2013 UWEX & WPVGA Grower Conference

IMPROVING NITROGEN USE EFFICIENCY IN VEGETABLE PRODUCTIONS SYSTEMS

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OUTLINE

- Defining nitrogen use efficiency
- Comparison of nitrogen use efficiency measurements across crops
- Thoughts on how we will progress
- Highlight our current research (opportunities for involvement!)

NITROGEN USE EFFICIENCY

- Grower
  - Am I being as efficient as I can with my N fertilizer?
  - What is the true value that I am getting with each additional pound of N fertilizer?
- Landscape
  - What is the relationship between amount of N applied and the amount of N leached?

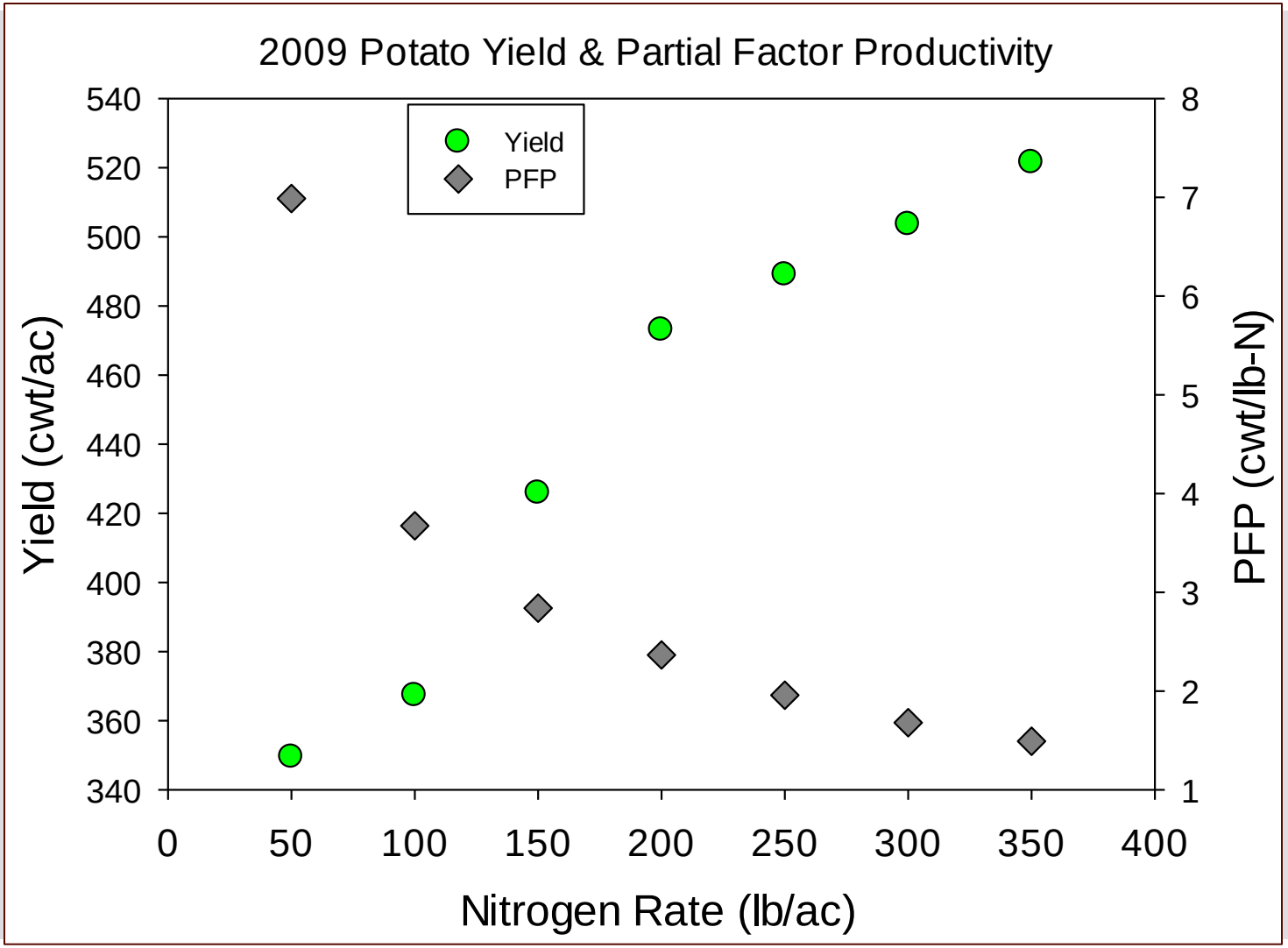
GROWER

- Partial factor productivity (PFP)
- Yield / N applied
- Based on UW guidelines

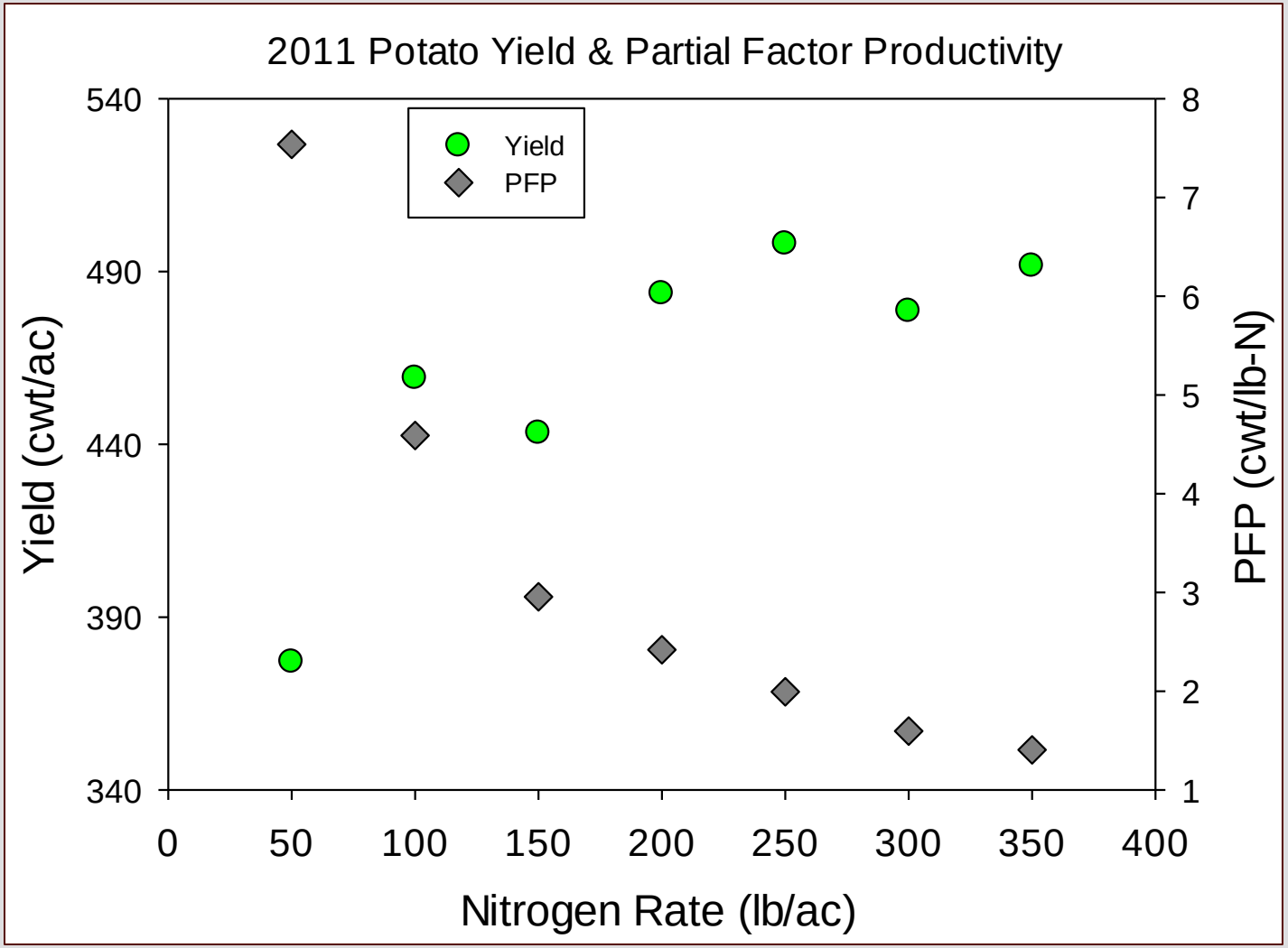
Yield Goal	N rate (lb/ac)	PFP (cwt/N)	PFP (lb/N)
250-350 cwt/ac	145	2.07	207
351-450 cwt/ac	180	2.22	222
451-550 cwt/ac	220	2.27	227
551-650 cwt/ac	250	2.40	240

