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# Impact of wheat cultivar development on biomass and subsoil carbon input: a case study along an erosion-deposition gradient

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**Table S1.** Soil types and physicochemical properties stratified by horizon. *WRB - World Reference Base for Soil Resources.

| Soil Type (WRB[1]) | Horizon (WRB[1]) | Depth cm | Bulk Density Mg $m^{-3}$ | > 2mm wt.-% | fine-earth mass (1m) kg $m^{-2}$ | AWC[2] vol.-% | sand wt.% of humus-/carbonate-free fine-earth (< 2mm) | silt | clay | SOC wt.% | $N_t$ g $kg^{-1}$ | $CaCO_3$ wt.% | pH 0.01M $CaCl_2$ | SOC (1m) kg $m^{-2}$ | $N_t$ (1m) g $m^{-2}$ | AWC (1m) L $m^{-2}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Calcaric Regosol (Rg-ca)** | Ap | 0 - 26 | 1,64 | 4 | 409 | 13 | 60 | 28 | 12 | 0,51 | 0,62 | 9,9 | 7,5 | 2,1 | 254 | 34 |
| | Ck | -48 | 1,66 | 5 | 347 | 13 | 61 | 27 | 12 | 0,10 | 0,15 | 11,7 | 7,7 | 0,3 | 52 | 29 |
| | CBkl | -85 | 1,86 | 4 | 661 | 12 | 61 | 27 | 12 | 0,10 | 0,19 | 11,7 | 7,7 | 0,7 | 126 | 44 |
| | Bkl | -200 | 1,84 | 3 | 268 | 12 | 61 | 26 | 13 | 0,10 | 0,15 | 11,8 | 7,7 | 0,3 | 40 | 18 |
| | | | | | | | | | | | | | | **3,4** | **472** | **125** |
| **Nudiargic Luvisol (LV-ng)** | Ap | 0-30 | 1,66 | 3 | 483 | 15 | 59 | 28 | 13 | 0,88 | 0,80 | 0,0 | 7,0 | 4,3 | 386 | 45 |
| | Bt | -50 | 1,74 | 3 | 338 | 9 | 55 | 27 | 19 | 0,37 | 0,35 | 0,0 | 7,2 | 1,3 | 118 | 18 |
| | Ck | -105 | 1,79 | 4 | 516 | 12 | 59 | 26 | 15 | 0,10 | 0,18 | 8,8 | 7,7 | 0,5 | 93 | 60 |
| | CBkl | -175 | 1,87 | 4 | - | - | 61 | 26 | 13 | 0,10 | 0,14 | 11,1 | 7,7 | **6,0** | **598** | **123** |
| **Calcic Luvisol (LV-cc)** | Ap | 0 - 30 | 1,63 | 3 | 489 | 16 | 59 | 32 | 9 | 0.78 | 0,77 | 0,0 | 5,5 | 3,8 | 378 | 48 |
| | E | -45 | 1,79 | 2 | 263 | 12 | 51 | 39 | 10 | 0.30 | 0,28 | 0,0 | 6,2 | 0,8 | 74 | 18 |
| | Bt | -100 | 1,76 | 2 | 949 | 9 | 50 | 31 | 19 | 0.29 | 0,28 | 0,0 | 6,8 | 2,8 | 261 | 50 |
| | Ck | -200 | 1,79 | 3 | - | - | 53 | 34 | 13 | 0,10 | 0,12 | 12,2 | 7,5 | **7,4** | **713** | **116** |
| **Gleyic-Colluvic Regosol (Rg-co.gl)** 50m to the S and 1m higher in terrain compared to RG-co.gl in Fig.1 | Ap | 0 - 30 | 1,62 | 2 | 486 | 18 | 63 | 27 | 10 | 0,90 | 0,90 | 0,0 | 5,1 | 4,4 | 437 | 54 |
| | Ab | -67 | 1,62 | 2 | 587 | 10 | 59 | 30 | 11 | 0,44 | 0,48 | 0,0 | 5,9 | 2,6 | 282 | 37 |
| | 2Ab | -107 | 1,65 | 3 | 528 | 12 | 57 | 28 | 15 | 0,56 | 0,60 | 0,0 | 6,4 | 3,0 | 317 | 40 |
| | Btl | -140 | 1,81 | 1 | - | - | 57 | 24 | 19 | 0,17 | 0,33 | 0,0 | 7,1 | **9,9** | **1036** | **131** |

