**Table S1. Pooled analysis of variance for different agronomic traits of oat (*Avena sativa* L.) genotypes**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source of variation** | **Df** | **DTF** | **PH** | **NOT** | **PL** | **SPP** | **MG** | **DTM** | **GW** | **DW** | **SY** | **TW** |
| Environment | 1 | 5803.82\*\* | 1375.9\*\* | 9447.5\*\* | 84.74\*\* | 40014.90\*\* | 0.02562 | 6094.46\*\* | 45889.2\*\* | 12440\*\* | 0.238 | 35.077\*\* |
| Replication within Env. | 2 | 5.93 | 69.8 | 40.7 | 2.14 | 96.21\*\* | 0.00986 | 6.02\* | 21.3 | 1132\*\* | 0.302 | 1.214 |
| Genotype | 55 | 105.73\*\* | 893.7\*\* | 5511.0\*\* | 84.64\*\* | 4454.05\*\* | 4.37660\*\* | 119.37\*\* | 40835.2\*\* | 8636\*\* | 407.224\*\* | 193.251\* |
| Gxe Interaction | 55 | 5.91 | 279.2\*\* | 1473.0\*\* | 14.27\*\* | 1022.16\*\* | 1.16420\*\* | 1.52 | 174.3\*\* | 263 | 0.910\*\* | 2.471\* |
| Pooled Error | 110 | 6.49 | 70.3 | 14.5 | 1.07 | 6.53 | 0.02636 | 1.71 | 16.2 | 213 | 0.130 | 0.458 |

**Table S2. Analysis of variance for quality parameters in oats (*Avena sativa* L.)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **D.f** | **TSS (%)** | **CP (%)** | **Fe (mg/kg)** | **Zn (mg/kg)** |
| Block (ignoring Treatments) | 4 | 0.15 \*\* | 2.33 \*\* | 35.45 \*\* | 48.92 \*\* |
| Block(eliminating Treatments) | 4 | 0.05 ns | 0.08 \* | 6.58 ns | 4.83 \* |
| Treatment (ignoring Blocks) | 55 | 0.7 \*\* | 2.09 \*\* | 195.83 \*\* | 135.06 \*\* |
| Treatment (eliminating Blocks) | 55 | 0.69 \*\* | 1.92 \*\* | 193.73 \*\* | 131.85 \*\* |
| Check | 4 | 1.03 \*\* | 2.06 \*\* | 658.45 \*\* | 215.09 \*\* |
| Test entries | 50 | 0.51 \*\* | 2.03 \*\* | 159.27 \*\* | 122.89 \*\* |
| Test vs. Check | 1 | 9.04 \*\* | 5.16 \*\* | 173.15 \*\* | 423.25 \*\* |
| Error | 16 | 0.02 | 0.02 | 3.09 | 1.4 |

**Table S3 : Pooled descriptive statistics for agronomic and quality traits in oats (*Avena sativa* L.)**

| **Trait** | **Mean** | **Min** | **Max** | **C.V** | **PV** | **GV** | **EV** | **GCV** | **PCV** | **ECV** | ***H2*** | **GA** | **GAM** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DTF** | 178.995 | 165.15 | 189.52 | 3.015 | 20.9 | 7.51 | 13.39 | 1.515 | 2.56 | 2.03 | 35.66 | 3.375 | 1.91 |
