Relationships between Grass Quality, Productivity and Utilisation on Sodic Sites and Crests

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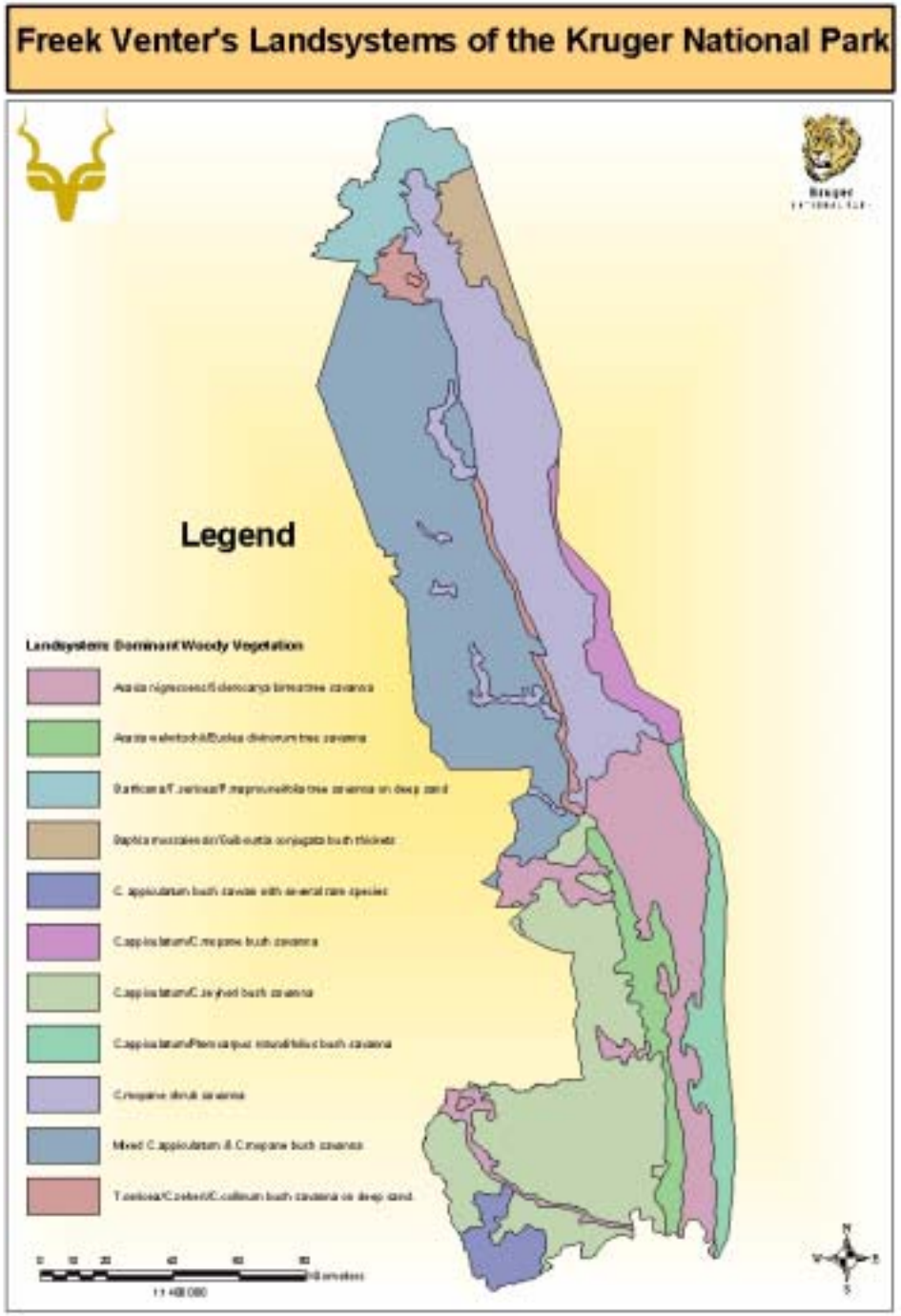
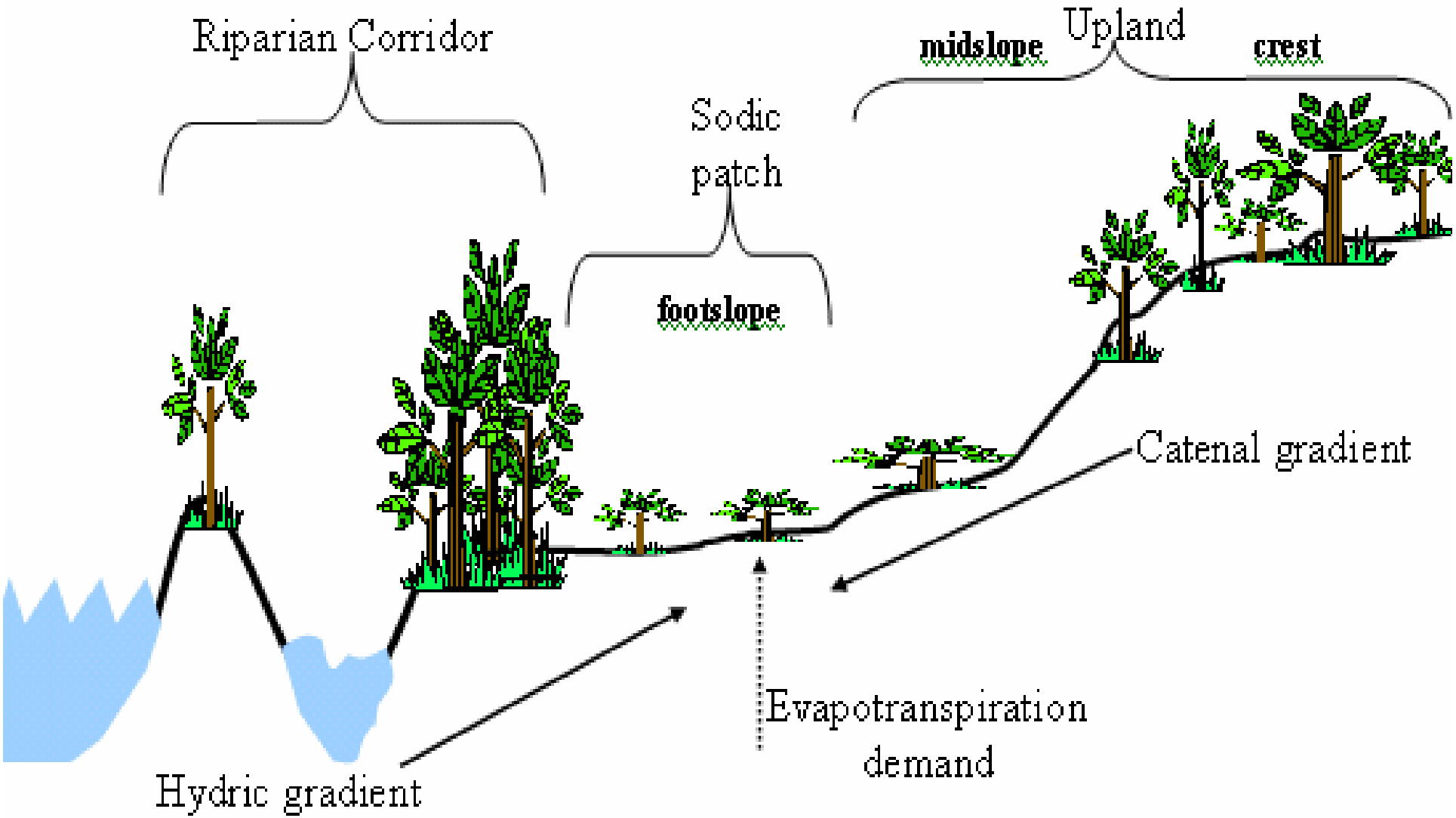
Land systems have been delineated based on:

- **Geology**
- **Precipitation**
- **Vegetation**

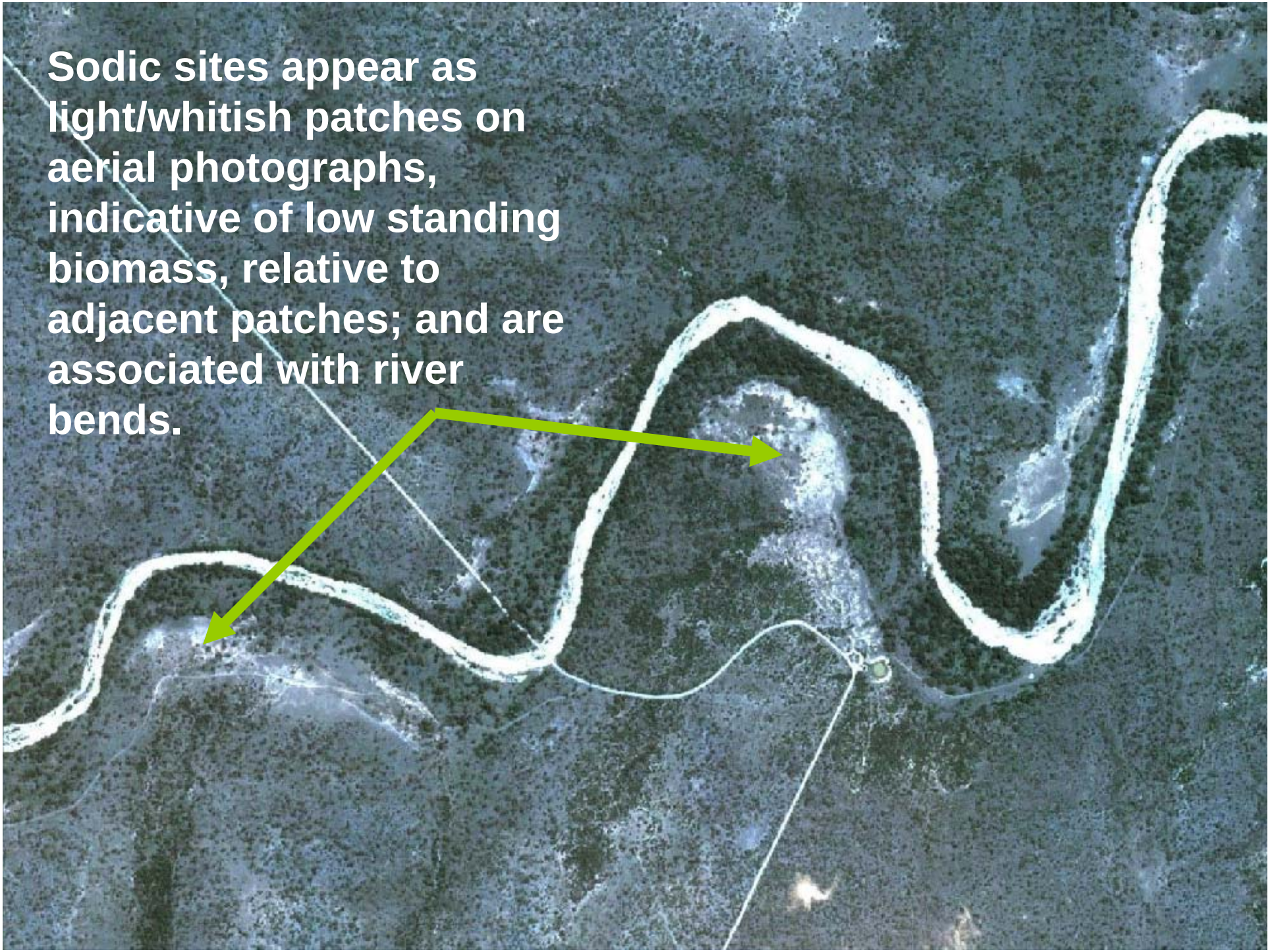
Landscape of study is Skukuza land system (*Combretum apiculatum/C. zeyheri* Bush savanna)

Relatively high rainfall on granitic parent material





Sodic sites are discontinuous, patchy elements of the footslope, characterised by low standing herbaceous crop, and sparse woody shrubs. This has led to a paradigm of putative low biomass production.


