

**Table S1. Symbols of durum wheat grain parameters and agronomic treatments**

| No | Durum wheat grain parameters                              | Symbol | Unit                |
|----|---|--------|---------------------|
| 1  | Thousand grain weight                                     | TGW    | g                   |
| 2  | Vitreousness  | V      | %                   |
| 3  | Ash content   | AC     | %                   |
| 4  | Falling number  | FN     | S                   |
| 5  | Protein content   | PC     | %                   |
| 6  | Phosphorus content  | P      | g kg <sup>-1</sup>  |
| 7  | Potassium content   | K      | g kg <sup>-1</sup>  |
| 8  | Magnesium content   | Mg     | g kg <sup>-1</sup>  |
| 9  | Calcium content   | Ca     | g kg <sup>-1</sup>  |
| 10 | Copper content  | Cu     | mg kg <sup>-1</sup> |
| 11 | Iron content  | Fe     | mg kg <sup>-1</sup> |
| 12 | Zinc content  | Zn     | mg kg <sup>-1</sup> |
| 13 | Manganese content   | Mn     | mg kg <sup>-1</sup> |
| 14 | Bran weight (GG30, 670 µm)                                | BW     | g                   |
| 15 | Flour weight (<112 µm)                                    | FW     | g                   |
| 16 | Type 1 semolina weight (GG74, 212 µm)                     | SW1    | g                   |
| 17 | Type 2 semolina weight (GG50, 355 µm)                     | SW2    | g                   |
| 18 | Type 3 semolina weight (GG38, 500 µm)                     | SW3    | g                   |
| 19 | Particle size index                                       | PSI    | %                   |
| 20 | Semolina yield  | SY     | %                   |
| 21 | Unpurified middlings yield (>125 - <550 µm)               | UMY    | %                   |
| 22 | Wet gluten  | GW     | %                   |
| 23 | Dry gluten  | GD     | %                   |
| 25 | Water-binding capacity                                    | GWC    | %                   |
| 25 | Gluten index  | GI     | %                   |
| No | Agronomic treatments                                      | Symbol |                     |
| 1  | no growth regulator, no N fertilization, 350 seeds per m2 | 000    |                     |
| 2  | no growth regulator, no N fertilization, 450 seeds per m2 | 001    |                     |
| 3  | no growth regulator, no N fertilization, 550 seeds per m2 | 002    |                     |
| 4  | no growth regulator, 80 kg N per ha, 350 seeds per m2     | 010    |                     |

|    |  |     |
|----|--|-----|
| 5  | no growth regulator, 80 kg N per ha, 450 seeds per m2              | 011 |
| 6  | no growth regulator, 80 kg N per ha, 550 seeds per m2              | 012 |
| 7  | no growth regulator, 120 kg N per ha, 350 seeds per m2             | 020 |
| 8  | no growth regulator, 120 kg N per ha, 450 seeds per m2             | 021 |
| 9  | no growth regulator, 120 kg N per ha, 550 seeds per m2             | 022 |
| 10 | growth regulator application, no N fertilization, 350 seeds per m2 | 100 |
| 11 | growth regulator application, no N fertilization, 450 seeds per m2 | 101 |
| 12 | growth regulator application, no N fertilization, 550 seeds per m2 | 102 |
| 13 | growth regulator application, 80 kg N per ha, 350 seeds per m2     | 110 |
| 14 | growth regulator application, 80 kg N per ha, 450 seeds per m2     | 111 |
| 15 | growth regulator application, 80 kg N per ha, 550 seeds per m2     | 112 |
| 16 | growth regulator application, 120 kg N per ha, 350 seeds per m2    | 120 |
| 17 | growth regulator application, 120 kg N per ha, 450 seeds per m2    | 121 |
| 18 | growth regulator application, 120 kg N per ha, 550 seeds per m2    | 122 |

**Table S2. Analysis of variance for grain and milling value parameters****Yield components****BW**

| Source        | DF  | SS     | MS    | F      | p-value  |
|---------------|-----|--------|-------|--------|----------|
| Environmental | 6   | 580561 | 96760 | 130.91 | 0.000000 |
| Treatments    | 17  | 22819  | 1342  | 1.82   | 0.035639 |
| Random error  | 102 | 75394  | 739   |        |          |
| Total         | 125 | 678774 |       |        |          |

