1. **Characterization of genotypes for root characters and traits related to WUE**
	1. **Characterization for root traits**

253 lines were evaluated from 2009-2013 (4 years) in raised structures measuring 30 x 1.5 x 1.2m (L x B x H) constructed for characterization of root traits and traits related to WUE. The structure has one central permanent wall with side collapsible walls that are constructed with hollow cement bricks and is secured by erecting wooden poles on either side which are held together tightly with a wire. This can accommodate 50 genotypes on either side. Once the structure is filled with soil, it’s watered regularly to allow compaction. When the bulk density of the structure reaches the bulk density of that of field, sowings were done and the plants were allowed to grow for 60-65 days which coincide with the maximum root growth. On the day of harvest, the side walls were carefully removed and with a jet of water the roots were washed and various shoot observations like SCMR, SLA, LAI, TDM, plant height, leaf number, stem girth and root traits like length, volume, weight were recorded.

Leaf samples were sent for 13C and 18O estimation after drying as these characters give an idea about WUE. Promising genotypes for each of these characters were identified. Range and mean values indicate extent of phenotypic variability and wide variability was present in the material studied. Promising genotypes were identified based on the rankings developed taking into consideration the important root and shoot characters that are positively related to TDM. The identified hybrids can be recommended for drought prone area and inbreds forms useful material as parents in breeding.

 **Mean and range values for different traits in different years**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No** | **year** | **D/S** | **Plant height** **(cm)** | **L No** | **Root length (cm)** | **Root volume (cc)** | **Root weight (g/plant)** | **LAI** | **TDM****(g/plant)** | **R/S (%)** |
| mean | range | mean | range | mean | range | mean | range | mean | range | mean | range | mean | range | mean | range |
| 1 | 2009 | 29-05 | 85 | 45-137 | 23 | 13-37 | 96 | 62-156 | 47 | 15-131 | 8 | 2.0-24.5 | 2.8 | 0.8-5.6 | 68 | 24-147 | 13 | 8 -20 |
| 2 | 2010 | 23-06 | 120 | 67-165 | 26 | 14-35 | 95 | 63-150 | 89 | 14-183 | 14 | 1.8-30.4 | 3 | 0.8-5.7 | 78 | 16-129 | 22 | 6 -32 |
| 3 | 2010 | 02-07 | 123 | 65-189 | 23 | 14-31 | 78 | 48-107 | 92 | 20-200 | 13 | 2.4-34.9 | 2.2 | 1.0-3.6 | 70 | 29-138 | 22 | 7 -34 |
| 4 | 2011 | 20-07 | 97 | 46-140 | 20 | 10 -28 | 91 | 42-143 | 66 | 11-203 | 10 | 1.1-29.3 | 2.3 | 0.5-4.6 | 67 | 16-159 | 17 | 7 -26 |
| 5 | 2012 | 12-09 | 104 | 67-133 | 22 | 14-32 | 69 | 43-120 | 50 | 24-100 | 6.8 | 3.5-18.3 | 1.3 | 0.7-2.7 | 57 | 34-94 | 13 | 8 -26 |
| 6 | 2013 | 02-0 9 | 128 | 83-173 | 25 | 15-33 | 57 | 43-78 | 70 | 31-113 | 8.9 | 4.3-13.8 | 2.2 | 1.2-3.1 | 72 | 39-104 | 14 | 8-21 |

