Characterization of the Root Zone of Introduced Switchgrass Growing in Soil from an Historic Brine Scar

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Historic Brine Scar in Tallgrass Prairie Preserve

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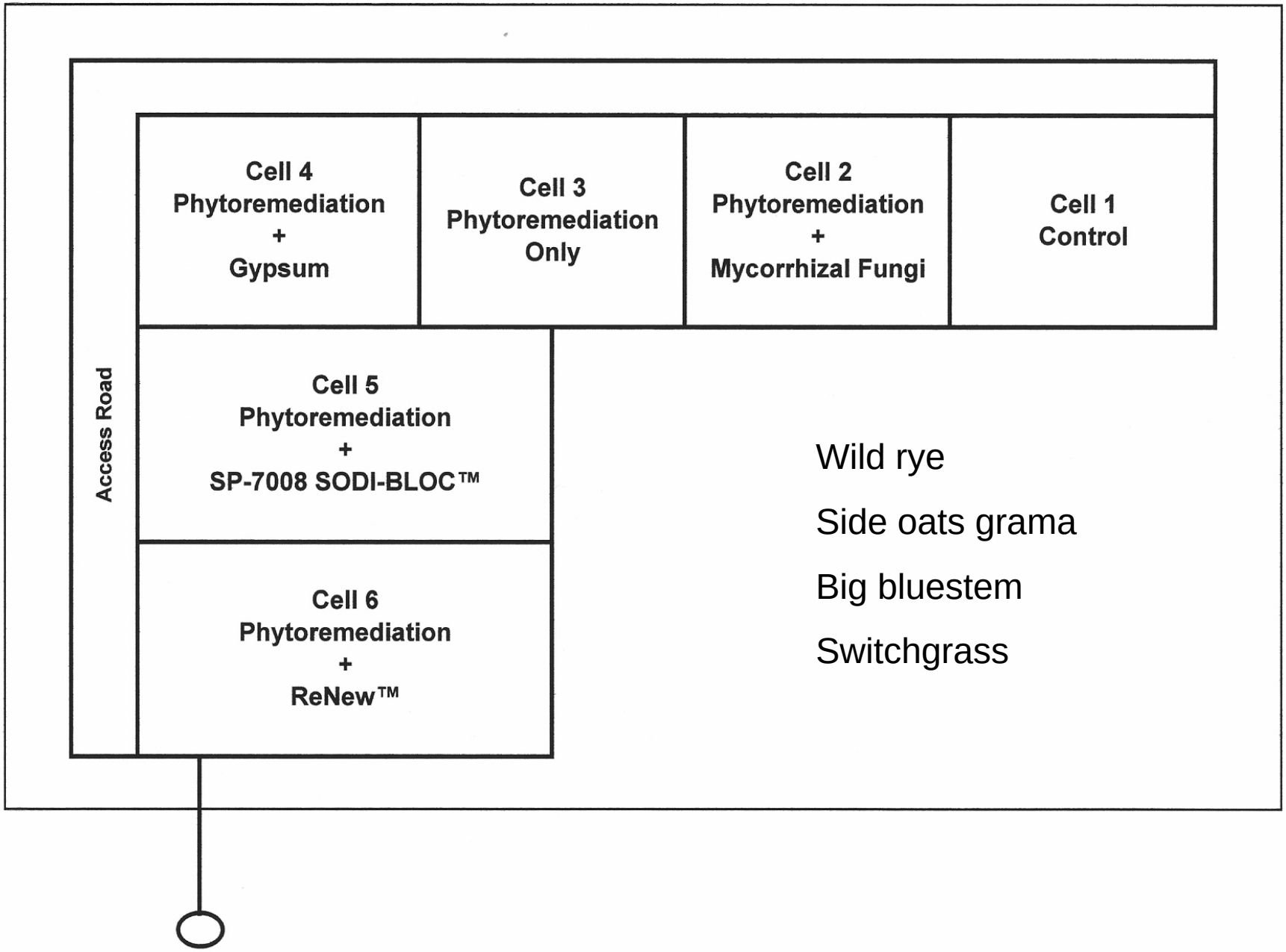
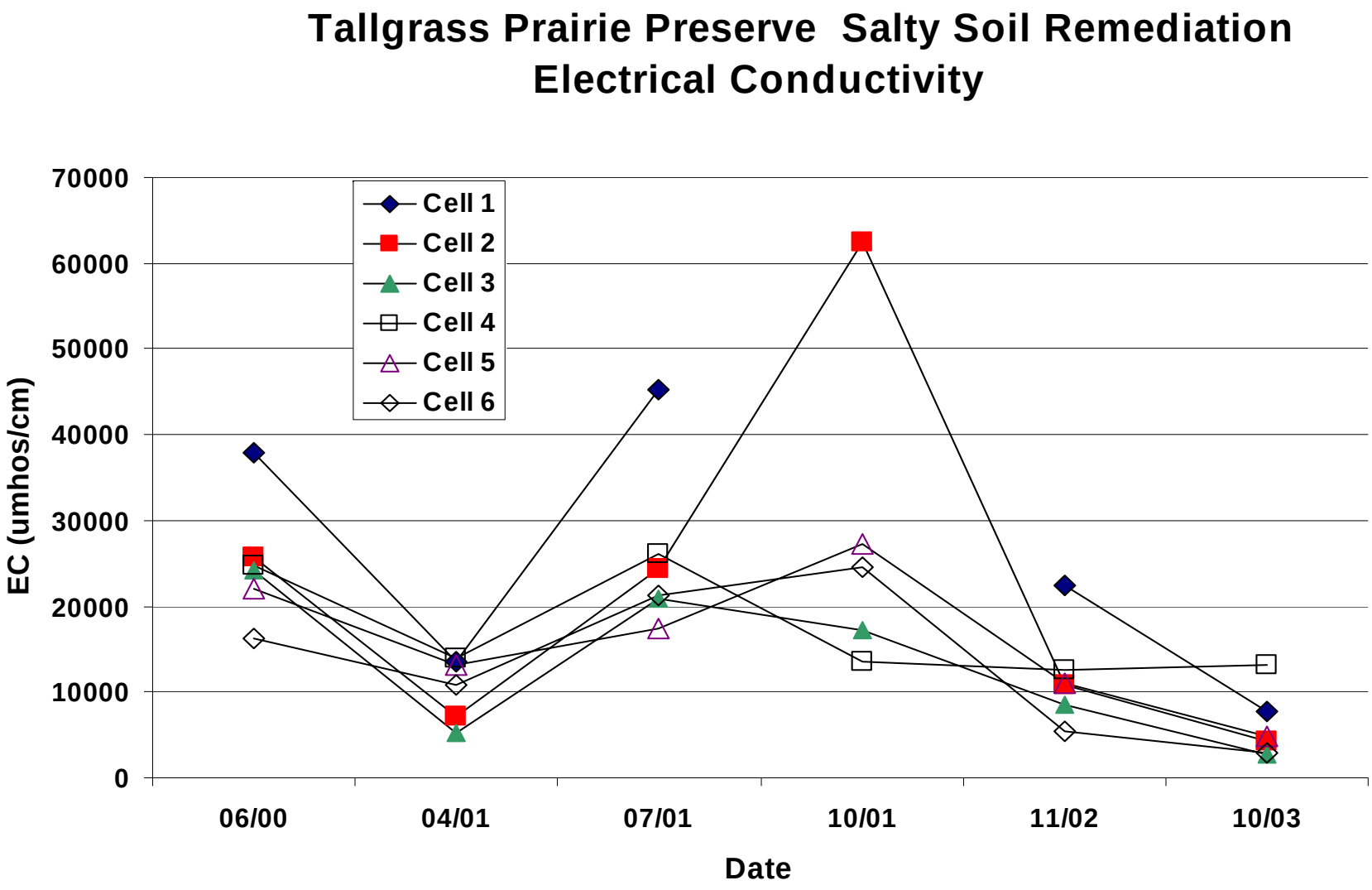
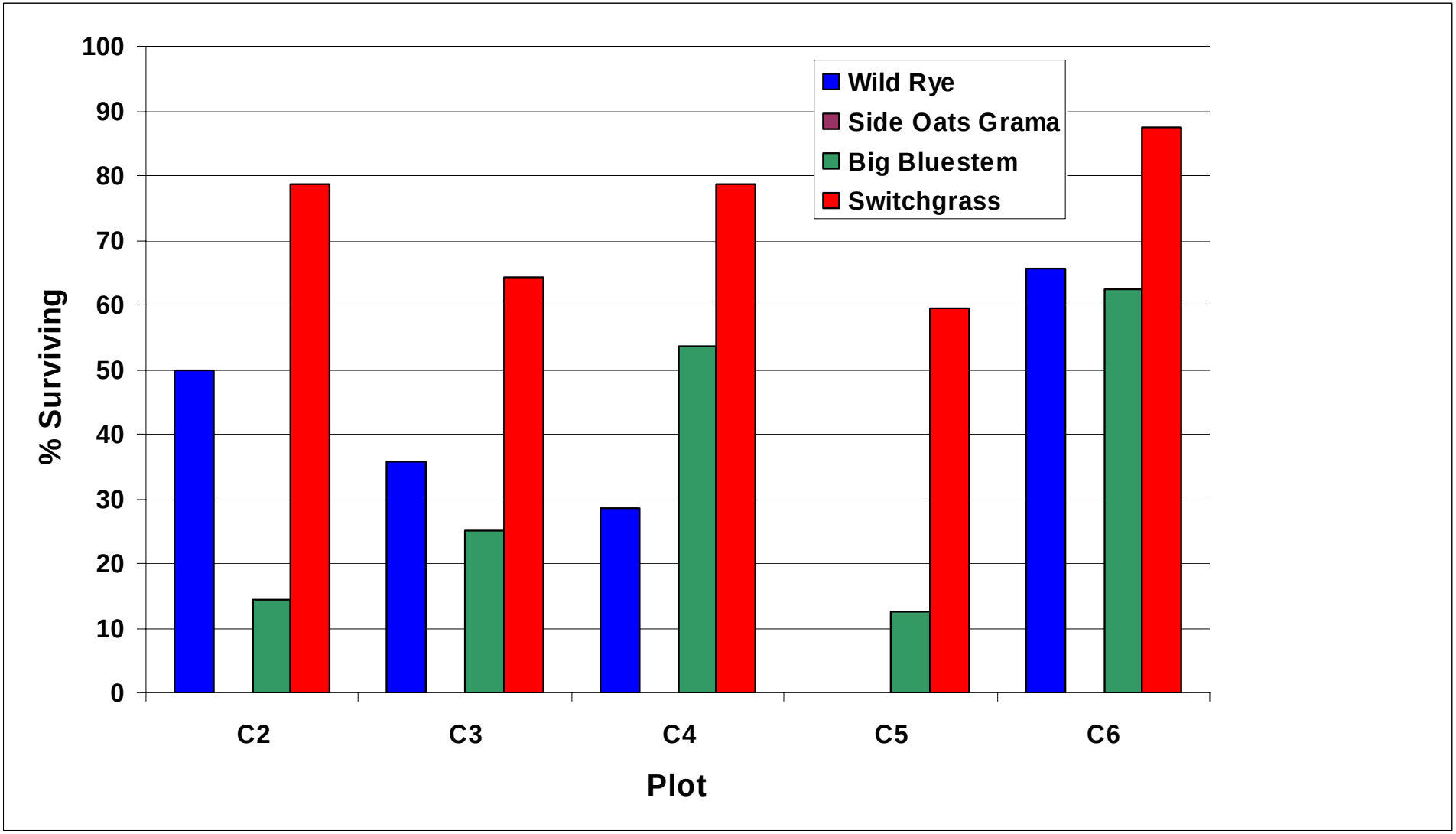
Tallgrass Prairie Preserve Salty Soil Remediation
Cell Layout





No statistically significant difference in treatments (2-6) in terms of reduction in electrical conductivity.