Sodic sites appear as light/whitish patches on aerial photographs, indicative of low standing biomass, relative to adjacent patches; and are associated with river bends.

GRASS BIOMASS PRODUCTIVITY

Hypothesis: Grass productivity is higher in sodic sites (SS) than on crests

Rationale:

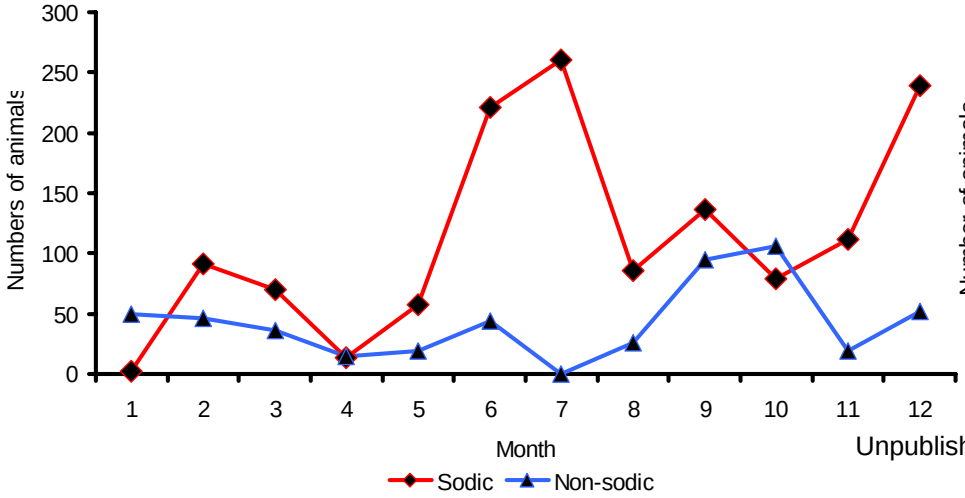
1 - Higher concentration of nutrients in SS soils

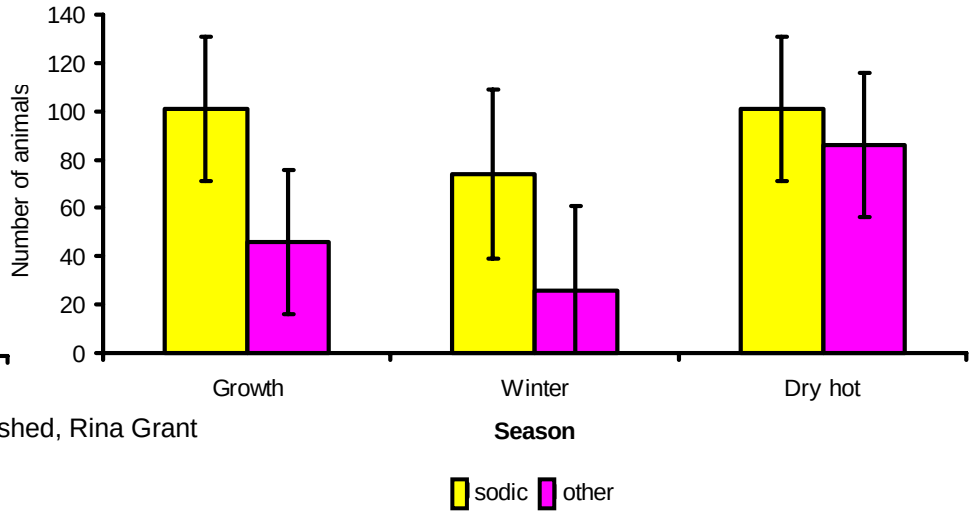
•Clay particulate matter deposition through leaching from upslope

2 - Higher numbers of large mammalian herbivores in SS relative to non-sodic patches:

•Higher levels of dung and urine deposition [cf. crests]?

•Intense and sustained herbivory may stimulate grass productivity





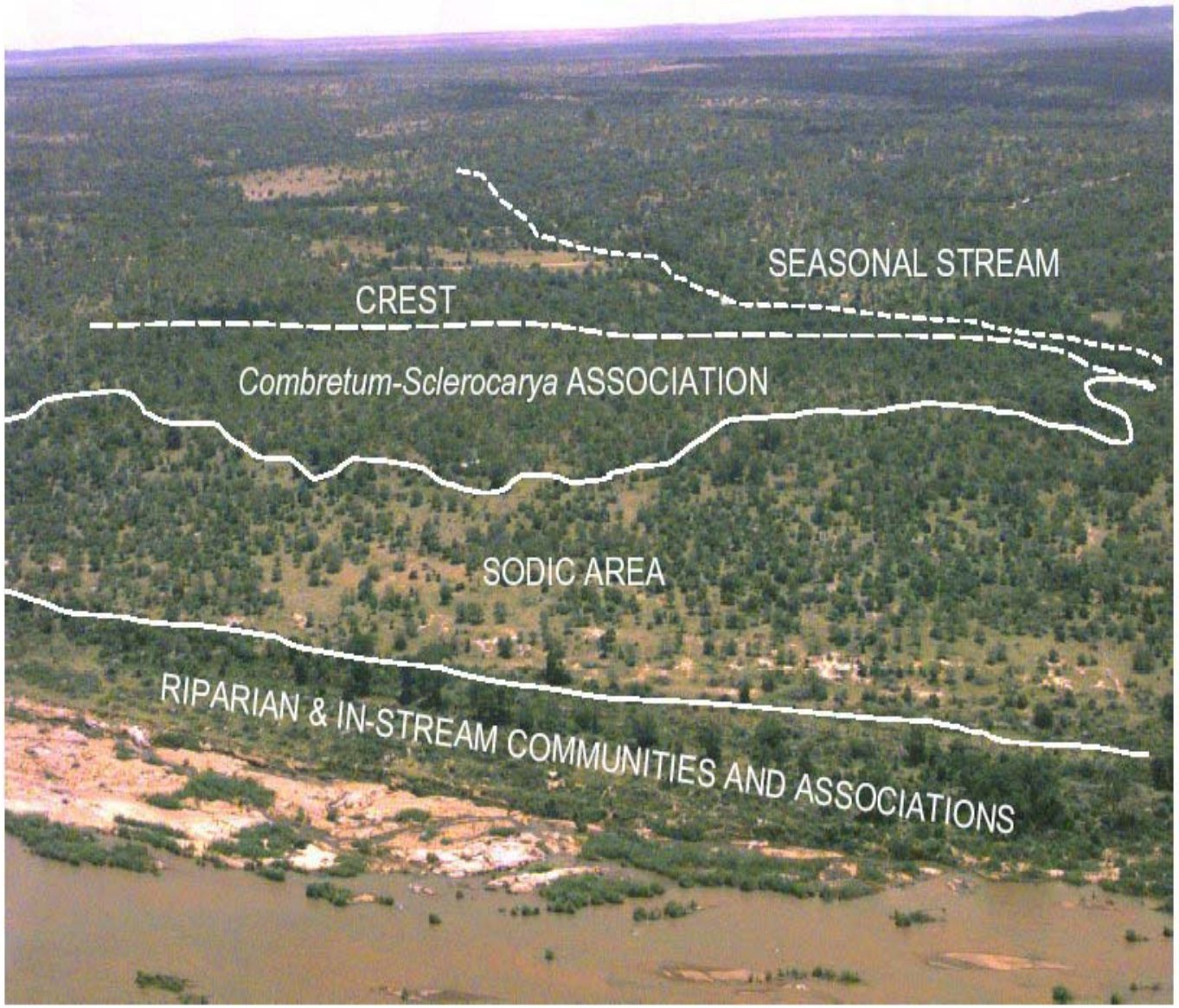
Unpublished, Rina Grant

3 – Relatively low standing crop vs. high herbivore presence in SS throughout the year possible indicator of high productivity

SITE

Nkuhlu Herbivore Exclosure

- **Encloses one entire catena with associated veg comms.**
- **Controlled herbivory since Nov 2001**

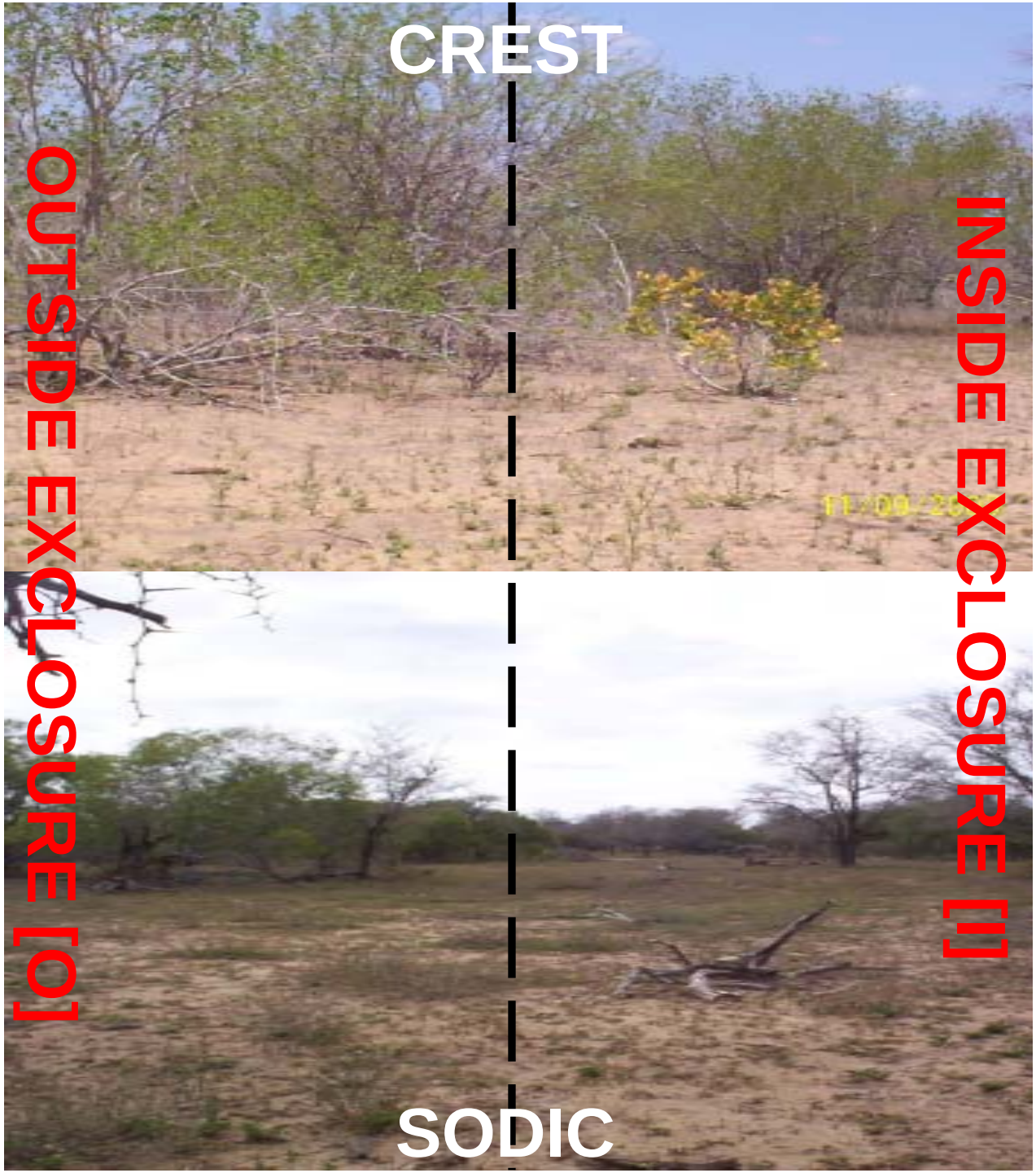


Aerial View of site on the Sabie River at Nkuhlu Picnic siteillustrating the major vegetation communities.