[1] WRB - World Reference Base for Soil Resources (IUSS, 2006) [2] Available Water Capacity (pF2.0 - pF4.2)

**Table S2.** Simulation results of various soil water content scenarios across different soil erosion gradients.

| | Soil water [$cm^3$ $cm^{-3}$] | RG-ca | Lv-ng | Lv-cc | Rg-co.gl |
|---|---|---|---|---|---|
| | | Root biomass [g $m^{-2}$] | | | |
| Ostpreußischer | 18.5 | 208 | 354 | 345 | 279 |
| | 21.5 | 171 | 357 | 345 | 273 |
| | 24.3 | 202 | 363 | 350 | 284 |
| | 27 | 213 | 363 | 362 | 297 |
| | 30 | 219 | 366 | 366 | 306 |
| | slope linear regression | 2.2 | 1.1 | 2.1 | 2.7 |
| Hadmerslebener | 18.5 | 185 | 289 | 330 | 215 |
| | 21.5 | 181 | 291 | 334 | 211 |
| | 24.3 | 210 | 292 | 340 | 229 |
| | 27 | 252 | 362 | 419 | 293 |
| | 30 | 266 | 381 | 418 | 311 |
| | slope linear regression | 8.3 | 8.9 | 9.1 | 9.6 |
| Ponticus | 18.5 | 182 | 320 | 315 | 223 |
| | 21.5 | 168 | 322 | 317 | 219 |
| | 24.3 | 198 | 321 | 319 | 226 |
| | 27 | 220 | 340 | 350 | 259 |
| | 30 | 229 | 346 | 352 | 274 |
| | slope linear regression | 5.1 | 2.4 | 3.8 | 5 |

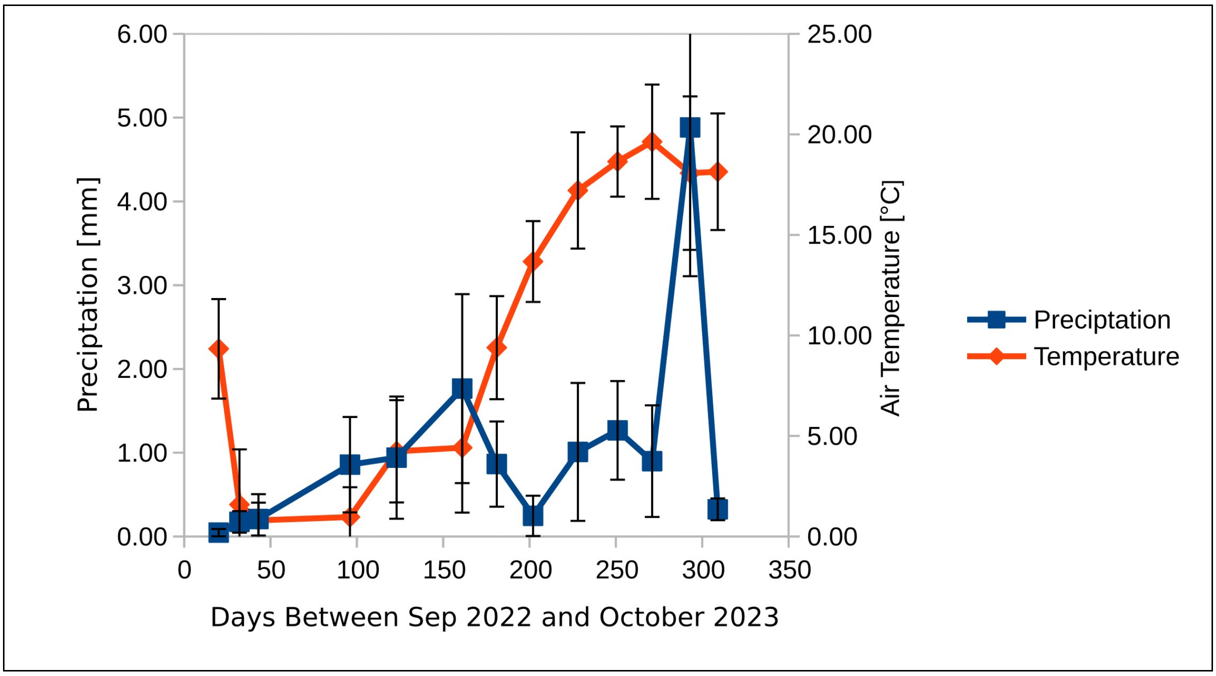


Figure S1. Precipitation and air temperature from September 2022 to October 2023.