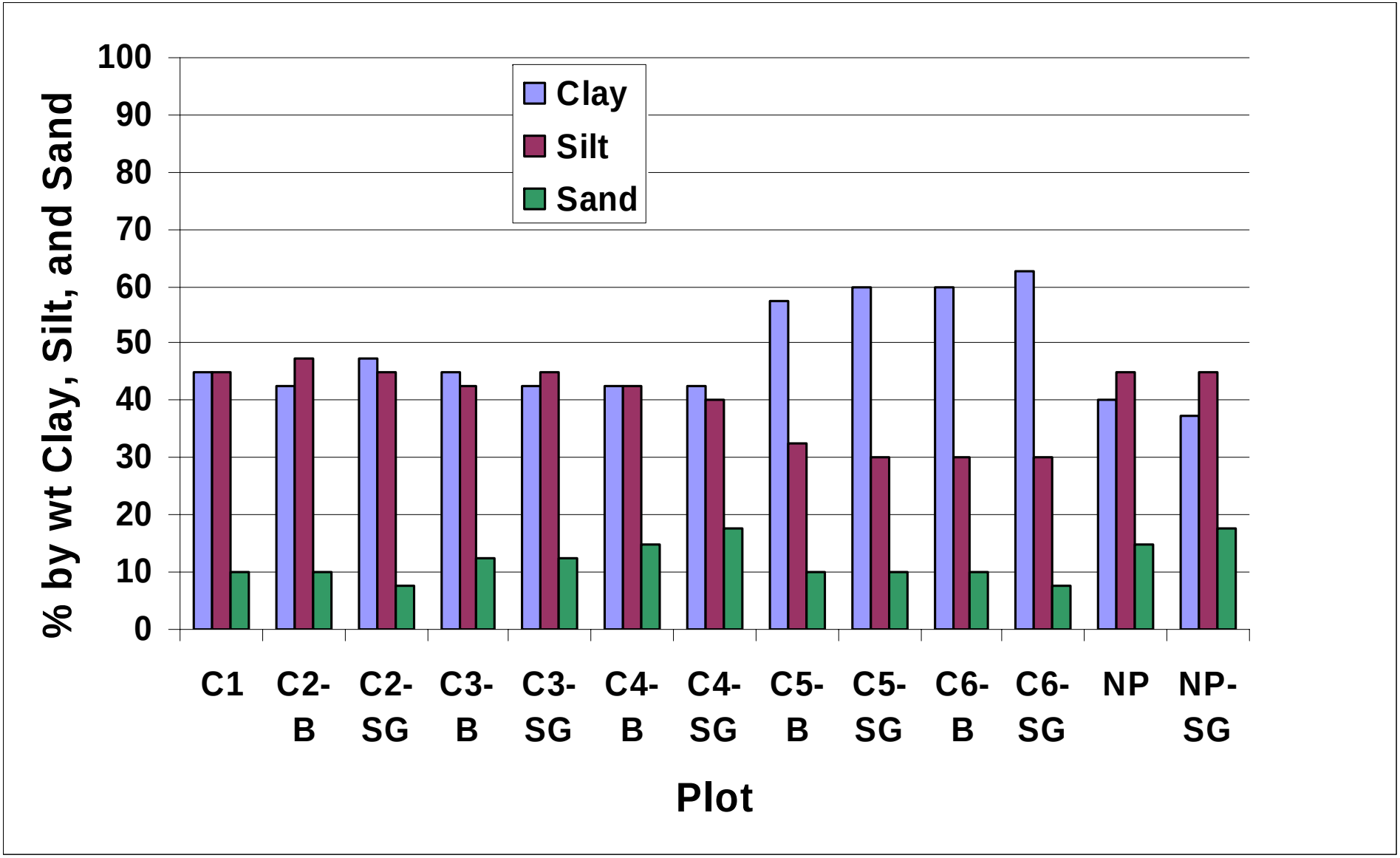
One-year Survival of Plants Introduced June 2002



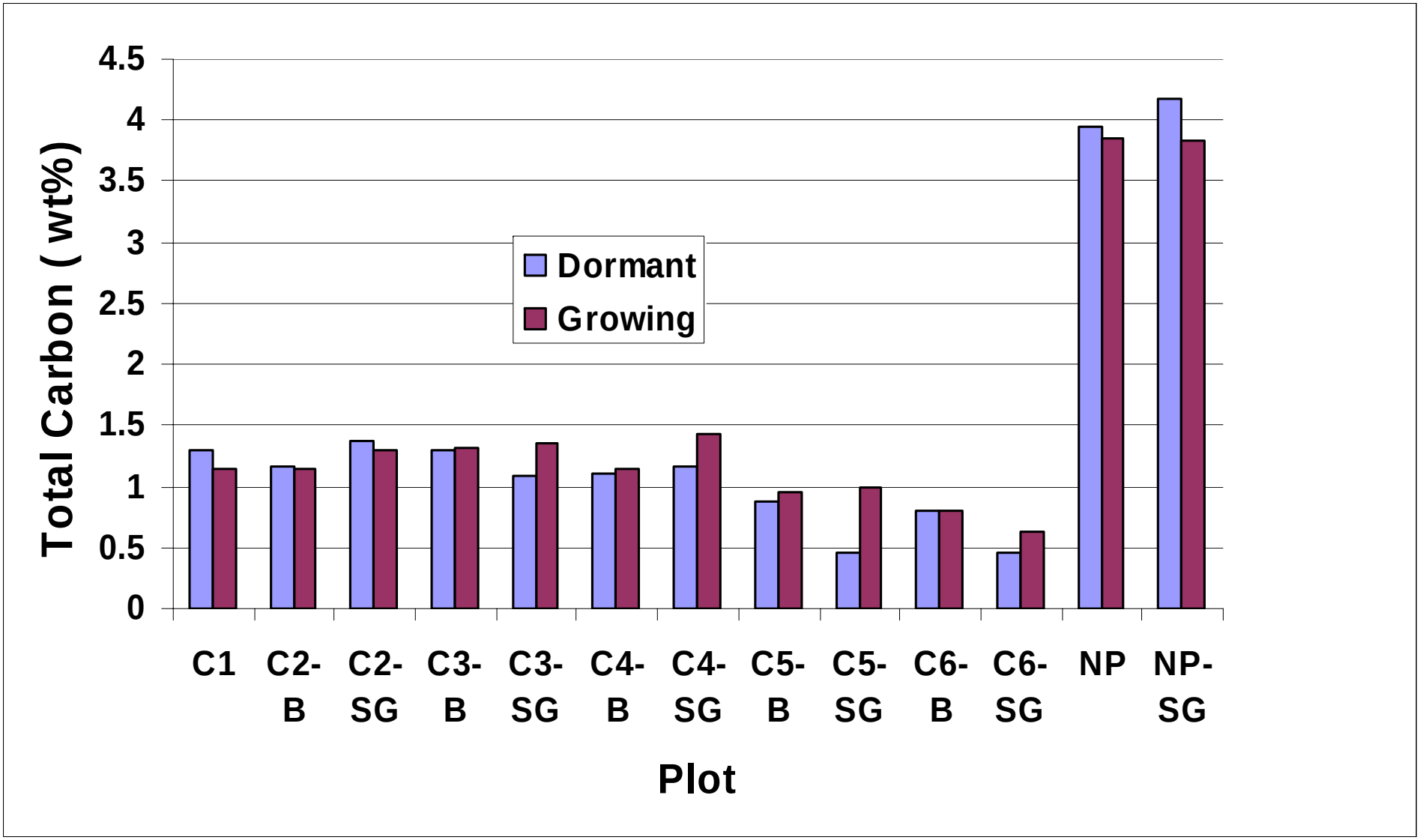
Switchgrass had best one-year survival; C6 treatment increased survival of big bluestem and wild rye.

Investigation of Switchgrass Root Zone

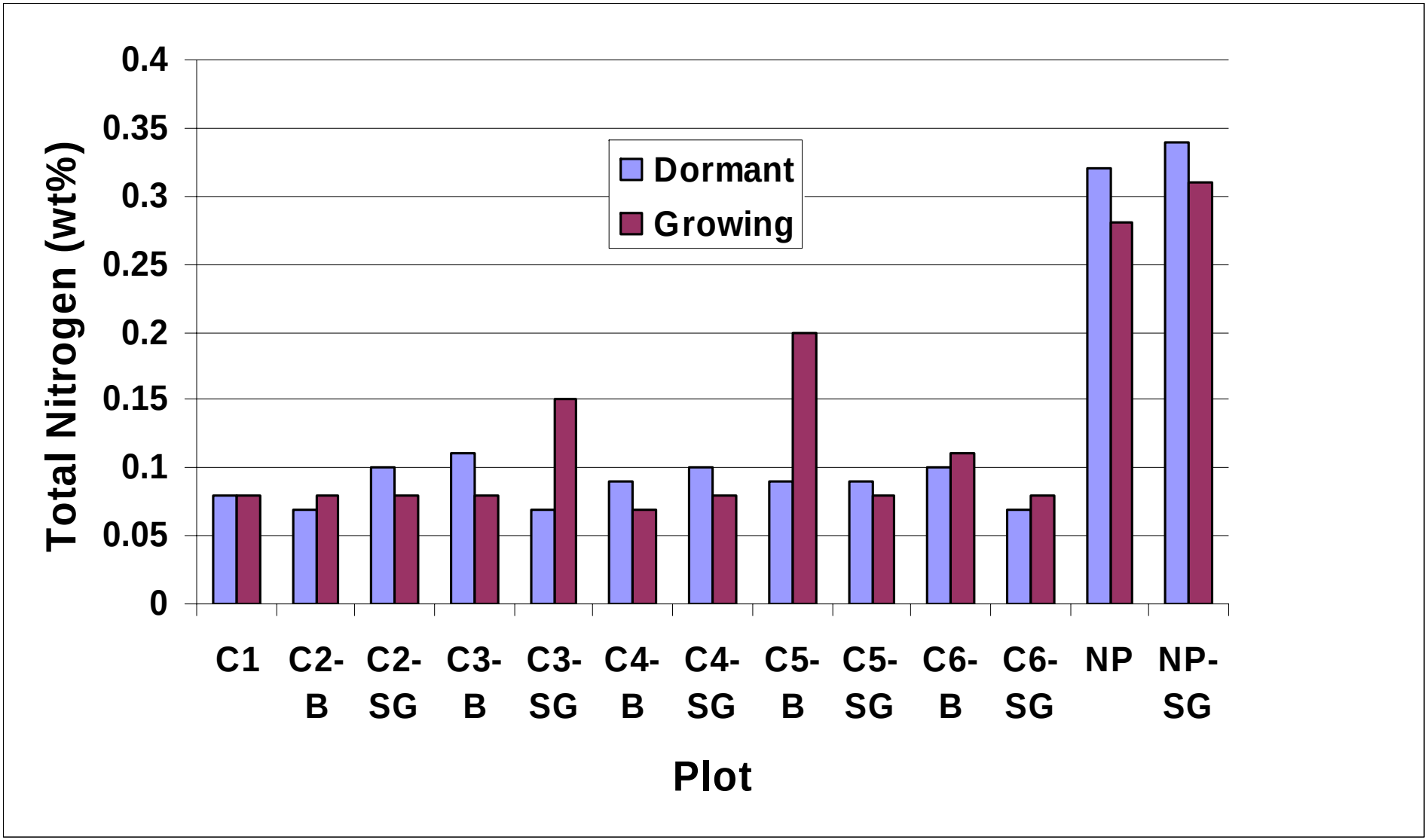
- Sampling
  - 0-15 cm interval
  - Between plant rows (bare) and around plant roots
  - February 2004 (Dormant)
  - July 2004 (Growing)
- Analyses
  - Nutrients
  - Texture
  - pH
  - PLFA
  - Mycorrhizal fungal spores (Dormant only)
  - Brine components
  - Fungal community structure (Fungilog)