| **PH** | 125.78 | 85.435 | 168.55 | 13.63 | 298.155 | 276.075 | 22.08 | 13.22 | 13.735 | 3.735 | 92.57 | 213.535 | 51.915 |
| **NOT** | 143.06 | 66.9 | 261.91 | 29.89 | 1881.51 | 1467.995 | 413.52 | 26.835 | 30.4 | 14.255 | 77.69 | 100.18 | 89.79 |
| **PL** | 28.005 | 17.06 | 43.335 | 19.21 | 23.485 | 18.935 | 4.55 | 15.475 | 17.29 | 7.565 | 79.535 | 32.97 | 26.24 |
| **SPP** | 112.975 | 55.885 | 194.8 | 32.165 | 1327.675 | 1275.41 | 52.265 | 31.8 | 32.43 | 6.325 | 96.135 | 69.46 | 48.885 |
| **MG** | 7.21 | 4.15 | 9.74 | 16.37 | 0.87 | 0.84 | 0.03 | 12.675 | 12.9 | 2.4 | 96.54 | 7.985 | 28.62 |
| **DTM** | 207.84 | 194.25 | 219.67 | 2.795 | 24.49 | 7.485 | 17 | 1.31 | 2.375 | 1.985 | 30.31 | 72.115 | 64.34 |
| **GW** | 411.3 | 131.19 | 612.565 | 24.685 | 11044.14 | 10884.01 | 160.13 | 25.36 | 25.55 | 2.81 | 98.49 | 21.13 | 64.85 |
| **DW** | 112.115 | 30.515 | 200.44 | 42.66 | 2399.905 | 2378.98 | 20.925 | 43.71 | 43.9 | 3.99 | 99.125 | 3.105 | 1.49 |
| **SY** | 32.58 | 16.905 | 61.74 | 31.12 | 105.895 | 105.42 | 0.48 | 31.505 | 31.575 | 2.02 | 99.54 | 1.855 | 25.68 |
| **TW** | 44.605 | 20.24 | 55.75 | 15.86 | 36.71 | 21.605 | 15.105 | 10.38 | 13.545 | 8.705 | 58.585 | 7.325 | 16.405 |
| **CP (%)** | 8.87 | 7.05 | 12.15 | 1.64 | 2.03 | 2.00 | 0.02 | 15.96 | 16.05 | 1.67 | 98.92 | 2.9 | 32.75 |
| **TSS (%)** | 2.80 | 1.32 | 5.53 | 5.45 | 0.51 | 0.49 | 0.02 | 24.99 | 25.50 | 5.11 | 95.99 | 1.41 | 50.5 |
| **Fe** | 73.86 | 50.30 | 100.38 | 2.40 | 159.27 | 156.18 | 3.09 | 16.92 | 17.09 | 2.38 | 98.06 | 25.53 | 34.57 |
| **Zn** | 47.60 | 27.09 | 69.74 | 2.55 | 122.89 | 121.50 | 1.40 | 23.16 | 23.29 | 2.48 | 98.86 | 22.61 | 47.5 |

**Table S4: Contribution of various agronomic and quality in four major principal components**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Particulars** | **PCA1** | **PCA2** | **PCA3** | **PCA4** |
| **a)Traits** |  | | | |
| DTF | 9.66 | 0.06 | 0.08 | 0.58 |
| PH | 19.42 | 0.08 | 0.39 | 0.00 |
| NOT | 15.51 | 0.16 | 0.06 | 0.17 |
| PL | 0.59 | 14.86 | 0.89 | 6.41 |
| SPP | 0.74 | 26.94 | 0.57 | 2.61 |
| MG | 0.07 | 19.98 | 5.77 | 0.01 |
| DTM | 16.35 | 1.58 | 0.03 | 0.80 |
