Supplementary File 1

**Supplementary file 1a.** Mungbean accessions from Vavilov Institute (VIR) collection

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sample name** | **Country**  | **Latitude** | **Longitude** | **NCBI SRA accession** | **NCBI Biosample accession** |
| 1.B | USA | NA | NA | SRR18125483 | SAMN26179197 |
| 100.A | Cyprus | 35.1856 | 33.3823 | SRR18125482 | SAMN26179198 |
| 101.A | Morocco | 33.9716 | -6.8498 | SRR18125266 | SAMN26179199 |
| 102.A | Israel | 32.4971 | 35.4973 | SRR18125200 | SAMN26179200 |
| 103.A | Indonesia | -6.5971 | 106.806 | SRR18125367 | SAMN26179201 |
| 104.B | Russia | 44.9003 | 131.8351 | SRR18125356 | SAMN26179202 |
| 105.A | Chile | -36.8305 | -73.1167 | SRR18125345 | SAMN26179203 |
| 106.A | India | 22.5587 | 88.2911 | SRR18125298 | SAMN26179204 |
| 107.A | India | 22.5726 | 88.3639 | SRR18125287 | SAMN26179205 |
| 108.A | India | 25.9821 | 85.6486 | SRR18125276 | SAMN26179206 |
| 109.A | Italy | 41.9028 | 12.4964 | SRR18125481 | SAMN26179207 |
| 10A | China | 47.1216 | 128.7382 | SRR18125398 | SAMN26179208 |
| 110.B | Portugal | 38.7223 | -9.1393 | SRR18125387 | SAMN26179209 |
| 111.A | Portugal | 38.7223 | -9.1393 | SRR18125376 | SAMN26179210 |
| 112.A | Russia | 45.0347 | 39.0978 | SRR18125329 | SAMN26179211 |
| 113.A | Tajikistan | 40.2675 | 69.6453 | SRR18125318 | SAMN26179212 |
| 114.B | India | 31.5204 | 74.3587 | SRR18125307 | SAMN26179213 |
| 115.B | India | 31.5204 | 74.3587 | SRR18125476 | SAMN26179214 |
| 116.A | Russia | 49.6152 | 127.9945 | SRR18125465 | SAMN26179215 |
| 116.B | Russia | 49.6152 | 127.9945 | SRR18125454 | SAMN26179216 |
| 117.B | Russia | 44.0281 | 131.3273 | SRR18125264 | SAMN26179217 |
| 118.A | Russia | 44.0118 | 131.3835 | SRR18125253 | SAMN26179218 |
| 119.A | Russia | 44.39 | 132.558 | SRR18125242 | SAMN26179219 |
| 11A | China | 47.1216 | 128.7382 | SRR18125231 | SAMN26179220 |
| 120.A | Argentina | -32.8895 | -68.8458 | SRR18125434 | SAMN26179221 |
| 122.A | Japan | 31.5969 | 130.5571 | SRR18125423 | SAMN26179222 |
| 123.B | Kyrgyzstan | 55.4649 | 65.3054 | SRR18125412 | SAMN26179223 |
| 124.B | Ethiopia | 12.9545 | 36.1573 | SRR18125223 | SAMN26179224 |
| 125.A | China | 42.5246 | 87.5396 | SRR18125212 | SAMN26179225 |
| 126.A | China | 42.5246 | 87.5396 | SRR18125201 | SAMN26179226 |
| 127.A | China | 42.5246 | 87.5396 | SRR18125199 | SAMN26179227 |
| 128.A | Democratic Republic of the Congo  | 1.9293 | 30.0492 | SRR18125198 | SAMN26179228 |
| 128.B | Democratic Republic of the Congo  | 1.9293 | 30.0492 | SRR18125197 | SAMN26179229 |
| 129.A | Korea | 37.5665 | 126.978 | SRR18125196 | SAMN26179230 |
| 12A | China | 47.1216 | 128.7382 | SRR18125195 | SAMN26179231 |
| 13.A | Iran | 32.4279 | 53.688 | SRR18125194 | SAMN26179232 |
| 130.A | Korea | 37.5665 | 126.978 | SRR18125371 | SAMN26179233 |
| 131.A | Korea | 37.5665 | 126.978 | SRR18125370 | SAMN26179234 |
| 132.B | Korea | 40.3399 | 127.5101 | SRR18125369 | SAMN26179235 |
| 133.A | Korea | 40.3399 | 127.5101 | SRR18125368 | SAMN26179236 |
| 134.A | Korea | 40.3399 | 127.5101 | SRR18125366 | SAMN26179237 |
| 135.A | Korea | 40.3399 | 127.5101 | SRR18125365 | SAMN26179238 |
| 136.A | Korea | 40.3399 | 127.5101 | SRR18125364 | SAMN26179239 |
| 137.A | China | 42.5246 | 87.5396 | SRR18125363 | SAMN26179240 |
| 138.A | China | 39.4677 | 75.9938 | SRR18125362 | SAMN26179241 |
| 139.A | Uzbekistan | 41.2995 | 69.2401 | SRR18125361 | SAMN26179242 |
| 14.B | Uzbekistan | 39.7681 | 64.4556 | SRR18125360 | SAMN26179243 |
| 140.B | China | 42.5246 | 87.5396 | SRR18125359 | SAMN26179244 |
| 141.A | China | 43.8256 | 87.6168 | SRR18125358 | SAMN26179245 |
| 142.B | China | 42.5246 | 87.5396 | SRR18125357 | SAMN26179246 |
| 144.A | Ukraine | 48.4647 | 35.0462 | SRR18125355 | SAMN26179247 |
| 145.A | Brazil | -22.9329 | -47.0738 | SRR18125354 | SAMN26179248 |
| 146.B | Kazakhstan | 43.222 | 76.8512 | SRR18125353 | SAMN26179249 |
| 147.A | Turkey | 39.7646 | 30.4559 | SRR18125352 | SAMN26179250 |
| 148.B | Turkey | 39.7646 | 30.4559 | SRR18125351 | SAMN26179251 |