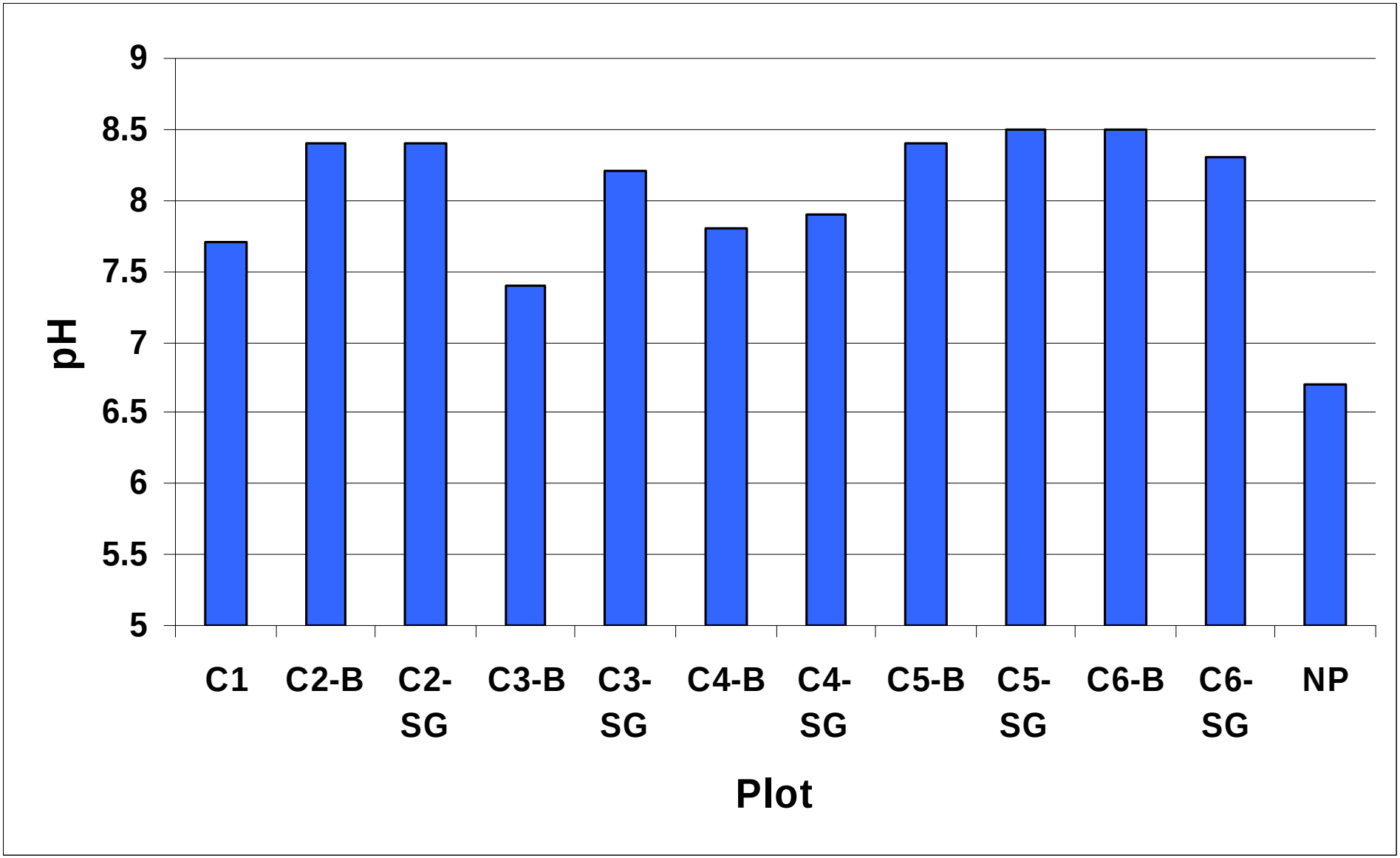
C5 and C6 are 60% clay



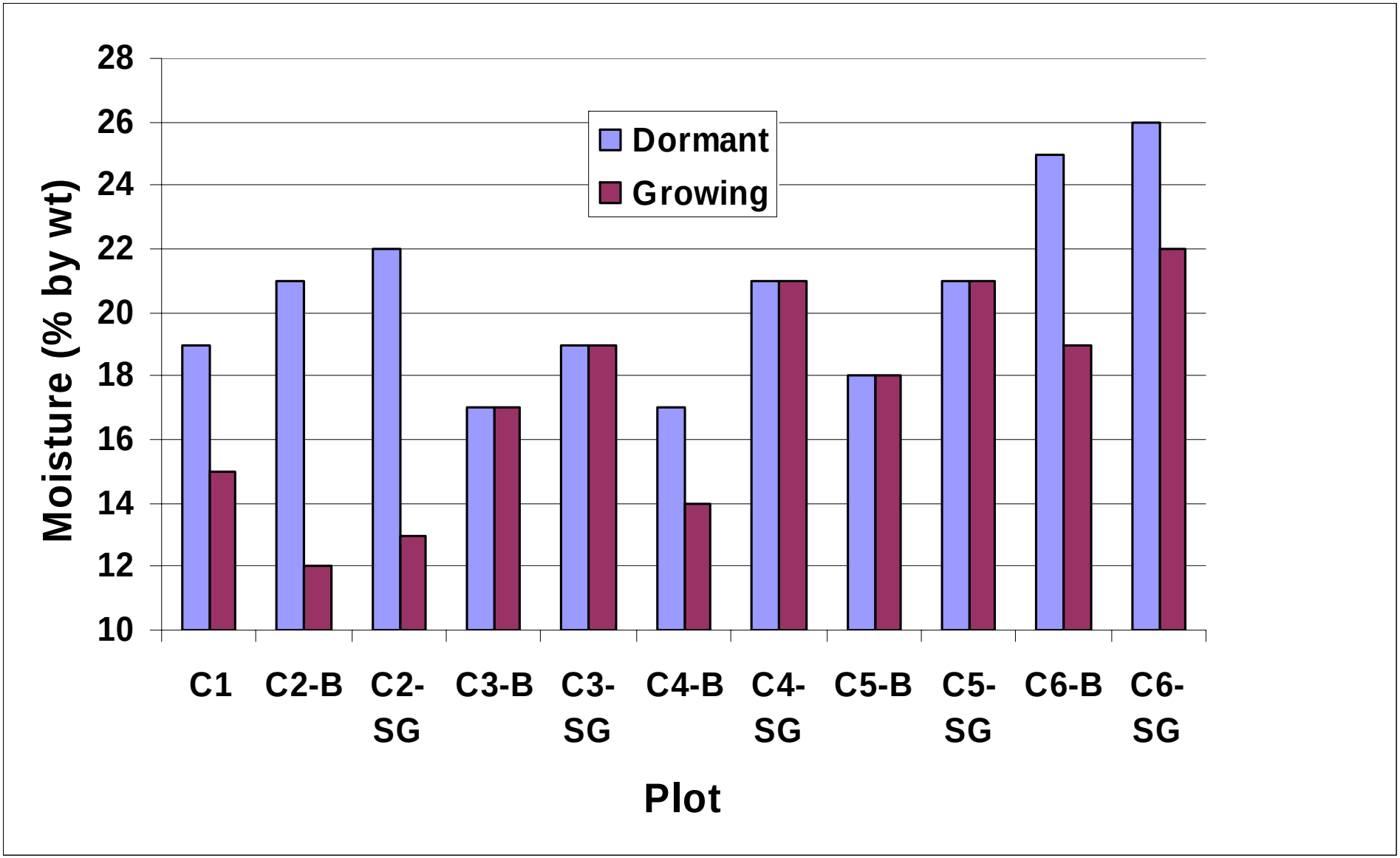
All plots are deficient in organic carbon relative to the native prairie.



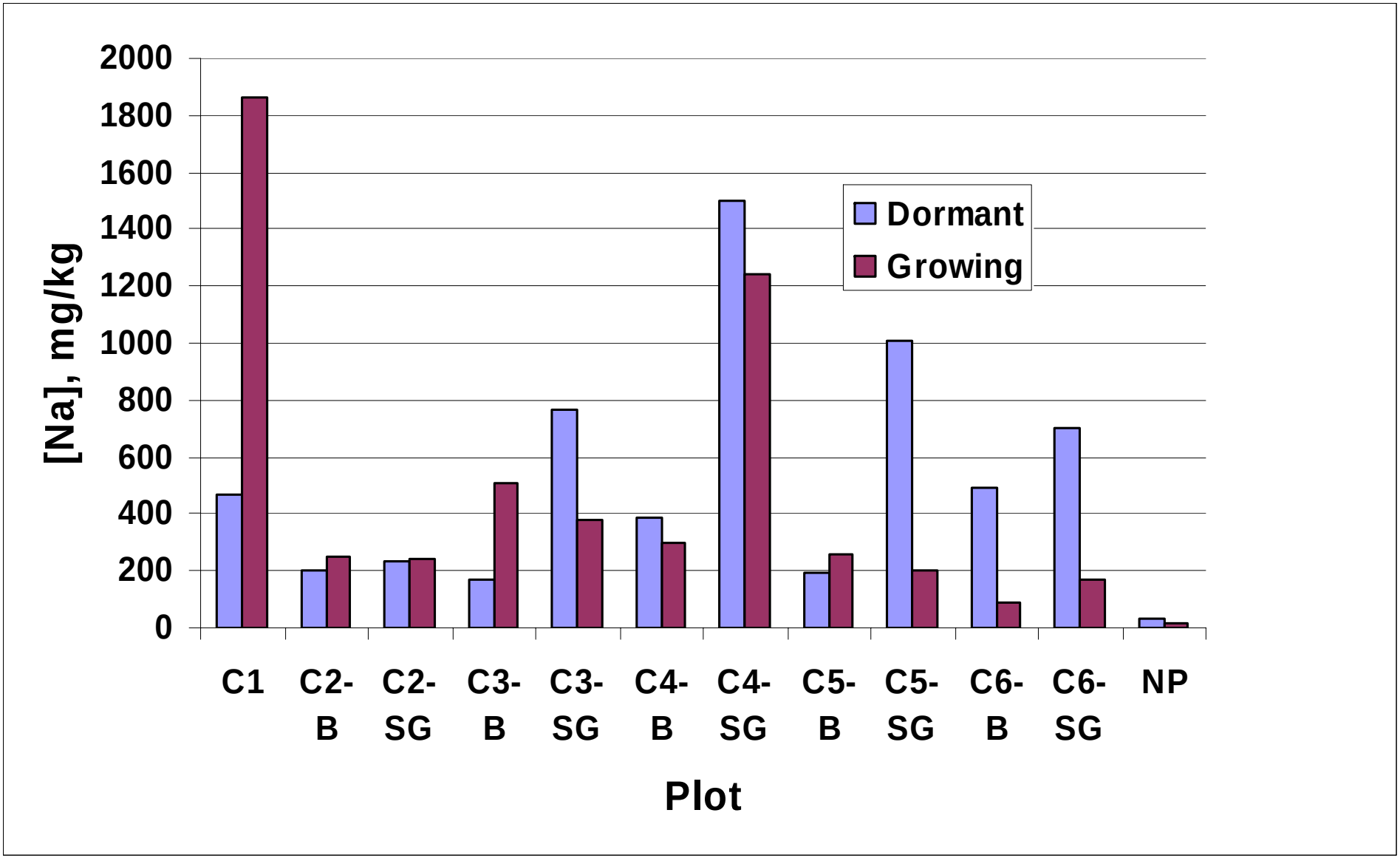
All plots are also deficient in organic nitrogen relative to the native prairie.