4 treatments:

1. **Inside crest**
2. **Inside sodic**
3. **Outside crest**
4. **Outside sodic**

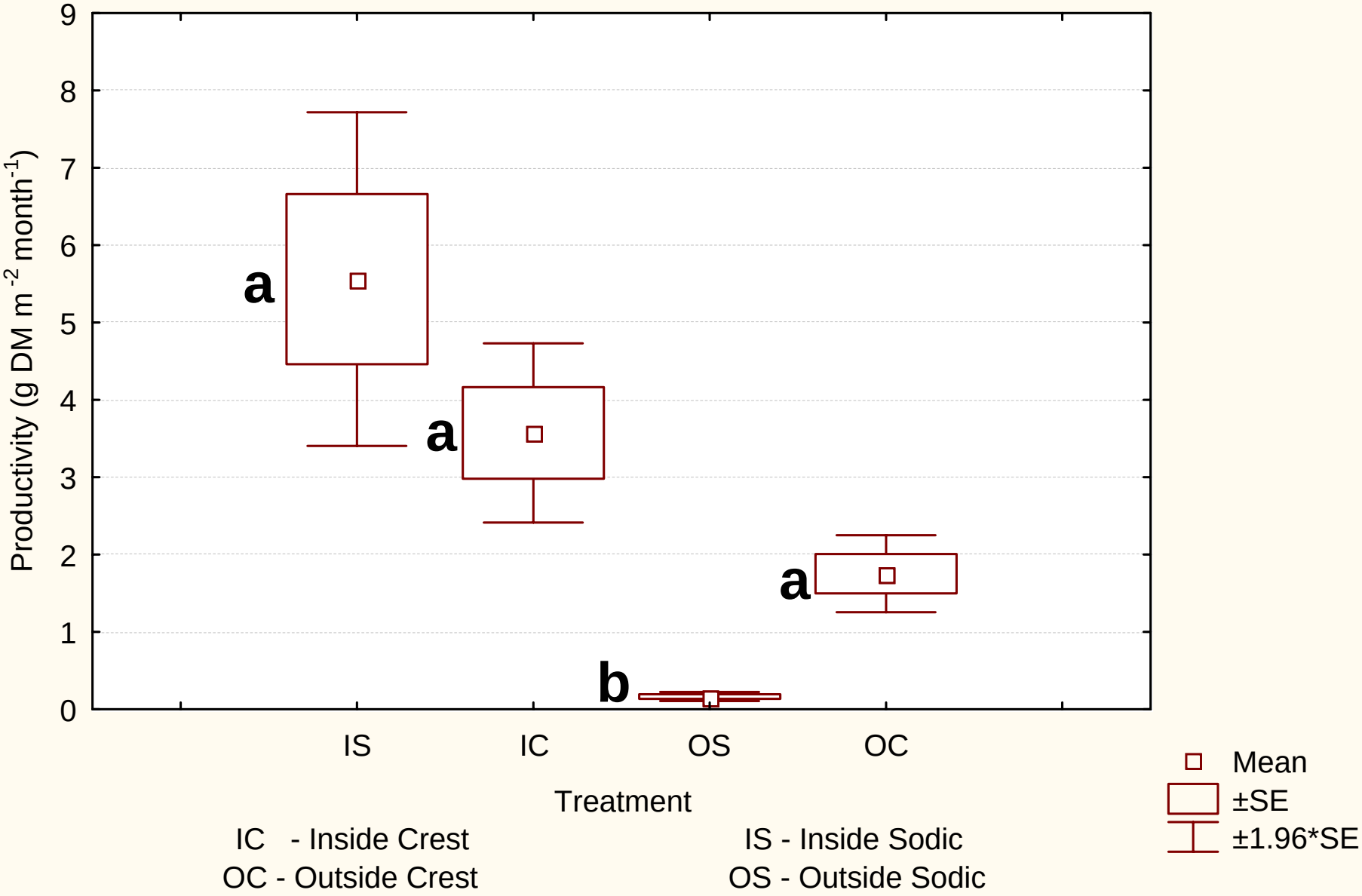
- **1m^2 permanently placed plots**
- **Grass clipped monthly during wet season**
- **Dry Mass (g)**



Grass Biomass Productivity

Three Growing Seasons (2002 - 2005)