| 149.A | Ukraine | 48.0386 | 30.9497 | SRR18125350 | SAMN26179252 |
| 151.A | Tajikistan | 38.5598 | 68.787 | SRR18125349 | SAMN26179253 |
| 154.A | Brazil | -14.235 | -51.9253 | SRR18125348 | SAMN26179254 |
| 155.A | United Kingdom | 52.3555 | -1.1743 | SRR18125347 | SAMN26179255 |
| 156.A | India | 25.9821 | 85.6486 | SRR18125346 | SAMN26179256 |
| 157.A | India | 25.9821 | 85.6486 | SRR18125344 | SAMN26179257 |
| 158.A | India | 25.9821 | 85.6486 | SRR18125343 | SAMN26179258 |
| 159.B | India | 25.9821 | 85.6486 | SRR18125342 | SAMN26179259 |
| 16.A | Uzbekistan | 39.7681 | 64.4556 | SRR18125341 | SAMN26179260 |
| 160.A | Uzbekistan  | 40.8154 | 72.2837 | SRR18125340 | SAMN26179261 |
| 161.A | Uzbekistan  | 40.8154 | 72.2837 | SRR18125339 | SAMN26179262 |
| 162.A | South Africa  | -26.7145 | 27.097 | SRR18125338 | SAMN26179263 |
| 163.A | South Africa  | -26.7145 | 27.097 | SRR18125337 | SAMN26179264 |
| 164.A | South Africa  | -26.7145 | 27.097 | SRR18125336 | SAMN26179265 |
| 165.B | USA | 39.9526 | -75.1652 | SRR18125299 | SAMN26179266 |
| 166.A | USA | 39.9526 | -75.1652 | SRR18125297 | SAMN26179267 |
| 167.B | Kyrgyzstan | 42.8224 | 75.3179 | SRR18125296 | SAMN26179268 |
| 168.A | Kyrgyzstan | 42.8224 | 75.3179 | SRR18125295 | SAMN26179269 |
| 17.B | Uzbekistan | 39.7681 | 64.4556 | SRR18125294 | SAMN26179270 |
| 170.A | Russia | 43.2562 | 46.5893 | SRR18125293 | SAMN26179271 |
| 171.A | Russia | 43.2562 | 46.5893 | SRR18125292 | SAMN26179272 |
| 172.B | Iran | 32.4279 | 53.688 | SRR18125291 | SAMN26179273 |
| 173.A | Iran | 32.4279 | 53.688 | SRR18125290 | SAMN26179274 |
| 174.A | Korea | 40.3399 | 127.5101 | SRR18125289 | SAMN26179275 |
| 175.A | Uzbekistan | 40.2504 | 63.2032 | SRR18125288 | SAMN26179276 |
| 175.B | Uzbekistan | 40.2504 | 63.2032 | SRR18125286 | SAMN26179277 |
| 176.A | Uzbekistan | 40.2504 | 63.2032 | SRR18125285 | SAMN26179278 |
| 177.A | Uzbekistan | 40.2504 | 63.2032 | SRR18125284 | SAMN26179279 |
| 178.A | Uzbekistan | 40.2504 | 63.2032 | SRR18125283 | SAMN26179280 |
| 179.A | Uzbekistan | 39.9208 | 66.4271 | SRR18125282 | SAMN26179281 |
| 18.B | Uzbekistan | 39.7681 | 64.4556 | SRR18125281 | SAMN26179282 |
| 180.A | Uzbekistan | 39.9208 | 66.4271 | SRR18125280 | SAMN26179283 |
| 181.A | Uzbekistan | 39.9208 | 66.4271 | SRR18125279 | SAMN26179284 |
| 182.B | Uzbekistan | 39.9208 | 66.4271 | SRR18125278 | SAMN26179285 |
| 183.A | Uzbekistan  | 40.3734 | 71.7978 | SRR18125277 | SAMN26179286 |
| 184.A | China | 41.482754 | 85.626702 | SRR18125275 | SAMN26179287 |
| 187.A | China | 38.10222 | 76.993816 | SRR18125274 | SAMN26179288 |
| 188.B | China | 41.1675 | 80.2634 | SRR18125273 | SAMN26179289 |
| 189.A | China | 41.1675 | 80.2634 | SRR18125272 | SAMN26179290 |
| 19.B | Iran | 32.4279 | 53.688 | SRR18125271 | SAMN26179291 |
| 190.A | China | 42.9513 | 89.1898 | SRR18125270 | SAMN26179292 |
| 191.A | China | 41.175324 | 85.660861 | SRR18125269 | SAMN26179293 |
| 192.A | India | 31.8183 | 75.2071 | SRR18125268 | SAMN26179294 |
| 193.A | India | 31.326 | 75.5762 | SRR18125267 | SAMN26179295 |
| 193.B | India | 31.326 | 75.5762 | SRR18125265 | SAMN26179296 |
| 194.A | India | 30.3752 | 76.7821 | SRR18125480 | SAMN26179297 |
| 195.A | India | 28.7041 | 77.1025 | SRR18125407 | SAMN26179298 |
| 195.B | India | 28.7041 | 77.1025 | SRR18125406 | SAMN26179299 |
| 197.A | India | 17.6599 | 75.9064 | SRR18125405 | SAMN26179300 |
| 199.A | Senegal | 14.4974 | -14.4524 | SRR18125404 | SAMN26179301 |
| 1A | USA | NA | NA | SRR18125403 | SAMN26179302 |
| 201.B | Pakistan | 31.5204 | 74.3587 | SRR18125402 | SAMN26179303 |
| 202.B | Canada | 43.6502 | -79.9036 | SRR18125401 | SAMN26179304 |
| 203.A | Ethiopia | 9.3126 | 42.1227 | SRR18125400 | SAMN26179305 |
| 204.B | Indonesia | -6.5971 | 106.806 | SRR18125399 | SAMN26179306 |
| 205.A | Indonesia | -6.5971 | 106.806 | SRR18125397 | SAMN26179307 |
| 205.B | Indonesia | -6.5971 | 106.806 | SRR18125396 | SAMN26179308 |
| 206.A | Hungary | 47.1625 | 19.5033 | SRR18125395 | SAMN26179309 |
