**Supplimentry Tables**

**Table.S1 Morphological Parameters of normal and QPM parents utilized for selection of recurrent parent type plants**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Parent** | **Time of Anthesis** | **Attitude of lateral branches** | **Anthocyanin colour of stem** | **Anthocyanin colouration at the base of glume** | **Anthocyanin colouration of glumes excluding base** | **Anthocyanin colouration of anthers** | **Anthocyanin colouration of silk** | **Ear-shape** | **Kernel row arrangement** | **Leaf attitude of blade** | **Plant height** |
| **1** | **IML-187** | **Early (3 days before BML-6)** | **wide** | **yes** | **Yes** | **Yes** | **Yes** | **Yes** | **cylindrical** | **Spiral at base and straight in the middle** | **drooping** | **medium** |
| **2** | **BML-6** | **medium** | **Semi erect** | **yes** | **No** | **No** | **No** | **No** | **Conico-cylindrical** | **straight** | **straight** | **short** |
| **3** | **DQL-2029-1** | **1 day after IML-187** | **wide** | **no** | **No** | **No** | **No** | **No** | **Long and Conical with reduced girth** | **spiral** | **Drooping with curls** | **tall** |
| **4** | **DQL-779-2-9** | **1 day BML-6** | **wide** | **no** | **Yes** | **Yes** | **No** | **Yes** | **Conico-cylindrical** | **spiral** | **Drooping with curls** | **tall** |

**Table.S2 SSR primers used in foreground and background selection**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No** | **Marker** | **Primer Sequence** | **Annealing Temp0C** | **LG** |
|  |  | **SSR markers for foreground selection** |  |  |
| **1** | ***Phi 057* :** | **F, 5’-CTCATCAGTGCCGTCGTCCAT-3’**  **R, 5’-CAGTCGCAAGAAACCGTTGCC-3’** | **55** | **7S** |
| **2** | ***Umc 1066*** | **F, 5’-ATGGAGCACGTCATCTCAATGG-3’**  **R, 5’-AGCAGCAGCAACGTCTATGACACT-3’** | **55** | **7S** |
| **3** | ***phi 112*** | **F, 5’-TGCCCTGCAGGTTCACATTGAGT-3’**  **R, 5’-AGGAGTACGCTTGGATGCTCTTC-3’** | **55** | **7S** |
|  |  | **SSR markers for background selection** |  |  |
| **1** | ***Bnlg-1335*** | **F,5-GAAGGTTGCTCTTCCACTGG-3’**  **R, 5’-TGGTTTGTGCAAGTGTCACC-3’** | **56** | **2L** |
| **2** | ***Umc-1029*** | **F, 5’-AACACCTGCTGGATATGGATCACT-3’**  **R, 5’-GGAAGAAAAATGTCGACCTGCTC-3’** | **55** | **7L** |
| **3** | ***Umc-1665*** | **F, 5’-CAATCAGGAGCCAGGGAGATG-3’**  **R , 5’-CTTAAACTTGTCGAGACGGTCCTG-3’** | **55** | **8L** |
| **4** | ***Umc-1293*** | **F, 5’-GTATCCGTTTCTCATGCAACACAC-3’**  **R, 5’-GATCTCGATCTGCTTCATCATCTG-3’** | **55** | **10S** |
| **5** | ***Umc-2210*** | **F, 5’-GATGCTACCATTTCAGTGAGCGAT-3’**  **R, 5’-AGCGGGTCGATCTTTCTCTTAGTT-3’** | **55** | **8L** |
| **6** | ***Umc-1728*** | **F, 5’-AGTACTTTCAGGCAGGGACCTTCT-3’**  **R, 5’-AACGCACTTCTTGTAGCTGTAGG-3’** | **55** | **8L** |