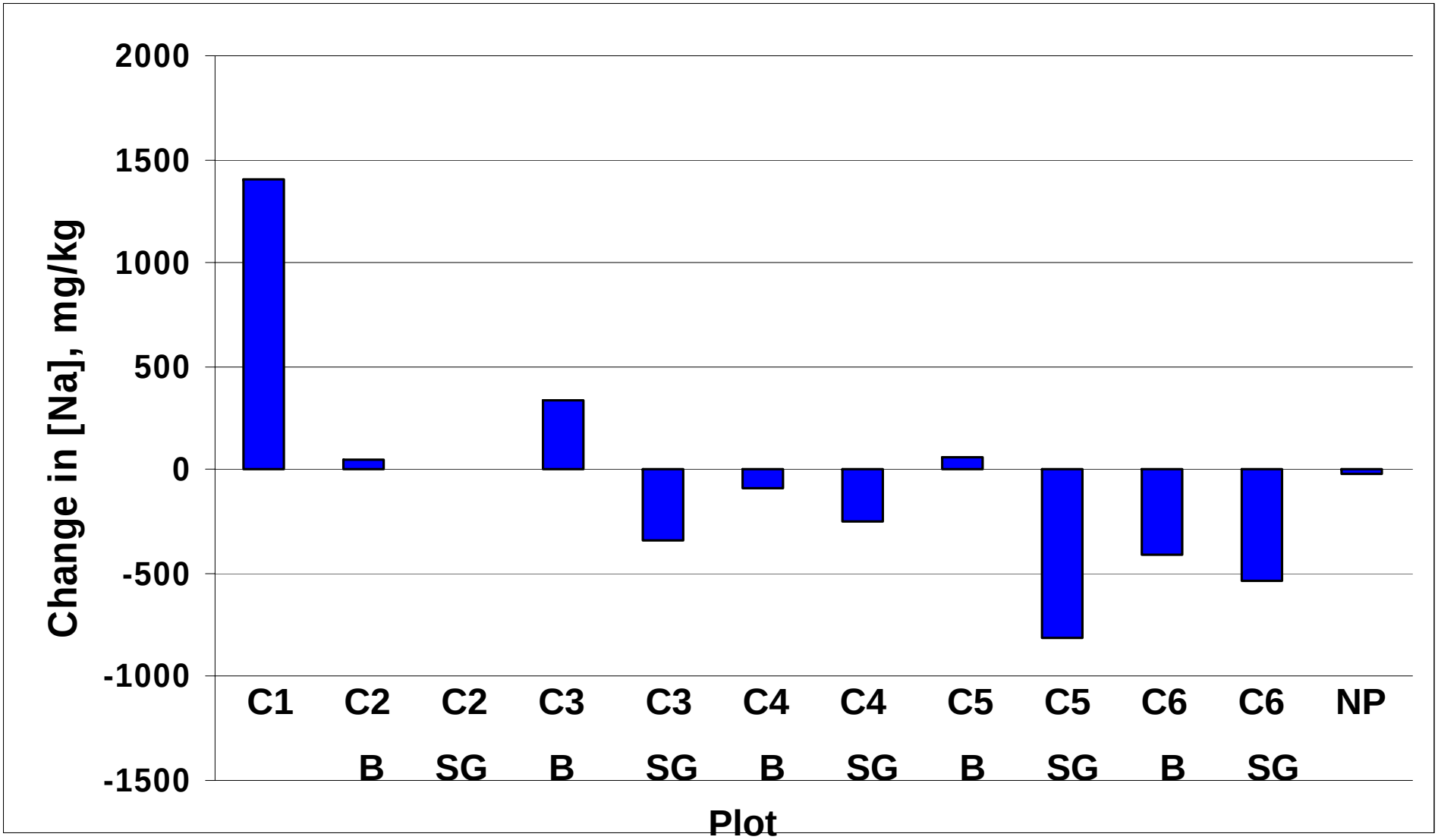


All plots are more alkaline than native prairie

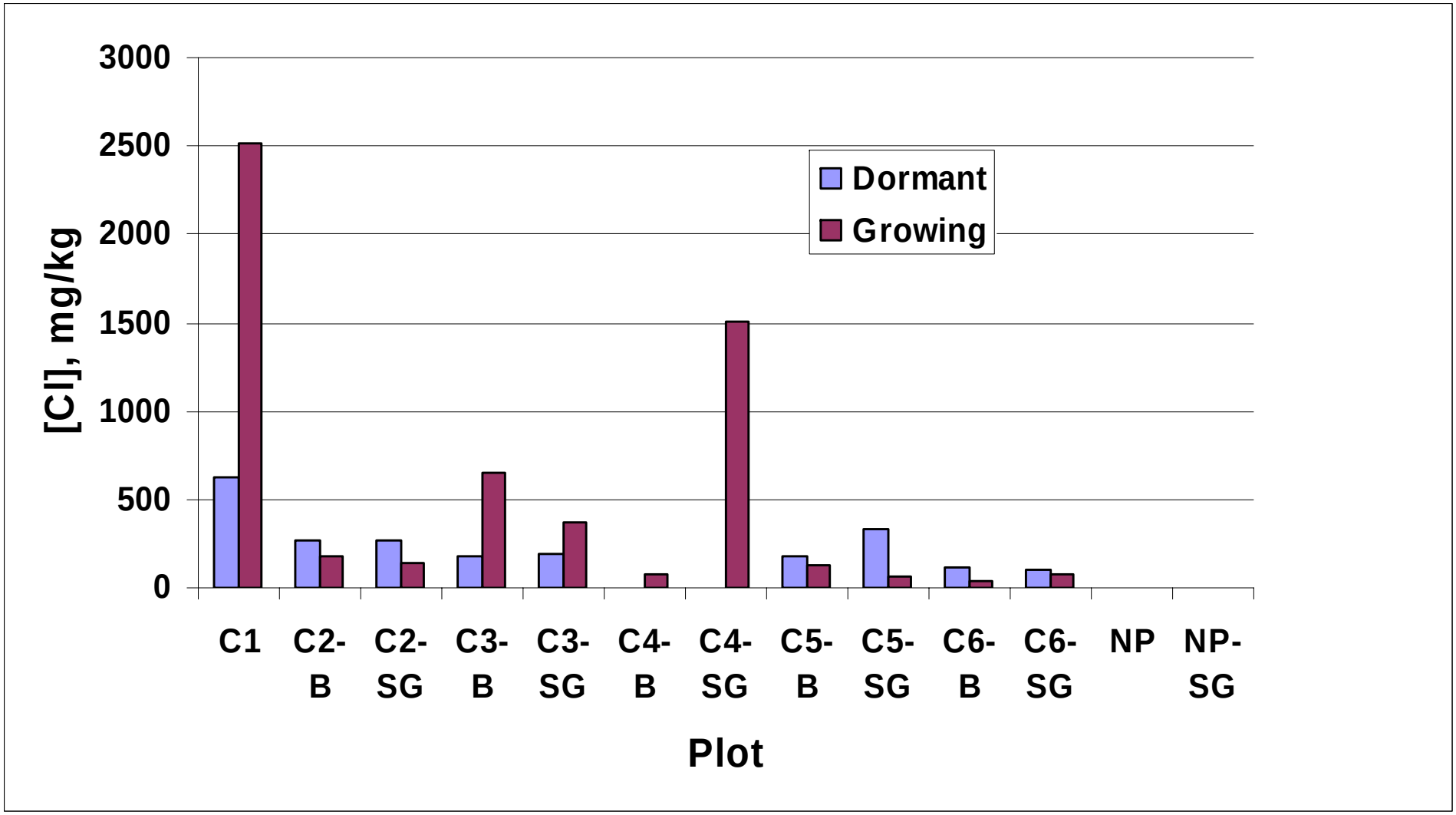


Consistently higher soil moistures in the switchgrass root zone compared to bare soil.

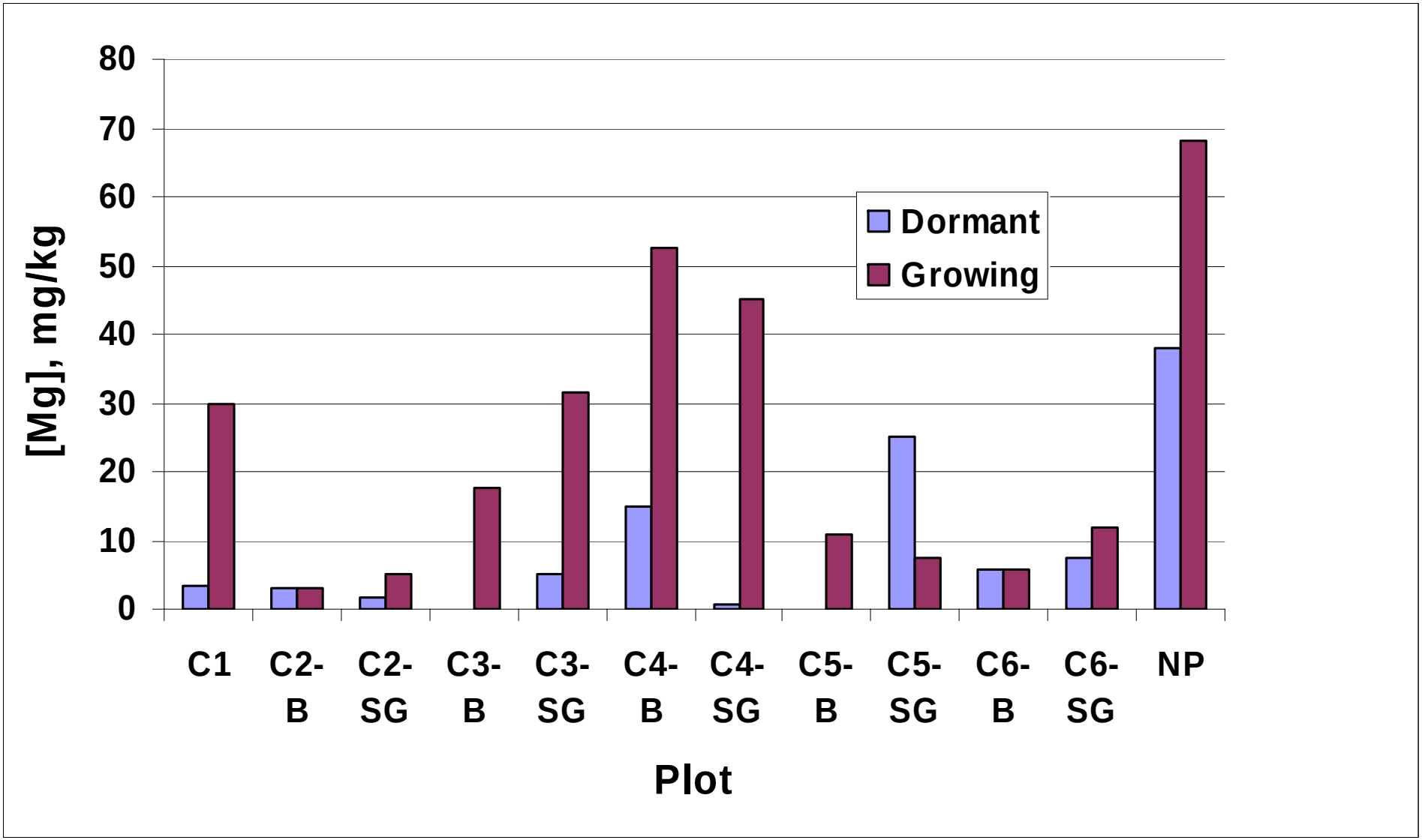

2000
1800
1600
1400
1200
1000
800
600
400
200
0
[Na], mg/kg
Dormant
Growing
C1
C2-B
C2-SG
C3-B
C3-SG
C4-B
C4-SG
C5-B
C5-SG
C6-B
C6-SG
NP
Plot



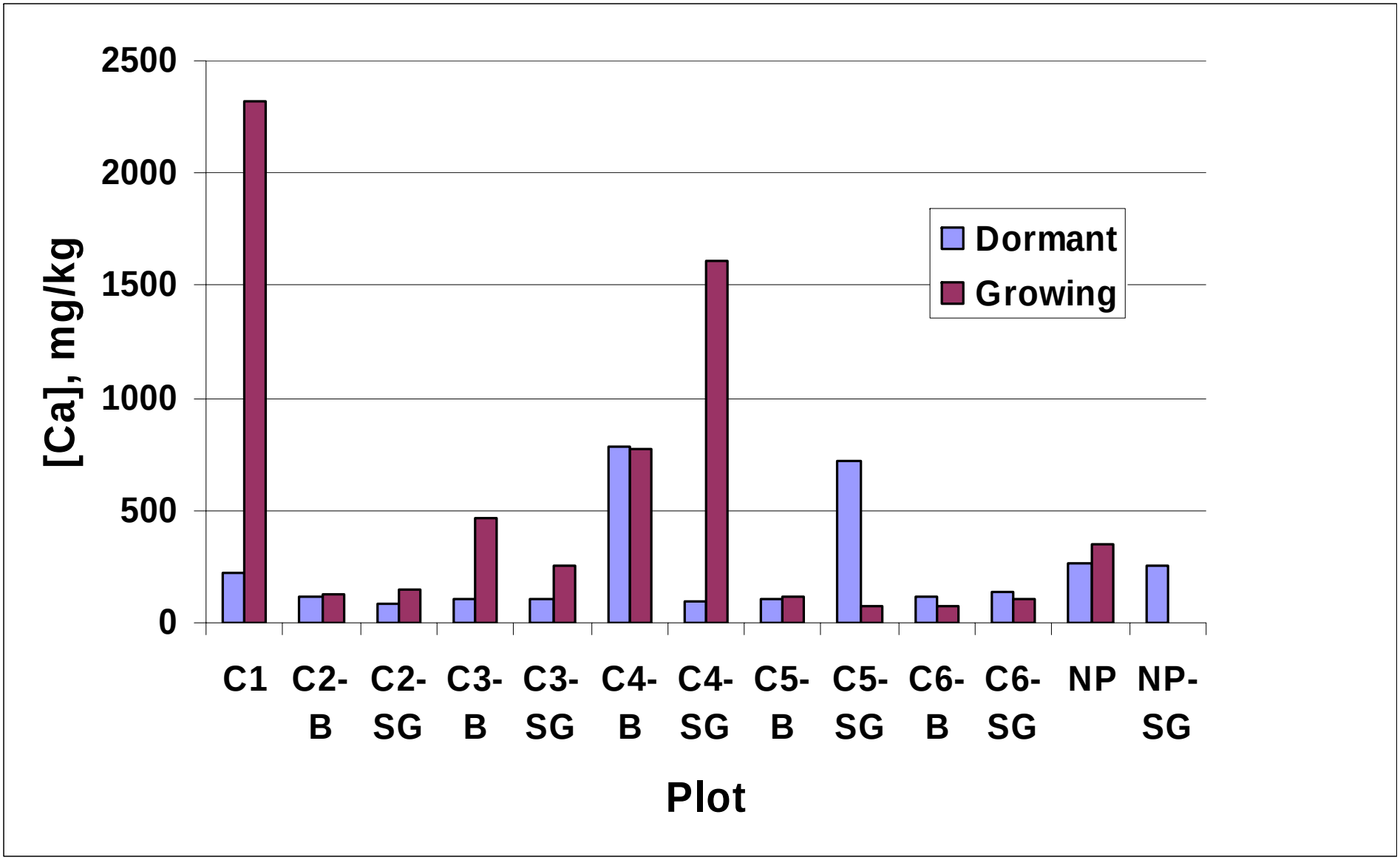
Greater reductions in Na^+ concentrations between Feb. and July were seen in the root zone of the switchgrass.