| 207.A | Viet Nam | 14.0583 | 108.2772 | SRR18125394 | SAMN26179310 |
| 21.B | Kazakhstan | 51.1605 | 71.4704 | SRR18125393 | SAMN26179311 |
| 210.A | Afghanistan | 36.6926 | 67.118 | SRR18125392 | SAMN26179312 |
| 212.A | Viet Nam | 21.0278 | 105.8342 | SRR18125391 | SAMN26179313 |
| 215.A | Guinea | 8.5383 | -9.4728 | SRR18125390 | SAMN26179314 |
| 216.A | Uzbekistan  | 39.972132 | 65.558096 | SRR18125389 | SAMN26179315 |
| 217.B | Uzbekistan  | 40.162885 | 66.227209 | SRR18125388 | SAMN26179316 |
| 218.A | Uzbekistan  | 40.013465 | 64.943243 | SRR18125386 | SAMN26179317 |
| 219.A | Turkmenistan | 40.243331 | 59.540314 | SRR18125385 | SAMN26179318 |
| 22.B | Kazakhstan | 42.3417 | 69.5901 | SRR18125384 | SAMN26179319 |
| 220.A | Turkmenistan | 40.243331 | 59.540314 | SRR18125383 | SAMN26179320 |
| 223.A | Uzbekistan | 40.483568 | 70.546311 | SRR18125382 | SAMN26179321 |
| 224.A | Iran | 32.6539 | 51.666 | SRR18125381 | SAMN26179322 |
| 225.A | Pakistan | 30.3753 | 69.3451 | SRR18125380 | SAMN26179323 |
| 226.B | Pakistan | 30.3753 | 69.3451 | SRR18125379 | SAMN26179324 |
| 227.A | Pakistan | 30.3753 | 69.3451 | SRR18125378 | SAMN26179325 |
| 228.B | Turkmenistan | 39.0041 | 63.5688 | SRR18125377 | SAMN26179326 |
| 229.A | Pakistan | 31.4504 | 73.135 | SRR18125375 | SAMN26179327 |
| 23.A | Kazakhstan | 42.3417 | 69.5901 | SRR18125374 | SAMN26179328 |
| 230.A | Pakistan | 31.4504 | 73.135 | SRR18125373 | SAMN26179329 |
| 230.B | Pakistan | 31.4504 | 73.135 | SRR18125372 | SAMN26179330 |
| 231.A | Tanzania | -6.369 | 34.8888 | SRR18125335 | SAMN26179331 |
| 232.A | Iran | 34.3277 | 47.0778 | SRR18125334 | SAMN26179332 |
| 233.A | Iran | 32.4279 | 53.688 | SRR18125333 | SAMN26179333 |
| 234.A | India | 28.6139 | 77.209 | SRR18125332 | SAMN26179334 |
| 235.A | Pakistan | 33.5651 | 73.0169 | SRR18125331 | SAMN26179335 |
| 235.B | Pakistan | 33.5651 | 73.0169 | SRR18125330 | SAMN26179336 |
| 236.A | Pakistan | 34.0155 | 71.6888 | SRR18125328 | SAMN26179337 |
| 237.A | Pakistan | 28.6001 | 77.227 | SRR18125327 | SAMN26179338 |
| 238.A | Egypt | 26.8206 | 30.8025 | SRR18125326 | SAMN26179339 |
| 239.A | Kazakhstan | 44.7689 | 77.5573 | SRR18125325 | SAMN26179340 |
| 24.A | Uzbekistan | 41.4065 | 60.3685 | SRR18125324 | SAMN26179341 |
| 240.A | Uzbekistan | 39.4065 | 67.1418 | SRR18125323 | SAMN26179342 |
| 240.B | Uzbekistan | 39.4065 | 67.1418 | SRR18125322 | SAMN26179343 |
| 241.A | Uzbekistan | 40.023044 | 67.433724 | SRR18125321 | SAMN26179344 |
| 242.A | Uzbekistan | 39.982851 | 67.486778 | SRR18125320 | SAMN26179345 |
| 244.A | Uzbekistan | 41.773406 | 63.780613 | SRR18125319 | SAMN26179346 |
| 245.A | Kazakhstan | 43.47491 | 75.335144 | SRR18125317 | SAMN26179347 |
| 246.A | Algeria | 35.6971 | -0.6308 | SRR18125316 | SAMN26179348 |
| 247.A | Tanzania | -5.0425 | 32.8197 | SRR18125315 | SAMN26179349 |
| 249.A | Australia | -32.9283 | 151.7817 | SRR18125314 | SAMN26179350 |
| 25.A | Uzbekistan | 41.4065 | 60.3685 | SRR18125313 | SAMN26179351 |
| 250.B | Russia | NA | NA | SRR18125312 | SAMN26179352 |
| 251.B | USA | NA | NA | SRR18125311 | SAMN26179353 |
| 252.A | Afghanistan | 34.7602 | 69.8121 | SRR18125310 | SAMN26179354 |
| 253.A | Afghanistan | 34.7602 | 69.8121 | SRR18125309 | SAMN26179355 |
| 254.A | Yemen | 15.5527 | 48.5164 | SRR18125308 | SAMN26179356 |
| 254.B | Yemen | 15.5527 | 48.5164 | SRR18125306 | SAMN26179357 |
| 255.A | Afghanistan | 36.6926 | 67.118 | SRR18125305 | SAMN26179358 |
| 256.A | Afghanistan | 36.6926 | 67.118 | SRR18125304 | SAMN26179359 |
| 257.B | Afghanistan | 36.6926 | 67.118 | SRR18125303 | SAMN26179360 |
| 258.B | Afghanistan | 33.9391 | 67.71 | SRR18125302 | SAMN26179361 |
| 259.B | Colombia | 4.5709 | -74.2973 | SRR18125301 | SAMN26179362 |
| 26.B | Uzbekistan | 41.4065 | 60.3685 | SRR18125300 | SAMN26179363 |
| 260.A | Philippines | 14.5995 | 120.9842 | SRR18125479 | SAMN26179364 |
| 261.B | Kenya | -1.2921 | 36.8219 | SRR18125478 | SAMN26179365 |
| 262.A | Kenya | -1.2921 | 36.8219 | SRR18125477 | SAMN26179366 |
| 263.A | Kenya | -1.2921 | 36.8219 | SRR18125475 | SAMN26179367 |
