Table S1. Least squares means and coefficient of variation (C.V.%) of kernel shape, color and nutrient traits of Native American maize landraces and results of a mixed model variance components analysis using kernel weight as a covariate, years (Yr), populations (Pop.) and their interaction as fixed factors, and accessions within landraces [Accn(landrace)], landraces within populations [landrace(Pop)] and years\*accessions within landraces [Yr\*accn (landrace)] as random factors. Variance component due to the interaction of years x landraces within populations was not significant for all traits and was deleted from the results. (Nutrient means are in μg g-1 kernel dry weight).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Trait | Mean | C.V.% | Covariate | Fixed factors | | | Random factors | | |
| KWT | Yr. | Pop. | Yr\* Pop | Accn  (landrace) | Landrace  (Pop.) | Yr\*accn  (landrace) |
|  |  |  | *p* (F) | | | | Percent variance (*p*<0.05) | | |
| KWT† | 27.80 | 21 |  | 0.01 | 0.001 | 0.98 | 83.7 |  | 9.5 |
| CIR | 0.79 | 10 | 0.163 | 0.68 | 0.691 | 0.51 | 66.9 | 9.5 | 4.4 |
| FDM | 1.03 | 9 | 0.001 | 0.22 | 0.001 | 0.68 | 26.7 | 10.4 |  |
| ASR | 1.18 | 9 | 0.042 | 0.24 | 0.024 | 0.32 | 18.5 | 21.1 |  |
| RND | 0.86 | 8 | 0.033 | 0.26 | 0.027 | 0.36 | 17.4 | 20.4 |  |
| SLD | 0.98 | 5 | 0.659 | 0.74 | 0.750 | 0.60 | 27.0 |  | 4.4 |
| DEN | 1.29 | 16 | 0.001 | 0.14 | 0.021 | 0.82 | 36.8 |  | 8.0 |
| *L\** | 53.74 | 48 | 0.561 | 0.02 | 0.162 | 0.51 | 38.0 | 22.5 | 12.7 |
| *a\** | 9.09 | 159 | 0.274 | 0.41 | 0.140 | 0.53 | 25.6 | 9.3 |  |
| *b\** | 16.58 | 70 | 0.452 | 0.20 | 0.433 | 0.75 | 15.0 |  | 20.3 |
| Protein | 12.09 | 16 | 0.001 | 0.05 | 0.028 | 0.51 | 44.7 | 41.2 | 5.4 |
| C:N | 24.55 | 18 | 0.001 | 0.05 | 0.041 | 0.29 | 44.2 | 39.7 | 13.9 |
| Micro-nutrients | |  |  |  |  |  |  |  |  |
| Al | 2.39 | 123 | 0.008 | 0.90 | 0.252 | 0.57 | 60.7 | 30.1 | 2.5 |
| Cu | 0.99 | 67 | 0.008 | 0.50 | 0.192 | 0.31 | 55.0 | 34.1 | 4.78 |
| Fe | 28.04 | 23 | 0.002 | 0.41 | 0.154 | 0.55 | 28.7 | 63.7 | 3.7 |
| Mn | 8.240 | 29 | 0.002 | 0.07 | 0.012 | 0.41 | 34.8 | 63.2 |  |
| Zn | 25.330 | 26 | 0.009 | 0.29 | 0.352 | 0.52 | 58.8 | 20.3 | 14.1 |
| Macro-nutrients | |  |  |  |  |  |  |  |  |
| Ca | 42.86 | 61 | 0.042 | 0.90 | 0.386 | 0.47 | 64.2 | 15.4 | 13.5 |
| K | 3619.0 | 12 | 0.162 | 0.91 | 0.791 | 0.93 | 32.8 | 58.2 | 3.4 |
| Mg | 1450.0 | 12 | 0.157 | 0.18 | 0.263 | 0.64 | 60.2 | 23.0 | 7.1 |
| P | 3481.0 | 11 | 0.095 | 0.56 | 0.102 | 0.06 | 48.3 | 40.8 | 4.7 |
| S | 1204.0 | 17 | 0.112 | 0.36 | 0.021 | 0.37 | 48.9 | 45.8 | 2.9 |

†: See Material and Methods for abbreviations.