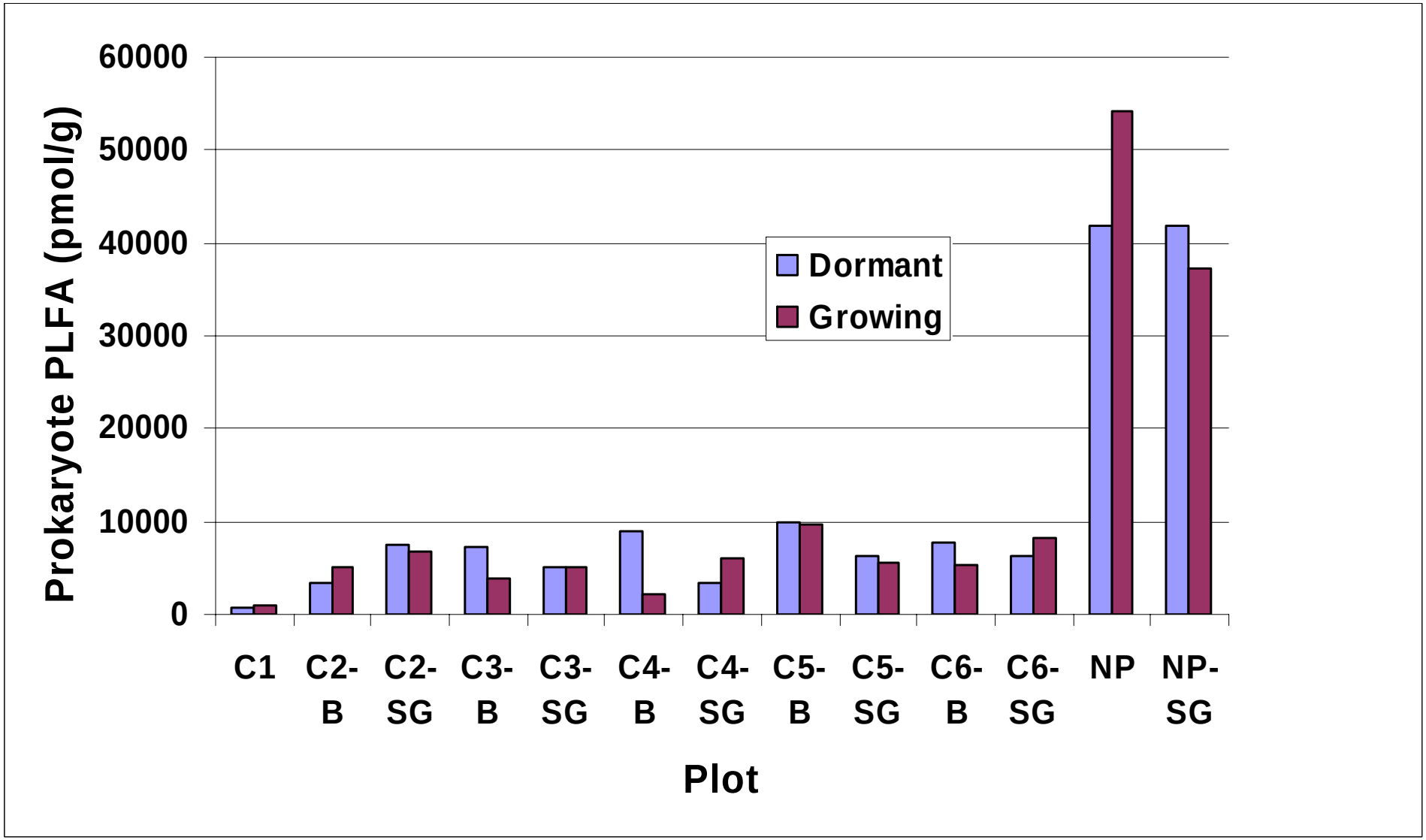
No real trends in Cl^- data.



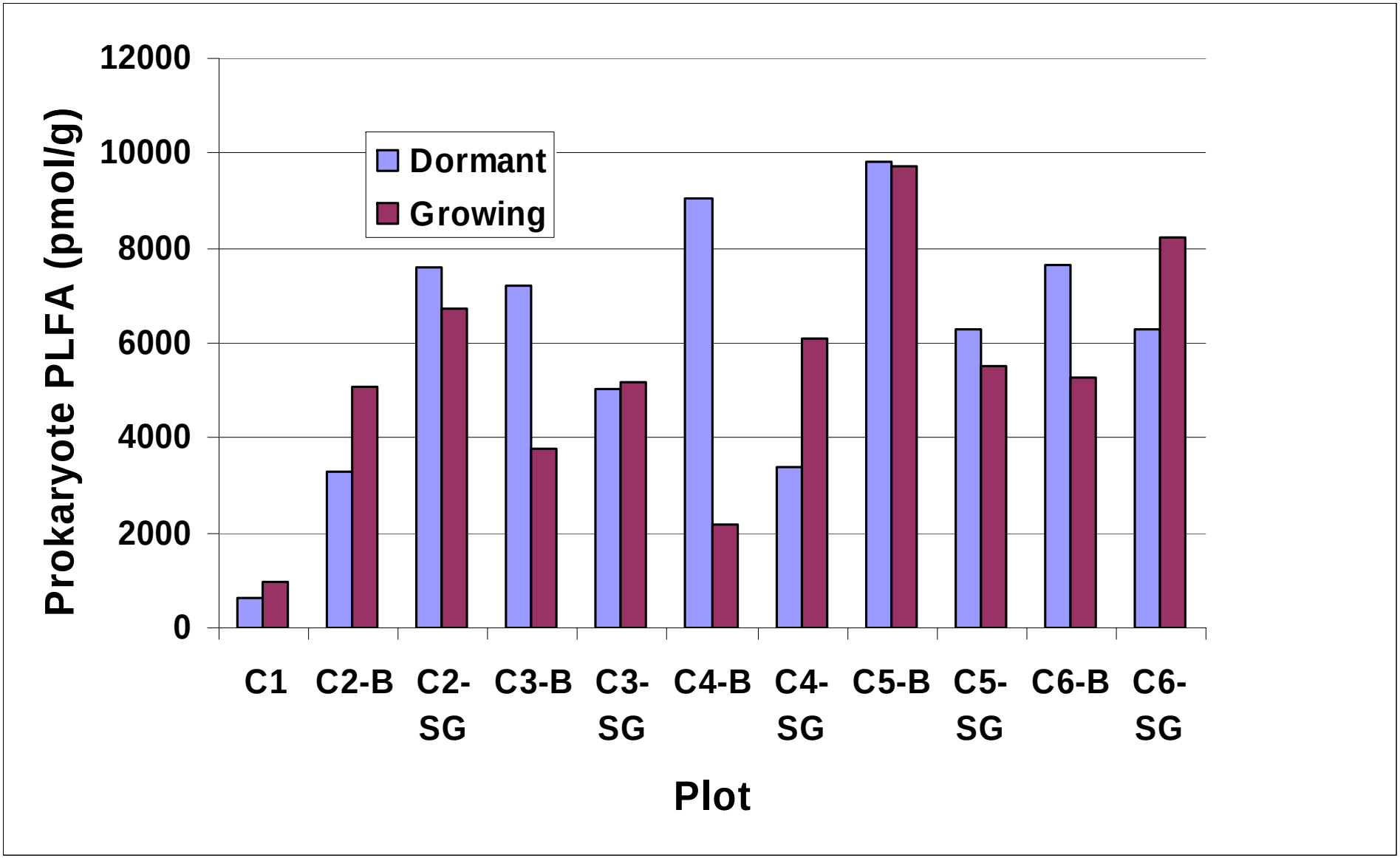
Mg^{+2} concentrations were generally depressed compared to native prairie and increased between the dormant and growing season. In all but one cell the largest increases were seen in the switchgrass root zone.



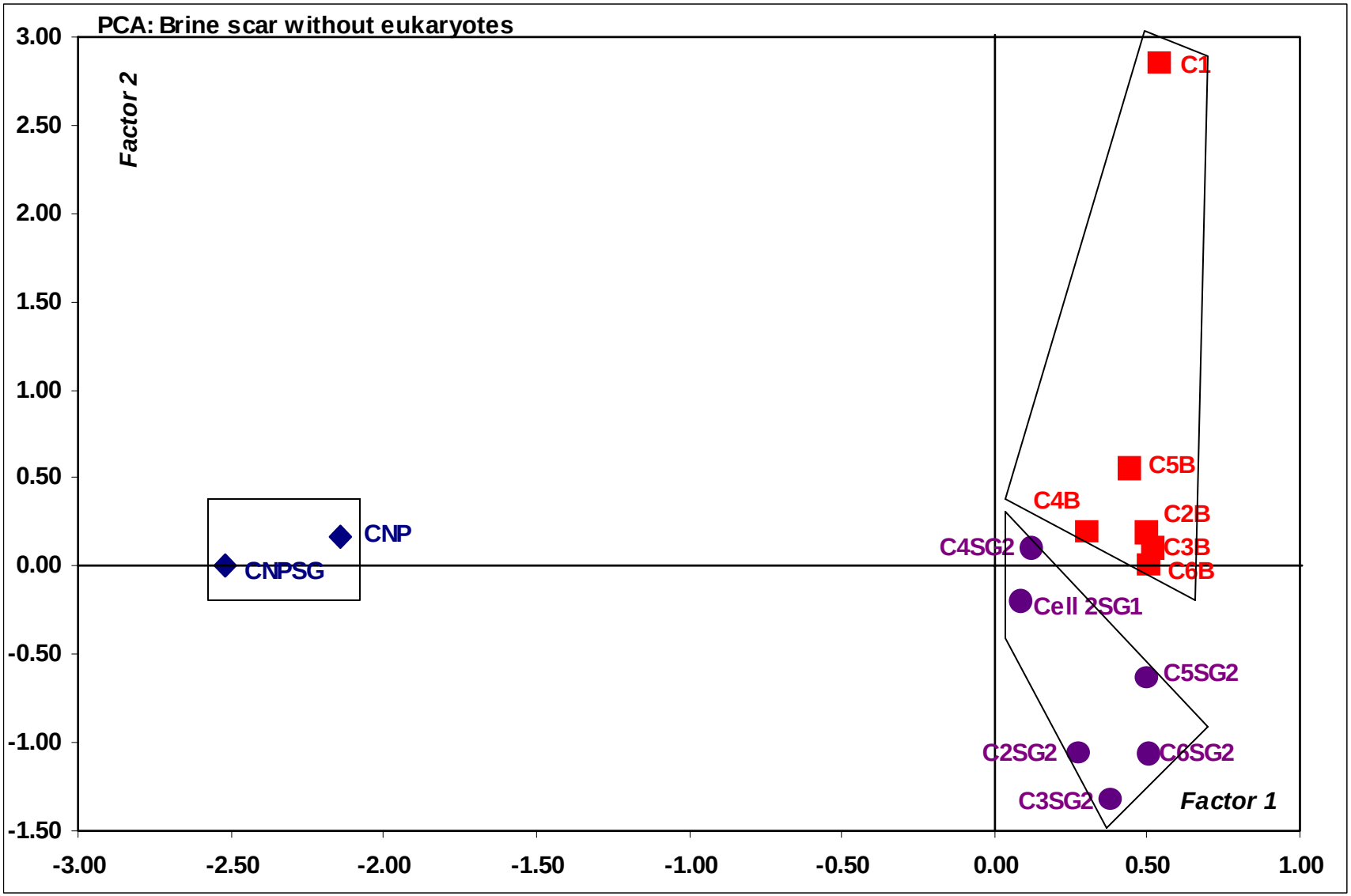
Ca^{+2} concentrations were elevated in cell 4 which had received a gypsum amendment. The switchgrass root zone in cell 4 experienced the greatest increase in Ca^{+2} among treated cells from the dormant to growing periods.