| 264.A | Kenya | -1.2921 | 36.8219 | SRR18125474 | SAMN26179368 |
| 265.B | Kenya | -1.2921 | 36.8219 | SRR18125473 | SAMN26179369 |
| 266.A | Kenya | -1.2921 | 36.8219 | SRR18125472 | SAMN26179370 |
| 267.A | Kenya | -1.2921 | 36.8219 | SRR18125471 | SAMN26179371 |
| 268.A | Kenya | -1.2921 | 36.8219 | SRR18125470 | SAMN26179372 |
| 269.B | Kenya | -1.2921 | 36.8219 | SRR18125469 | SAMN26179373 |
| 27.A | Uzbekistan | 39.7681 | 64.4556 | SRR18125468 | SAMN26179374 |
| 270.A | Kenya | -1.2921 | 36.8219 | SRR18125467 | SAMN26179375 |
| 271.A | South Korea | 35.8987 | 127.0392 | SRR18125466 | SAMN26179376 |
| 272.A | Australia | NA | NA | SRR18125464 | SAMN26179377 |
| 273.A | Kenya | -1.2921 | 36.8219 | SRR18125463 | SAMN26179378 |
| 274.A | Kenya | -1.2921 | 36.8219 | SRR18125462 | SAMN26179379 |
| 275.A | Kenya | -1.2921 | 36.8219 | SRR18125461 | SAMN26179380 |
| 276.A | Kenya | -1.2921 | 36.8219 | SRR18125460 | SAMN26179381 |
| 277.B | Kazakhstan | 43.1521 | 68.2581 | SRR18125459 | SAMN26179382 |
| 278.B | Kazakhstan | 43.0631 | 69.0851 | SRR18125458 | SAMN26179383 |
| 279.A | Kazakhstan | 41.5295 | 69.4133 | SRR18125457 | SAMN26179384 |
| 28.A | Russia | 42.1432 | 47.095 | SRR18125456 | SAMN26179385 |
| 280.B | Kazakhstan | 41.5295 | 69.4133 | SRR18125455 | SAMN26179386 |
| 281.B | South Korea | 35.8987 | 127.0392 | SRR18125453 | SAMN26179387 |
| 282.B | South Korea | 35.8987 | 127.0392 | SRR18125452 | SAMN26179388 |
| 283.B | South Korea | 35.8987 | 127.0392 | SRR18125451 | SAMN26179389 |
| 284.A | Tajikistan | 38.0116 | 71.003 | SRR18125450 | SAMN26179390 |
| 285.A | Tajikistan | 37.074793 | 67.957222 | SRR18125449 | SAMN26179391 |
| 286.A | Tajikistan | 37.028926 | 68.004059 | SRR18125448 | SAMN26179392 |
| 287.A | Tajikistan | 39.179338 | 68.012339 | SRR18125447 | SAMN26179393 |
| 288.A | Philippines | 14.5995 | 120.9842 | SRR18125446 | SAMN26179394 |
| 289.B | Philippines | 14.5995 | 120.9842 | SRR18125445 | SAMN26179395 |
| 290.A | China | 40.2374 | 116.2305 | SRR18125444 | SAMN26179396 |
| 290.B | China | 40.2374 | 116.2305 | SRR18125263 | SAMN26179397 |
| 291.A | China | 40.2374 | 116.2305 | SRR18125262 | SAMN26179398 |
| 292.A | China | 30.7378 | 112.2384 | SRR18125261 | SAMN26179399 |
| 293.A | China | 30.7378 | 112.2384 | SRR18125260 | SAMN26179400 |
| 294.A | China | 40.2374 | 116.2305 | SRR18125259 | SAMN26179401 |
| 295.B | China | 37.8957 | 114.9042 | SRR18125258 | SAMN26179402 |
| 296.A | China | 37.8957 | 114.9042 | SRR18125257 | SAMN26179403 |
| 297.A | China | 47.1216 | 128.7382 | SRR18125256 | SAMN26179404 |
| 298.B | China | 47.1216 | 128.7382 | SRR18125255 | SAMN26179405 |
| 299.A | China | 40.2374 | 116.2305 | SRR18125254 | SAMN26179406 |
| 2A | China | 47.1216 | 128.7382 | SRR18125252 | SAMN26179407 |
| 3.B | China | 47.1216 | 128.7382 | SRR18125251 | SAMN26179408 |
| 30.A | Russia | 42.1432 | 47.095 | SRR18125250 | SAMN26179409 |
| 300.A | China | 47.1216 | 128.7382 | SRR18125249 | SAMN26179410 |
| 31.A | Russia | 42.1432 | 47.095 | SRR18125248 | SAMN26179411 |
| 32.B | Russia | 42.1432 | 47.095 | SRR18125247 | SAMN26179412 |
| 33.A | USA | NA | NA | SRR18125246 | SAMN26179413 |
| 34.A | USA | NA | NA | SRR18125245 | SAMN26179414 |
| 34.B | USA | NA | NA | SRR18125244 | SAMN26179415 |
| 35.A | Russia | NA | NA | SRR18125243 | SAMN26179416 |
| 36.A | Russia | 43.1198 | 131.8869 | SRR18125241 | SAMN26179417 |
| 37.A | USA | NA | NA | SRR18125240 | SAMN26179418 |
| 38.B | China | 44.9188 | 130.5244 | SRR18125239 | SAMN26179419 |
| 39.A | Iran | 36.3394 | 59.4698 | SRR18125238 | SAMN26179420 |
| 3A | China | 47.1216 | 128.7382 | SRR18125237 | SAMN26179421 |
| 40.B | Iran | 36.3394 | 59.4698 | SRR18125236 | SAMN26179422 |
| 41.B | Iran | 32.4279 | 53.688 | SRR18125235 | SAMN26179423 |
| 42.A | Iran | 32.4279 | 53.688 | SRR18125234 | SAMN26179424 |
| 43.A | Iran | 32.4279 | 53.688 | SRR18125233 | SAMN26179425 |
| 44.B | Turkmenistan | 37.9153 | 58.0897 | SRR18125232 | SAMN26179426 |
| 45.A | Turkmenistan | 37.9153 | 58.0897 | SRR18125230 | SAMN26179427 |
