**Table S1 Pedigree and released information of 23 Yannong cultivars/lines**

|  |  |  |
| --- | --- | --- |
| **Cultivar/line** | **Pedigree** | **Released number** |
| Yannong 15 | Youbaomai/(St2422//464) | Shandong (1982) |
| Yannong 17 | Zhengmai 366/Tainong 18 | Shandong Province regional trail the 2nd year |
| Yannong 23 | Yan 1061/Lumai 14 | Shandong (2003) |
| Yannong 24 | Shan 229/Anmai 1 | Shandong (2004) |
| Yannong 30 | Yannong 09135/Jimai 22 | National regional trail the 2nd year |
| Yannong 31 | Yannong 09135/Jimai 22 | Shandong Province production test |
| Yannong 37 | Lumai 21/Jimai 22 | Shandong Province regional trail the 2nd year |
| Yannong 161 | Jimai 22/Yannong 1212 | Shandong (2021) |
| Yannong 191 | Recurrent selection populations of dwarf male | - |
| Yannong 215 | Yan 672/Yannong 999 | Shandong (2020) |
| Yannong 301 | Jimai 22/Yan 1201 | Shandong (2021) |
| Yannong 377 | By114/Yan 6089 | Shandong (2020) |
| Yannong 390 | Jimai 22/Yannong 23 | - |
| Yannong 572 | SN055849/Jimai 22 | Shandong Province production test |
| Yannong 745 | Yanong 999/Jimai 22 | National regional trail the 2nd year |
| Yannong 836 | Yan 9292 selection of satellite on-board processing systems | Shandong (2010), National Authorized (2014) |
| Yannong 999 | Yanhangxuan 2/Lin 9511//Yan BLU14-15 | Shandong (2011) , South region of Huang-Huai (2016), Shanxi (2018) |
| Yannong 1212 | Yan 5072/Shi 94-5300 | Shandong (2018), Hebei (2019), Guoshenmai (2020, 2021) |
| Yan 2415 | Yan 849/Lumai 21 | Shandong (2006) |
| Yannong 5158 | Yanhang 2/Yannong 15 | Shandong (2007), Anhui (2009), Jiangsu (2010) |
| Lumai 21 | Lumai 13/Baofeng 7228 | Shandong (1996) |
| Lumai 14 | C149/F4530 | Shandong (1990), Shanxi (1992), North region of Huang-Huai (1993) |
| Yannong 1766 | Yannong 09135/Jimai 22 | National production test |

**Table S2 Wheat accessions with known powdery mildew (*Pm*) and strip rust (*Yr*) resistance gene**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | ***Pm* gene** | **Cultivar/line** | **No.** | ***Yr* gene** | **Cultivar/line** |
| 1 | *Pm1* | Axminster/8\*Cc | 1 | *Yr1* | YR1/6\*AOC |
| 2 | *Pm2* | D57-5D | 2 | *Yr5* | Triticum. spelta album |
| 3 | *Pm4a* | Yuma/8\*Cc | 3 | *Yr9* | Ruihua 055 |
| 4 | *Pm5e* | Xiaobaidongmai | 4 | *Yr10* | Moro |
| 5 | *Pm6* | Coker 747 | 5 | *Yr15* | Yr15/6\*Avocet S |
| 6 | *Pm12* | CI14119 | 6 | *Yr17* | Yr17/6\*Avocet S |
| 7 | *Pm21* | Yangmai5/Sub.6V | 7 | *Yr18* | Yr18/6\*Avocet S |
