Economic and Environmental Consequences of Over-Watering

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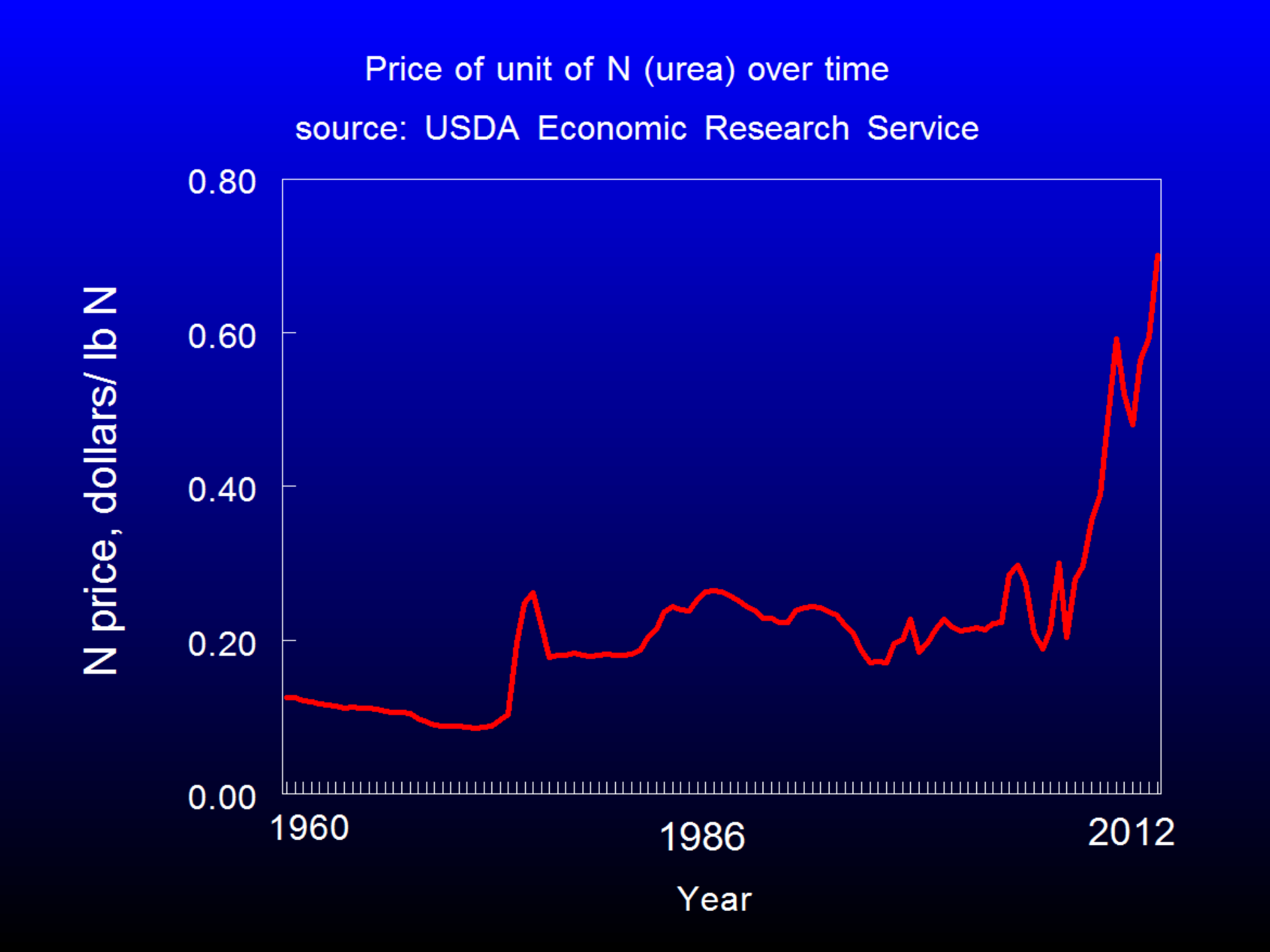
Issues related to excessive irrigation:

Increased crop disease
Reduced crop quality
Surface soil loss
Nitrate leaching


Price of unit of N (urea) over time
source: USDA Economic Research Service
N price, dollars/ lb N
0.80
0.60
0.40
0.20
0.00
1960
1986
2012
Year

Nitrogen accounting:

Pre-plant soil available N (NO_3 + NH_4)
Fertilizer N
N mineralization
N in irrigation water

} N inputs

Crop N uptake (bulb + top N content) } N output

N inputs - N outputs + fall residual soil N = N loss or N gain

Pre-plant and post-harvest soil available N:

Soil samples in 1 foot increments to 6 feet

N mineralization:

Breakdown of organic matter releasing plant available N: NH_4 and NO_3

N mineralization:

Determined by :

1) N accounting:
   N inputs – N outputs + residual soil N = mineralized N

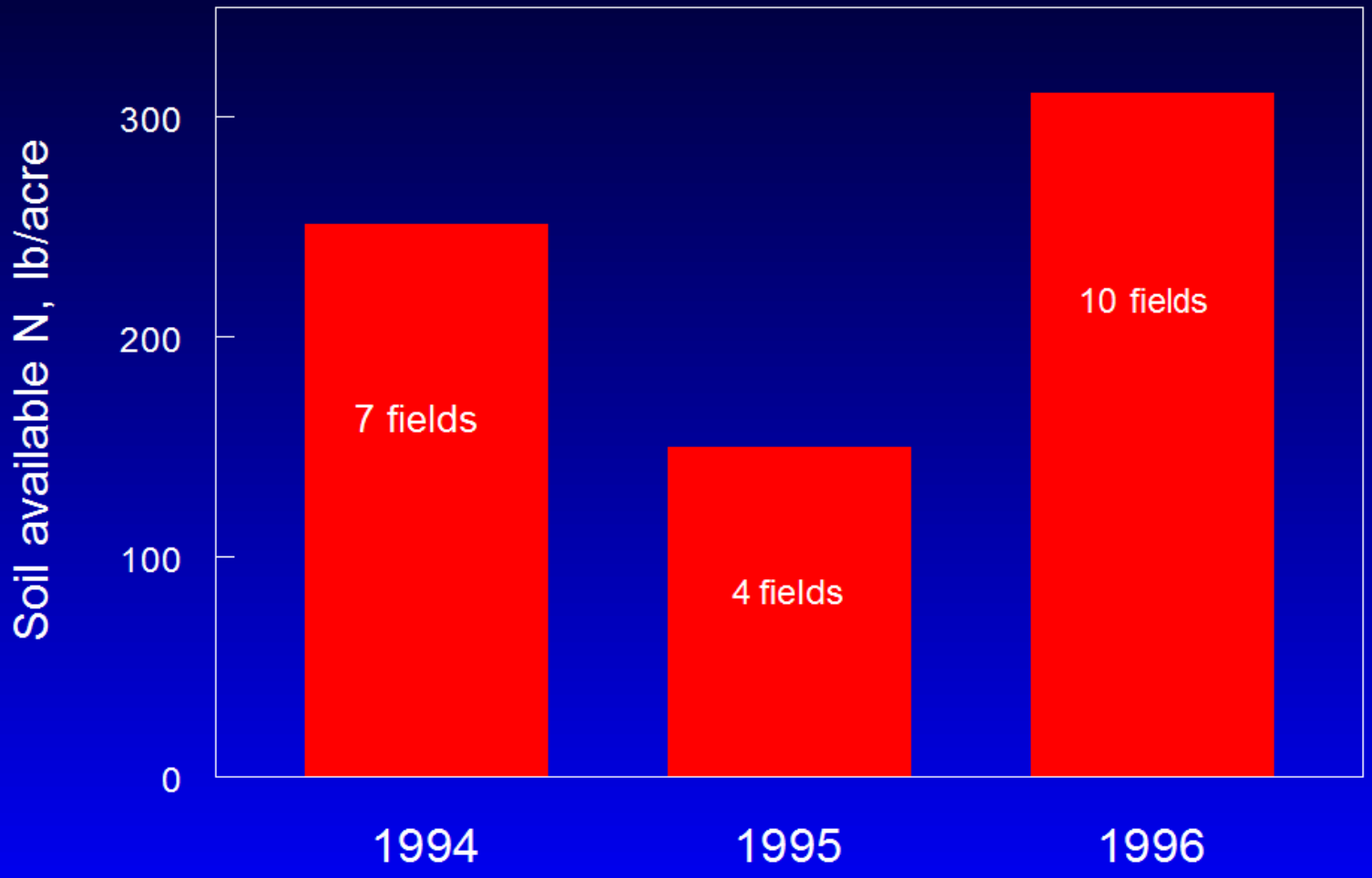
2) buried bag method: incubation of soil samples in plastic bags buried in field and analyzed for N over time

3) anaerobic incubation of soil sample at 74 ^{o}F

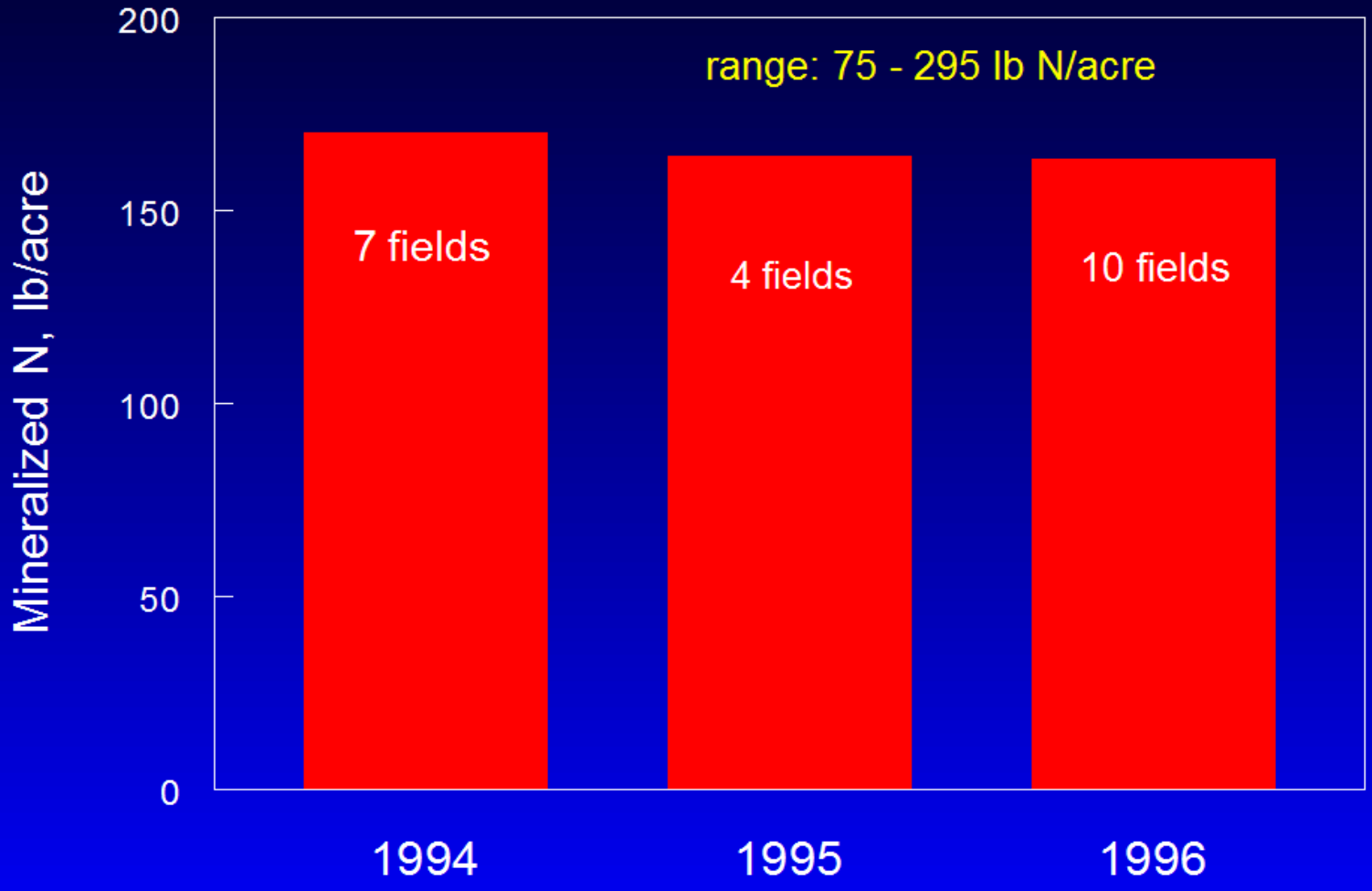
Crop N uptake
Malheur Experiment Station, 1990

Crop	lbs N uptake per unit yield	Yield	Total uptake, lb/acre
Onion	0.21/cwt	1000 cwt	210
Potato	0.40/cwt	600 cwt	240
Sugar Beet	7.62/ton	40 ton	305
Wheat	1.63/bu	162 bu	264

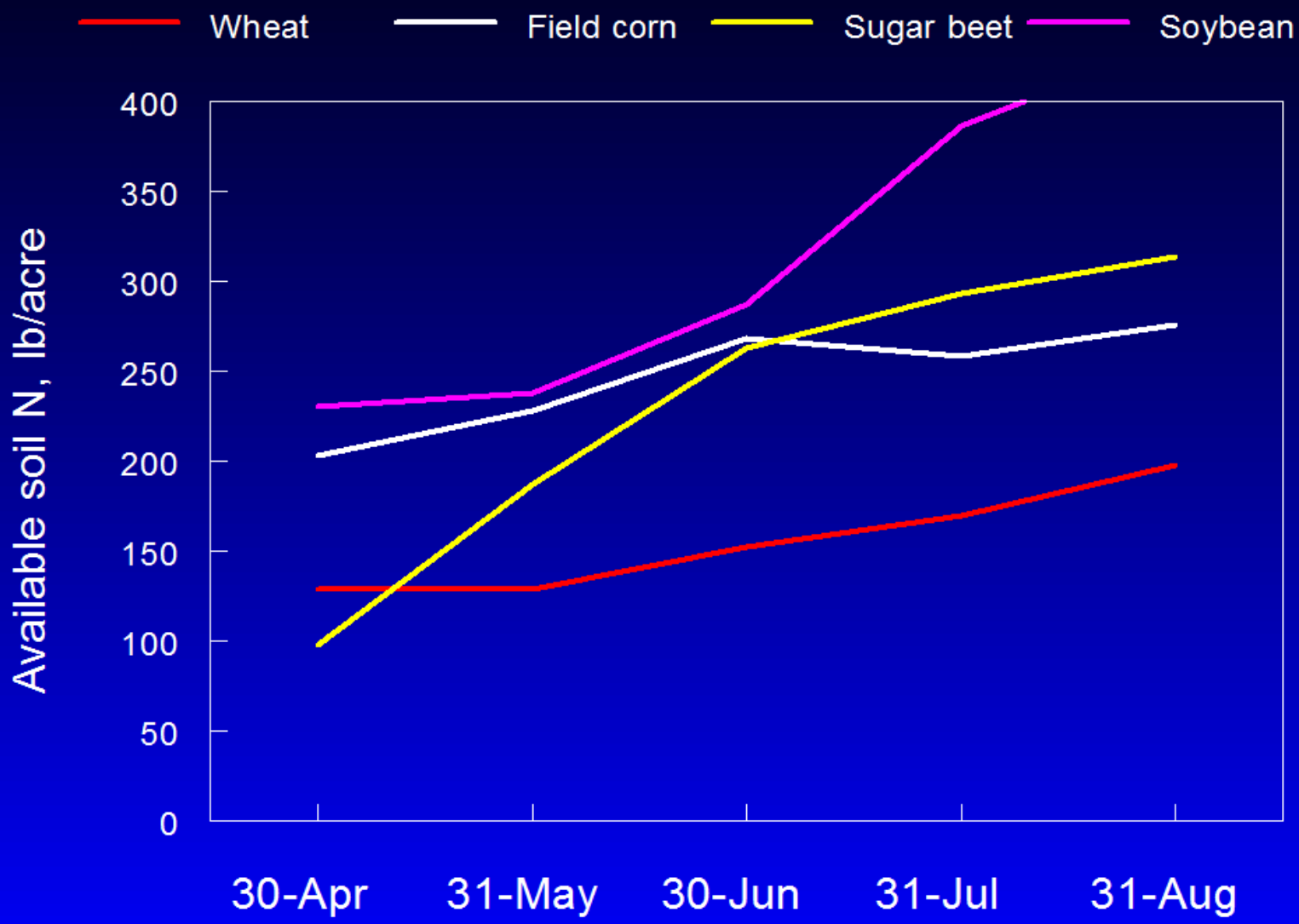
Residual available soil N (0 - 3 feet) in Treasure Valley soils in the spring in fields with different previous crops



N mineralization (anaerobic incubation method) in Treasure Valley fields with different previous crops



N mineralization over time in Treasure Valley soils in 1994 in fields with different previous crops, buried bag method