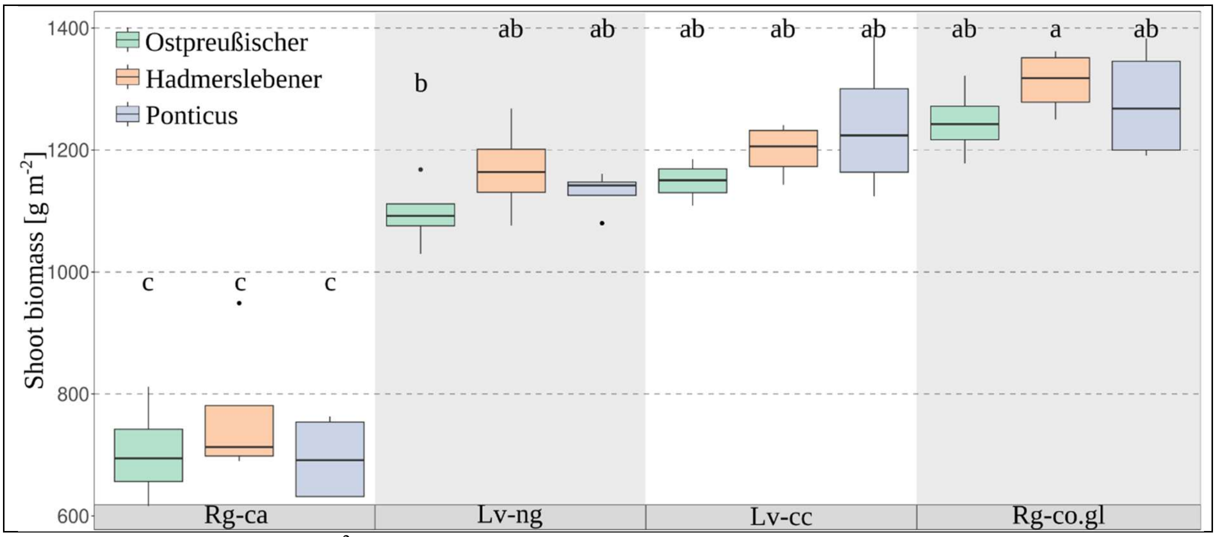


Figure S2. Shoot biomass (g $m^{-2}$) of three wheat cultivars (Ostpreußischer, Hadmerslebener, and Ponticus) under different soil erosional status: Calacric Regosol (RG-ca), Nudiargic Luvisol (LV-ng), Calcic Luvisol (LV-cc) and Gleyic-Colluvic Regosol (RG-co.gl). The letters above the boxplots indicate significant differences in grain yield between treatments ($p < 0.05$), based on post-hoc tests.

