**Table S1.** List of Sunflower Accessions used in present study

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S. No.  | Accession No.  | Source  | S. No.  | Accession No.  | Source |
| 1  | CMS-HAP-12  | *NARC, Islamabad*  | 56  | RHP-38  | *NARC, Islamabad* |
| 2  | CMS-HAP-56  | *NARC, Islamabad*  | 57  | RHP-77  | *NARC, Islamabad* |
| 3  | CMS-HAP-101  | *NARC, Islamabad*  | 58  | RHP-82  | *NARC, Islamabad* |
| 4  | CMS-HAP-54  | *NARC, Islamabad*  | 59  | RHP-42  | *NARC, Islamabad* |
| 5  | CMS-HAP-103  | *NARC, Islamabad*  | 60  | RHP-73  | *NARC, Islamabad* |
| 6  | CMS-HAP-24  | *NARC, Islamabad*  | 61  | RHP-74DN  | *NARC, Islamabad* |
| 7  | CMS-HAP-110  | *NARC, Islamabad*  | 62  | RHP-7485  | *NARC, Islamabad* |
| 8  | CMS-HAP-112  | *NARC, Islamabad*  | 63  | RHP-7490  | *NARC, Islamabad* |
| 9  | CMS-HAP-25  | *NARC, Islamabad*  | 64  | RHP-7495  | *NARC, Islamabad* |
| 10  | CMS-HAP-111  | *NARC, Islamabad*  | 65  | RHP-7498  | *NARC, Islamabad* |
| 11  | CMS-HAP-10  | *NARC, Islamabad*  | 66  | RHP-74100  | *NARC, Islamabad* |
| 12  | CMS-HAP-114  | *NARC, Islamabad*  | 67  | RHP-74105  | *NARC, Islamabad* |
| 13  | CMS-HAP-115  | *NARC, Islamabad*  | 68  | RHP-74107  | *NARC, Islamabad* |
| 14  | CMS-HAP-03  | *NARC, Islamabad*  | 69  | RHP-74108  | *NARC, Islamabad* |
| 15  | CMS-HAP-99  | *NARC, Islamabad*  | 70  | RHP-74110  | *NARC, Islamabad* |
| 16  | CMS-HAP-125  | *NARC, Islamabad*  | 71  | RHP-74112  | *NARC, Islamabad* |
| 17  | CMS-HAP-118  | *NARC, Islamabad*  | 72  | RHP-74115  | *NARC, Islamabad* |
| 18  | CMS-HAP-116  | *NARC, Islamabad*  | 73  | RHP-74120  | *NARC, Islamabad* |
| 19  | CMS-HAP-121  | *NARC, Islamabad*  | 74  | RHP-74125  | *NARC, Islamabad* |
| 20  | CMS-HAP-117  | *NARC, Islamabad*  | 75  | RHP-74128  | *NARC, Islamabad* |
| 21  | CMS-HAP-122  | *NARC, Islamabad*  | 76  | RHP-74130  | *NARC, Islamabad* |
| 22  | CMS-HAP-120  | *NARC, Islamabad*  | 77  | RHP-71  | *NARC, Islamabad* |
| 23  | CMS-HAP-123  | *NARC, Islamabad*  | 78  | SFP-14  | *NARC, Islamabad* |
| 24  | CMS-HAP-102  | *NARC, Islamabad*  | 79  | SFP-12  | *NARC, Islamabad* |
| 25  | CMS-HAP-08  | *NARC, Islamabad*  | 80  | SFP-10  | *NARC, Islamabad* |
| 26  | CMS-HAP-119  | *NARC, Islamabad*  | 81  | SFP-40  | *NARC, Islamabad* |
| 27  | HAP-12  | *NARC, Islamabad*  | 82  | SFP-42  | *NARC, Islamabad* |
| 28  | HAP-56  | *NARC, Islamabad*  | 83  | SFP-38  | *NARC, Islamabad* |
| 29  | HAP-101  | *NARC, Islamabad*  | 84  | SFP-18  | *NARC, Islamabad* |