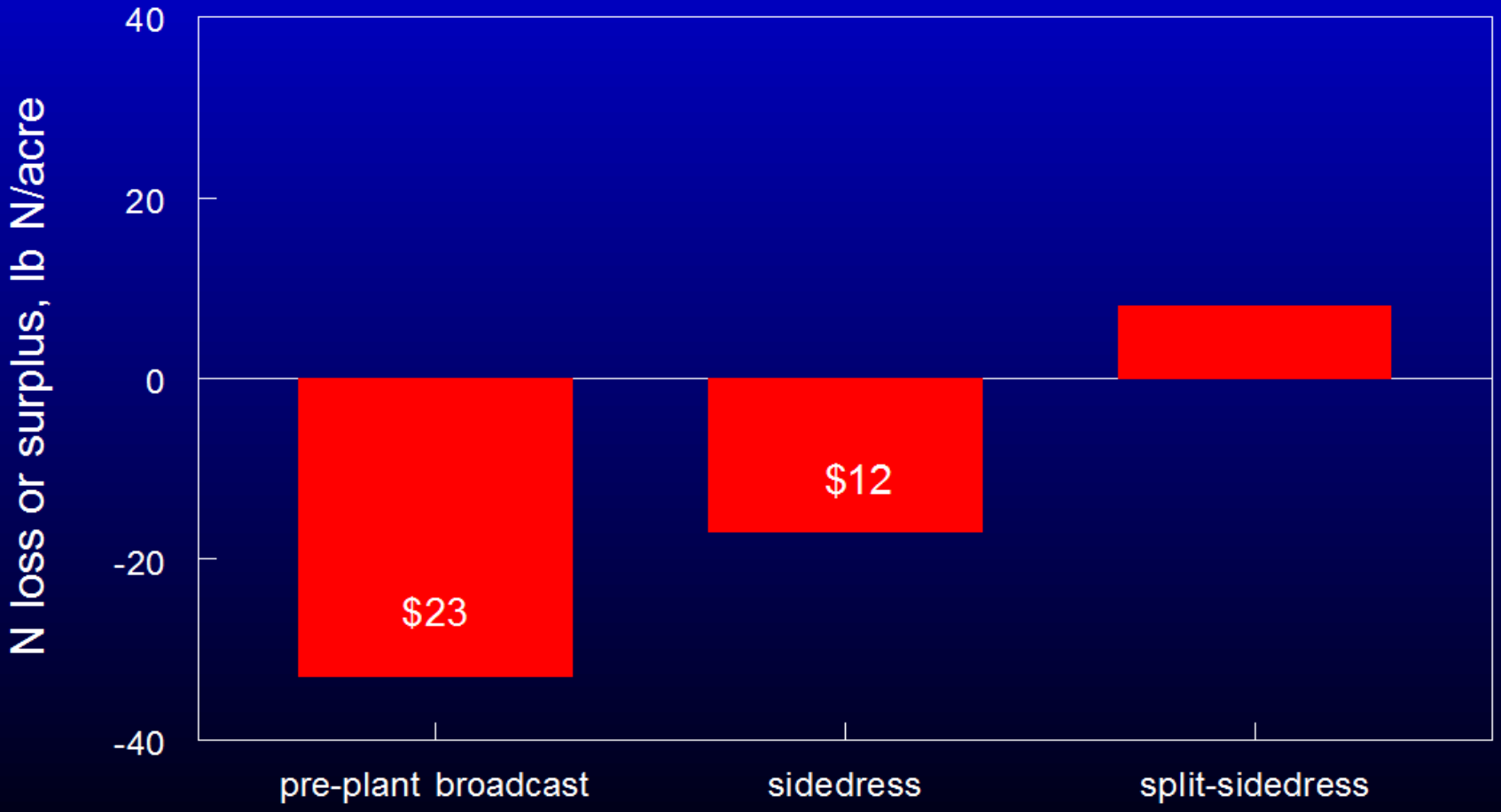
Factors influencing N loss with furrow irrigation:

N application method:

-pre-plant broadcast vs. sidedress

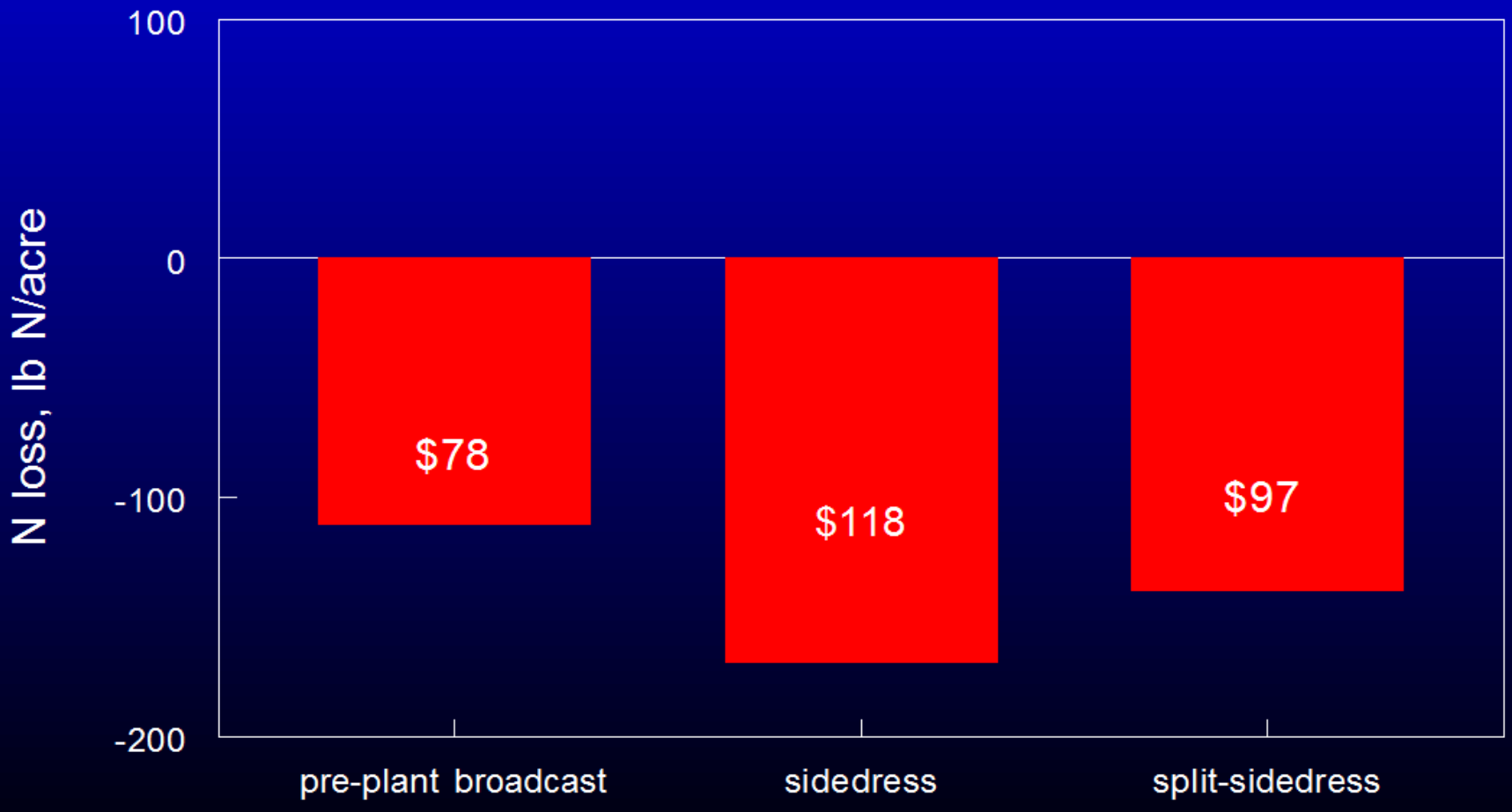
N loss (0 - 6 feet) from furrow-irrigated onion

Total N applied: 100 lb/acre Malheur Experiment Station, 1990



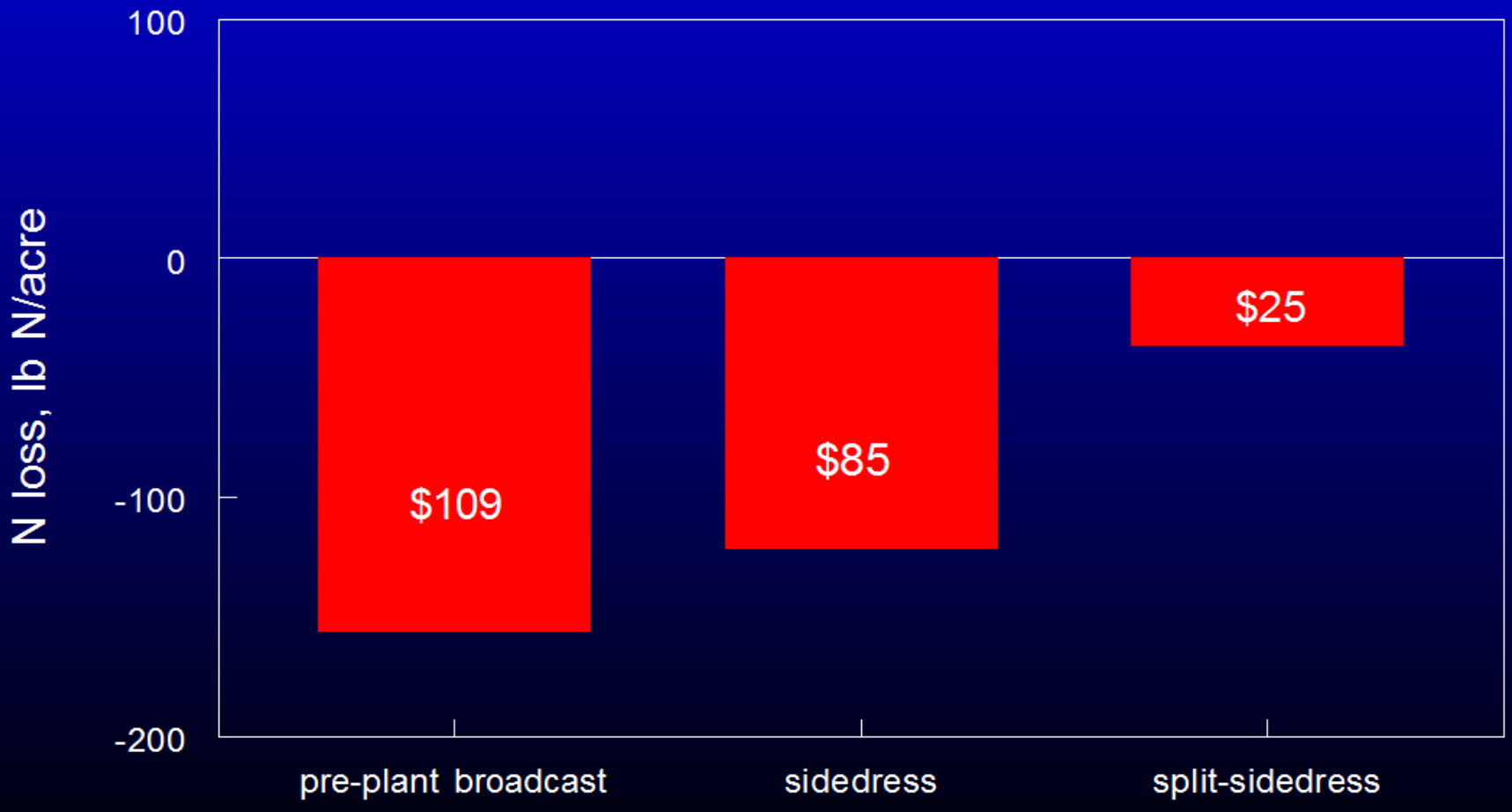
N loss (0 - 6 feet) from furrow-irrigated onion on Nyssa silt loam

Total N applied: 200 lb/acre, Malheur Experiment Station, 1991



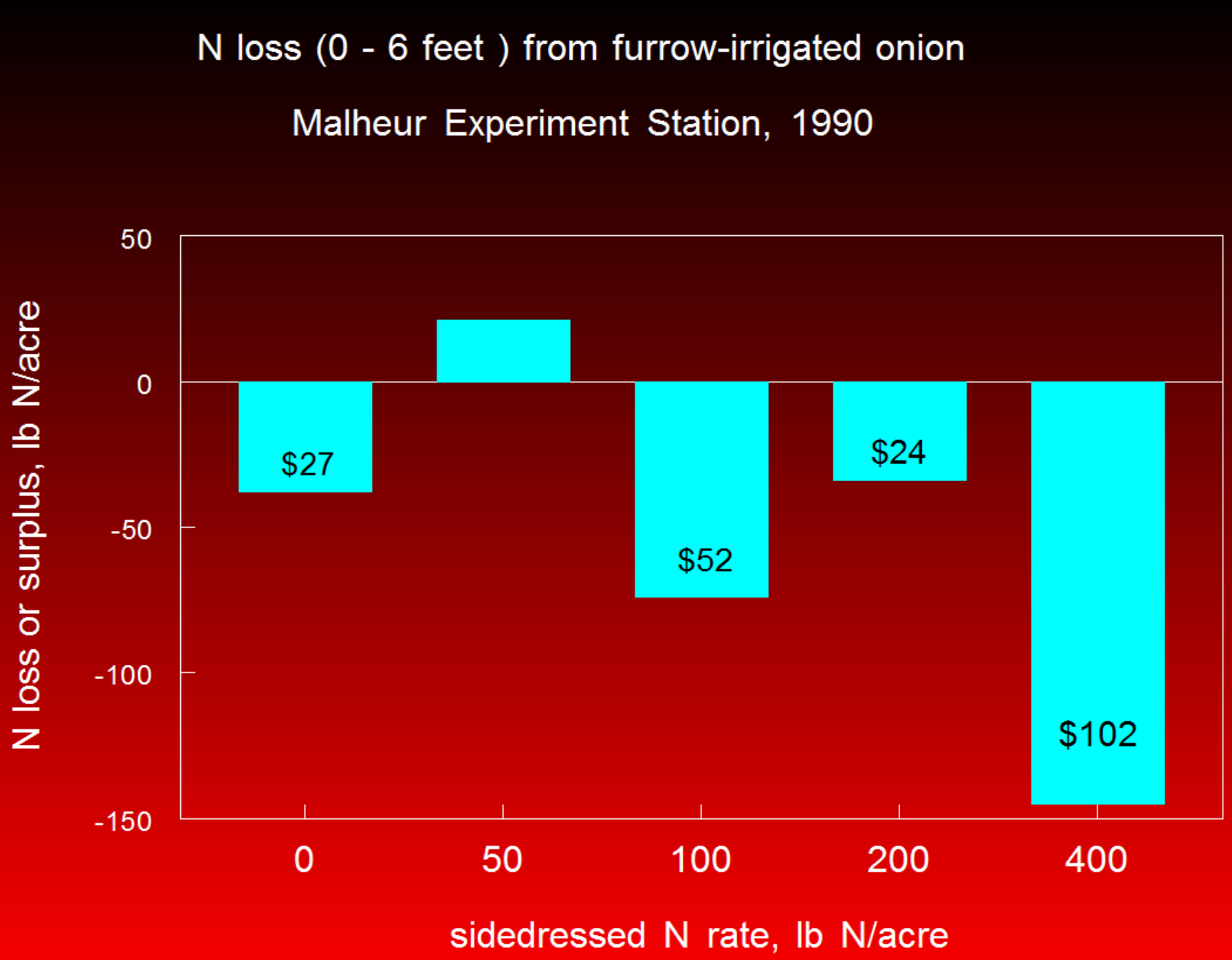
N loss (0 - 6 feet) from furrow-irrigated onion on Nyssa silt loam

