Supplementary Figures

Reduction in nutritional quality and growing area suitability of common bean under climate change induced drought stress in Africa

Marijke Hummel[1], Brendan F. Hallahan[1], Galina Brychkova[1], Julian Ramirez-Villegas[2], Veronica Guwela[1], Bartholomew Chataika[3], Edna Curley[1], Peter C. McKeown[1], Liam Morrison[1], Elise Talsma[2], Steve Beebe[2], Andy Jarvis[2], Rowland Chirwa[3], and Charles Spillane[1,*]

Supplementary Figure Legends

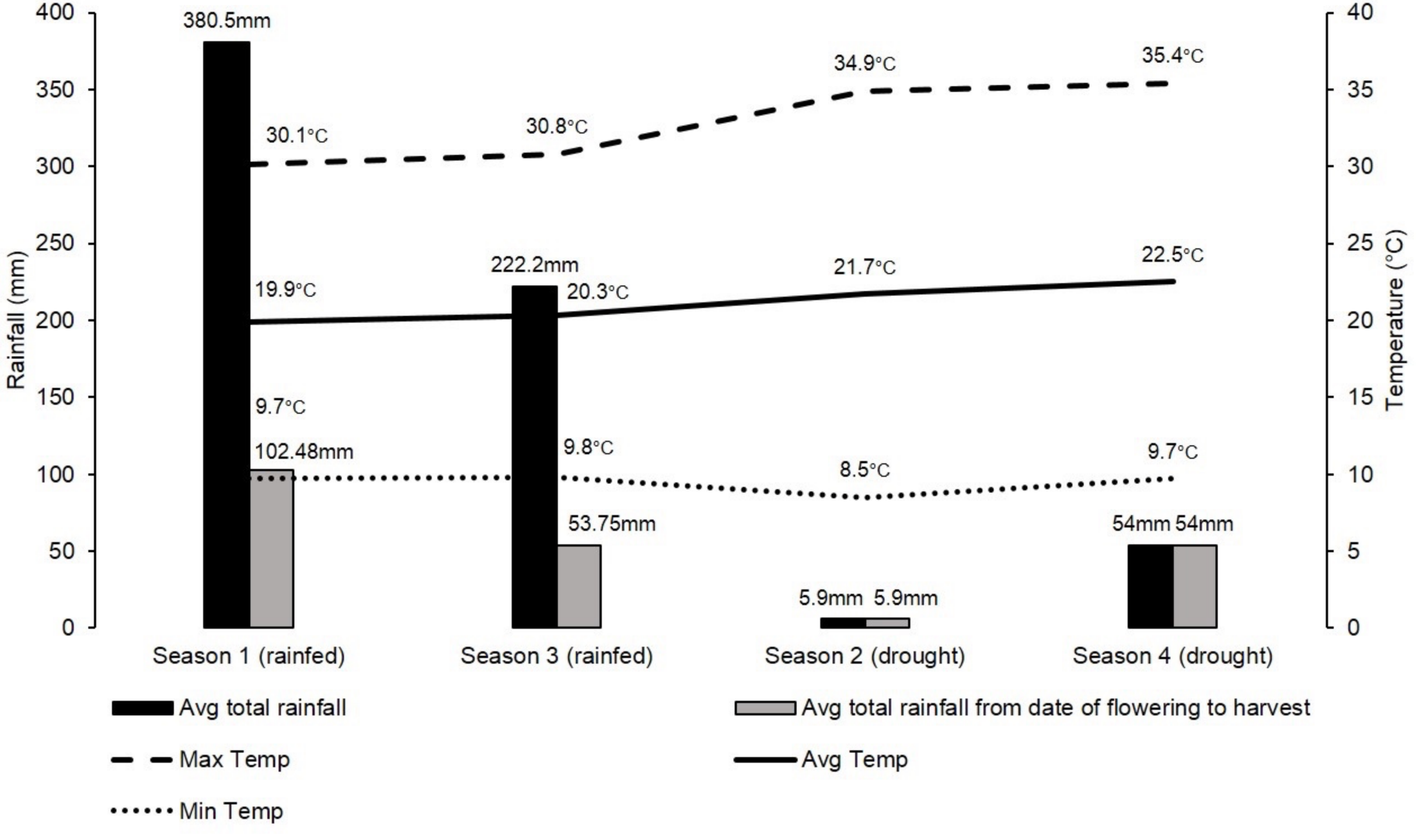
Supplementary Figure 1 | Rainfall and temperature data during crop growing period across rainfed (Season 1 and 3) and drought (Season 2 and 4) conditions. Source: Chitedze weather station.