| 46.A | Turkmenistan | 37.9153 | 58.0897 | SRR18125443 | SAMN26179428 |
| 47.A | Turkmenistan | 37.9153 | 58.0897 | SRR18125442 | SAMN26179429 |
| 48.B | Turkmenistan | 37.9153 | 58.0897 | SRR18125441 | SAMN26179430 |
| 49.B | Turkmenistan | 37.9172 | 58.0907 | SRR18125440 | SAMN26179431 |
| 4A | China | 47.1216 | 128.7382 | SRR18125439 | SAMN26179432 |
| 5.B | China | 47.1216 | 128.7382 | SRR18125438 | SAMN26179433 |
| 50.A | Turkmenistan | 37.9172 | 58.0907 | SRR18125437 | SAMN26179434 |
| 51.B | Turkmenistan | 37.9601 | 58.3261 | SRR18125436 | SAMN26179435 |
| 52.A | Turkmenistan | 37.9601 | 58.3261 | SRR18125435 | SAMN26179436 |
| 53.B | USA | 40.1605 | -103.2144 | SRR18125433 | SAMN26179437 |
| 54.A | USA | 40.1605 | -103.2144 | SRR18125432 | SAMN26179438 |
| 55.B | Ukraine | 48.3794 | 31.1656 | SRR18125431 | SAMN26179439 |
| 56.A | Kazakhstan | 43.3667 | 68.4094 | SRR18125430 | SAMN26179440 |
| 57.A | Iran | 34.7608 | 48.3988 | SRR18125429 | SAMN26179441 |
| 58.A | Iran | 35.6892 | 51.389 | SRR18125428 | SAMN26179442 |
| 59.B | Kazakhstan | 43.3667 | 68.4094 | SRR18125427 | SAMN26179443 |
| 6.B | China | 47.1216 | 128.7382 | SRR18125426 | SAMN26179444 |
| 60.A | Kazakhstan | 42.2663 | 68.1431 | SRR18125425 | SAMN26179445 |
| 61.A | Uzbekistan | 41.2995 | 69.2401 | SRR18125424 | SAMN26179446 |
| 62.A | Uzbekistan | 41.2995 | 69.2401 | SRR18125422 | SAMN26179447 |
| 63.A | Uzbekistan | 41.2995 | 69.2401 | SRR18125421 | SAMN26179448 |
| 64.B | Uzbekistan | 41.2995 | 69.2401 | SRR18125420 | SAMN26179449 |
| 65.B | Uzbekistan | 41.2995 | 69.2401 | SRR18125419 | SAMN26179450 |
| 66.B | Uzbekistan | 41.2995 | 69.2401 | SRR18125418 | SAMN26179451 |
| 67.A | Uzbekistan | 41.2995 | 69.2401 | SRR18125417 | SAMN26179452 |
| 68.A | Uzbekistan | 41.2995 | 69.2401 | SRR18125416 | SAMN26179453 |
| 69.A | Uzbekistan | 40.4915 | 68.7811 | SRR18125415 | SAMN26179454 |
| 70.A | Uzbekistan | 39.627 | 66.975 | SRR18125414 | SAMN26179455 |
| 71.A | Uzbekistan | 39.627 | 66.975 | SRR18125413 | SAMN26179456 |
| 72.A | Uzbekistan | 39.627 | 66.975 | SRR18125411 | SAMN26179457 |
| 73.B | Uzbekistan | 39.627 | 66.975 | SRR18125410 | SAMN26179458 |
| 74.A | Uzbekistan | 39.627 | 66.975 | SRR18125409 | SAMN26179459 |
| 75.A | Uzbekistan | 39.627 | 66.975 | SRR18125408 | SAMN26179460 |
| 76.A | Uzbekistan | 41.2995 | 69.2401 | SRR18125229 | SAMN26179461 |
| 77.A | Uzbekistan | 39.7681 | 64.4556 | SRR18125228 | SAMN26179462 |
| 79.B | Uzbekistan | 39.7681 | 64.4556 | SRR18125227 | SAMN26179463 |
| 7A | China | 47.1216 | 128.7382 | SRR18125226 | SAMN26179464 |
| 8.B | China | 47.1216 | 128.7382 | SRR18125225 | SAMN26179465 |
| 81.B | Afghanistan | 34.1769 | 61.7006 | SRR18125224 | SAMN26179466 |
| 82.B | Afghanistan | 34.1769 | 61.7006 | SRR18125222 | SAMN26179467 |
| 83.A | Afghanistan | 34.1769 | 61.7006 | SRR18125221 | SAMN26179468 |
| 84.A | Afghanistan | 34.1769 | 61.7006 | SRR18125220 | SAMN26179469 |
| 85.A | Afghanistan | 34.1769 | 61.7006 | SRR18125219 | SAMN26179470 |
| 86.A | Afghanistan | 36.6153 | 66.9293 | SRR18125218 | SAMN26179471 |
| 88.B | Afghanistan | NA | NA | SRR18125217 | SAMN26179472 |
| 89.B | Afghanistan | 33.9391 | 67.71 | SRR18125216 | SAMN26179473 |
| 90.B | Uzbekistan | NA | NA | SRR18125215 | SAMN26179474 |
| 91.A | Japan | 35.719 | 139.7456 | SRR18125214 | SAMN26179475 |
| 92.A | Japan | 35.719 | 139.7456 | SRR18125213 | SAMN26179476 |
| 93.B | Armenia | 40.0691 | 45.0382 | SRR18125211 | SAMN26179477 |
| 94.A | Iran | 35.102 | 59.1042 | SRR18125210 | SAMN26179478 |
| 95.A | Azerbaijan | 40.4093 | 49.8671 | SRR18125209 | SAMN26179479 |
| 96.A | Azerbaijan | 40.1431 | 47.5769 | SRR18125208 | SAMN26179480 |
| 97.A | Turkmenistan  | 39.0041 | 63.5688 | SRR18125207 | SAMN26179481 |
| 98.B | Panama | 9.3593 | -79.8999 | SRR18125206 | SAMN26179482 |
| 99.A | Panama | 9.3593 | -79.8999 | SRR18125205 | SAMN26179483 |
| 99.B | Panama | 9.3593 | -79.8999 | SRR18125204 | SAMN26179484 |
| 9A | China | 47.1216 | 128.7382 | SRR18125203 | SAMN26179485 |
| M7.A | India | 31.5204 | 74.3587 | SRR18125202 | SAMN26179486 |