**FW**

| Source        | DF  | SS      | MS     | F      | p-value  |
|---------------|-----|---------|--------|--------|----------|
| Environmental | 6   | 46261.1 | 7710.2 | 24.363 | 0.000000 |
| Treatments    | 17  | 13624.3 | 801.4  | 2.532  | 0.002138 |
| Random error  | 102 | 32280.6 | 316.5  |        |          |
| Total         | 125 | 92166.0 |        |        |          |

**SW1**

| Source        | DF  | SS     | MS    | F      | p-value  |
|---------------|-----|--------|-------|--------|----------|
| Environmental | 6   | 535201 | 89200 | 68.851 | 0.000000 |
| Treatments    | 17  | 87158  | 5127  | 3.957  | 0.000006 |
| Random error  | 102 | 132146 | 1296  |        |          |
| Total         | 125 | 754505 |       |        |          |

**SW2**

| Source        | DF  | SS      | MS     | F      | p-value  |
|---------------|-----|---------|--------|--------|----------|
| Environmental | 6   | 928515  | 154752 | 298.70 | 0.000000 |
| Treatments    | 17  | 20459   | 1203   | 2.32   | 0.004980 |
| Random error  | 102 | 52845   | 518    |        |          |
| Total         | 125 | 1001819 |        |        |          |

**SW3**

| Source        | DF  | SS      | MS     | F      | p-value  |
|---------------|-----|---------|--------|--------|----------|
| Environmental | 6   | 963140  | 160523 | 111.74 | 0.000000 |
| Treatments    | 17  | 67321   | 3960   | 2.76   | 0.000855 |
| Random error  | 102 | 146532  | 1437   |        |          |
| Total         | 125 | 1176993 |        |        |          |

**PSI**

| Source        | DF  | SS      | MS     | F      | p-value  |
|---------------|-----|---------|--------|--------|----------|
| Environmental | 6   | 362.521 | 60.420 | 18.892 | 0.000000 |
| Treatments    | 17  | 121.224 | 7.131  | 2.230  | 0.007226 |
| Random error  | 102 | 326.223 | 3.198  |        |          |
| Total         | 125 | 809.968 |        |        |          |

**SY**

| Source        | DF  | SS     | MS    | F    | p-value  |
|---------------|-----|--------|-------|------|----------|
| Environmental | 6   | 1151.3 | 191.9 | 59.2 | 0.000000 |
| Treatments    | 17  | 55.1   | 3.2   | 1.0  | 0.464353 |
| Random error  | 102 | 330.6  | 3.2   |      |          |
| Total         | 125 | 1537.0 |       |      |          |

**TGW**

| Source        | DF  | SS     | MS    | F     | p-value  |
|---------------|-----|--------|-------|-------|----------|
| Environmental | 6   | 4321.6 | 720.3 | 303.1 | 0.000000 |
| Treatments    | 17  | 89.5   | 5.3   | 2.21  | 0.007684 |
| Random error  | 102 | 242.4  | 2.4   |       |          |
| Total         | 125 | 4653.5 |       |       |          |

**PC**

| Source        | DF  | SS     | MS    | F     | p-value  |
|---------------|-----|--------|-------|-------|----------|
| Environmental | 6   | 174.62 | 29.10 | 40.34 | 0.000000 |
| Treatments    | 17  | 28.04  | 1.65  | 2.29  | 0.005766 |
| Random error  | 102 | 73.59  | 0.72  |       |          |

|               |     |         |        |        |          |
|---------------|-----|---------|--------|--------|----------|
| Total         | 125 | 276.24  |        |        |          |
| AC            |     |         |        |        |          |
| Source        | DF  | SS      | MS     | F      | p-value  |
| Environmental | 6   | 2.7313  | 0.4552 | 46.80  | 0.000000 |
| Treatments    | 17  | 0.4415  | 0.0260 | 2.67   | 0.001221 |
| Random error  | 102 | 0.9922  | 0.0097 |        |          |
| Total         | 125 | 4.1649  |        |        |          |
| FN            |     |         |        |        |          |
| Source        | DF  | SS      | MS     | F      | p-value  |
| Environmental | 6   | 76069   | 12678  | 20.21  | 0.000000 |
| Treatments    | 17  | 10548   | 620    | 0.99   | 0.476353 |
| Random error  | 102 | 63985   | 627    |        |          |
| Total         | 125 | 150603  |        |        |          |
| V             |     |         |        |        |          |
| Source        | DF  | SS      | MS     | F      | p-value  |
| Environmental | 3   | 12442.8 | 4147.6 | 27.492 | 0.000000 |
| Treatments    | 17  | 5948.3  | 349.9  | 2.319  | 0.010684 |
| Random error  | 51  | 7694.2  | 150.9  |        |          |
| Total         | 71  | 26085.3 |        |        |          |