Kruskal-Wallis test: H (3, N= 705) =50.37384 p < 0.05

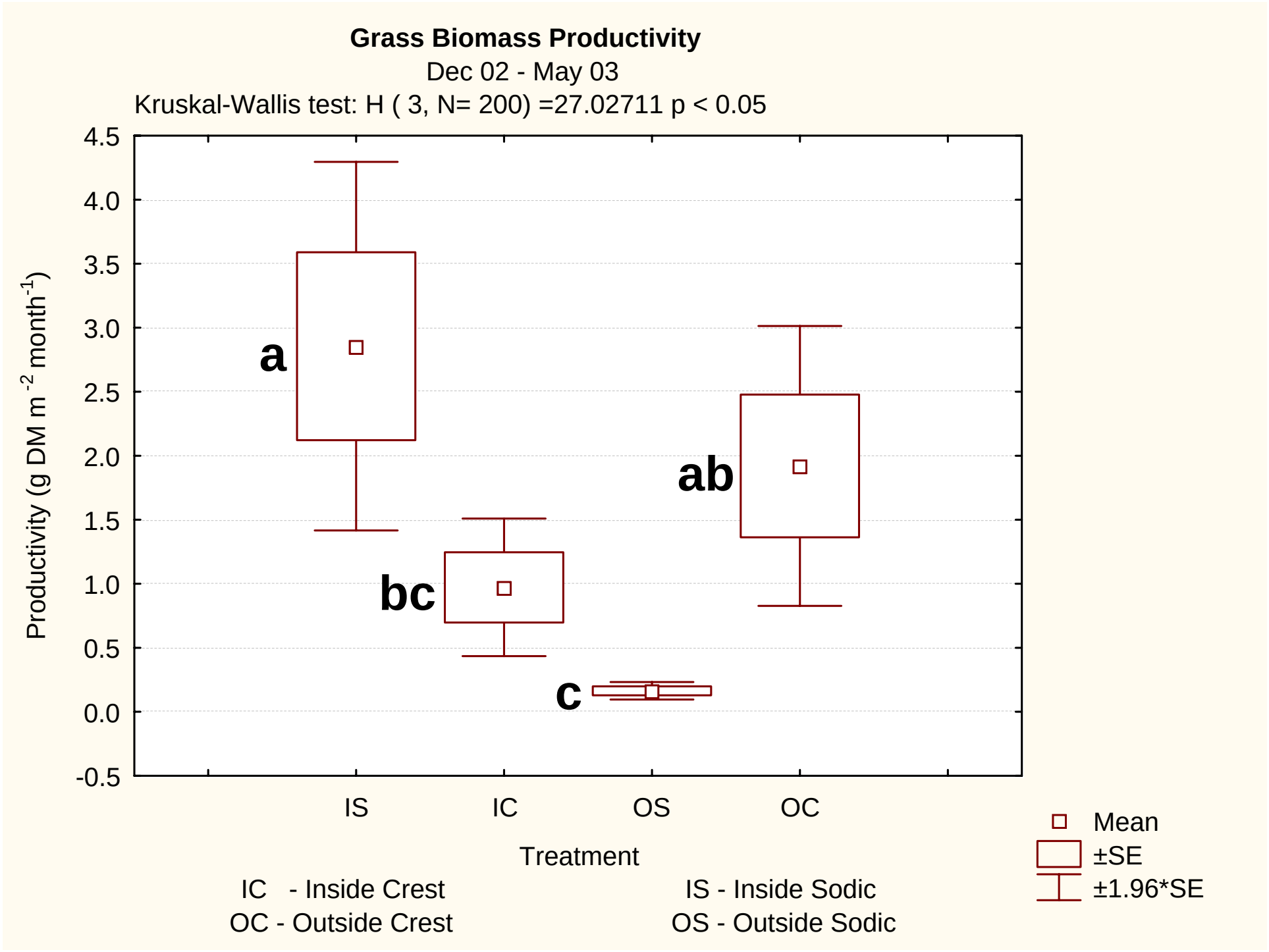


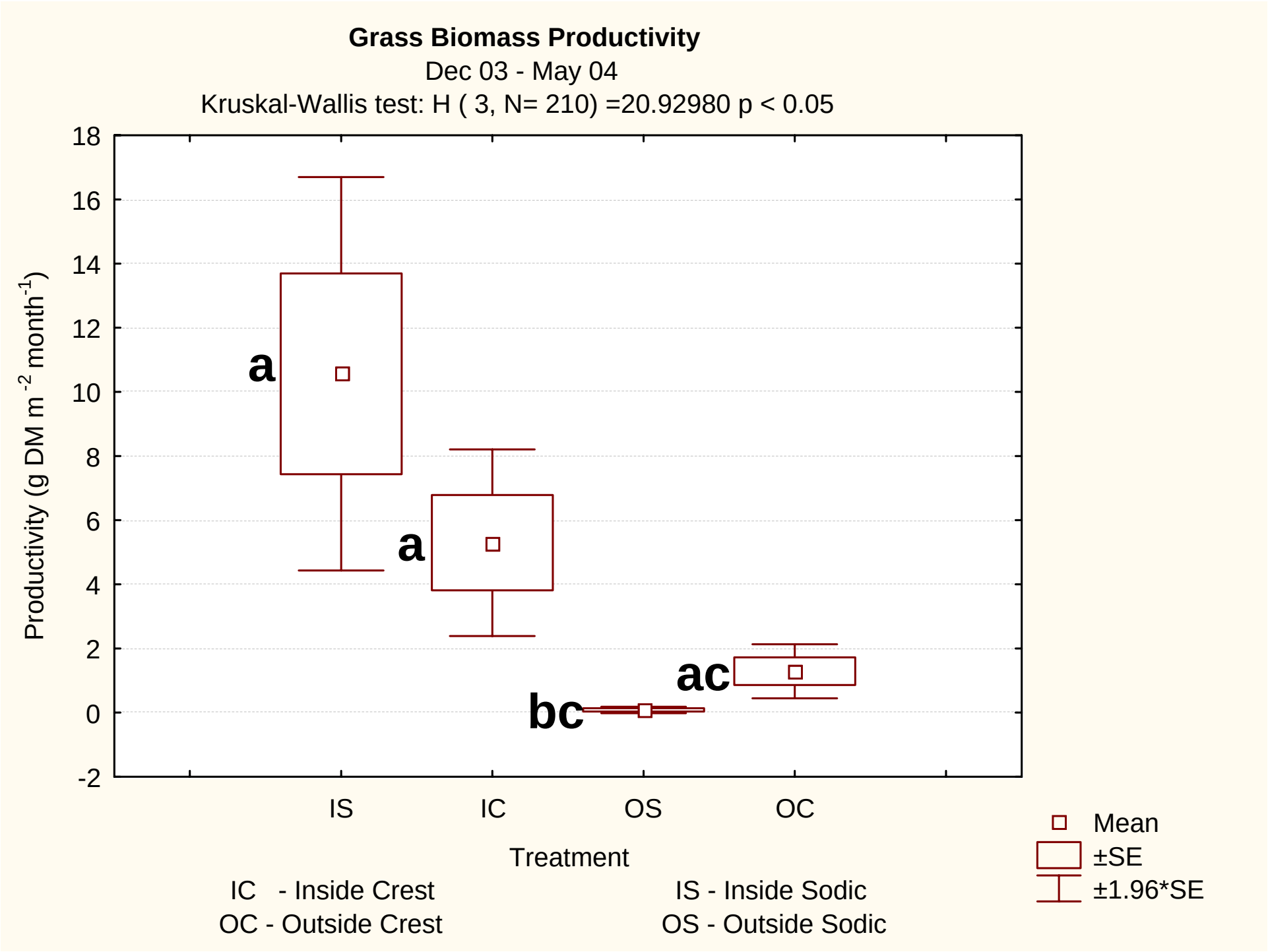
IC - Inside Crest

IS - Inside Sodic

OC - Outside Crest

OS - Outside Sodic

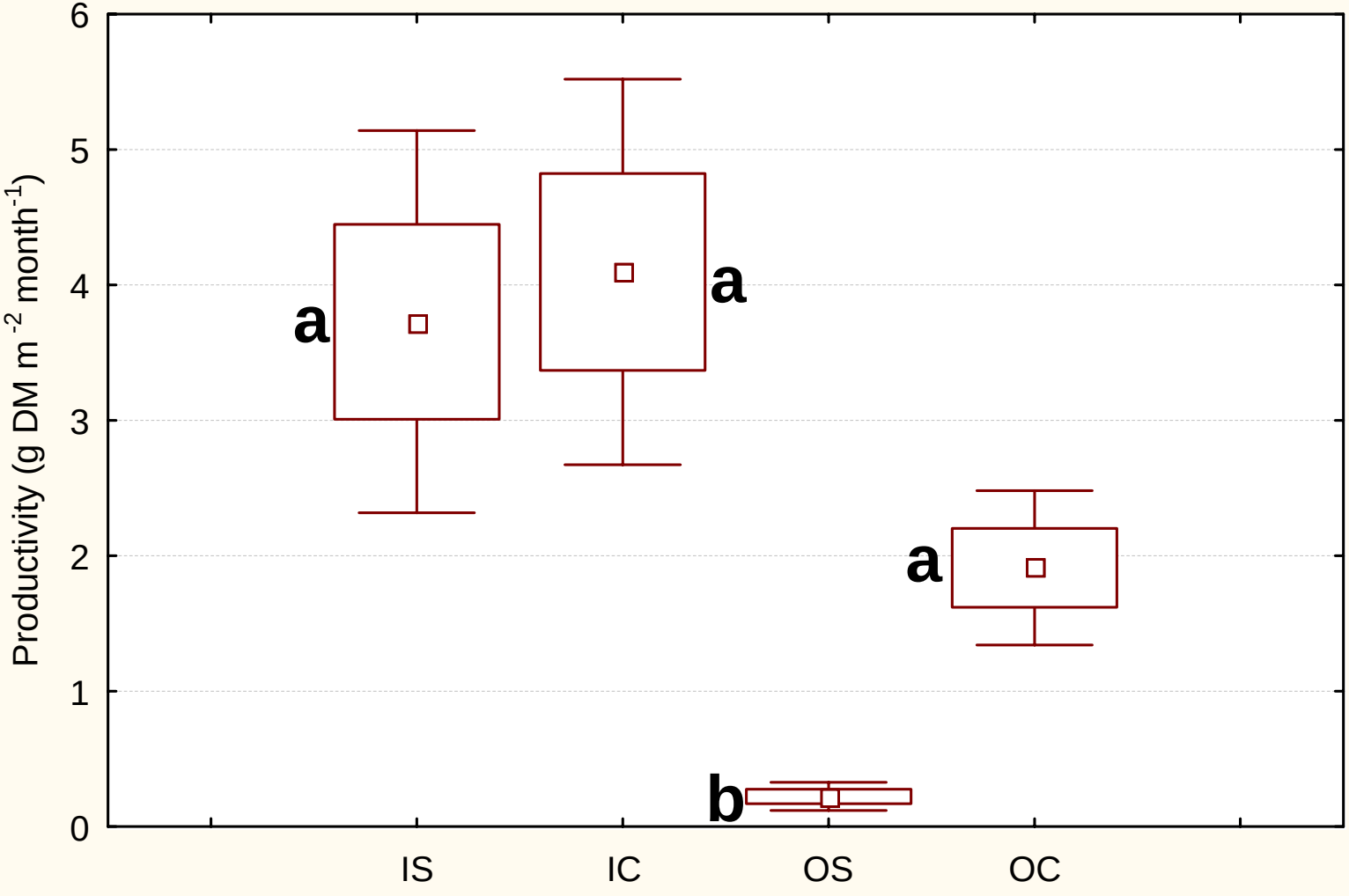

Grass Biomass Productivity
Dec 02 - May 03
Kruskal-Wallis test: H (3, N= 200) =27.02711 p < 0.05
Productivity (g DM m -2 month-1)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
a
bc
c
ab
IS
IC
OS
OC
Treatment
IC - Inside Crest
OC - Outside Crest
IS - Inside Sodic
OS - Outside Sodic
Mean
±SE
±1.96*SE


Grass Biomass Productivity
Dec 03 - May 04
Kruskal-Wallis test: H (3, N= 210) =20.92980 p < 0.05
Productivity (g DM m -2 month-1)
18
16
14
12
10
8
6
4
2
0
-2
a
a
bc
ac
IS
IC
OS
OC
Treatment
IC - Inside Crest
IS - Inside Sodic
OC - Outside Crest
OS - Outside Sodic
Mean
±SE
±1.96*SE

