WASHINGTON STATE UNIVERSITY
IRRIGATED SOIL MANAGEMENT

Cover Crops for Grape Production

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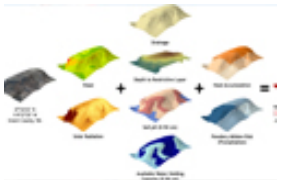
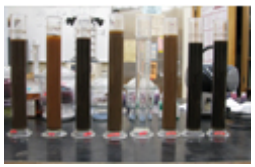
WATER | GIS AND MAPPING | NUTRIENTS | TESTING | CHEMISTRY | SOILS | PLANTS

Recent Research

- Olmstead et al., winegrapes (late 1990s)
- Bair et al., juice grapes (early 2000s)

Olmstead Research

- 175 different plants evaluated for two years
- Emergence and stand density recorded
- Assessed for regeneration in second year

Olmstead et al., year 2

- Seven single species, two mixes
- All commercially available

Table 3 Cover crops selected from large evaluation trial in 1998. Entries commercially available were planted in a commercial vineyard (Alderridge Vineyard, Corus Brands, Inc.), Alderdale, WA, 1999.

Scientific name	PI number or common name
Secale cereale	Cereal rye[a]
Agropyron cristatum	Fairway crested wheatgrass[a]
Agropyron cristatum *Elytrigia intermedia* *Lolium perenne*	Canada mix[b]
Festuca ovina duriuscula *Festuca ovina* *Festuca arundinacea*	Fescue mix[a,b]
Poa ampla	Sherman big bluegrass[a,b]
Medicago lupulina	George black medic[a]
Medicago lupulina	Dr. B black medic
Medicago polymorpha	Santiago burr medic or burclover[a,c]
Trifolium subterraneum	Koala sub-clover[a]
Trifolium hirtum	Monte Frio rose clover[a]
Medicago truncatula	Parabinga barrel medic
Medicago rigidula	N/A, PI # W6 8309
Medicago orbicularis	Button medic, PI # W6 5203
Medicago scutellata	Snail medic, PI # 487392
Medicago littoralis	Strand medic, PI # 537180

[a]Commercially available seed.
[b]Added in 1999 to commercial trial; not evaluated in initial 1998 trial.
[c]Santiago was substituted for Parabinga in the 1999 commercial trial due to seed unavailability.

Olmstead Results

Table 4 Establishment and growth of nine cover crop candidates and resident vegetation in 1999 commercial vineyard trial at Alderdale, WA.

Species	Seeding rate (kg/ha)	Emergence (%) DOY 72	Plant height (cm) DOY 152	Vegetative cover (%) DOY 197	Phenological stage DOY 166
Cereal rye	14.6	76.3 b†	56.3a	32.0ab	80-90% bloom, extensive tillering
Fairway crested wheatgrass	22.4	85.6a	26.3 cd	28.6abc	20% bloom, extensive tillering
Canada mix[a]	22.4	62.5 c	34.9 bc	28.2abc	30-40% bloom
Fescue mix[b]	22.4	40.0 de	34.8 bc	10.2 d	20-30% bloom
Sherman big bluegrass	22.4	62.5 c	24.2 d	16.6 cd	Vegetative
George black medic	11.2	23.8 f	4.8 e	9.3 d	75-85% bloom, seed pods present and maturing
Santiago burr medic	28.0	42.5 d	8.9 e	19.9 bcd	100% bloom, seed maturing, plants entering dormancy
Koala sub-clover	28.0	28.8 f	4.2 e	17.2 cd	85% bloom, seeds set into ground
Monte Frio rose clover	28.0	31.3 ef	7.8 e	10.8 d	90-95% bloom, seed heads present
Control	N/A	N/A	37.8 b	36.6a	N/A

†Means with the same letter are not significantly different (Fisher's LSD, $p < 0.05$).
[a]Canada mix consists of Fairway crested wheatgrass, pubescent wheatgrass, and perennial ryegrass.
[b]Fescue mix consists of tall, hard, and sheep fescues.

Olmstead Conclusions

- Viable Cover Crops:
  - Fairway crested wheatgrass
  - Canada mix
  - Cereal rye
  - Santiago burr medic
- Canada mix (drought-tolerant grasses) reduced weed growth without herbicides.
- Summer dormant characteristics reduced mowing requirements throughout the season.

Olmstead Conclusions - Legumes

- Established slowly and sparsely
- May offer an alternative for vineyards using micro- or overhead sprinklers