#### Gluten-related parameters

|               |    |         |        |        |          |
|---------------|----|---------|--------|--------|----------|
| GI            |    |         |        |        |          |
| Source        | DF | SS      | MS     | F      | p-value  |
| Environmental | 2  | 920.28  | 460.14 | 3.7258 | 0.034430 |
| Treatments    | 17 | 4556.01 | 268.00 | 2.1700 | 0.026740 |
| Random error  | 34 | 4199.05 | 123.50 |        |          |
| Total         | 53 | 9675.34 |        |        |          |
| GW            |    |         |        |        |          |
| Source        | DF | SS      | MS     | F      | p-value  |
| Environmental | 2  | 11.44   | 5.72   | 5.03   | 0.012211 |
| Treatments    | 17 | 81.60   | 4.80   | 4.22   | 0.000174 |
| Random error  | 34 | 38.67   | 1.14   |        |          |
| Total         | 53 | 131.70  |        |        |          |
| GS            |    |         |        |        |          |
| Source        | DF | SS      | MS     | F      | p-value  |
| Environmental | 2  | 1.070   | 0.535  | 4.38   | 0.020282 |
| Treatments    | 17 | 10.184  | 0.599  | 4.91   | 0.000040 |
| Random error  | 34 | 4.152   | 0.122  |        |          |
| Total         | 53 | 15.406  |        |        |          |
| GWC           |    |         |        |        |          |
| Source        | DF | SS      | MS     | F      | p-value  |
| Environmental | 2  | 5.56    | 2.78   | 4.99   | 0.012591 |
| Treatments    | 17 | 35.15   | 2.07   | 3.71   | 0.000558 |
| Random error  | 34 | 18.95   | 0.56   |        |          |
| Total         | 53 | 59.66   |        |        |          |

#### Macroelements

|               |    |          |          |       |          |
|---------------|----|----------|----------|-------|----------|
| N (total)     |    |          |          |       |          |
| Source        | DF | SS       | MS       | F     | p-value  |
| Environmental | 1  | 2.592100 | 2.592100 | 98.82 | 0.000000 |
| Treatments    | 17 | 0.930089 | 0.054711 | 2.09  | 0.069780 |
| Random error  | 17 | 0.445900 | 0.026229 |       |          |
| Total         | 35 | 3.968089 |          |       |          |
| P             |    |          |          |       |          |
| Source        | DF | SS       | MS       | F     | p-value  |

|               |    |          |          |       |          |
|---------------|----|----------|----------|-------|----------|
| Environmental | 1  | 0.006669 | 0.006669 | 27.79 | 0.000062 |
| Treatments    | 17 | 0.007814 | 0.000460 | 1.91  | 0.095331 |
| Random error  | 17 | 0.004081 | 0.000240 |       |          |
| Total         | 35 | 0.018564 |          |       |          |

#### K

| Source        | DF | SS       | MS      | F       | p-value  |
|---------------|----|----------|---------|---------|----------|
| Environmental | 1  | 0.52804  | 0.52804 | 0.93490 | 0.347149 |
| Treatments    | 17 | 9.49290  | 0.55841 | 0.98865 | 0.509248 |
| Random error  | 17 | 9.60186  | 0.56482 |         |          |
| Total         | 35 | 19.62280 |         |         |          |

#### Mg

| Source        | DF | SS       | MS      | F        | p-value  |
|---------------|----|----------|---------|----------|----------|
| Environmental | 1  | 7.0579   | 7.05788 | 1.009357 | 0.329144 |
| Treatments    | 17 | 118.6954 | 6.98208 | 0.998518 | 0.501202 |
| Random error  | 17 | 118.8716 | 6.99245 |          |          |
| Total         | 35 | 244.6249 |         |          |          |

#### Ca

| Source        | DF | SS       | MS       | F       | p-value  |
|---------------|----|----------|----------|---------|----------|
| Environmental | 1  | 0.012844 | 0.012844 | 188.962 | 0.000000 |
| Treatments    | 17 | 0.001300 | 0.000076 | 1.125   | 0.405473 |
| Random error  | 17 | 0.001156 | 0.000068 |         |          |
| Total         | 35 | 0.015300 |          |         |          |