Grass Biomass Productivity

Dec 04 - Jun 05

Kruskal-Wallis test: H (3, N= 345) =28.12785 p < 0.05



IC - Inside Crest

OC - Outside Crest

IS - Inside Sodic

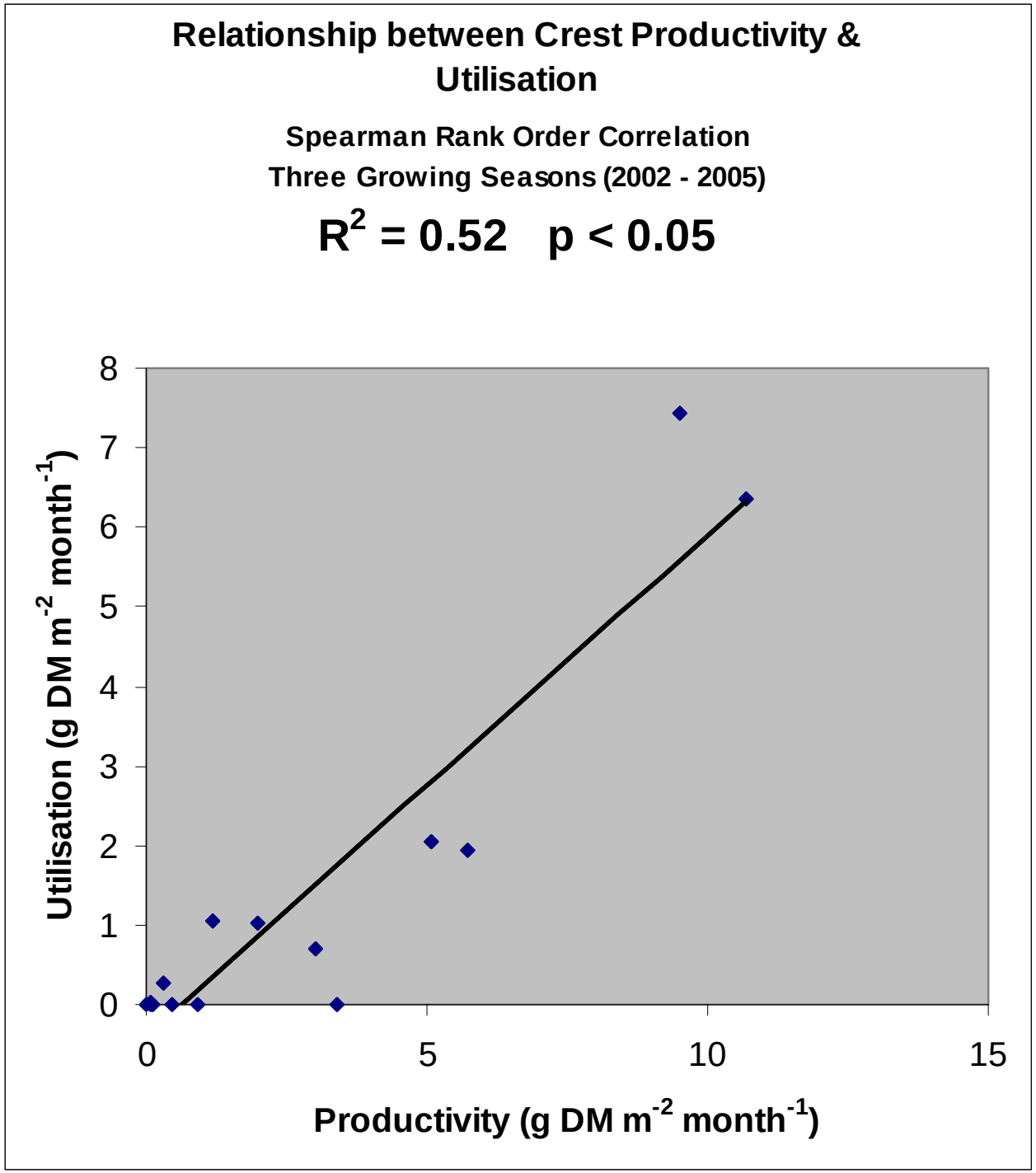
OS - Outside Sodic

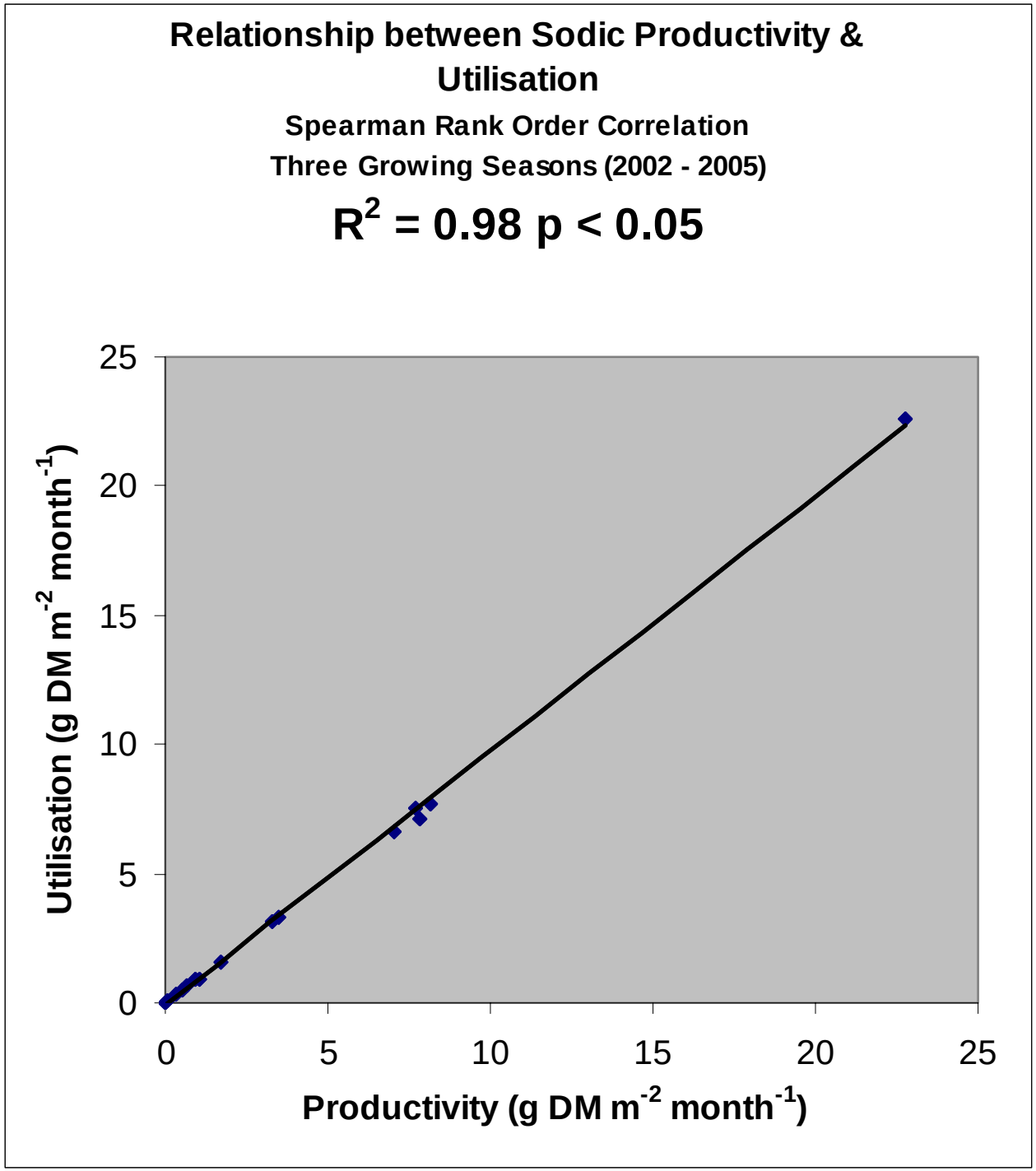
Mean

±SE

±1.96*SE

Utilisation = Grass Productivity Inside – Grass Productivity Outside




Relationship between Sodic Productivity & Utilisation
Spearman Rank Order Correlation
Three Growing Seasons (2002 - 2005)
R2 = 0.98 p < 0.05
Utilisation (g DM m-2 month-1)
Productivity (g DM m-2 month-1)
0
5
10
15
20
25

FORAGE QUALITY

Hypothesis: forage quality is higher in Sodic sites (SS) than in crest zones; which leads to significantly increased utilisation by herbivores

Rationale

•EDAPHIC - clay particulate matter through leaching from upslope through illuvial catenal processes

•Higher concentration of large herbivores = urine & dung deposition

METHODOLOGY

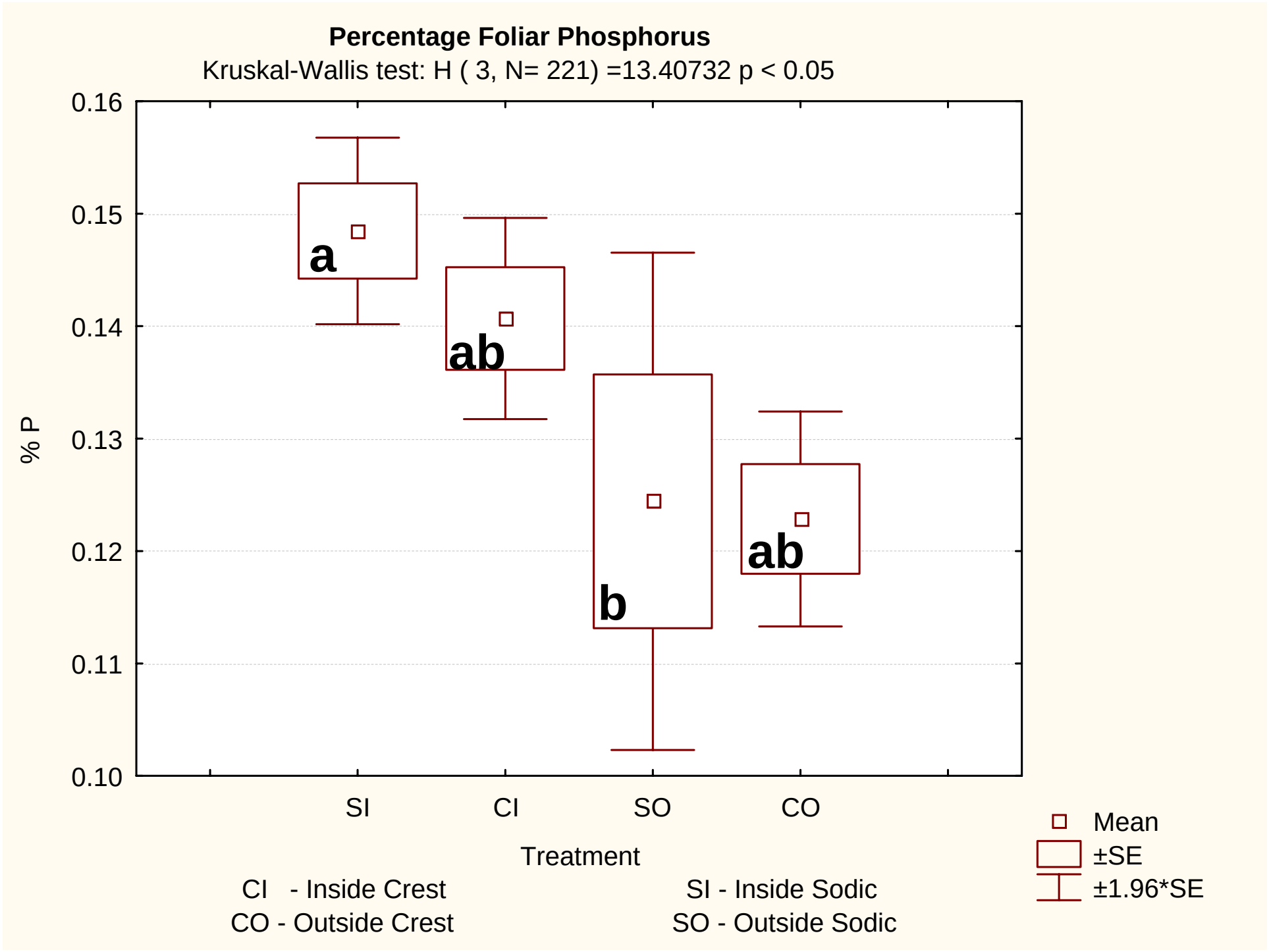
Analysis on the grass samples was done for:

