Table S1. Fatty acid composition, the content of storage compounds and seed viability of 42 oilseed rape accessions multiplied in 1983 and maintained since at 7±3°C, 6±2% seed moisture content. Counts were conducted for percentage of normal seedlings (%NS) and total germination (%TG) in 1983, 1990, 1993, 2009 and 2014. The germination data are given as the arithmetic mean, along with the standard deviation (SD) and range [minimum (Min) to maximum (Max)] derived from four replicates per accession. Least significant difference (LSD5%) is given between genotypes. The half-viability period (P50) is estimated for each accession and is based on the evaluated %TG over the years. The fatty acid composition and storage compound data represent the mean of three replicates. TSW, thousand seed weight; NIRS, Near Infrared Spectroscopy.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Trait** | **Test Year** | **Mean** | **SD** |  | **Min** | **Max** | **LSD5%** |
|  | TSW in g | 2009 | 4.45 | 0.64 |  | 3.00 | 5.70 |  |
| **Germination** | %TG | 1983 | 94.71 | 5.37 |  | 80.00 | 100.00 |  |
| %TG | 1990 | 92.97 | 4.64 |  | 83.00 | 100.00 |  |
| %TG | 1993 | 79.10 | 12.48 |  | 57.00 | 99.00 |  |
| %TG | 2009 | 65.67 | 14.23 |  | 41.75 | 98.00 | 15.81 |
| %NS | 2009 | 21.11 | 24.00 |  | 0.00 | 90.00 | 11.19 |
| %TG | 2014 | 35.10 | 28.67 |  | 2.00 | 97.00 | 7.23 |
| %NS | 2014 | 13.11 | 25.28 |  | 0.00 | 87.00 | 4.52 |
| P50 in y |  | 26.72 | 8.70 |  | 15.22 | 50.69 |  |
| **Fatty Acids** | 14:0 Myristic acid in % | 2014 | 0.05 | 0.01 |  | 0.04 | 0.06 | 0.00 |
| 16:0 Palmitic acid in % | 2014 | 4.63 | 0.30 |  | 4.00 | 5.18 | 0.20 |
| 16:1 Palmitoleic acid in % | 2014 | 0.28 | 0.02 |  | 0.22 | 0.32 | 0.02 |
| 18:0 Stearic acid in % | 2014 | 1.44 | 0.12 |  | 1.23 | 1.80 | 0.10 |
| 18:1 Oleic acid in % | 2014 | 57.41 | 6.79 |  | 33.72 | 64.43 | 1.66 |
| 18:2 Linoleic acid in % | 2014 | 19.46 | 1.73 |  | 15.69 | 22.52 | 0.44 |
| 18:3 α-Linolenic acid in % | 2014 | 9.36 | 1.11 |  | 7.16 | 11.10 | 0.26 |
| 20:0 Arachidic acid in % | 2014 | 0.52 | 0.04 |  | 0.46 | 0.61 | 0.00 |
| 20:1 Eicosenoic acid in % | 2014 | 3.13 | 2.91 |  | 1.09 | 12.48 | 0.62 |
| 20:2 Eicosadienoic acid in % | 2014 | 0.12 | 0.09 |  | 0.06 | 0.43 | 0.02 |
| 22:0 Behenic acid in % | 2014 | 0.31 | 0.03 |  | 0.25 | 0.37 | 0.00 |
| 22:1 Erucic acid in % | 2014 | 3.18 | 5.75 |  | 0.05 | 23.14 | 1.33 |
|  | 24:0 Lignoceric acid in % | 2014 | 0.13 | 0.02 |  | 0.10 | 0.16 | 0.00 |
|  | 24:1 Nervonic acid in % | 2014 | 0.20 | 0.08 |  | 0.13 | 0.43 | 0.03 |
|  | Total Saturated Acids | 2014 | 7.03 | 0.35 |  | 6.39 | 7.72 | 0.18 |
|  | Total Unsaturated Acids | 2014 | 92.96 | 0.35 |  | 92.26 | 93.26 | 0.19 |
| **NIRS** | Oil in % | 2014 | 44.61 | 1.91 |  | 41.10 | 48.17 | 0.69 |