#### Microelements

#### Cu

| Source        | DF | SS      | MS     | F     | p-value  |
|---------------|----|---------|--------|-------|----------|
| Environmental | 1  | 1.0678  | 1.0678 | 3.311 | 0.086469 |
| Treatments    | 17 | 6.0700  | 0.3571 | 1.107 | 0.418060 |
| Random error  | 17 | 5.4822  | 0.3225 |       |          |
| Total         | 35 | 12.6200 |        |       |          |

#### Fe

| Source        | DF | SS      | MS     | F      | p-value  |
|---------------|----|---------|--------|--------|----------|
| Environmental | 1  | 882.09  | 882.09 | 28.439 | 0.000055 |
| Treatments    | 17 | 398.42  | 23.44  | 0.756  | 0.715106 |
| Random error  | 17 | 527.28  | 31.02  |        |          |
| Total         | 35 | 1807.79 |        |        |          |

#### Zn

| Source        | DF | SS      | MS      | F       | p-value  |
|---------------|----|---------|---------|---------|----------|
| Environmental | 1  | 1501.56 | 1501.56 | 194.885 | 0.000000 |
| Treatments    | 17 | 160.34  | 9.43    | 1.224   | 0.340713 |
| Random error  | 17 | 130.98  | 7.70    |         |          |
| Total         | 35 | 1792.89 |         |         |          |

#### Mn

| Source        | DF | SS     | MS     | F     | p-value  |
|---------------|----|--------|--------|-------|----------|
| Environmental | 1  | 239.73 | 239.73 | 93.66 | 0.000000 |
| Treatments    | 17 | 79.10  | 4.65   | 1.82  | 0.113989 |
| Random error  | 17 | 43.51  | 2.56   |       |          |
| Total         | 35 | 362.35 |        |       |          |

**Table S3. Matrices of simple correlation coefficients and estimates of main effects (n=18 agronomic treatments)**

**Yield components vs. bran yield**

Bran Yield (BY)

| Variable | TGW     | V       | PC      | AC      | FN      | GI      | BY      |
|----------|---------|---------|---------|---------|---------|---------|---------|
| TGW      | 1.0000  | 0.4344  | 0.2764  | 0.1466  | 0.4435  | -0.0020 | -0.3852 |
| V        | 0.4344  | 1.0000  | 0.8624  | 0.7255  | 0.1541  | -0.3859 | -0.4844 |
| PC       | 0.2764  | 0.8624  | 1.0000  | 0.9080  | 0.0637  | -0.6650 | -0.3468 |
| AC       | 0.1466  | 0.7255  | 0.9080  | 1.0000  | 0.0396  | -0.6005 | -0.1019 |
| FN       | 0.4435  | 0.1541  | 0.0637  | 0.0396  | 1.0000  | -0.2198 | -0.4634 |
| GI       | -0.0020 | -0.3859 | -0.6650 | -0.6005 | -0.2198 | 1.0000  | 0.1808  |
| BY       | -0.3852 | -0.4844 | -0.3468 | -0.1019 | -0.4634 | 0.1808  | 1.0000  |

| Variable | Main effect | SE     | t stat. | p-value |
|----------|-------------|--------|---------|---------|
| TGW      | 0.1417      | 0.2543 | 0.5575  | 0.5884  |
| V        | -0.1963     | 0.4946 | -0.3968 | 0.6991  |
| PC       | -1.4189     | 0.8723 | -1.6266 | 0.1321  |
| AC       | 1.1856      | 0.4972 | 2.3845  | 0.0362  |
| FN       | -0.5046     | 0.2448 | -2.0617 | 0.0637  |
| GI       | -0.2372     | 0.3430 | -0.6914 | 0.5037  |