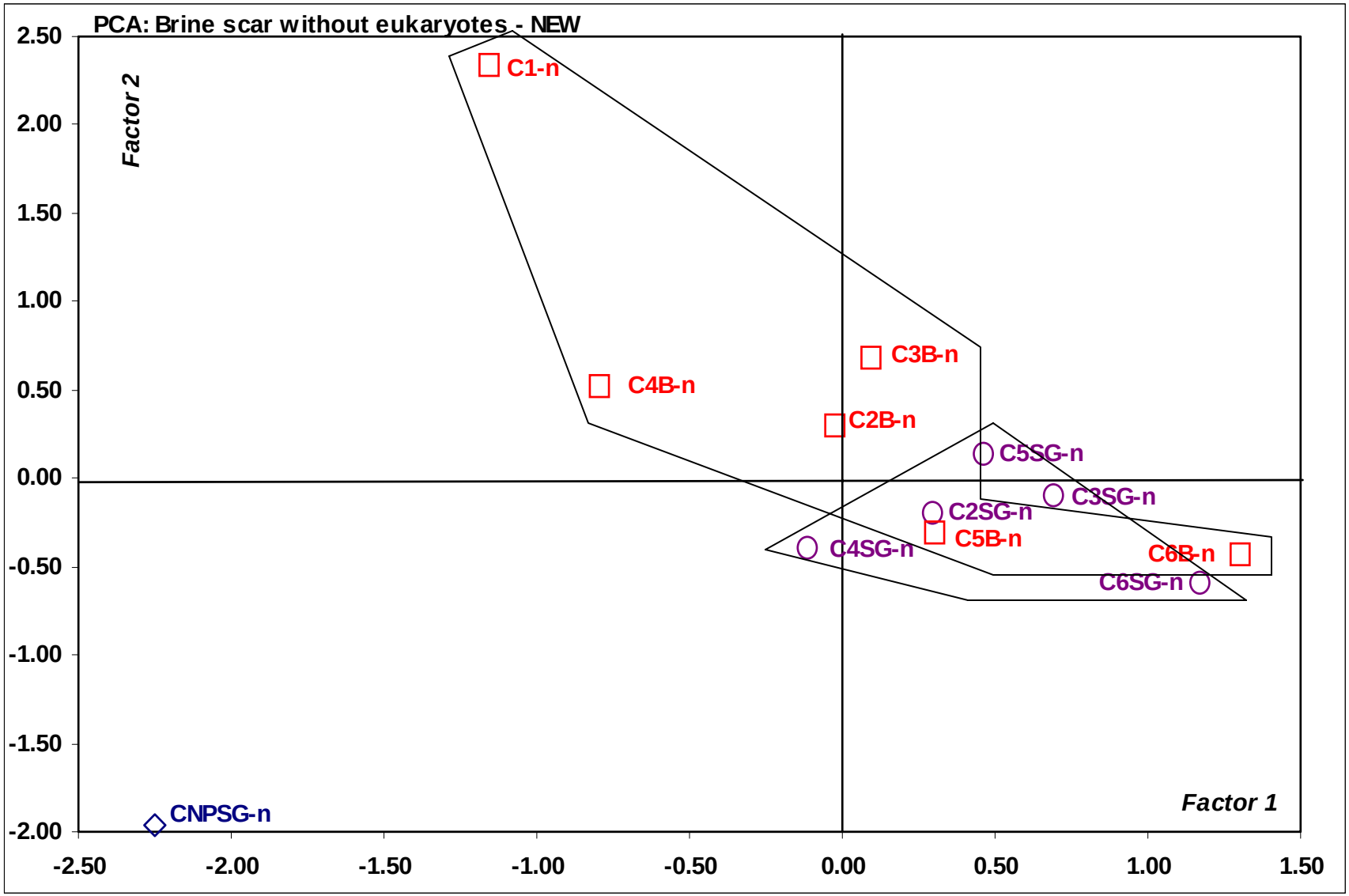
Concentrations of viable bacteria were depressed in all plots compared to native prairie.



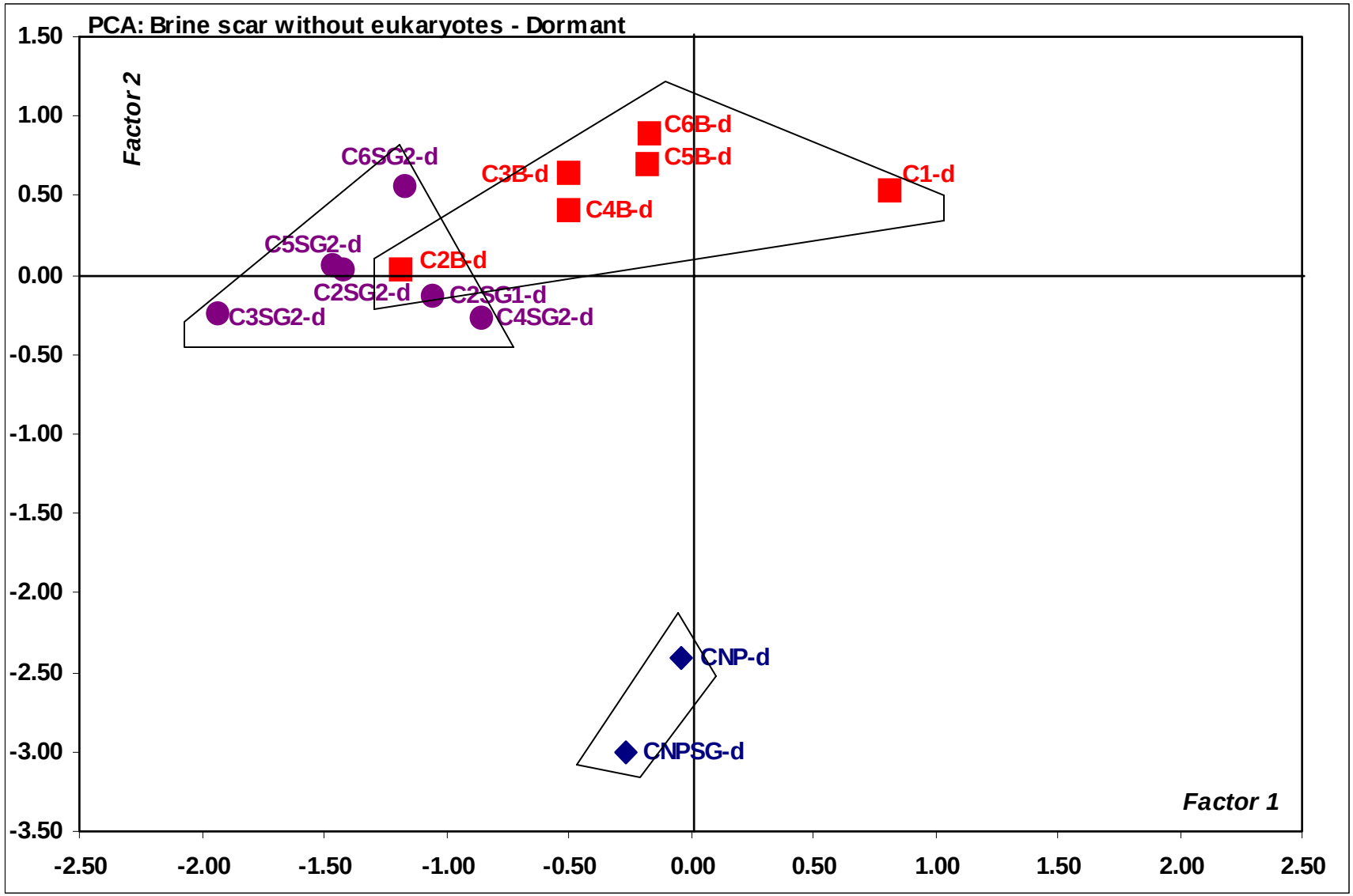
Lowest viable bacteria in cell 1. During the growing season there were greater concentrations of bacteria in the switchgrass root zone except in cell 5 (an effect of clay concentration?)


PCA: Brine scar without eukaryotes
Factor 2
Factor 1
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-3.00
-2.50
-2.00
-1.50
-1.00
-0.50
0.00
0.50
1.00
C1
C5B
C4B
C2B
C3B
C6B
C4SG2
Cell 2SG1
C5SG2
C2SG2
C6SG2
C3SG2
CNP
CNPSG