Table S2. Least squares means (upper row for each trait) and mean separation (percent pair wise significant differences; %PSD, lower row) for kernel shape, color, and nutrient traits between landraces and between accessions within landraces of Native American maize. Landrace means within each trait followed by the same letter do not differ significantly; DMRT = 0.05. (Nutrient means are in μg g-1 kernel dry weight; See Materials and methods for trait abbreviations).

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Trait | Population [1] | | | | | | *Population [2]* | | | |
| landrace | BIF | HCC | MFC | PLC | PMP | SBD | *JAG* | *JDG* | *JPB* | *JVR* |
| No. accns. 2 | | 3 | 2 | 5 | 2 | 2 | 4 | 3 | 2 | 2 |
| KWT | 33.2a | 26.3bc | 22.26b | 33.2a | 30.0a | 29.8a | 21.7c | 32.9a | 22.9b | 23.6b |
|  | 100 | 100 | 100 | 70 | 100 | 100 | 67 | 100 | 100 | 100 |
| CIR | 0.82a | 0.79a | 0.77a | 0.81a | 0.58b | 0.81a | 0.79a | 0.82a | 0.81a | 0.80a |
|  | 0 | 0 | 100 | 0 | 100 | 0 | 50 | 0 | 0 | 0 |
| FDM | 1.05a | 0.99a | 0.97a | 1.10a | 1.09a | 1.08a | 0.97a | 1.07a | 0.96a | 0.94a |
|  | 0 | 0 | 0 | 0 | 100 | 0 | 17 | 67 | 0 | 100 |
| ASR | 1.24a | 1.13b | 1.17b | 1.23a | 1.29a | 1.22a | 1.15b | 1.12b | 1.13b | 1.13b |
|  | 0 | 0 | 0 | 20 | 100 | 100 | 33 | 33 | 0 | 0 |
| RND | 0.81b | 0.89a | 0.86a | 0.82b | 0.78b | 0.82b | 0.88a | 0.90a | 0.89a | 0.89a |
|  | 0 | 0 | 0 | 10 | 100 | 100 | 33 | 33 | 0 | 100 |
| SLD | 0.98a | 0.98a | 0.97a | 0.98a | 0.97a | 0.98a | 0.98a | 0.98a | 0.98a | 0.98a |
|  | 0 | 0 | 0 | 0 | 100 | 0 | 50 | 0 | 0 | 0 |
| DEN | 1.51a | 1.30b | 1.19c | 1.38b | 1.34b | 1.29b | 1.15c | 1.37b | 1.20c | 1.27b |
|  | 100 | 67 | 100 | 60 | 0 | 0 | 33 | 0 | 0 | 100 |
| *L\** | 23.3c | 39.1c | 78.0a | 60.2b | 34.4 | 57.0b | 52.4b | 60.2b | 57.8b | 72.8a |
|  | 100 | 100 | 100 | 60 | 100 | 100 | 83 | 33 | 100 | 100 |
| *a\** | 10.7b | 9.5b | 0.07c | 16.6a | 20.1a | 5.4b | 11.7b | 7.3b | 7.2b | -1.7c |
|  | 0 | 0 | 100 | 60 | 0 | 0 | 0 | 0 | 100 | 0 |
| *b\** | 10.4b | 11.7b | 20.5a | 20.3a | 16.2a | 15.4a | 17.3a | 18.2a | 15.4a | 20.9a |
|  | 100 | 33 | 0 | 0 | 100 | 100 | 50 | 0 | 100 | 100 |
| Protein % | 13.9a | 12.4a | 12.5a | 12.8a | 14.6a | 12.8a | 9.4b | 12.1a | 10.5b | 13.2a |
|  | 100 | 100 | 0 | 70 | 0 | 100 | 67 | 100 | 0 | 100 |
| C:N ratio | 20.9b | 23.3b | 23.2b | 22.6b | 20.2b | 23.1b | 31.3a | 23.9b | 27.4a | 22.2b |