Total N applied: 200 lb/acre, Malheur Experiment Station, 1992

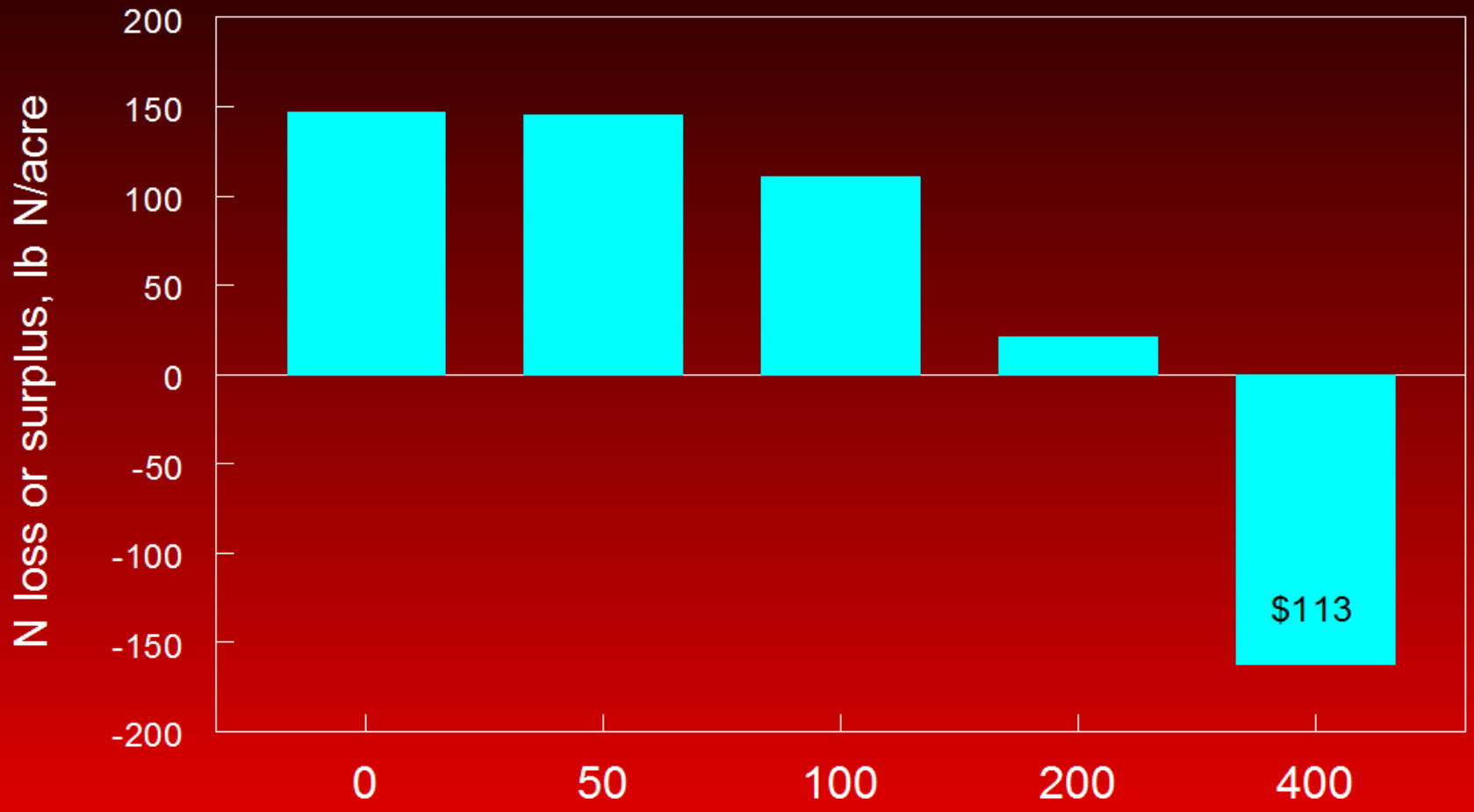


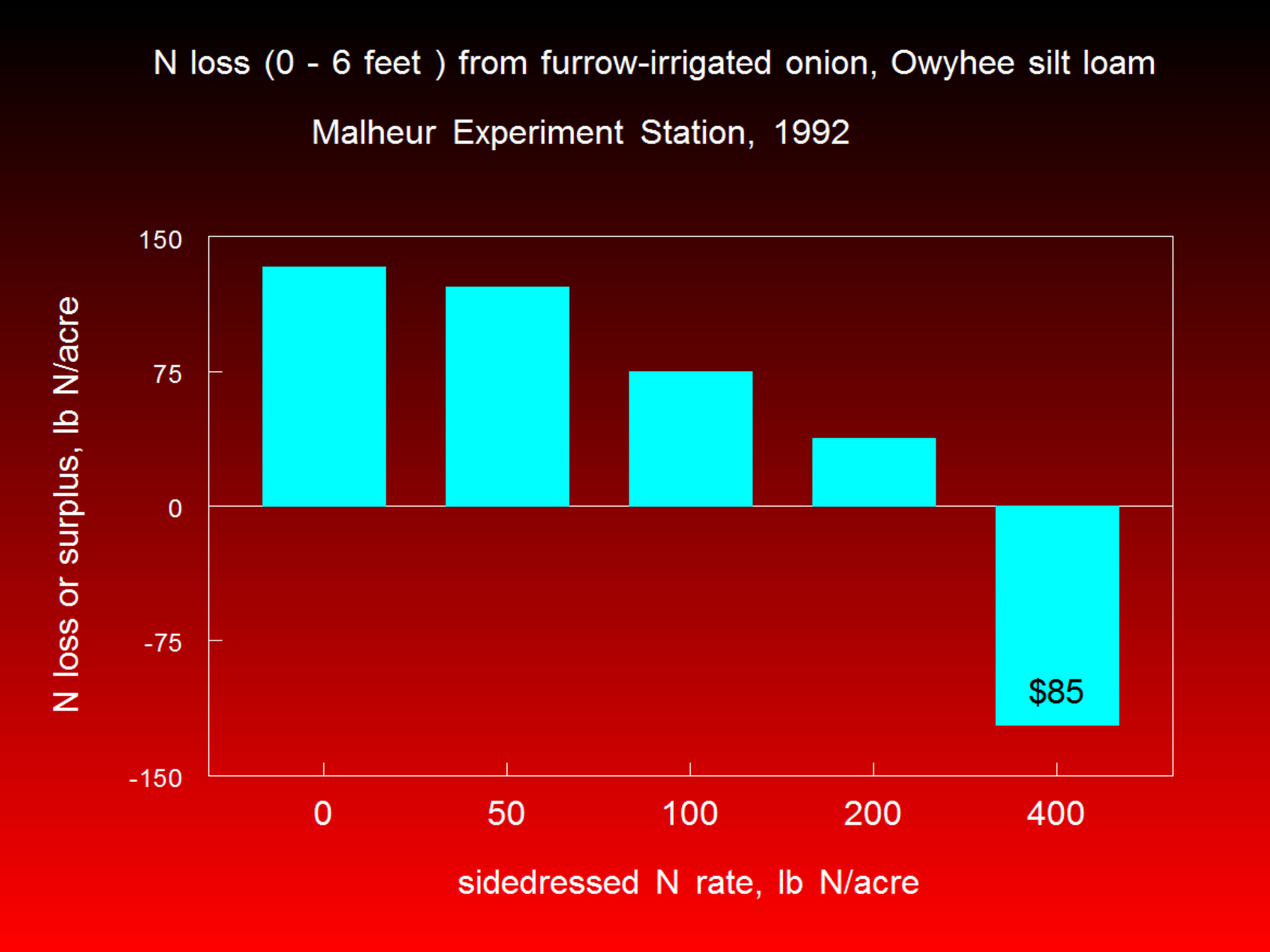
Factors influencing N loss with furrow irrigation:

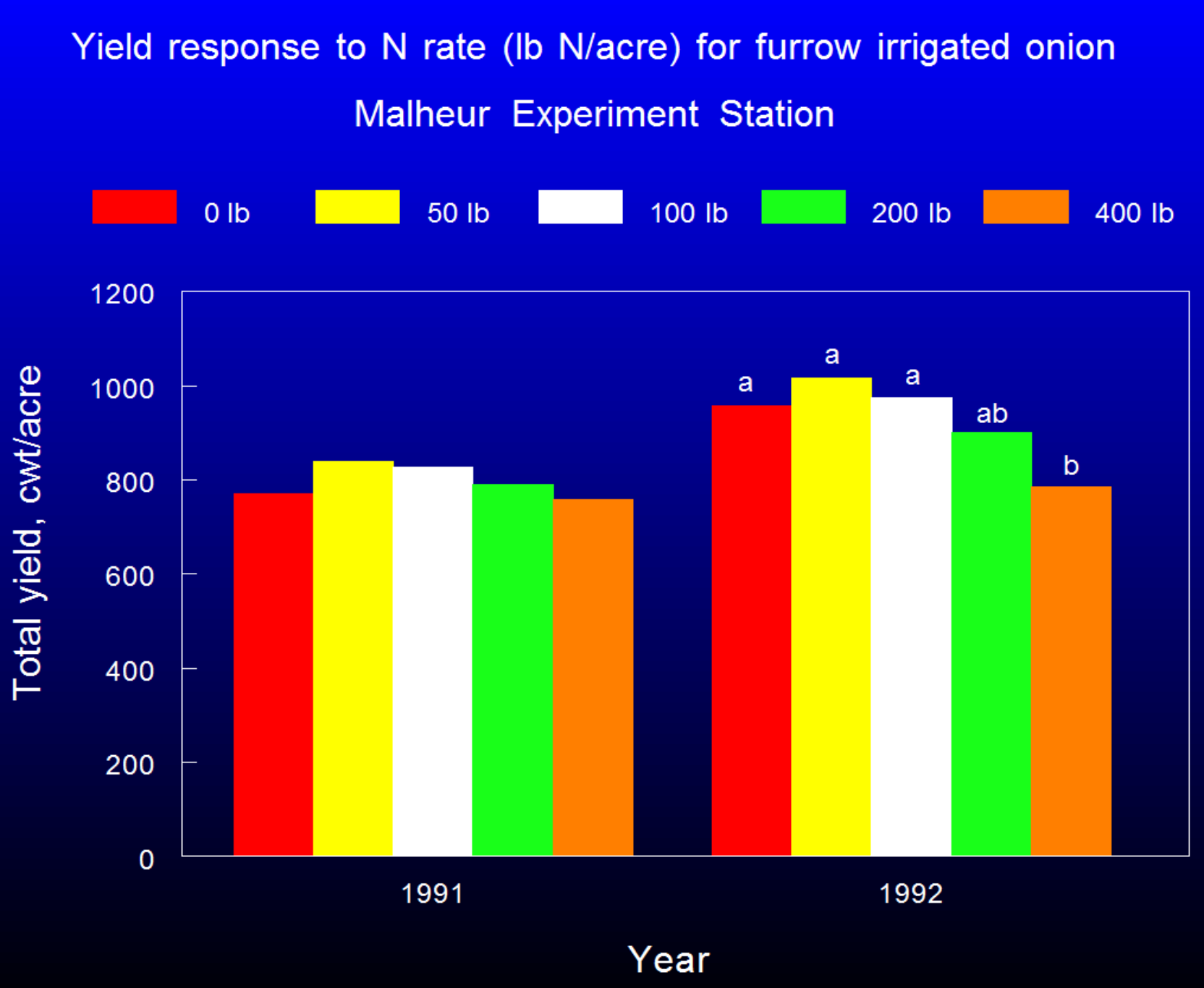
N fertilizer rate


N loss (0 - 6 feet) from furrow-irrigated onion
Malheur Experiment Station, 1990
N loss or surplus, lb N/acre
50
0
-50
-100
-150
$27
$52
$24
$102
0
50
100
200
400
sidedressed N rate, lb N/acre

N loss or surplus (0 - 6 feet) from furrow-irrigated onion on Owyhee silt loam, Malheur Experiment Station, 1991




N loss (0 - 6 feet) from furrow-irrigated onion, Owyhee silt loam
Malheur Experiment Station, 1992
150
75
0
-75
-150
N loss or surplus, lb N/acre
$85
0
50
100
200
400
sidedressed N rate, lb N/acre

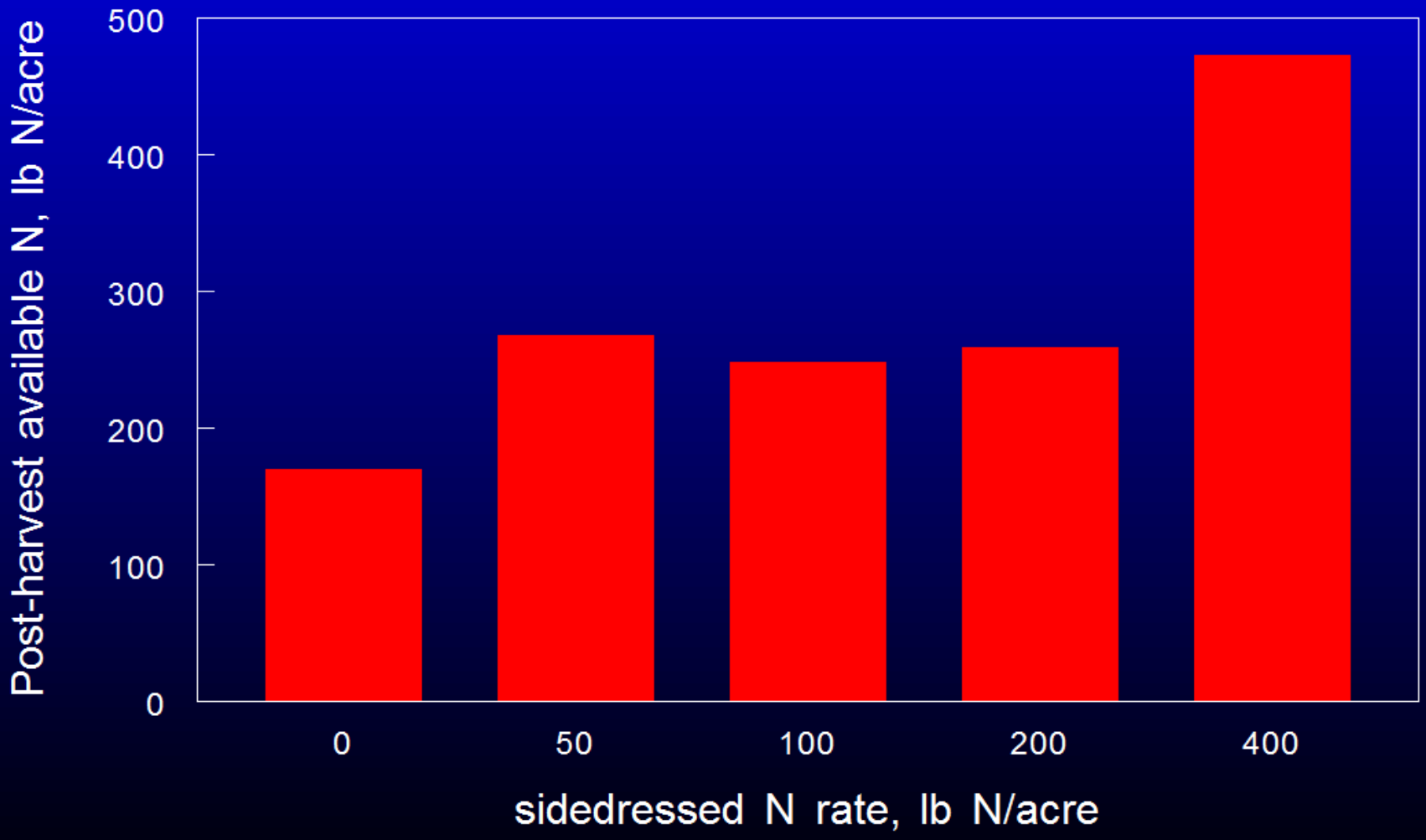

Yield response to N rate (lb N/acre) for furrow irrigated onion
Malheur Experiment Station
0 lb
50 lb
100 lb
200 lb
400 lb
Total yield, cwt/acre
1200
1000
800
600
400
200
0
a
a
a
ab
b
1991
1992
Year

Can leftover soil N be recovered after onion crop?

Unfertilized sugar beets and wheat after onion

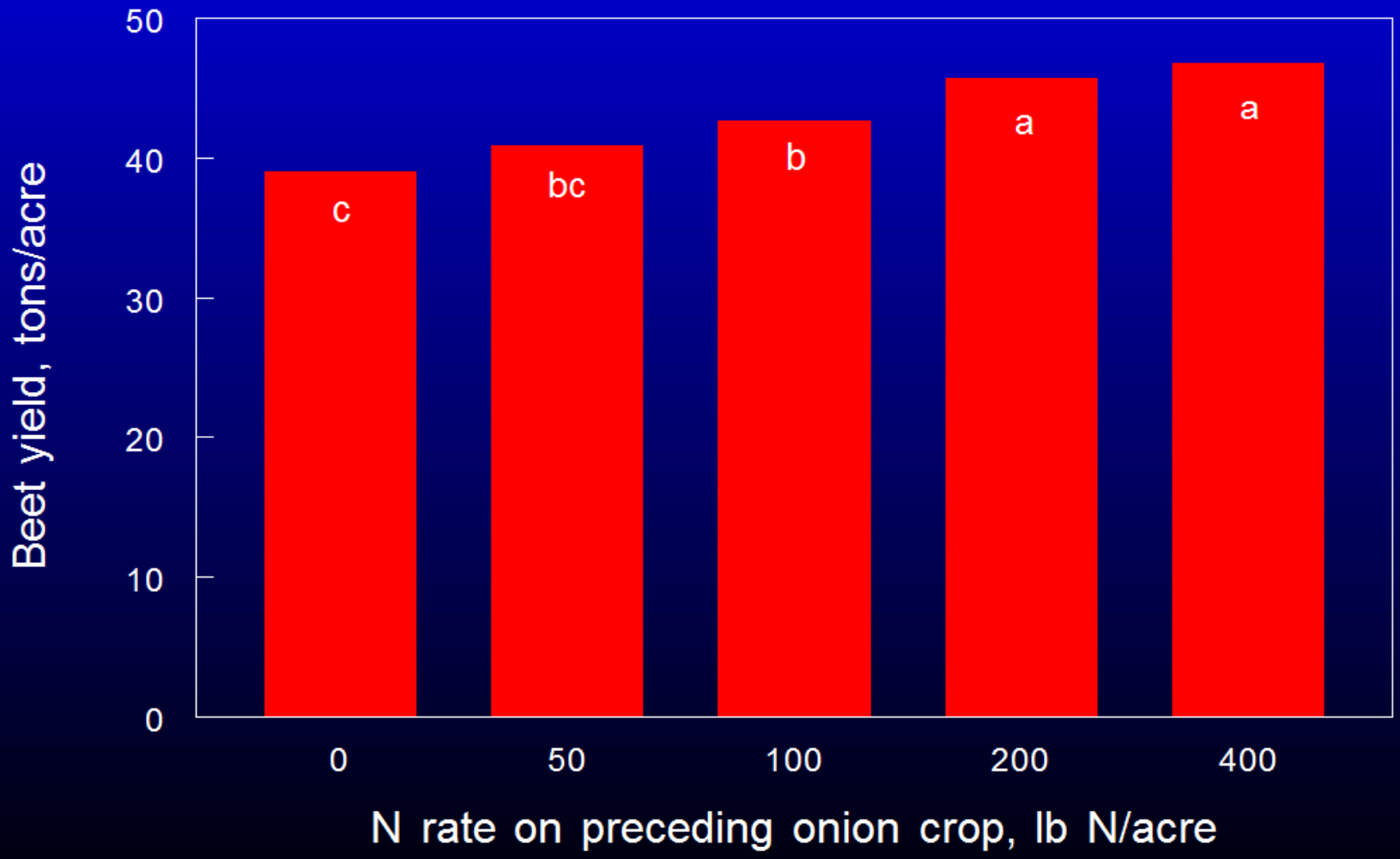
Post-harvest available N (0 - 6 feet) after furrow-irrigated onion