**Supplementary file 1b.** Outgroup *f*3 statistics among all possible combinations of genetic group pairs

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Outgroup (C)** | **Source1****(A)** | **Source2****(B)** | ***f*3** | **Standard error** | **Z-score** | **Significant**  |
| *sublobata* | CA | EA | 0.232 | 0.005 | 42.66 | Yes |
| *sublobata* | CA | SA | 0.209 | 0.005 | 38.41 | Yes |
| *sublobata* | CA | SEA | 0.213 | 0.005 | 39.03 | Yes |
| *sublobata* | EA | SA | 0.209 | 0.005 | 38.79 | Yes |
| *sublobata* | EA | SEA | 0.218 | 0.005 | 40.75 | Yes |
| *sublobata* | SA | SEA | 0.211 | 0.005 | 39.41 | Yes |

Abbreviations: SA, South Asia; SEA, Southeast Asia; EA, East Asia and CA, Central Asia

(*f*3 statistics with Z-score > |3| are considered significant)

**Supplementary file 1c.** Admixture *f*3 statistics among all possible population trios

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Target****(C)** | **Source1****(A)** | **Source2****(B)** | ***f*3** | **Standard error** | **Z-score** | **Significant** |
| EA | SA | CA | 0.005 | 0.001 | 4.82 | Yes |
| EA | SEA | CA | -0.001 | 0.001 | -0.51 | No |
| EA | SEA | SA | 0.020 | 0.002 | 13.48 | Yes |
| SEA | CA | EA | 0.030 | 0.002 | 14.7 | Yes |
| SEA | SA | CA | 0.014 | 0.002 | 8.82 | Yes |
| SEA | SA | EA | 0.009 | 0.001 | 6.86 | Yes |
| SA | CA | EA | 0.032 | 0.002 | 16.66 | Yes |
| SA | CA | SEA | 0.011 | 0.001 | 9.02 | Yes |
| SA | EA | SEA | 0.017 | 0.001 | 12.91 | Yes |
| CA | EA | SA | 0.011 | 0.001 | 9.55 | Yes |
| CA | EA | SEA | 0.016 | 0.002 | 10.37 | Yes |
| CA | SEA | SA | 0.031 | 0.002 | 15.65 | Yes |

Abbreviations: SA, South Asia; SEA, Southeast Asia; EA, East Asia and CA, Central Asia

(*f*3 statistics with Z-score > |3| are considered significant, but only negative *f3* statistics denote the target population being admixed from source1 and source2.)

**Supplementary file 1d.** Mantel tests for isolation by distance of inferred genetic group (Q ≥ 0.5)

|  |  |  |
| --- | --- | --- |
| **Group** | ***r*** | ***P*** |
| SA | 0.4319 | 0.008\* |
| SEA | 0.3312 | 0.041\* |
| EA | 0.0461 | 0.052 |
| CA | 0.0070 | 0.435 |
| Southern | 0.2934 | 0.001\* |
| Northern | 0.2777 | 0.001\* |

Abbreviations: SA, South Asia; SEA, Southeast Asia; EA, East Asia; CA, Central Asia; *r*, Mantel correlation; significance level \* *P* < 0.05

**Supplementary file 1e.** Description of bioclimatic variables used in ecological niche modelling

|  |  |  |
| --- | --- | --- |
| **Bioclimatic variable** | **Variable**  | **Unit** |
| Bio1 | Annual mean temperature | oC |
| Bio2 | Mean diurnal range (mean of monthly (max temp - min temp)) | oC |
| Bio3 | Isothermality (Bio2/Bio7) (×100) | oC |
| Bio4 | Temperature seasonality (standard deviation ×100) | oC |
| Bio5 | Max temperature of warmest month | oC |
| Bio6 | Min temperature of coldest month | oC |
| Bio7 | Temperature annual range (Bio5-Bio6) | oC |
| Bio8 | Mean temperature of wettest quarter | oC |
| Bio9 | Mean temperature of driest quarter | oC |
| Bio10 | Mean temperature of warmest quarter | oC |
| Bio11 | Mean temperature of coldest quarter | oC |
| Bio12 | Annual precipitation | mm |
| Bio13 | Precipitation of wettest month | mm |
| Bio14 | Precipitation of driest month | mm |
| Bio15 | Precipitation seasonality (coefficient of variation) | mm |
| Bio16 | Precipitation of wettest quarter | mm |
| Bio17 | Precipitation of driest quarter | mm |
| Bio18 | Precipitation of warmest quarter | mm |
| Bio19 | Precipitation of coldest quarter | mm |

