 50% N at Seeding + 50% PE	90	90	105	60
6. 66% N at Seeding + 34% PE	90	90	105	60
7. 50% N at Seeding + PE GreenSeeker	52	52	64	38
8. 66% N at Seeding + PE GreenSeeker	62	68	95	49

Total N Applied for the Various Treatments
(kg N/ha)

Treatments	Durum	Spring wheat	Barley	Oat
1. Check	0	0	0	0
2. N Rich	130	130	160	120
3. Farmer Practice (FP)	90	90 (36.4)	105	60
4. 66% of FP (RR)	59	59	69	40
5. 50% N at Seeding + 50% PE	90	90	105	60
6. 66% N at Seeding + 34% PE	90	90	105	60
7. 50% N at Seeding + PE GreenSeeker	52	52 (37.9)	64	38
8. 66% N at Seeding + PE GreenSeeker	62	68 (38.8)	95	49

Grain Yield (bus/acre)

Treatments	Canola
1. Check	
2. N Rich	
3. Farmer Practice (FP)	
4. 66% of FP (RR)	
5. 66% N at Seeding + 34% PE Mid-Bolting	
6. 66% N at Seeding + PE GreenSeeker#1	
7. 66% N at Seeding + PE GreenSeeker#2	

Grain Yield (bus/acre)

Check vs Rest

Treatments	Canola
1. Check	26.6
2. N Rich	45.3
3. Farmer Practice (FP)	36.9
4. 66% of FP (RR)	30.8
5. 66% N at Seeding + 34% PE Mid-Bolting	43.1
6. 66% N at Seeding + PE GreenSeeker#1	39.2
7. 66% N at Seeding + PE GreenSeeker#2	38.9

Grain Yield (bus/acre)

NR vs All N Treatment

Treatments	Canola
1. Check	26.6
2. N Rich	45.3
3. Farmer Practice (FP)	36.9
4. 66% of FP (RR)	30.8
5. 66% N at Seeding + 34% PE Mid-Bolting	43.1
6. 66% N at Seeding + PE GreenSeeker#1	39.2
7. 66% N at Seeding + PE GreenSeeker#2	38.9

Grain Yield (bus/acre)

FP vs Split

Treatments	Canola
1. Check	26.6
2. N Rich	45.3
3. Farmer Practice (FP)	36.9
4. 66% of FP (RR)	30.8
5. 66% N at Seeding + 34% PE Mid-Bolting	43.1
6. 66% N at Seeding + PE GreenSeeker#1	39.2
7. 66% N at Seeding + PE GreenSeeker#2	38.9

Grain Yield (bus/acre)

FP vs GreenSeeker

Treatments	Canola
1. Check	26.6
2. N Rich	45.3
3. Farmer Practice (FP)	36.9
4. 66% of FP (RR)	30.8
5. 66% N at Seeding + 34% PE Mid-Bolting	43.1
6. 66% N at Seeding + PE GreenSeeker#1	39.2
7. 66% N at Seeding + PE GreenSeeker#2	38.9

Total N for Various Treatments
(kg N/ha)

Treatments	Canola
1. Check	0
2. N Rich	150
3. Farmer Practice (FP)	100
4. 66% of FP (RR)	66
5. 66% N at Seeding + 34% PE	100
6. 66% N at Seeding + PE GreenSeeker#1	68
7. 66% N at Seeding + PE GreenSeeker#2	66

Grain Yield (bus/acre)

Treatments	Winter Wheat
1. Check	
2. N Rich	
3. Farmer Practice (FP)	
4. 66 % of FP (RR)	
5. 66 % N in Early Spring and 34 % at Feekes 4-5	
6. 66 % N in Early Spring + balance with GreenSeeker (GS) at Feekes 4-5	
7. 34 % N in Early Spring and 66 % at Feekes 4-5	
8. 34 % N in Early Spring + balance with GreenSeeker (GS) at Feekes 4-5	

Grain Yield (bus/acre)

Check vs Rest

Treatments	Winter Wheat
1. Check	21.4
2. N Rich	60.0
3. Farmer Practice (FP)	60.6
4. 66 % of FP (RR)	45.9
5. 66 % N in Early Spring and 34 % at Feekes 4-5	-
6. 66 % N in Early Spring + balance with GreenSeeker (GS) at Feekes 4-5	47.6
7. 34 % N in Early Spring and 66 % at Feekes 4-5	62.7
8. 34 % N in Early Spring + balance with GreenSeeker (GS) at Feekes 4-5	46.7

Grain Yield (bus/acre)

FP vs Split

Treatments	Winter Wheat
1. Check	21.4
2. N Rich	60.0
3. Farmer Practice (FP)	60.6
4. 66 % of FP (RR)	45.9
5. 66 % N in Early Spring and 34 % at Feekes 4-5	-
6. 66 % N in Early Spring + balance with GreenSeeker (GS) at Feekes 4-5	47.6
7. 34 % N in Early Spring and 66 % at Feekes 4-5	62.7
8. 34 % N in Early Spring + balance with GreenSeeker (GS) at Feekes 4-5	46.7

Grain Yield (bus/acre)

FP vs GreenSeeker

Treatments	Winter Wheat
1. Check	21.4
2. N Rich	60.0
3. Farmer Practice (FP)	60.6
4. 66 % of FP (RR)	45.9
5. 66 % N in Early Spring and 34 % at Feekes 4-5	-
6. 66 % N in Early Spring + balance with GreenSeeker (GS) at Feekes 4-5	47.6
7. 34 % N in Early Spring and 66 % at Feekes 4-5	62.7
8. 34 % N in Early Spring + balance with GreenSeeker (GS) at Feekes 4-5	46.7

Total N Applied for Various Treatments
(kg N/ha)

Treatments	Winter wheat
1. Check	0
2. N Rich	206
3. Farmer Practice (FP)	118
4. 66% of FP (RR)	78
5. 66% N at Seeding + 34% PE	118
6. 66% N at Seeding + PE GreenSeeker	90
7. 34% N at Seeding + PE 66%	118
8. 34% N at Seeding + PE GreenSeeker	62

Conclusions

- **PE-N treatment performed equally as all N applied at seeding in all crops except for durum**
- **Use of GS^{tm} Algorithms resulted in less N applied and similar yields for spring wheat and canola**
- **Algorithms for durum, barley and winter wheat need more development**
- **PE-N with 50 or 60% of N at seeding is feasible.**

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Thank-you

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