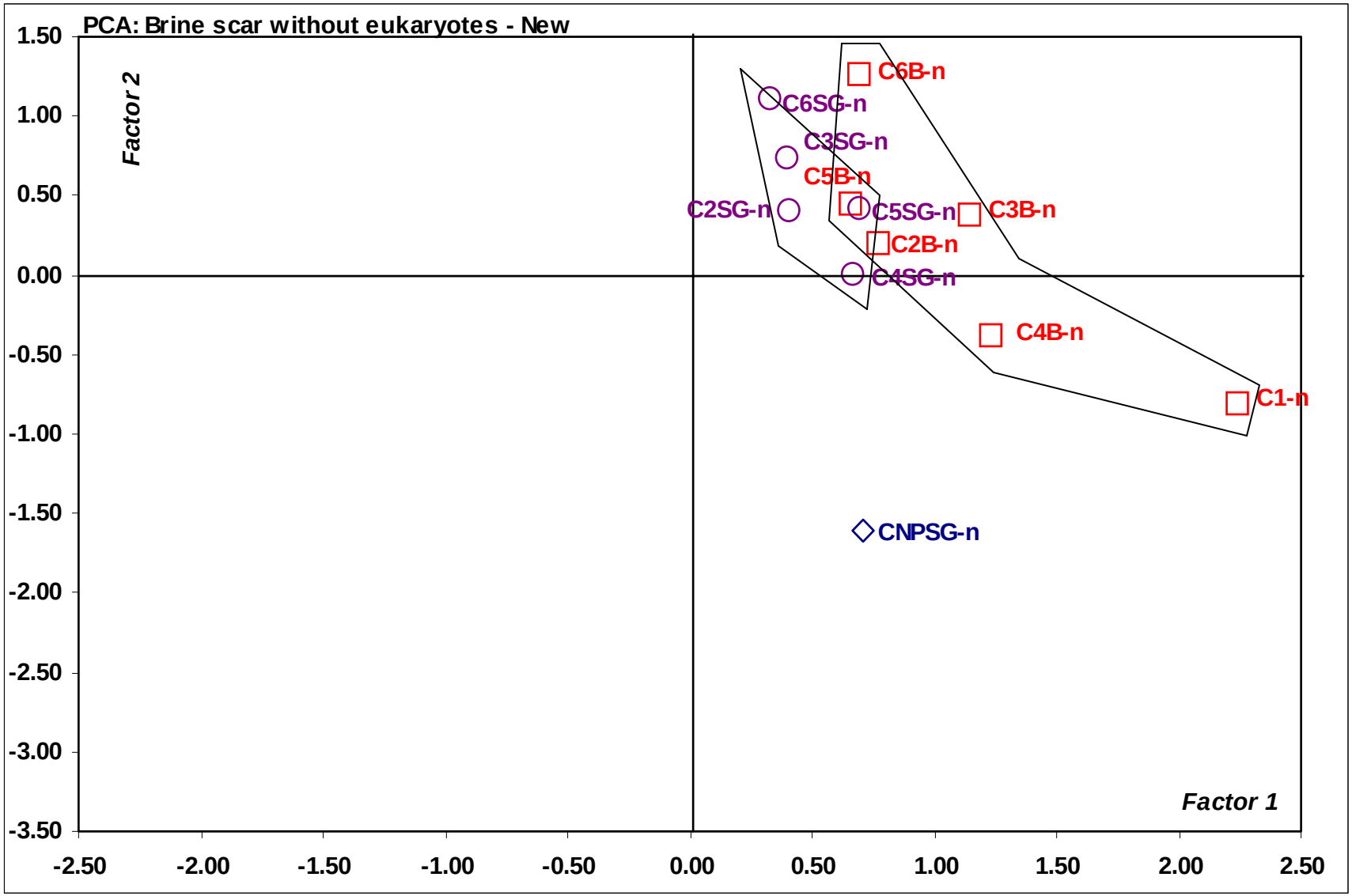
Dormant



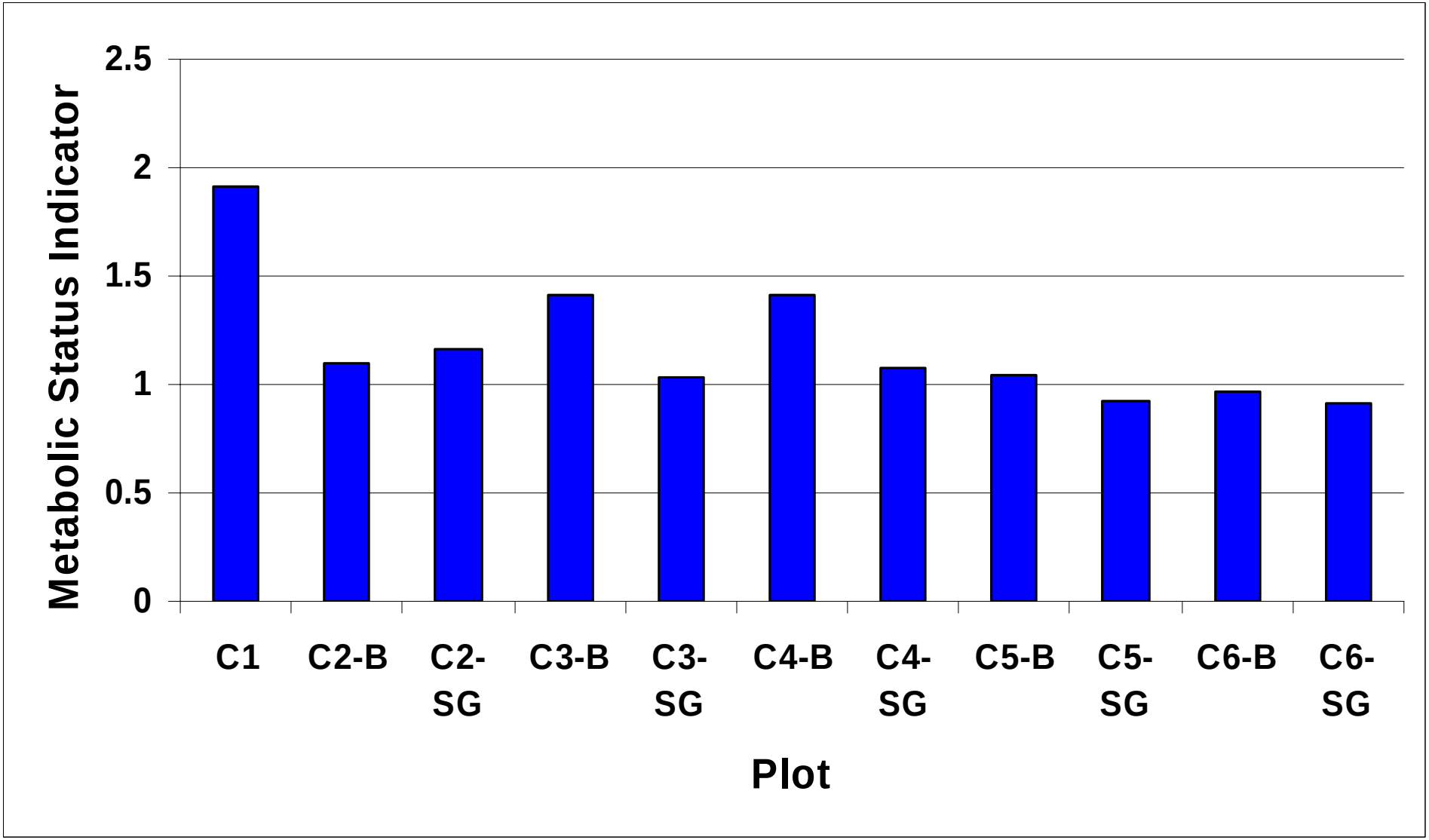
Growing Season


PCA: Brine scar without eukaryotes - Dormant
Factor 2
Factor 1
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
-3.50
-2.50
-2.00
-1.50
-1.00
-0.50
0.00
0.50
1.00
1.50
2.00
2.50
C6B-d
C5B-d
C3B-d
C1-d
C4B-d
C6SG2-d
C5SG2-d
C2B-d
C2SG2-d
C2SG1-d
C3SG2-d
C4SG2-d
CNP-d
CNPSG-d