Pe 0.22365115 R2 0.602718 p-value 0.06742

**Yield components vs. flour yield**

Flour Yield (FY)

| Variable | TGW     | V       | PC      | AC      | FN      | GI      | FY      |
|----------|---------|---------|---------|---------|---------|---------|---------|
| TGW      | 1.0000  | 0.4344  | 0.2764  | 0.1466  | 0.4435  | -0.0020 | 0.5374  |
| V        | 0.4344  | 1.0000  | 0.8624  | 0.7255  | 0.1541  | -0.3859 | 0.4620  |
| PC       | 0.2764  | 0.8624  | 1.0000  | 0.9080  | 0.0637  | -0.6650 | 0.1169  |
| AC       | 0.1466  | 0.7255  | 0.9080  | 1.0000  | 0.0396  | -0.6005 | -0.0243 |
| FN       | 0.4435  | 0.1541  | 0.0637  | 0.0396  | 1.0000  | -0.2198 | 0.6033  |
| GI       | -0.0020 | -0.3859 | -0.6650 | -0.6005 | -0.2198 | 1.0000  | 0.0920  |
| FY       | 0.5374  | 0.4620  | 0.1169  | -0.0243 | 0.6033  | 0.0920  | 1.0000  |

| Variable | Main effect | SE     | t stat. | p-value |
|----------|-------------|--------|---------|---------|
| TGW      | 0.0462      | 0.1970 | 0.2345  | 0.8189  |
| V        | 1.0436      | 0.3831 | 2.7238  | 0.0198  |
| PC       | -0.4686     | 0.6757 | -0.6935 | 0.5024  |
| AC       | -0.3250     | 0.3852 | -0.8438 | 0.4168  |
| FN       | 0.4855      | 0.1896 | 2.5605  | 0.0265  |
| GI       | 0.0948      | 0.2657 | 0.3566  | 0.7282  |

Pe 0.12730184 R2 0.761602 p-value 0.005849

**Yield components vs. semolina yield**

Semolina Yield (SY)

| Variable | TGW     | V       | PC      | AC      | FN      | GI      | SY      |
|----------|---------|---------|---------|---------|---------|---------|---------|
| TGW      | 1.0000  | 0.4344  | 0.2764  | 0.1466  | 0.4435  | -0.0020 | -0.0492 |
| V        | 0.4344  | 1.0000  | 0.8624  | 0.7255  | 0.1541  | -0.3859 | 0.1605  |
| PC       | 0.2764  | 0.8624  | 1.0000  | 0.9080  | 0.0637  | -0.6650 | 0.3371  |
| AC       | 0.1466  | 0.7255  | 0.9080  | 1.0000  | 0.0396  | -0.6005 | 0.1600  |
| FN       | 0.4435  | 0.1541  | 0.0637  | 0.0396  | 1.0000  | -0.2198 | -0.0143 |
| GI       | -0.0020 | -0.3859 | -0.6650 | -0.6005 | -0.2198 | 1.0000  | -0.3347 |
| SY       | -0.0492 | 0.1605  | 0.3371  | 0.1600  | -0.0143 | -0.3347 | 1.0000  |

| Variable | Main effect | SE | t stat. | p-value |
|----------|-------------|----|---------|---------|
|----------|-------------|----|---------|---------|

|     |         |        |         |        |
|-----|---------|--------|---------|--------|
| TGW | -0.2354 | 0.3112 | -0.7564 | 0.4653 |
| V   | -0.8251 | 0.6055 | -1.3627 | 0.2002 |
| PC  | 2.3633  | 1.0678 | 2.2132  | 0.0489 |
| AC  | -1.2300 | 0.6087 | -2.0208 | 0.0683 |
| FN  | 0.1627  | 0.2996 | 0.5430  | 0.5979 |
| GI  | 0.2151  | 0.4199 | 0.5123  | 0.6186 |

Pe 0.36387293 R2 0.404658 p-value 0.355039

#### Micro-nutrients vs. bran yield

##### Bran Yield (BY)

| Variable | Cu      | Fe      | Zn     | Mn     | BY      |
|----------|---------|---------|--------|--------|---------|
| Cu       | 1.0000  | 0.5960  | 0.4480 | 0.1662 | -0.1413 |
| Fe       | 0.5960  | 1.0000  | 0.1973 | 0.1705 | -0.2013 |
| Zn       | 0.4480  | 0.1973  | 1.0000 | 0.4167 | 0.2676  |
| Mn       | 0.1662  | 0.1705  | 0.4167 | 1.0000 | 0.1129  |
| BY       | -0.1413 | -0.2013 | 0.2676 | 0.1129 | 1.0000  |

| Variable | Main effect | SE     | t stat. | p-value |
|----------|-------------|--------|---------|---------|
| Cu       | -0.2376     | 0.3486 | -0.6815 | 0.5075  |
| Fe       | -0.1399     | 0.3194 | -0.4379 | 0.6686  |
| Zn       | 0.3972      | 0.3100 | 1.2812  | 0.2225  |
| Mn       | 0.0107      | 0.2809 | 0.0380  | 0.9703  |