| 8 | *Pm24* | Chiyacao | 8 | *Yr24* | K733 |
| 9 | *Pm33* | Am 9/3 | 9 | *Yr26* | Yangmai 5 |
| 10 | *Pm34* | Chuanmai 44 | 10 | *Yr29* | Zhongmai 527 |
| 11 | *Pm35* | Pubing 01 | 11 | *Yr30* | Opata 85 |
| 12 | *Pm42* | P63 | 12 | *Yr41* | Chuannong 19 |
| 13 | *Pm45* | D57-6D | 13 | *Yr67* | C591 |
| 14 | *Pm47* | Hongyanglazi | 14 | *YrSP* | Spaldings Prolific |
| 15 | *Pm52* | Liangxing 99 |  |  |  |

**Table S3 Information of molecular markers in this study**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Gene** | **Marker** | **Primer sequence (5’-3’)** | **Reference** | **Gel** |
| **Molecular markers for powdery mildew (*Pm*) resistance genes** | | | | |
| *Pm1* | *MAG2185-F* | GCTCCACTACTTCATCATCC | (Liang et al., 2016) | PAGE |
| *MAG2185-R* | ACCACAACGAACACCAACCT |
| *Pm2* | *CFD81-F* | TATCCCCAATCCCCTCTTTC | (Ma et al., 2015) | PAGE |
| *CFD81-R* | GTCAATTGTGGCTTGTCCCT |
| *BWM20-F* | GCTTCATCCTCAGCTTCGTC | PAGE |
| *BWM20-R* | GGAGGAAACAAAGGCACAGA |
| *Pm2b-map-3-F* | ACCACAACGAACACCAACCT | (Jin et al., 2021) | PAGE |
| *Pm2b-map-3-R* | ACGGGTAACCATCGAGATCA |
| *YTU-KASP-Pm2-F* | gaaggtgaccaagttcatgctTGTTGGACGAGAAAAGGAGAAA | (Yu et al., 2022) | KASP |
| *YTU-KASP-Pm2-H* | gaaggtcggagtcaacggattTGTTGGACGAGAAAAGGAGAAC |
| *YTU-KASP-Pm2-C* | CAATTCATCTGAGGTGTTGGC |
| *Pm4a* | *Xgwm356-F* | AGCGTTCTTGGGAATTAGAGA | (Ma et al., 2004) | PAGE |
| *Xgwm356-R* | CCAATCAGCCTGCAACAAC |
| *Pm5e* | *WMC364-F* | ATCACAATGCTGGCCCTAAAAC | (Zhu et al., 2008) | PAGE |
| *WMC364-R* | CAGTGCCAAAATGTCGAAAGTC |
| *Pm6* | *CIT02g-18-F* | GGCCTTAGTGGTGATGCAGT | (Wan et al., 2020) | PAGE |
| *CIT02g-18-R* | GCGGCTTGTCGGTGTATAG |
| *CIT02g-20-F* | GCGGCTTGTCGGTGTATAG | PAGE |
| *CIT02g-20-R* | TGTTCACACAAGCAGCAAGTT |
| *Pm12/21* | *MBH1-F* | GCCATTATAGTCAAGAGTGCACTAGCTGT | (Bie et al., 2015) | PAGE |
| *MBH1-R* | AGCTCCTCTCGTTCTCCAATGCT |
| *Pm24* | *GWM337-F* | CCTCTTCCTCCCTCACTTAGC | (Xue et al., 2012) | PAGE |
| *GWM337-R* | TGCTAACTGGCCTTTGCC |
| *STS-Pm24-F* | TATGGTGTCATTTAAGGCTGAG | (Lu et al., 2020) | PAGE |
| *STS-Pm24-R* | TTTCTCACATCCTCATCAAACC |
| *Pm33* | *GWM111-F* | TCTGTAGGCTCTCTCCGACTG | (Zhu et al., 2005) | PAGE |
| *GWM111-R* | ACCTGATCAGATCCCACTCG |
| *Pm34* | *BARC144-F* | GCGTTTTAGGTGGACGACATAGATAGA | (Miranda et al., 2006) | PAGE |
| *BARC144-R* | GCGCCACGGGCATTTCTCATAC |
| *Pm35* | *CFD26-F* | TCAAGATCGTGCCAAATCAA | (Miranda et al., 2007) | PAGE |
| *CFD26-R* | ACTCCAAGCTGAGCACGTTT |