**Supplementary file 1f.** Pearson’s correlation coefficient between pairs of bioclimatic variables (denoted in lower triangle)



**Supplementary file 1g.** Comparison of bioclimatic variables among the four genetic groups analysed with multivariate analysis of variance (MANOVA)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Predictor** | **Test statistic** | **Df** | **Observed value** | **F value** | **Num. Df** | **Den. Df** | ***P*** |
| Genetic group | Pillai  | 3 | 1.790 | 44.215 | 24 | 717 | < 2e-16 |
|  | Wilks  | 3 | 0.024 | 74.690 | 24 | 688 | < 2e-16 |
|  | Hotelling-Lawley | 3 | 12.716 | 124.870 | 24 | 707 | < 2e-16 |
|   | Roy | 3 | 10.777 | 321.960 | 8 | 239 | < 2e-16 |

Df = degree of freedom among groups; Num. Df = degrees of freedom of the model; Den. Df = degree of freedom of residual

**Supplementary file 1h.** Summary of analysis of variance (ANOVA) for bioclimatic variables

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bioclimatic variable** | **Df** | **Sum square** | **Mean square** | **F value** | ***P*** |
| Bio1 (Annual temperature) | 3 | 183.688 | 61.229 | 235.97 | <2.2e-16 |
| Bio2 (Mean diurnal temperature range) | 3 | 66.253 | 22.085 | 29.813 | <2.2e-16 |
| Bio3 (Isothermality) | 3 | 188.031 | 62.677 | 259.34 | <2.2e-16 |
| Bio8 (Mean temperature of wettest quarter) | 3 | 177.063 | 59.021 | 205.91 | <2.2e-16 |
| Bio12 (Annual precipitation)  | 3 | 157.890 | 52.630 | 144.11 | <2.2e-16 |
| Bio14 (Precipitation of driest month) | 3 | 29.859 | 9.952 | 11.183 | <6.6e-07 |
| Bio15 (Precipitation seasonality) | 3 | 119.810 | 39.938 | 76.62 | <2.2e-16 |
| Bio19 (Precipitation of coldest quarter) | 3 | 44.212 | 14.737 | 17.732 | < 1.9e-10 |

Df = degree of freedom

**Supplementary file 1i.** Correlation between eight bioclimatic variables and climatic PC axes 1 to 4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bioclimatic variable** | **PC1** | **PC2** | **PC3** | **PC4** |
| Bio1 (Annual temperature) | **-0.445** | -0.107 | 0.390 | -0.056 |
| Bio2 (Mean diurnal temperature range) | 0.193 | **-0.564** | 0.062 | 0.253 |
| Bio3 (Isothermality) | **-0.430** | -0.082 | **0.492** | -0.184 |
| Bio8 (Mean temperature of wettest quarter) | **-0.486** | 0.042 | -0.287 | 0.049 |
| Bio12 (Annual precipitation)  | **-0.401** | 0.366 | 0.066 | 0.202 |
| Bio14 (Precipitation of driest month) | 0.017 | **0.582** | -0.248 | 0.259 |
| Bio15 (Precipitation seasonality) | -0.323 | -0.365 | -0.292 | **0.667** |
| Bio19 (Precipitation of coldest quarter) | 0.279 | 0.235 | **0.607** | **0.587** |

(Correlation coefficients with absolute values higher than 0.4 are in bold.)

**Supplementary file 1j.** Comparison of summer growing season data including temperature and precipitation of May, July and September among the four genetic groups analysed with multivariate analysis of variance (MANOVA)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Predictor** | **Test statistic** | **Df** | **Observed value** | **F value** | **Num. Df** | **Den. Df** | ***P*** |
| Genetic group | Pillai  | 3 | 1.915 | 70.907 | 18 | 723 | < 2e-16 |
|  | Wilks  | 3 | 0.010 | 156.350 | 18 | 676 | < 2e-16 |
|  | Hotelling-Lawley | 3 | 19.873 | 262.400 | 18 | 713 | < 2e-16 |
|   | Roy | 3 | 15.400 | 618.570 | 6 | 241 | < 2e-16 |

Df = degree of freedom among groups; Num. Df = degrees of freedom of the model; Den. Df = degree of freedom of residual

**Supplementary file 1k.** ANOVA table for all evaluated field traits (phenology, reproduction and size) as well as drought-related traits