Malheur Experiment Station, 1992



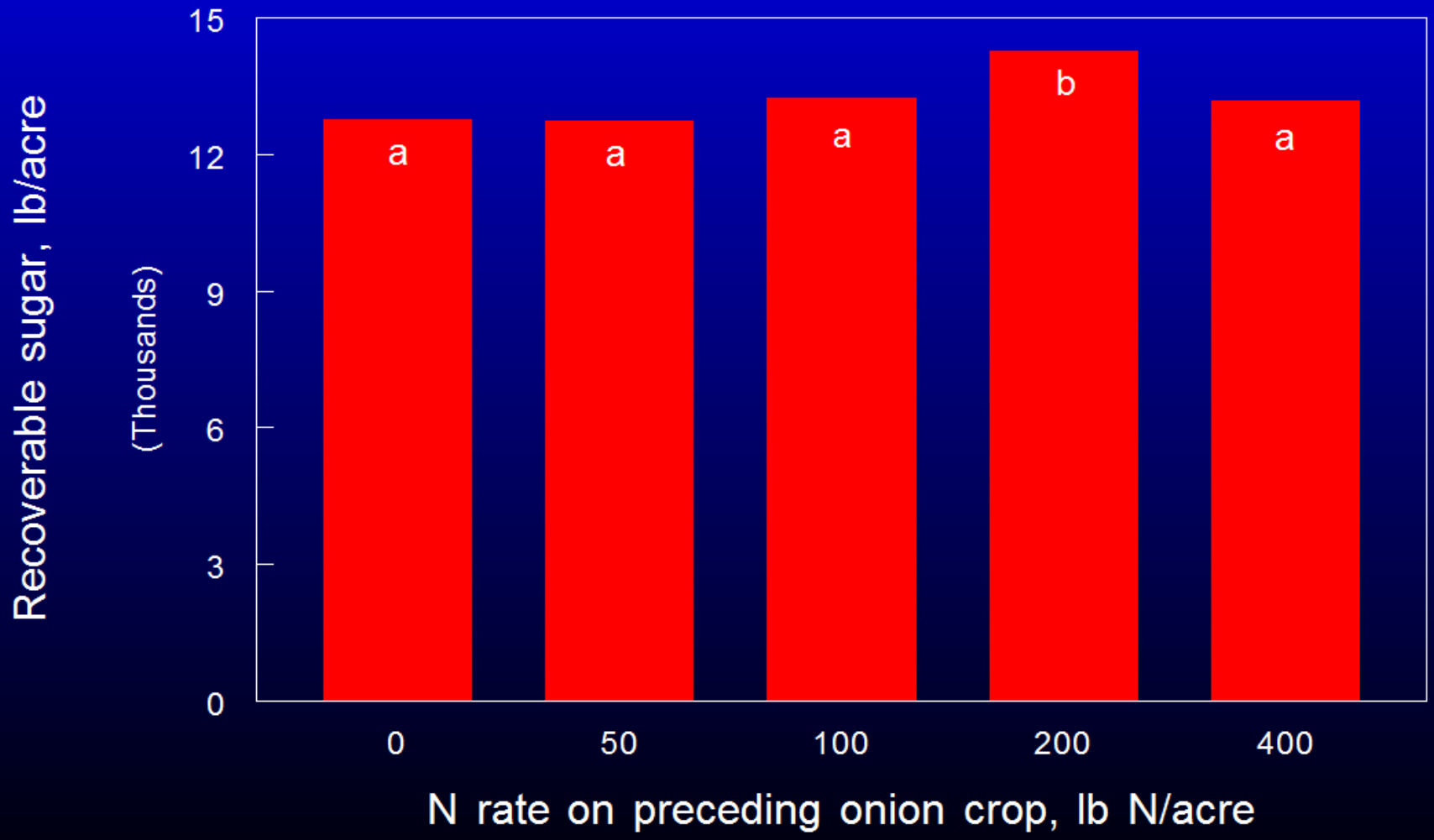
Sugar beet yield in response to N rate on preceding onion crop

Malheur Experiment Station, 1992



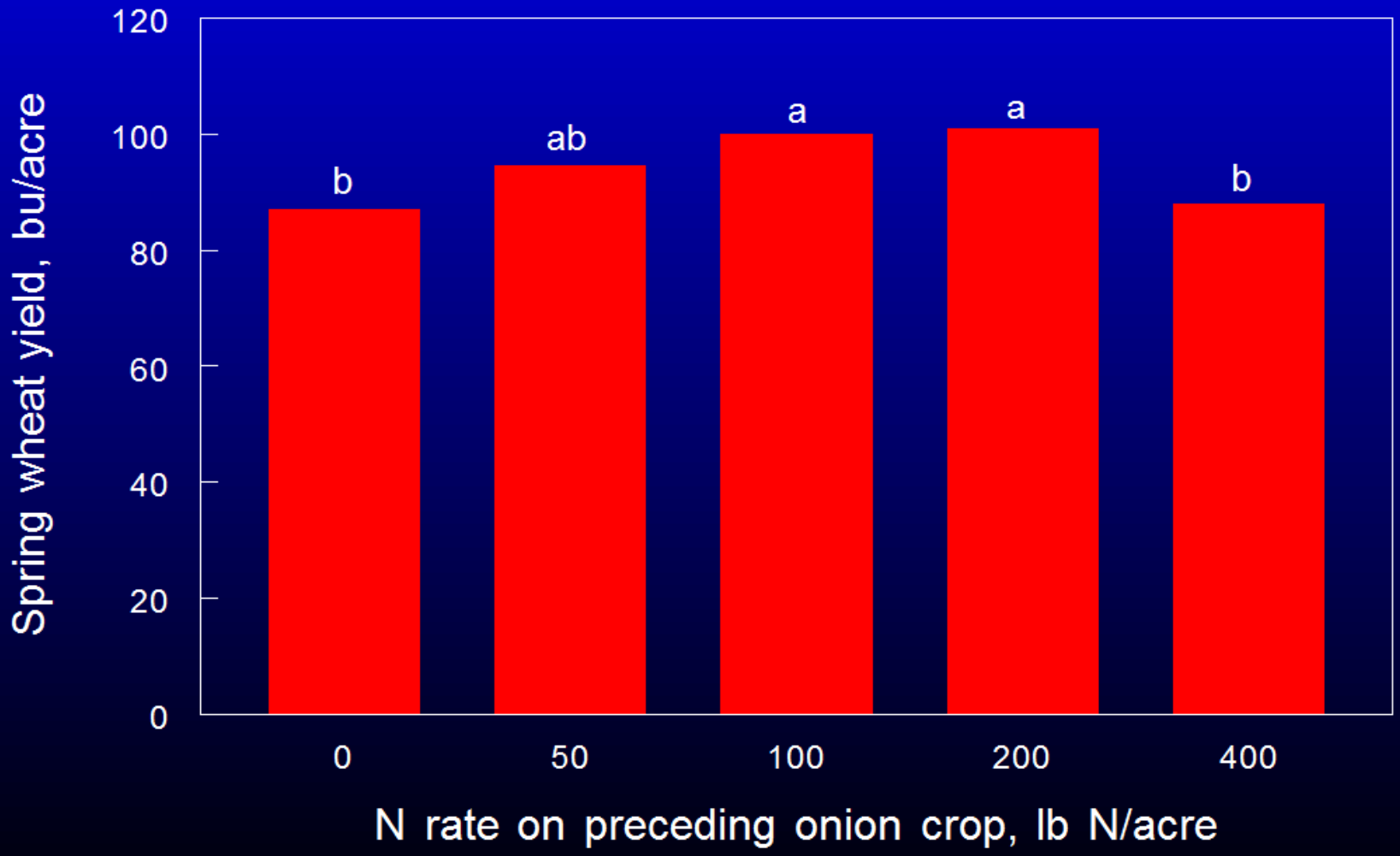
Recoverable sugar in response to N rate on preceding onion crop

Malheur Experiment Station, 1992



Spring wheat yield in response to N rate on preceding onion crop

Malheur Experiment Station, 1992



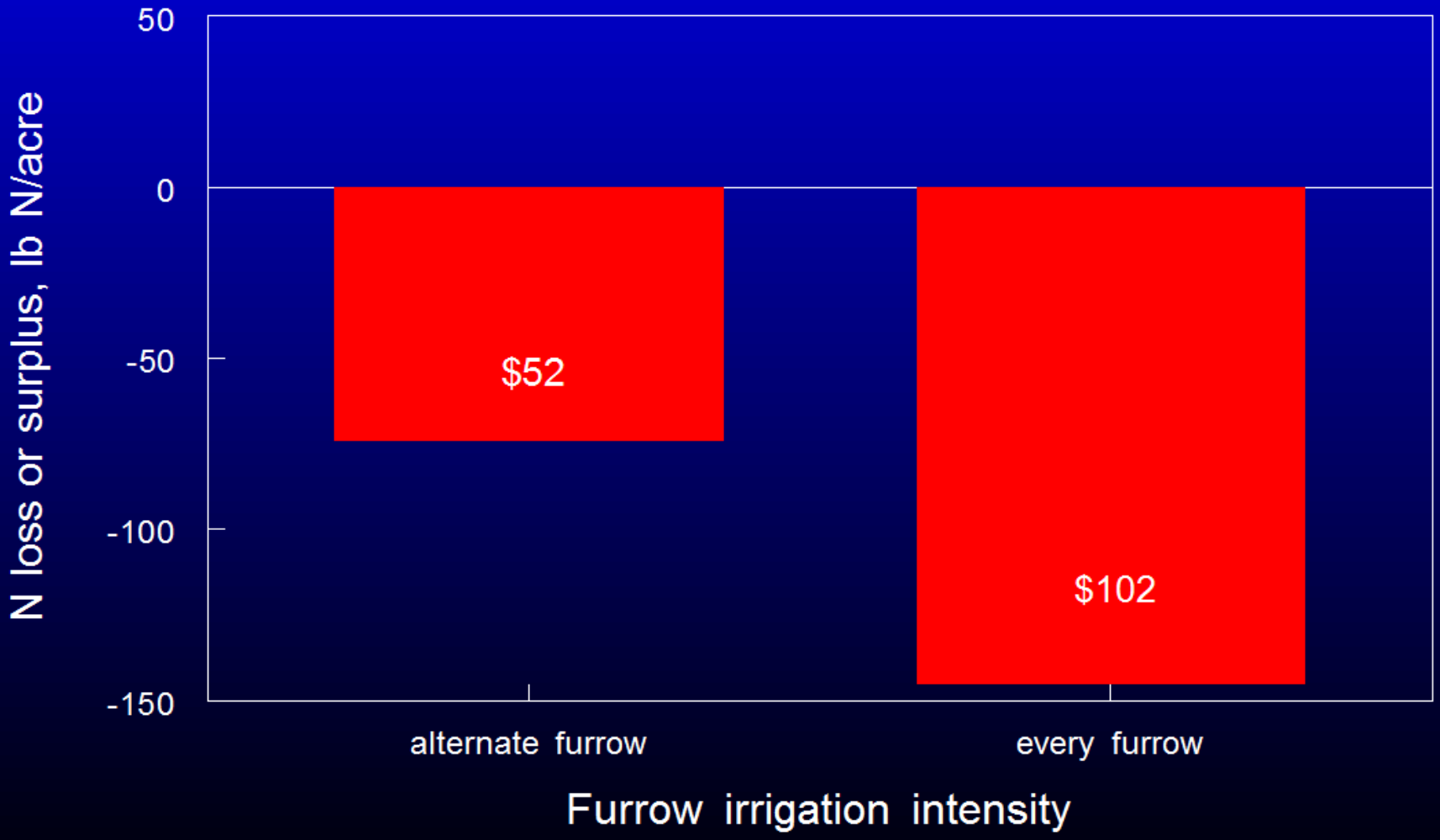
Factors influencing N loss with furrow irrigation:

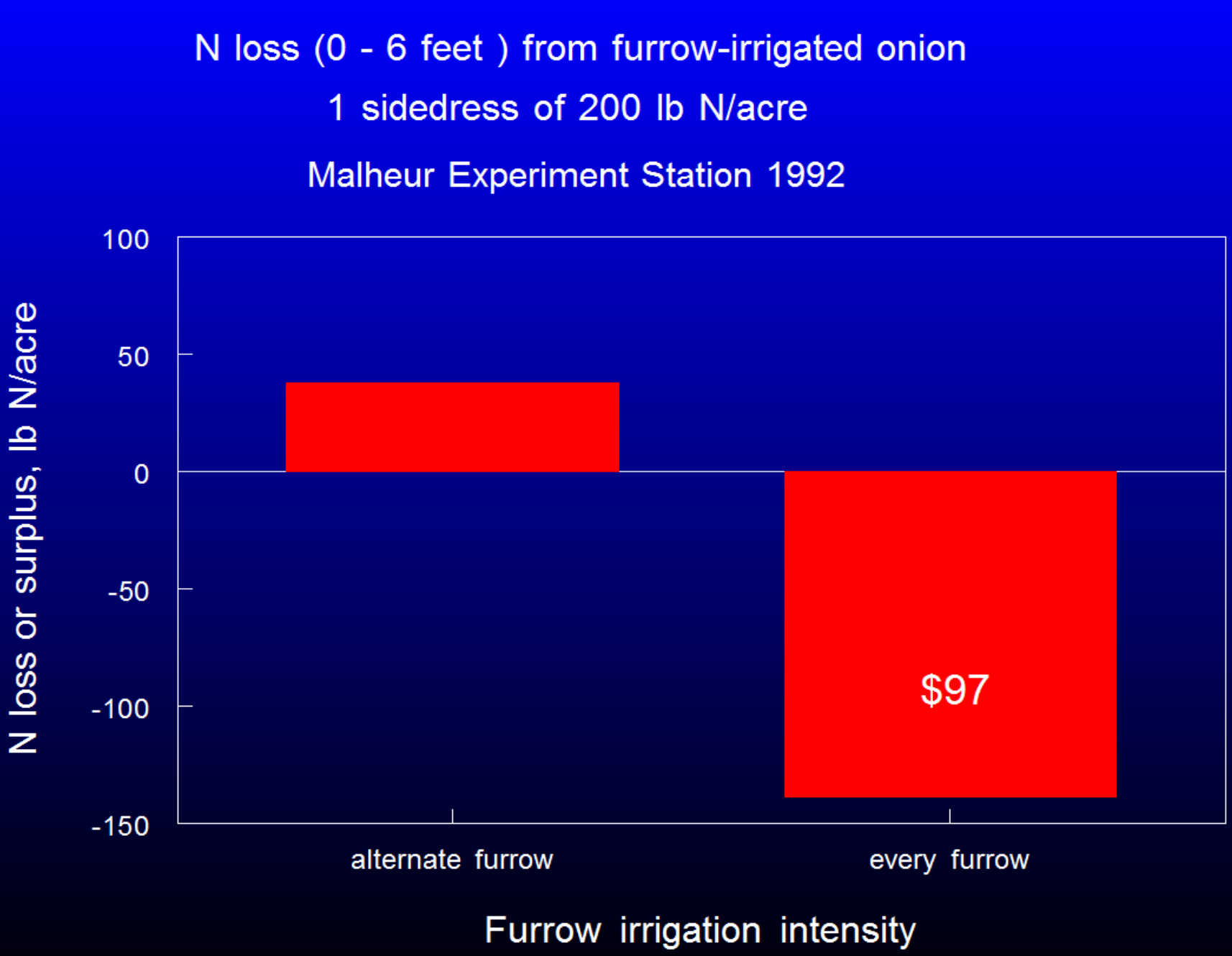
Irrigation intensity:

- every furrow vs. alternate furrow

N loss (0 - 6 feet) from furrow-irrigated onion

Total N applied: 400 lb/acre, Malheur Experiment Station, 1990




N loss (0 - 6 feet) from furrow-irrigated onion
1 sidedress of 200 lb N/acre
Malheur Experiment Station 1992
N loss or surplus, lb N/acre
100
50
0
-50
-100
-150
$97
alternate furrow
every furrow
Furrow irrigation intensity

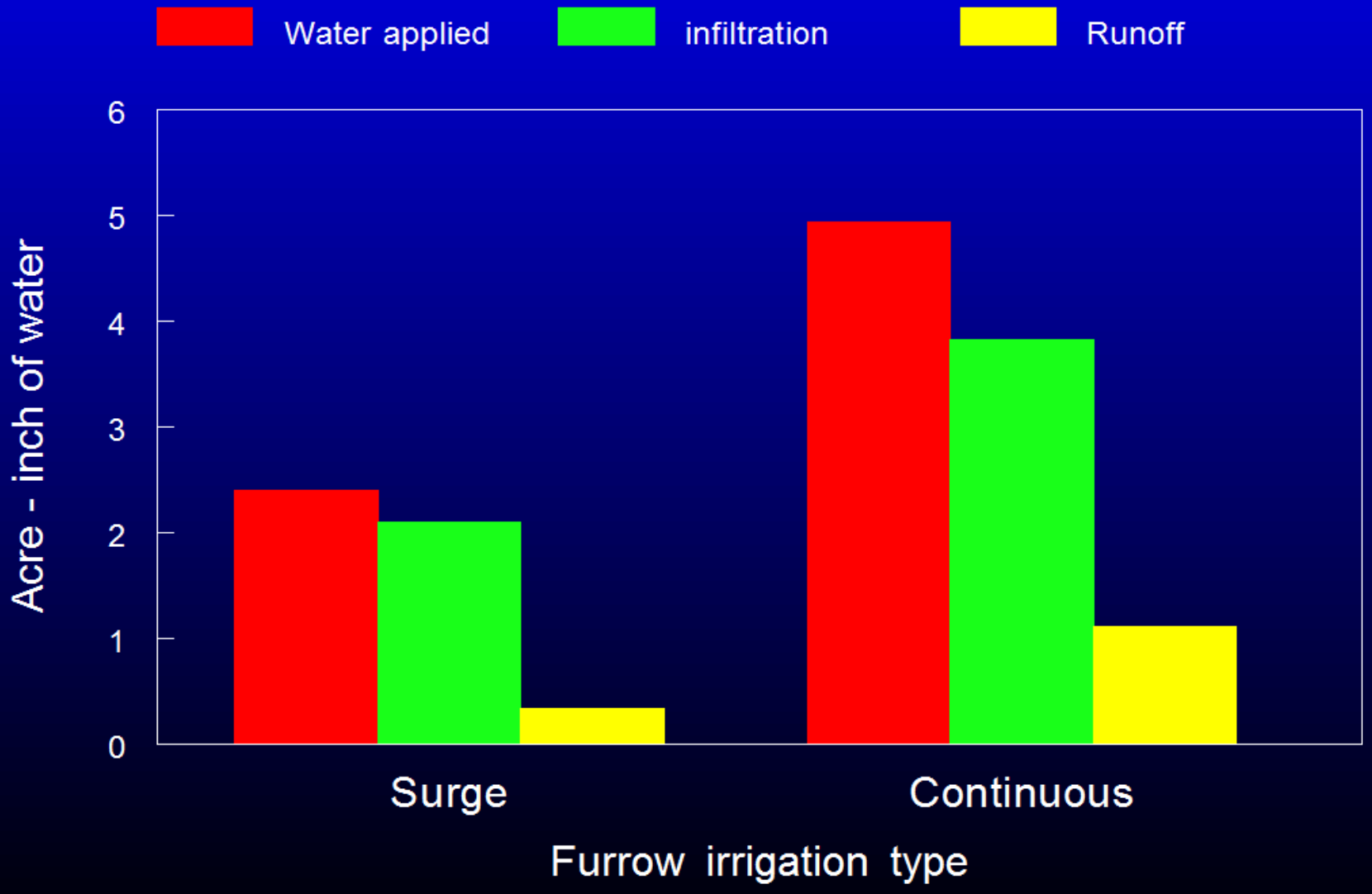
Factors influencing N loss with furrow irrigation:

Irrigation method:

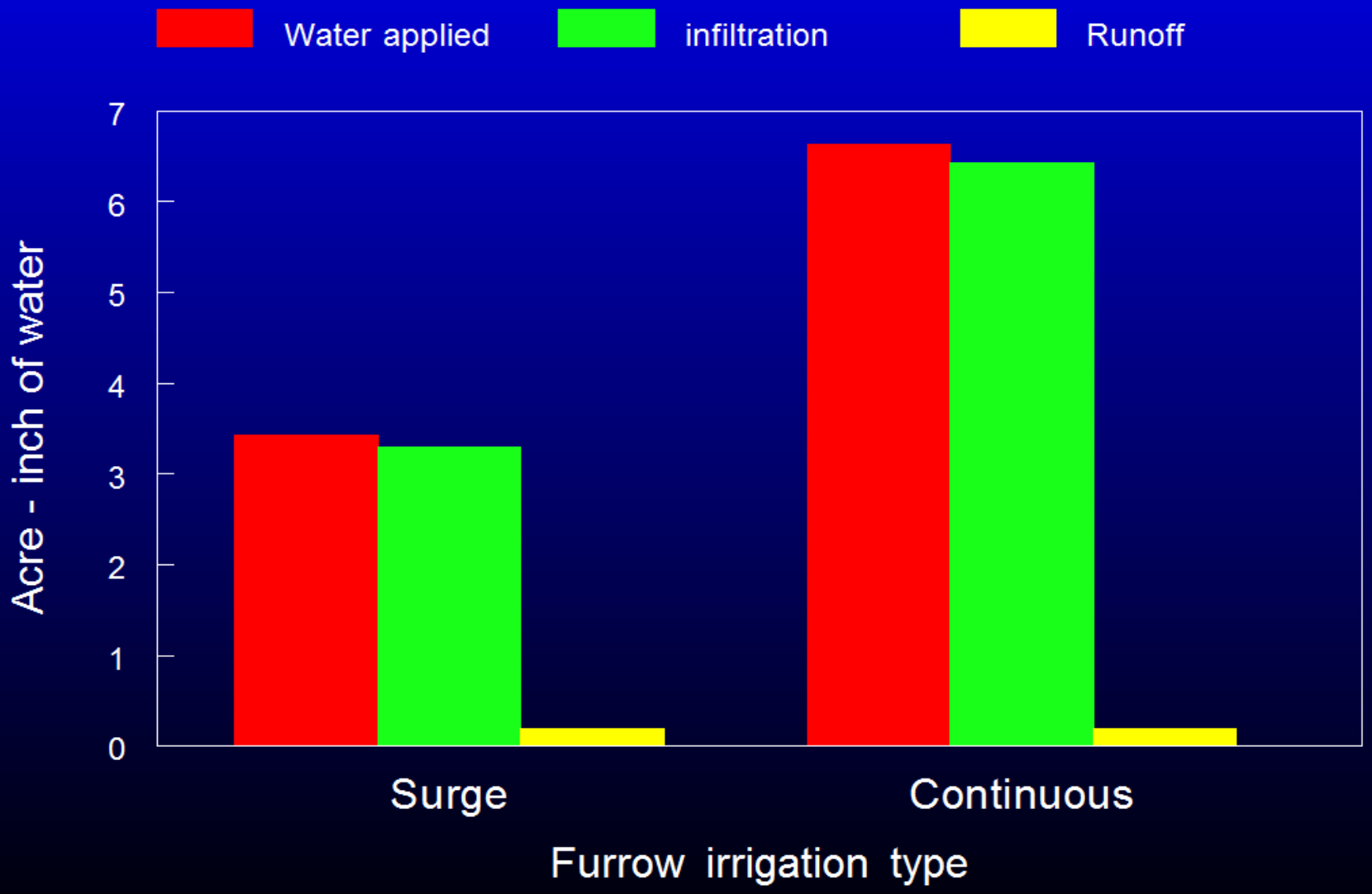
-Conventional furrow irrigation vs. Surge irrigation

Surge irrigation = oscillating furrow irrigation

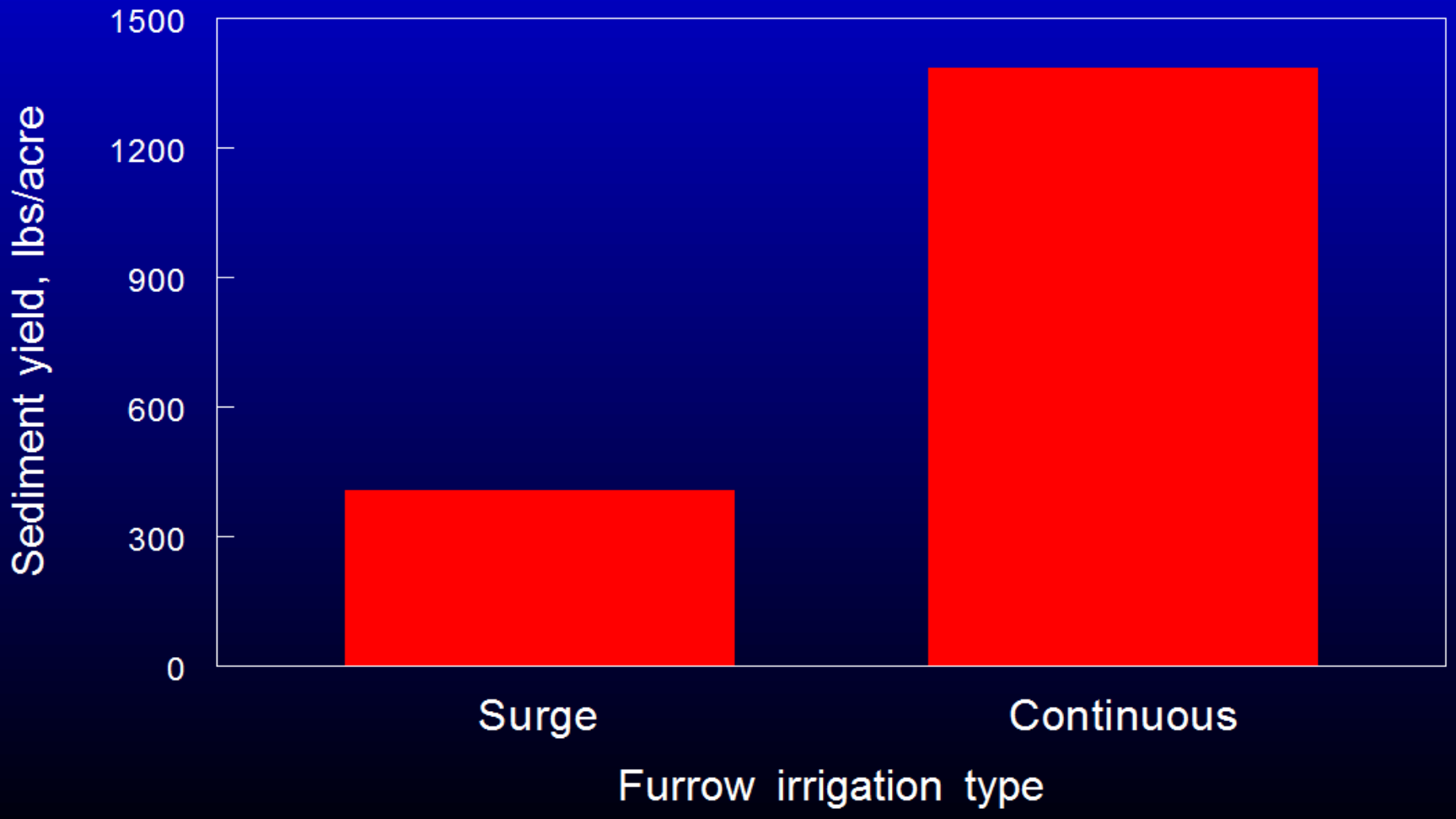
Water applied, infiltration, and runoff - average of 5 irrigations to spring wheat, Malheur Experiment Station, 1993



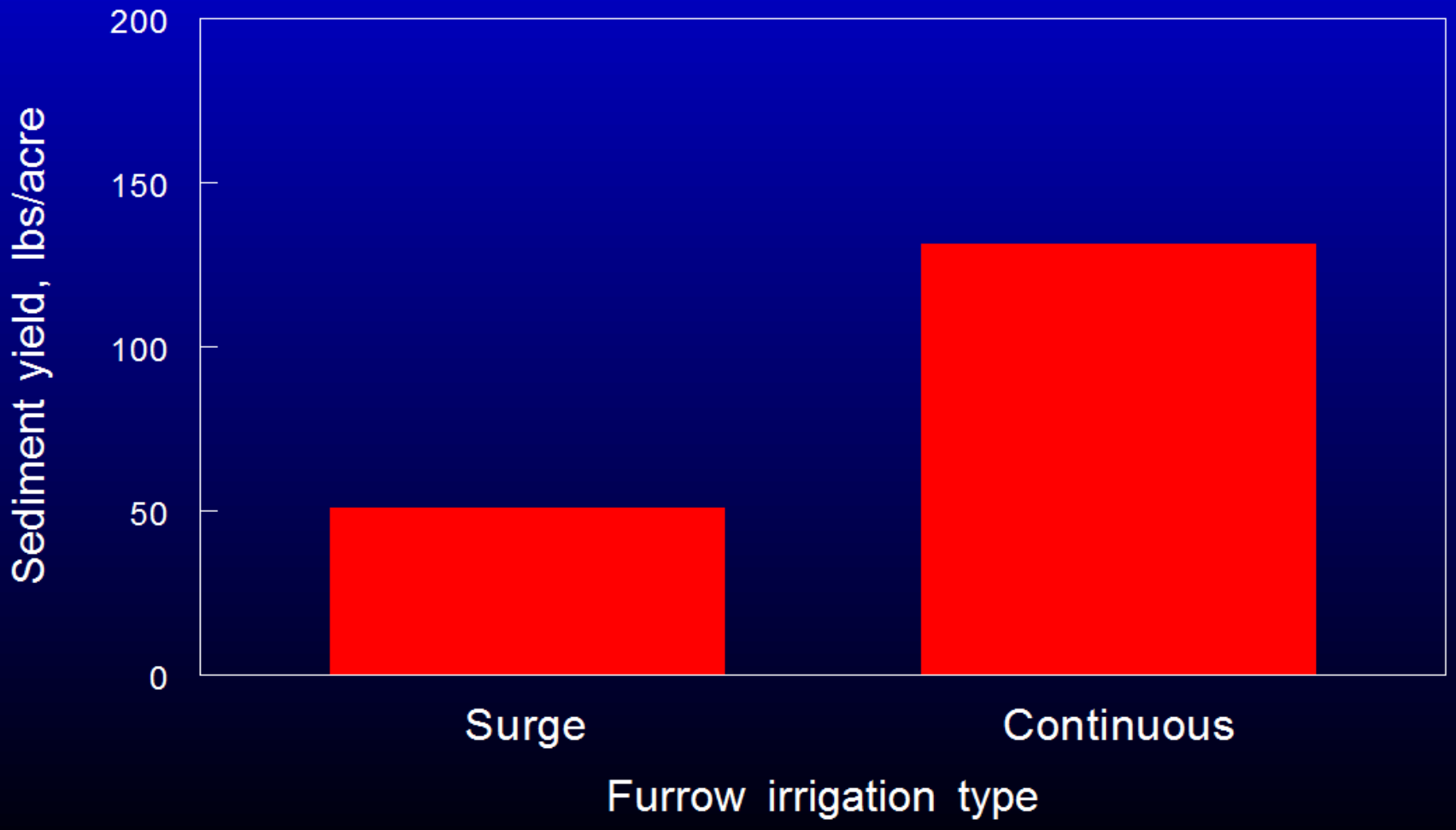
Water applied, infiltration, and runoff - average of 5 irrigations to winter wheat, Malheur Experiment Station, 1994



Sediment yield in runoff - total of 5 irrigations to spring wheat, Malheur Experiment Station, 1993

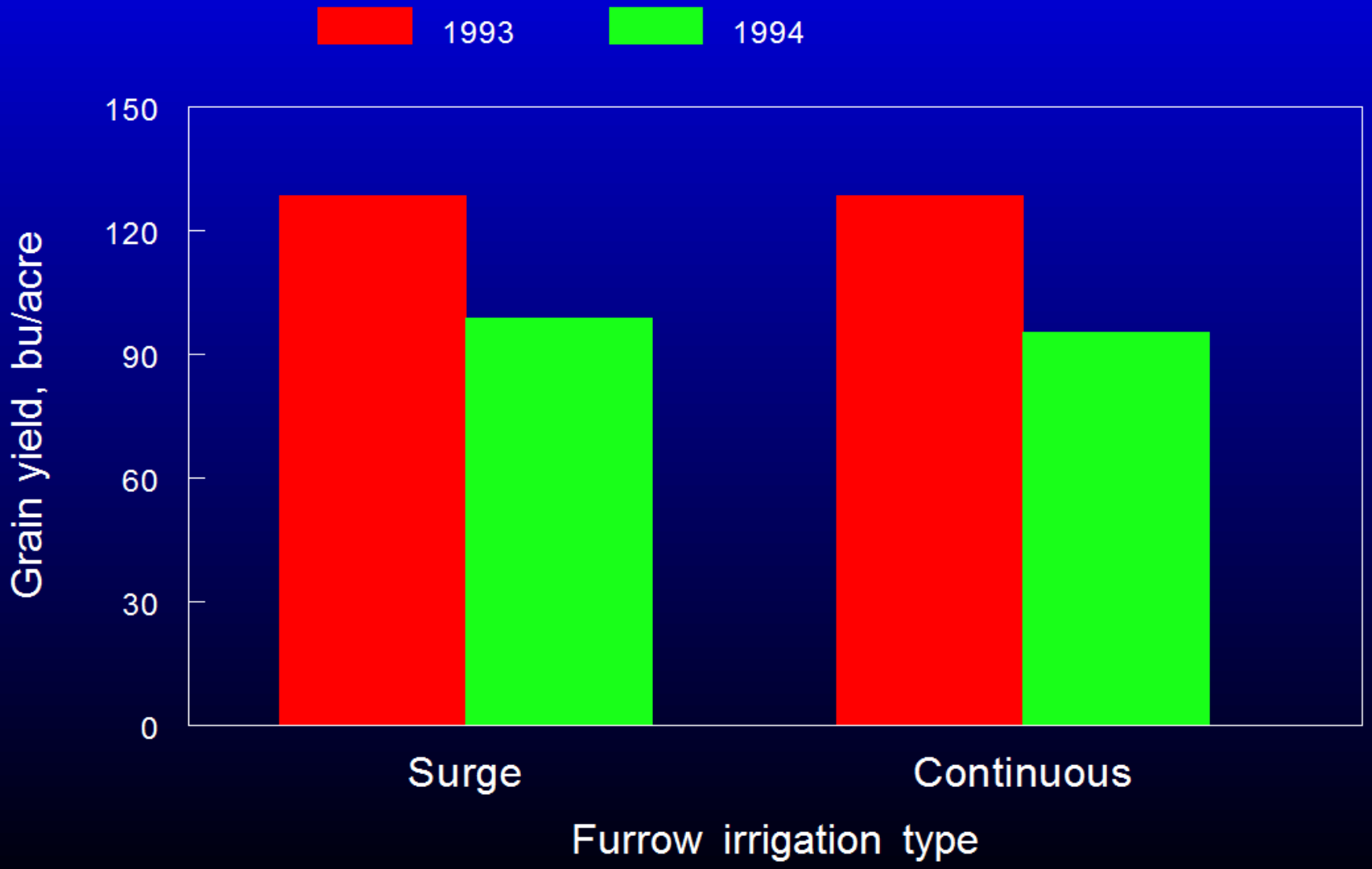


Sediment yield in runoff - total of 4 irrigations to winter wheat, Malheur Experiment Station, 1994