| *Pm42* | *Xgwm148-F* | GTGAGGCAGCAAGAGAGAAA | (Hua et al., 2009) | PAGE |
| *Xgwm148-R* | CAAAGCTTGACTCAGACCAAA |
| *Pm45* | *CFD80-F* | ATAGGGGTTTTGAATCACTCC | (Ma et al., 2011) | PAGE |
| *CFD80-R* | TTGGATTTGCAGAGCCTTCT |
| *Pm47* | *GWM46-F* | GCACGTGAATGGATTGGAC | (Xiao et al., 2013) | PAGE |
| *GWM46-R* | TGACCCAATAGTGGTGGTCA |
| *Pm52* | *Xicssl 326-F* | AAGATGCACTTACCCAAAAAC | (Wu et al., 2019) | PAGE |
| *Xicssl 326-R* | TGCTACATATAACTGCTGCTG |
| *Xicscl795-F* | GTCAACCTCATCTTCTCCTG | PAGE |
| *Xicscl795-R* | AGATGCATATCACATTCACG |
| **Molecular markers for stripe rust (*Yr*) resistance genes** | | | | |
| *Yr1* | *GWM372-F* | AATAGA GCCCTGGGACTGGG | (Liu et al., 2006) | Agarose gel |
| *GWM372-R* | GAAGGACGACATTCCACCTG |
| *Yr5* | *WMC1750-F* | GCTCAGTCAAACCGCTACTTCT | (Chen et al., 2003) | PAGE |
| *WMC1750-R* | CACTACTCCAATCTATCGCCGT |
| *Yr9* | *H20-F* | GTTGGAAGGGAGCTCGAGCTG | (Liu et al., 2008) | Agarose gel |
| *H20-R* | GTTGGGCAGAAAGGTCGACATC |
| *Yr10* | *SC200-F* | CTGCAGAGTGACATCATACA | (Shao et al., 2001) | PAGE |
| *SC200-R* | TCGAACTAGTAGATGCTGGC |
| *Yr15* | *Y15K1-F2* | GGAGATAGAGCACATTACAGAC | (Klymiuk et al., 2018) | Agarose gel |
| *UHW301R* | TTTCGCATCCCACCCTACTG |
| *Barc8-F* | GCGGGAATCATGCATAGGAAAACAGAA | (Peng et al., 2000) | PAGE |
| *Barc8-R* | GCGGGGGCGAAACATACACATAAAAACA |
| *Yr17* | *SC2372-F* | AGGGGCTACTGACCAAGGCT | (Jia et al., 2010) | Agarose gel |
| *SC2372-R* | TGCAGCTACAGCAGTATGTACACAAAA |
| *Yr18* | *csLV34-F* | GTTGGTTAAGACTGGTGATGG | (Lagudah et al., 2006) | Agarose gel |
| *csLV34-R* | TGCTTGCTATTGCTGAATAGT |
| *Yr24* | *Xgwm11-F* | GGATAGTCAGACAATTCTTGTG | (Liu et al., 2005) | PAGE |
| *Xgwm11-R* | GTGAATTGTGTCTTGTATGCTTCC |
| *Yr26* | *WE173-F* | GGGACAAGGGGAGTTGAAGC | (Wang et al., 2008) | PAGE |
| *WE173-R* | GAGAGTTCCAAGCAGAACAC |
| *Yr29* | *csLV46-F* | CGAGACGTCGTCTTCTCTAAC | (Ren et al., 2017) | PAGE |
| *csLV46-R* | GTGTATGTGTTGATTCTCCTCG |
| *Yr30* | *Xgwm533-F* | GTTGCTTTAGGGGAAAAGCC | (Hayden et al., 2004) | Agarose gel |
| *Xgwm533-R* | AAGGCGAATCAAACGGAATA |
| *Yr41* | *Xgwm410-F* | GCTTGAGACCGGCACAGT | (Luo et al., 2008) | PAGE |
| *Xgwm410-R* | CGAGACCTTGAGGGTCTAGA |
| *Xgwm374-F* | ATAGTGTGTTGCATGCTGTGTG | PAGE |
| *Xgwm374-R* | TCTAATTAGCGTTGGCTGCC |
| *Yr67* | *Xbarc182-F* | CCATGGCCAACAGCTCAAGGTCTC | (Xu et al., 2014) | PAGE |
| *Xbarc182-R* | CGCAAAACCGCATCAGGGAAGCACCAAT |
| *Xcfa2040-F* | TCAAATGATTTCAGGTAACCACTA | PAGE |
| *Xcfa2040-R* | TTCCTGATCCCACCAAACAT |