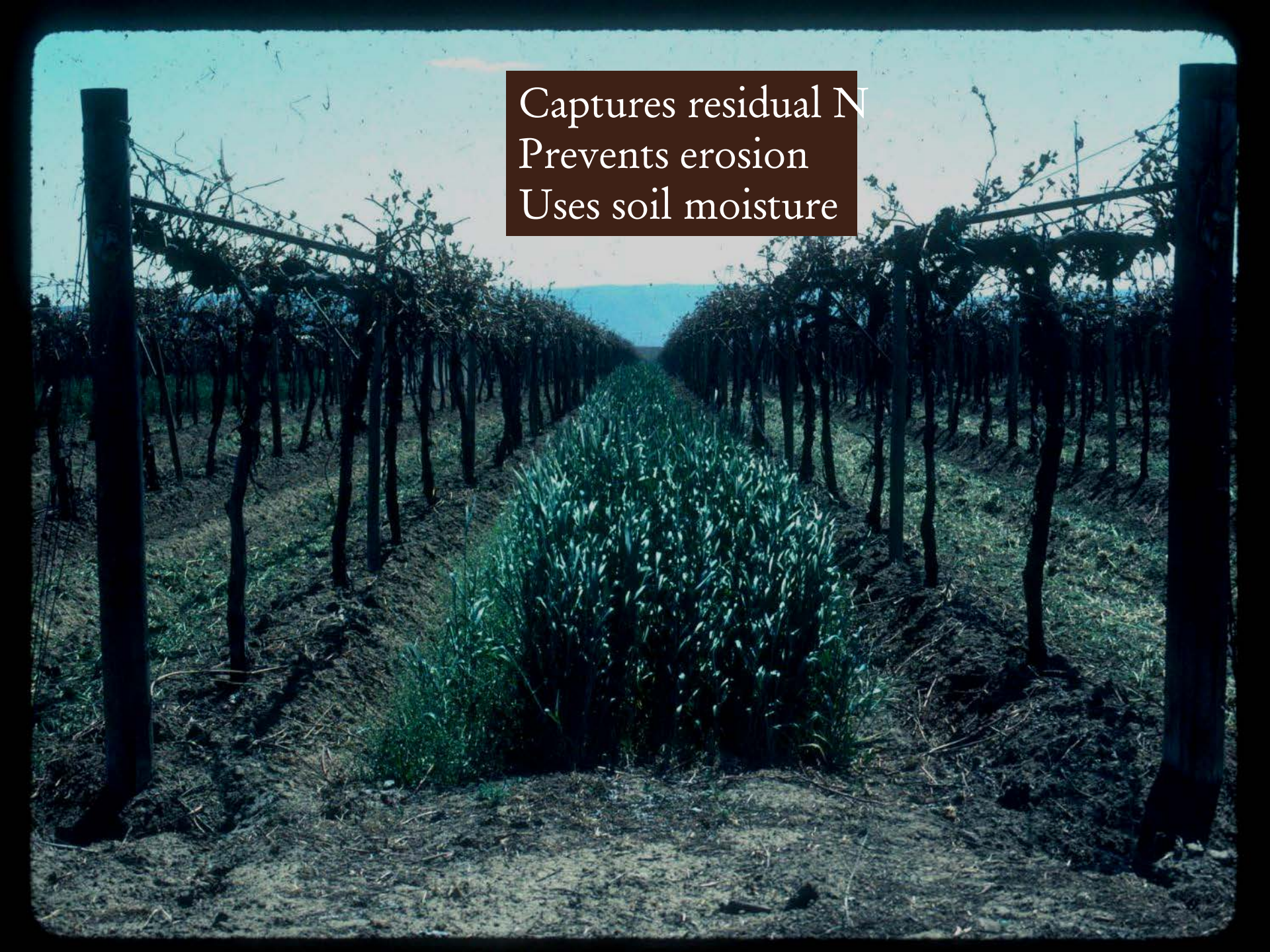
Photo by Allyson Leonhard

Bair Research

- Concord grape
- Legumes
  - Vetch
  - Yellow Sweet Clover
- Blood Meal
- Urea
- Control
- Organic and conventional vineyards

(small grains for last 3)

Materials


Captures residual N
Prevents erosion
Uses soil moisture

Cover Crops for N Supply

- Challenges
  - **Crop that will fix needed nitrogen**
  - **Nitrogen must meet crop timing**
    - **Biomass produced at appropriate time**
    - **Mineralization to release organic N to soil**
    - **Inorganic nitrogen uptake by vines**
  - **Cover crop must fit into vineyard management**

Cover Crops for N Supply

Legume	Lbs N/ac
Alfalfa	158-230
Hairy Vetch	133-211
Red Clover	163-229
Sweet Clover	238

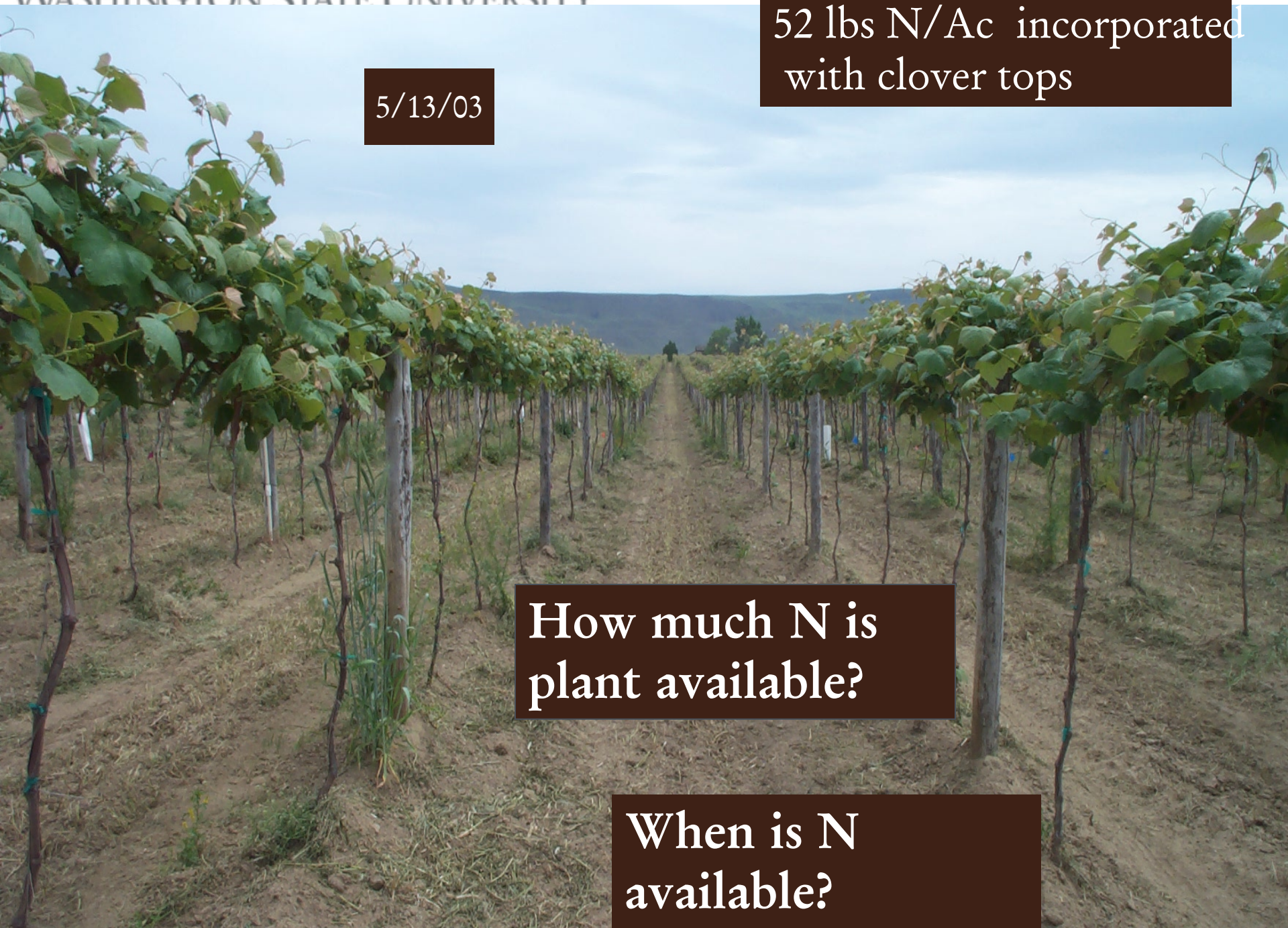
Cover Crops for N Supply

- Research approach
  - Compare sweet clover and hairy vetch
  - Compare fall and spring planting
  - Compare N availability to soluble N
  - Compare N availability to inorganic N


5/13/03


5/13/03
52 lbs N/Ac incorporated with clover tops


52 lbs N/Ac incorporated with clover tops
5/13/03
How much N is plant available?