Spring and winter wheat yield in 1993 and 1994, respectively

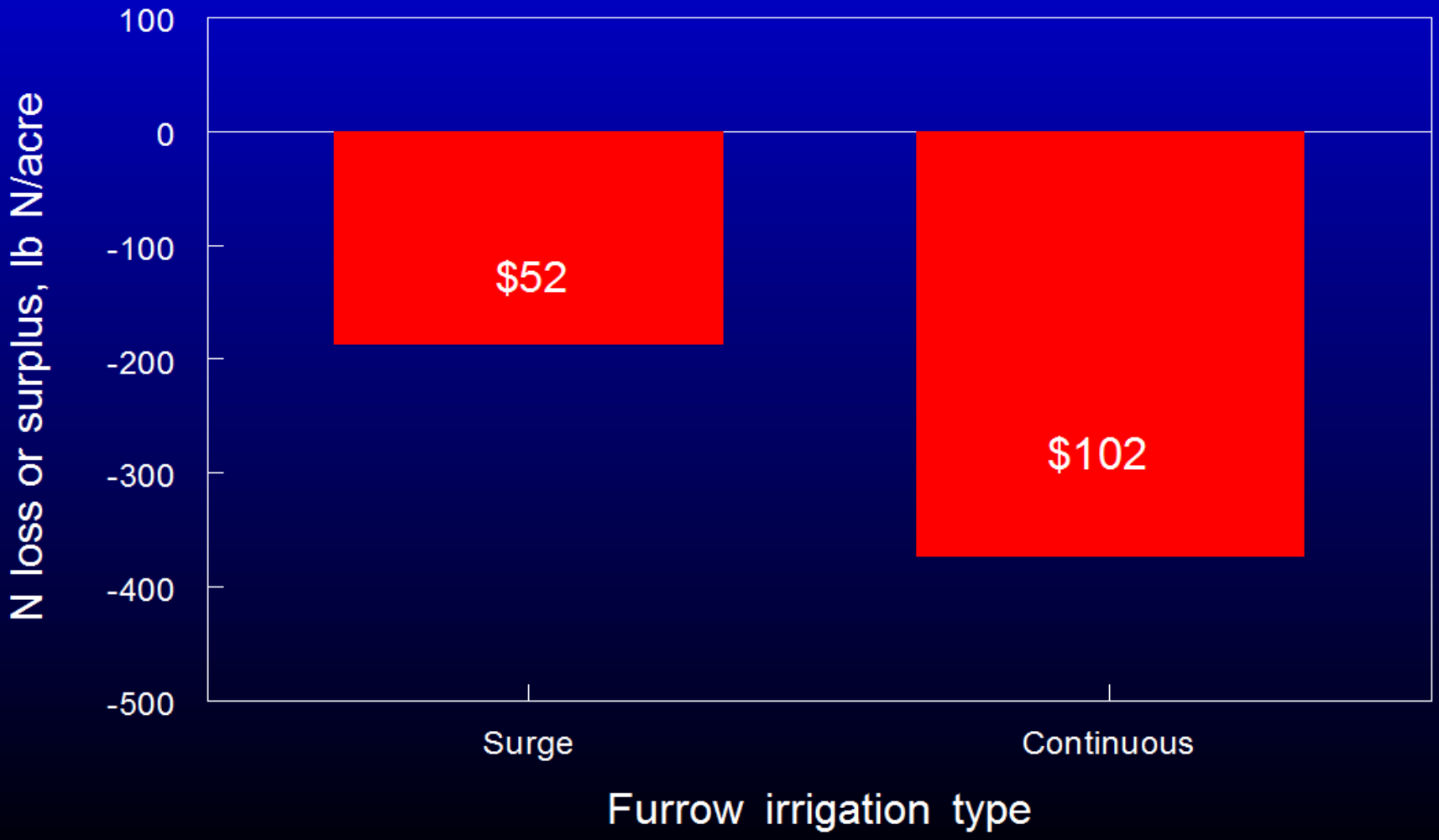
Malheur Experiment Station

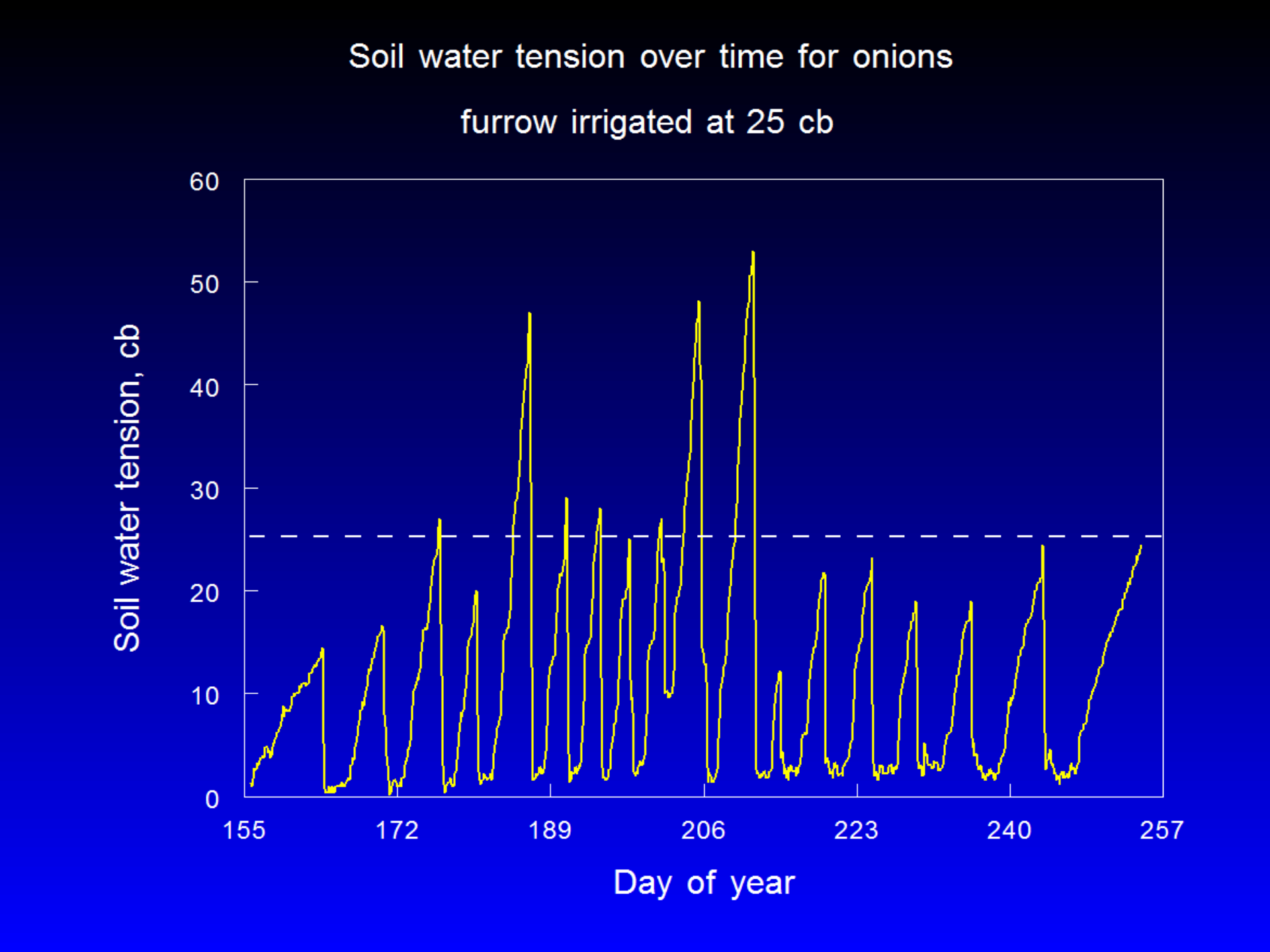


N loss (0 - 5 feet) from furrow-irrigated onion

100 lb N/acre fall broadcast, 130 lb N/acre spring sidedress

Nyssa, OR, 1992

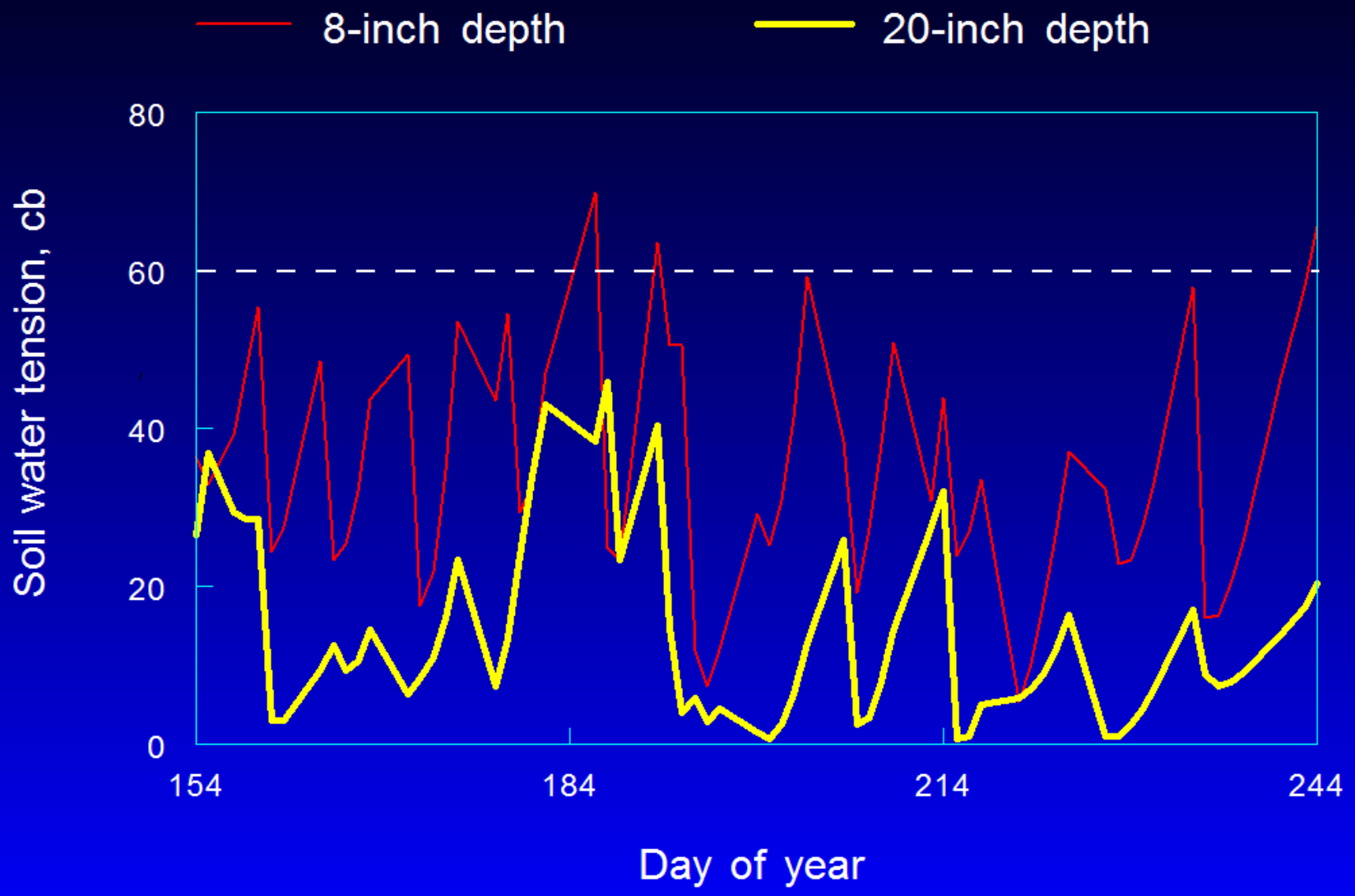



Soil water tension over time for onions
furrow irrigated at 25 cb
Soil water tension, cb
60
50
40
30
20
10
0
155
172
189
206
223
240
257
Day of year

Other crops:

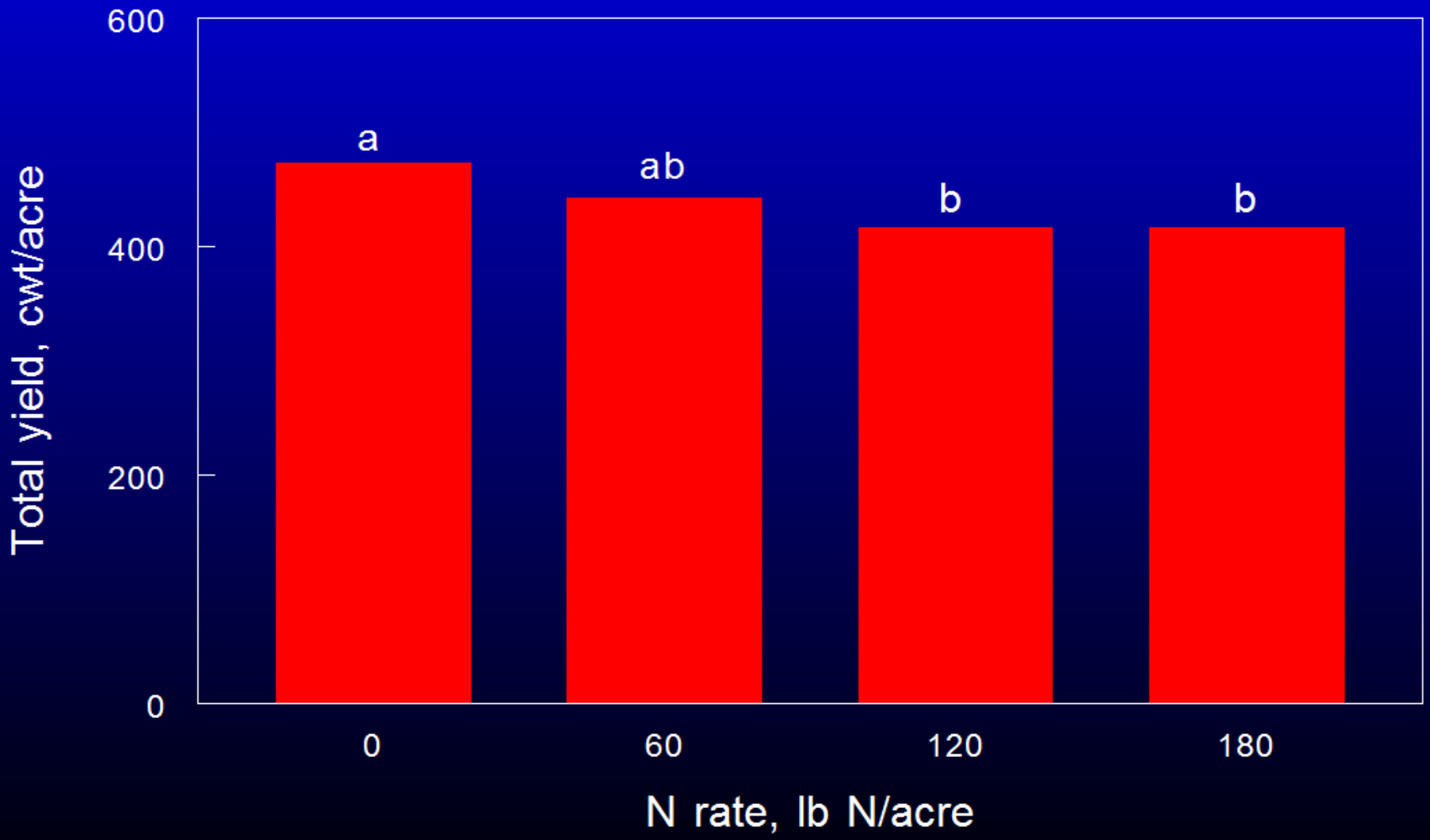
Potato response to N rate under furrow and sprinkler irrigation

Soil water tension over time for potato furrow irrigated at 60 cb
Malheur Experiment Station, 1994.



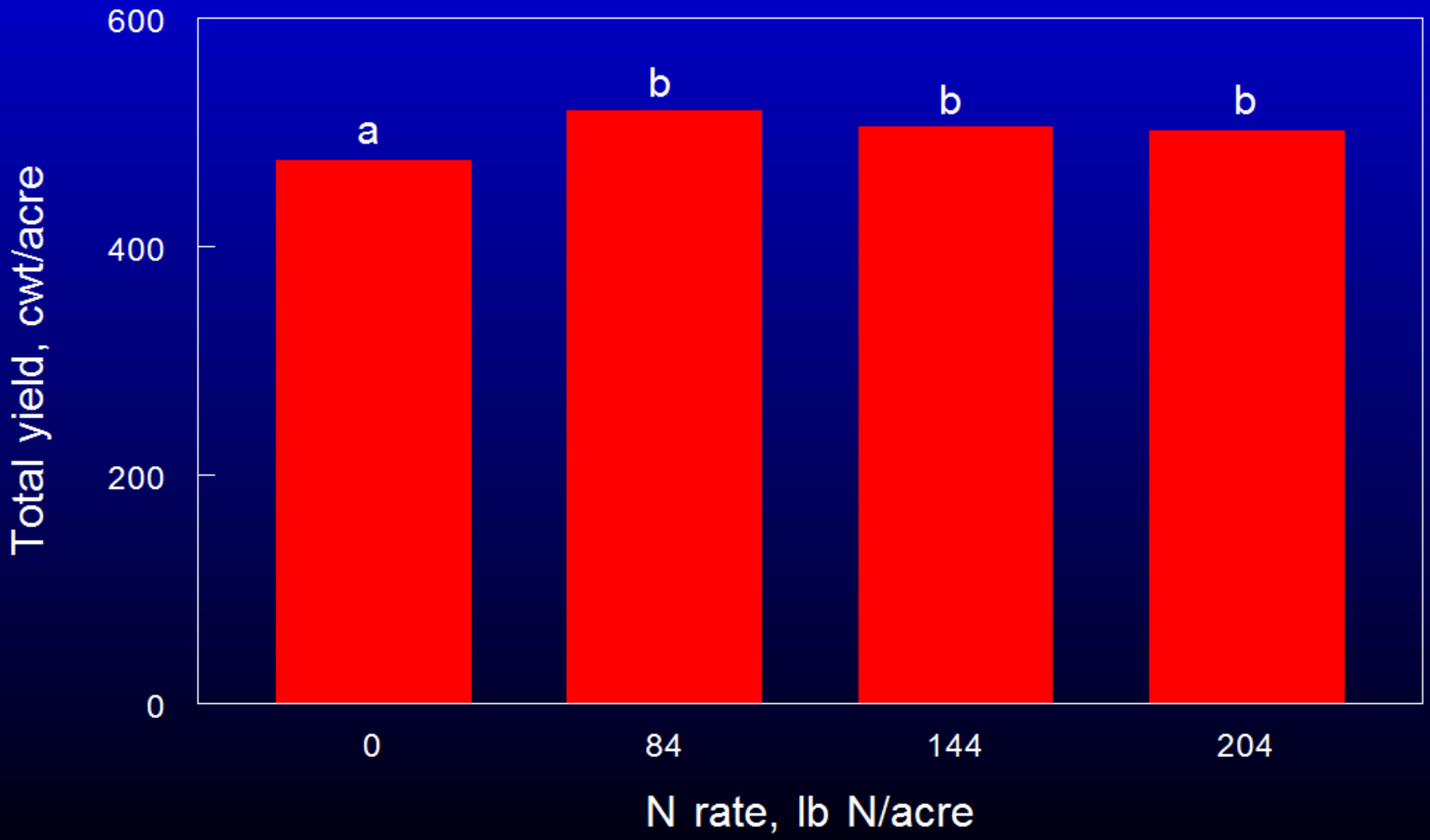
Yield response to N rate for furrow-irrigated potato