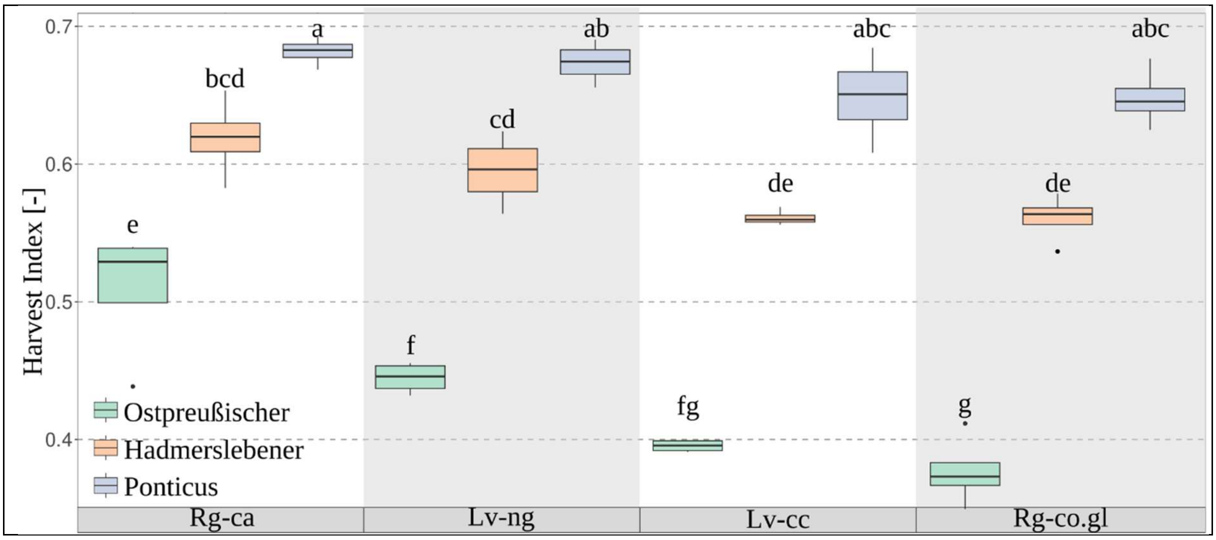


Figure S3. Harvest index (-) of three wheat cultivars (Ostpreußischer, Hadmerslebener, and Ponticus) under different soil erosional status: Calacric Regosol (RG-ca), Nudiargic Luvisol (LV-ng), Calcic Luvisol (LV-cc) and Gleyic-Colluvic Regosol (RG-co.gl). The letters above the boxplots indicate significant differences in grain yield between treatments ($p < 0.05$), based on post-hoc tests.