| GW | 19.04 | 0.39 | 0.45 | 0.47 |
| DW | 13.63 | 0.00 | 0.32 | 3.02 |
| SY | 1.85 | 24.22 | 1.49 | 8.56 |
| TW | 0.04 | 7.36 | 27.69 | 0.00 |
| CP | 0.03 | 0.00 | 5.19 | 41.50 |
| TSS | 1.85 | 1.21 | 2.55 | 22.25 |
| IRON | 0.65 | 1.11 | 28.37 | 11.77 |
| ZINC | 0.56 | 2.04 | 26.15 | 1.86 |
| **b)Eigen value** | 4.77 | 2.58 | 1.88 | 1.25 |
| **c)Percentage of variance** | 31.79 | 17.20 | 12.53 | 8.34 |

**Table S5: Diversity (D2) Analysis in oat (*Avena sativa* L.) genotypes**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Average inter cluster (above diagonal) and intra cluster (diagonal) distances** | | | | | | |
| **CLUSTER** | **C1** | **C2** | **C3** | **C4** | **C5** | **C6** |
| **C1** | 3.232 | 5.518 | 6.399 | 7.121 | 5.540 | 5.870 |
| **C2** |  | 3.978 | 5.120 | 5.385 | 4.578 | 5.598 |
| **C3** |  |  | 4.360 | 6.675 | 5.258 | 5.198 |
| **C4** |  |  |  | 4.379 | 5.206 | 8.151 |
| **C5** |  |  |  |  | 3.992 | 5.548 |
| **C6** |  |  |  |  |  | 3.565 |
| **Distribution of genotypes into different clusters** | | | | | | |
| **Cluster** | **No. of genotypes** | **Name of the genotypes** | | | | |
| I | 4 | SFO-1, SFO-2, SFO-3, SFO-4 | | | | |
| II | 16 | SFO-6, KYOTO I, NGB 12221.2, ALTERSE JAVNE, ALDEN, CECILE, DAN, BAMBU, COLLA, GALLOP, AVOINE UF GROSSE, SISU, ENGEL BREKT II, KAEMPE GUL, MAGNE, LOGOWO | | | | |
| III | 12 | BORRIS OPUS II, EDIT, HANNES, VIRMA, BELIDA, HANNIJ 7773, ARGUS, KLOCK EXTRA, FREDDY, GULDREG II, BALLET II, KRON | | | | |
| IV | 10 | DIANA, ADLER, GULDREGNI I, KYTO, FEMIA, BLENDA, KUNGES, BIRI, JADDER, LINDA | | | | |
| V | 10 | BALLET I, ASLAK, EKO, LBION, BOY, ARNE, DULA, SILLA, ORN, ANGELKA | | | | |
| VI | 4 | ESA, SPRING BAMBU II, KYOTO II, SELMA | | | | |

**legend:** Days to 50% flowering (DTF), plant height (PH), days to maturity (DTM), main culm diameter (MG), panicle length (PL), seeds per panicle (SPP),1000 seed weight (TW), green fodder yield (GW), dry fodder yield (DW), seed yield (SY) and number of tillers / m2 (NOT) grain crude protein content (CP%), total soluble sugars (TSS), iron (GFe) and zinc content (GZn), Genotype x environment interaction (GXE), Principal component (PC), Cold tolerance