Supplementary Figure 2 | Present-day drought season weather conditions mimics future bean growing season weather conditions. Using MarkSim standalone V.2 software two weather scenarios were simulated in Malawi for the year 2095. Under RCP 8.5 the months of March, April and May (bean growing season) will experience an average rainfall and temperature similar to that recorded in our field trials. (a) Ensemble of 7 of the most highly cited (>400 citations) General Circulation Models (GCMs). (b) Ensemble of all 17 GCMs.

Supplementary Figure 3 | Box and whisker plot showing average grain yield of 20 common bean varieties grown under rainfed and drought-stress conditions. 'X' indicates mean value.
*** $P < 0.001$

Supplementary Figure 4 | Percentage grain (A) Boron, (B) Sodium, (C) Magnesium, (D) Phosphorus, (E) Sulphur, (F) Potassium, (G) Calcium, (H) Titanium, (I) Chromium, (J) Manganese, (K) Copper, (L) Arsenic, (M) Rubidium, (N) Strontium, (O) Molybdenum, (P) Cadmium, (Q) Cobalt, (R) Nickel, (S) ^{57}Iron, (T) lead, (U) ^{56}Iron, (V) zinc, (W) phytic acid and protein (X) concentration change of each common bean variety under drought conditions relative to rainfed conditions.

Supplementary Figure 5 | Scatterplot comparing combinations of Fe and Zn concentrations in the CIAT core collection of 1000 cultivated common bean accessions (black circles) with equivalent values for the twenty common bean varieties tested in this study under rainfed (green circles) or drought conditions (red triangles).


Rainfall (mm)