|  | 100 | 100 | 0 | 80 | 0 | 100 | 83 | 100 | 0 | 100 |
| Micro-nutrients | |  |  |  |  |  |  |  |  |  |
| Al | 1.9b | 1.4c | 0.52e | 1.3c | 1.4c | 3.6a | 3.3a | 2.0b | 1.1d | 1.2d |
|  | 100 | 0 | 0 | 60 | 0 | 100 | 67 | 67 | 100 | 0 |
| Cu | 2.3a | 0.6c | 0.4c | 0.8c | 1.8a | 1.2b | 0.7 | 1.0b | 0.5c | 1.5ab |
|  | 100 | 67 | 100 | 60 | 0 | 100 | 83 | 33 | 0 | 100 |
| Fe | 32.9b | 22.4c | 22.7c | 31.5b | 48.3a | 29.2b | 21.5c | 26.5bc | 30.6b | 28.1b |
|  | 0 | 100 | 100 | 80 | 0 | 100 | 83 | 100 | 0 | 100 |
| Mn | 10.2b | 9.2b | 11.2b | 8.4b | 14.0a | 8.7b | 6.4bc | 7.1bc | 5.1c | 9.0b |
|  | 100 | 100 | 100 | 80 | 0 | 100 | 67 | 100 | 100 | 100 |
| Zn | 29.4a | 20.5b | 22.8b | 27.0a | 32.8a | 23.5b | 28.4a | 23.9b | 15.4c | 32.5a |
|  | 0 | 67 | 0 | 80 | 0 | 100 | 83 | 67 | 0 | 100 |
| Macro-nutrients | |  |  |  |  |  |  |  |  |  |
| Ca | 37.7c | 41.4c | 32.6cd | 44.6c | 86.6a | 23.6e | 62.2b | 42.2c | 30.6d | 46.1c |
|  | 100 | 67 | 100 | 70 | 0 | 0 | 83 | 67 | 0 | 0 |
| K | 3949a | 3318b | 4117a | 3384b | 4363a | 3921a | 3396b | 3355b | 3521b | 4273a |
|  | 100 | 100 | 100 | 50 | 0 | 100 | 83 | 100 | 100 | 100 |
| Mg | 1580a | 1381b | 1443b | 1417b | 1625a | 1567a | 1495b | 1412b | 1126c | 1566a |
|  | 0 | 100 | 100 | 40 | 0 | 100 | 83 | 100 | 0 | 100 |
| P | 3845a | 3405b | 3473b | 3502b | 4136a | 3547b | 3288c | 3388c | 2929c | 4148a |
|  | 0 | 100 | 100 | 40 | 0 | 100 | 83 | 100 | 0 | 100 |
| S | 1465a | 1167c | 1156c | 1215c | 1581a | 1307b | 1121c | 1095cd | 946d | 1338b |
|  | 100 | 100 | 100 | 10 | 0 | 100 | 100 | 100 | 100 | 100 |

Table S3. Significant percent variance explained by color space descriptors (*Lab*) and residual mean squares error (*RMSE*) in the partial least squares validation models for kernel nutrient composition in 10 Native American maize landraces (ß**\*** indicates a significant (p<0.05) regression coefficient).

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Trait/  nutrient | Population  [1] | | | | | |  | *Population*  *[2]* | | | |
| landrace: | BIF | HCC | MFC | PLC | PMP | SBD |  | *JAG* | *JDG* | *JPB* | *JVR* |
| Protein  ß\* | 58.0  *Lab* | 48.0  *Lb* | 27.2  *a* | 44.5  *La* | 42.6  *Lb* | 23.0  *Lb* |  | 19.2  *Lb* | 21.8  *Lab* | 25.9  *Lb* | 64.5  *Lab* |
| *RMSE* | 0.08 | 0.09 | 0.05 | 0.05 | 0.05 | 0.29 |  | 0.21 | 0.11 | 0.04 | 0.19 |
