Use of Manure in Potato Production

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Research Questions

1. Nutrient Availability?
2. Effects on disease?
   - scab
   - tuber decay
   - foliar diseases
3. Management to improve compatibility?
   - rate
   - timing

Possible potato benefits from the manure:

- Adds macro and micro nutrients
- Increases CEC
- Increases soil OM
- Decreases bulk density
- Increases moisture holding capacity
- Reduces Mn and/or Al toxicity

- Increases yield and quality

Possible potato problems from manure:

- Increased scab
- Increased tuber decay
- Decreased solids
- Increased foliar disease

Wisconsin Experiments:

- N Availability (Antigo)
- P Availability (Antigo)
- Manure rate vs. scab (Antigo and Rhinelander)
- Manure timing and disease (Antigo)
- Experiments conducted 2000 and 2001

Nutrient Availability Experiment:

a) N availability to potatoes

1. 0, 60, 120, 180, 240 lb N/a fertilizer
2. 327/298 and 654/517 lb N/a dairy manure

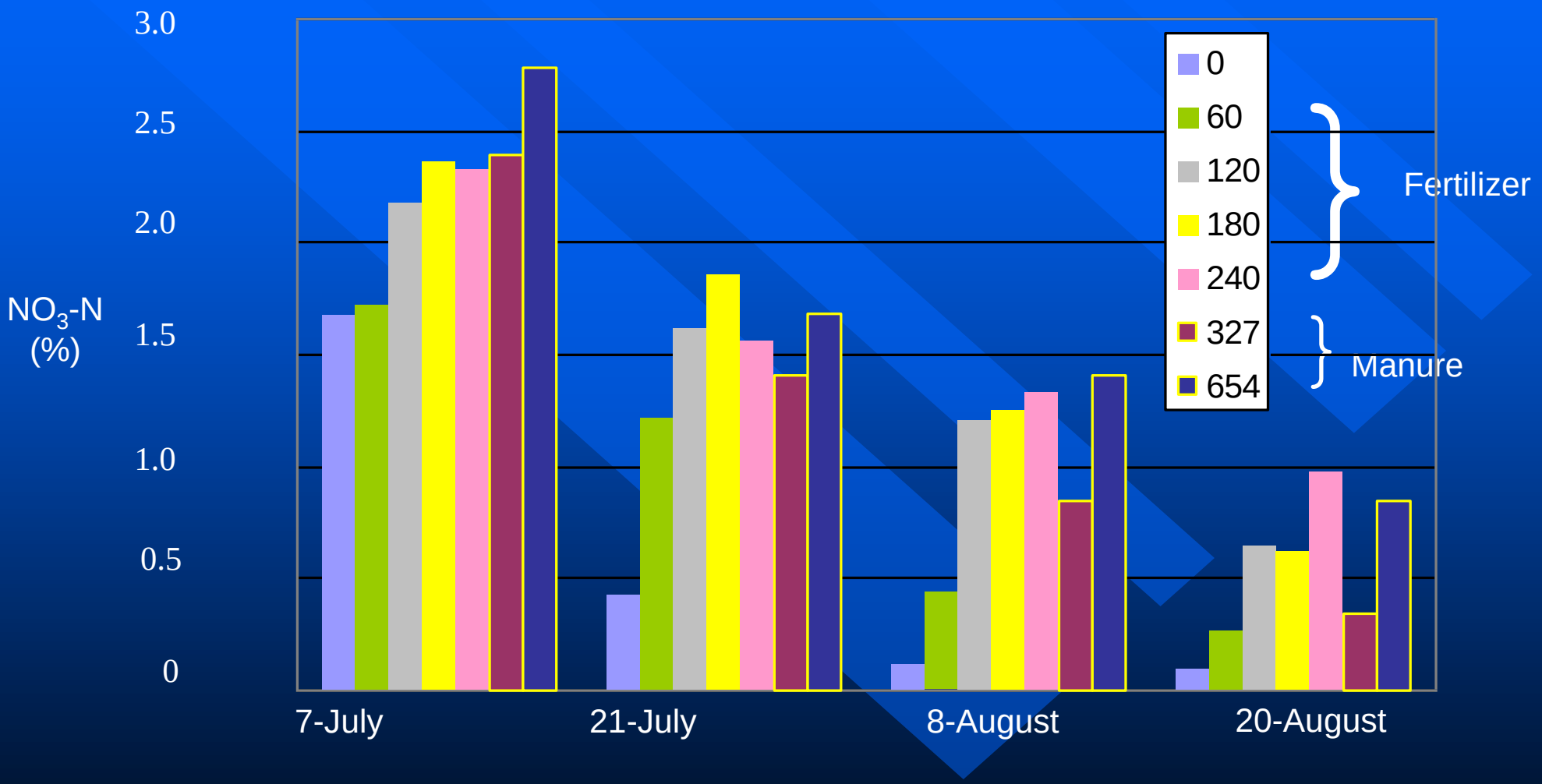
b) P availability to potatoes

1. 0, 60, 120, 180, 240 lb P_2O_5/a fertilizer
2. 137/122 and 273/212 lb P_2O_5/a dairy manure

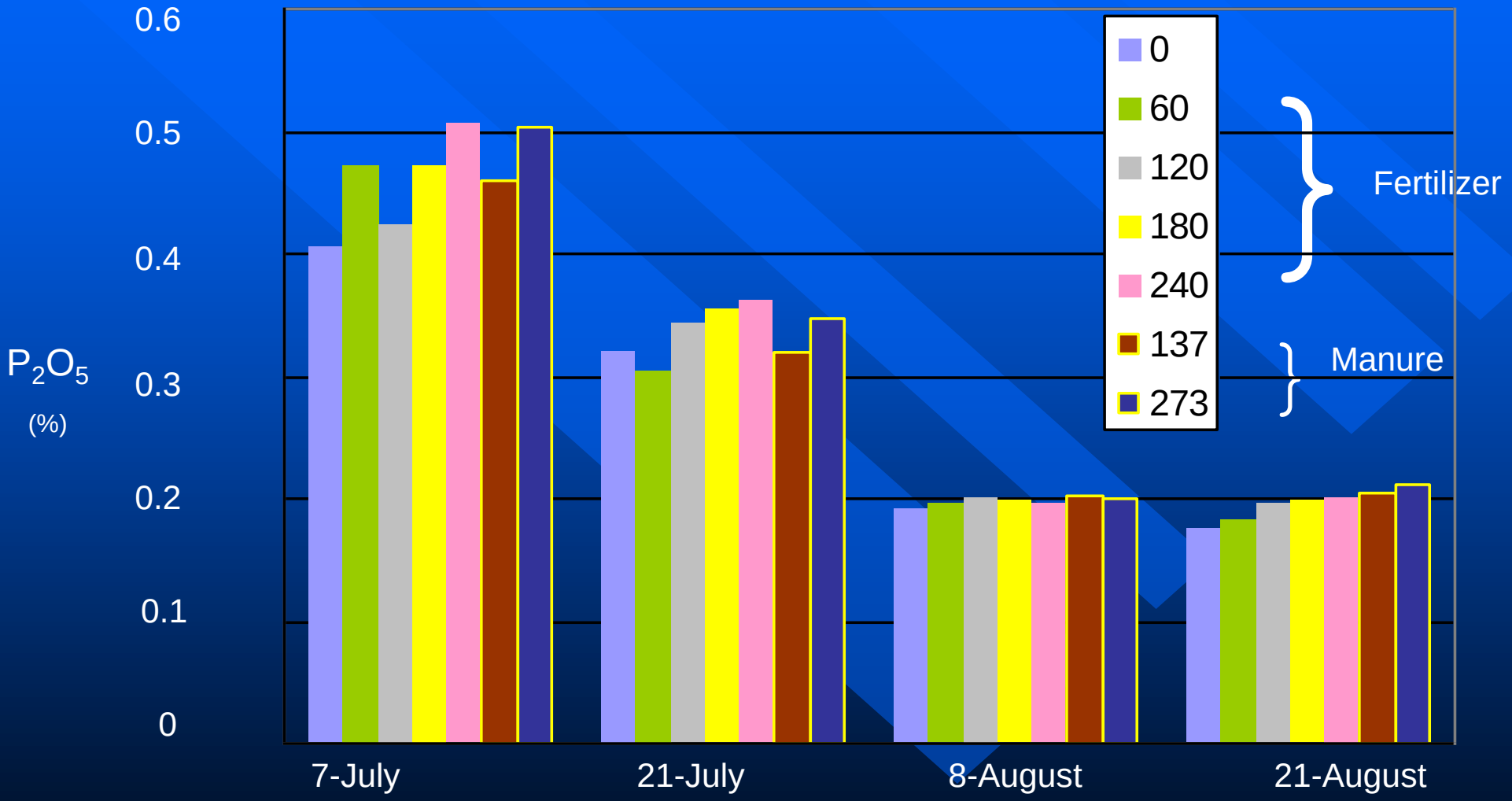
Dairy manure and fertilizer N rate on Snowden tuber yield and quality at Antigo, 2000-2001.