rating (CTR), Electrolyte leakage (EL). **TSS**=Total Soluble Sugar, **CP**=Crude Protein, **Fe**=Iron, **Zn**=Zinc, *Rabi* (November to June cropping season)

**Table S6. List of genotypes evaluated from 2018-2022**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.no** | **Genotypes** | **First year**  **(2018-19)** | **Second year**  **(2019-20)** | **Third year**  **(2020-2021)** | **Fourth year**  **(2021-2022)** |
|  | ABED MAX | ✓ | ✓ |  |  |
|  | ADLER | ✓ | ✓ | ✓ | ✓ |
|  | ADMO | ✓ |  |  |  |
|  | AG 0153 | ✓ |  |  |  |
|  | AGUS TIDLING | ✓ |  |  |  |
|  | AJAX | ✓ | ✓ |  |  |
|  | ALDEN | ✓ | ✓ | ✓ | ✓ |
|  | ALDEN II | ✓ |  |  |  |
|  | ALGERIBEE | ✓ |  |  |  |
|  | ALTERSE JAVNE | ✓ | ✓ | ✓ | ✓ |
|  | ANGELICA | ✓ | ✓ | ✓ | ✓ |
|  | ANGUS PIDLING | ✓ |  |  |  |
|  | ANGUS SIDLING | ✓ |  |  |  |
|  | ARGUS | ✓ | ✓ | ✓ | ✓ |
|  | ARGUS II | ✓ |  |  |  |
|  | ARLA | ✓ | ✓ |  |  |
|  | ARNE | ✓ | ✓ | ✓ | ✓ |
|  | AVAR | ✓ |  |  |  |
|  | ASIAB | ✓ |  |  |  |
|  | ASLAK | ✓ | ✓ | ✓ | ✓ |
|  | AVOINE UF GROSSE | ✓ | ✓ | ✓ | ✓ |
|  | BALLET I | ✓ | ✓ | ✓ | ✓ |
|  | BALETT | ✓ |  |  |  |
|  | BALLET II | ✓ | ✓ | ✓ | ✓ |
|  | BAMBU | ✓ | ✓ | ✓ | ✓ |
|  | BAMBU II | ✓ |  |  |  |
|  | BELIDA | ✓ | ✓ | ✓ | ✓ |
|  | BELINDA | ✓ |  |  |  |
|  | BENTO PAJBJBERG | ✓ | ✓ |  |  |
|  | BIKINI | ✓ |  |  |  |
|  | BIRI | ✓ | ✓ | ✓ | ✓ |
|  | BLENDA | ✓ | ✓ | ✓ | ✓ |
|  | BODIL | ✓ | ✓ |  |  |
|  | BORRIS FALK | ✓ | ✓ |  |  |
|  | BORRIS OPUS II | ✓ | ✓ | ✓ | ✓ |
|  | BORRIS STAND | ✓ | ✓ |  |  |
|  | BORSTLOS PROBSTEIER 3 | ✓ | ✓ |  |  |
|  | BOY | ✓ | ✓ | ✓ | ✓ |
|  | CECILE | ✓ | ✓ | ✓ | ✓ |
|  | CHICA | ✓ | ✓ |  |  |
|  | CODOR | ✓ |  |  |  |
|  | COLLA | ✓ | ✓ | ✓ | ✓ |
|  | CONDOR | ✓ | ✓ |  |  |
|  | DAN Y | ✓ |  |  |  |
|  | DAN | ✓ | ✓ | ✓ | ✓ |
|  | DIAMENT | ✓ | ✓ |  |  |
|  | DIANA | ✓ | ✓ | ✓ | ✓ |
|  | DULA | ✓ | ✓ | ✓ | ✓ |
|  | DULLA | ✓ |  |  |  |
|  | EAGLE | ✓ | ✓ |  |  |
|  | EDIT | ✓ | ✓ | ✓ | ✓ |
|  | EKO | ✓ | ✓ | ✓ | ✓ |
|  | ENGEL BREKT I | ✓ |  |  |  |
|  | ENGEL BREKT II | ✓ | ✓ | ✓ | ✓ |
|  | ENGEL BREKT II SVALOF | ✓ | ✓ |  |  |
|  | ENGELBREKT SVALOF | ✓ |  |  |  |
|  | ESA | ✓ | ✓ | ✓ | ✓ |
|  | EYRIS | ✓ |  |  |  |
