Objective 1 :To develop suitable methodology for safflower core based on quantitative characters.

|  |  |  |
| --- | --- | --- |
| Activities | Output | Practical utility of the output |
| Compilation and preparation of the total safflower germplasm data | Safflower germplasm contains 6375 accessions belonging to 57 countries. The data was pre cleaned and preprocessed to eliminate data entry errors. The suitability of the data was done by deleting missing or blank data for further statistical analysis. | After eliminating misssing values 6201 accessions was ready for diversity analysis |
| statistics for the total germplasm data | The entire germplasm collection of safflower was stratified in to 5 regions: Asia, Africa, America and Europe. The information on country of origin was not available on 39 accessions. They were grouped in to unknown region. Desriptive satistics was calculated. | Diversity of germplasm was known and useful in comparision of core with total germplasm for all quantitative descriptors. |
| Comparison of different clustering methods, sampling techniques for selecting the core. | Different clustering methods was used for classification of accessions. Out of all methods Wards minimum variance method was suitable for this data.  Diferent sampling techniques was used from each cluster for developing 10% of total germplasm. startified sampling was found suitable to develop core. | core will be useful for better utilization and accessibility to vast collection of germplasm material. |

Objective 2 :To develop safflower core collection using quantitative traits.

|  |  |  |
| --- | --- | --- |
| Development of safflower core using the best method of classification and sampling procedure. | 13 descriptors used in developing the core subset .  The total accessions arrayed into 20 distinct clusters using wards minimum variance method. From each cluster stratified sampling is carried out to establish core subset of 620 (10%) accessions. | 620 accessions were used for development of subcore. |

Objective 3 : To develop safflower core subset

|  |  |  |
| --- | --- | --- |
| Activities | Output | Practical utility of the output |
| Development of core subset | 155 safflower sub core accessions have been developed from 620 safflower core set based on 13 characters. | Core subset have been characterized for the extent of genetic diversity, population structure using SSR markers. |

Objective 4 : To compare core and core subsets and entire collection for various parameters to determine whether core collection is representative of entire collection.

|  |  |  |
| --- | --- | --- |
| Comparision of subcore with core and entire germplasm | Differences among means of the entire collection, core and subset for the 13 quantitative descriptors used in developing the core subset were not significant, and the variances of the entire collection and core subset were homogeneous for all the traits. The zero mean difference per cent and more than 80 coincidence rate per cent indicated the representativeness of core with total collection. | represented the genetic spectrum in the whole collections that captures most of available diversity of species. |

Objective 5 : To study the performance of developed core at multi-locations

|  |  |  |
| --- | --- | --- |
| Field trials at different AICRP centres.  150 accessions with 2 checks was evaluated at 8 AICRP centres in ARBD design. | SY- 276-2823 kg/ha  Oil content – 21.2-32.3 %  D 50% -78-106  DM-124-163  PH-50-106.6 cm  100 swt-2.7-6.8 g  Plant spread-19-67 cm  Effective capitula-21-53 | Data generated from the field trials was utilized in evaluation of the subcore. |
| Analysis of of core subset data of multi-location trials | Data was divided in to 9 clusters in rainfed situation and 7 clusters in Irrigated situation. 19 accessions showed better performance than checks in rainfed and irrigated situation. | Breeders can select the best accessions for their crossing program. |

**Materials and methods :**

Safflower germplasm contains 6375 accessions belonging to 57 countries. The data was pre cleaned and preprocessed to eliminate data entry errors. The suitability of the data was done by deleting missing or blank data for further statistical analysis. The data on qualitative traits was standardized each variable to eliminate scale differences.

Range, Mean and variance of morphological and agronomical descriptors recorded in the entire collection. The entire germplasm collection of safflower was stratified in to 5 regions: Asia, Africa, America and Europe. The information on country of origin was not available on 39 accessions. They were grouped in to unknown region. The principal component analysis (PCA) was performed on the accessions from each region. This analysis provides a reduced dimension model that would indicate measured differences among the groups. The variation captured by first five PCA scores in the five regions ranged from 65.76 to 98.38%.