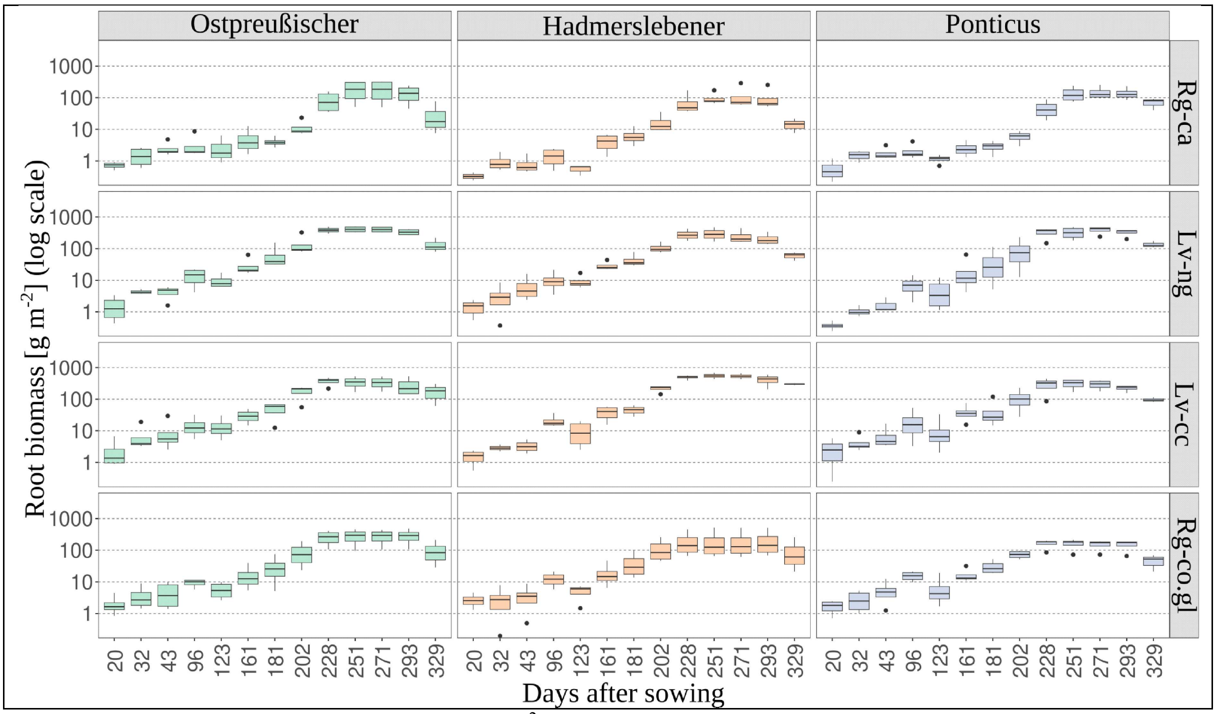


Figure S4. Crop season root biomass (g $m^{-2}$) evolution for the three wheat cultivars (Ostpreußischer, Hadmerslebener, and Ponticus) under different soil erosion-deposition gradient: Calacric Regosol (RG-ca), Nudiargic Luvisol (LV-ng), Calcic Luvisol (LV-cc) and Gleyic-Colluvic Regosol (RG-co.gl).

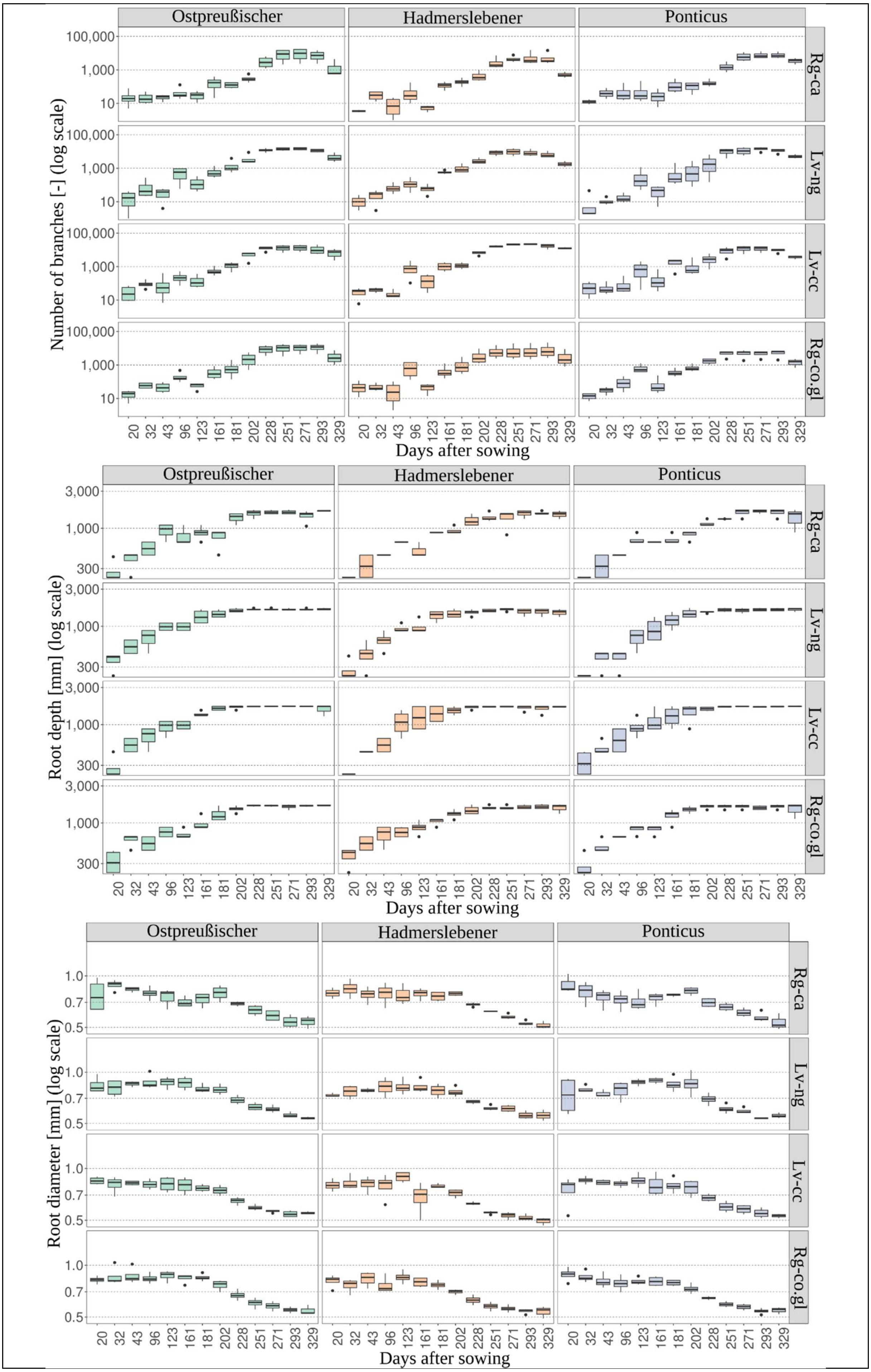
Ostpreußischer
Hadmerslebener
Ponticus
Rg-ca
Lv-ng
Lv-cc
Rg-co.gl
Number of branches [-] (log scale)
100,000
1,000
10
20 32 43 96 123 161 181 202 228 251 271 293 329
Days after sowing
Root depth [mm] (log scale)
3,000
1,000
300
Root diameter [mm] (log scale)
1.0
0.7
0.5