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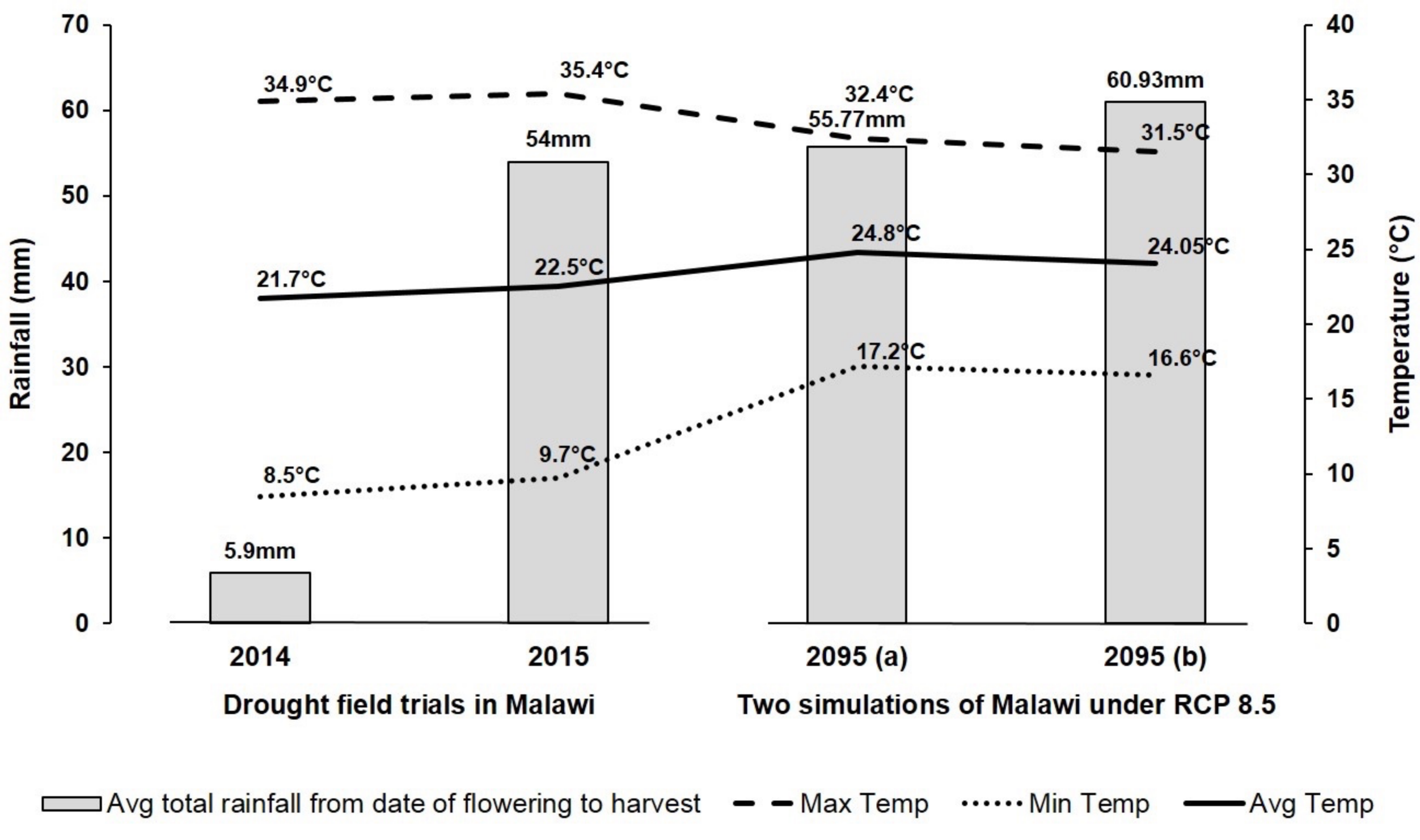
222.2mm
102.48mm
53.75mm
5.9mm 5.9mm
54mm 54mm
30.1°C
30.8°C
34.9°C
35.4°C
19.9°C
20.3°C
21.7°C
22.5°C
9.7°C
9.8°C
8.5°C
9.7°C
Season 1 (rainfed)
Season 3 (rainfed)
Season 2 (drought)
Season 4 (drought)
Avg total rainfall
Avg total rainfall from date of flowering to harvest
Max Temp
Avg Temp
Min Temp


Rainfall (mm)
Temperature (°C)
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20
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34.9°C
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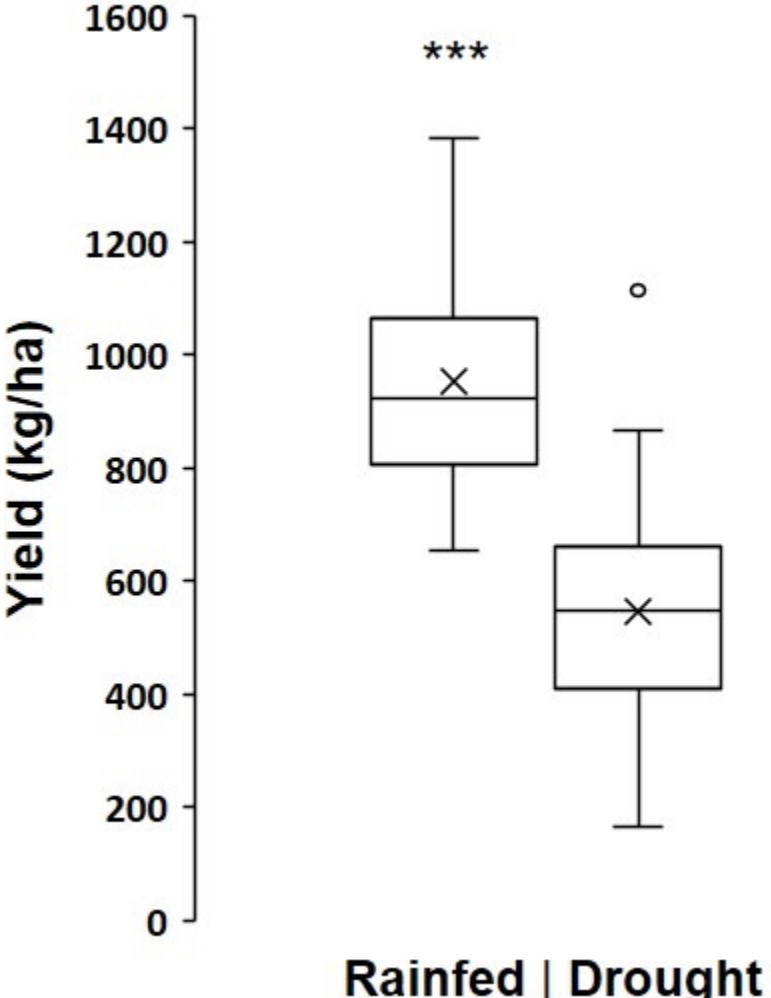
32.4°C
31.5°C
21.7°C
22.5°C
24.8°C
24.05°C
8.5°C
9.7°C
17.2°C
16.6°C
5.9mm
54mm
55.77mm
60.93mm
2014
2015
2095 (a)
2095 (b)