A total of 6201 safflower germplasm accessions were used for development of core after elimination of missing and blank values from 6374 accessions. A core was developed based on 13 quantitative descriptors.

|  |  |  |  |
| --- | --- | --- | --- |
| **S .No** | **Character** | **S.No** | **Character** |
| 1 | Days to 50% flowering | 8 | Average number of primary branches per plant |
| 2 | Days to physiological maturity | 9 | Average number of capitula per plant |
| 3 | Plant height (cm) | 10 | Internode length (cm) |
| 4 | Plant spread (cm) | 11 | Dia. of main capitula at maturity (cm) |
| 5 | Length on first primary branch (cm) | 12 | Seed yield per plant (g) |
| 6 | Ang of first primary branch to main stem | 13 | 100 seed weight (g) |
| 77 | Ht. from ground level to 1st pri. branch (cm) |  |  |

Statistical Rationale for construction of core

Comparison between core and entire collection

|  |  |
| --- | --- |
| **Comparision** | **Test** |
| Means | Newman-Keuls procedure(Newman 1939, Keuls 1952) |
| Varinaces | Levene’s test (Levene, 1960) |
| CV | Hu et al, 2000 |
| Range | Hu et al, 2000 |

**Percentage of the significant difference between the core collections and the initial collection is calculated for**



Mean difference percentage

*Variance difference percentage *



The coincidence rate



*Variable* rate

The core collection is considered to be the representative of the initial collection under the following situations:

1. not more than 20% of the traits have different means (significant at a=0.05) between the core collection and the initial collection
2. The *CR% retained by the core collection is no less than 80%.*

*(3 )High VD% and High VR%*

* Upadhyaya et al proposed mini core i.e 10% of core or 1% of total collection .But it is too small to represents the entire diversity with 62 accessions.
* So the core of core(Corley Holbrook et al, 2005)\* for field evaluation that is subcore will be developed with same methodology with 20, 30 and 40% of different sampling fractions.

**Results and discussion :**

Total of 6374 accessions originating from 57 countries was used. The data was precleaned and preprocessed and data was standardized and devided in to 5 Strata . Variation captured by First five PCA scores in the five regions ranged from 65.76 to 98.38 per cent.

A core subset of 620 (10%) accessions was established using wards minimum variance method. These 620 accessions arrayed into 20 distinct clusters

* Total of 6374 accessions originating from 57 countries was used.
* The data was precleaned and preprocessed
* Data was standardized
* 5 Strata
* Principal component analysis
* Variation captured by First five PCA scores in the five regions ranged from 65.76 to 98.38 per cent.
* The total accessions arrayed into 20 distinct clusters using wards minimum variance method. From each cluster stratified sampling is carried out to establish core subset of 620 (10%) accessions. Differences among means of the entire collection and core subset for the 13 quantitative descriptors used in developing the core subset were not significant, and the variances of the entire collection and core subset were homogeneous for all the traits. The zero MD (Mean aractersrepresentativeness of core with total collection.

Differences among means of the entire collection and core subset for the 13 quantitative descriptors used in developing the core subset were not significant, and the variances of the entire collection and core subset were homogeneous for all the traits. The core subset captured 100% range variation for 13 descriptors and The differences among means and variances, of the entire collection and core subset for the 13 agronomic descriptors were also not significantly different. However, this core subset captured over 70% range variation.