| 30  | HAP-54  | *NARC, Islamabad*  | 85  | SFP-36  | *NARC, Islamabad* |
| 31  | HAP-103  | *NARC, Islamabad*  | 86  | SFP-31  | *NARC, Islamabad* |
| 32  | HAP-24  | *NARC, Islamabad*  | 87  | SFP-37  | *NARC, Islamabad* |
| 33  | HAP-110  | *NARC, Islamabad*  | 88  | SFP-24  | *NARC, Islamabad* |
| 34  | HAP-112  | *NARC, Islamabad*  | 89  | SFP-09  | *NARC, Islamabad* |
| 35  | HAP-25  | *NARC, Islamabad*  | 90  | SFP-41  | *NARC, Islamabad* |
| 36  | HAP-102  | *NARC, Islamabad*  | 91  | SFP-19  | *NARC, Islamabad* |
| 37  | HAP-10  | *NARC, Islamabad*  | 92  | SFP-22  | *NARC, Islamabad* |
| 38  | HAP-114  | *NARC, Islamabad*  | 93  | SFP-25  | *NARC, Islamabad* |
| 39  | HAP-116  | *NARC, Islamabad*  | 94  | SFP-43  | *NARC, Islamabad* |
| 40  | HAP-123  | *NARC, Islamabad*  | 95  | SFP-33  | *NARC, Islamabad* |
| 41  | HAP-111  | *NARC, Islamabad*  | 96  | SFP-46  | *NARC, Islamabad* |
| 42  | HAP-99  | *NARC, Islamabad*  | 97  | SFP-08  | *NARC, Islamabad* |
| 43  | HAP-122  | *NARC, Islamabad*  | 98  | SFP-07  | *NARC, Islamabad* |
| 44  | HAP-120  | *NARC, Islamabad*  | 99  | SFP-16  | *NARC, Islamabad* |
| 45  | HAP-03  | *NARC, Islamabad*  | 100  | SFP-26  | *NARC, Islamabad* |
| 46  | HAP-08  | *NARC, Islamabad*  | 101  | SFP-13  | *NARC, Islamabad* |
| 47  | RHP-68  | *NARC, Islamabad*  | 102  | SFP-35  | *NARC, Islamabad* |
| 48  | RHP-72  | *NARC, Islamabad*  | 103  | SFP-20  | *NARC, Islamabad* |
| 49  | RHP-53  | *NARC, Islamabad*  | 104  | SFP-32  | *NARC, Islamabad* |
| 50  | RHP-73-1  | *NARC, Islamabad*  | 105  | RHP-83  | *NARC, Islamabad* |
| 51  | RHP-46  | *NARC, Islamabad*  | 106  | RHP-84  | *NARC, Islamabad* |
| 52  | RHP-76  | *NARC, Islamabad*  | 107  | RHP-88  | *NARC, Islamabad* |
| 53  | RHP-41  | *NARC, Islamabad*  | 108  | RHP-86  | *NARC, Islamabad* |
| 54  | RHP-81  | *NARC, Islamabad*  | 109  | RHP-89  | *NARC, Islamabad* |
| 55  | RHP-69  | *NARC, Islamabad* |  |  |  |

**Table S2.** List of SSR markers used to study the association mapping and population structure in sunflower

|  |  |  |  |
| --- | --- | --- | --- |
| Primer Name  | Linkage Group  | Forward Sequence  | Reverse Sequence |
| ORS-605  | 1  | CGCGTGATGTGACGATTATT  | ACGGAGCAAAGTTTCGAGGT |
| ORS-543  | 1  | CCAAGTTTCAGTTACAATCCATGA  | GGTCATTAGGAGTTTGGGATCA |
| ORS-371  | 1  | CACACCACCAAACATCAACC  | GGTGCCTTCTCTTCCTTGTG |
| ORS-453  | 2  | CCTGTGAGCTACAATACTCCCACA  | GATTCTGATTAGGCGGTGGT |