- How much yield you got per unit N

PFP ACROSS N RATES



PFP ACROSS N RATES



GROWER

- Sweet corn

Yield (ton/ac)	N rate (lb/ac)	PFP (ton/N)	PFP (lb/N)
2	150	0.01	20
4	150	0.03	60
6	150	0.04	80
8	150	0.05	100
10	150	0.07	140
12	150	0.08	150
10	200	0.05	100
12	200	0.06	120

GROWER

- Field corn

Yield (bu/ac)	N rate (lb/ac)	PFP (ton/N)	PFP (lb/N)
200	175	1.14	64
200	200	1.00	56
200	225	0.89	50
250	175	1.43	80
250	200	1.25	70
250	225	1.11	62

GROWER

- Snap bean

Yield (ton/ac)	N rate (lb/ac)	PFP (ton/N)	PFP (lb/N)
2	60	0.03	60
4	60	0.07	140
6	60	0.10	200
8	60	0.13	260
10	60	0.17	340
12	60	0.20	400
10	80	0.13	260
12	80	0.15	300

THE PROBLEM

4 variables are changing every year

- Yield
- The amount of N you apply
- The price of fertilizer
- The value of the crop

- The economic optimum will be changing each year

THE PFP AS A TOOL FOR GROWERS

- Evaluate your different cropping systems in terms of PFP
- Calculate your overall return on N
- But what is the real value of N – the N you applied didn't get you all of the yield
- Agronomic efficiency

AGRONOMIC EFFICIENCY

Potato:

- Wet year: 64
- Dry year: 21

Sweet corn:

- Dry year #1: 124
- Dry year #2: 83

Snap bean:

- Wet year: 56
- Dry year: 31

LANDSCAPE NUE

- Partial nitrogen balance (PNB) or removal efficiency
- N removed / N applied
- Apparent nitrogen uptake efficiency
- (N uptake – N uptake with no N applied) / N applied