Mean and variances for 13 quantitative characters

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | core | | | |  | Total collection | | | |  |
| Variable | Min | Max | Mean | Var | Range | Min | Max | Mean | Var | Range |
| Days to 50% flowering | 61.0 | 108.0 | 79.4 | 40.4 | 47.0 | 40.0 | 108.0 | 79.8 | 41.0 | 68.0 |
| Days to physiological maturity | 90.0 | 153.0 | 119.0 | 120.7 | 63.0 | 90.0 | 154.0 | 119.0 | 118.2 | 64.0 |
| Plant height (cm) | 17.0 | 114.0 | 69.8 | 294.7 | 97.0 | 16.0 | 144.0 | 69.6 | 306.6 | 128.0 |
| Plant spread (cm) | 9.0 | 92.0 | 39.8 | 179.5 | 83.0 | 7.0 | 120.0 | 39.2 | 171.1 | 113.0 |
| Length on first primary branch (cm) | 7.0 | 73.0 | 34.9 | 142.9 | 66.0 | 6.0 | 90.0 | 34.6 | 150.1 | 84.0 |
| Ang of first primary branch to main stem | 20.0 | 60.0 | 42.9 | 59.2 | 40.0 | 10.0 | 70.0 | 42.6 | 60.8 | 60.0 |
| Ht. from ground level to 1st pri. branch (cm) | 3.0 | 82.0 | 30.3 | 221.5 | 79.0 | 2.0 | 98.0 | 30.8 | 221.7 | 96.0 |
| Avg No of primary branches/plant | 2.0 | 24.0 | 9.0 | 13.5 | 22.0 | 2.0 | 65.0 | 9.1 | 14.2 | 63.0 |
| Average number of capitula per plant | 5.0 | 120.0 | 24.5 | 221.9 | 115.0 | 2.0 | 158.0 | 24.0 | 202.2 | 156.0 |
| Internode length (cm) | 1.0 | 7.0 | 2.5 | 0.7 | 6.0 | 1.0 | 10.0 | 2.5 | 0.8 | 9.0 |
| Dia. of main capitula at maturity (cm) | 1.0 | 3.1 | 2.1 | 0.1 | 2.1 | 1.0 | 4.1 | 2.1 | 0.1 | 3.1 |
| Seed yield per plant (g) | 0.8 | 86.0 | 13.6 | 97.5 | 85.2 | 0.1 | 105.0 | 12.8 | 88.0 | 104.9 |
| 100 seed weight (g) | 1.5 | 8.9 | 4.5 | 1.7 | 7.4 | 0.7 | 15.3 | 4.5 | 1.7 | 14.6 |

Percentage of the trait differences between the core collections and the initial collection

|  |  |  |
| --- | --- | --- |
| **Statistic** | **Core** | **The core collection is considered to be the representative of the**  **initial collection under the following situations** |
| MD% | 0 | <20% |
| VD% | 60.1 | Higher values |
| CR% | 87.8 | >80% |
| VR% | 98.4 | Higher values |

* A core of 620 (10% of total accessions) was developed.
* Developed core contains 620 accessions which is too large to manage field trial.
* The problem is how to reduce the size of the core subset further with out losing the diversity.
* Upadhyaya et al proposed mini core i.e 10% of core or 1% of total collection .But it is too small to represents the entire diversity with 62 accessions.
* So the core of core(Corley Holbrook et al, 2005)\* for field evaluation will be developed with same methodology with 20, 30 and 40% of different sampling fractions.

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Field evaluation of sub core data :