| **7** | ***Bnlg-1666*** | **F, 5-GCTGGTAGCTTTCAGATGGC-3’**  **R, 5’-TGTCCCTCCTCCAGTTTCAC-3** | **55** | **7L** |
| **8** | ***Bnlg 166*** | **F, 5-GCCAACGTTTCCAGCCTGA-3’**  **R, 5’- CTCCGTTTGCCCGAGTCC-3’** | **55** | **2S** |
| **9** | ***Phi 056*** | **F, 5’-ACTTGCTTGCCTGCCGTTAC-3’**  **R, 5’-CGCACACCACTTCCCAGAA-3’** | **55** | **1S** |
| **10** | ***Bnlg-240*** | **F, 5’-AAGAACAGAAGGCATTGATACATAA-3’**  **R, 5’-TGCAGGTGTATGGGCAGCTA-3’** | **55** | **8L** |
| **11** | ***Bnlg-198*** | **F, 5’-GTTTGGTCTTGCTGAAAAATAAAA-3’**  **R, 5’-GCTGGAGGCCTACATTATTATCTC-3’** | **55** | **2L** |
| **12** | ***Umc-1478*** | **F,5’-GAAGCTTCTCCTCTCGCGTCTC-3’**  **R, 5’-CAGTCCCAGACCCTAGCTCAGTC-3’** | **55** | **5S** |
| **13** | ***Umc-1077*** | **F, 5’-CAGCCACAGTGAGGCACATC-3’**  **R, 5’-CAGAGACTCTCCATTATCCCTCCA-3’** | **54** | **10L** |
| **14** | ***Umc-1424*** | **F, 5’-CCGGCTGCAGGGGTAGTAGTAG-3’**  **R, 5’-ATGGTCAGGGGCTACGAGGAG-3’** | **55** | **6L** |
| **15** | ***Umc-1664*** | **F, 5’-AATTGTTTACTGCGCTGAAACTCC-3’**  **R, 5’-CCTCTTTGCCTGTACCGTGTATTC-3’** | **54** | **1L** |
| **16** | ***Umc-1141*** | **F,5’-AGAGGAGAAAGAGACAGACAGGCA-3’**  **R,5’-CAGGAACTGAATGAAAGCAACTCA-3’** | **53** | **8L** |
| **17** | ***Umc-1002*** | **F,5’-AGCTAGCTATACACCGCCAGG-3’**  **R,5’-TCAGTTTGGAACAGGGAAAAGTA-3’** | **55** | **6S** |
| **18** | ***Umc-1147*** | **F,5’-GAGAAACCATCGACCCTTCCTAAC-3’**  **R, 5’-TTCCTATGGTACAGTTCTCCCTCG-3’** | **56** | **1L** |
| **19** | ***Umc-1762*** | **F, 5’-CTTACTCCAGGCACTCCATACCAT-‘3**  **R, 5’-ATCCAGGTGAATGGTGTTTACGAT-‘3** | **55** | **6L** |
| **20** | ***Umc-1786*** | **F,5’-CATTTTTCGCATTTAGGAAATCCA-3’**  **R, 5’-ACCGTGACTTCCTCCTCATAACTG-3’** | **55** | **8** |
| **21** | ***Umc-1594*** | **F,5’-GCCAGGGGAGAAATAAAATAAAGC-3’**  **R,5’-CACTGCAGGCCACACATACATA-3’** | **55** | **3L** |
| **22** | ***Umc-2144*** | **F,5’-CCAGCCCCTATCTATTTGCTTGT-3’**  **R,5’-GAATACTATATCACGGTCGGTCGG-3’** | **56** | **2L** |
| **23** | ***Umc-1823*** | **F,5’-AAAGCCTTACTGTTATTAGGCTAGGCA-3’**  **R,5’-AGAAAACCAGCCCCAGATGTTC-3’** | **55** | **2S** |
| **24** | ***Umc-1036*** | **F,5’-CTGCTGCTCAAGGAGATGGAGA-3’**  **R,5’-GACACACATGCACGAGCAGACT-3’** | **55** | **7S** |
| **25** | ***Umc-1063*** | **AGGCCACTGAGCAGGTGAAG**  **GTGATGGTAGAGGAGTCCTTGGTG** | **54** | **6L** |
| **26** | ***Umc-1766*** | **ACAAGAAGGAATCGAGAGCAAATG**  **CTTCGGGATGGAGTCGTAGTTC** | **55** | **5S** |
| **27** | ***Umc-1018*** | **GAACGGATATTGGAACCTGTGC**  **GTGCACGGTGTCGTACTTGAAC** | **55** | **6S** |
| **28** | ***Umc-1026*** | **TCGTCGTCTCCAATCATACGTG**  **GCTACACGATACCATGGCGTTT** | **55** | **2S** |