Previous crop: soybean. Malheur Experiment Station, 1994



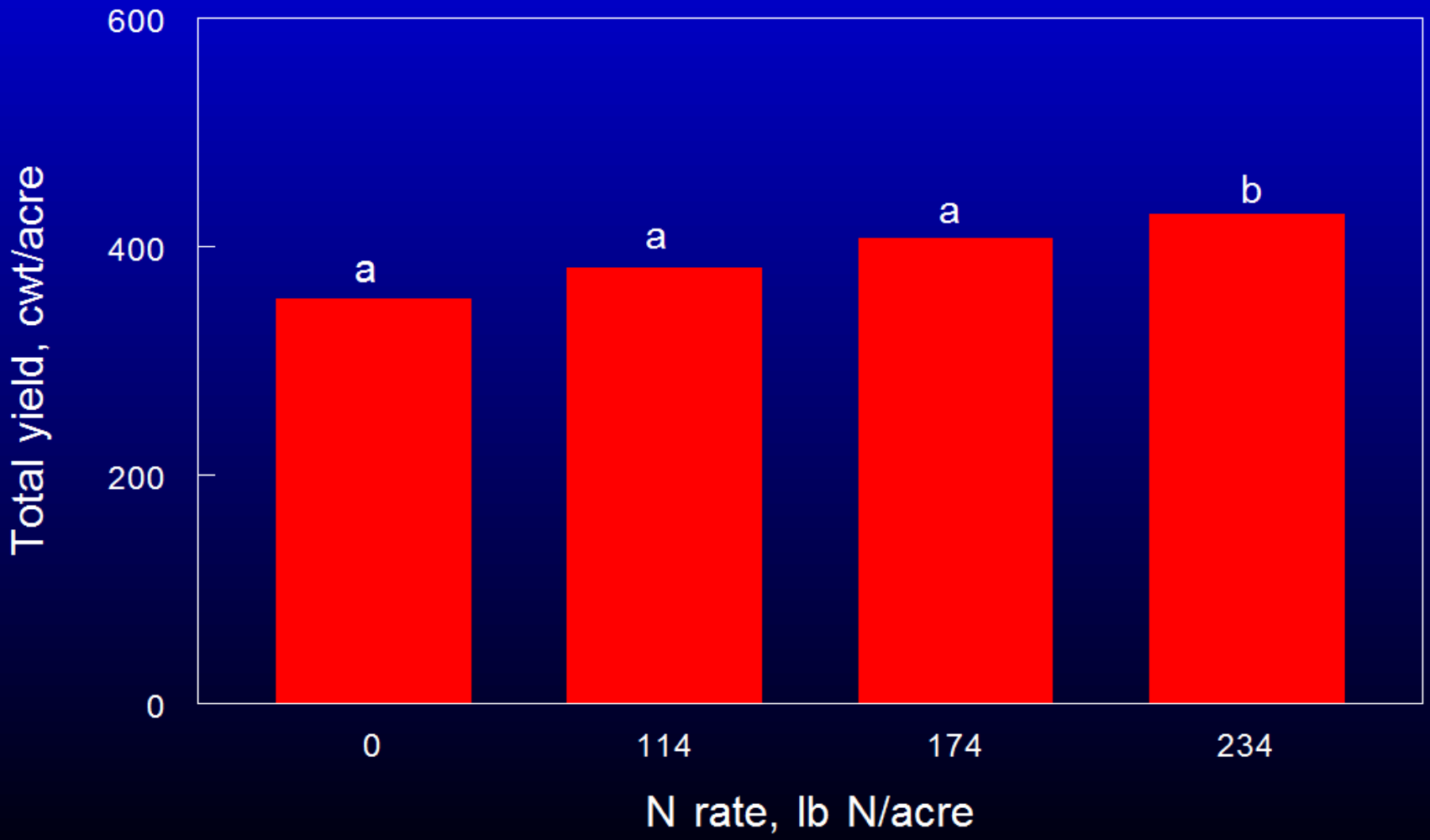
Yield response to N rate for furrow-irrigated potato

Previous crop: wheat. Malheur Experiment Station, 1995



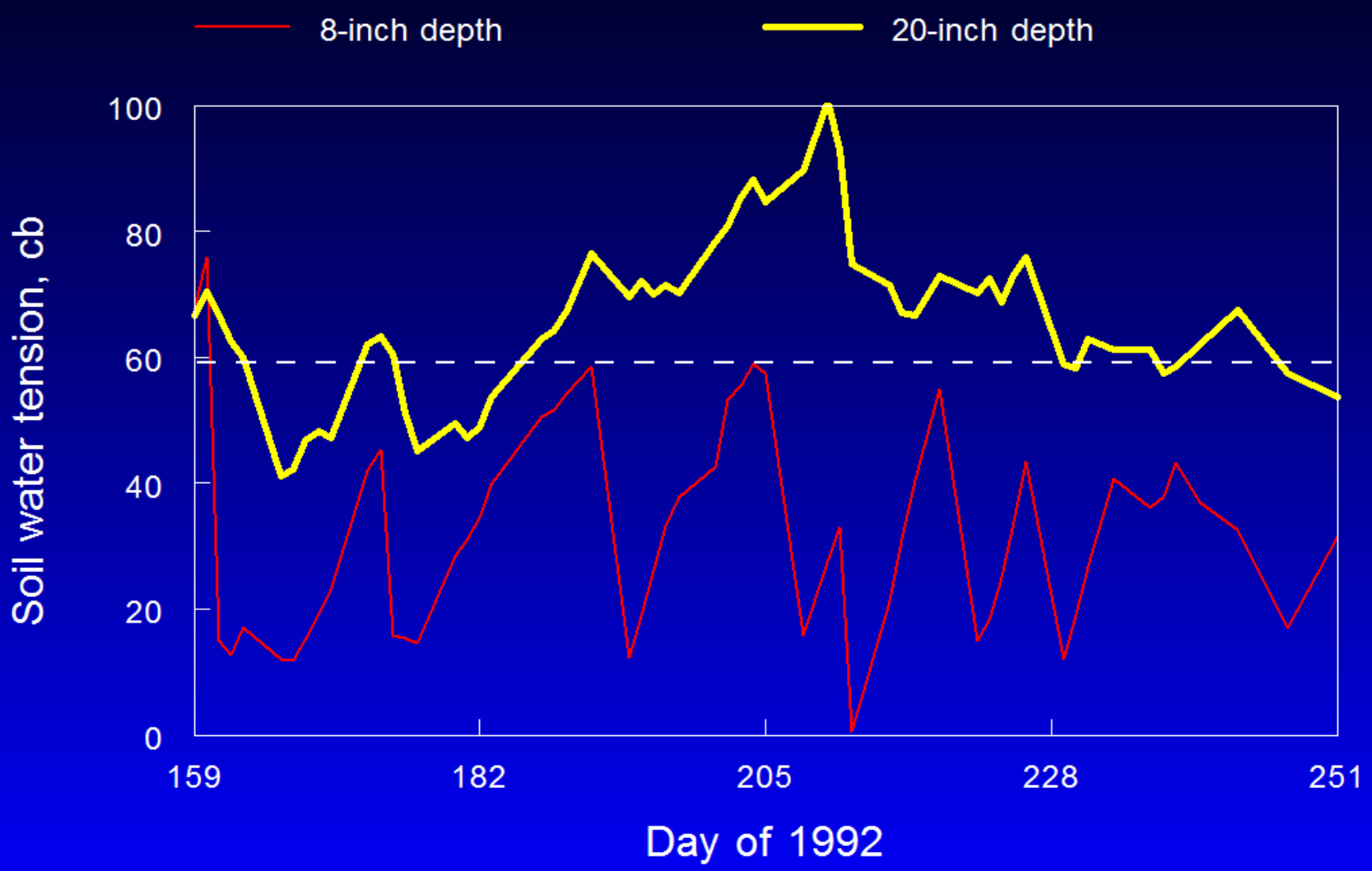
Yield response to N rate for furrow-irrigated potato

Previous crop: wheat. Malheur Experiment Station, 1996



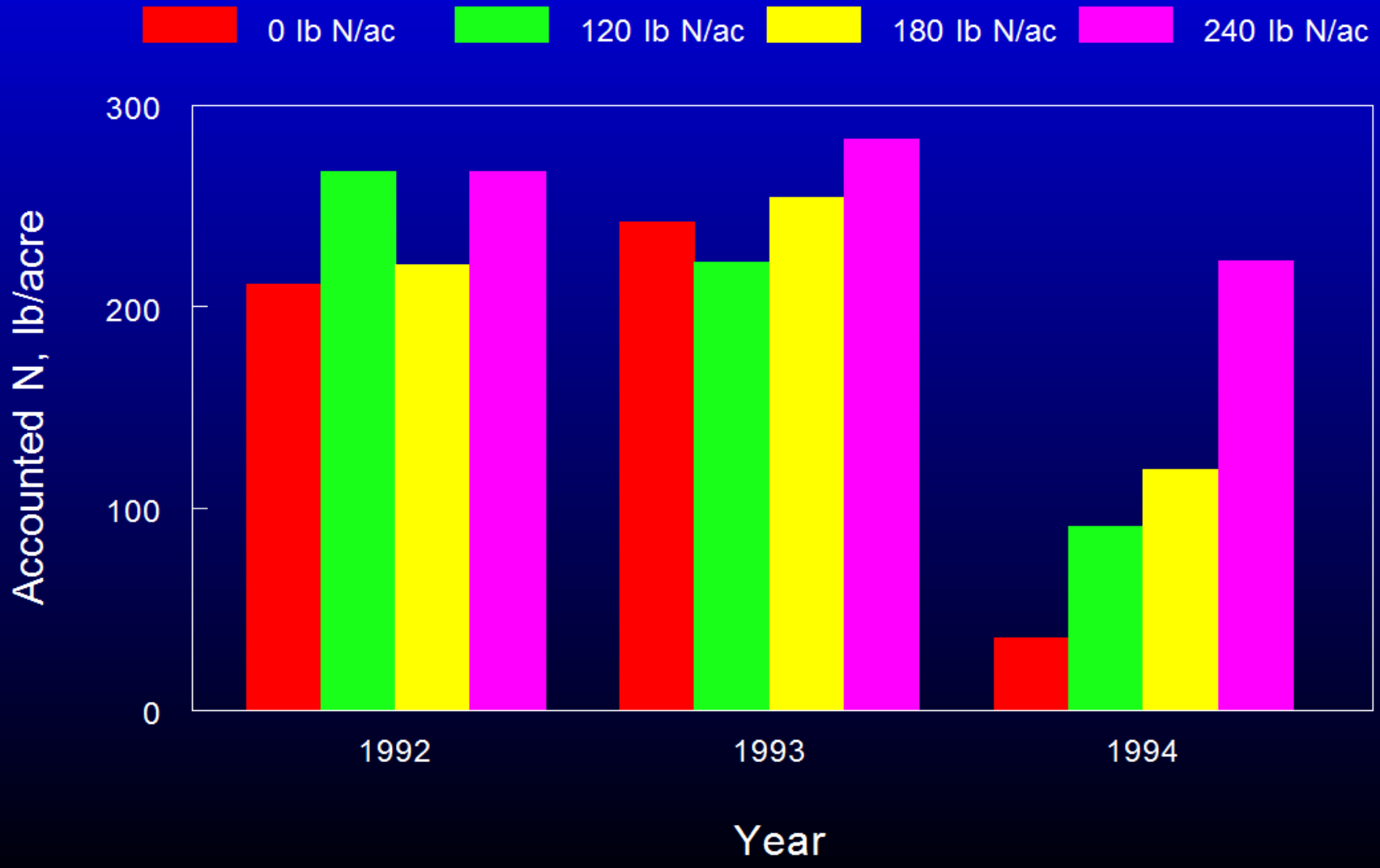
Soil water tension for potato sprinkler irrigated at 60 cb

Malheur Experiment Station, 1992

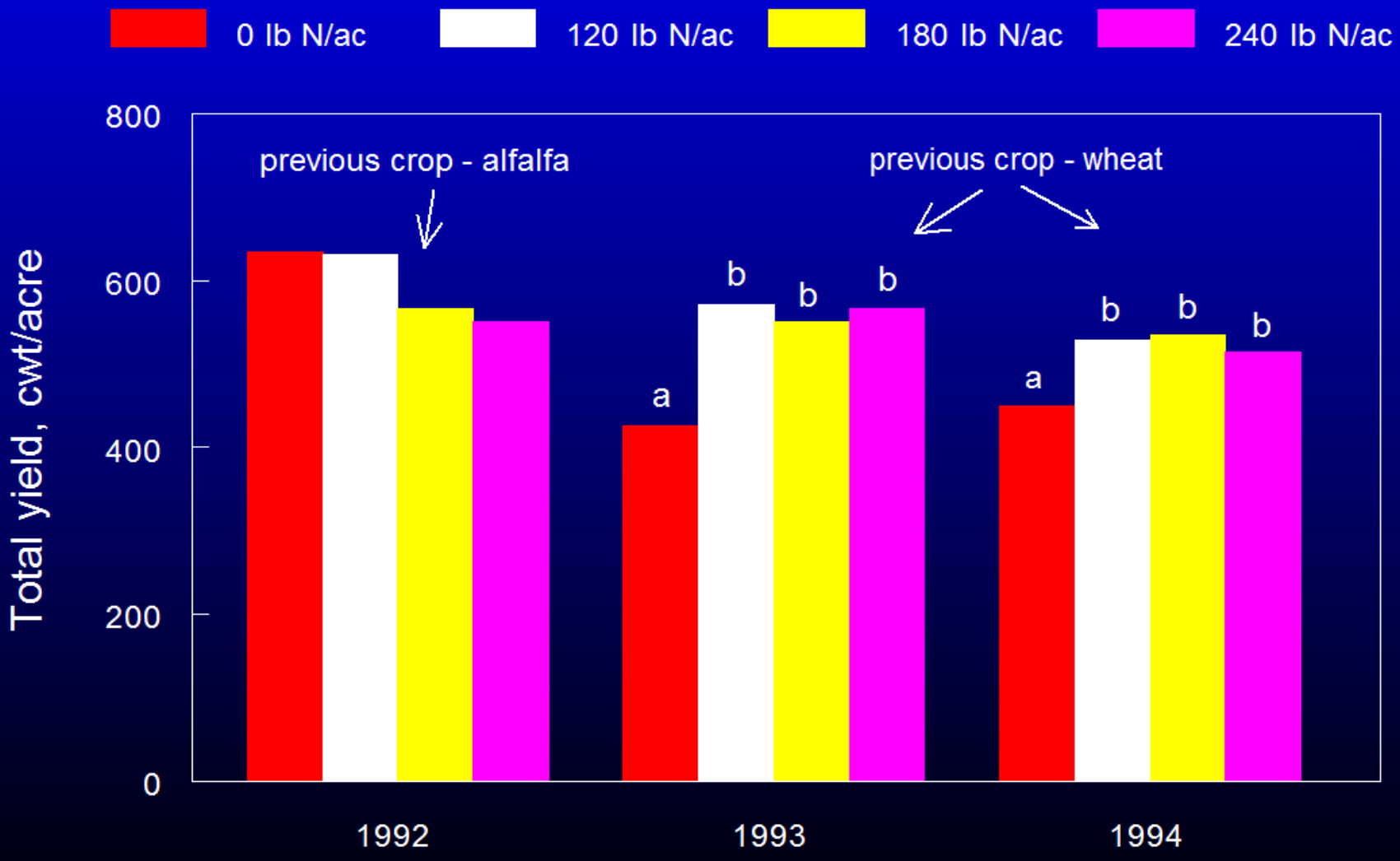


N surplus in sprinkler-irrigated potato fertilized at 4 N rates

Malheur Experiment Station



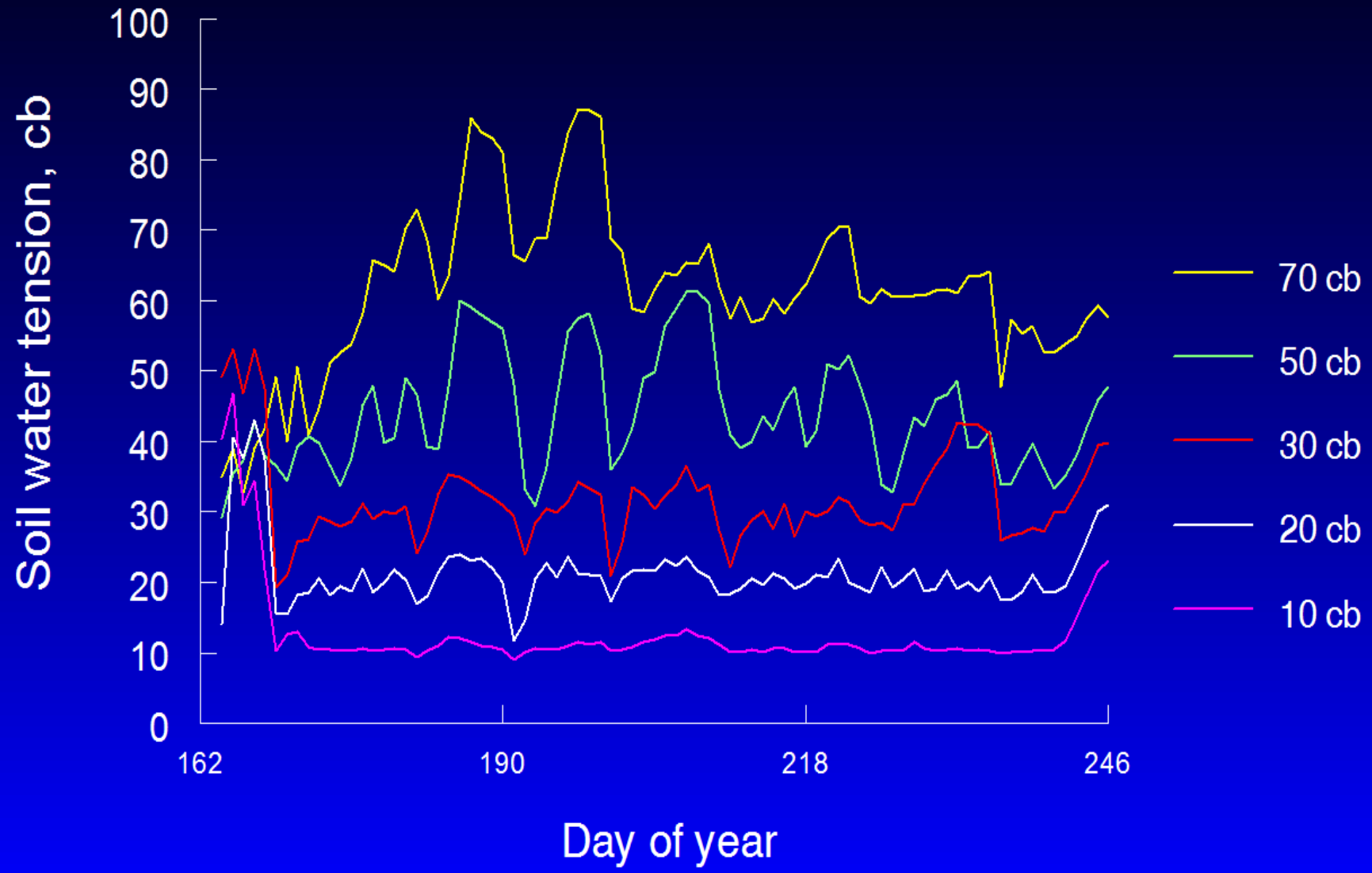
Yield response to N rate for sprinkler-irrigated potato
Malheur Experiment Station