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Rainfed** | | | | | | | | | |
| **Accession** | **SY** | **OC** | **OY** | **D50%** | **DM** | **LPB** | **Plspread** | **PH** | **Effec.capitula** | **Swt** |
| **GMU 40** | 1809 | 26.19 | 474 | 87 | 131 | 44 | 51 | 63.98 | 53 | 4.23 |
| **GMU 95** | 1472 | 26.68 | 393 | 84 | 129 | 42 | 51 | 69.02 | 39 | 5.49 |
| **GMU 216** | 1361 | 26.30 | 358 | 85 | 130 | 46 | 45 | 66.53 | 34 | 5.95 |
| **GMU 224** | 1951 | 24.85 | 485 | 86 | 129 | 33 | 40 | 70.44 | 21 | 4.91 |
| **GMU 330** | 1503 | 26.94 | 405 | 88 | 130 | 33 | 36 | 66.04 | 23 | 5.52 |
| **GMU 473** | 949 | 24.68 | 234 | 90 | 131 | 35 | 37 | 64.42 | 30 | 5.41 |
| **GMU 593** | 851 | 27.14 | 231 | 91 | 131 | 43 | 39 | 71.38 | 20 | 4.53 |
| **GMU 599** | 1424 | 27.49 | 391 | 91 | 133 | 45 | 40 | 76.69 | 30 | 4.72 |
| **GMU 638** | 1001 | 27.55 | 276 | 86 | 130 | 44 | 48 | 74.31 | 27 | 5.06 |
| **GMU 659** | 2049 | 26.62 | 545 | 92 | 520 | 36 | 47 | 70.27 | 30 | 5.40 |
| **GMU 671** | 763 | 27.14 | 207 | 85 | 128 | 30 | 36 | 59.16 | 21 | 4.95 |
| **GMU 707** | 455 | 28.10 | 128 | 86 | 129 | 40 | 37 | 80.07 | 23 | 4.07 |
| **GMU 744** | 897 | 28.45 | 255 | 85 | 129 | 31 | 37 | 58.11 | 15 | 5.78 |
| **GMU 765** | 586 | 27.20 | 159 | 88 | 132 | 35 | 31 | 62.38 | 23 | 4.57 |
| **GMU 774** | 1360 | 28.35 | 386 | 85 | 126 | 28 | 38 | 62.82 | 24 | 4.58 |
| **GMU 819** | 521 | 27.48 | 143 | 84 | 128 | 34 | 28 | 65.13 | 23 | 4.47 |
| **GMU 821** | 634 | 28.97 | 184 | 92 | 132 | 37 | 39 | 79.78 | 29 | 4.44 |
| **GMU 864** | 517 | 26.76 | 138 | 89 | 131 | 28 | 26 | 71.42 | 16 | 3.74 |
| **GMU 878** | 776 | 28.09 | 218 | 81 | 126 | 33 | 33 | 59.31 | 25 | 5.34 |
| **GMU 1047** | 867 | 28.73 | 249 | 86 | 127 | 40 | 35 | 60.27 | 28 | 4.31 |
| **GMU 1059** | 1447 | 28.27 | 409 | 83 | 128 | 35 | 33 | 63.51 | 25 | 4.97 |
| **GMU 1078** | 1846 | 25.60 | 472 | 86 | 126 | 38 | 45 | 69.44 | 31 | 4.35 |
| **GMU 1137** | 884 | 28.78 | 255 | 85 | 131 | 25 | 25 | 51.89 | 14 | 4.04 |
| **GMU 1185** | 399 | 24.33 | 97 | 85 | 128 | 46 | 35 | 66.38 | 27 | 3.66 |
| **GMU 1250** | 463 | 23.60 | 109 | 88 | 131 | 26 | 27 | 62.09 | 14 | 3.48 |
| **GMU 1287** | 550 | 23.45 | 129 | 87 | 130 | 28 | 30 | 67.07 | 18 | 4.80 |
| **GMU 1315** | 1181 | 25.14 | 297 | 82 | 126 | 41 | 32 | 60.47 | 29 | 5.04 |
| **GMU 1339** | 1421 | 28.72 | 408 | 83 | 128 | 37 | 43 | 61.11 | 26 | 5.10 |