| Glucosinolates in µmol g-1 DW | 2014 | 56.63 | 26.84 |  | 9.13 | 85.10 | 3.53 |
| Protein in % | 2014 | 24.24 | 1.92 |  | 19.13 | 27.03 | 0.42 |
| Protein i.S. in % | 2014 | 43.74 | 2.53 |  | 36.93 | 47.20 | 0.44 |
| H2O in % | 2014 | 5.05 | 0.31 |  | 4.40 | 5.77 | 0.18 |

Table S2. Overview for different network settings for three best combination methods and %TG 2014 as target value. Values in brackets indicate the parameter for the neural network method, e.g. five centers for RBF. NaN (not a number): models failed due to missing or incomplete data in older %TG.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Method** | **Lignoceric acid** | | **Nervonic acid** | | **Glucosinolates** | |
| **in %** | | **in %** | | **in µmol g-1 DW** | |
| **Neural Network** | **rM** | **R²** | **rM** | **R²** | **rM** | **R²** |
| PLS [5], 10-fold | 0.97 | -0.03 | 0.91 | 0.33 | 0.69 | -0.18 |
| RBF [3], 10-fold | NaN | 0.00 | NaN | 0.00 | NaN | 0.00 |
| RBF [5], 10-fold | NaN | -0.05 | NaN | -0.01 | NaN | -0.21 |
| RBF [7], 10-fold | NaN | -0.02 | NaN | -0.01 | NaN | 0.00 |
| RBF [10], 10-fold | NaN | 0.00 | NaN | -0.01 | NaN | -0.02 |
| MLP [5], 10-fold | 0.71 | 0.10 | 0.46 | 0.09 | 0.96 | 0.58 |
| MLP [10], 10-fold | 0.46 | -0.22 | 0.84 | 0.57 | 0.59 | 0.20 |
| MLP [5 3], 10-fold | -0.82 | -0.87 | 0.88 | 0.69 | 0.86 | 0.52 |

Table S3. Overview of best correlation coefficient rM and its mean and standard deviation, as well as fitting parameter R2 with its mean and standard deviation for three indifferent input vectors for %TG 2014 and %NS 2104, respectively. Results were obtained by network setups as indicated, e.g. a partial least square (PLS) and multilayer perceptron (MLP) with 5 components for lignoceric acid.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Target value** | **Input vector** | **rM** | **Mean(rM)** | **Std(rM)** | **R²** | **Mean(R2)** | **Std(R²)** | **Neural Network** |
| %TG 2014 | 24:0 Lignoceric acid in % | 0.97 | 0.63 | 0.47 | -0.03 | -0.11 | 0.07 | PLS [5] |
| 24:1 Nervonic acid in % | 0.91 | 0.37 | 0.16 | 0.33 | 0.52 | 0.27 | PLS [5] |
| Glucosinolates in µmol g-1 DW | 0.96 | 0.33 | 0.43 | 0.58 | 0.61 | 0.30 | MLP [5] |
| %NS 2014 | Oil in % | 0.99 | 0.83 | 0.12 | 0.90 | 0.67 | 0.21 | MLP [5] |
| 20:1 Eicosenoic acid in % | 0,99 | 0.77 | 0.21 | 0.62 | 0.35 | 0.32 | MLP [5] |
| 18:0 Stearic acid in % | 0.99 | 0.67 | 0.43 | 0.42 | 0.27 | 0.21 | MLP [5] |

