



Molecular selection in three winter wheat populations for *Fhb1* resistance gene to fusarium head blight

Piotr Słowacki, Magdalena Radecka-Janusik and Paweł Cz. Czembor
Plant Breeding & Acclimatization Institute – National Research Institute,
Radzików, 05-870 Błonie, Poland

Objective

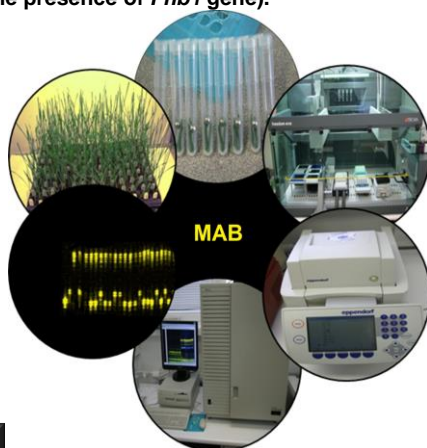
Marker Assisted Backcrossing (MAB) may be an efficient strategy to increase breeding progress, especially for traits such as resistance to fusarium head blight (FHB) that are difficult to select for under field conditions and that are controlled by multiple genes. The purpose of the presented work is to incorporate resistance gene *Fhb1* located on chromosome 3B into three Polish advanced breeding lines of winter wheat (recurrent parents, RPs): SMH8527 (Smolice Plant Breeding Company, IHAR Group), DL414/10 (Danko Plant Breeding Company) and STH1178 (Strzelce Plant Breeding Company, IHAR Group). The donor of the resistance gene is wheat line All62 (F₅BC₂) derived from the cross between Sumai 3 and Polish cultivar Muszelka. This line was confirmed with molecular markers to contain *Fhb1* gene. (Fig.1)

Methods

In order to reduce the size of the donor chromosome segment containing the target locus, plant selection in the offspring populations (F₁BC₁) is focused on selecting individuals with the target gene (*Fhb1*) and recombination events between the target locus and linked flanking markers (recombinant selection).

DNA polymorphism between RPs and *Fhb1* gene donor at ten SSR flanking markers (gwm389, barc238, gpw7080, gwm493, barc131, wmc754, gpw3248, barc92 and cfp1274) spanning ca 40cM, allowed us to choose two polymorphic flanking markers and two central markers (confirming the presence of *Fhb1* gene).

Figure 2. Diagram presents the workflow of DNA isolation, PCR and gel electrophoresis used in Marker Assisted Backcrossing



Results

A total of 360 samples (120 for each combination) were tested with two flanking markers (cfp1274 and gwm389) and one of the two central markers (UMN10 or cfb6033). Thirty one individuals were chosen after the analysis (SMH8527 – 8 ; DL414/10 – 8 ; STH1178 – 15) for next backcross. (Tab.)

Acknowledgments

The research was financially supported by The Ministry of Agriculture and Rural Development under the Program 2014-2020: Basic Research for Biological Progress in Crop Production.

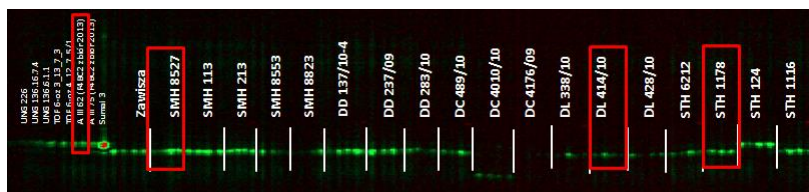


Figure 1. Amplification products of the UMN10 marker linked to the *Fhb1* gene. Highlighted are the lines used for this work.

Table. Molecular analysis of the 3 combinations. Chosen individuals marked in blue.