Pe 0.58862522 R2 0.169229 p-value 0.62928

#### Micro-nutrients vs. flour yield

##### Flour yield (FY)

|    | Cu     | Fe     | Zn      | Mn     | FY      |
|----|--------|--------|---------|--------|---------|
| Cu | 1.0000 | 0.5960 | 0.4480  | 0.1662 | 0.6245  |
| Fe | 0.5960 | 1.0000 | 0.1973  | 0.1705 | 0.5599  |
| Zn | 0.4480 | 0.1973 | 1.0000  | 0.4167 | -0.0668 |
| Mn | 0.1662 | 0.1705 | 0.4167  | 1.0000 | 0.1542  |
| FY | 0.6245 | 0.5599 | -0.0668 | 0.1542 | 1.0000  |

| Variable | Main effect | SE     | t stat. | p-value |
|----------|-------------|--------|---------|---------|
| Cu       | 0.6893      | 0.2369 | 2.9096  | 0.0122  |
| Fe       | 0.2126      | 0.2170 | 0.9795  | 0.3452  |
| Zn       | -0.5070     | 0.2107 | -2.4065 | 0.0317  |
| Mn       | 0.2146      | 0.1909 | 1.1245  | 0.2811  |

Pe 0.21484806 R2 0.616464 p-value 0.00987

#### Micro-nutrients vs. semolina yield

##### Semolina yield (SY)

|    | Cu      | Fe      | Zn      | Mn      | SY      |
|----|---------|---------|---------|---------|---------|
| Cu | 1.0000  | 0.5960  | 0.4480  | 0.1662  | -0.4623 |
| Fe | 0.5960  | 1.0000  | 0.1973  | 0.1705  | -0.3158 |
| Zn | 0.4480  | 0.1973  | 1.0000  | 0.4167  | -0.2844 |
| Mn | 0.1662  | 0.1705  | 0.4167  | 1.0000  | -0.3095 |
| SY | -0.4623 | -0.3158 | -0.2844 | -0.3095 | 1.0000  |

| Variable | Main effect | SE     | t stat. | p-value |
|----------|-------------|--------|---------|---------|
| Cu       | -0.4022     | 0.3268 | -1.2309 | 0.2402  |
| Fe       | -0.0360     | 0.2994 | -0.1202 | 0.9062  |
| Zn       | 0.0017      | 0.2906 | 0.0057  | 0.9955  |
| Mn       | -0.2372     | 0.2633 | -0.9009 | 0.3840  |

Pe 0.35565886 R2 0.270241 p-value 0.355659

#### Macro-nutrients vs. bran yield

Bran Yield (BY)

|    | P       | K       | Mg      | Ca      | BY      |
|----|---------|---------|---------|---------|---------|
| P  | 1.0000  | 0.2976  | -0.1491 | -0.0366 | -0.1677 |
| K  | 0.2976  | 1.0000  | 0.1291  | -0.4152 | -0.0787 |
| Mg | -0.1491 | 0.1291  | 1.0000  | 0.5262  | -0.1196 |
| Ca | -0.0366 | -0.4152 | 0.5262  | 1.0000  | 0.1170  |
| BY | -0.1677 | -0.0787 | -0.1196 | 0.1170  | 1.0000  |

| Variable | Main effect | SE     | t stat. | p-value |
|----------|-------------|--------|---------|---------|
| P        | -0.2838     | 0.2904 | -0.9772 | 0.3463  |
| K        | 0.2344      | 0.3529 | 0.6644  | 0.5181  |
| Mg       | -0.4142     | 0.3631 | -1.1408 | 0.2745  |
| Ca       | 0.4220      | 0.3899 | 1.0822  | 0.2988  |

Pe 0.64212761 R2 0.128073 p-value 0.7519

#### Macro-nutrients vs. flour yield

Flour Yield (FY)

|    | P       | K       | Mg      | Ca      | FY      |
|----|---------|---------|---------|---------|---------|
| P  | 1.0000  | 0.2976  | -0.1491 | -0.0366 | 0.7076  |
| K  | 0.2976  | 1.0000  | 0.1291  | -0.4152 | 0.3179  |
| Mg | -0.1491 | 0.1291  | 1.0000  | 0.5262  | -0.2284 |
| Ca | -0.0366 | -0.4152 | 0.5262  | 1.0000  | -0.2863 |
| FY | 0.7076  | 0.3179  | -0.2284 | -0.2863 | 1.0000  |

| Variable | Main effect | SE     | t stat. | p-value |
|----------|-------------|--------|---------|---------|
| P        | 0.7037      | 0.2042 | 3.4463  | 0.0043  |
| K        | -0.0095     | 0.2481 | -0.0384 | 0.9700  |
| Mg       | 0.0234      | 0.2553 | 0.0916  | 0.9284  |
| Ca       | -0.2768     | 0.2742 | -1.0097 | 0.3311  |