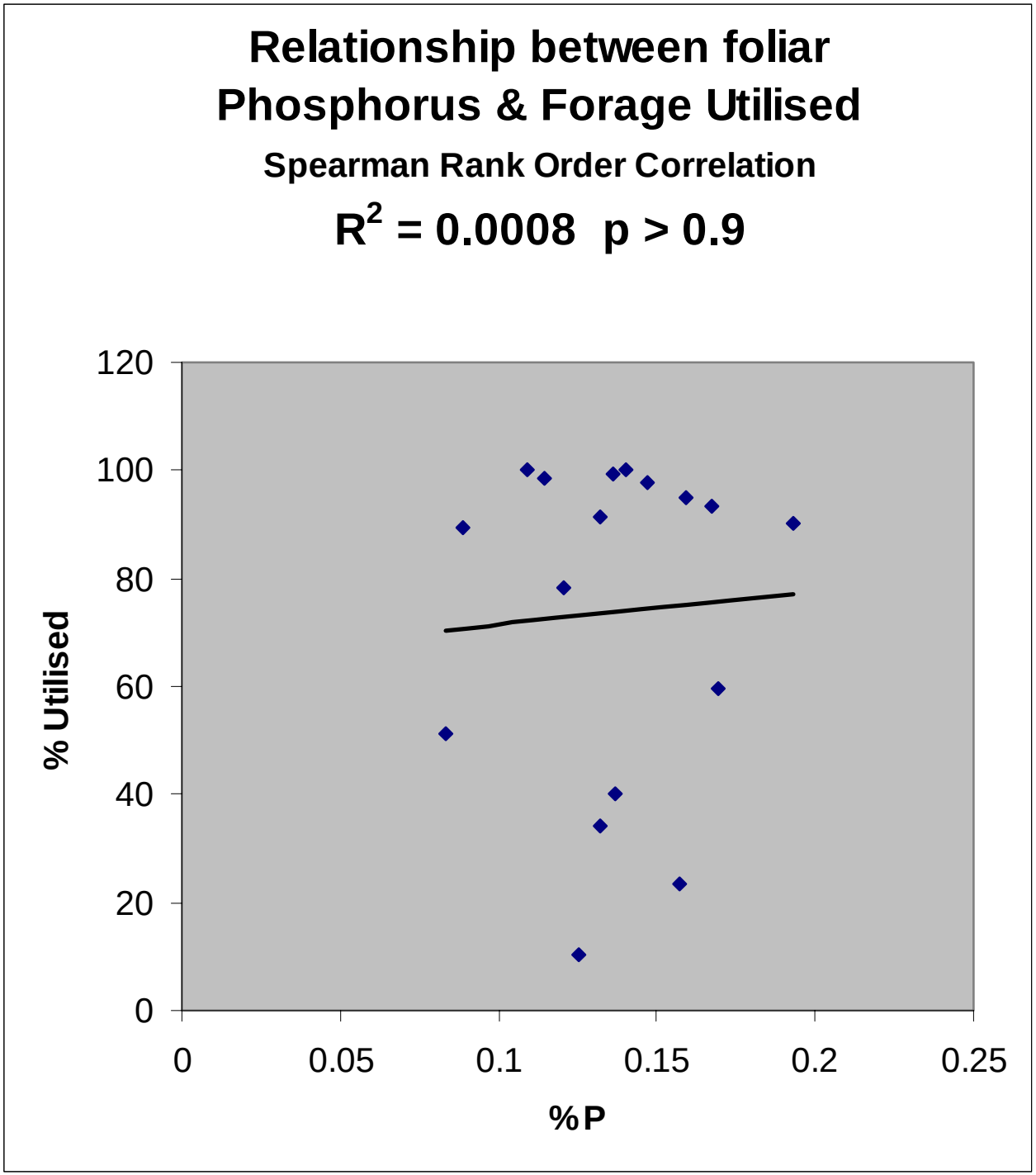
%P

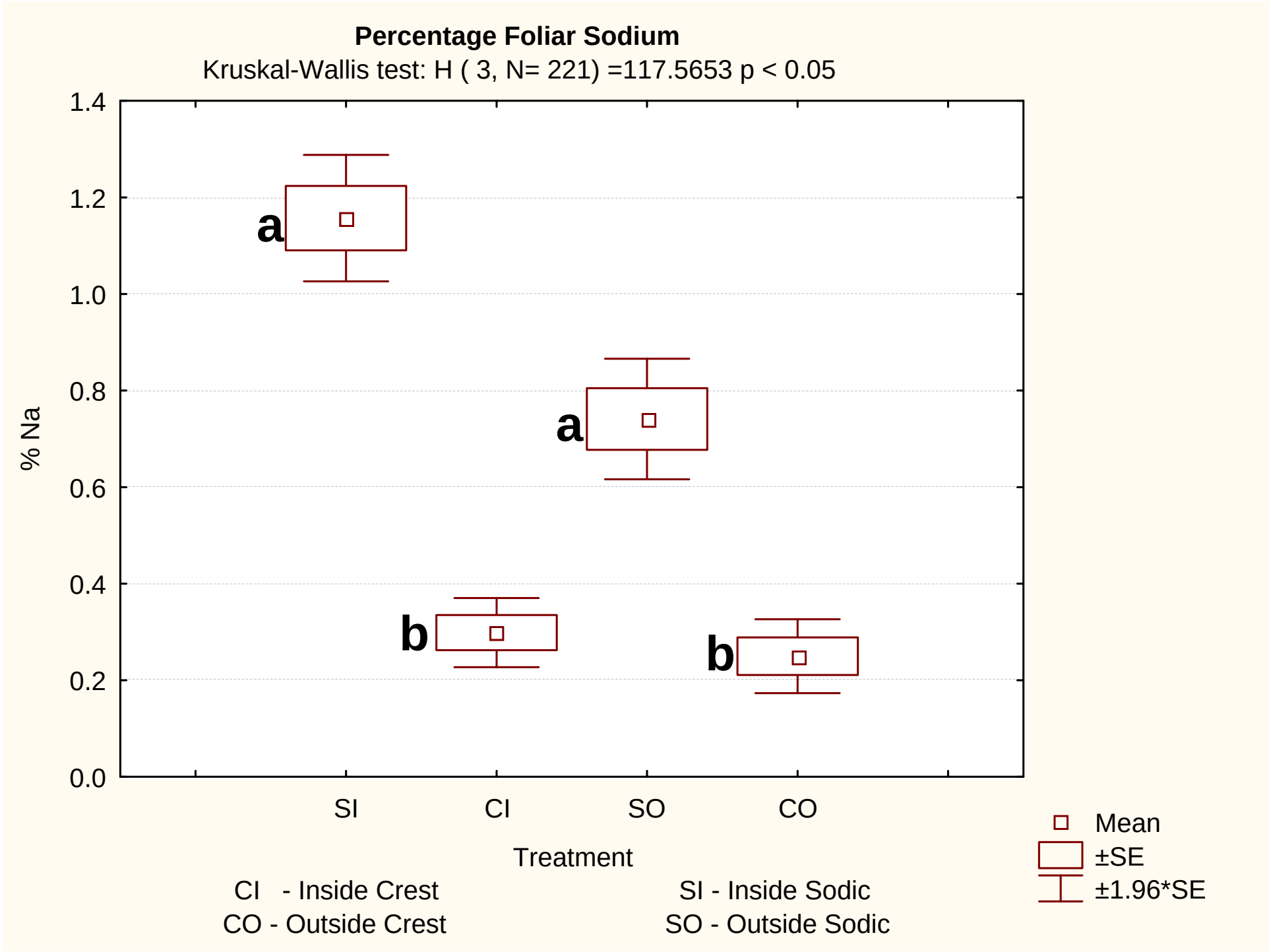
%Na

%N

%C


Percentage Foliar Phosphorus
Kruskal-Wallis test: H (3, N= 221) =13.40732 p < 0.05
0.16
0.15
0.14
0.13
0.12
0.11
0.10
% P
a
ab
b
ab
SI
CI
SO
CO
Treatment
Mean
±SE
±1.96*SE
CI - Inside Crest
CO - Outside Crest
SI - Inside Sodic
SO - Outside Sodic

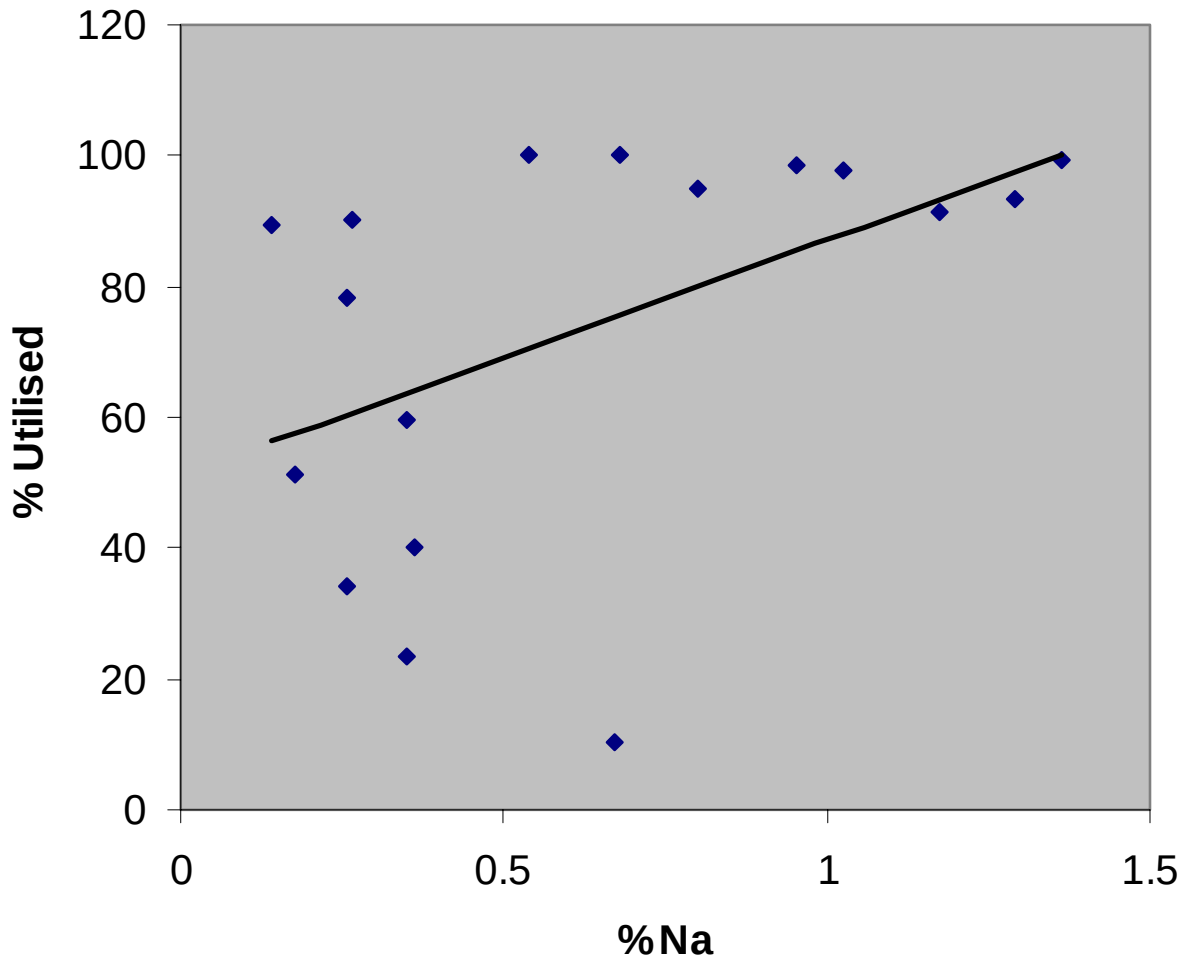

Relationship between foliar Phosphorus & Forage Utilised
Spearman Rank Order Correlation
R2 = 0.0008 p > 0.9
% Utilised
120
100
80
60
40
20
0
0
0.05
0.1
0.15
0.2
0.25
%P

