**S1 File. Supporting information:**

**Table A.** Results of physical characteristic testing with P-values in **bold** denoting significant correlations between physical properties of novel non-woven and control materials (described in Table 2) used in Phase II and III.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Physical property | Thickness | Wt | Transmittance | Perm | Pore\_size | WVT |
| Thickness |  |  |  |  |  |  |
| Wt | 0.083 |  |  |  |  |  |
| Transmittance | 0.098 | **0.036** |  |  |  |  |
| Perm | **0.021** | **0.046** | 0.104 |  |  |  |
| Pore\_size | **<.001** | **0.022** | 0.111 | **0.010** |  |  |
| WVT | 0.233 | 0.189 | 0.113 | **0.046** | 0.292 |  |

**Table B**. Arabidopsis trait-by-trait correlations for Phase II and Phase III. Significant correlations are highlighted in **bold**.

|  |  |  |
| --- | --- | --- |
|  | Total seed weight (g) | Individual seed weight (mg) |
|  | Phase II | Phase III | Phase II | Phase III |
| Individual seed weight (mg) | **<.001** | 0.838 |  |  |
| Germination % | 0.319 | 0.838 | **0.045** | **0.008** |

**Table C.** Miscanthus biological testing results (Phase II only) with significant results highlighted in **bold (**along with average least significant difference given in parentheses).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Seed number | Average seed number (mg) | Mean seed weight (mg) | Mean seed area | Mean seed width | Mean seed length |
| PCB  | A | B | A | B | A | B | A | B | A | B | A | B |
| A | 8.80 | 11.25 | 7.64 | 8.45 | 0.81 | 0.63 | 1.62 | 1.43 | 0.84 | 0.75 | 2.20 | 2.10 |
| B | 1.50 | 16.00 | 1.30 | 10.58 | 0.88 | 0.64 | 1.70 | 1.42 | 0.83 | 0.78 | 2.33 | 2.12 |
| C1 | 13.50 | 7.00 | 17.90 | 4.78 | 0.69 | 0.77 | 1.45 | 1.52 | 0.80 | 0.80 | 2.15 | 2.18 |
| W | 6.33 | 13.33 | 5.67 | 9.30 | 0.84 | 0.66 | 1.57 | 1.43 | 0.83 | 0.77 | 2.17 | 2.17 |
| Unbagged | 6.00 | 10.60 | 3.00 | 5.90 | 0.60 | 0.52 | 1.43 | 1.28 | 0.77 | 0.72 | 2.17 | 1.92 |
| *Genotype P-value* | *0.112* | *0.304* | *0.142* | *0.054* | ***0.017 (0.04)***  | *0.099* |
| *PCB P-value* | *0.999* | *0.875* | *0.600* | *0.469* | *0.248* | *0.435* |
| *Genotype x PCB P-value* | *0.312* | *0.129* | *0.919* | *0.777* | *0.781* | *0.720* |

**Table D.** Wheat biological testing results as means of traits and significance values in Phase II and Phase III testing with significant results highlighted in **bold (**along with average least significant difference given in parentheses).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PCB | Phase  | Seed number | Weight (g) | TGW | Seed area (mm) | Width (mm) | Length (mm) | Germination % |
| A | II | 18.85 | 0.46 | 41.03 | 16.85 | 3.48 | 6.14 | 97.41 |
| B | II | 18.15 | 0.46 | 42.49 | 17.53 | 3.56 | 6.20 | 91.33 |
| C1 | II | 21.40 | 0.54 | 41.20 | 17.16 | 3.48 | 6.11 | 91.50 |
| N | II | 19.25 | 0.42 | 33.95 | 15.53 | 3.33 | 5.94 | 82.08 |
| *P-value* | *0.625* | *0.636* | ***0.020 (5.86)*** | *0.119* | *0.191* | *0.259* | *0.093* |
| C2 | III | 20.76 | 0.91 | 42.21 | 19.10 | 3.66 | 6.64 | 44.46 |
| D | III | 18.80 | 0.83 | 40.06 | 19.45 | 3.54 | 6.89 | 82.04 |
| E | III | 18.48 | 0.68 | 38.76 | 17.58 | 3.41 | 6.43 | 68.55 |
| N | III | 22.19 | 0.71 | 31.66 | 15.17 | 3.24 | 5.79 | 67.76 |
| *P-value* | *0.528* | *0.255* | ***0.023 (7.08)*** | ***<0.001(2.63)*** | ***0.002 (0.41)*** | ***<0.001 (0.74)*** | *0.059* |

**Table E.** Sugar beet biological testing results as means of traits and significance values in Phase III testing with significant results highlighted in **bold** **(**along with average least significant difference given in parentheses).