N Rate	N source	Total Yield 2000	Total Yield 2001	Tuber D. M. 2000	Tuber D. M. 2001
lb/acre		**-------- cwt/acre --------**		**----------- % -----------**	
0	---	422 **b**	329	22.4 **b**	22.7
60	Fertilizer	528 a	341	21.3 a	22.0
120	Fertilizer	566 a	333	20.9 a	22.3
180	Fertilizer	580 a	321	21.2 a	22.2
240	Fertilizer	523 a	332	20.9 a	22.2
327/298	Manure	528 a	381	20.6 a	21.6
654/517	Manure	606 a	375	20.4 a	21.7
Pr > F		0.01	0.24	<0.01	0.65

Dairy manure and fertilizer N rates on petiole NO_3-N levels in Snowdens at Antigo, 2000.



Dairy manure and fertilizer P_2O_5 rates on petiole total P levels in Snowdens at Antigo, 2000.



Dairy manure and fertilizer N rates on severity of scab at Antigo, 2000-2001.

Nitrogen		2000		2001	
Rate	Source	Lesion Area Index	Lesion Type Index	Lesion Area Index	Lesion Type Index
lbs/acre		----------%----------			
0	-------	1.13	2.38	5.38	23.0
60	Fertilizer	1.88	4.88	4.13	12.1
120	Fertilizer	2.63	6.50	11.38	31.3
180	Fertilizer	1.50	3.88	9.25	25.0
240	Fertilizer	1.25	3.88	9.00	28.4
Low	Manure	1.50	4.25	7.00	17.6
High	Manure	2.88	5.13	8.00	17.3
Pr > F		0.11	0.30	0.28	0.60

Lysimeter NO_3-N concentrations as affected by manure or fertilizer applications at Antigo, 2000.

N Rate	N Source	16 June †	23 June	7 July	21 July	9 Aug
lb/acre		---------- ppm ----------				
0	**--------**	**12.2 (5.5)**	**14.3 (7.9)**	**12.6 (6.0)**	**12.6 (5.4)**	**7.5 (5.1)**
327	**Fertilizer**	**---**	**10.8 (0)**	**12.3 (3.1)**	**13.3 (4.8)**	**11.8 (4.5)**
654	**Manure**	**11.8 (8.0)**	**22.6 (7.8)**	**18.9 (8.4)**	**17.3 (9.8)**	**25.7 (11.4)**
Pr > F		**0.38**	**0.47**	**0.39**	**0.22**	**0.10**
$LSD_{0.05}$		**NS**	**NS**	**NS**	**NS**	**24.0**

†Values as means across replicates. Standard deviations are given in parentheses.