| SMH8527 x All62 (F5BC2) | | | | | DL414/10 - 8 x All62 (F5BC2) | | | | | STH1178 - 15 x All62 (F5BC2) | | | | |
|-------------------------|-------|--------|-----|-----|------------------------------|-------|--------|-----|-----|------------------------------|-------|--------|-----|-----|
| Sample | UMN10 | cp1274 | | | Sample | UMN10 | cp1274 | | | Sample | UMN10 | cp1274 | | |
| All62 | 239 | 240 | 241 | 250 | All62 | 239 | 236 | 245 | 250 | All62 | 239 | 236 | 245 | 250 |
| SMH8527 | 1 | 1 | 1 | 1 | DL414/10 | 1 | 1 | 1 | 1 | STH1178 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 202 | 1 | 1 | 1 | 1 | 402 | 1 | 1 | 1 | 1 |
| 2 | 1 | 1 | 1 | 1 | 203 | 1 | 1 | 1 | 1 | 403 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 | 1 | 204 | 1 | 1 | 1 | 1 | 404 | 1 | 1 | 1 | 1 |
| 4 | 1 | 1 | 1 | 1 | 205 | 1 | 1 | 1 | 1 | 405 | 1 | 1 | 1 | 1 |
| 5 | 1 | 1 | 1 | 1 | 206 | 1 | 1 | 1 | 1 | 406 | 1 | 1 | 1 | 1 |
| 6 | 1 | 1 | 1 | 1 | 207 | 1 | 1 | 1 | 1 | 407 | 1 | 1 | 1 | 1 |
| 7 | 1 | 1 | 1 | 1 | 208 | 1 | 1 | 1 | 1 | 408 | 1 | 1 | 1 | 1 |
| 8 | 1 | 1 | 1 | 1 | 209 | 1 | 1 | 1 | 1 | 409 | 1 | 1 | 1 | 1 |
| 9 | 1 | 1 | 1 | 1 | 210 | 1 | 1 | 1 | 1 | 410 | 1 | 1 | 1 | 1 |
| 10 | 1 | 1 | 1 | 1 | 211 | 1 | 1 | 1 | 1 | 411 | 1 | 1 | 1 | 1 |
| 11 | 1 | 1 | 1 | 1 | 212 | 1 | 1 | 1 | 1 | 412 | 1 | 1 | 1 | 1 |
| 12 | 1 | 1 | 1 | 1 | 213 | 1 | 1 | 1 | 1 | 413 | 1 | 1 | 1 | 1 |
| 13 | 1 | 1 | 1 | 1 | 214 | 1 | 1 | 1 | 1 | 414 | 1 | 1 | 1 | 1 |
| 14 | 1 | 1 | 1 | 1 | 215 | 1 | 1 | 1 | 1 | 415 | 1 | 1 | 1 | 1 |
| 15 | 1 | 1 | 1 | 1 | 216 | 1 | 1 | 1 | 1 | 416 | 1 | 1 | 1 | 1 |
| 16 | 1 | 1 | 1 | 1 | 217 | 1 | 1 | 1 | 1 | 417 | 1 | 1 | 1 | 1 |
| 17 | 1 | 1 | 1 | 1 | 218 | 1 | 1 | 1 | 1 | 418 | 1 | 1 | 1 | 1 |
| 18 | 1 | 1 | 1 | 1 | 219 | 1 | 1 | 1 | 1 | 419 | 1 | 1 | 1 | 1 |
| 19 | 1 | 1 | 1 | 1 | 220 | 1 | 1 | 1 | 1 | 420 | 1 | 1 | 1 | 1 |
| 20 | 1 | 1 | 1 | 1 | 221 | 1 | 1 | 1 | 1 | 421 | 1 | 1 | 1 | 1 |
| 21 | 1 | 1 | 1 | 1 | 222 | 1 | 1 | 1 | 1 | 422 | 1 | 1 | 1 | 1 |
| 22 | 1 | 1 | 1 | 1 | 223 | 1 | 1 | 1 | 1 | 423 | 1 | 1 | 1 | 1 |
| 23 | 1 | 1 | 1 | 1 | 224 | 1 | 1 | 1 | 1 | 424 | 1 | 1 | 1 | 1 |
| 24 | 1 | 1 | 1 | 1 | 225 | 1 | 1 | 1 | 1 | 425 | 1 | 1 | 1 | 1 |