| **GMU 1354** | 1710 | 28.15 | 481 | 84 | 127 | 35 | 41 | 62.84 | 25 | 4.97 |
| **GMU 1409** | 534 | 28.07 | 150 | 86 | 128 | 32 | 39 | 60.67 | 27 | 5.30 |
| **GMU 1485** | 823 | 25.79 | 212 | 84 | 129 | 34 | 41 | 63.64 | 30 | 4.65 |
| **GMU 1603** | 1665 | 30.05 | 500 | 81 | 127 | 36 | 41 | 62.18 | 26 | 5.98 |
| **GMU 1626** | 1032 | 29.74 | 307 | 87 | 134 | 25 | 39 | 51.49 | 28 | 5.48 |
| **GMU 1638** | 1682 | 27.54 | 463 | 89 | 129 | 39 | 37 | 63.78 | 26 | 5.11 |
| **GMU 1695** | 1077 | 29.88 | 322 | 83 | 127 | 30 | 36 | 55.56 | 25 | 4.96 |
| **GMU 1708** | 1570 | 28.76 | 452 | 89 | 134 | 30 | 38 | 62.42 | 26 | 5.76 |
| **GMU 1748** | 1086 | 28.14 | 306 | 84 | 129 | 37 | 43 | 68.11 | 30 | 4.56 |
| **GMU 1765** | 810 | 29.42 | 238 | 91 | 135 | 36 | 29 | 58.71 | 21 | 5.04 |
| **GMU 1812** | 683 | 26.79 | 183 | 87 | 128 | 48 | 43 | 75.40 | 29 | 3.51 |
| **GMU 1824** | 847 | 28.11 | 238 | 85 | 130 | 34 | 43 | 79.11 | 20 | 4.16 |
| **GMU 1855** | 1201 | 29.29 | 352 | 88 | 132 | 28 | 42 | 59.31 | 22 | 5.39 |
| **GMU 1871** | 1183 | 28.82 | 341 | 86 | 133 | 33 | 37 | 66.31 | 19 | 4.99 |
| **GMU 1875** | 1169 | 27.71 | 324 | 85 | 128 | 34 | 35 | 75.36 | 27 | 4.34 |
| **GMU 2016** | 1649 | 28.71 | 473 | 82 | 128 | 42 | 51 | 67.62 | 35 | 5.59 |
| **GMU 2129** | 1604 | 28.16 | 452 | 88 | 131 | 40 | 41 | 58.16 | 34 | 5.49 |
| **GMU 2136** | 1408 | 29.39 | 414 | 83 | 127 | 38 | 42 | 74.04 | 23 | 4.75 |
| **GMU 2198** | 1812 | 25.13 | 455 | 84 | 125 | 38 | 41 | 75.38 | 25 | 5.89 |
| **GMU 2240** | 803 | 28.51 | 229 | 84 | 131 | 24 | 30 | 50.27 | 18 | 4.75 |
| **GMU 2413** | 1245 | 29.78 | 371 | 83 | 127 | 39 | 35 | 62.42 | 27 | 4.61 |
| **GMU 2432** | 1729 | 28.30 | 489 | 83 | 127 | 40 | 47 | 65.38 | 26 | 5.39 |
| **GMU 2437** | 1721 | 29.66 | 510 | 80 | 126 | 35 | 37 | 64.87 | 30 | 4.74 |
| **GMU 2472** | 943 | 30.17 | 284 | 85 | 136 | 30 | 37 | 61.58 | 27 | 4.83 |
| **GMU 2594** | 1030 | 30.49 | 314 | 80 | 125 | 34 | 40 | 67.53 | 30 | 4.45 |
| **GMU 2616** | 1275 | 29.90 | 381 | 81 | 125 | 35 | 33 | 64.42 | 26 | 4.88 |
| **GMU 2718** | 2101 | 29.56 | 621 | 86 | 128 | 41 | 45 | 67.80 | 35 | 4.59 |
| **GMU 2749** | 917 | 27.32 | 250 | 81 | 124 | 34 | 34 | 60.82 | 29 | 4.35 |
| **GMU 2860** | 649 | 28.22 | 183 | 86 | 127 | 37 | 30 | 71.29 | 25 | 4.50 |