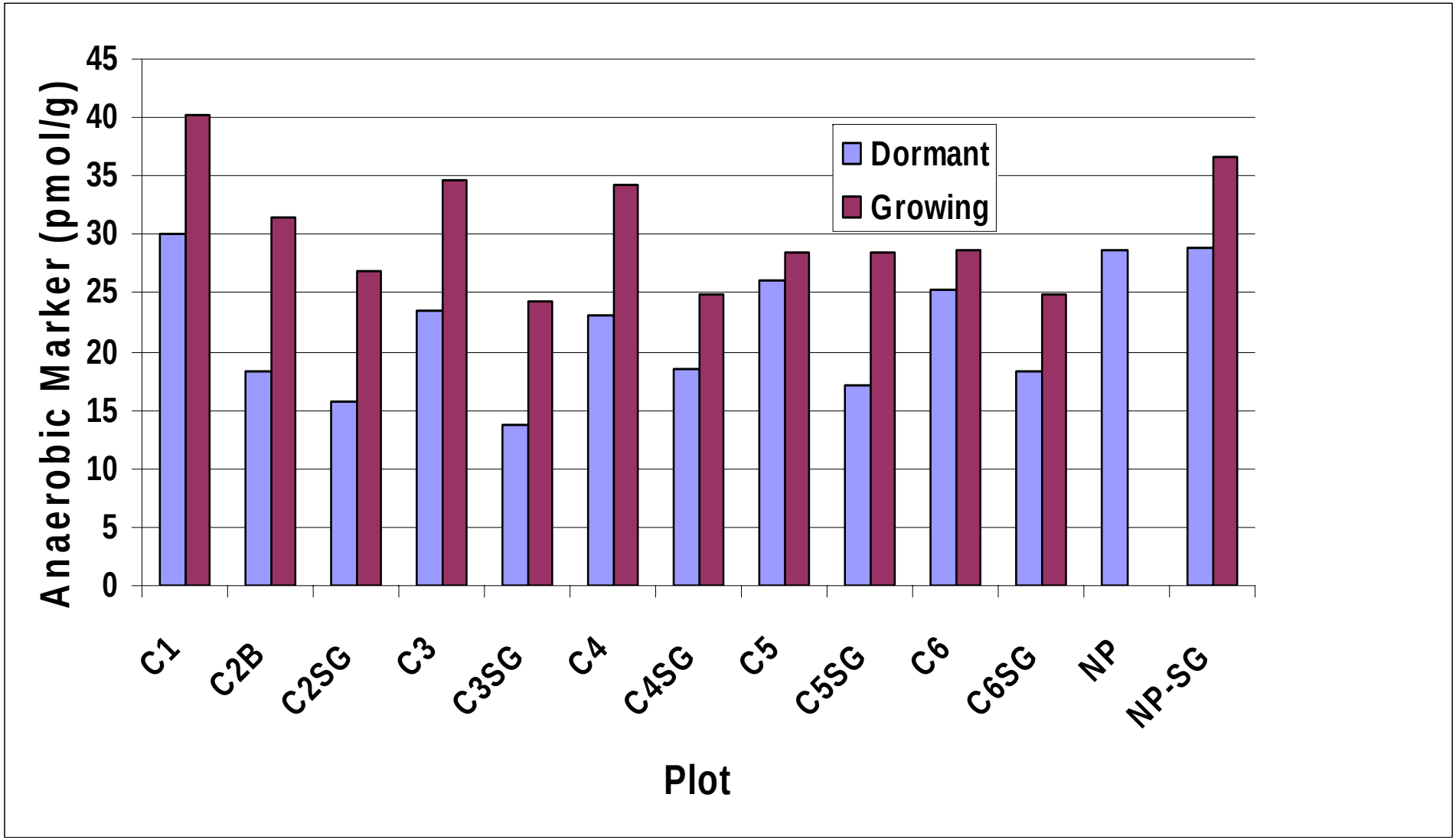
Dormant



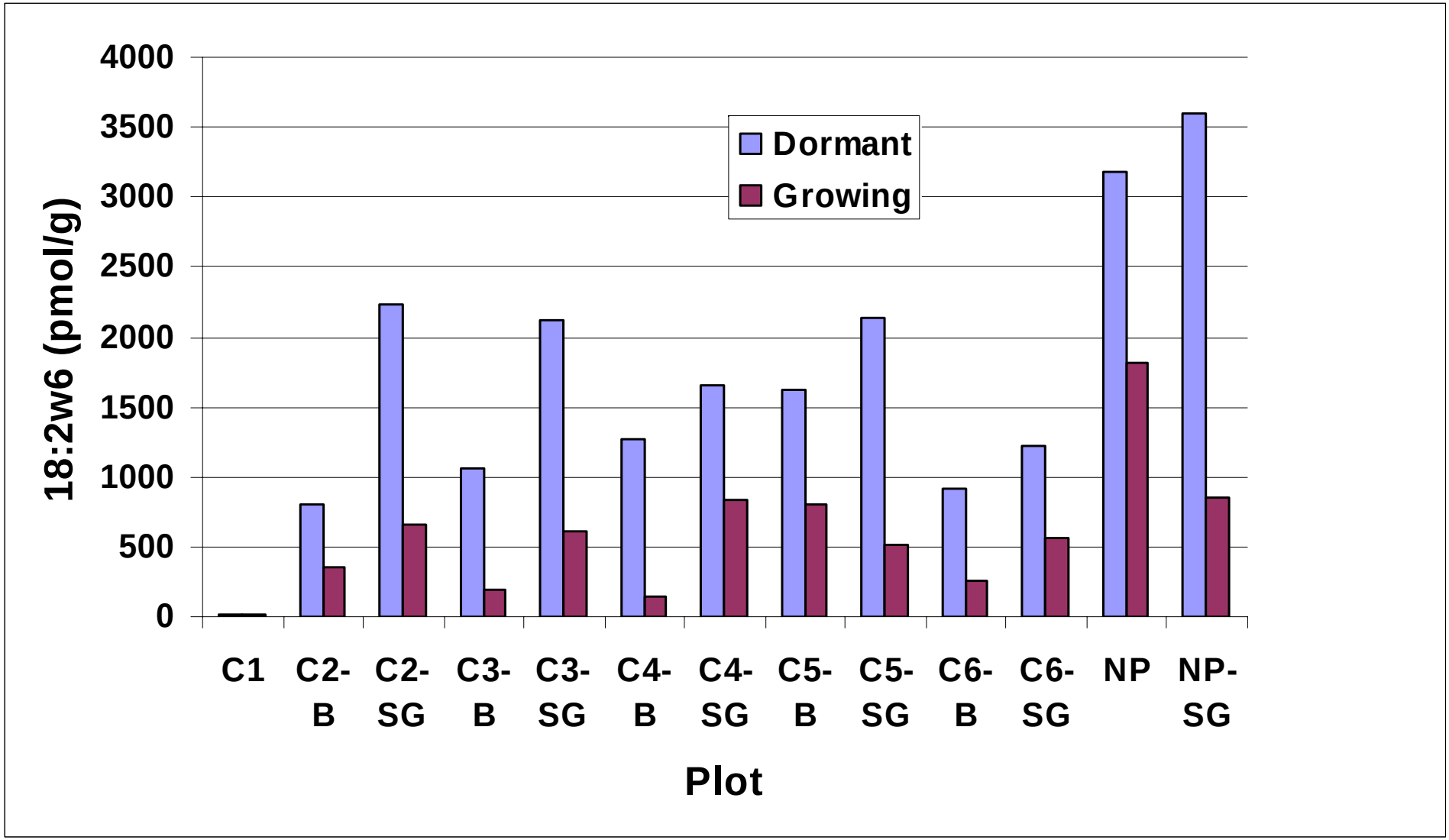
Growing Season



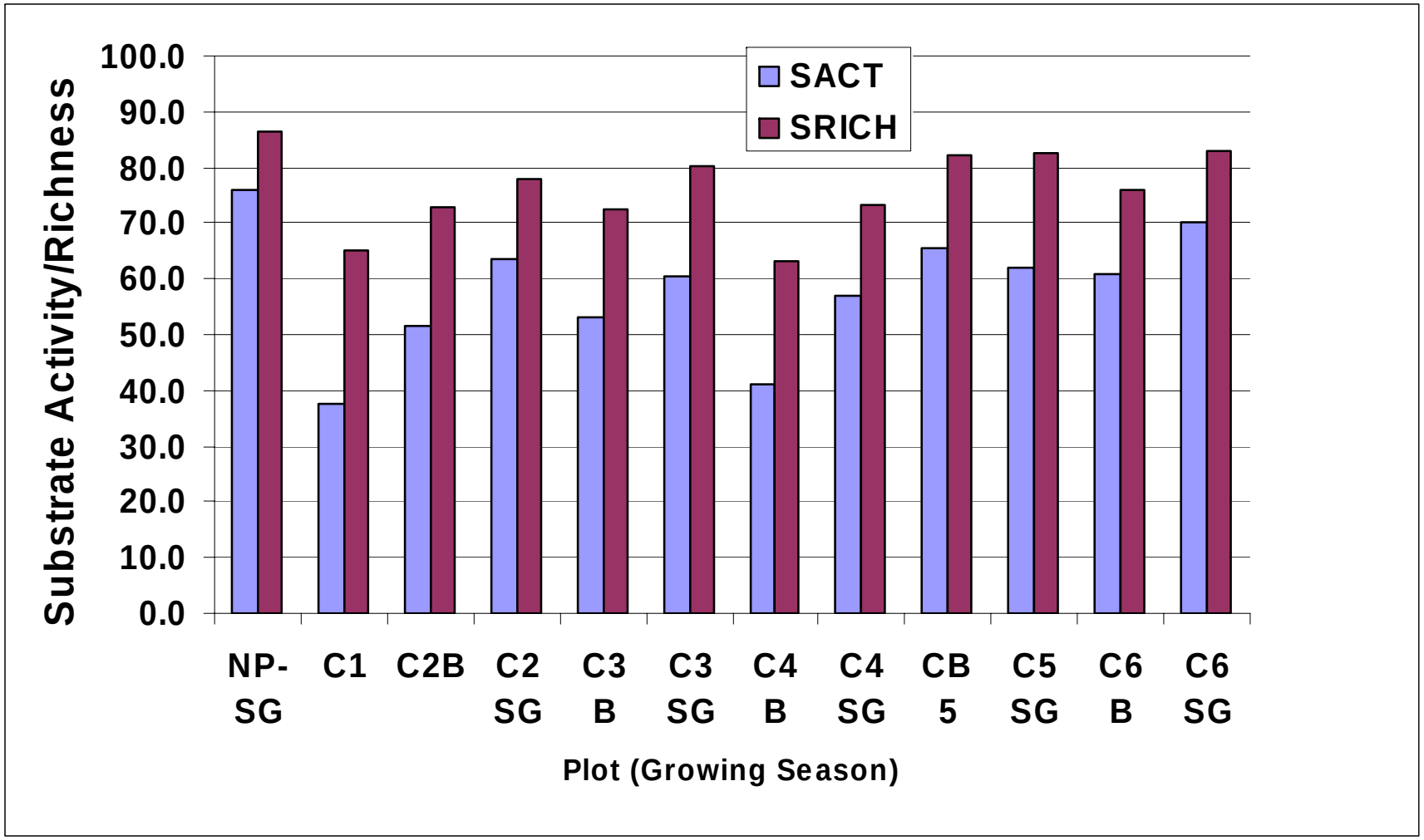
Faster growth rates seen in switchgrass root zone during growing season (exception C2).



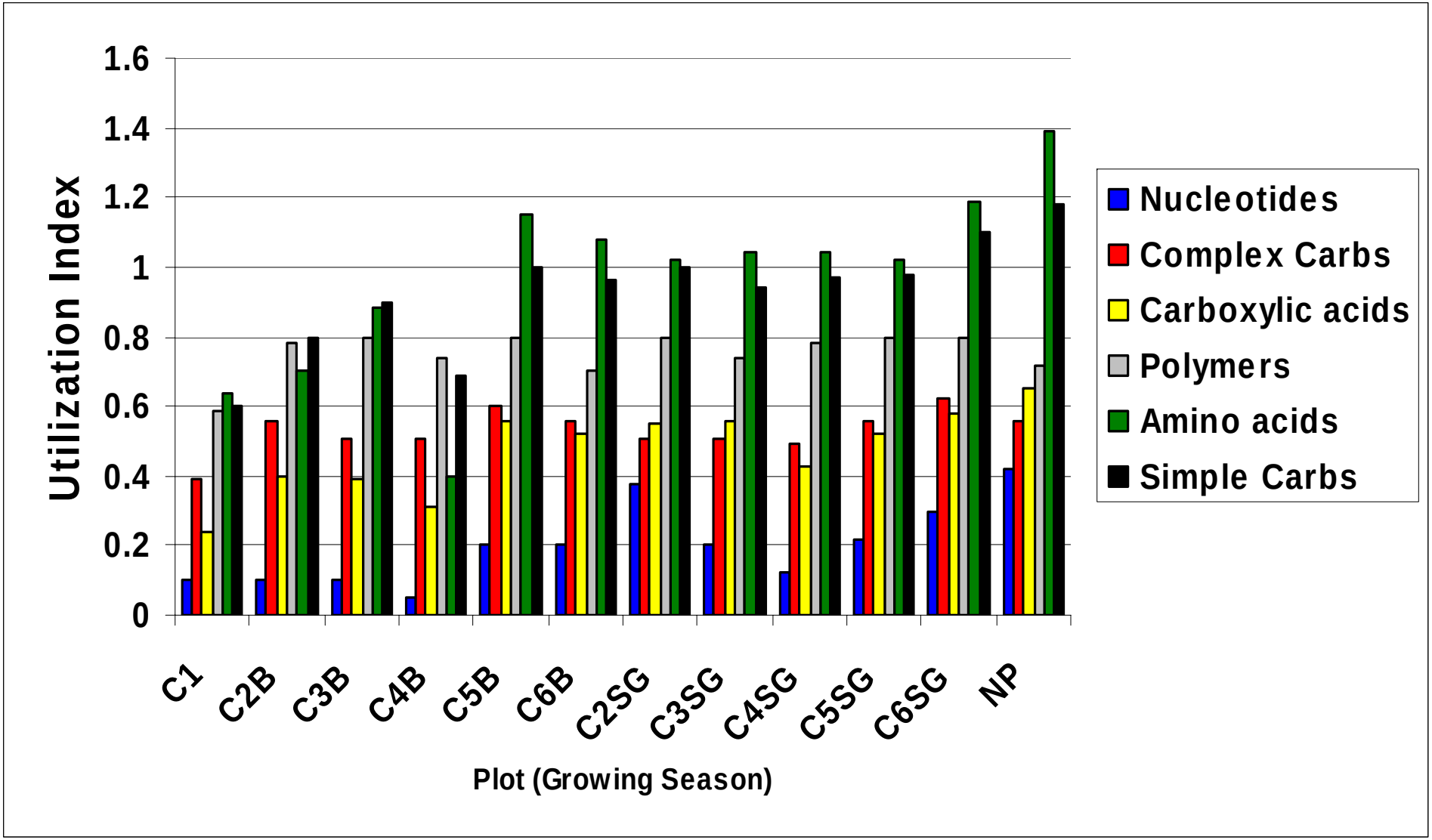
Lower concentrations of anaerobic markers in the switchgrass root zone during both dormant and growing seasons.



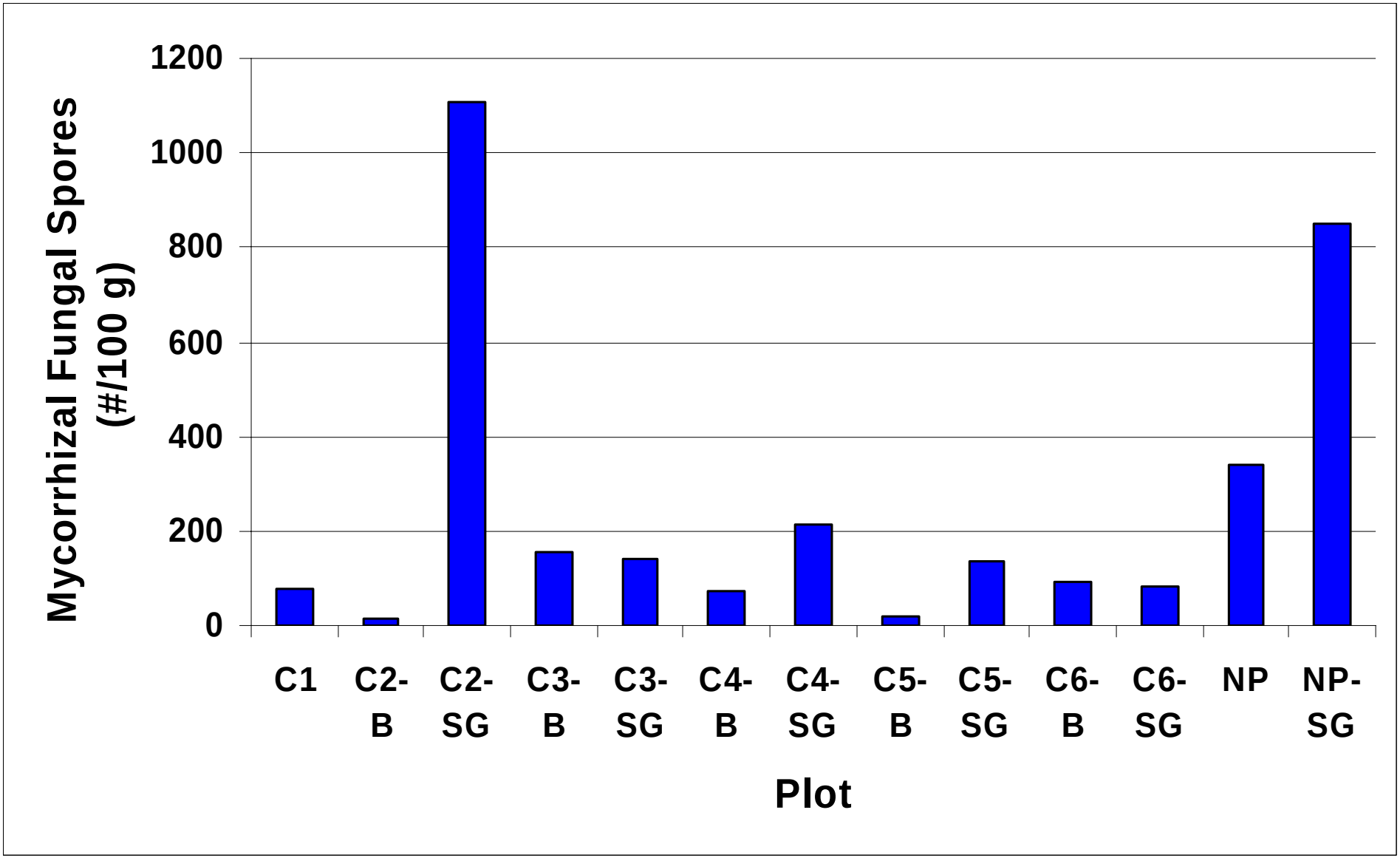
Significant decrease in fungi concentrations from dormant to growing season probably reflecting shift to bacterial dominated community. In both seasons highest concentrations of fungi were seen in the switchgrass root zone.



Fungal diversity was higher in the switchgrass root zone (except in cell 5). Both substrate activity and substrate richness were significantly different (95% C.L.) in the bare and root zone soil.



Utilization rates of most types of substrates were higher in the switchgrass root zone.



Data suggest significant infection of switchgrass by mycorrhizal fungi in the inoculated cell.

Conclusions

- Switchgrass has shown high rates of survival in poor quality soil (low nutrient pool and high clay content) with moderate concentrations of brine components
- Qualities of switchgrass root zone compared to bare soil:
  - Better moisture retention
  - Increased Na^+ leaching
  - Higher concentrations of bacteria growing at faster rates overall
  - Shift in bacterial community structure
  - Greater aerobic activity
  - Higher concentrations and nutritional diversity of fungi
- All of these qualities contribute to the restoration of soil structure and ultimately to the restoration of the plant community. Diversity below ground yields diversity above ground and vice versa.

Acknowledgement

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Energy Environment Economy

Integrated Petroleum Environmental Consortium

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