Drought field trials in Malawi
Two simulations of Malawi under RCP 8.5
Avg total rainfall from date of flowering to harvest
Max Temp
Min Temp
Avg Temp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Yield (kg/ha)
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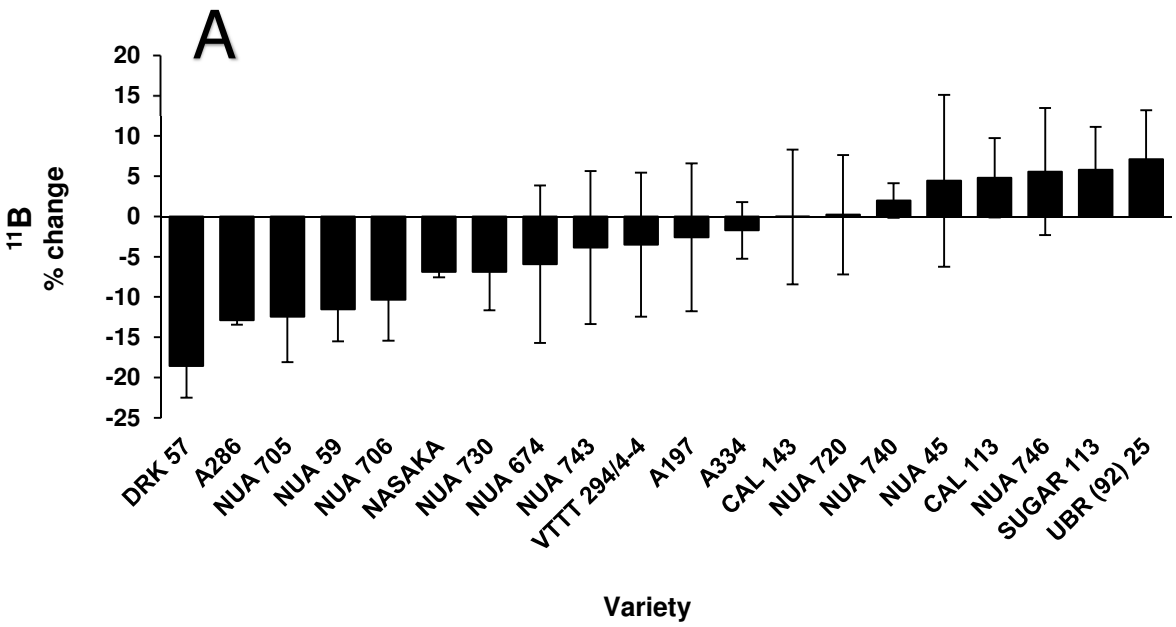
Rainfed | Drought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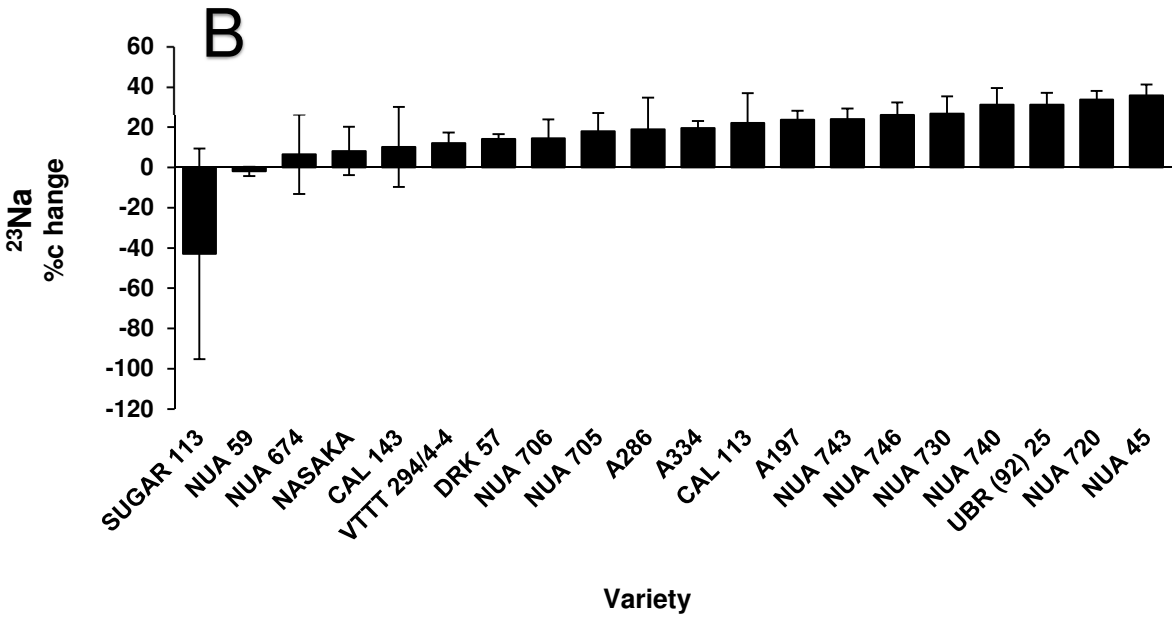
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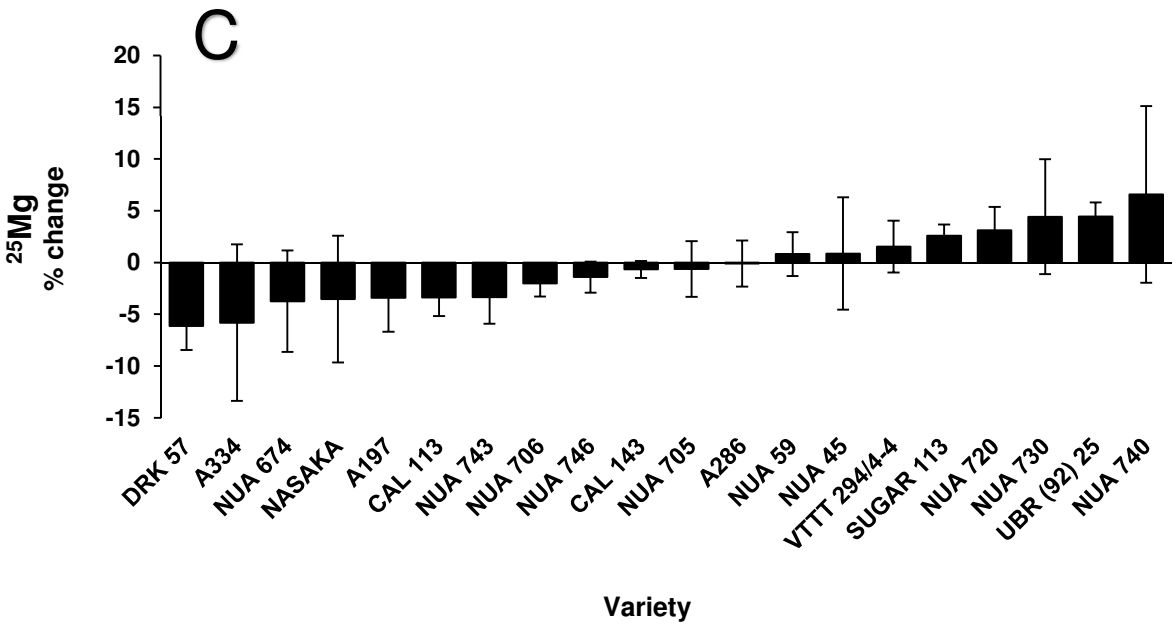
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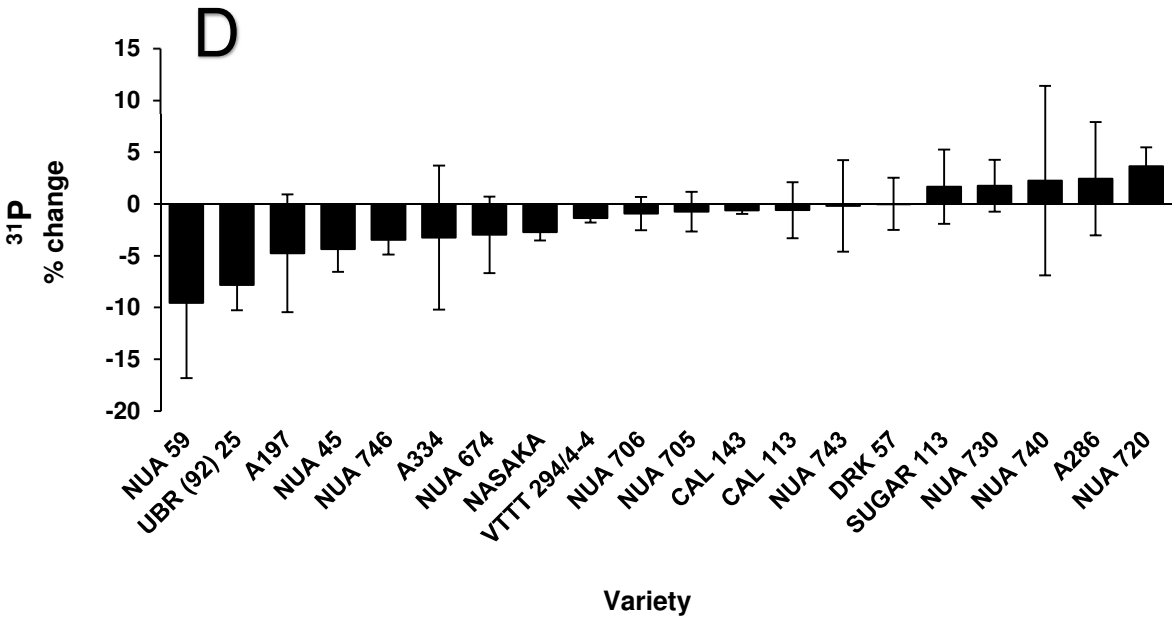
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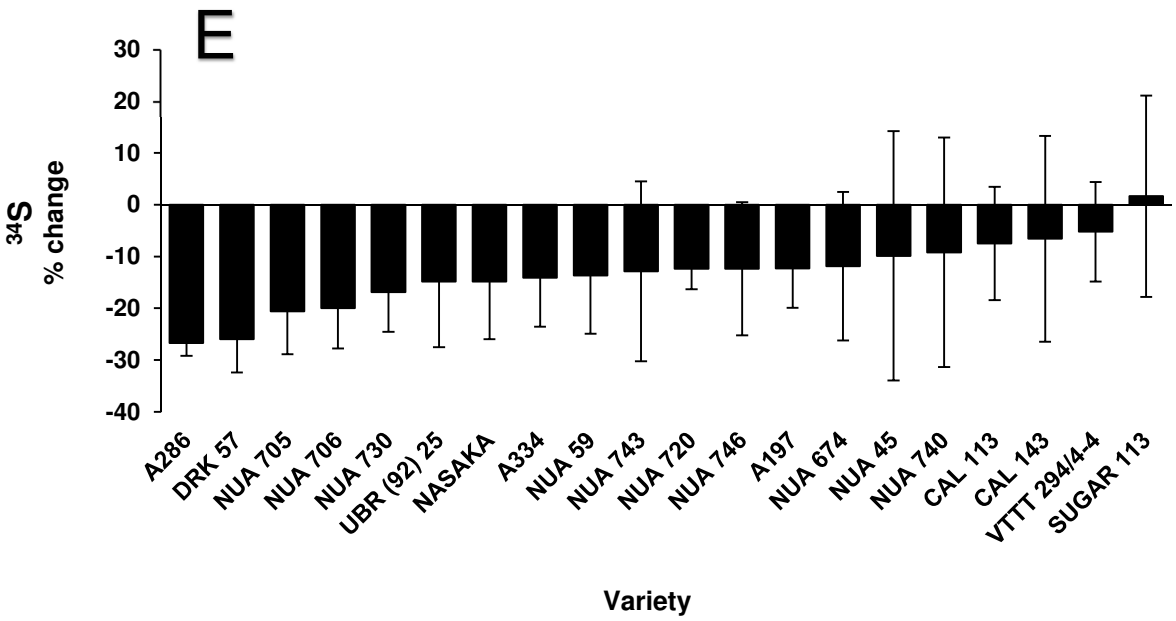
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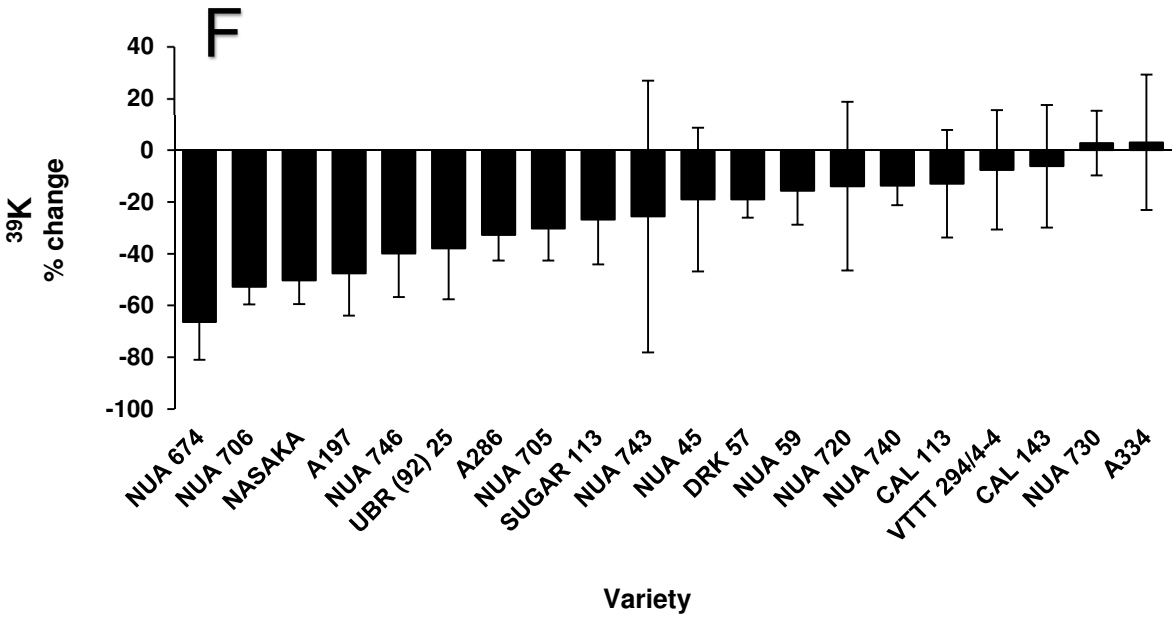