|  |  |  |
| --- | --- | --- |
| .  | Total seed weight (g) | Number of seeds |
| Genotype | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| C2 | 6.6 | 7.4 | 10.3 | 5.0 | 14.5 | 10.7 | 8.7 | 6.8 | 704 | 800 | 1026 | 696 | 886 | 1091 | 688 | 997 |
| D | 5.0 | 3.3 | 8.9 | 7.8 | 8.5 | 6.3 | 4.0 | 2.3 | 602 | 464 | 813 | 969 | 604 | 732 | 315 | 385 |
| E | 8.4 | 7.0 | 6.5 | 13.4 | 7.6 | 10.5 | 8.7 | 7.2 | 790 | 873 | 677 | 1462 | 508 | 1287 | 739 | 908 |
| K | 9.5 | 6.0 | 11.5 | 5.3 | 9.8 | 19.4 | 10.2 | 6.7 | 986 | 719 | 1163 | 664 | 643 | 1266 | 786 | 924 |
| Unbagged | 17.4 | 14.3 | 20.9 | 16.3 | 41.2 | 56.9 | 48.8 | 17.6 | 1658 | 1644 | 1828 | 1779 | 2607 | 2770 | 1992 | 2206 |
| *P-value genotype* | ***<0.001 (2.3)*** | ***<0.001 (213.9)*** |
| *P-value PCB* | ***<0.001 (1.8)*** | ***<0.001 (169.1)*** |
| *P-value gen x PCB* | 0.197 | ***<0.001 (478.2)*** |

|  |  |  |
| --- | --- | --- |
|  | Germination % | Number of seedlings |
| Genotype | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| C2 | 80 | 96 | 100 | 100 | 29 | 90 | 97 | 52 | 60980 | 77837 | 102620 | 69560 | 24913 | 99223 | 67277 | 56231 |
| D | 95 | 100 | 77 | 93 | 32 | 84 | 89 | 51 | 57789 | 46380 | 99608 | 87247 | 18556 | 61397 | 28643 | 21499 |
| E | 100 | 91 | 100 | 100 | 67 | 79 | 87 | 73 | 78975 | 80620 | 67660 | 146180 | 33997 | 126300 | 63533 | 66000 |
| K | 100 | 82 | 100 | 100 | 45 | 97 | 100 | 66 | 98580 | 58318 | 116280 | 66360 | 28421 | 124463 | 78600 | 57998 |
| Unbagged | 20 | 13 | 20 | 17 | 11 | 20 | 20 | 4 | 52960 | 8987 | 53520 | 22183 | 12748 | 64920 | 34800 | 9764 |
| *P-value genotype* | *0.008* | ***<0.001 (26755)*** |
| *P-value PCB* | ***<0.001 (10.2)*** | ***<0.001 (21145)*** |
| *P-value gen x PCB* | ***<0.001 (28.9)*** | ***0.745 (59818)*** |

**Table F.** Internal PCB temperatures recorded using iButton sensors enclosed in test PCBs over both experimental testing phases (Phase II: 4096 observations; Phase III: 4077 observations).

|  |  |  |
| --- | --- | --- |
|  |  | Temperature |
| PCB | Phase  | Min (°C) | Max (°C) | Range (°C) | Lower quartile | Upper quartile |
| A | II | 14.36 | 41.09 | 26.73 | 18.12 | 27.87 |
| B | II | 14.35 | 40.10 | 25.75 | 18.11 | 26.11 |
| C1 | II | 14.56 | 41.80 | 27.24 | 18.57 | 27.82 |
| N | II | 15.05 | 42.54 | 27.49 | 19.06 | 29.06 |
| Unbagged | II | 14.64 | 37.88 | 23.24 | 18.65 | 25.40 |
| C2 | III | 14.10 | 41.59 | 27.49 | 18.11 | 26.36 |
| D | III | 14.62 | 37.37 | 22.75 | 18.62 | 25.88 |
| E | III | 14.60 | 40.34 | 25.74 | 18.60 | 26.86 |
| N | III | 14.09 | 43.57 | 29.48 | 18.10 | 27.86 |
| Unbagged | III | 15.05 | 42.54 | 27.49 | 19.06 | 29.06 |

**Table G.** Unbagged performance of Phase III sugar beet genotypes for all biological traits.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Genotype | Total seed weight (g) | Number of seeds | Germination % | Number of seedlings |
| 1 | 17.38 | 1658 | 20.00 | 52960.00 |
| 2 | 14.32 | 1644 | 13.33 | 8986.67 |
| 3 | 20.94 | 1828 | 20.00 | 53520.00 |
| 4 | 16.33 | 1779 | 16.67 | 22183.33 |
| 5 | 41.21 | 2607 | 10.93 | 12748.27 |
| 6 | 56.89 | 2770 | 20.00 | 64920.00 |
| 7 | 48.75 | 1992 | 20.00 | 34800.00 |
| 8 | 17.62 | 2206 | 4.47 | 9764.13 |