POTATO

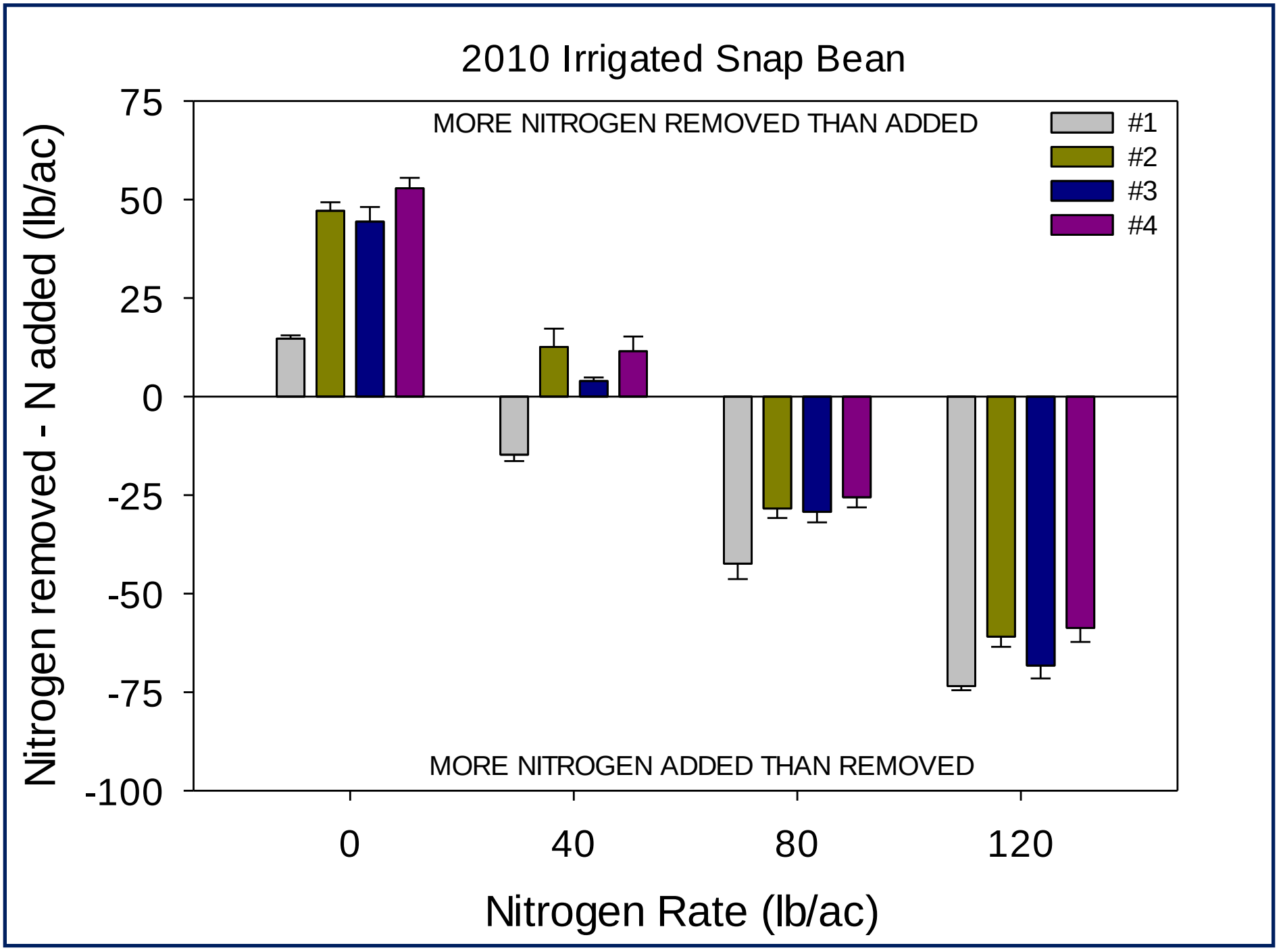
	N removed	PNB	N uptake	UpE
2010	lb-N/ac	%	lb-N/ac	%
250 Conv	101	40	144	35
250 ESN	103	41	128	29
200 ESN	98	49	134	39
0	47		56	
2011				
250 Conv	169	68	251	45
250 ESN	178	71	244	42
200 ESN	184	92	243	52
0	121		138	