Pe 0.24578018 R2 0.568848 p-value 0.01981

#### Macro-nutrients vs. semolina yield

Semolina Yield (SY)

|    | P       | K       | Mg      | Ca      | SY      |
|----|---------|---------|---------|---------|---------|
| P  | 1.0000  | 0.2976  | -0.1491 | -0.0366 | -0.5136 |
| K  | 0.2976  | 1.0000  | 0.1291  | -0.4152 | -0.2264 |
| Mg | -0.1491 | 0.1291  | 1.0000  | 0.5262  | 0.3956  |
| Ca | -0.0366 | -0.4152 | 0.5262  | 1.0000  | 0.1428  |
| SY | -0.5136 | -0.2264 | 0.3956  | 0.1428  | 1.0000  |

| Variable | Main effect | SE     | t stat. | p-value |
|----------|-------------|--------|---------|---------|
| P        | -0.3562     | 0.2370 | -1.5030 | 0.1567  |
| K        | -0.3001     | 0.2880 | -1.0422 | 0.3163  |
| Mg       | 0.5234      | 0.2963 | 1.7664  | 0.1008  |
| Ca       | -0.2702     | 0.3182 | -0.8492 | 0.4111  |

Pe 0.35244952 R2 0.419322 p-value 0.10884

**Table S4. PC1-3 loadings**

| Variable | PC1    | PC2    | PC3    |
|----------|--------|--------|--------|
| TGW      | -0.671 | -0.435 | -0.021 |
| V        | -0.827 | 0.259  | -0.361 |
| PC       | -0.777 | 0.566  | -0.105 |
| AC       | -0.688 | 0.585  | 0.123  |
| FN       | -0.522 | -0.459 | -0.048 |
| GI       | 0.514  | -0.598 | -0.177 |
| GW       | -0.752 | -0.080 | 0.580  |
| GD       | -0.740 | 0.038  | 0.592  |
| GWC      | -0.747 | -0.143 | 0.565  |
| P        | -0.361 | -0.630 | -0.035 |
| K        | -0.444 | -0.319 | 0.394  |
| Mg       | -0.031 | 0.345  | 0.305  |
| Ca       | 0.117  | 0.484  | 0.078  |
| Cu       | -0.135 | -0.871 | -0.073 |
| Fe       | -0.233 | -0.583 | -0.175 |
| Zn       | 0.076  | -0.464 | 0.681  |
| Mn       | -0.268 | -0.318 | 0.543  |
| BW       | 0.484  | 0.144  | 0.629  |
| FW       | -0.552 | -0.604 | -0.494 |
| SW1      | 0.895  | -0.135 | 0.320  |
| SW2      | -0.475 | -0.094 | -0.566 |
| SW3      | -0.810 | 0.435  | -0.155 |
| 000      | 0.345  | 0.051  | 0.345  |
| 001      | 0.323  | 0.208  | 0.323  |
| 002      | 0.351  | 0.171  | 0.351  |
| 010      | -0.066 | -0.502 | -0.066 |
| 011      | -0.031 | -0.348 | -0.031 |
| 012      | 0.066  | -0.372 | 0.066  |
| 020      | -0.267 | -0.248 | -0.267 |
| 021      | -0.282 | -0.091 | -0.282 |
| 022      | -0.142 | -0.192 | -0.142 |
| 100      | 0.233  | 0.038  | 0.233  |
| 101      | 0.091  | 0.111  | 0.091  |
| 102      | 0.281  | 0.113  | 0.281  |
| 110      | 0.064  | -0.037 | 0.064  |
| 111      | 0.088  | 0.080  | 0.088  |
| 112      | 0.009  | 0.044  | 0.009  |
| 120      | -0.327 | 0.397  | -0.327 |
| 121      | -0.400 | 0.245  | -0.400 |
| 122      | -0.333 | 0.333  | -0.333 |