**Table H.** Correlation between physical and biological properties for sugar beet genotypes G\_01 and G\_98 Phase II testing with significant results highlighted in **bold**. R2 correlation values are given in parentheses for significant results.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Total seed weight (g) | Number of seeds | Germination % |
| Physical property | G\_01 | G\_98 | G\_01 | G\_98 | G\_01 | G\_98 |
| Thicknesss (mm) | 0.381 | 0.082 | 0.476 | 0.073 | 0.928 | 0.371 |
| Weight (gm-2) | 0.655 | 0.958 | 0.752 | 0.927 | 0.693 | 0.276 |
| % transmittance1 | 0.161 | **0.015 (0.971)** | 0.172 | **0.015 (0.921)** | 0.548 | 0.206 |
| Air permeability (1m-2s-1) | 0.713 | 0.251 | 0.789 | 0.228 | 0.844 | 0.262 |
| Max. pore size (um) | 0.482 | 0.115 | 0.504 | 0.098 | 0.767 | 0.090 |
| WVT (%) | 0.503 | 0.127 | 0.522 | 0.110 | 0.767 | 0.083 |

**Table I.** Correlation between physical and biological properties by genotype (denoted 1-8) for sugar beet Phase III testing with significant results highlighted in **bold**. R2 correlation values are given in parentheses for significant results.

|  |  |
| --- | --- |
|  | Total seed weight (g) |
| Physical property | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Thicknesss (mm) | 0.579 | **0.028 (0.944)** | 0.899 | 0.886 | 0.335 | 0.676 | 0.234 | 0.127 |
| Weight (gm-2) | 0.891 | 0.422 | 0.524 | 0.379 | 0.010 | 0.913 | 0.650 | 0.618 |
| % transmittance1 | 0.059 | 0.280 | 0.637 | 0.856 | 0.824 | 0.086 | **0.018 (0.964)** | 0.121 |
| Air permeability (1m-2s-1) | 0.588 | 0.729 | 0.053 | 0.146 | 0.403 | 0.218 | 0.416 | 0.656 |
| Max. pore size (um) | 0.586 | **0.041 (0.920)** | 0.837 | 0.823 | 0.298 | 0.651 | 0.231 | 0.139 |
| WVT (%) | 0.412 | 0.751 | 0.455 | 0.708 | 0.660 | 0.217 | 0.682 | 0.970 |
|   | Number of seeds |
| Thicknesss (mm) | 0.698 | 0.124 | 0.726 | 0.869 | 0.427 | 0.322 | 0.219 | 0.068 |
| Weight (gm-2) | 0.922 | 0.656 | 0.478 | 0.400 | **0.031 (0.939)** | 0.903 | 0.704 | 0.450 |
| % transmittance1 | 0.070 | 0.281 | 0.447 | 0.782 | 0.908 | 0.076 | **0.041 (0.920)** | 0.134 |
| Air permeability (1m-2s-1) | 0.389 | 0.909 | **0.006 (0.989)** | 0.107 | 0.404 | 0.702 | 0.538 | 0.528 |
| Max. pore size (um) | 0.687 | 0.151 | 0.669 | 0.806 | 0.385 | 0.339 | 0.225 | 0.070 |
| WVT (%) | 0.234 | 0.793 | 0.441 | 0.642 | 0.676 | 0.737 | 0.758 | 0.997 |
|   | Germination % |
| Thicknesss (mm) | 0.118 | 0.725 | 0.118 | 0.118 | 0.876 | 0.533 | 0.746 | 0.814 |
| Weight (gm-2) | 0.570 | 0.887 | 0.570 | 0.570 | 0.446 | 0.816 | 0.432 | 0.498 |
| % transmittance1 | 0.098 | 0.081 | 0.098 | 0.098 | 0.626 | 0.162 | 0.532 | 0.445 |
| Air permeability (1m-2s-1) | 0.574 | 0.411 | 0.574 | 0.574 | 0.536 | 0.884 | **0.019 (0.999)** | 0.740 |
| Max. pore size (um) | 0.125 | 0.716 | 0.125 | 0.125 | 0.929 | 0.560 | 0.687 | 0.859 |
| WVT (%) | 0.931 | 0.223 | 0.931 | 0.931 | 0.924 | 0.655 | 0.505 | 0.750 |
|   | Number of seedlings |
| Thicknesss (mm) | 0.862 | 0.118 | 0.897 | 0.984 | 0.443 | 0.377 | 0.233 | 0.180 |
| Weight (gm-2) | 0.716 | 0.553 | 0.641 | 0.458 | 0.878 | 0.971 | 0.607 | 0.733 |
| % transmittance1 | 0.151 | 0.540 | 0.819 | 0.900 | 0.267 | 0.080 | **0.019 (0.409)** | 0.141 |
| Air permeability (1m-2s-1) | 0.530 | 0.899 | 0.142 | 0.166 | 0.940 | 0.720 | 0.360 | 0.759 |
| Max. pore size (um) | 0.859 | 0.149 | 0.960 | 0.920 | 0.480 | 0.395 | 0.225 | 0.200 |
| WVT (%) | 0.183 | 0.477 | 0.443 | 0.653 | 0.907 | 0.688 | 0.665 | 0.966 |