Table S4. Multivariate regression reveals correlation coefficients for %NS 2014 for a combination of fatty acids, compounds, historic viability data and thousand seed weight (TSW). Values for rM represent best fit at p<0.01 using either + MLP with five neurons in a single layer, x RBF with five centres or \* PLS with five components. Compounds include oil, glucosinolates, protein and H2O content. Fatty acids include all individual fatty acids. Second column: TSW is an additional input vector alongside input values as indicated by the first column, third column %NS 2009, fourth column: TSW and %NS 2009 form additional input vectors.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Additional Input Values** | **TSW** | | **%NS 2009** | | **TSW and %NS 2009** | |
| **Input Values** | **rM** | **R²** | **rM** | **R²** | **rM** | **R²** |
| Fatty acids | 0.86**x** | 0.60 | 0.90**\*** | 0.73 | 0.91**\*** | 0.62 |
| Compounds | 0.93**\*** | 0.26 | 0.95**+** | 0.67 | 0.99**+** | 0.29 |
| Fatty acids and compounds | 0.99**+** | 0.05 | 0.73**\*** | 0.32 | 0.99**+** | 0.73 |
| 14:0 Myristic acid in % | 0.97**+** | 0.46 | 0.94**\*** | 0.86 | 0.99**\*** | 0.77 |
| 16:0 Palmitic acid in % | 0.99**x** | 0.76 | 0.97**\*** | 0.89 | 0.96**\*** | 0.86 |
| 16:1 Palmitoleic acid in % | 0.98**x** | 0.63 | 0.96**\*** | 0.91 | 0.89**\*** | 0.60 |
| 18:0 Stearic acid in % | 0.86**x** | 0.70 | 0.99**\*** | 0.79 | 0.99**\*** | 0.83 |
| 18:1 Oleic acid in % | 0.91**+** | 0.65 | 0.98**\*** | 0.87 | 0.94**\*** | 0.87 |
| 18:2 Linoleic acid in % | 0.76**+** | 0.16 | 0.90**\*** | 0.62 | 0.99**\*** | 0.87 |
| 18:3 α-Linolenic acid in % | 0.98**+** | 0.42 | 0.99**\*** | 0.82 | 0.97**\*** | 0.87 |
| 20:0 Arachidic acid in % | 0.90**x** | 0.76 | 0.92**+** | 0.71 | 0.94**\*** | 0.74 |
| 20:1 Eicosenoic acid in % | 0.87**+** | 0.75 | 0.98**\*** | 0.83 | 0.97**\*** | 0.79 |
| 20:2 Eicosadienoic acid in % | 0.80**\*** | 0.34 | 1.00**\*** | 0.79 | 0.99**\*** | 0.87 |
| 22:0 Behenic acid in % | 0.96**x** | 0.59 | 1.00**\*** | 0.89 | 0.56**\*** | 0.19 |
| 22:1 Erucic acid in % | 0.95**+** | 0.61 | 0.98**+** | 0.91 | 0.98**\*** | 0.74 |
| 24:0 Lignoceric acid in % | 0.95**x** | 0.69 | 0.97**+** | 0.80 | 0.88**\*** | 0.66 |
| 24:1 Nervonic acid in % | 0.99**+** | 0.47 | 0.94**\*** | 0.85 | 0.99**+** | 0.59 |
| Oil in % | 0.99**+** | 0.92 | 0.92**\*** | 0.63 | 0.94**\*** | 0.83 |
| Glucosinolates in µmol | 0.80**x** | 0.63 | 0.99**\*** | 0.89 | 0.95**\*** | 0.86 |
| Protein in % | 1.00**+** | 0.63 | 0.92**\*** | 0.60 | 1.00**+** | 0.72 |
| H2O in % | 1.00**x** | 0.68 | 0.96**\*** | 0.80 | 0.97**\*** | 0.91 |
| Stearic, Linoleic, Arachidic, Eicosadienoic and Erucic acid in %, Glucosinolates in µmol g-1 DW | 1.00**+** | 0.77 | 0.93**\*** | 0.78 | 0.97**\*** | 0.92 |
| Oleic, α-Linolenic, Arachidic, Eicosenoic and Eicosadienoic acid in %, Glucosinolates in µmol g-1 DW | 0.99**+** | 0.89 | 0.79**\*** | 0.49 | 0.97**\*** | 0.93 |
| α-Linolenic acid in %, Oil in % and Glucosinolates in µmol g-1 DW | 0.90**\*** | 0.54 | 0.84**\*** | 0.50 | 0.99**\*** | 0.59 |