Figure S5. Number of root branches (-), root depth (mm) and root diameter (mm) evolution for the three wheat cultivars (Ostpreußischer, Hadmerslebener, and Ponticus) under different soil erosional status: Calacric Regosol (RG-ca), Nudiargic Luvisol (LV-ng), Calcic Luvisol (LV-cc) and Gleyic-Colluvic Regosol (RG-co.gl). The letters above the boxplots indicate significant differences in grain yield between treatments ($p < 0.05$), based on post-hoc tests.

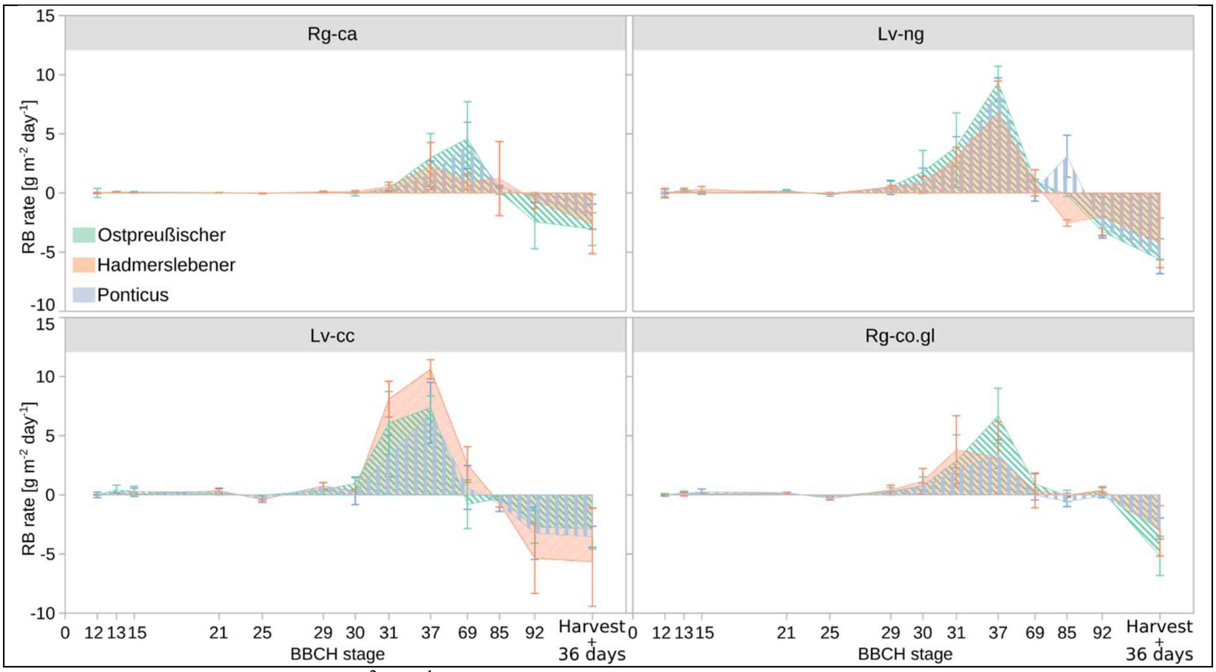


Figure S6. Root biomass rate (g m$^{-2}$ day$^{-1}$) and standard error for the entire crop season for the three wheat cultivars (Ostpreußischer, Hadmerslebener, and Ponticus) under different soil erosional status: Calacric Regosol (RG-ca), Nudiargic Luvisol (LV-ng), Calcic Luvisol (LV-cc) and Gleyic-Colluvic Regosol (RG-co.gl).