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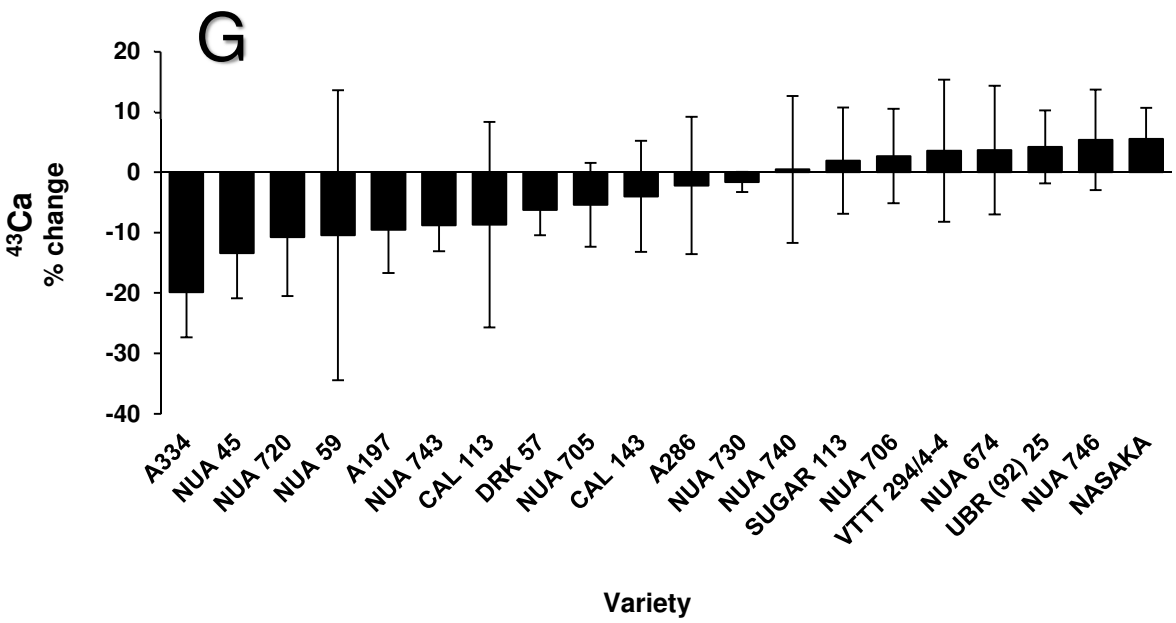
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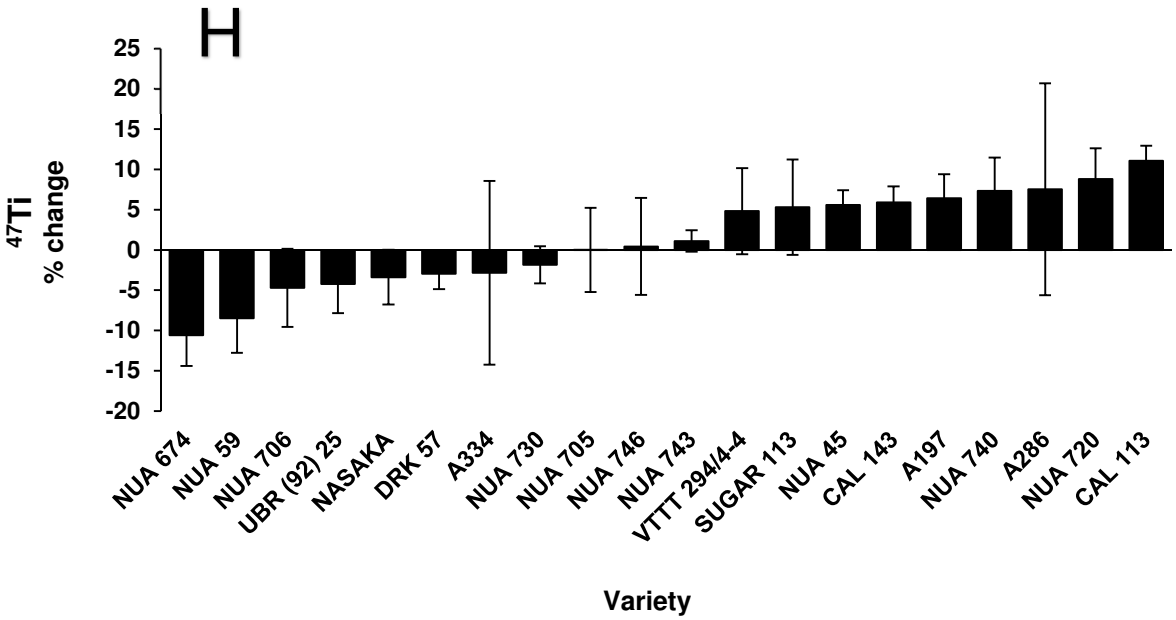
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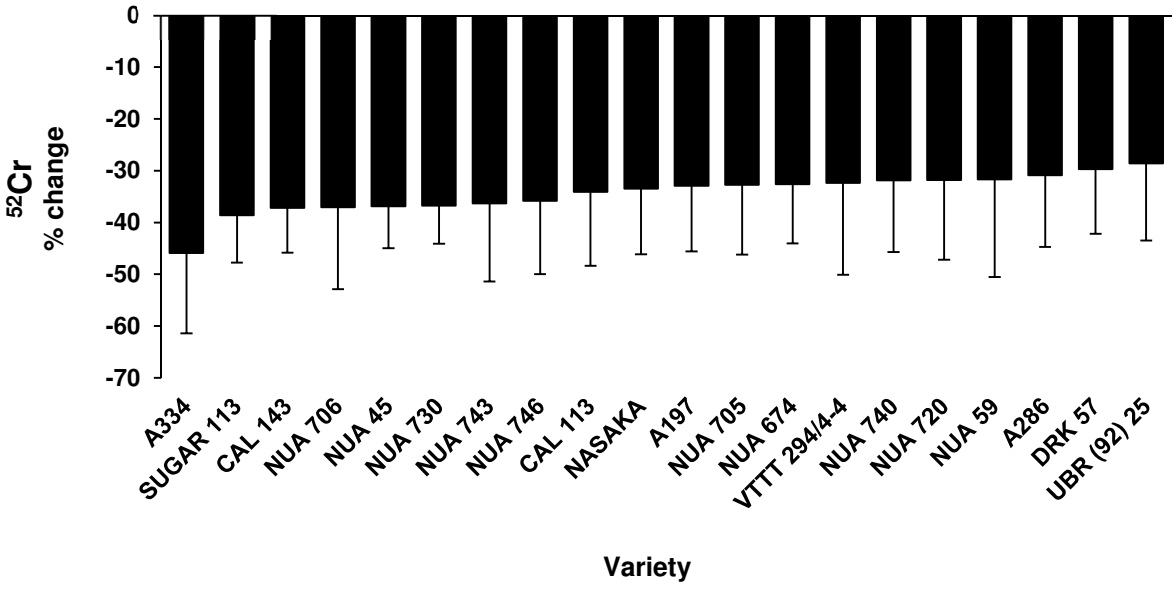
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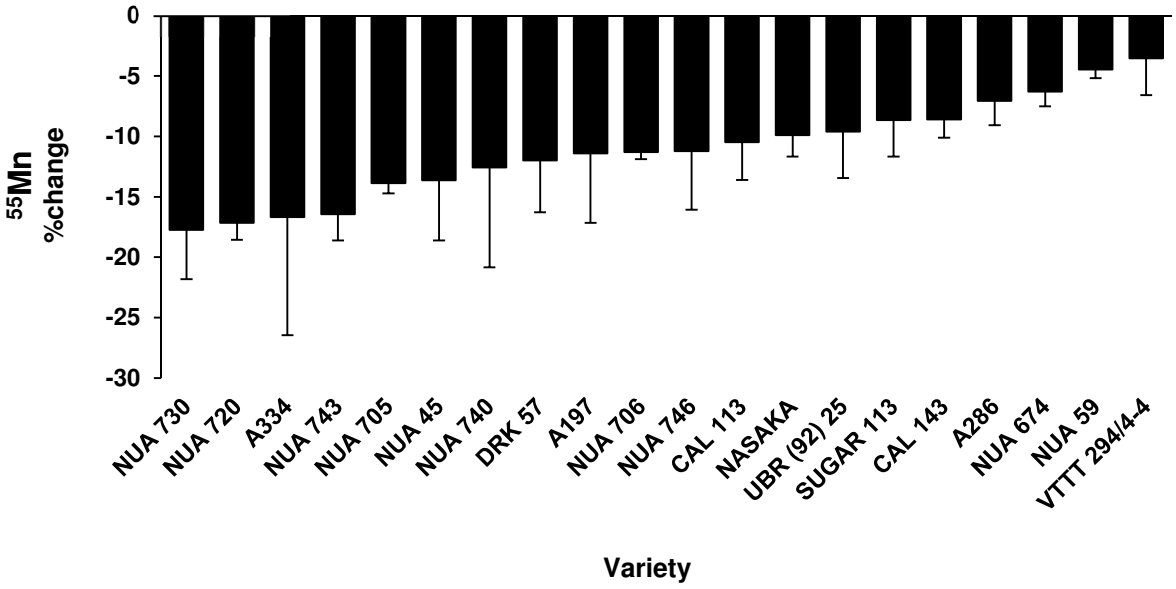
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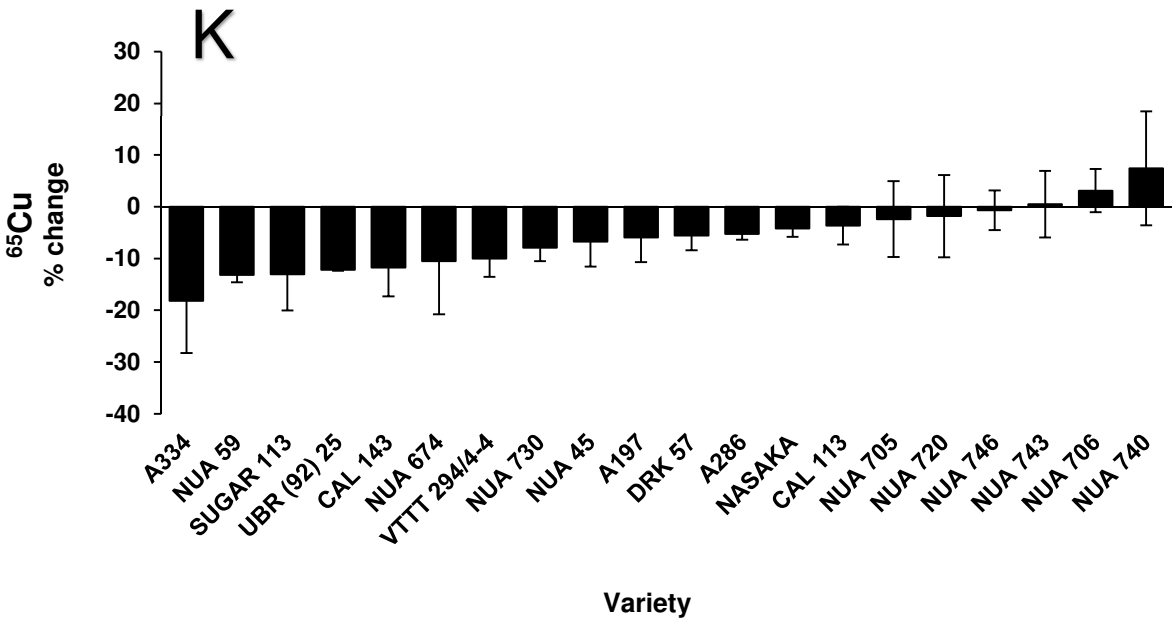
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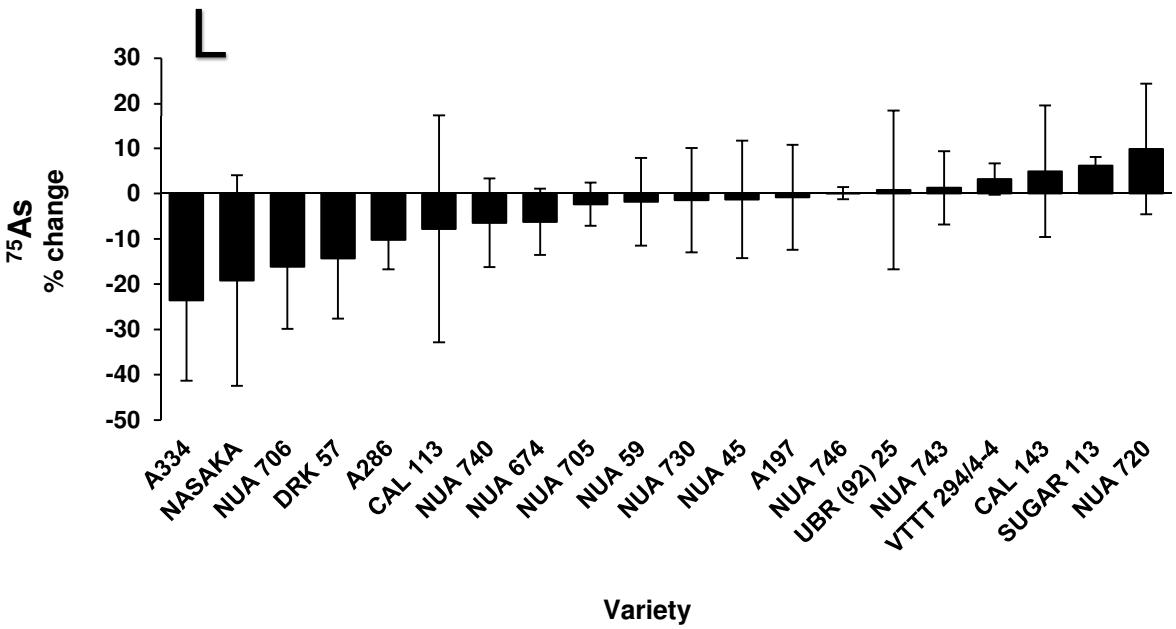
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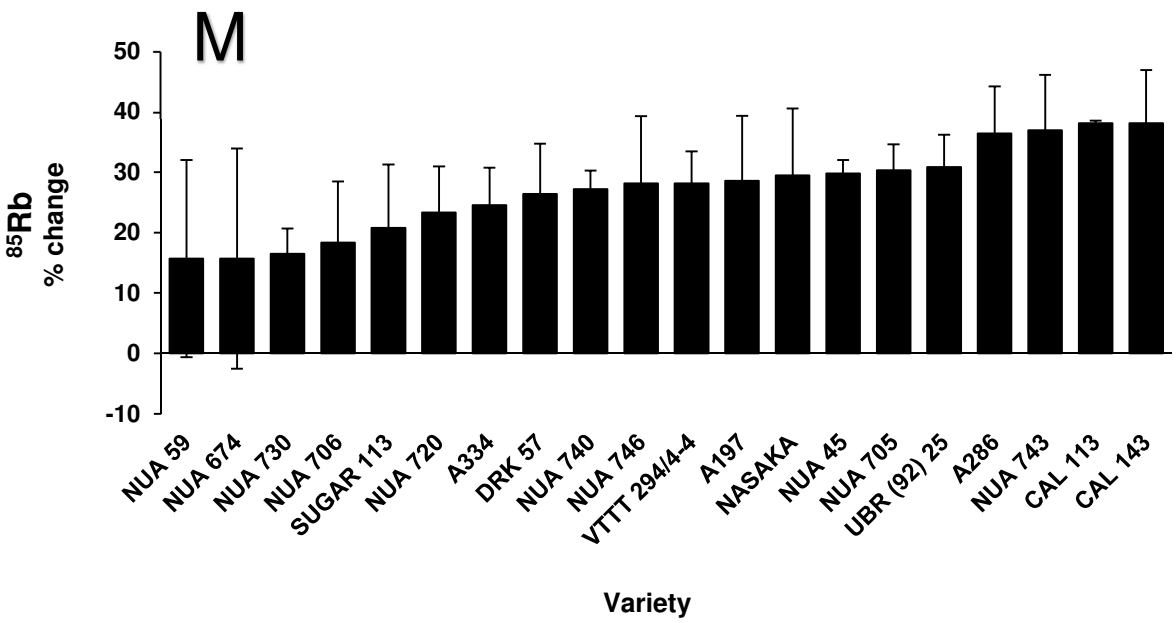
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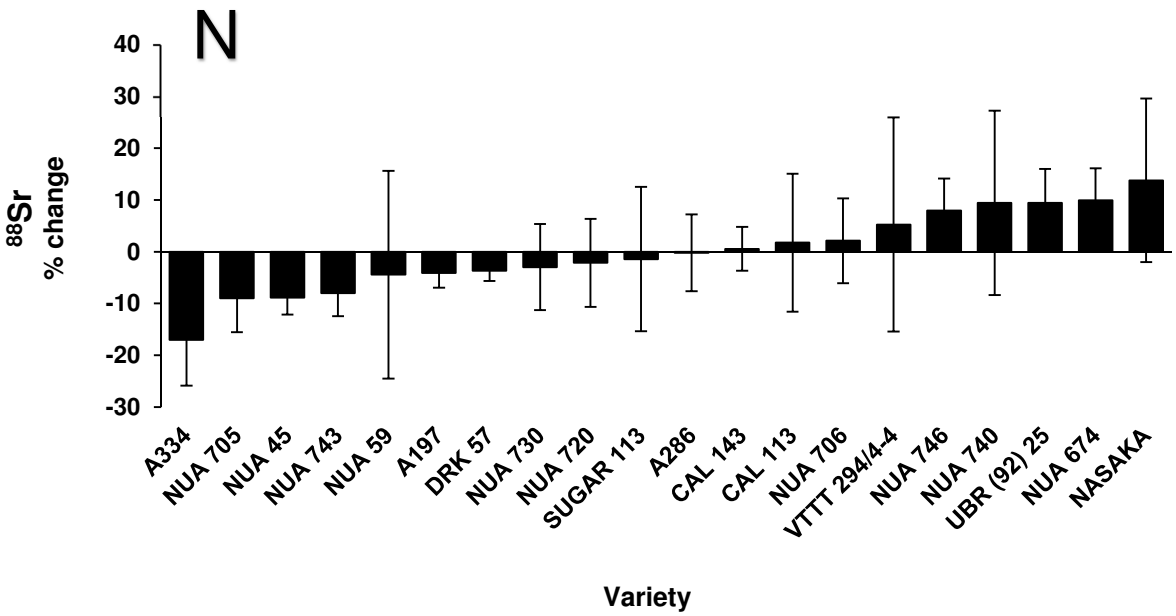