| 25 | 1 | 1 | 1 | 1 | 226 | 1 | 1 | 1 | 1 | 426 | 1 | 1 | 1 | 1 |
| 26 | 1 | 1 | 1 | 1 | 227 | 1 | 1 | 1 | 1 | 427 | 1 | 1 | 1 | 1 |
| 27 | 1 | 1 | 1 | 1 | 228 | 1 | 1 | 1 | 1 | 428 | 1 | 1 | 1 | 1 |
| 28 | 1 | 1 | 1 | 1 | 229 | 1 | 1 | 1 | 1 | 429 | 1 | 1 | 1 | 1 |
| 29 | 1 | 1 | 1 | 1 | 230 | 1 | 1 | 1 | 1 | 430 | 1 | 1 | 1 | 1 |
| 30 | 1 | 1 | 1 | 1 | 231 | 1 | 1 | 1 | 1 | 431 | 1 | 1 | 1 | 1 |
| 31 | 1 | 1 | 1 | 1 | 232 | 1 | 1 | 1 | 1 | 432 | 1 | 1 | 1 | 1 |
| 32 | 1 | 1 | 1 | 1 | 233 | 1 | 1 | 1 | 1 | 433 | 1 | 1 | 1 | 1 |
| 33 | 1 | 1 | 1 | 1 | 234 | 1 | 1 | 1 | 1 | 434 | 1 | 1 | 1 | 1 |
| 34 | 1 | 1 | 1 | 1 | 235 | 1 | 1 | 1 | 1 | 435 | 1 | 1 | 1 | 1 |
| 35 | 1 | 1 | 1 | 1 | 236 | 1 | 1 | 1 | 1 | 436 | 1 | 1 | 1 | 1 |
| 36 | 1 | 1 | 1 | 1 | 237 | 1 | 1 | 1 | 1 | 437 | 1 | 1 | 1 | 1 |
| 37 | 1 | 1 | 1 | 1 | 238 | 1 | 1 | 1 | 1 | 438 | 1 | 1 | 1 | 1 |
| 38 | 1 | 1 | 1 | 1 | 239 | 1 | 1 | 1 | 1 | 439 | 1 | 1 | 1 | 1 |
| 39 | 1 | 1 | 1 | 1 | 240 | 1 | 1 | 1 | 1 | 440 | 1 | 1 | 1 | 1 |
| 40 | 1 | 1 | 1 | 1 | 241 | 1 | 1 | 1 | 1 | 441 | 1 | 1 | 1 | 1 |
| 41 | 1 | 1 | 1 | 1 | 242 | 1 | 1 | 1 | 1 | 442 | 1 | 1 | 1 | 1 |
| 42 | 1 | 1 | 1 | 1 | 243 | 1 | 1 | 1 | 1 | 443 | 1 | 1 | 1 | 1 |
| 43 | 1 | 1 | 1 | 1 | 244 | 1 | 1 | 1 | 1 | 444 | 1 | 1 | 1 | 1 |
| 44 | 1 | 1 | 1 | 1 | 245 | 1 | 1 | 1 | 1 | 445 | 1 | 1 | 1 | 1 |
| 45 | 1 | 1 | 1 | 1 | 246 | 1 | 1 | 1 | 1 | 446 | 1 | 1 | 1 | 1 |
| 46 | 1 | 1 | 1 | 1 | 247 | 1 | 1 | 1 | 1 | 447 | 1 | 1 | 1 | 1 |
| 47 | 1 | 1 | 1 | 1 | 248 | 1 | 1 | 1 | 1 | 448 | 1 | 1 | 1 | 1 |
| 48 | 1 | 1 | 1 | 1 | 249 | 1 | 1 | 1 | 1 | 449 | 1 | 1 | 1 | 1 |
| 49 | 1 | 1 | 1 | 1 | 250 | 1 | 1 | 1 | 1 | 450 | 1 | 1 | 1 | 1 |
| 50 | 1 | 1 | 1 | 1 | 251 | 1 | 1 | 1 | 1 | 451 | 1 | 1 | 1 | 1 |
| 51 | 1 | 1 | 1 | 1 | 252 | 1 | 1 | 1 | 1 | 452 | 1 | 1 | 1 | 1 |
| 52 | 1 | 1 | 1 | 1 | 253 | 1 | 1 | 1 | 1 | 453 | 1 | 1 | 1 | 1 |
| 53 | 1 | 1 | 1 | 1 | 254 | 1 | 1 | 1 | 1 | 454 | 1 | 1 | 1 | 1 |
| 54 | 1 | 1 | 1 | 1 | 255 | 1 | 1 | 1 | 1 | 455 | 1 | 1 | 1 | 1 |
| 55 | 1 | 1 | 1 | 1 | 256 | 1 | 1 | 1 | 1 | 456 | 1 | 1 | 1 | 1 |
| 56 | 1 | 1 | 1 | 1 | 257 | 1 | 1 | 1 | 1 | 457 | 1 | 1 | 1 | 1 |