| **29** | ***Umc-1415*** | **GTGAGATATATCCCCGCCTTCC**  **AGACTTCCTGAAGCTCGGTCCTA** | **54** | **8L** |
| **30** | ***Umc-1708*** | **GATATGTCGAGCTTCGCTGGAG**  **CGCACACTAAAGCATCCTTAACCT** | **55** | **7L** |
| **31** | ***Bnlg-1621*** | **CTCTTCGATCTTTAAGAGAGAGAGAG**  **ACACGAGGCACTGGTACTAACG** | **54** | **2S** |
| **32** | ***Bnlg-1306*** | **CACCTTGAAAGCATCCTCGT**  **CAAAAACAAATGGCAGCTGA** | **55** | **5L** |
| **33** | ***Bnlg-1056*** | **ATCGTTGTTGGGTACACGGT**  **ACGGGTAGTGGTGAAGATGC** | **55** | **8L** |
| **34** | ***Phi-129*** | **GTCGCCATACAAGCAGAAGTCCA**  **TCCAGGATGGGTGTCTCATAAAACTC** | **55** | **6L** |
| **35** | ***Phi-061*** | **GACGTAAGCCTAGCTCTGCCAT**  **AAACAAGAACGGCGGTGCTGATTC** | **56** | **9S** |
| **36** | ***Phi-067*** | **CTGCAAAGGTAAGCACTAGGATGCT**  **CATCATTGATCCGGGTGTCGCTTT** | **55** | **9S** |
| **37** | ***Phi-452693*** | **CAAGTGCTCCGAGATCTTCCA**  **CGCGAACATATTCAGAAGTTTG** | **55** | **6L** |
| **38** | ***Phi-051*** | **GGCGAAAGCGAACGACAACAATCTT**  **CGACATCGTCAGATTATATTGCAGACCA** | **54** | **7L** |
| **39** | ***Bmc-1655*** | **ATTAAAATCTTGCTGATGGCG**  **TTCTGTTCCCGCCTGTACTT** | **54** | **10L** |
| **40** | ***Umc-1918*** | **CACAAGAACATTATGACGACCGAG**  **AAGCAGGAGACATCGTTTAAGTCG** | **55** | **6L** |

***Source*:** [**https://maizegdb.org/**](https://maizegdb.org/)

**Table S3. Polymorphism of markers to be used in foreground (1-3) and background selection(4-43)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No** | **SSR** | **IML-187** | **BML-6** | **DQL-2029-1** | **DQL-779-2-9** | **Status** |
|  | ***Phi 112*** | **160bp** | **160bp** | **160bp** | **160bp** | **Monomorphic** |
|  | ***Phi 057*** | **160** | **160** | **170** | **170** | **Polymorphic** |
|  | ***Umc 1066*** | **160** | **160** | **170** | **160** | **Polymorphic** |
|  | ***Bnlg-1335*** | **160bp** | **170bp** | **165bp** | **165bp** | **Polymorphic** |
|  | ***Umc-1029*** | **140** | **130** | **150** | **140** | **Polymorphic** |
|  | ***Umc-1665*** | **160** | **160** | **160** | **160** | **Monomorphic** |
|  | ***Umc-1293*** | **180** | **180** | **180** | **180** | **Monomorphic** |
|  | ***Umc-2210*** | **110** | **90** | **90** | **100** | **Polymorphic** |
|  | ***Umc-1728*** | **170** | **170** | **180** | **190** | **Polymorphic** |
|  | ***Bnlg-1666*** | **200** | **180** | **190** | **170** | **Polymorphic** |
|  | ***Bnlg-166*** | **90,140** | **120** | **130** | **120,110** | **Polymorphic** |
|  | ***Phi-056*** | **220** | **210** | **210** | **200** | **Polymorphic** |
|  | ***Bnlg-240*** | **100** | **100** | **110** | **120** | **Polymorphic** |
|  | ***Bnlg-198*** | **230** | **200** | **210** | **200** | **Polymorphic** |