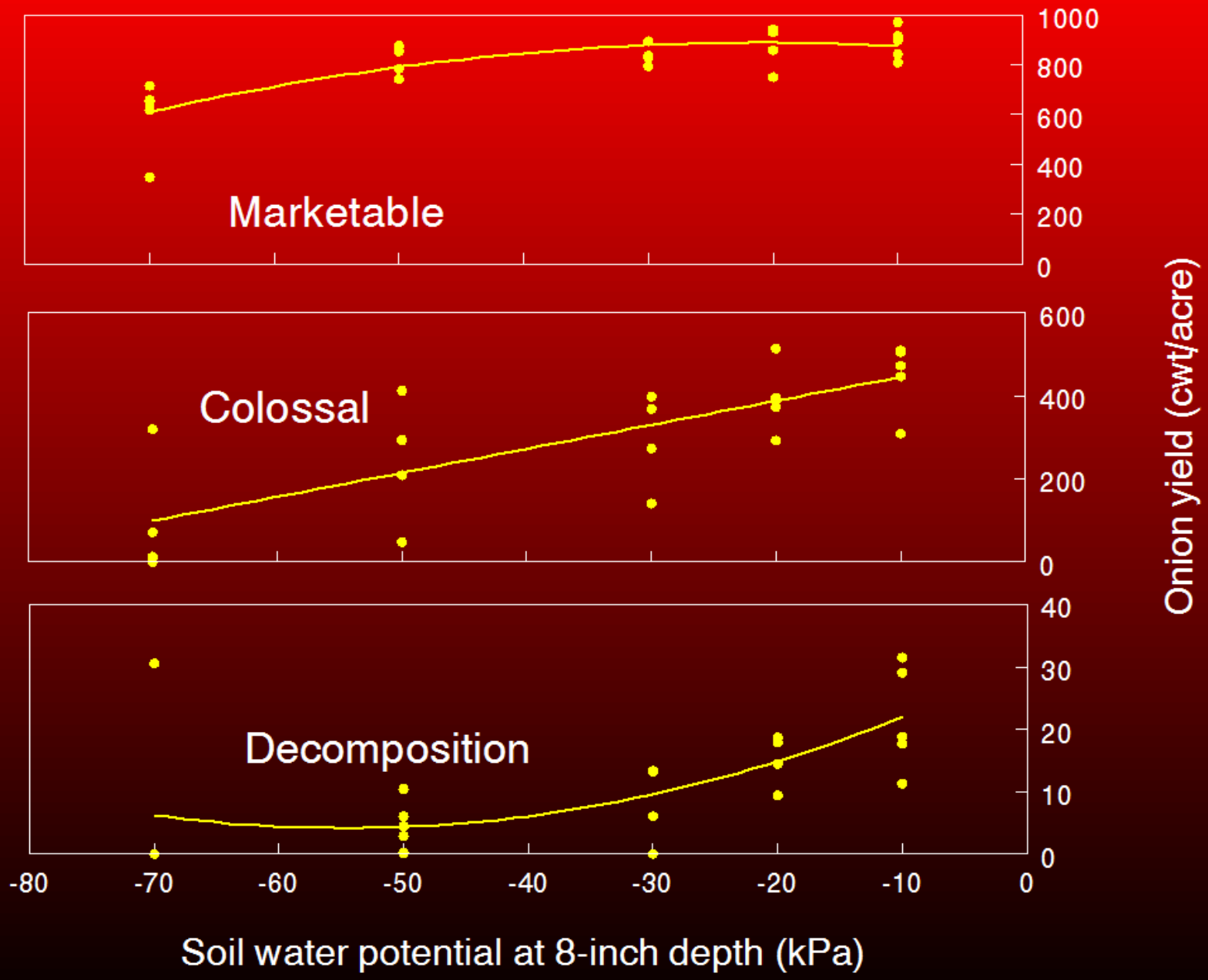


Drip irrigation of onion:

irrigation scheduling

response to N rate


Soil water tension for onions drip irrigated
at 5 soil water tensions, Malheur Experiment Station, 1997
Soil water tension, cb
100
90
80
70
60
50
40
30
20
10
0
162
190
218
246
Day of year
70 cb
50 cb
30 cb
20 cb
10 cb


Marketable
1000
800
600
400
200
0
Colossal
600
400
200
0
Decomposition
40
30
20
10
0
-80
-70
-60
-50
-40
-30
-20
-10
0
Soil water potential at 8-inch depth (kPa)
Onion yield (cwt/acre)

Onion yield response to N rate under drip irrigation:

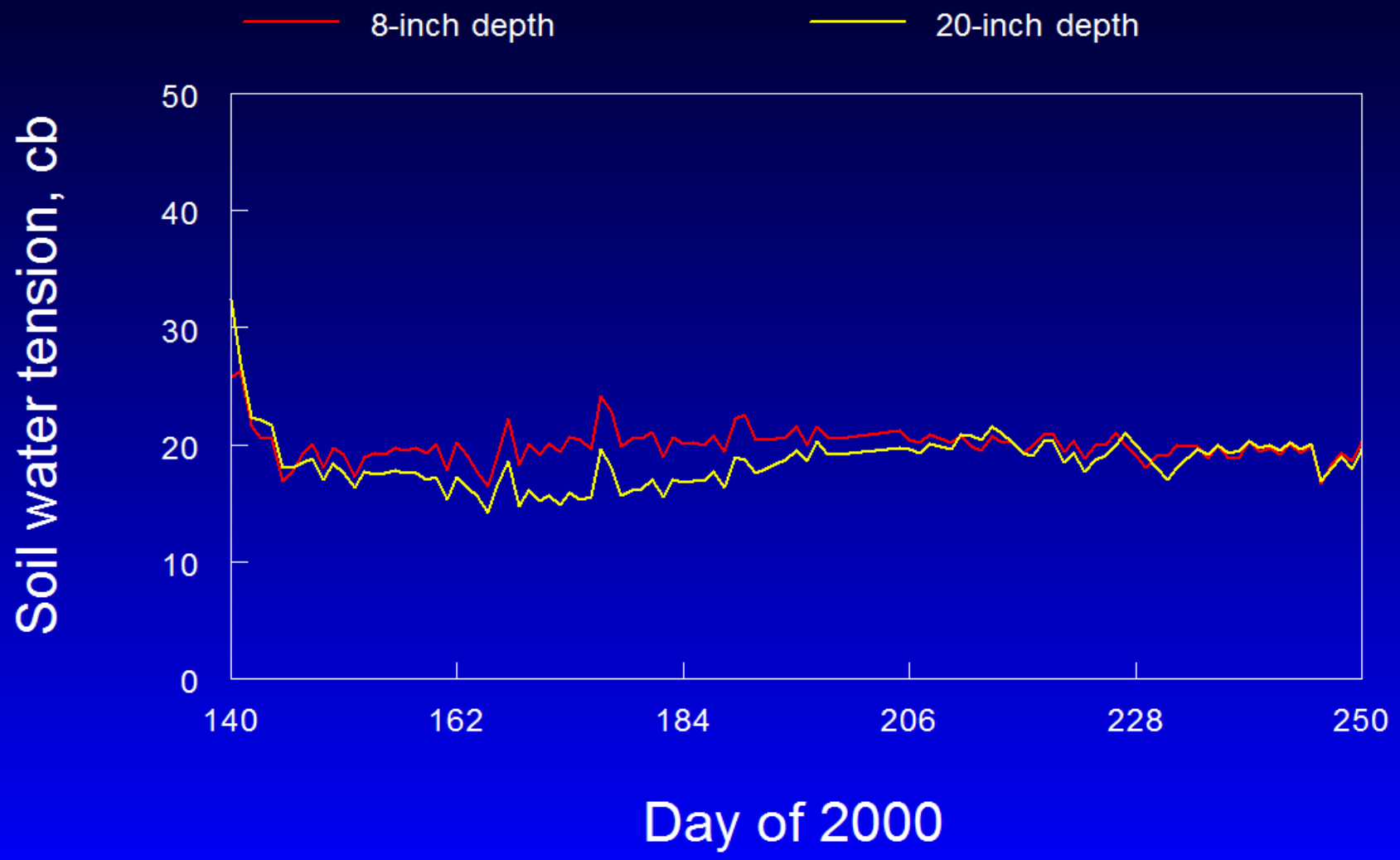
- Onions drip irrigated at 20 cb

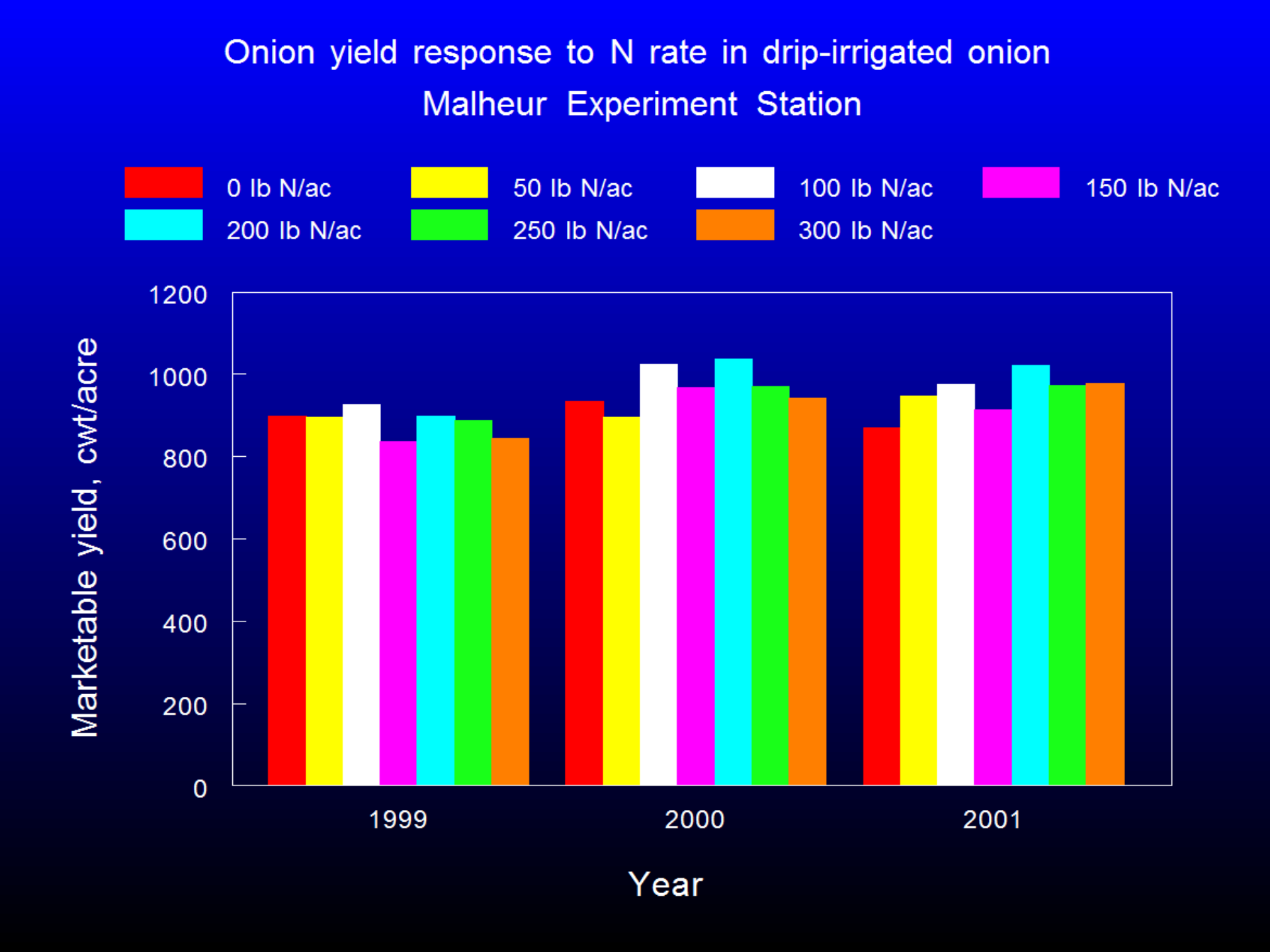
- 7 N rates

0 lb N/acre
50 lb N/acre
100 lb N/acre
150 lb N/acre
200 lb N/acre
250 lb N/acre
300 lb N/acre

Soil water tension for onion drip-irrigated at 20 cb

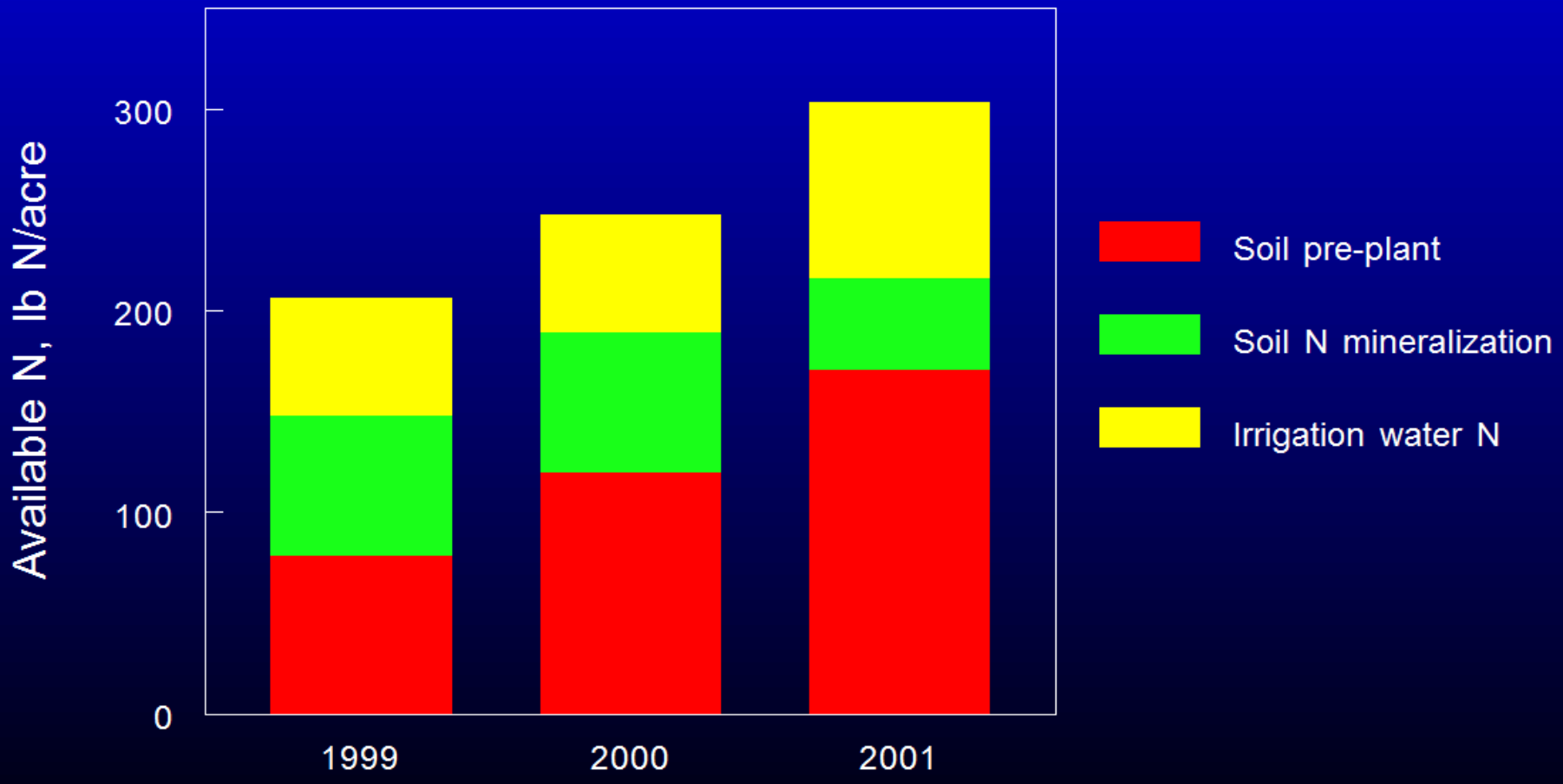
Malheur Experiment Station , 2000




Onion yield response to N rate in drip-irrigated onion
Malheur Experiment Station
0 lb N/ac
50 lb N/ac
100 lb N/ac
150 lb N/ac
200 lb N/ac
250 lb N/ac
300 lb N/ac
Marketable yield, cwt/acre
1200
1000
800
600
400
200
0
1999
2000
2001
Year

Non-fertilizer N sources (0 - 2 feet) for drip-irrigated onion

Malheur Experiment Station, 1999 - 2001



Conclusions about over - irrigation:

- Soil moisture monitoring allows precision irrigation reducing N leaching
- Less N fertilizer is needed if soil and tissue testing is used
- Other benefits: better crop yield and quality


More information:
www.cropinfo.net