| Myristic, Stearic, Oleic, α-Linolenic, Arachidic, Eicosenoic, Eicosadienoic, Erucic, Lignoceric and Nervonic acid in % | 0.87**\*** | 0.56 | 0.96**\*** | 0.91 | 0.85**\*** | 0.72 |
| Myristic, Stearic, Oleic, α-Linolenic, Arachidic, Eicosenoic, Eicosadienoic, Erucic, Lignoceric and Nervonic acid in %, Oil in %, Glucosinlates in µmol g-1 DW | 0.68**+** | 0.45 | 0.99**+** | 0.54 | 0.88**+** | 0.64 |
| Myristic, Stearic, Oleic, α-Linolenic, Arachidic, Eicosenoic, Eicosadienoic, Erucic, Lignoceric and Nervonic acid in %, Oil, Proteins and H2O in %, Glucosinolates in µmol g-1 DW | 0.82**\*** | 0.55 | 0.81**\*** | 0.63 | 0.89**\*** | 0.73 |

Table S5. Multivariate regression reveals correlation coefficients for %TG 2014 for a combination of fatty acids, compounds, historic viability data and thousand seed weight (TSW). Values for rM represent best fit at p<0.01 using either + MLP with five neurons in a single layer, x RBF with five centres or \* PLS with five components. Compounds include oil, glucosinolates, protein and H2O content. Fatty acids include all individual fatty acids. Second column: TSW is an additional input vector alongside input values as indicated by the first column, third column %TG 1983, 1990, 1993 and 2009 form additional input vectors, fourth column: TSW, %TG 1983, 1990, 1993 and 2009 form additional input vectors. NaN (not a number): models failed due to missing or incomplete data in older %TG.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Additional Input Values** | **TSW** | | **%TG 1983, 1990, 1993, 2009** | | **TSW and % TG 1983, 1990, 1993, 2009** | |
| **Input Values** | **rM** | **R²** | **rM** | **R²** | **rM** | **R²** |
| Fatty acids | 0.52**+** | 0.16 | NaN | NaN | NaN | NaN |
| Compounds | 0.97**+** | 0.20 | NaN | NaN | NaN | NaN |
| Fatty acids and compounds | 0.77**\*** | 0.19 | 0.86**+** | 0.70 | 0.94**\*** | 0.86 |
| 14:0 Myristic acid in % | 0.87**+** | 0.69 | 0.88**\*** | 0.73 | 0.90**\*** | 0.78 |
| 16:0 Palmitic acid in % | 0.83**\*** | 0.34 | 0.90**\*** | 0.75 | 0.74**\*** | 0.44 |
| 16:1 Palmitoleic acid in % | 0.95**x** | 0.88 | 0.89**\*** | 0.78 | 0.92**\*** | 0.75 |
| 18:0 Stearic acid in % | 0.95**+** | 0.81 | 0.79**+** | 0.58 | 0.98**\*** | 0.77 |
| 18:1 Oleic acid in % | 0.89**+** | 0.50 | 0.87**\*** | 0.73 | 0.93**x** | 0.02 |
| 18:2 Linoleic acid in % | 0.93**+** | 0.83 | 0.92**\*** | 0.59 | 0.98**+** | 0.96 |
| 18:3 α-Linolenic acid in % | 0.96**x** | 0.32 | 0.93**\*** | 0.86 | 0.96**\*** | 0.90 |
| 20:0 Arachidic acid in % | 0.78**x** | 0.21 | 0.80**\*** | 0.61 | 0.99**\*** | 0.85 |
| 20:1 Eicosenoic acid in % | 0.78**x** | 0.59 | 0.94**\*** | 0.56 | 0.83**\*** | 0.73 |