|  | ***Umc-1478*** | **160** | **160** | **170** | **170** | **Polymorphic** |
|  | ***Umc-1077*** | **130** | **130** | **120** | **120** | **polymorphic** |
|  | ***Umc-1424*** | **150** | **170** | **160** | **160** | **Polymorphic** |
|  | ***Umc-1664*** | **145** | **145** | **145** | **145** | **monomorphic** |
|  | ***Umc-1141*** | **110** | **90** | **90** | **90** | **polymorphic** |
|  | ***Umc-1002*** | **160** | **170** | **170** | **160** | **Polymorphic** |
|  | ***Umc-1147*** | **80** | **70** | **80** | **70** | **Polymorphic** |
|  | ***Umc-1762*** | **160** | **160** | **170** | **170** | **Polymorphic** |
|  | ***Umc-1786*** | **120** | **120** | **120** | **120** | **Monomorphic** |
|  | ***Umc-1594*** | **140** | **125** | **100** | **90** | **Polymorphic** |
|  | ***Umc-2144*** | **150** | **150** | **140** | **150** | **Polymorphic** |
|  | ***Umc-1823*** | **80** | **80** | **80,160** | **80,160** | **Residual hetero** |
|  | ***Umc-1036*** | **170** | **190** | **160** | **160** | **Polymorphic** |
|  | ***Umc-1063*** | **160** | **170** | **170** | **160** | **Polymorphic** |
|  | ***Umc-1766*** | **185** | **185** | **185** | **185** | **monomorphic** |
|  | ***Umc-1018*** | **110** | **110** | **110** | **110** | **Monomorphic** |
|  | ***Umc-1026*** | **120** | **120** | **120** | **120** | **Monomorphic** |
|  | ***Umc-1415*** | **140** | **140** | **140** | **140** | **monomorphic** |
|  | ***Umc-1708*** | **60** | **60** | **60** | **60** | **Monomorphic** |
|  | ***Bnlg-1621*** | **180** | **190** | **160** | **160** | **Polymorphic** |
|  | ***Bnlg-1306*** | **170** | **170** | **170** | **170** | **Monomorphic** |
|  | ***Bnlg-1056*** | **110** | **110** | **110** | **110** | **Monomorphic** |
|  | ***Phi-129*** | **100** | **100** | **100** | **100** | **Monomorphic** |
|  | ***Phi-061*** | **75** | **80** | **60** | **60** | **Polymorphic** |
|  | ***Phi-067*** | **200** | **200** | **190** | **190** | **Polymorphic** |
|  | ***Phi-452693*** | **220** | **200** | **210** | **215** | **Polymorphic** |
|  | ***Phi-051*** | **130** | **130** | **120** | **120** | **polymorphic** |
|  | ***Bmc-1655*** | **150** | **150** | **150** | **150** | **Monomorphic** |
|  | ***Umc-1918*** | **180** | **180** | **180** | **180** | **Monomorphic** |
| **Monomorphic** | | | **15** | **Polymorphic** | | **25** |

**Table S4: Marker Segregation at *02* locus in BC1F1 population and selection of plants to generate BC2F1**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Crosses** | **BC1F1 Plants genotyped** | **Heterozygous plants** | **Homozygous plants** | **χ2 ratio** | **χ2 value**  **(at 5%**  **probability-**  **3.841)** | **Plants selected based on marker and phenotype** |
| **1** | **F1** x IML-187 | 96 | 40 | 56 | 2.66 | Non significant | 20 |