| 57 | 1 | 1 | 1 | 1 | 258 | 1 | 1 | 1 | 1 | 458 | 1 | 1 | 1 | 1 |
| 58 | 1 | 1 | 1 | 1 | 259 | 1 | 1 | 1 | 1 | 459 | 1 | 1 | 1 | 1 |
| 59 | 1 | 1 | 1 | 1 | 260 | 1 | 1 | 1 | 1 | 460 | 1 | 1 | 1 | 1 |
| 60 | 1 | 1 | 1 | 1 | 261 | 1 | 1 | 1 | 1 | 461 | 1 | 1 | 1 | 1 |
| 61 | 1 | 1 | 1 | 1 | 262 | 1 | 1 | 1 | 1 | 462 | 1 | 1 | 1 | 1 |
| 62 | 1 | 1 | 1 | 1 | 263 | 1 | 1 | 1 | 1 | 463 | 1 | 1 | 1 | 1 |
| 63 | 1 | 1 | 1 | 1 | 264 | 1 | 1 | 1 | 1 | 464 | 1 | 1 | 1 | 1 |
| 64 | 1 | 1 | 1 | 1 | 265 | 1 | 1 | 1 | 1 | 465 | 1 | 1 | 1 | 1 |
| 65 | 1 | 1 | 1 | 1 | 266 | 1 | 1 | 1 | 1 | 466 | 1 | 1 | 1 | 1 |
| 66 | 1 | 1 | 1 | 1 | 267 | 1 | 1 | 1 | 1 | 467 | 1 | 1 | 1 | 1 |
| 67 | 1 | 1 | 1 | 1 | 268 | 1 | 1 | 1 | 1 | 468 | 1 | 1 | 1 | 1 |
| 68 | 1 | 1 | 1 | 1 | 269 | 1 | 1 | 1 | 1 | 469 | 1 | 1 | 1 | 1 |
| 69 | 1 | 1 | 1 | 1 | 270 | 1 | 1 | 1 | 1 | 470 | 1 | 1 | 1 | 1 |
| 70 | 1 | 1 | 1 | 1 | 271 | 1 | 1 | 1 | 1 | 471 | 1 | 1 | 1 | 1 |
| 71 | 1 | 1 | 1 | 1 | 272 | 1 | 1 | 1 | 1 | 472 | 1 | 1 | 1 | 1 |
| 72 | 1 | 1 | 1 | 1 | 273 | 1 | 1 | 1 | 1 | 473 | 1 | 1 | 1 | 1 |
| 73 | 1 | 1 | 1 | 1 | 274 | 1 | 1 | 1 | 1 | 474 | 1 | 1 | 1 | 1 |
| 74 | 1 | 1 | 1 | 1 | 275 | 1 | 1 | 1 | 1 | 475 | 1 | 1 | 1 | 1 |
| 75 | 1 | 1 | 1 | 1 | 276 | 1 | 1 | 1 | 1 | 476 | 1 | 1 | 1 | 1 |
| 76 | 1 | 1 | 1 | 1 | 277 | 1 | 1 | 1 | 1 | 477 | 1 | 1 | 1 | 1 |
| 77 | 1 | 1 | 1 | 1 | 278 | 1 | 1 | 1 | 1 | 478 | 1 | 1 | 1 | 1 |
| 78 | 1 | 1 | 1 | 1 | 279 | 1 | 1 | 1 | 1 | 479 | 1 | 1 | 1 | 1 |
| 79 | 1 | 1 | 1 | 1 | 280 | 1 | 1 | 1 | 1 | 480 | 1 | 1 | 1 | 1 |
| 80 | 1 | 1 | 1 | 1 | 281 | 1 | 1 | 1 | 1 | 481 | 1 | 1 | 1 | 1 |
| 81 | 1 | 1 | 1 | 1 | 282 | 1 | 1 | 1 | 1 | 482 | 1 | 1 | 1 | 1 |
| 82 | 1 | 1 | 1 | 1 | 283 | 1 | 1 | 1 | 1 | 483 | 1 | 1 | 1 | 1 |
| 83 | 1 | 1 | 1 | 1 | 284 | 1 | 1 | 1 | 1 | 484 | 1 | 1 | 1 | 1 |
| 84 | 1 | 1 | 1 | 1 | 285 | 1 | 1 | 1 | 1 | 485 | 1 | 1 | 1 | 1 |
| 85 | 1 | 1 | 1 | 1 | 286 | 1 | 1 | 1 | 1 | 486 | 1 | 1 | 1 | 1 |
| 86 | 1 | 1 | 1 | 1 | 287 | 1 | 1 | 1 | 1 | 487 | 1 | 1 | 1 | 1 |
| 87 | 1 | 1 | 1 | 1 | 288 | 1 | 1 | 1 | 1 | 488 | 1 | 1 | 1 | 1 |
| 88 | 1 | 1 | 1 | 1 | 289 | 1 | 1 | 1 | 1 | 489 | 1 | 1 | 1 | 1 |
| 89 | 1 | 1 | 1 | 1 | 290 | 1 | 1 | 1 | 1 | 490 | 1 | 1 | 1 | 1 |