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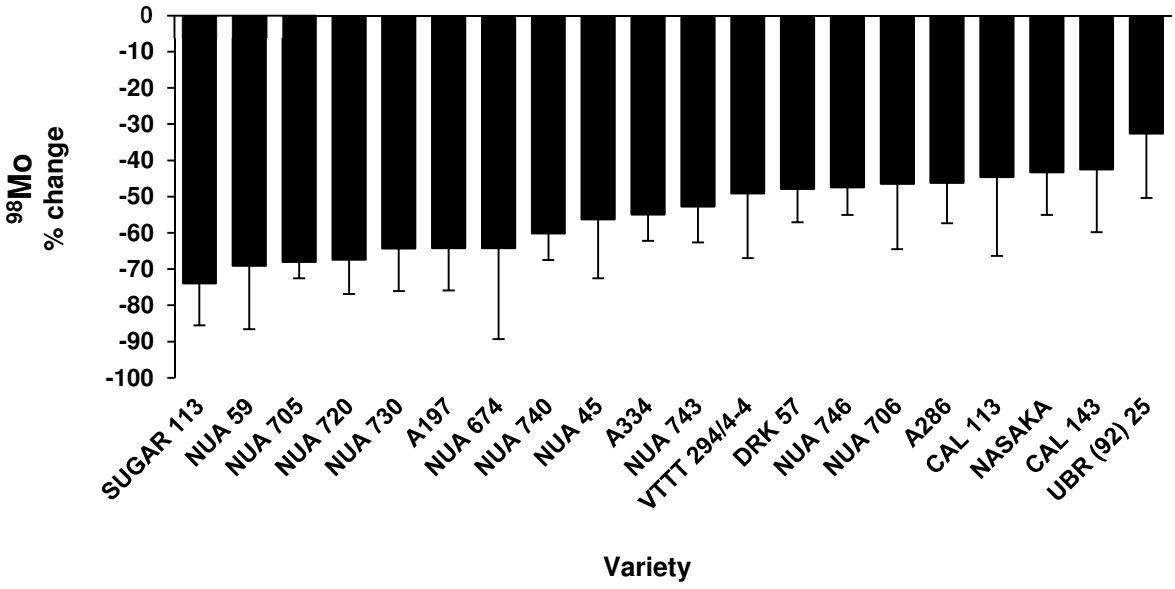
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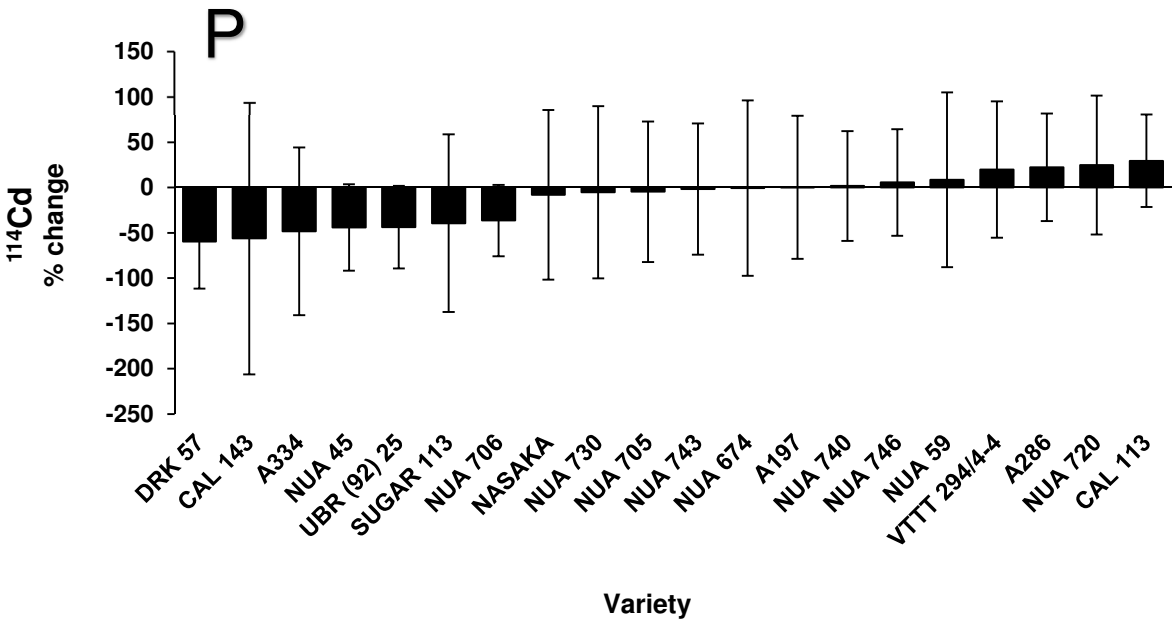
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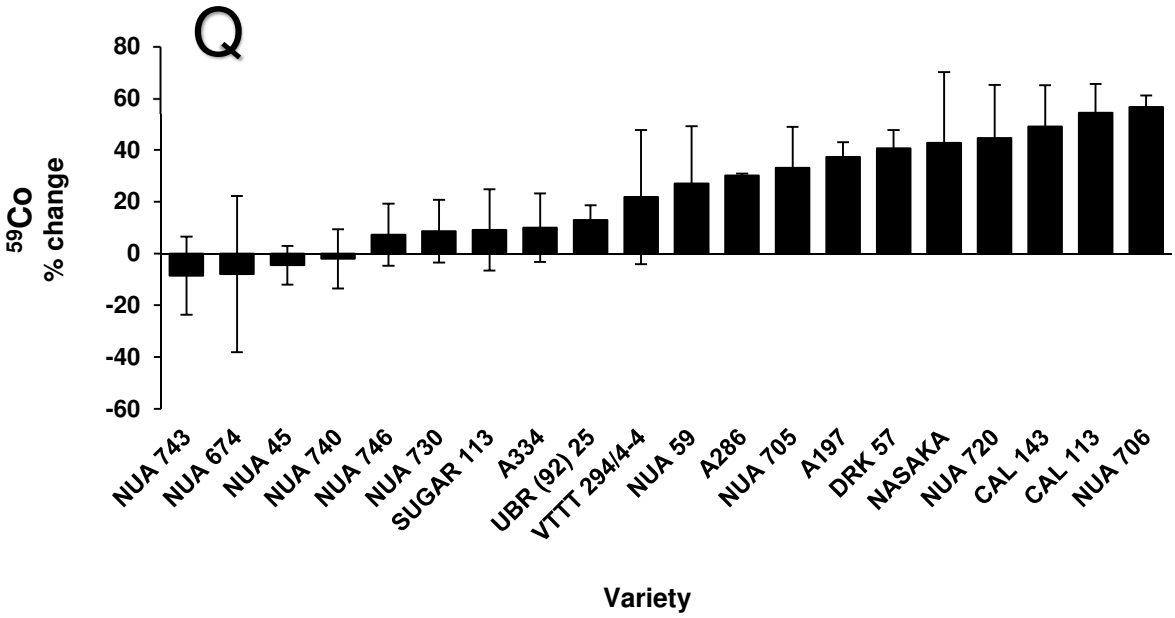
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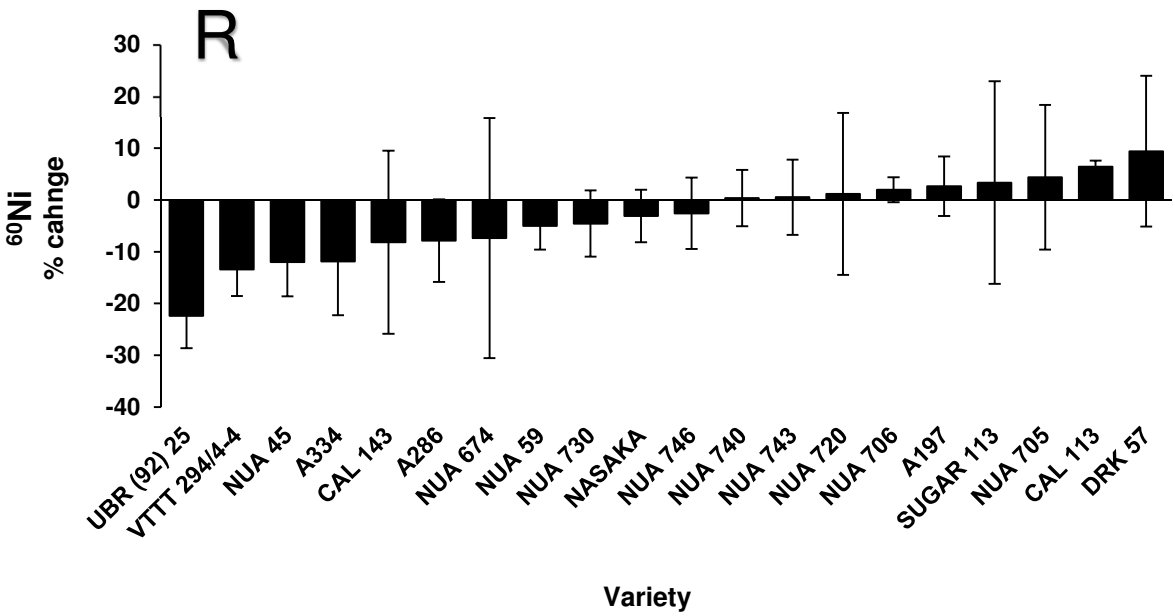
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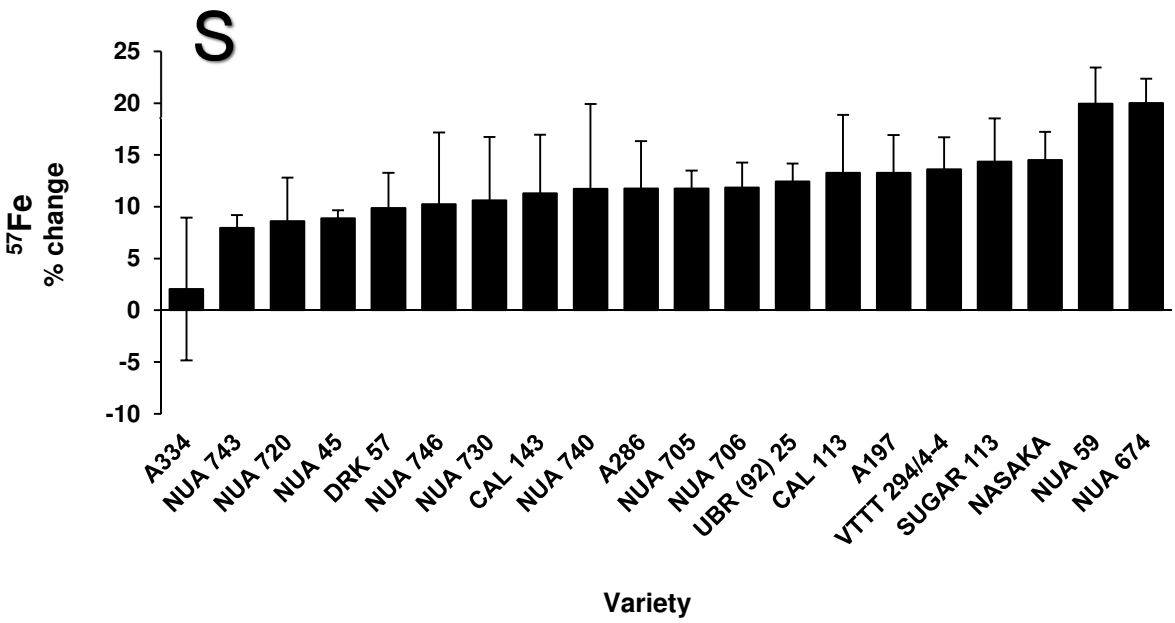
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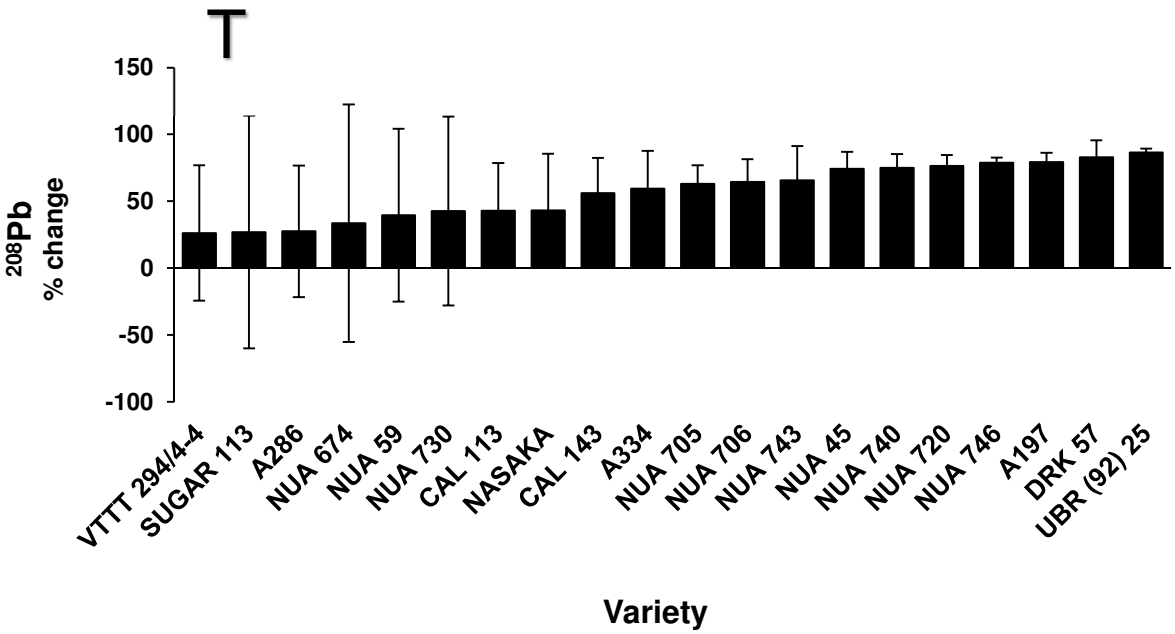
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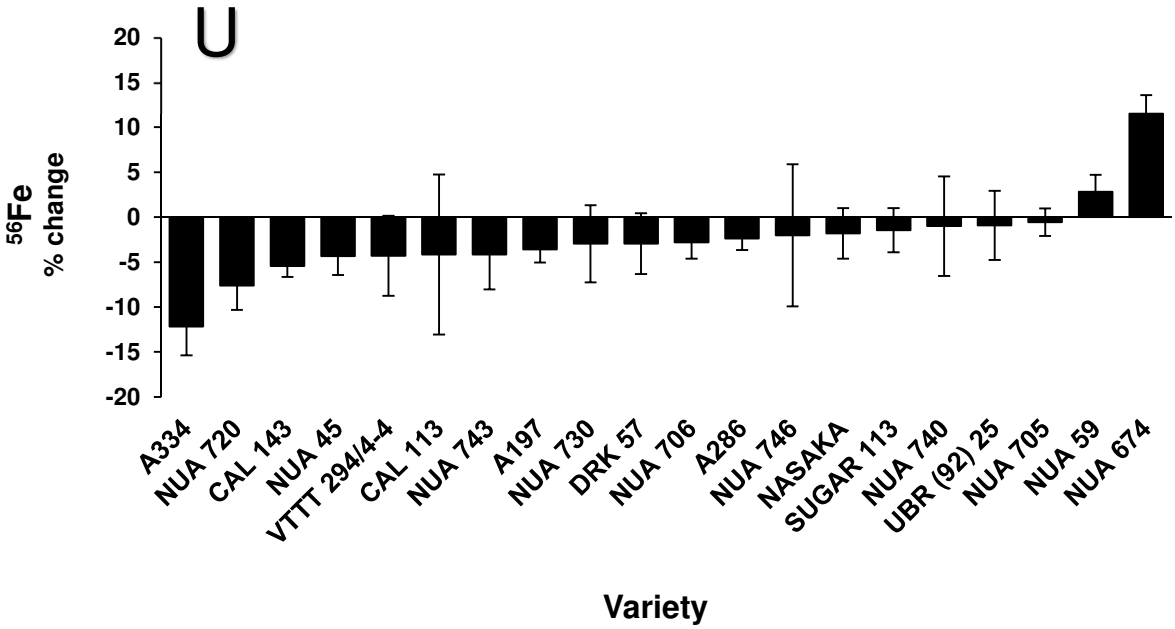
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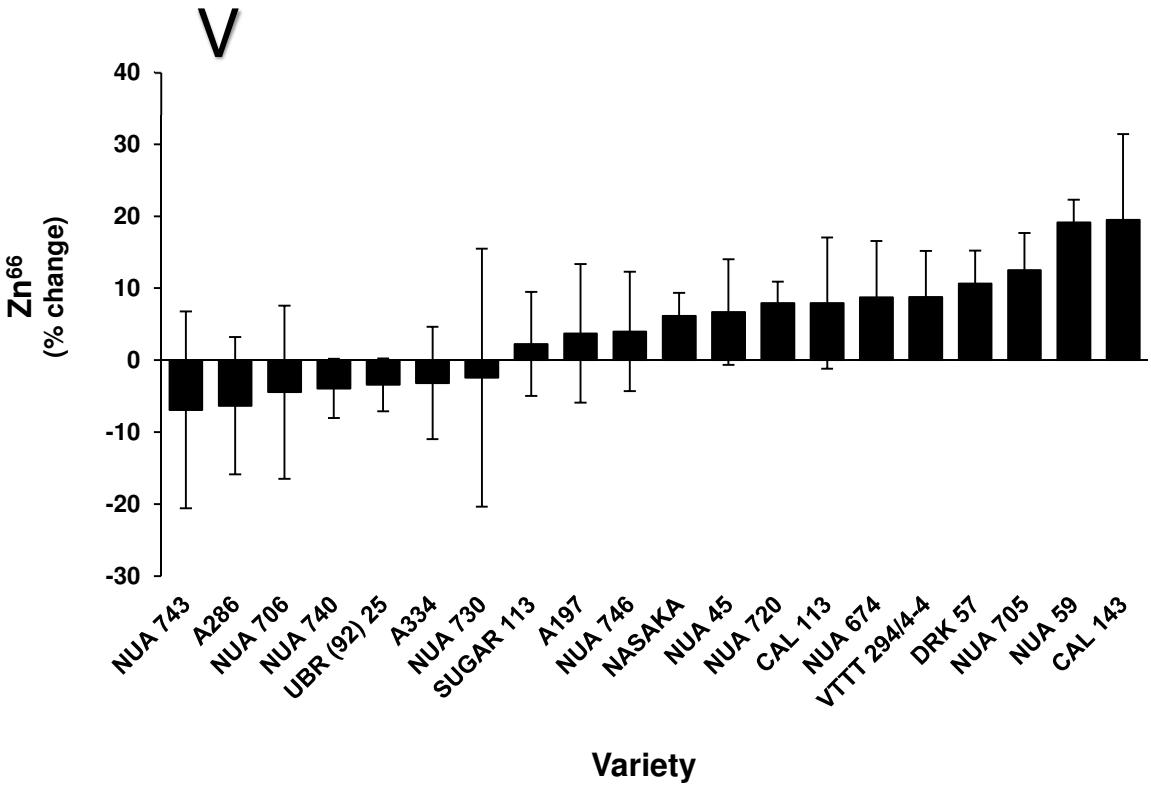