| **2** | **F1** x BML6 | 100 | 43 | 57 | 1.96 | Non significant | 23 |

**Table S5: Marker Segregation at *02* locus and background selection in BC2F1 population to generate BC2F2**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SNo.** | **Crosses** | **Plant population in each BC2F1** | **Germinated and raised** | **BC2F1 used for**  **Foreground**  **Selection** | **Hetero**  **zygous** | **Homo**  **Zygous** | **χ2 ratio** | **χ2 value**  **(at 5%**  **probability-**  **3.841)** | **Plants used in background marker analysis** | **Selected based on background**  **markers and phenotype** |
| **1** | [(IML-187 x DQL-779-2-9) x IML-187] (♀) x IML-187 (♂) | 200 | 89 | 89 | 36 | 53 | 3.2 | NS | 36 | 18 |
| **2** | [(BML-6 x DQL-2029-1) x BML-6] (♀) x BML-6 (♂) | 200 | 103 | 103 | 44 | 59 | 2.18 | NS | 44 | 16 |

**Table S6. Phenotyping of BC2F3 kernels for endosperm modification**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.No.** | **Crosses (♀ X ♂)** | **No. of lines screened samples** | **No. of BC2F2**  **plants with kernels**  **25%**  **or less opaque** | **No. of BC2F2 plants with kernels more than 25 % opaque** | **Selected BC2F2 lines with kernels 25% or less opaqueness** |
| **1.** | IML-187(♀) x DQL-2029-1 (♂) | 16 | 10 | 6 | IML-187 x DQL-2029-1 /BC2F3-3  IML-187 x DQL-2029-1 / BC2F3-5  IML-187 x DQL-2029-1 / BC2F3-6  IML-187 x DQL-2029-1 / BC2F3-7  IML-187 x DQL-2029-1 / BC2F3-11  IML-187 x DQL-2029-1 / BC2F3-29  IML-187 x DQL-2029-1 / BC2F3-15  IML-187 x DQL-2029-1 / BC2F3-16  IML-187 x DQL-2029-1 / BC2F3-17  IML-187 x DQL-2029-1 / BC2F3-23 |
| **2.** | BML-6(♀) x DQL-779-2-9 (♂) | 14 | 8 | 6 | BML-6 x DQL-779-2-9 / BC2F3-1  BML-6 x DQL-779-2-9 / BC2F3-2  BML-6 x DQL-779-2-9 / BC2F3-31  BML-6 x DQL-779-2-9 / BC2F3-4  BML-6 x DQL-779-2-9 / BC2F3-9  BML-6 x DQL-779-2-9 / BC2F3-20  BML-6 x DQL-779-2-9 / BC2F3-13  BML-6 x DQL-779-2-9 / BC2F3-14 |

**Table S7. Protein, tryptophan, lysine and (QI) in 18 selected lines from both the BC2F3 maize lines**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S No.** | **Sample** | **Protein% in Sample** | **Tryptophan% in Sample** | **Lysine% in Protein** | **Quality Index** |
| **1** | IML-187 x DQL-2029-1 BC2F3:3 | 8.594 | 0.069 | 3.191 | 0.798 |
| **2** | IML-187 x DQL-2029-1 BC2F3:5 | 8.990 | 0.068 | 3.042 | 0.760 |
| **3** | IML-187 x DQL-2029-1 BC2F3:6 | 8.999 | 0.083 | 3.680 | 0.920 |
| **4** | IML-187 x DQL-2029-1 BC2F3:7 | 8.887 | 0.084 | 3.770 | 0.942 |
| **5** | IML-187 x DQL-2029-1 BC2F3:11 | 8.504 | 0.068 | 3.202 | 0.801 |