Effect of fertilizer or manure on post-harvest soil test levels at Antigo averaged for 2000-2001.

		N Experiment		P Experiment	
Rate	Source	pH	P	pH	P
lb/acre			ppm		ppm
0	------	4.96	176	4.68	134
60	Fertilizer	4.82	164	4.83	136
120	Fertilizer	4.86	156	4.67	140
180	Fertilizer	4.92	147	4.78	147
240	Fertilizer	4.85	163	4.85	163
Lo	Manure	4.97	151	4.58	139
Hi	Manure	4.95	168	4.72	146

All plots in the N experiment received 240 lb P2O5/acre and all plots in the P experiment received 240 lb N/acre as fertilizer.

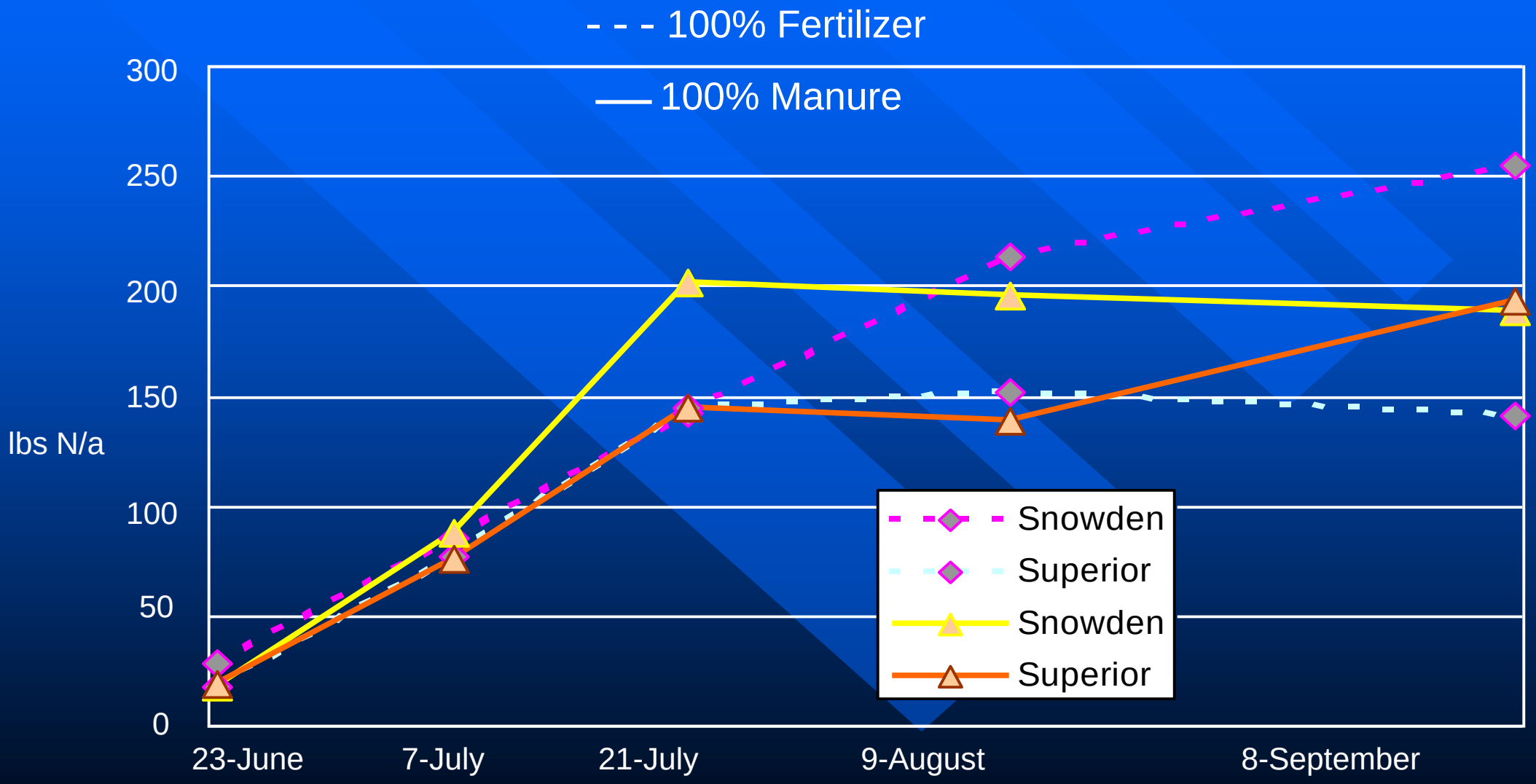
Manure/Scab Experiments

- Antigo and Rhinelander
- Nutrient Sources
  - 100% Fertilizer; 67% Fertilizer + 33% manure; 100% manure
- Varieties
  - R. Norkotah; Norland or W-1151R; Snowden; Superior

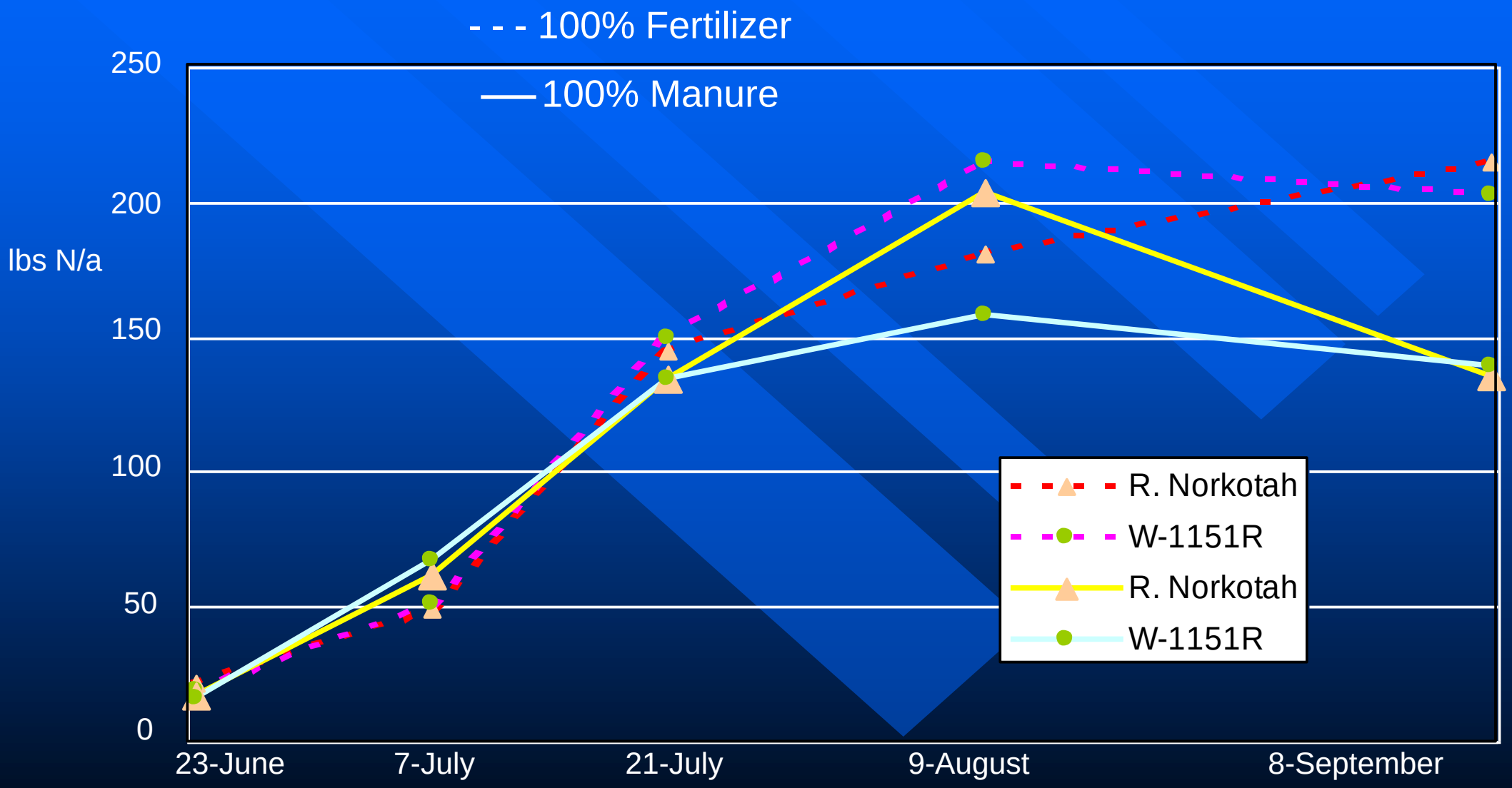
Main effect of nutrient source on yield and quality of several potato varieties at Antigo and Rhinelander, 2000 and 2001.