| **GMU 2944** | 1090 | 23.92 | 261 | 80 | 126 | 39 | 41 | 62.64 | 28 | 4.09 |
| **GMU 2969** | 1017 | 26.36 | 268 | 84 | 128 | 41 | 37 | 61.87 | 28 | 6.82 |
| **GMU 2985** | 1698 | 27.38 | 465 | 82 | 128 | 37 | 42 | 66.98 | 28 | 5.42 |
| **GMU 2987** | 1625 | 30.61 | 498 | 86 | 129 | 37 | 46 | 63.31 | 38 | 4.58 |
| **GMU 3047** | 663 | 28.54 | 189 | 87 | 132 | 45 | 50 | 73.36 | 32 | 5.36 |
| **GMU 3084** | 1268 | 28.36 | 360 | 89 | 132 | 43 | 48 | 67.60 | 30 | 4.90 |
| **GMU 3095** | 1206 | 28.58 | 345 | 87 | 131 | 40 | 41 | 69.80 | 35 | 5.31 |
| **GMU 3177** | 1148 | 29.14 | 335 | 78 | 124 | 36 | 45 | 56.64 | 36 | 3.46 |
| **GMU 3189** | 311 | 27.22 | 85 | 83 | 126 | 34 | 32 | 65.20 | 17 | 4.71 |
| **GMU 3208** | 1741 | 28.95 | 504 | 87 | 130 | 43 | 62 | 73.38 | 39 | 5.00 |
| **GMU 3256** | 1367 | 29.36 | 401 | 82 | 129 | 40 | 39 | 62.47 | 25 | 4.43 |
| **GMU 3281** | 1634 | 31.75 | 519 | 87 | 129 | 45 | 39 | 77.20 | 30 | 4.57 |
| **GMU 3386** | 1101 | 27.74 | 305 | 85 | 128 | 38 | 43 | 74.76 | 29 | 4.58 |
| **GMU 3436** | 1024 | 28.99 | 297 | 83 | 126 | 32 | 35 | 58.42 | 20 | 4.57 |
| **GMU 3491** | 543 | 27.57 | 150 | 83 | 127 | 30 | 27 | 56.51 | 19 | 3.78 |
| **GMU 3537** | 731 | 25.02 | 183 | 87 | 128 | 39 | 41 | 74.18 | 27 | 4.03 |
| **GMU 3607** | 889 | 30.62 | 272 | 83 | 129 | 42 | 35 | 79.11 | 26 | 5.01 |
| **GMU 3617** | 1558 | 27.82 | 433 | 85 | 130 | 49 | 46 | 70.22 | 32 | 5.05 |
| **GMU 3629** | 1063 | 28.65 | 304 | 89 | 128 | 33 | 41 | 58.62 | 22 | 5.21 |
| **GMU 3639** | 968 | 30.03 | 291 | 88 | 126 | 35 | 42 | 63.58 | 30 | 4.12 |
| **GMU 3703** | 853 | 29.03 | 248 | 87 | 130 | 41 | 42 | 61.11 | 26 | 4.15 |
| **GMU 3707** | 977 | 29.10 | 284 | 86 | 129 | 30 | 31 | 67.42 | 29 | 4.44 |
| **GMU 3740** | 911 | 32.31 | 294 | 83 | 128 | 31 | 35 | 59.67 | 30 | 4.32 |
| **GMU 3780** | 857 | 28.62 | 245 | 84 | 128 | 41 | 41 | 77.76 | 32 | 3.99 |
| **GMU 3822** | 480 | 27.42 | 132 | 87 | 129 | 31 | 42 | 60.29 | 23 | 3.69 |
| **GMU 3852** | 1542 | 30.56 | 471 | 81 | 128 | 34 | 47 | 72.53 | 26 | 5.24 |
| **GMU 3929** | 1577 | 29.64 | 467 | 82 | 128 | 36 | 44 | 73.44 | 24 | 4.93 |
| **GMU 3968** | 2101 | 27.66 | 581 | 90 | 134 | 45 | 52 | 74.60 | 27 | 4.66 |
| **GMU 4010** | 620 | 30.14 | 187 | 90 | 132 | 39 | 30 | 75.93 | 17 | 2.99 |
| **GMU 4038** | 1028 | 28.95 | 297 | 83 | 129 | 33 | 40 | 70.76 | 28 | 4.77 |