| C:N  ß\* | 49.3  *Lb* | 57.0  *Lb* | 39.7  *L* | 41.1  *La* | 35.7  *Lb* | 20.0  *Lb* |  | 22.5  *Lb* | 20.2  *La* | 15.7  *Lb* | 65.0  *Lb* |
| *RMSE* | 0.82 | 0.98 | 0.36 | 0.58 | 0.46 | 2.94 |  | 4.96 | 1.32 | 0.74 | 2.05 |
| Micro-nutrients | |  |  |  |  |  |  |  |  |  |  |
| Al  ß\* | 24.7  *L* | 38.9  *La* |  | 27.6  *Lab* | 25.5  *Lab* | 31.0  *Lab* |  |  |  |  |  |
| *RMSE* | 2.02 | 0.35 |  | 0.88 | 1.42 | 1.25 |  |  |  |  |  |
| Cu  ß\* | 49.1  *Lb* | 22.8  *Lb* | 53.2  *La* | 36.9  *La* | 35.2  *Lb* | 16.0  *ab* |  | 41.8  *Lb* | 53.4  *Lab* | 69.4  *Lab* |  |
| *RMSE* | 0.18 | 0.15 | 0.15 | 0.52 | 0.23 | 0.43 |  | 0.28 | 0.22 | 0.09 |  |
| Fe  ß\* | 62.7  *Lab* | 38.8  *Lb* | 73.4  *La* |  | 55.8  *Lb* |  |  | 37.8  *Lab* | 15.9  *Lb* | 38.5  *Lab* | 14.7  *a* |
| *RMSE* | 0.58 | 2.08 | 0.04 |  | 1.8 |  |  | 2.75 | 3.19 | 2.54 | 2.88 |
| Mn  ß\* | 68.6  *Lab* | 33.9  *La* | 55.4  *La* | 15.6  *La* | 34.8  *Lab* | 13.0  *L* |  | 10.8  *Lab* | 8.9  *L* | 81.4  *La* | 62.3  *Lab* |
| *RMSE* | 0.63 | 0.75 | 0.41 | 0.85 | 0.67 | 1.25 |  | 1.05 | 1.05 | 0.18 | 1.29 |
| Zn  ß\* | 40.9  *Lab* | 20.9  *Lab* | 39.6  *Lb* | 15.3  *Lab* | 35.2  *Lab* |  |  | 16.7  *La* | 25.1  *Lab* | 32.8  *Lab* | 69.3  *Lab* |
| *RMSE* | 2.01 | 3.88 | 1.26 | 3.98 | 1.14 |  |  | 4.31 | 2.65 | 2.38 | 5.81 |
| Macro-nutrients | |  |  |  |  |  |  |  |  |  |  |
| Ca  ß\* | 76.0  *Lb* | 86.2  *Lab* | 57.2  *La* |  | 44.7  *Lb* | 30.0  *Lab* |  |  |  |  |  |
| *RMSE* | 5.77 | 3.63 | 1.89 |  | 5.82 | 6.46 |  |  |  |  |  |
| K  ß\* | 67.6  *Lb* | 41.8  *La* | 53.9  *Lb* | 28.2  *Lab* | 54.5  *Lab* | 14.0  *ab* |  | 23.8  *Lab* | 40.7  *Lab* | 77.4  *Lab* | 35.0  *Lab* |
| *RMSE* | 187 | 307 | 65.40 | 185 | 38.3 | 268 |  | 228 | 201 | 62.1 | 164 |
| Mg  ß\* | 18.5  *a* | 42.0  *Lab* | 74.5  *Lab* | 25.8  *ab* | 34.7  *Lb* | 10.0  *Lb* |  | 12.8  *Lb* | 39.5  *Lb* | 52.2  *Lb* | 64.6  *Lab* |
| *RMSE* | 47.1 | 61.20 | 22.6 | 76.0 | 7.2 | 204 |  | 131 | 98.14 | 32.8 | 136 |
| P  ß\* | 25.6  *Lab* | 50.41  *Lb* | 85.2  *Lb* | 22.7  *La* | 26.2  *Lb* |  |  | 13.9  *b* | 30.3  *Lb* | 63.7  *Lab* | 49.6  *Lab* |
| *RMSE* | 105 | 158 | 54.4 | 134 | 13.8 |  |  | 342 | 238 | 29.8 | 368 |
| S  ß\* | 70.0  *Lb* | 24.8  *L* | 59.2  *La* | 25.7  *Lb* | 55.7  *Lb* | 18.0  *Lb* |  | 24.2  *Lab* | 18.6  *L* | 70.5  *Lb* | 62.7  *Lb* |
| *RMSE* | 95.0 | 124 | 32.8 | 65.6 | 30.3 | 198 |  | 113 | 81.09 | 17.6 | 133 |