| ORS-1053  | 2  | TTTCATCACATTAGACCATAGACCA  | GGCTTTCCTTCGTGGTTTGTAT |
| ORS-752  | 3  | CACTGATGAACAAGTGCGAGA  | ATGATTCCCATACCCACCAA |
| ORS-924  | 3  | TAAATCGCCATACCACTCCATC  | TATCAGCAGGAAGAACGCCTAAT |
| ORS-366  | 4  | AACCAACTGAGCATTCTTGTGA  | GCGCTAGGTTAAAGAGGACAAA |
| ORS-1068  | 4  | AATTTGTCGACGGTGACGATAG  | TTTTGTCATTTCATTACCCAAGG |
| ORS-337  | 4  | TTGGTTCATTCATCCTTGGTC  | GGGTTGGTGGTTAATTCGTC |
| ORS-1024  | 5  | GGGAAGTGGGCTTGTCTATGTAT  | AACACACCGAAATCACCTATGAA |
| ORS-533  | 5  | TGGTGGAGGTCACTATTGGA  | AGGAAAGAAGGAAGCCGAGA |
| ORS-608  | 6  | CATGGAAAGCCGAGTTCTCT  | CGTGCGTGATTAACATACCC |
| ORS-1256  | 6  | GATGTTGATGTTGGTGAAGTTGC  | CTCCGTCACCTTAAGCACTTGTA |
| ORS-400  | 7  | CGAACCCGTCTGTACCGTTT  | ACTTCGTTCACAAGGCACAA |
| ORS-700  | 7  | GTACCCACCACGCTTAACCA  | AGTCTTCCACAGCAACGTCA |
| ORS-830  | 8  | CAAGTGCATTAGGTGGTTCTAACA  | GCCCTCTGACTGTTGTATGACTG |
| ORS-599  | 8  | TTCCCTATCACACGCCTCTC  | GAAAGGAAGTAGCGGTGGTG |
| ORS-882  | 9  | AAACCGGCATGTAAGATATTCG  | ATCGGGAGCAGAAGAAGAGTATG |
| ORS-617  | 9  | GGTACTTGGTATTCATGGGTCAT  | GACACCGCCAACTTAACACTT |
| ORS-795  | 9  | CGCTAGTTACACCGCAGATG  | TGTCCACAGGTTGAAGATCG |
| ORS-613  | 10  | GTAAACCCTAGGTCAATTTGCAG  | ATCTCCGGAAAACATTCTCG |
| ORS-1088  | 10  | ACTATCGAACCTCCCTCCAAAC  | GGATTTCTTTCATCTTTGTGGTG |
| ORS-433  | 10  | CCGAGGTTTGATCGCTATTT  | AGCGTTTGTGATTTGATTACGA |
| ORS-769  | 11  | GTTTATTTATGTAGAAATGTTCTGGAA  | ATGTGGTGGTAAGGGTTGTTG |
| ORS-697  | 11  | TTGGGCTGTGGTTCCTTAAC  | AAGAGATGGGAGTGTTGATGC |
| ORS-1085  | 12  | GACCTCAAGGCATGCTAACACTC  | ACTAAGTGTGTGGACGGGGAAA |
| ORS-1040  | 12  | CTGCTGATCGTTTCTTGGATAGA  | TGCTAATCCTTCTAATCAACTTCCAC |
| ORS-879  | 13  | GAACCTCCCTTTGTCTGCATATC  | CTCCGGTTGCTGTTGATGTCT |
| ORS-781  | 13  | GTCAACCCATGACCCAAACC  | GATGTGGAGGAGAGAGGGTGT |
| ORS-511  | 13  | TGGCTCAGATTAAGTTCACACAG  | CGGGTTGCGAGTAACAGGTA |
| ORS-307  | 14  | CAGTTCCCTGAAACCAATTCA  | GCAGTAGAAGATGACGGGATG |
| ORS-1086  | 14  | TTGTTTGTCGCACACTCAAGATT  | ATTATCGGCACATCTTTGGATTT |
| ORS-857  | 15  | ACATCCGAACGAAGGACAATC  | CAAGAAAGTATGTCACCCAATAGCA |
| ORS-562  | 15  | CACACACACAAACCCTAGCTCT  | CAATCATATCGAGCACACATCA |
| ORS-768  | 16  | CCACTCATCATCAAGCCTAACA  | AGGTGGTGCTGGTTGTAGGT |
| ORS-1064  | 16  | TGAATGATCTATGAGTGGTGATGG  | ACTCGCAGTGGTAAGTCGTTAGG |
| ORS-495  | 16  | CCAGGATTAGGTAGCTTAGTTCG  | GCGATCTGAGGTTGACTCGT |
| ORS-811  | 17  | CCTTCTCCTCAATCTTTGGCTA  | AGGAATGAAATGGGTGTGTGT |
| ORS-845  | 17  | GGTGCCCTATCTTCATTCTCTG  | CTAAAGGGTATCACACATTTGACATT |