52 lbs N/Ac incorporated with clover tops
5/13/03
How much N is plant available?
When is N available?

Treatment*	Commercial Vineyard	Research Vineyard
Control (0 N fertilizer)		√
112 kg N ha^{-1} (Blood meal)	√	
112 kg N ha^{-1} (Conventional)		√
Yellow Sweet Clover[1]	√	√
Yellow Sweet Clover[2]	√	
Hairy Vetch[1]	√	√
Hairy Vetch[2]	√	
Hairy Vetch[3]	√	

[1] Fall plant
[2] Spring plant
[3] Half fall plant, half spring plant
* All treatments incorporated at bloom (late spring)

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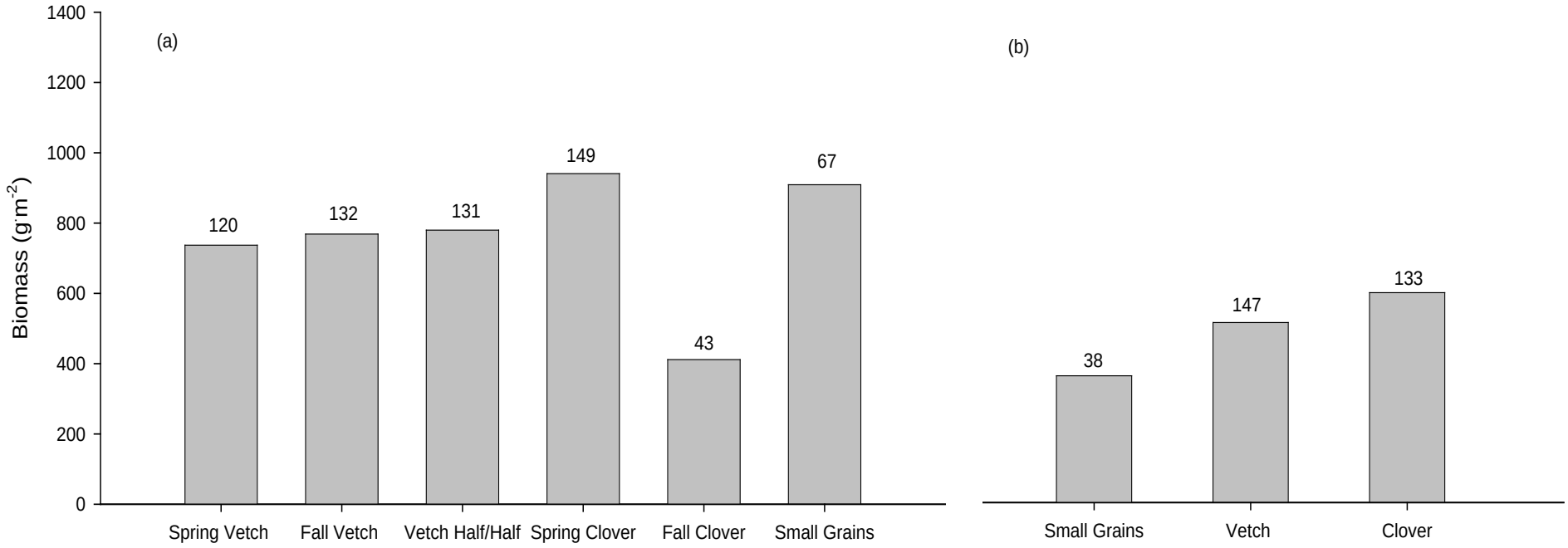
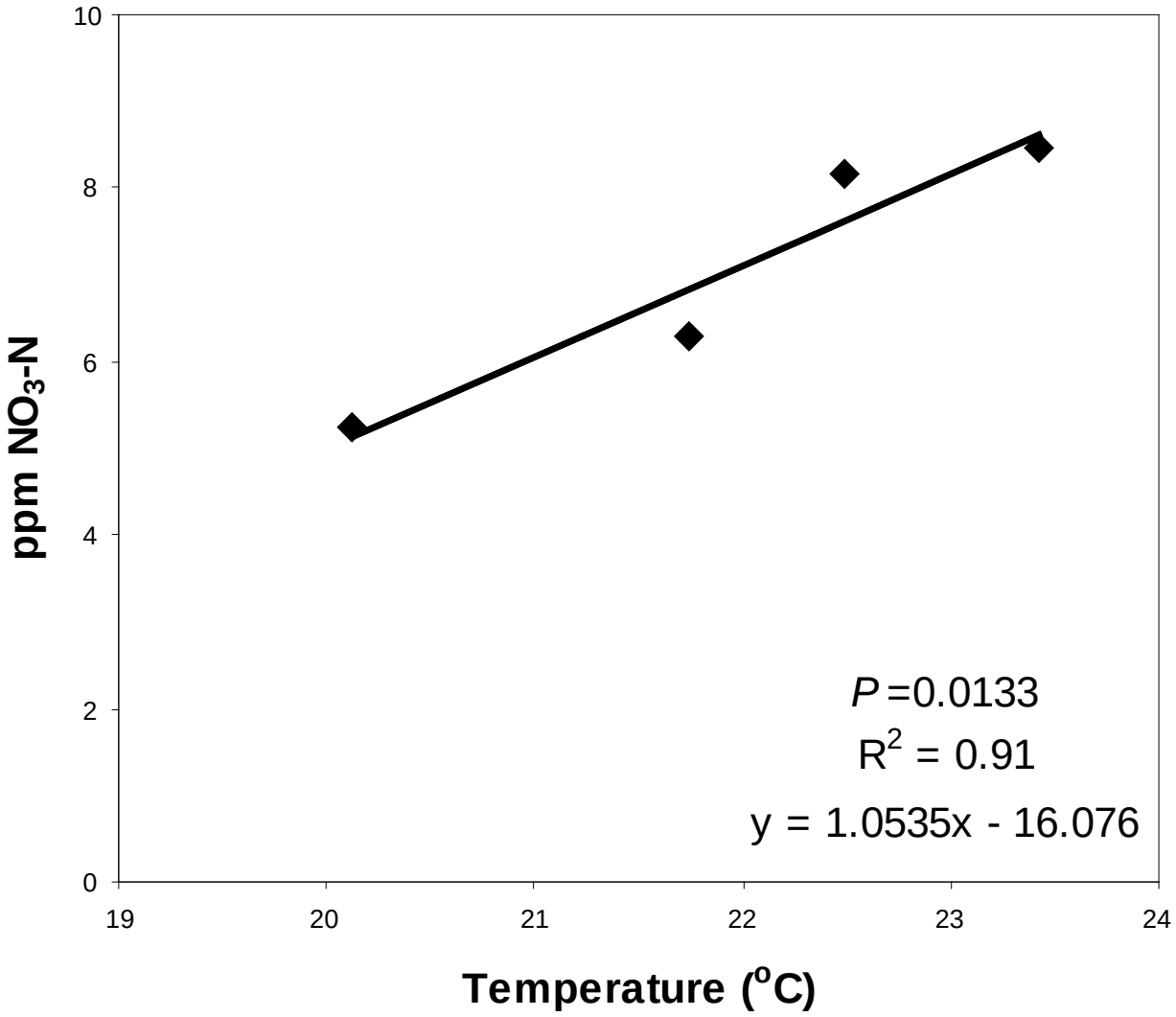
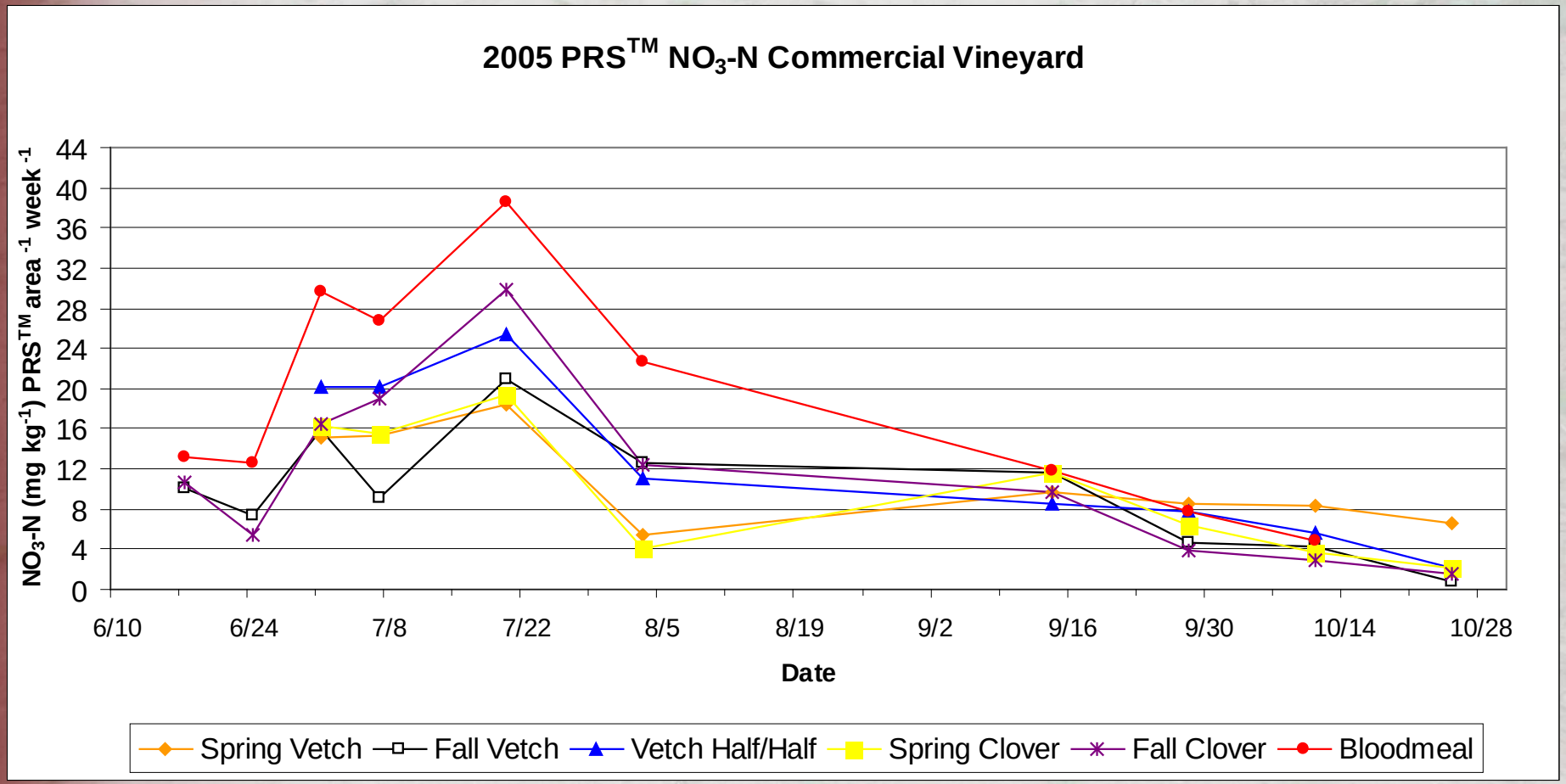
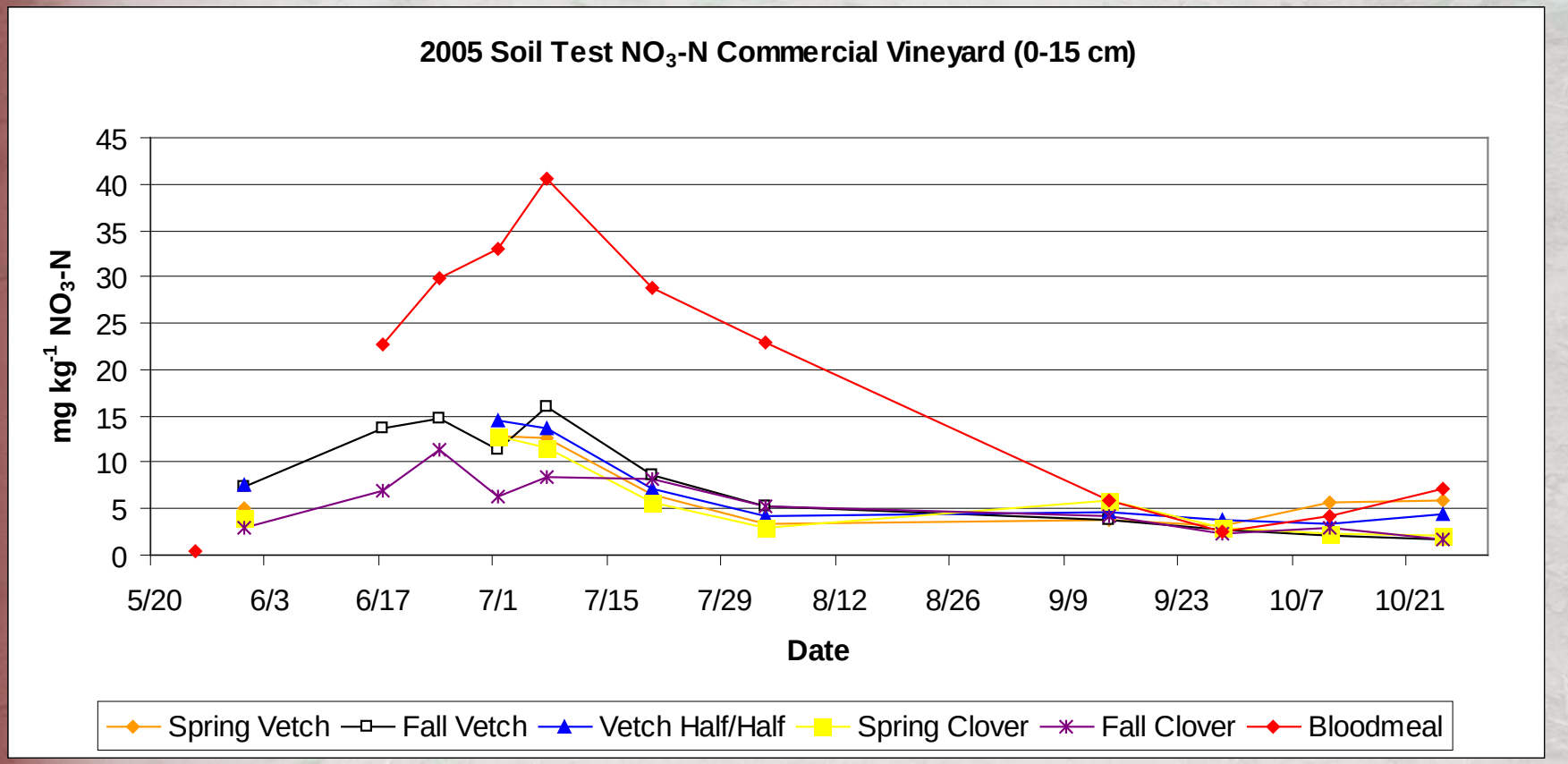
Growth of Fall Planted