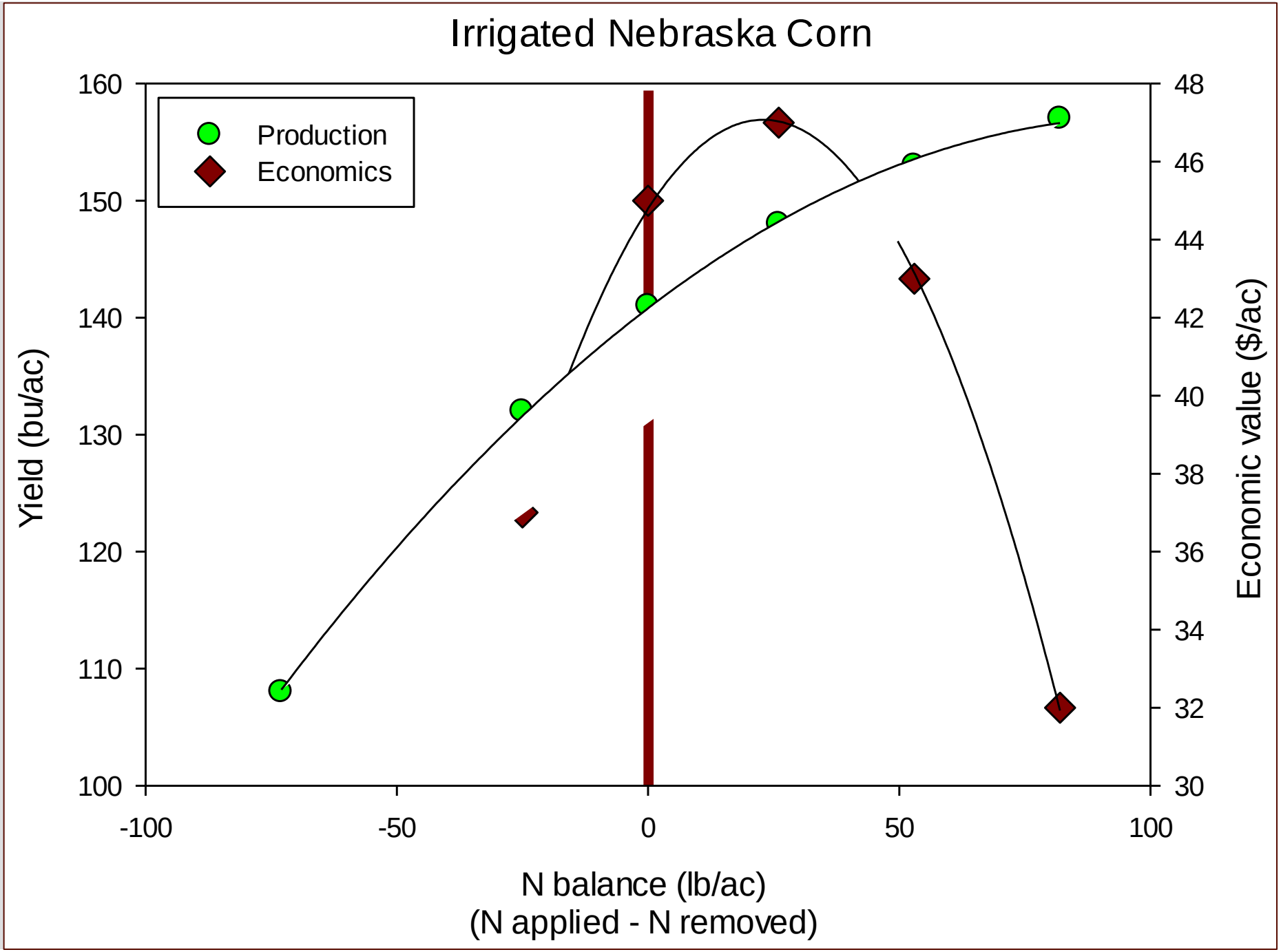
SWEET CORN

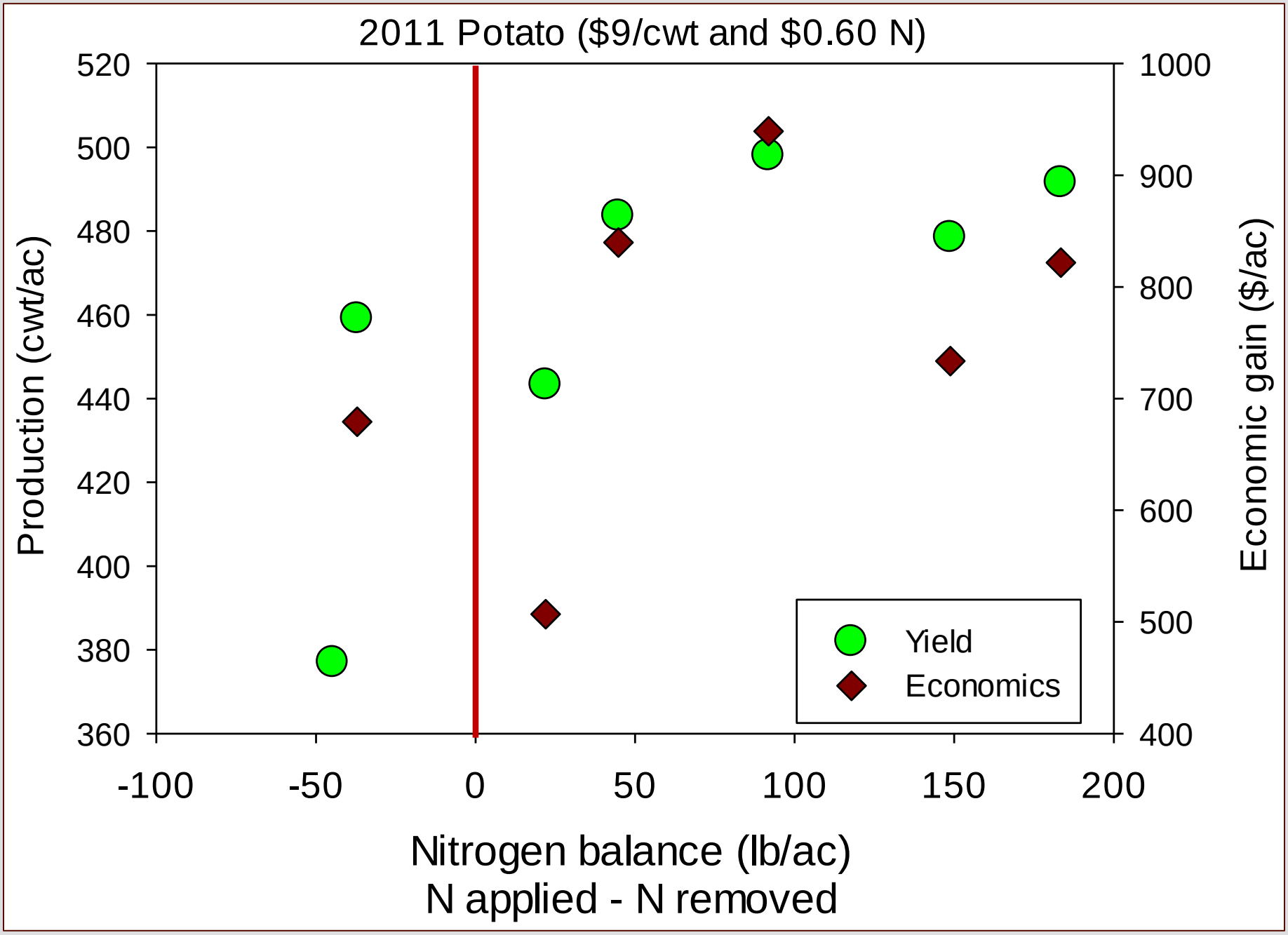
	N removed	PNB	N uptake	UpE
2011	lb-N/ac	%	lb-N/ac	%
200 Conv	60	34	156	69
150 Conv	58	43	150	88
0	6		33	