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Garden** | **Model r^2** | **Group *F*** | **Group *P***  | **SEA1** | **SA1** | **CA1** | **Tukey2** |
| **Phenology:** |   |   |   |   |   |   |   |   |
| Days to 50% flowering | Pakistan 2015 | 0.2388 | 7.2144 | 0.0019\* | -0.3702 | 0.6296 | -0.3525 | B,A,B |
| Days to 50% flowering | Taiwan 1984 | 0.5266 | 25.5887 | <.0001\* | 0.5723 | 0.3197 | -1.0685 | A,A,B |
| Days to 50% flowering | Taiwan 2018 | 0.4465 | 18.5544 | <.0001\* | 0.0974 | 0.6569 | -0.9633 | A,A,B |
| **Reproduction:** |  |  |  |  |  |  |  |  |
| 100 seed weight, g | Pakistan 2015 | 0.4722 | 20.5761 | <.0001\* | 0.9050 | -0.6397 | -0.2756 | A,B,B |
| Pod length, cm | Pakistan 2015 | 0.2621 | 8.1698 | 0.0009\* | 0.6810 | -0.2605 | -0.4896 | A,B,B |
| Pod length, cm | Taiwan 1984 | 0.7173 | 58.3615 | <.0001\* | 1.0524 | -0.1980 | -1.0232 | A,B,C |
| Pods per plant | Pakistan 2015 | 0.4471 | 18.5988 | <.0001\* | -0.6441 | 0.8455 | -0.3062 | B,A,B |
| 1000 seed weight, g | Taiwan 1984 | 0.6248 | 38.3053 | <.0001\* | 0.9979 | -0.8380 | -0.1340 | A,C,B |
| Seed yield per plant, g | Pakistan 2015 | 0.4666 | 20.1225 | <.0001\* | -0.6210 | 0.8752 | -0.3712 | B,A,B |
| Seeds per pod | Pakistan 2015 | 0.1300 | 3.4372 | 0.0406\* | -0.4875 | 0.2418 | 0.2806 | A,A,A |
| Seeds per pod | Taiwan 1984 | 0.1611 | 4.4168 | 0.0176\* | 0.1413 | 0.3386 | -0.6107 | AB,A,B |
| **Plant size:** |  |  |  |  |  |  |  |  |
| Petiole length, cm | Pakistan 2015 | 0.2943 | 9.5907 | 0.0003\* | 0.5435 | 0.0878 | -0.7798 | A,A,B |
| Plant height, cm | Pakistan 2015 | 0.0001 | 0.0024 | 0.9976 | 0.0075 | 0.0055 | -0.0158 | A,A,A |
| Plant height at flowering, cm | Taiwan 1984 | 0.3981 | 15.2115 | <.0001\* | 0.4811 | 0.3024 | -0.9705 | A,A,B |
| Plant height at maturity, cm | Taiwan 1984 | 0.5472 | 27.8000 | <.0001\* | 0.3480 | 0.5605 | -1.1362 | A,A,B |
| Primary leaf length, cm | Taiwan 1984 | 0.5454 | 27.5930 | <.0001\* | 0.9813 | -0.4212 | -0.6253 | A,B,B |
| Primary leaf width, cm | Taiwan 1984 | 0.6053 | 35.2773 | <.0001\* | 1.0244 | -0.6010 | -0.4313 | A,B,B |
| Terminal leaflet length, cm | Pakistan 2015 | 0.2186 | 6.4340 | 0.0034\* | 0.3062 | 0.2643 | -0.7167 | A,A,B |
| Terminal leaflet width, cm | Pakistan 2015 | 0.1680 | 4.6458 | 0.0145\* | 0.4361 | 0.0387 | -0.5734 | A,AB,B |
| **Drought (PEG6000):** |  |  |  |  |  |  |  |  |
| Shoot dry weight (SDW), mg | NTU 2021 | 0.5998 | 36.7246 | <.0001\* | 1.0508 | -0.5607 | -0.5483 | A,B,B |
| Root dry weight (RDW), mg | NTU 2021 | 0.5964 | 36.2048 | <.0001\* | 1.0299 | -0.6933 | -0.3336 | A,B,B |
| Total dry weight (TDW), mg | NTU 2021 | 0.5934 | 35.7555 | <.0001\* | 1.0448 | -0.5883 | -0.5028 | A,B,B |
| Root:Shoot ratio dry weight (RSRDW) | NTU 2021 | 0.3261 | 11.8577 | <.0001\* | -0.2316 | -0.4342 | 0.9112 | B,B,A |
| **Drought (Control):** |  |  |  |  |  |  |  |  |
| Shoot dry weight (SDW), mg | NTU 2021 | 0.5779 | 33.5453 | <.0001\* | 1.0275 | -0.4709 | -0.6484 | A,B,B |
| Root dry weight (RDW), mg | NTU 2021 | 0.5205 | 26.5962 | <.0001\* | 0.9716 | -0.6077 | -0.3811 | A,B,B |
| Total dry weight (TDW), mg | NTU 2021 | 0.5638 | 31.6722 | <.0001\* | 1.0195 | -0.5374 | -0.5430 | A,B,B |
| Root:Shoot ratio dry weight (RSRDW) | NTU 2021 | 0.1753 | 5.2083 | 0.0089\* | -0.3036 | -0.2004 | 0.6773 | B,B,A |

\*Significant at *P* < 0.05; 1: least-square means of each group after inverse normal transformation of raw data; 2: levels not connected by same letter are significantly different.

**Supplementary file 1l.** Mean of eight bioclimatic variables of the genetic groups

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bioclimatic variable** | **Northeast Asia**  | **Northwest Asia**  | **Southeast Asia**  | **South Asia**  | **Central Asia**  |
| **(N = 37)**  | **(N = 45)**  | **(N = 45)**  | **(N = 49)**  | **(N = 72)**  |
| **Mean ± SD** | **Mean ± SD** | **Mean ± SD** | **Mean ± SD** | **Mean ± SD** |
| **Bio1** | 62.49 ± 55.39 | 117.58 ± 54.30 | 256.47 ± 19.29 | 255.57 ± 14.80 | 128.72 ± 41.10 |
| **Bio2** | 115.22 ± 15.44 | 124.38 ± 20.14 | 102.02 ± 16.11 | 127.24 ± 16.12 | 130.08 ± 13.89 |
| **Bio3** | 25.14 ± 2.04 | 31.02 ± 4.47 | 51.58 ± 7.19 | 42.8 ± 4.58 | 32.4 ± 3.52 |
| **Bio8** | 207.86 ± 31.97 | 107.89 ± 67.90 | 271.47 ± 11.68 | 283.92 ± 23.02 | 92.04 ± 42.23 |
| **Bio12** | 821.59 ± 299.98 | 301.24 ± 201.00 | 1477.69 ± 380.18 | 750.39 ± 329.19 | 285.67 ± 145.24 |
| **Bio14** | 12.14 ± 11.72 | 5.18 ± 8.99 | 6.33 ± 4.34 | 2.47 ± 3.44 | 2.51 ± 4.98 |
| **Bio15** | 95.35 ± 24.52 | 65.4 ± 20.35 | 84.78 ± 7.25 | 124.47 ± 23.48 | 70.92 ± 12.92 |
| **Bio19** | 42.51 ± 38.23 | 88.33 ± 67.16 | 48.02 ± 24.91 | 34 ± 33.99 | 92.15 ± 45.19 |