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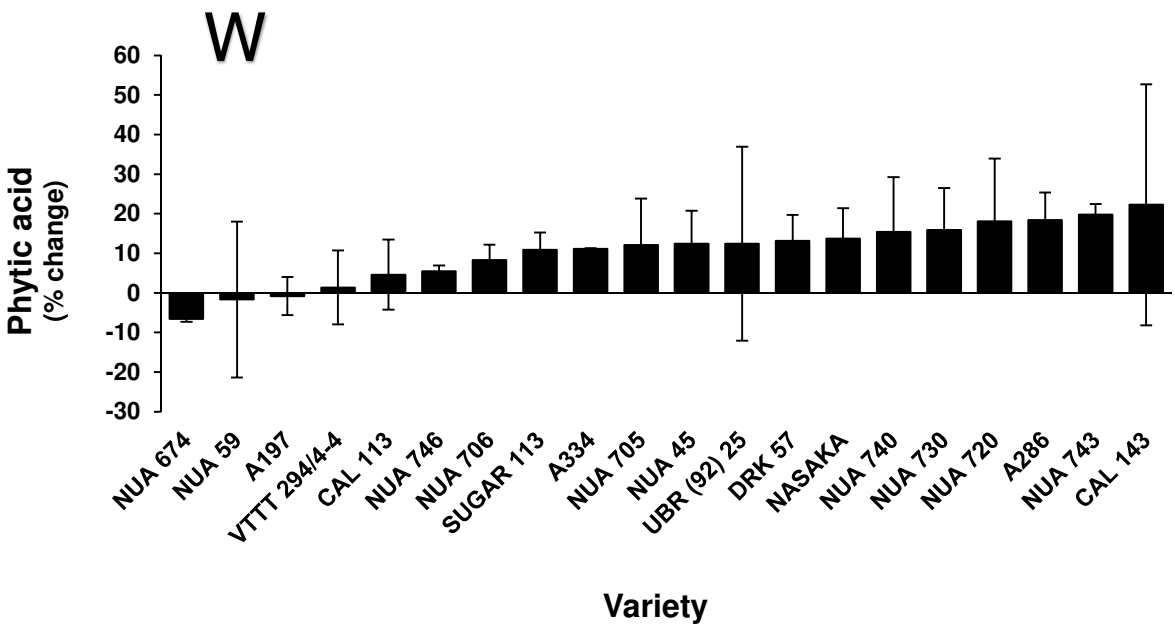
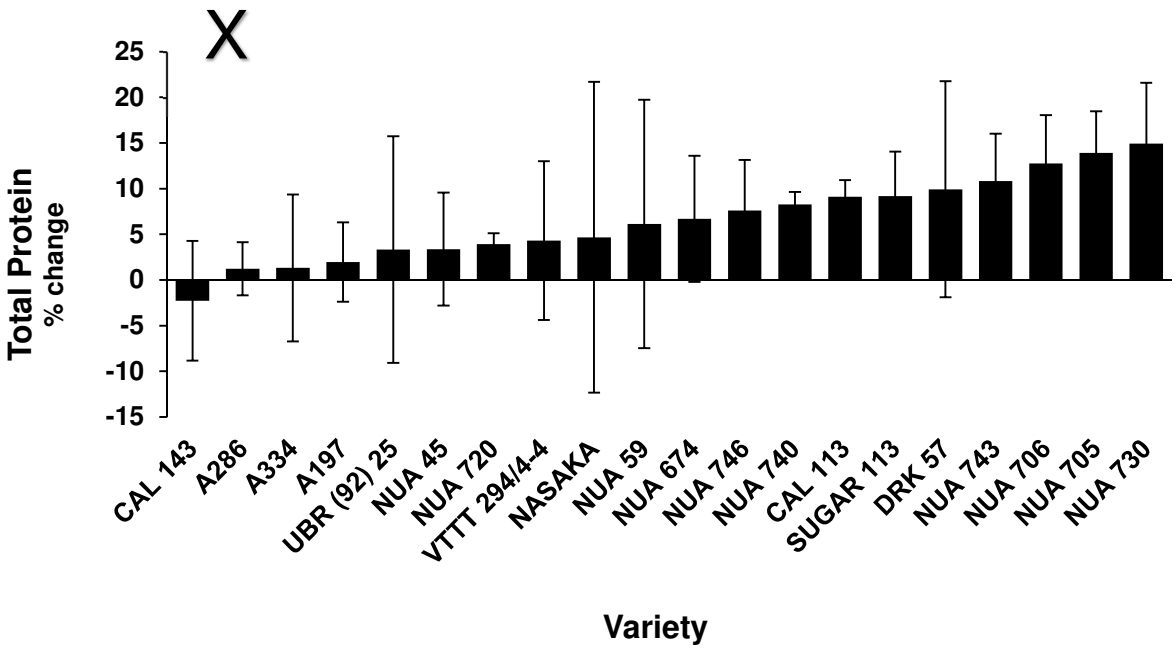
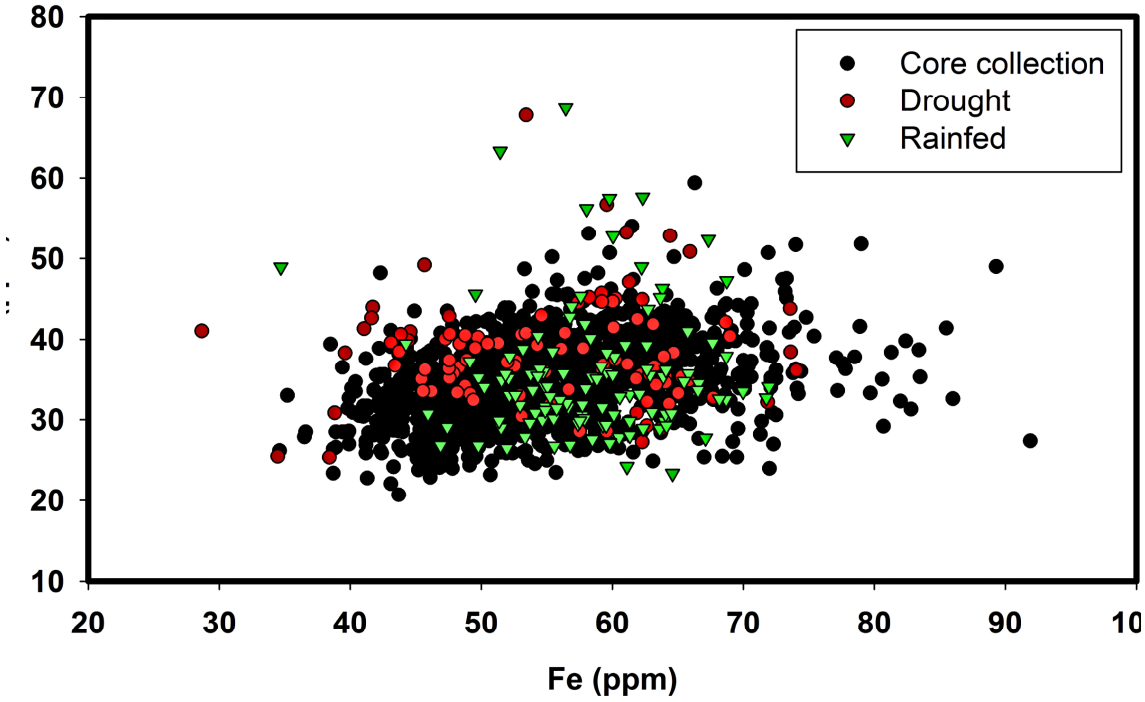
CAL 143
Variety


W
Phytic acid
(% change)
60
50
40
30
20
10
0
-10
-20
-30
NUA 674
NUA 59
A197
VTTT 294/4-4
CAL 113
NUA 746
NUA 706
SUGAR 113
A334
NUA 705
NUA 45
UBR (92) 25
DRK 57
NASAKA
NUA 740
NUA 730
NUA 720
A286
NUA 743
CAL 143
Variety


X
Total Protein
% change
25
20
15
10
5
0
-5
-10
-15
CAL 143
A286
A334
A197
UBR (92) 25
NUA 45
NUA 720
VTTT 294/4-4
NASAKA
NUA 59
NUA 674
NUA 746
NUA 740
CAL 113
SUGAR 113
DRK 57
NUA 743
NUA 706
NUA 705
NUA 730
Variety


Core collection
Drought
Rainfed
80
70
60
50
40
30
20
10
20
30
40
50
60
70
80
90
Fe (ppm)