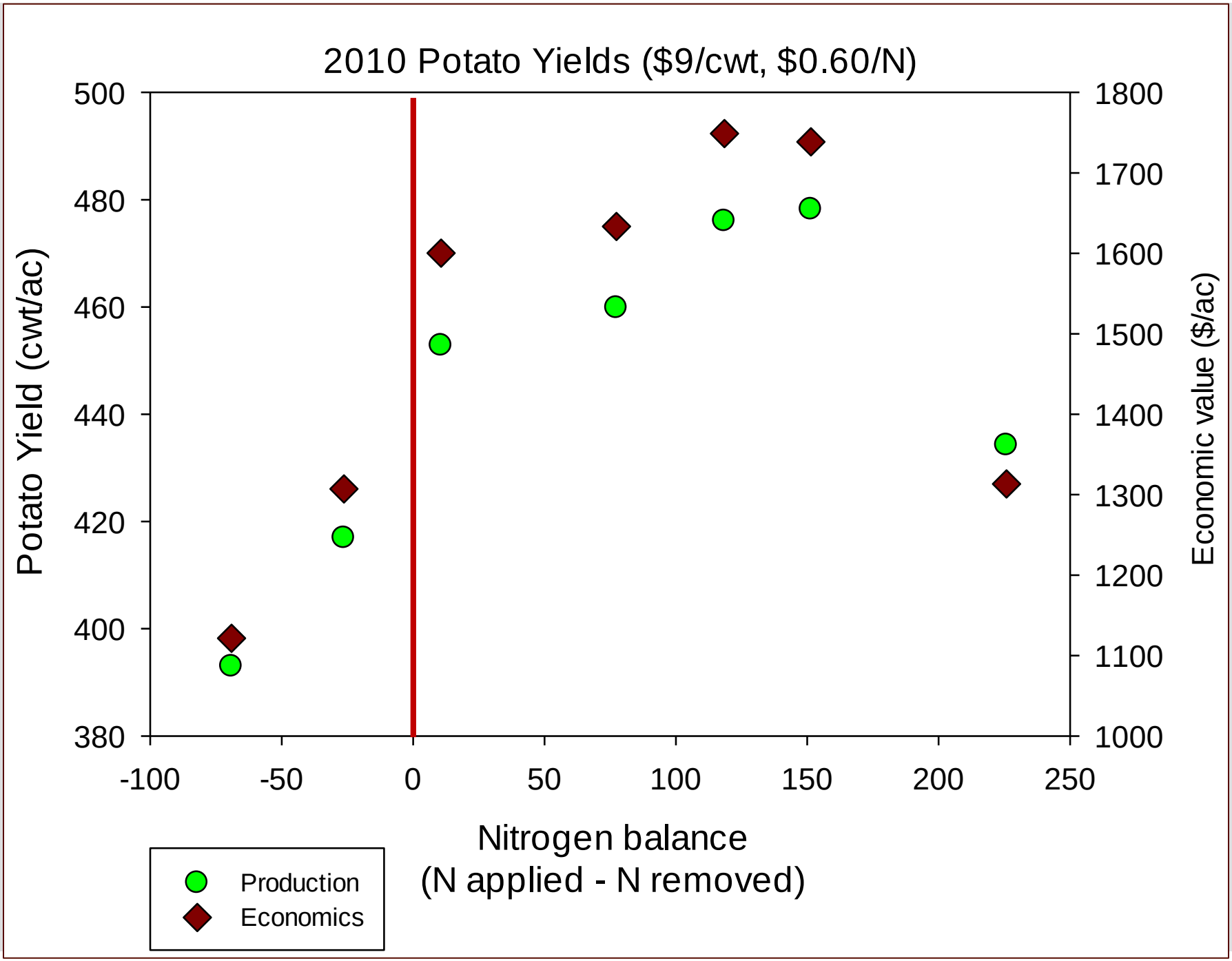
SNAP BEAN

N rate	N removed	PNB	N uptake	UpE
2010	lb-N/ac	%	lb-N/ac	%
0	47		159	
60	53	88	172	22
100	52	52	164	5
140	59	42	199	3


2010 Irrigated Snap Bean
MORE NITROGEN REMOVED THAN ADDED
MORE NITROGEN ADDED THAN REMOVED
#1
#2
#3
#4
75
50
25
0
-25
-50
-75
-100
Nitrogen removed - N added (lb/ac)
0
40
80
120
Nitrogen Rate (lb/ac)


Irrigated Nebraska Corn
Production
Economics
Yield (bu/ac)
Economic value ($/ac)
N balance (lb/ac)
(N applied - N removed)
160
150
140
130
120
110
100
48
46
44
42
40
38
36
34
32
30
-100
-50
0
50
100


2011 Potato ($9/cwt and $0.60 N)
Production (cwt/ac)
Economic gain ($/ac)
520
500
480
460
440
420
400
380
360
1000
900
800
700
600
500
400
-100
-50
0
50
100
150
200
Yield
Economics
Nitrogen balance (lb/ac)
N applied - N removed


2010 Potato Yields ($9/cwt, $0.60/N)
Potato Yield (cwt/ac)
Economic value ($/ac)
500
480
460
440
420
400
380
1800
1700
1600
1500
1400
1300
1200
1100
1000
-100
-50
0
50
100
150
200
250
Nitrogen balance
(N applied - N removed)
Production
Economics

WHAT'S THE VALUE

- Growers can use PFP to evaluate the economic risk of over/under applying
- The PNB can be used to evaluate the N remaining in the soil system
- The UpE can be used to estimate how much N wasn't even used

WHERE ADVANCEMENTS IN NUE WILL COME FROM

Removal Efficiency

- Bigger yields with same N
- Same yields with less N (i.e. supplemental N is not needed)
- Removal of plant biomass

Uptake Efficiency

- Greater understanding the relationship among N uptake, N management, and N leaching events.

CURRENT PROJECTS

USDA-NRCS CIG (PI: Bussan)

- Field trials (half-pivot, replicated strips, or single strips)
  - PCU vs. Conventional
  - Manure vs. Non-manure
  - Clover vs. no cover crop

USDA-SCRI (PI: Mitchell)

- Small plot research (sweet corn & snap beans)
  - Nitrogen rate on snap bean
  - Optimizing PCU in sweet corn

QUESTIONS?
COMMENTS?
CONCERNS?