| **6** | IML-187 x DQL-2029-1 BC2F3:29 | 7.960 | 0.047 | 2.377 | 0.594 |
| **7** | IML-187 x DQL-2029-1 BC2F3:15 | 8.210 | 0.060 | 2.909 | 0.727 |
| **8** | IML-187 x DQL-2029-1 BC2F3:16 | 9.020 | 0.051 | 2.277 | 0.569 |
| **9** | IML-187 x DQL-2029-1 BC2F3:17 | 8.792 | 0.057 | 2.612 | 0.653 |
| **10** | IML-187 x DQL-2029-1 BC2F3:23 | 9.075 | 0.074 | 3.225 | 0.815 |
| **11** | BML-6 x DQl-779-2-9 BC2F3:1 | 8.556 | 0.063 | 2.944 | 0.736 |
| **12** | BML-6 x DQl-779-2-9 BC2F3:2 | 8.482 | 0.075 | 3.523 | 0.881 |
| **13** | BML-6 x DQl-779-2-9 BC2F3:31 | 8.984 | 0.053 | 2.367 | 0.592 |
| **14** | BML-6 x DQl-779-2-9 BC2F3:4 | 9.017 | 0.087 | 3.865 | 0.966 |
| **15** | BML-6 x DQl-779-2-9 BC2F3:9 | 8.750 | 0.096 | 4.404 | 1.101 |
| **16** | BML-6 x DQl-779-2-9 BC2F3:20 | 9.834 | 0.117 | 4.752 | 1.188 |
| **17** | BML-6 x DQl-779-2-9 BC2F3:13 | 9.029 | 0.083 | 3.689 | 0.922 |
| **18** | BML-6 x DQl-779-2-9 BC2F3:14 | 9.168 | 0.069 | 2.995 | 0.755 |
| **19** | IML-187 | 8.05 | 0.045 | 1.66 | 0.614 |
| **20** | BML-6 | 8.44 | 0.042 | 1.51 | 0.629 |
| **21** | DQL-2029-1 | 9.75 | 0.074 | 3.01 | 0.821 |
| **22** | DQL-779-2-9 | 10.182 | 0.090 | 3.547 | 0.887 |
|  | **General Mean** | 8.485 | 0.0675 |  |  |
|  | **C.D at 5%** | 0.597 | 0.0035 | 0.215 | 0.106 |
|  | **(SEM)** | 0.210 | 0.0012 | 0.075 | 0 .037 |
|  | **CV%** | 4.107 | 3.193 | 4.281 | 8.48 |

**Table: S8. Performance of Converted versions of SMH-5**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sno.** | **Entry no.** | **Sample** | **Protein% in Sample** | **Tryptophan% in Sample** | **Grain Yield qha-1** |
|  | **6** | IML-187: BC2F3:**6 x** BML-6: BC2F3:**2** | 9.88 | 0.078 | 74.8 |
|  |  | IML-187: BC2F3:**6 x** BML-6 : BC2F3:**4** | 9.12 | 0.082 | 62.5 |
|  |  | IML-187: BC2F3:**6 x** BML-6 : BC2F3:**9** | 10.02 | 0.074 | 67.9 |
|  |  | IML-187: BC2F3:**6 x** BML-6 : BC2F3:20 | 8.86 | 0.075 | 70.2 |
|  |  | IML-187: BC2F3:**6 x** BML-6 : BC2F3:13 | 8.14 | 0.091 | 80.1 |
|  | **7** | IML-187: BC2F3:**7x** BML-6: BC2F3:**2** | 9.35 | 0.083 | 80.0 |
|  |  | IML-187: BC2F3:**7x** BML-6 : BC2F3:**4** | 10.76 | 0.090 | 59.7 |
|  |  | IML-187: BC2F3:**7 x** BML-6 : BC2F3:**9** | 9.11 | 0.107 | 72.1 |
|  |  | IML-187: BC2F3:**7 x** BML-6 : BC2F3:20 | 8.59 | 0.078 | 66.8 |
|  |  | IML-187: BC2F3:**7x** BML-6 : BC2F313 | 9.86 | 0.112 | 58.5 |
|  | **23** | IML-187: BC2F3:**23 x** BML-6: BC2F3:**2** | 10.26 | 0.079 | 84.5 |
|  |  | IML-187: BC2F3:**23x** BML-6 : BC2F3:**4** | 9.55 | 0.087 | 75.0 |
|  |  | IML-187: BC2F3:**23 x** BML-6 : BC2F3**9** | 9.34 | 0.092 | 63.2 |
|  |  | IML-187: BC2F3:**23 x** BML-6 : BC2F3:20 | 9.74 | 0.087 | 61.1 |
|  |  | IML-187: BC2F3:**23x** BML-6 : BC2F3:13 | 10.8 | 0.099 | 60.5 |