Nutrient	Total yield		Yield US #1 (6-13 oz)		Dry Matter	
Source	2000	2001	2000	2001	2000	2001
	----------cwt/acre----------				---------%---------	
Antigo						
100% Fertilizer	497	254	210	84	19.2	19.1
67% Fertilizer/33%manure	467	292	210	90	19.0	19.1
100% manure	519	317	230	109	17.5	19.2
Rhinelander						
100% Fertilizer	334	412	164	148	20.6	21.2
67% Fertilizer/33% manure	371	418	178	166	20.8	20.2
100% manure	390	388	186	136	20.2	20.8

Total nitrogen uptake curves for Snowden and Superior varieties at Antigo, 2000.



Total nitrogen uptake curves for R. Norkotah and W-1151R varieties at Antigo, 2000.



Interaction of nutrient source and potato variety on scab evaluations at Antigo 2000 and 2001.

Variety	2000			2001		
	100% Fertilizer	67% Fert/ 33% manure	100% Manure	100% Fertilizer	67% Fert/ 33% manure	100% Manure
	----------%----------					
	Area					
R. Norkotah	11.8	16.1	7.5	5.1	7.1	6.6
W-1151 R	7.2	4.5	7.4	25.1	18.1	25.3
Snowden	1.6	2.1	7.4	8.8	11.5	7.6
Superior	5.0	2.5	6.0	9.1	9.8	9.8

Interaction of nutrient source and potato variety on scab evaluations at Rhinelander 2000-2001.

Variety	2000			2001		
	100% Fertilizer	67% Fert/ 33% manure	100% Manure	100% Fertilizer	67% Fert/ 33% manure	100% Manure
	----------%----------					
	Area					
R. Norkotah	0.7	0.5	0.0	4.8	7.3	8.8
W-1151 R	1.5	0.0	0.0	2.0	3.0	3.5
Snowden	0.8	0.0	0.0	2.0	4.0	10.0
Superior	0.0	0.0	0.0	2.2	1.5	4.8