| 20:2 Eicosadienoic acid in % | 0.79**x** | 0.50 | 0.98**\*** | 0.92 | 0.96**+** | 0.66 |
| 22:0 Behenic acid in % | 0.77**+** | 0.58 | 0.97**+** | 0.30 | 0.98**\*** | 0.95 |
| 22:1 Erucic acid in % | 0.94**x** | 0.35 | 0.84**+** | 0.57 | 0.95**\*** | 0.84 |
| 24:0 Lignoceric acid in % | 0.75**\*** | 0.49 | 0.88**\*** | 0.76 | 0.98**\*** | 0.91 |
| 24:1 Nervonic acid in % | 0.78**x** | 0.42 | 0.98**\*** | 0.77 | 1.00**\*** | 0.91 |
| Oil in % | 0.95**\*** | 0.26 | 0.98**\*** | 0.89 | 0.90**\*** | 0.78 |
| Glucosinolates in µmol g-1 DW | 0.94**+** | 0.71 | 0.92**\*** | 0.83 | 0.99**\*** | 0.82 |
| Protein in % | 0.92**+** | 0.64 | 0.95**\*** | 0.87 | 0.90**\*** | 0.56 |
| H2O in % | 0.87**x** | 0.52 | 0.97**\*** | 0.89 | 0.98**+** | 0.67 |
| Stearic, Linoleic, Arachidic, Eicosadienoic and Erucic acid in %, Glucosinolates in µmol g-1 DW | 0.93**+** | 0.84 | 0.98**\*** | 0.53 | 0.98**\*** | 0.79 |
| Oleic, α-Linolenic, Arachidic, Eicosenoic and Eicosadienoic acid in %, Glucosinolates in µmol g-1 DW | 0.91**+** | 0.56 | 0.77**\*** | 0.57 | 0.96**\*** | 0.92 |
| α-Linolenic acid in %, Oil in % and Glucosinolates in µmol g-1 DW | 0.96**x** | 0.00 | NaN | NaN | NaN | NaN |
| Myristic, Stearic, Oleic, α-Linolenic, Arachidic, Eicosenoic, Eicosadienoic, Erucic, Lignoceric and Nervonic acid in % | 0.86**+** | 0.19 | NaN | NaN | NaN | NaN |
| Myristic, Stearic, Oleic, α-Linolenic, Arachidic, Eicosenoic, Eicosadienoic, Erucic, Lignoceric and Nervonic acid in %, Oil in %, Glucosinlates in µmol g-1 DW | 0.71**\*** | 0.33 | NaN | NaN | NaN | NaN |
| Myristic, Stearic, Oleic, α-Linolenic, Arachidic, Eicosenoic, Eicosadienoic, Erucic, Lignoceric and Nervonic acid in %, Oil, Proteins and H2O in %, Glucosinolates in µmol g-1 DW | 0.71**+** | 0.34 | NaN | NaN | NaN | NaN |



**Figure S1.** Significant correlations at p<0.05 between seed viability, the half-viability period (P50), linolenic acid, seed components and thousand seed weight (TSW) among a set of oilseed rape accessions stored for 31 years. Seed viability is represented by total germination (%TG). Colour code represents linear correlation coefficients (rL).

 







**Figure S2.** Distribution of fatty acids and seed components in 37 oilseed rape accessions measured after 31 years of storage. Fatty acid compositions are given as percentage of the total fatty acid content. Saturated and unsaturated acids were calculated by adding up fatty acids having single or at least one double bond, respectively.



**Figure S3**. Two first principal components (PCAs) show distribution of accessions in relation to oil contents. PCAs are calculated based on different input factors, i.e. all fatty acids (FA) and seed compounds and/or historic viability data and/ or thousand seed weight (TSW)