| 90 | 1 | 1 | 1 | 1 | 291 | 1 | 1 | 1 | 1 | 491 | 1 | 1 | 1 | 1 |
| 91 | 1 | 1 | 1 | 1 | 292 | 1 | 1 | 1 | 1 | 492 | 1 | 1 | 1 | 1 |
| 92 | 1 | 1 | 1 | 1 | 293 | 1 | 1 | 1 | 1 | 493 | 1 | 1 | 1 | 1 |
| 93 | 1 | 1 | 1 | 1 | 294 | 1 | 1 | 1 | 1 | 494 | 1 | 1 | 1 | 1 |
| 94 | 1 | 1 | 1 | 1 | 295 | 1 | 1 | 1 | 1 | 495 | 1 | 1 | 1 | 1 |
| 95 | 1 | 1 | 1 | 1 | 296 | 1 | 1 | 1 | 1 | 496 | 1 | 1 | 1 | 1 |
| 96 | 1 | 1 | 1 | 1 | 297 | 1 | 1 | 1 | 1 | 497 | 1 | 1 | 1 | 1 |
| 97 | 1 | 1 | 1 | 1 | 298 | 1 | 1 | 1 | 1 | 498 | 1 | 1 | 1 | 1 |
| 98 | 1 | 1 | 1 | 1 | 299 | 1 | 1 | 1 | 1 | 499 | 1 | 1 | 1 | 1 |
| 99 | 1 | 1 | 1 | 1 | 300 | 1 | 1 | 1 | 1 | 500 | 1 | 1 | 1 | 1 |
| 100 | 1 | 1 | 1 | 1 | 301 | 1 | 1 | 1 | 1 | 501 | 1 | 1 | 1 | 1 |
| 101 | 1 | 1 | 1 | 1 | 302 | 1 | 1 | 1 | 1 | 502 | 1 | 1 | 1 | 1 |
| 102 | 1 | 1 | 1 | 1 | 303 | 1 | 1 | 1 | 1 | 503 | 1 | 1 | 1 | 1 |
| 103 | 1 | 1 | 1 | 1 | 304 | 1 | 1 | 1 | 1 | 504 | 1 | 1 | 1 | 1 |
| 104 | 1 | 1 | 1 | 1 | 305 | 1 | 1 | 1 | 1 | 505 | 1 | 1 | 1 | 1 |
| 105 | 1 | 1 | 1 | 1 | 306 | 1 | 1 | 1 | 1 | 506 | 1 | 1 | 1 | 1 |
| 106 | 1 | 1 | 1 | 1 | 307 | 1 | 1 | 1 | 1 | 507 | 1 | 1 | 1 | 1 |
| 107 | 1 | 1 | 1 | 1 | 308 | 1 | 1 | 1 | 1 | 508 | 1 | 1 | 1 | 1 |
| 108 | 1 | 1 | 1 | 1 | 309 | 1 | 1 | 1 | 1 | 509 | 1 | 1 | 1 | 1 |
| 109 | 1 | 1 | 1 | 1 | 310 | 1 | 1 | 1 | 1 | 510 | 1 | 1 | 1 | 1 |
| 110 | 1 | 1 | 1 | 1 | 311 | 1 | 1 | 1 | 1 | 511 | 1 | 1 | 1 | 1 |
| 111 | 1 | 1 | 1 | 1 | 312 | 1 | 1 | 1 | 1 | 512 | 1 | 1 | 1 | 1 |
| 112 | 1 | 1 | 1 | 1 | 313 | 1 | 1 | 1 | 1 | 513 | 1 | 1 | 1 | 1 |
| 113 | 1 | 1 | 1 | 1 | 314 | 1 | 1 | 1 | 1 | 514 | 1 | 1 | 1 | 1 |
| 114 | 1 | 1 | 1 | 1 | 315 | 1 | 1 | 1 | 1 | 515 | 1 | 1 | 1 | 1 |
| 115 | 1 | 1 | 1 | 1 | 316 | 1 | 1 | 1 | 1 | 516 | 1 | 1 | 1 | 1 |
| 116 | 1 | 1 | 1 | 1 | 317 | 1 | 1 | 1 | 1 | 517 | 1 | 1 | 1 | 1 |
| 117 | 1 | 1 | 1 | 1 | 318 | 1 | 1 | 1 | 1 | 518 | 1 | 1 | 1 | 1 |
| 118 | 1 | 1 | 1 | 1 | 319 | 1 | 1 | 1 | 1 | 519 | 1 | 1 | 1 | 1 |
| 119 | 1 | 1 | 1 | 1 | 320 | 1 | 1 | 1 | 1 | 520 | 1 | 1 | 1 | 1 |
| 120 | 1 | 1 | 1 | 1 | 321 | 1 | 1 | 1 | 1 | 521 | 1 | 1 | 1 | 1 |
| 121 | 1 | 1 | 1 | 1 | 322 | 1 | 1 | 1 | 1 | 522 | 1 | 1 | 1</ | |