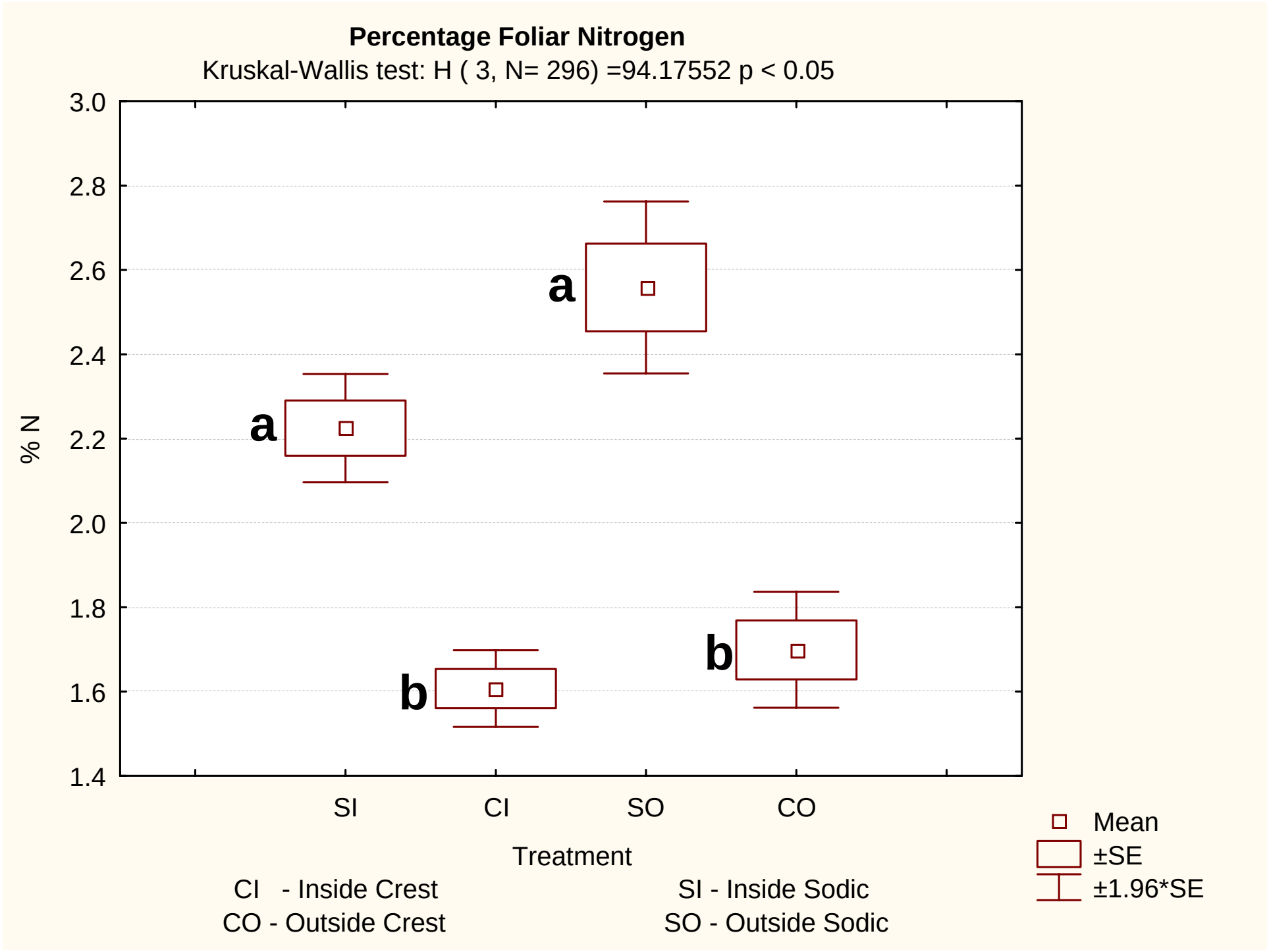

Percentage Foliar Sodium
Kruskal-Wallis test: H (3, N= 221) =117.5653 p < 0.05
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
% Na
a
a
b
b
SI
CI
SO
CO
Treatment
CI - Inside Crest
SI - Inside Sodic
CO - Outside Crest
SO - Outside Sodic
Mean
±SE
±1.96*SE

Relationship between foliar Sodium & Forage Utilised

Spearman Rank Order Correlation

$R^2 = 0.32$ $p < 0.05$

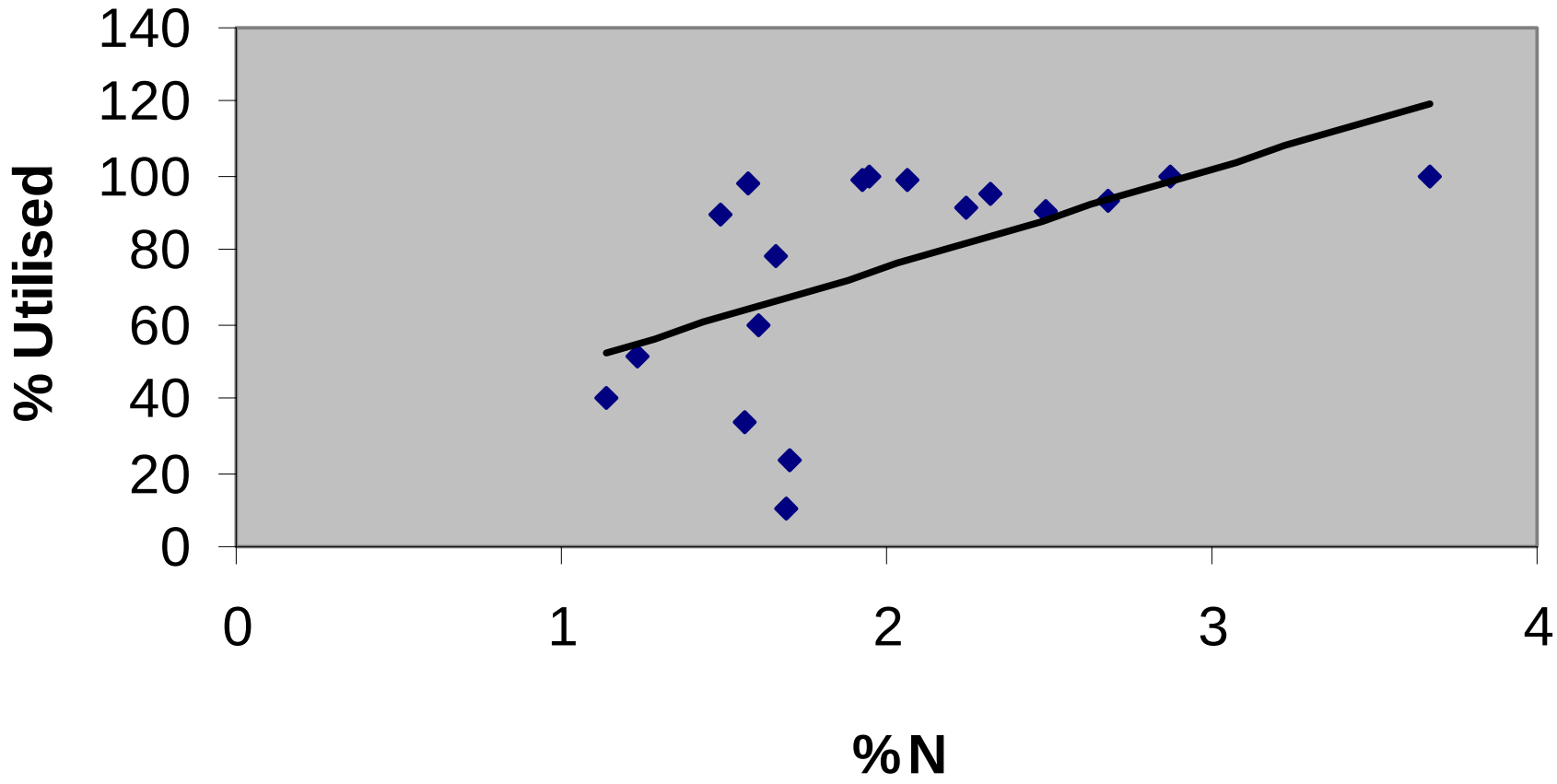


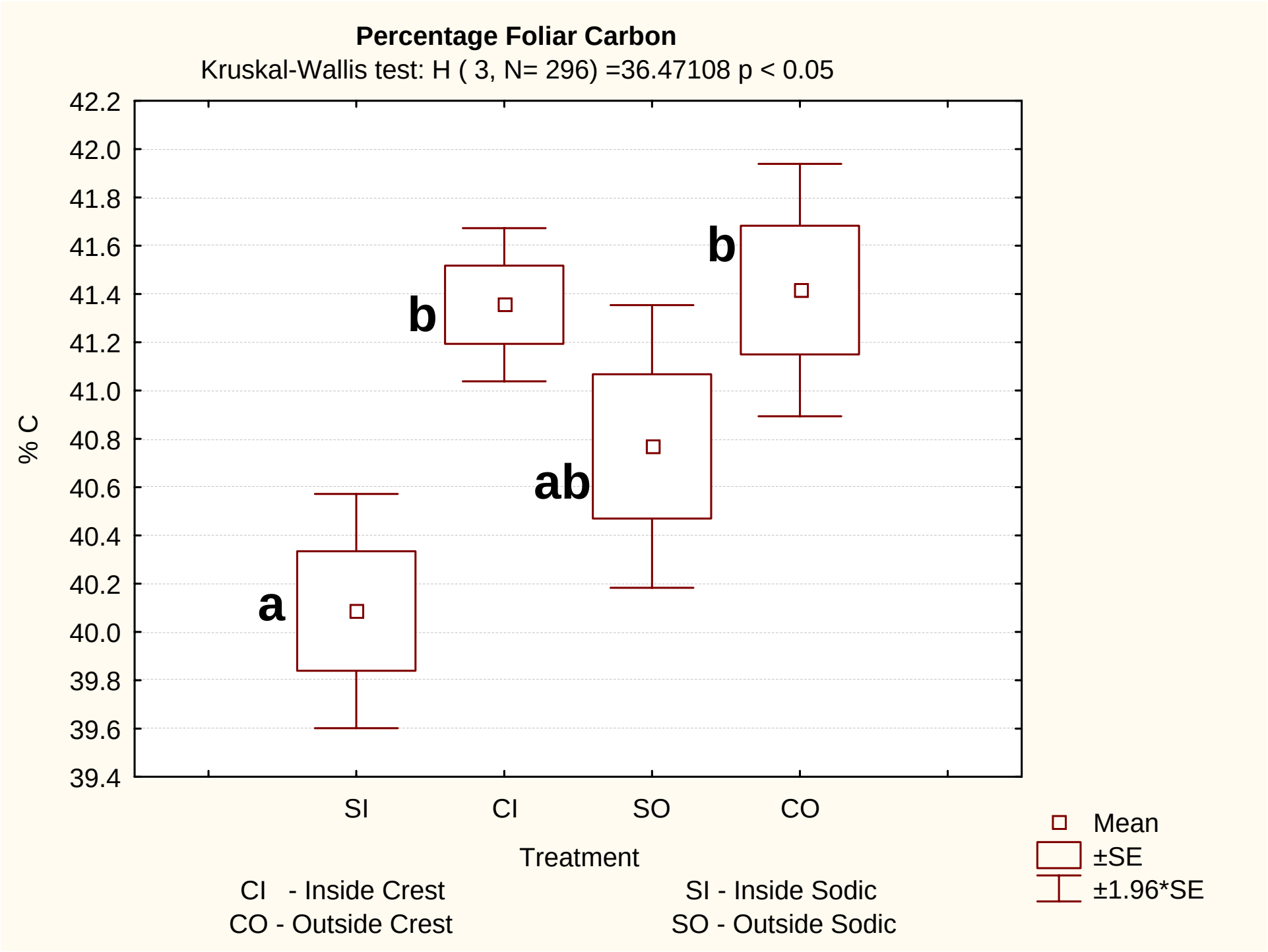

Percentage Foliar Nitrogen
Kruskal-Wallis test: H (3, N= 296) =94.17552 p < 0.05
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
% N
a
a
b
b
SI
CI
SO
CO
Treatment
CI - Inside Crest
CO - Outside Crest
SI - Inside Sodic
SO - Outside Sodic
Mean
±SE
±1.96*SE