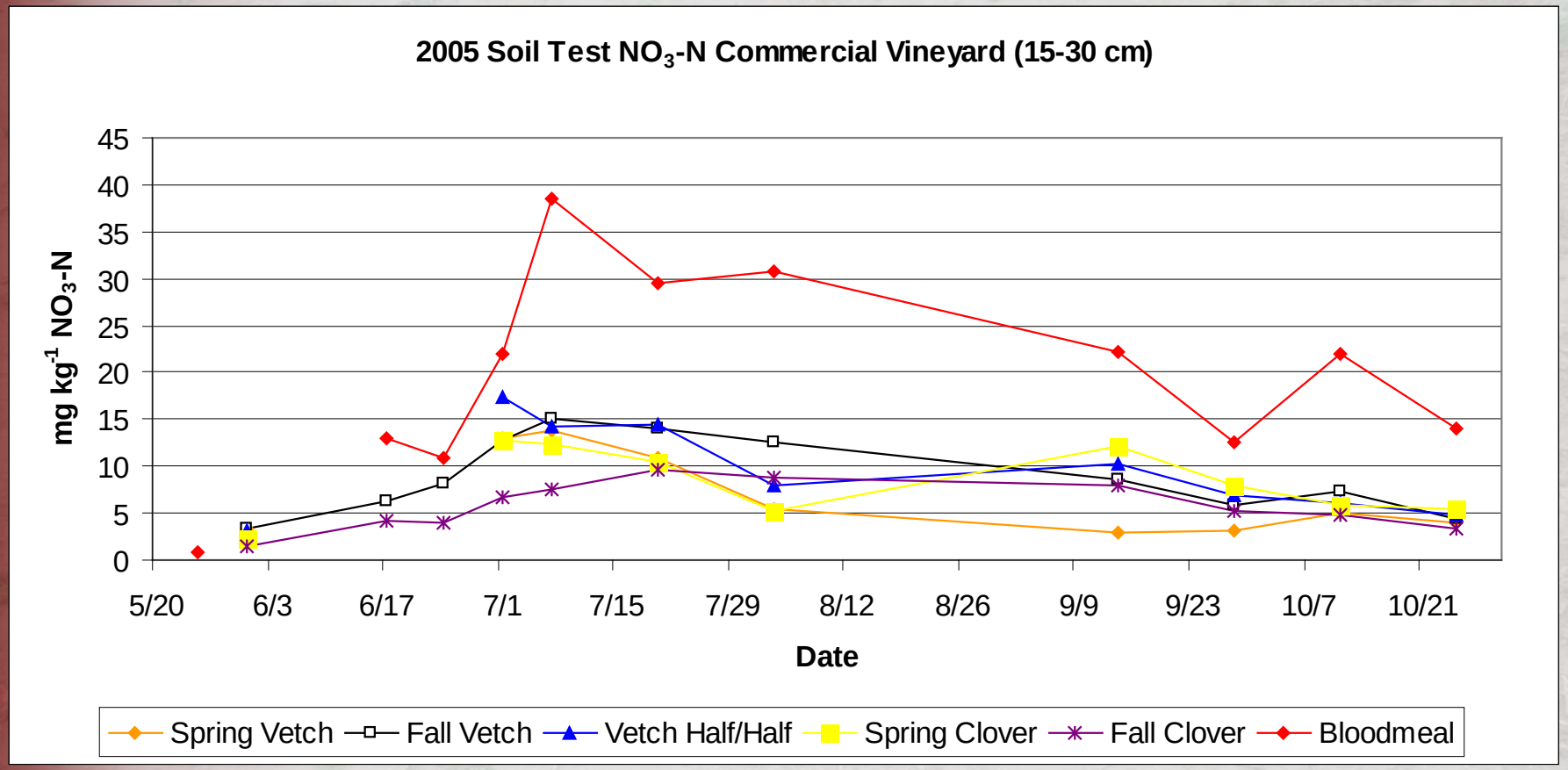
Results - Biomass

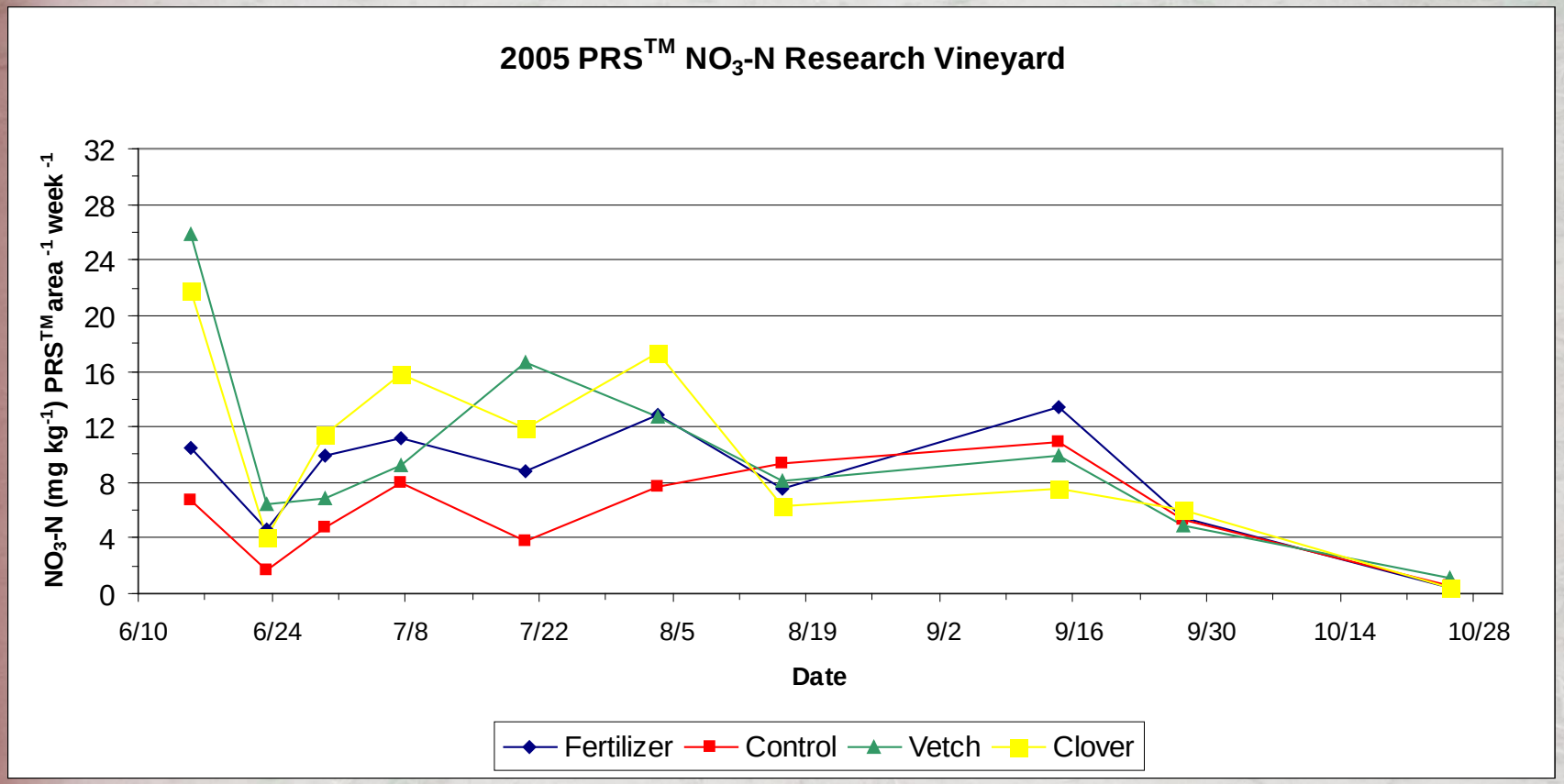


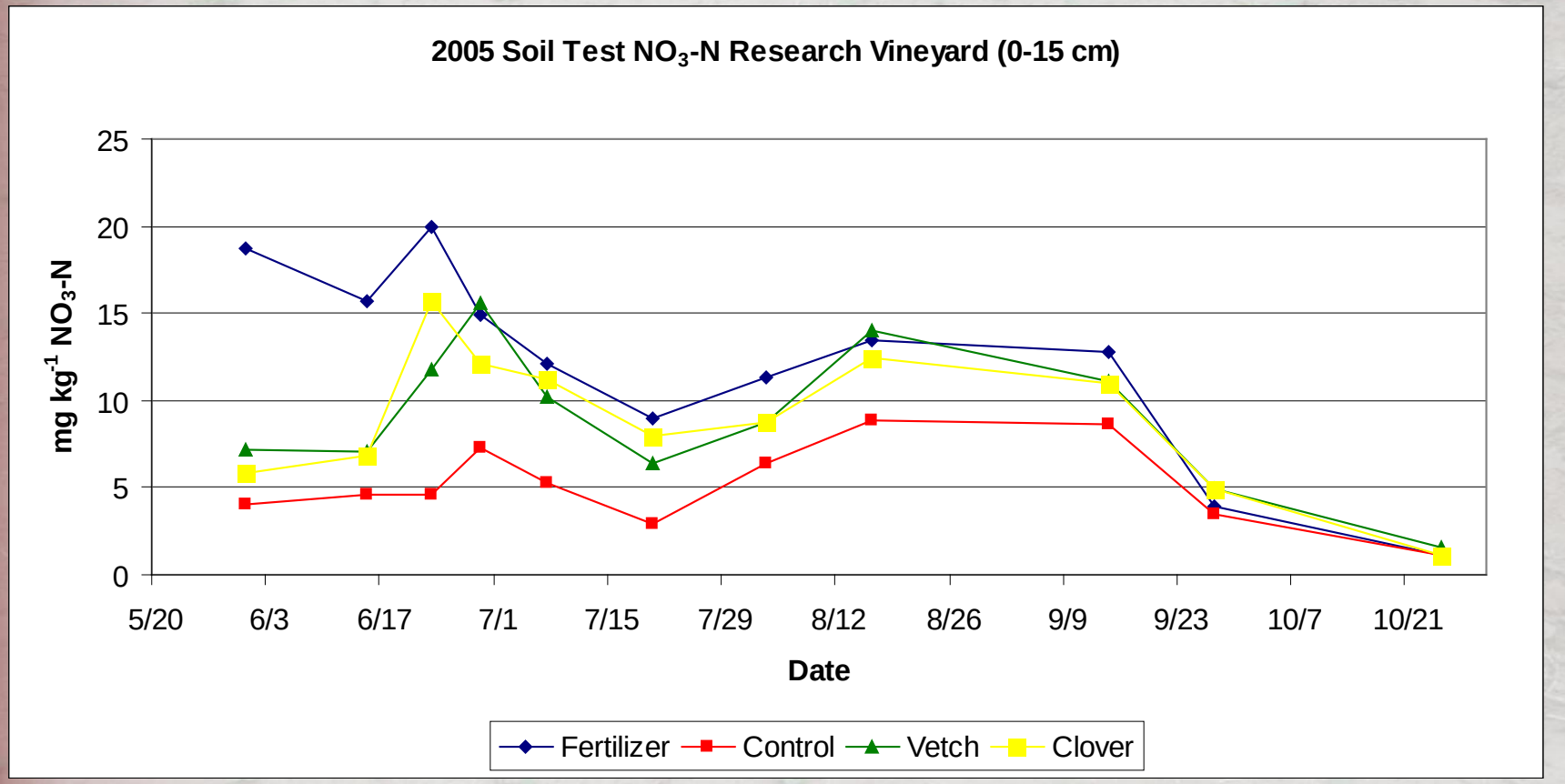

10
8
6
4
2
0
ppm NO3-N
19
20
21
22
23
24
Temperature (°C)
P =0.0133
R2 = 0.91
y = 1.0535x - 16.076

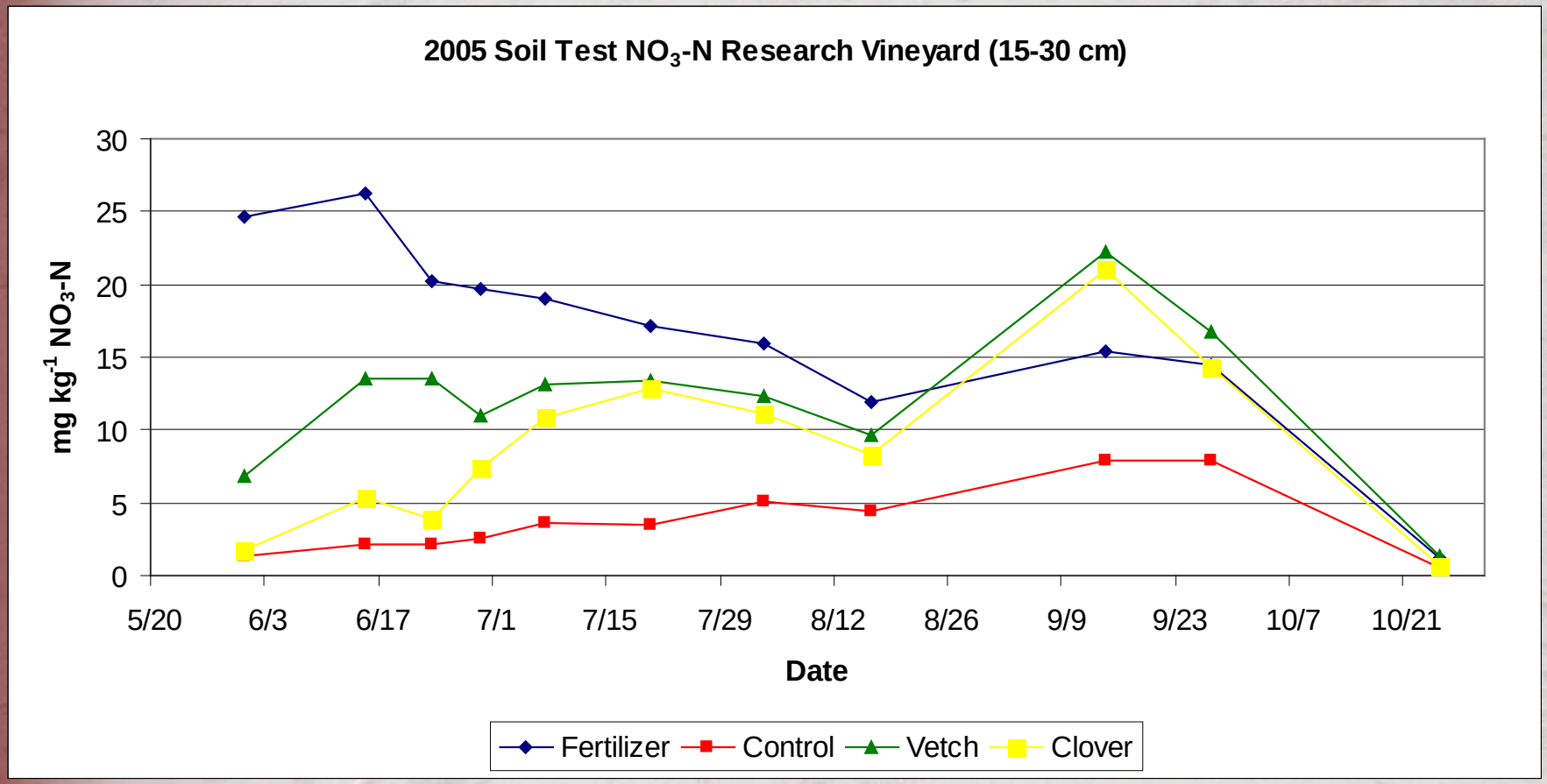

2005 PRS™ NO3-N Commercial Vineyard
NO3-N (mg kg-1) PRS™ area -1 week -1
0
4
8
12
16
20
24
28
32
36
40
44
6/10
6/24
7/8
7/22
8/5
8/19
9/2
9/16
9/30
10/14
10/28
Date
Spring Vetch
Fall Vetch
Vetch Half/Half
Spring Clover
Fall Clover
Bloodmeal


2005 Soil Test NO3-N Commercial Vineyard (0-15 cm)
mg kg-1 NO3-N
45
40
35
30
25
20
15
10
5
0
5/20
6/3
6/17
7/1
7/15
7/29
8/12
8/26
9/9
9/23
10/7
10/21
Date
Spring Vetch
Fall Vetch
Vetch Half/Half
Spring Clover
Fall Clover
Bloodmeal


2005 Soil Test NO3-N Commercial Vineyard (15-30 cm)
mg kg-1 NO3-N
45
40
35
30
25
20
15
10
5
0
5/20
6/3
6/17
7/1
7/15
7/29
8/12
8/26
9/9
9/23
10/7
10/21
Date
Spring Vetch
Fall Vetch
Vetch Half/Half
Spring Clover
Fall Clover
Bloodmeal