 **Root traits and shoot traits of promising lines in different years**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Genotype** | **Root length****(cm)** | **Root volume****(cc)** | **Root weight****(g/plant)** | **TDM (g/plant)** | **LAI** | **SCMR** | **SLA (cm2/g)** |
|  | **2009-10** |
| 1 | GP9 – 515 – 7 – 3 | 156 | 110 | 16.6 | 136 | 5.6 | 35.8 | 253 |
| 2 | GP9 – 38 – C – 2 – 1 | 124 | 81 | 11.4 | 100 | 4.3 | 37.7 | 262 |
| 3 | GP - 776 – 2B | 91 | 81 | 12.2 | 93 | 4.2 | 38.7 | 273 |
| 4 | GP4 – 187 | 102 | 78 | 13.6 | 106 | 4.2 | 36.5 | 236 |
| 5 | GP2 – 1746 | 122 | 71 | 11.8 | 97 | 4.4 | 38.8 | 248 |
| 6 | GP4 – 2704 | 127 | 89 | 12.6 | 97 | 4.0 | 32.5 | 252 |
| 7 | GP4 - 2935 | 132 | 75 | 11.7 | 86 | 3.5 | 41.6 | 231 |
| 8 | EC 602036 | 114 | 71 | 13.7 | 96 | 3.7 | 342 | 270 |
| 9 | EC 623018 | 120 | 66 | 9.9 | 89 | 3.5 | 40.0 | 256 |
| C1 | KBSH-1 | 137 | 131 | 24.5 | 147 | 5.6 | 38.8 | 262 |
| C2 | PAC-1091 | 145 | 101 | 15.5 | 118 | 5.3 | 39.8 | 262 |
|  | **2010-11** |
| 10 | SCG 5 | 108 | 163 | 30.4 | 129 | 4.5 | 34.6 | 252 |
| 11 | SCG 6 | 129 | 133 | 23.0 | 105 | 2.9 | 34.0 | 238 |
| 12 | SCG 10 | 100 | 156 | 23.4 | 104 | 3.2 | 29.8 | 205 |
| 13 | SCG 40 | 91 | 200 | 34.9 | 138 | 3.3 | 33.1 | 219 |
| 14 | SCG 47 | 85 | 152 | 21.0 | 102 | 3.6 | 32.5 | 197 |
| 15 | SCG 61 | 100 | 187 | 24.9 | 123 | 3.4 | 32.1 | 202 |
| 16 | SCG 64 | 103 | 129 | 20.6 | 106 | 3.8 | 35.6 | 256 |
| 17 | SCG 92 | 110 | 106 | 23.0 | 117 | 3.2 | 37.1 | 208 |
| C1 | DRSH-1 | 107 | 191 | 26.3 | 113 | 3.1 | 31.8 | 208 |
| C2 | KBSH-1 | 105 | 154 | 18.7 | 114 | 3.2 | 32.0 | 205 |
|  | **2011-12** |
| 18 | SCG 12 | 122 | 114 | 17.0 | 129 | 4.8 | 32.5 | 202 |
| 19 | SCG 18 | 97 | 90 | 14.4 | 110 | 3.4 | 37.4 | 198 |
| 20 | SCG 20 | 119 | 108 | 16.2 | 97 | 4.0 | 36.6 | 240 |
| 21 | SCG 21 | 134 | 116 | 16 | 93 | 4.2 | 35.1 | 261 |
| 22 | SCG 37 | 111 | 79 | 14.2 | 112 | 3.0 | 37.9 | 158 |
| 23 | SCG 67 | 125 | 125 | 19.5 | 120 | 3.1 | 34.5 | 180 |
| 24 | GMU 558 | 98 | 78 | 11.8 | 102 | 4.7 | 35.2 | 233 |
| C1 | DRSH-1 | 143 | 203 | 29.3 | 159 | 4.9 | 33.3 | 221 |
| C2 | KBSH-44 | 129 | 98 | 14.1 | 97 | 3.4 | 35.9 | 234 |
| C3 | KBSH-1 | 105 | 100 | 16.9 | 110 | 2.7 | 36.4 | 190 |
|  | **2012-13** |
| 25 | 106 A | 67 | 93 | 18.3 | 89 | 1.8 | 38.8 | 182 |
| 26 | 335 A | 68 | 63 | 8.1 | 56 | 1.2 | 34.7 | 175 |
| 27 | 850 A | 53 | 55 | 7.7 | 62 | 1.0 | 40.2 | 149 |
| 28 | 298 R | 84 | 73 | 10.2 | 91 | 1.8 | 36.5 | 160 |
| 29 | 856 R | 82 | 72 | 9.7 | 62 | 1.5 | 39.4 | 165 |
| 30 | R -7 | 64 | 87 | 10.7 | 70 | 1.6 | 40.6 | 184 |
| 31 | RCR 119 | 74 | 56 | 8.3 | 64 | 1.6 | 39.5 | 178 |
| 32 | RCR -3 | 61 | 54 | 8.9 | 64 | 1.2 | 42.2 | 201 |
| 33 | RCR -92 | 59 | 45 | 7.3 | 56 | 1.3 | 35.6 | 210 |
| 34 | AKSFI – 42 – 1 | 97 | 82 | 10.8 | 94 | 2.0 | 34.7 | 154 |
| 35 | CSFI – 5075 | 70 | 90 | 10.1 | 60 | 1.2 | 35.1 | 170 |
| 36 | CSFI - 5135 | 76 | 56 | 6.8 | 57 | 0.9 | 41.5 | 148 |
| 37 | DS – 2 | 90 | 96 | 11.5 | 68 | 1.3 | 36.1 | 158 |
| 38 | CSFI – 5261 | 90 | 52 | 6.8 | 62 | 1.6 | 35.2 | 195 |
| 39 | AKSFI – 51 – 6 - 1 | 70 | 69 | 7.1 | 55 | 1.3 | 38.2 | 167 |
| 40 | CSFI - 99 | 56 | 47 | 6.7 | 62 | 1.6 | 34.9 | 201 |
| 41 | BSFH -111 | 86 | 67 | 9.4 | 75 | 1.3 | 39.2 | 162 |
| 42 | NSFH- 1001 | 94 | 55 | 9.0 | 83 | 1.9 | 40.3 | 174 |
| C1 | DRSH -1© | 120 | 100 | 10.0 | 92 | 2.0 | 38.6 | 161 |
| C2 | KBSH -1© | 73 | 62 | 8.4 | 61 | 1.6 | 40.0 | 184 |
| C3 | KBSH -44© | 101 | 60 | 7.6 | 77 | 1.6 | 40.0 | 155 |