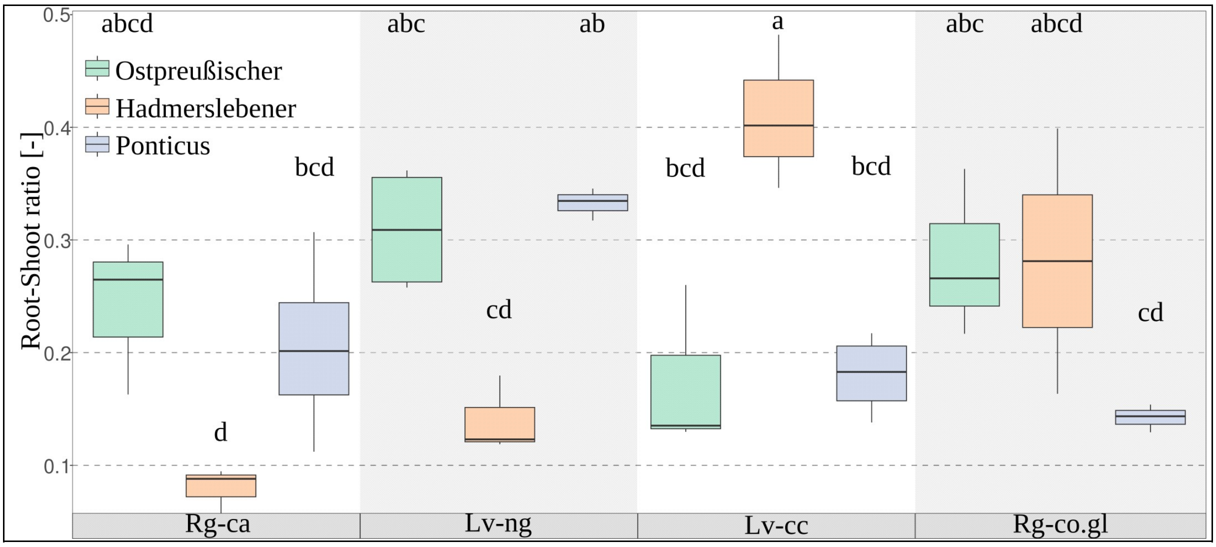


Figure S7: Root-shoot ratio (-) of three wheat cultivars (Ostpreußischer, Hadmerslebener, and Ponticus) under different soil erosion-deposition gradient: Calacric Regosol (RG-ca), Nudiargic Luvisol (LV-ng), Calcic Luvisol (LV-cc) and Gleyic-Colluvic Regosol (RG-co.gl). The letters above the boxplots indicate significant differences in grain yield between treatments ($p < 0.05$), based on post-hoc tests.

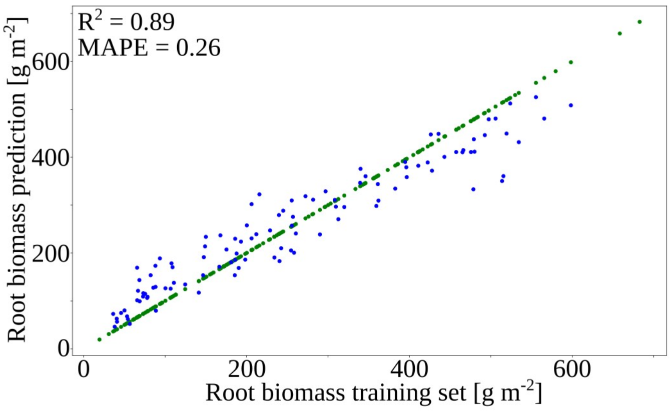


Figure S8. Metrics of supervised machine learning random forest (RF) meta-estimator (mean absolute percentage error (MAPE)).