|  | FEMIA | ✓ | ✓ | ✓ | ✓ |
|  | FIX | ✓ |  |  |  |
|  | FOLD | ✓ |  |  |  |
|  | FORTUNA | ✓ |  |  |  |
|  | FREDDY | ✓ | ✓ | ✓ | ✓ |
|  | FYRIS | ✓ |  |  |  |
|  | GALLOP | ✓ | ✓ | ✓ | ✓ |
|  | GB250061 | ✓ |  |  |  |
|  | GOTA | ✓ | ✓ |  |  |
|  | GRAKAL | ✓ |  |  |  |
|  | GRANE | ✓ |  |  |  |
|  | GRENADER | ✓ |  |  |  |
|  | GULDREG II | ✓ | ✓ | ✓ | ✓ |
|  | GULDREGNI | ✓ |  | ✓ | ✓ |
|  | GULDREGNI I | ✓ | ✓ |  |  |
|  | HANNES | ✓ | ✓ | ✓ | ✓ |
|  | HANNIJ 7773 | ✓ | ✓ | ✓ | ✓ |
|  | HANSLAPJARUI ME0403 | ✓ |  |  |  |
|  | HEDEHAVRE LYGBY | ✓ |  |  |  |
|  | HEDEHAVRELY NGBY | ✓ |  |  |  |
|  | HEDVIG | ✓ |  |  |  |
|  | HEIN I | ✓ |  |  |  |
|  | HEIN II | ✓ | ✓ |  |  |
|  | HENNES VIROJOKIME 0101 | ✓ |  |  |  |
|  | HIRD | ✓ |  |  |  |
|  | HOJER 4017 | ✓ |  |  |  |
|  | HVITLING | ✓ |  |  |  |
|  | JADDER | ✓ | ✓ | ✓ | ✓ |
|  | JOTUL | ✓ |  |  |  |
|  | KAEMPE GUL | ✓ | ✓ | ✓ | ✓ |
|  | KAPP | ✓ | ✓ |  |  |
|  | KARHU | ✓ |  |  |  |
|  | KATRI | ✓ |  |  |  |
|  | KLOCK EXTRA | ✓ | ✓ | ✓ | ✓ |
|  | KLOCK X | ✓ |  |  |  |
|  | KLOCK PURE | ✓ |  |  |  |
|  | KLOCK HAURE III | ✓ |  |  |  |
|  | KLOCK II | ✓ |  |  |  |
|  | KLOCK II SVALOFF | ✓ |  |  |  |
|  | KLOCK III | ✓ | ✓ |  |  |
|  | KONING TIGER | ✓ |  |  |  |
|  | KOST | ✓ |  |  |  |
|  | KRON | ✓ | ✓ | ✓ | ✓ |
|  | KUNGES | ✓ | ✓ | ✓ | ✓ |
|  | KYOTO I | ✓ | ✓ | ✓ | ✓ |
|  | KYOTO P | ✓ |  |  |  |
|  | KYOTO II | ✓ | ✓ | ✓ | ✓ |
|  | KYRO | ✓ |  |  |  |
|  | KYTO | ✓ | ✓ | ✓ | ✓ |
|  | LBION | ✓ | ✓ | ✓ | ✓ |
|  | LIGOWO II | ✓ |  |  |  |
|  | LIGOWO III | ✓ |  |  |  |
|  | LIGOWO IV | ✓ |  |  |  |
|  | LINDA | ✓ | ✓ | ✓ | ✓ |
|  | LOGOWO | ✓ | ✓ | ✓ | ✓ |
|  | LYNGBY HEOEHAVRE 2 | ✓ |  |  |  |
|  | MAGNE | ✓ | ✓ | ✓ | ✓ |
|  | MAGNE II | ✓ |  |  |  |
|  | MATILDA | ✓ |  |  |  |
|  | MESDAG | ✓ |  |  |  |
|  | MINOR ABED | ✓ | ✓ |  |  |
|  | NGB 12221.2 | ✓ | ✓ | ✓ | ✓ |
|  | NGB 25006.1 | ✓ | ✓ |  |  |
|  | NORD FINSKSEL | ✓ |  |  |  |
|  | NORD FINSKSEL 0660 | ✓ |  |  |  |
|  | ORN | ✓ | ✓ | ✓ | ✓ |
|  | SELMA | ✓ | ✓ | ✓ | ✓ |
|  | SILLA | ✓ | ✓ | ✓ | ✓ |
|  | SISU | ✓ | ✓ | ✓ | ✓ |
|  | SPRING BAMBU II | ✓ | ✓ | ✓ | ✓ |
|  | VIRMA | ✓ | ✓ | ✓ | ✓ |
|  | ERO | ✓ |  |  |  |