| **GMU 4066** | 701 | 26.41 | 185 | 88 | 130 | 25 | 32 | 62.47 | 28 | 2.97 |
| **GMU 4109** | 1583 | 29.49 | 467 | 86 | 129 | 33 | 52 | 71.02 | 33 | 4.63 |
| **GMU 4201** | 276 | 26.29 | 73 | 84 | 127 | 28 | 30 | 54.38 | 18 | 5.97 |
| **GMU 4223** | 1177 | 28.88 | 340 | 83 | 129 | 37 | 41 | 66.11 | 30 | 4.85 |
| **GMU 4234** | 956 | 29.59 | 283 | 84 | 127 | 41 | 43 | 64.20 | 24 | 4.35 |
| **GMU 4305** | 1128 | 27.47 | 310 | 83 | 126 | 39 | 41 | 62.42 | 33 | 4.58 |
| **GMU 4381** | 519 | 27.75 | 144 | 82 | 126 | 33 | 27 | 61.20 | 17 | 3.92 |
| **GMU 4400** | 518 | 27.38 | 142 | 81 | 126 | 30 | 30 | 56.60 | 16 | 4.75 |
| **GMU 4420** | 1217 | 26.26 | 320 | 83 | 127 | 40 | 46 | 69.71 | 25 | 4.75 |
| **GMU 4429** | 374 | 26.35 | 99 | 84 | 127 | 28 | 33 | 66.76 | 19 | 4.75 |
| **GMU 4502** | 1924 | 29.91 | 576 | 83 | 126 | 43 | 55 | 67.00 | 32 | 4.98 |
| **GMU 4507** | 837 | 27.32 | 229 | 79 | 124 | 35 | 39 | 57.00 | 21 | 5.47 |
| **GMU 4549** | 535 | 28.67 | 153 | 89 | 132 | 39 | 38 | 73.82 | 19 | 5.57 |
| **GMU 4558** | 799 | 25.20 | 201 | 83 | 127 | 29 | 34 | 74.47 | 15 | 5.04 |
| **GMU 4623** | 1270 | 29.28 | 372 | 82 | 127 | 40 | 55 | 73.64 | 27 | 5.54 |
| **GMU 4627** | 1528 | 29.18 | 446 | 81 | 126 | 37 | 45 | 69.09 | 29 | 4.54 |
| **GMU 4646** | 561 | 31.09 | 174 | 84 | 128 | 34 | 32 | 54.67 | 20 | 3.84 |
| **GMU 4688** | 1030 | 28.11 | 289 | 87 | 129 | 34 | 35 | 71.62 | 24 | 4.58 |
| **GMU 4693** | 671 | 29.43 | 197 | 91 | 135 | 33 | 30 | 69.56 | 19 | 2.69 |
| **GMU 4696** | 1610 | 25.59 | 412 | 91 | 135 | 41 | 46 | 82.49 | 22 | 5.12 |
| **GMU 4773** | 601 | 27.11 | 163 | 87 | 130 | 39 | 39 | 66.36 | 17 | 3.81 |
| **GMU 4812** | 446 | 28.15 | 126 | 80 | 126 | 30 | 33 | 63.24 | 21 | 4.56 |
| **GMU 4839** | 606 | 22.80 | 138 | 90 | 130 | 26 | 36 | 88.83 | 16 | 4.33 |
| **GMU 4934** | 1167 | 26.84 | 313 | 81 | 125 | 49 | 49 | 72.36 | 35 | 4.52 |
| **GMU 4966** | 1464 | 29.87 | 437 | 83 | 127 | 41 | 47 | 70.62 | 24 | 4.68 |
| **GMU 4972** | 519 | 28.04 | 145 | 85 | 127 | 33 | 34 | 65.20 | 24 | 5.23 |
| **GMU 5032** | 1792 | 25.88 | 464 | 85 | 129 | 42 | 52 | 79.38 | 27 | 6.12 |
| **GMU 5044** | 1397 | 27.78 | 388 | 89 | 134 | 38 | 45 | 68.80 | 30 | 6.31 |
| **GMU 5046** | 1679 | 28.29 | 475 | 82 | 126 | 43 | 42 | 68.42 | 32 | 5.45 |
| **GMU 5075** | 1005 | 26.09 | 262 | 86 | 528 | 40 | 40 | 68.49 | 24 | 4.71 |