Relationship between foliar Nitrogen & Forage Utilised

Spearman Rank Order Correlation

$R^2 = 0.41$ $p < 0.05$

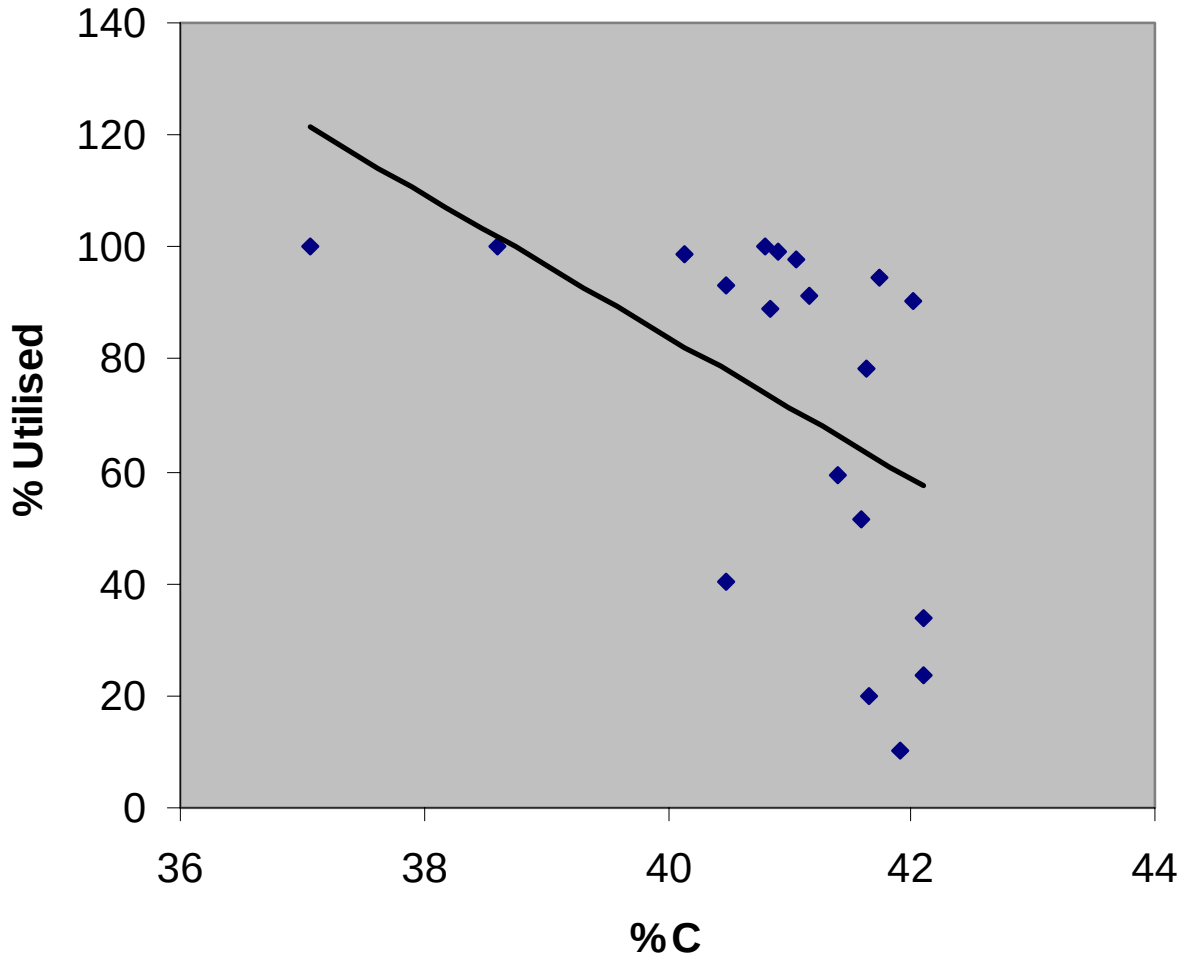


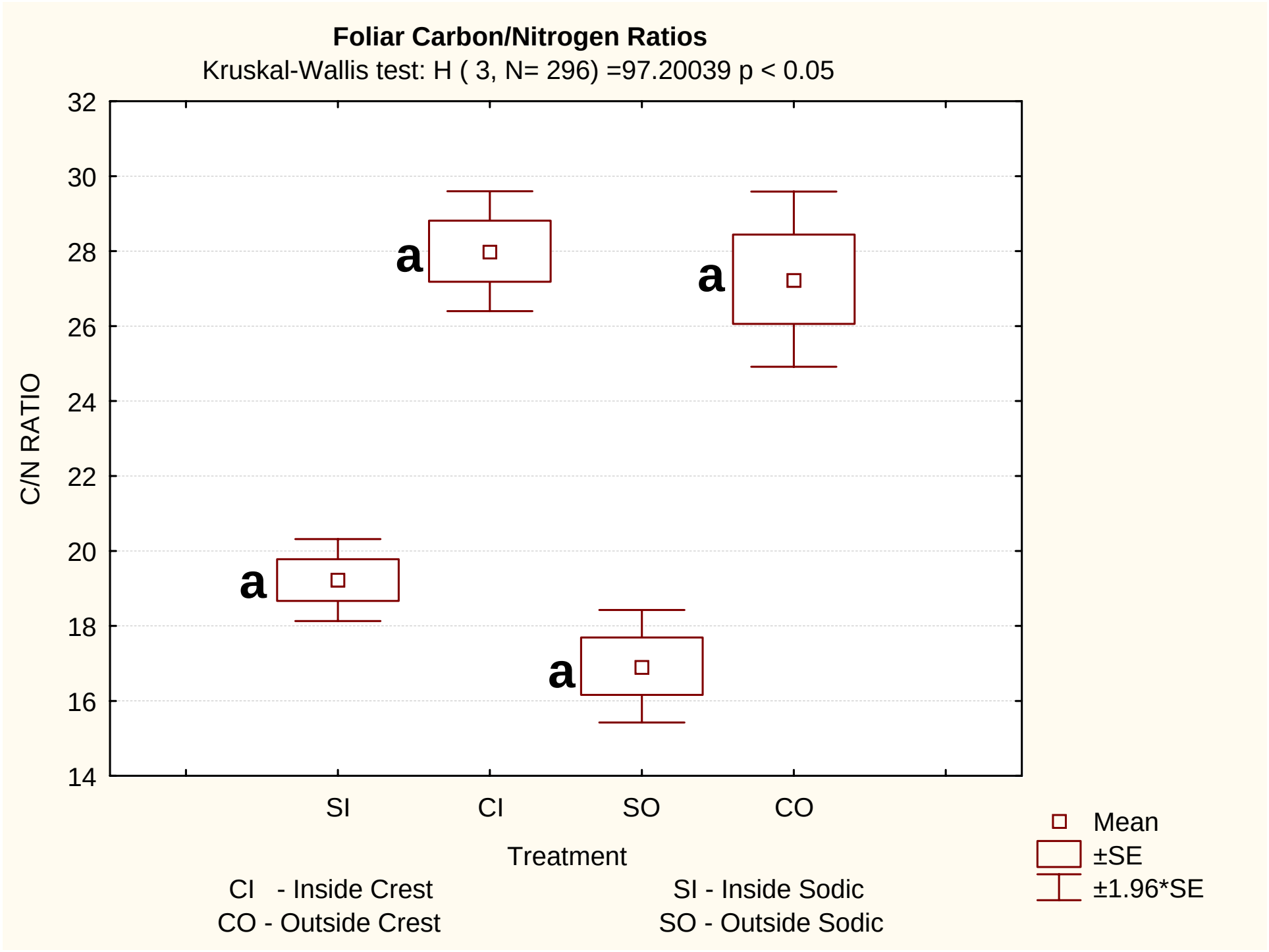

Percentage Foliar Carbon
Kruskal-Wallis test: H (3, N= 296) =36.47108 p < 0.05
% C
42.2
42.0
41.8
41.6
41.4
41.2
41.0
40.8
40.6
40.4
40.2
40.0
39.8
39.6
39.4
a
b
ab
b
SI
CI
SO
CO
Treatment
Mean
±SE
±1.96*SE
CI - Inside Crest
CO - Outside Crest
SI - Inside Sodic
SO - Outside Sodic

Relationship between foliar Carbon & Forage Utilised

Spearman Rank Order Correlation

$R^2 = 0.49$ $p < 0.05$

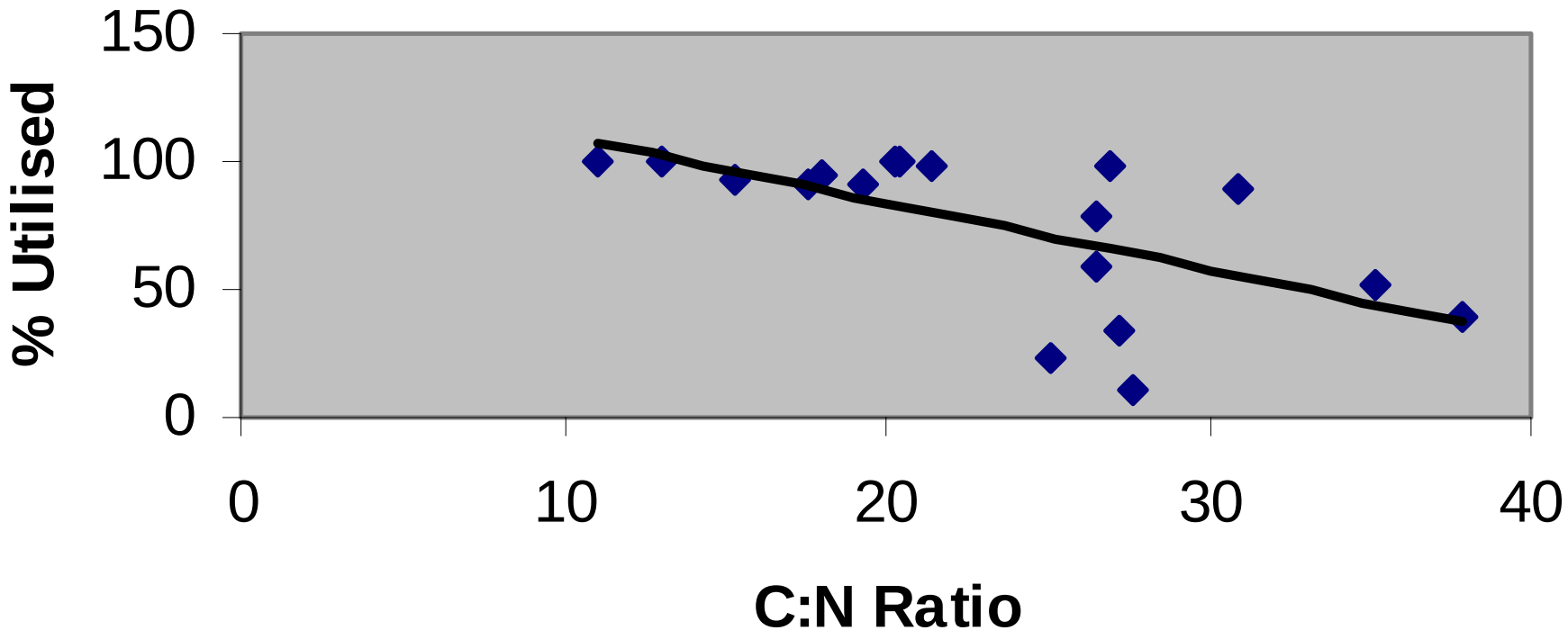



Foliar Carbon/Nitrogen Ratios
Kruskal-Wallis test: H (3, N= 296) =97.20039 p < 0.05
C/N RATIO
32
30
28
26
24
22
20
18
16
14
a
a
a
SI
CI
SO
CO
Treatment
Mean
±SE
±1.96*SE
CI - Inside Crest
CO - Outside Crest
SI - Inside Sodic
SO - Outside Sodic

Relationship between foliar Carbon/Nitrogen & Forage Utilised

Spearman Rank Order Correlation

$R^2 = 0.48$ $p < 0.05$



CONCLUSIONS

1. **Sodic site grass biomass productivity (1m^2 scale) is not significantly different than on Crests**

2. **Sodic Site forage is utilised significantly more than Crest forage**

3. **Sodic site forage quality is significantly higher than crest forage (high %Na, low C/N); which leads to higher utilisation by herbivores.**

Sodic sites are important elements in the semi-arid granitic savanna landscape in terms of high quantity & quality forage supply:

- **high utilisation scores of the sward & sustained & relatively high presence by large mammalian grazers**
- **Significantly higher %Na and lower C/N ratios in SS forage are strongly correlated to utilisation**