2005 PRS™ NO3-N Research Vineyard
NO3-N (mg kg-1) PRS™ area -1 week -1
32
28
24
20
16
12
8
4
0
6/10
6/24
7/8
7/22
8/5
8/19
9/2
9/16
9/30
10/14
10/28
Date
Fertilizer
Control
Vetch
Clover


2005 Soil Test NO3-N Research Vineyard (0-15 cm)
mg kg-1 NO3-N
25
20
15
10
5
0
5/20
6/3
6/17
7/1
7/15
7/29
8/12
8/26
9/9
9/23
10/7
10/21
Date
Fertilizer
Control
Vetch
Clover


2005 Soil Test NO3-N Research Vineyard (15-30 cm)
mg kg-1 NO3-N
30
25
20
15
10
5
0
5/20
6/3
6/17
7/1
7/15
7/29
8/12
8/26
9/9
9/23
10/7
10/21
Date
Fertilizer
Control
Vetch
Clover

Total N Contributions

Vineyard	Cover	N Generated
1	Small Grain	27
1	Fall Vetch	130
1	Fall Clover	118
2	Small Grains	60
2	Fall Vetch	118
2	Fall Clover	37
2	Spring Vetch	107
2	Spring Clover	133
2	Vetch Half&Half	117

Summary

- Leguminous cover crops can supply adequate N
- N release coincides with plant demand
- Development of adequate stand is critical
- Larger seed size and fall planting are advantageous

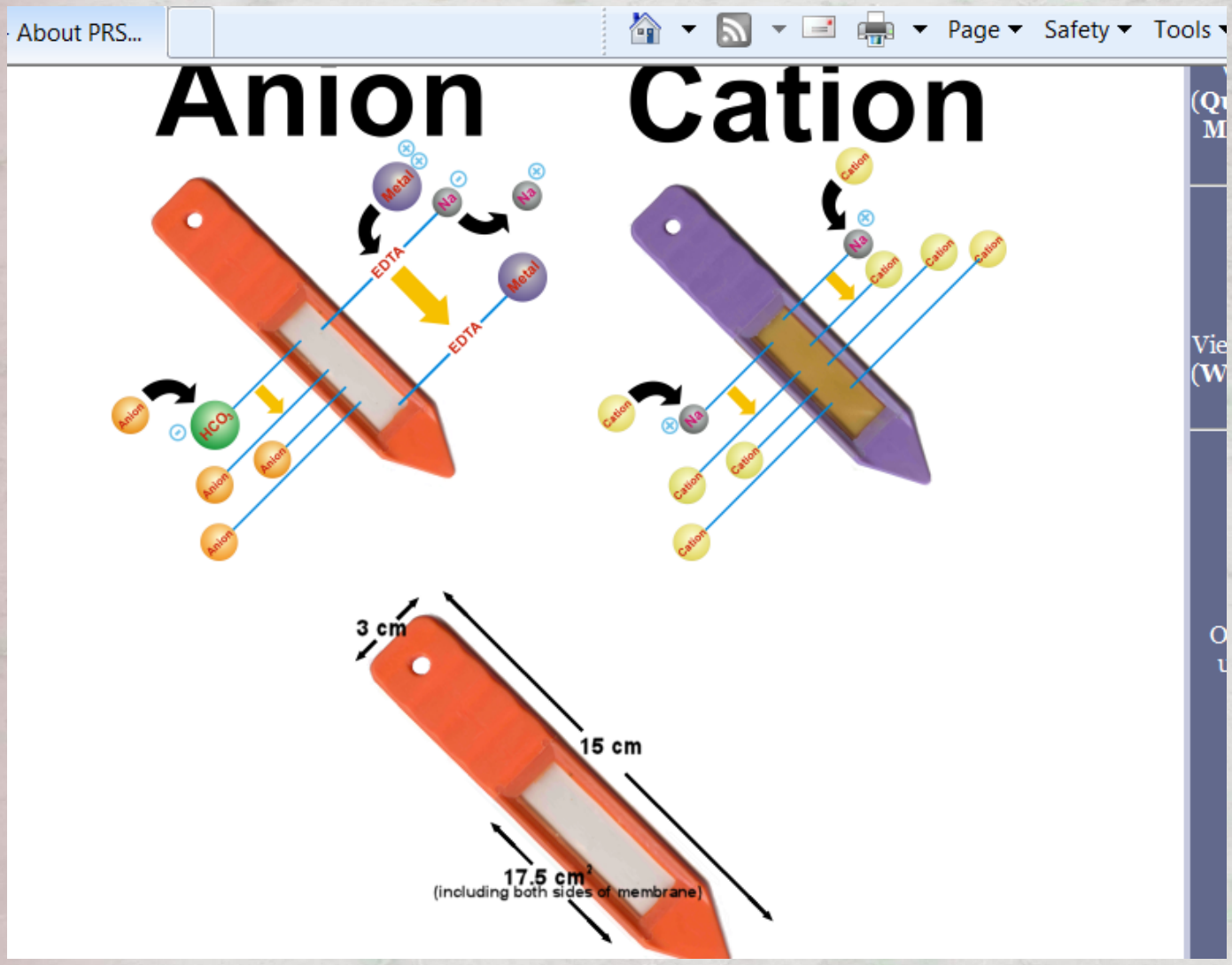
GROW YOUR NITROGEN

References

- Bair, K. E., J. R. Davenport, and R. G. Stevens. 2008. Release of Available Nitrogen Following Incorporation of a Legume Cover Crop in Concord Grape. HortScience43: 875 – 880.
- Davenport, J. R., K. E. Bair, and R. G. Stevens. 2011. The Relationship Between Soil Temperature and N Release in Organic and Conventionally Managed Vineyards. Commun. Soil Sci. Plant Anal: In Press
- Olmstead,M.A., R.L. Wample, S.L. Greene, and J.M. Tarara. 2001. Evaluation of Potential Cover Crops for Inland Pacific Northwest Vineyards Am. J. Enol. Vit. 54:292-303.

Tree Fruit or Vines

- Legumes can work in perennial fruit crops
- Choice of material matters
- Establishment
- Competition
- Complete for Concord with annual tillage
- Half for Apple with mow and blow
- OH Sprinkler likely better than drip


About PRS...
Page
Safety
Tools
Anion
Cation
Metal
Na
EDTA
Anion
HCO_3
Cation
3 cm
15 cm
17.5 cm^2
(including both sides of membrane)

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