| *YrSP* | *dp269-F* | CTGCTGTCACCGCTCTCC | (Feng et al., 2015) | PAGE |
| *dp269-R* | AGTCACACGCCCTACTCTCC |
| **Molecular markers for pre-sprouting harvest(PHS) resistance genes** | | | | |
| *Vp-1B* | *Vp1B3-F* | TGCTCCTTTCCCAATTGG | (Yang et al., 2007) | PAGE |
| *Vp1B3-R* | ACCCTCCTGCAGCTCATTG |
| *Vp1-b2-F* | TGCTCCTTTCCCAATTGG | (Chang et al., 2010) | PAGE |
| *Vp1-b2-R* | TGCTTCTCTTCTCTCACCAGTG |
| *TaAFP-B* | *AFPB-F* | CTTCCTGAGAATTTGGCCGT | (Feng et al., 2019) | PAGE |
| *AFPB-R* | TGAGCTCGACCACCTCGTCG |
| **Molecular markers for drought resistance genes** | | | | |
| *Dreb1* | *P18-F* | CCCAACCCAAGTGATAATAATCT | (Wei. 2007) | PAGE |
| *P18-R* | TTGTGCTCCTCATGGGTACTT |
| *P20-F* | TCGTCCCTCTTCTCGCTCCAT |
| *P20-R* | GCGGTTGCCCCATTAGACATAG |
| *P21-F* | CGGAACCACTCCCTCCATCTC |
| *P21-R* | CGGTTGCCCCATTAGACGTAA |
| *P22-F* | CTGGCACCTCCATTGCCGCT |
| *P22-R* | AGTACATGAACTCAACGCACAGGACAAC |
| *P25-F* | CTGGCACCTCCATTGCTGCC |
| *P25-R* | AGTACATGAACTCAACGCACAGGACAAC |
| *TaCRT-D* | *DF* | GTGGGACTCAAACAAAGAAG | (Wang et al., 2017) | PAGE |
| *DR* | TTAGAACTGAATGATGCATT |
| **Molecular markers for dwarfing genes** | | | | |
| *Rht-B1b* | *BF* | GGTAGGGAGGCGAGAGGCGAG | (Ellis et al., 2002) | PAGE |
| *MR1* | CATCCCCATGGCCATCTCGAGCTA |
| *Rht-D1b* | *DF* | CGCGCAATTATTGGCCAGAGATAG |
| *MR2* | CCCCATGGCCATCTCGAGCTGCTA |
| *Rht8* | *GWM-261-F* | CTCCCCTGTACGCCTAAGGC | (Korzun et al., 1998) | PAGE |
| *GWM-261-R* | CTCGCGCTACTAGCCATTG |
| **Molecular markers for vernalization genes** | | | | |
| *Vrn-A1c* | *Intr1/A/F2* | AGCCTCCACGGTTTGAAAGTAA | (Fu et al., 2005) | PAGE |
| *Intr/A/R3* | AAGTAAGACAACACGAATGTGAGA |
| *vrn-A1* | *VRN1AF* | GAAAGGAAAAATTCTGCTCG | (Yan et al., 2004) | PAGE |
| *VRN-INT1R* | GCAGGAAATCGAAATCGAAG |
| *Intr1/C/F* | GCACTCCTAACCCACTAACC | (Fu et al., 2005) | PAGE |
| *Intr1/AB/R* | TCATCCATCATCAAGGCAAA |
| *Vrn-B1* | *Intr/B/F* | CAAGTGGAACGGTTAGGACA |
| *Intr1/B/R3* | CTCATGCCAAAAATTGAAGATGA |
| *vrn-B1* | *Intr/B/F* | CAAGTGGAACGGTTAGGACA |
| *Intr1/B/R4* | CAAATGAAAAGGAATGAGAGCA |
| *Vrn-D1* | *Intr/D/F* | GTTGTCTGCCTCATCAAATCC |
| *Intr1/D/R3* | GGTCACTGGTGGTCTGTGC |
| *vrn-D1* | *Intr/D/F* | GTTGTCTGCCTCATCAAATCC |
| *Intr1/D/R4* | AAATGAAAAGGAACGAGAGCG |
| *Vrn-B3* | *FT-B-INS-F* | CATAATGCCAAGCCGGTGAGTAC | (Yan et al., 2006) | PAGE |
| *FT-B-INS-R* | ATGTCTGCCAATTAGCTAGC |
| *vrn-B3* | *FT-B-NOINS-F* | ATGCTTTCGCTTGCCATCC |
| *FT-B-NOINS-R* | CTATCCCTACCGGCCATTAG |

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