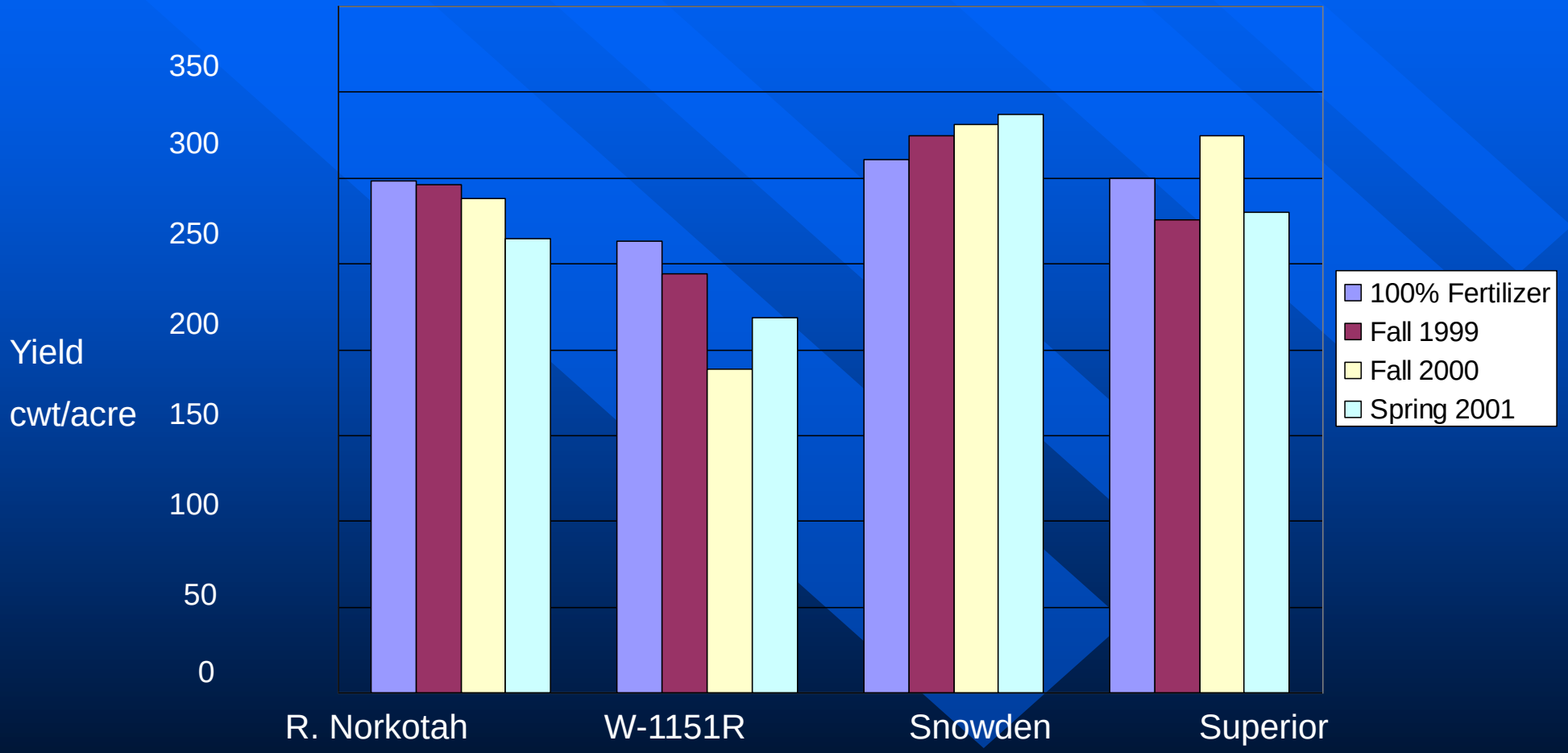
Manure/Timing experiment

Antigo 2001 only

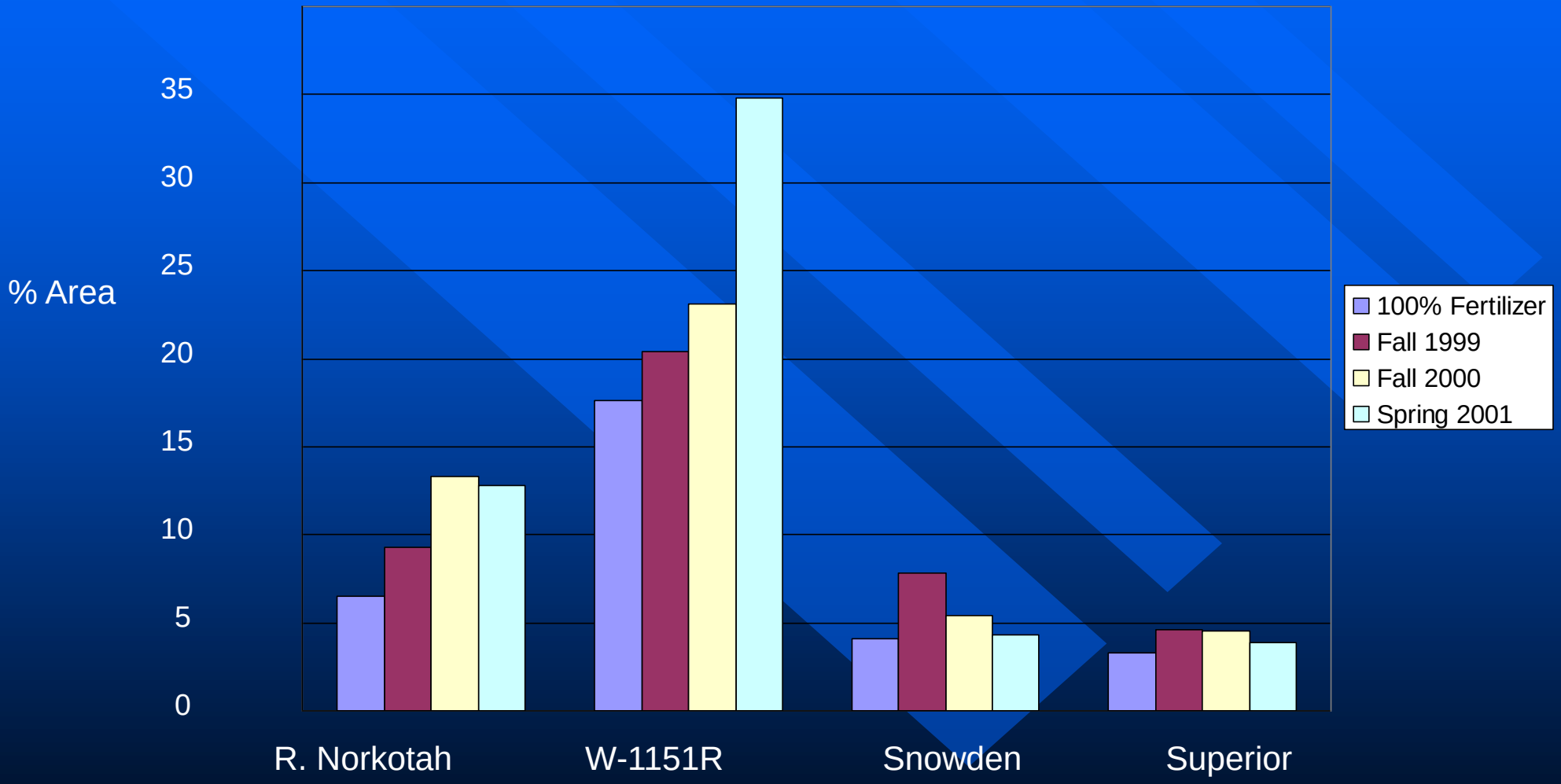
Effect of manure application timing on disease incidence

- Manure applied Nov ‘99, Nov ‘00, April ‘01
- Applications 18, 6, and 1 month before planting

Effect of timing of dairy manure application on yield and quality of several potato varieties at Antigo, WI, 2001.



Effect of timing of dairy manure application on scab incidence on several potato varieties at Antigo, 2001.



Summary:

- Manure = increased yield across experiments
  - Extra nutrients
  - Improves soil physical properties
- Manure N availability estimation
  - 18-27% in 2000
  - ? In 2001
- Decreased Solids

Summary Cont'd:

- Rhinelander 2001- scab increase in all varieties in manure plots
- Timing of application influenced R. Norkotah and W-1151R
- Snowden and Superior → no response to timing at Antigo