| **GMU 5081** | 1878 | 28.09 | 528 | 84 | 127 | 42 | 42 | 72.84 | 26 | 4.29 |
| **GMU 5133** | 1251 | 27.01 | 338 | 81 | 126 | 39 | 36 | 62.18 | 26 | 6.13 |
| **GMU 5163** | 923 | 26.96 | 249 | 83 | 127 | 34 | 35 | 58.11 | 34 | 3.99 |
| **GMU 5170** | 1538 | 28.56 | 439 | 87 | 129 | 35 | 48 | 63.60 | 36 | 3.50 |
| **GMU 5239** | 1612 | 29.66 | 478 | 85 | 129 | 43 | 49 | 67.09 | 31 | 4.57 |
| **GMU 5295** | 1457 | 29.33 | 427 | 85 | 127 | 40 | 56 | 66.82 | 41 | 3.39 |
| **GMU 5335** | 375 | 21.19 | 79 | 91 | 131 | 37 | 19 | 79.49 | 15 | 2.89 |
| **GMU 5361** | 923 | 26.69 | 246 | 81 | 126 | 38 | 32 | 67.31 | 20 | 3.77 |
| **GMU 5663** | 2586 | 26.76 | 692 | 86 | 129 | 44 | 49 | 69.29 | 36 | 5.74 |
| **GMU 5668** | 766 | 29.08 | 223 | 88 | 127 | 42 | 40 | 81.13 | 30 | 4.03 |
| **GMU 5701** | 587 | 26.23 | 154 | 86 | 128 | 46 | 34 | 75.13 | 16 | 4.64 |
| **GMU 5728** | 1958 | 28.57 | 559 | 85 | 128 | 40 | 48 | 69.56 | 39 | 4.86 |
| **GMU 5825** | 1528 | 27.64 | 422 | 81 | 126 | 37 | 43 | 68.18 | 27 | 4.42 |
| **GMU 5841** | 617 | 27.70 | 171 | 83 | 127 | 32 | 35 | 72.38 | 22 | 4.71 |
| **GMU 5848** | 1289 | 29.98 | 386 | 90 | 134 | 38 | 40 | 60.80 | 25 | 5.52 |
| **GMU 5908** | 1579 | 30.01 | 474 | 86 | 129 | 43 | 45 | 69.09 | 28 | 4.35 |
| **GMU 5923** | 863 | 26.16 | 226 | 81 | 127 | 37 | 41 | 69.11 | 27 | 5.50 |
| **GMU 5935** | 412 | 27.42 | 113 | 83 | 127 | 26 | 29 | 60.18 | 21 | 3.96 |
| **GMU 6026** | 2823 | 30.71 | 867 | 84 | 127 | 44 | 56 | 74.69 | 31 | 5.69 |
| **GMU 6057** | 951 | 28.08 | 267 | 85 | 127 | 30 | 30 | 64.87 | 20 | 4.83 |
| **GMU 6119** | 1197 | 30.45 | 364 | 85 | 127 | 33 | 34 | 71.02 | 29 | 4.33 |
| **GMU 6192** | 913 | 26.62 | 243 | 89 | 130 | 36 | 48 | 77.29 | 29 | 4.77 |
| **GMU 6252** | 742 | 26.70 | 198 | 80 | 126 | 35 | 41 | 64.92 | 25 | 3.39 |
| **GMU 6306** | 1516 | 27.82 | 422 | 82 | 126 | 33 | 49 | 69.96 | 26 | 5.22 |
| **GMU 6312** | 864 | 30.20 | 261 | 83 | 127 | 35 | 42 | 69.76 | 30 | 4.35 |
| **GMU 6424** | 1164 | 29.31 | 341 | 82 | 127 | 31 | 36 | 70.82 | 25 | 3.75 |
| **GMU 6506** | 1515 | 28.84 | 437 | 80 | 126 | 36 | 51 | 67.62 | 31 | 4.84 |
| **GMU 6548** | 1667 | 29.26 | 488 | 84 | 128 | 37 | 48 | 66.87 | 29 | 6.23 |
| **GMU 6556** | 887 | 27.29 | 242 | 82 | 128 | 28 | 32 | 70.36 | 22 | 4.86 |
| **GMU 6663** | 1258 | 29.67 | 373 | 82 | 128 | 35 | 45 | 65.47 | 28 | 3.86 |
| **GMU 6851** | 1430 | 28.88 | 413 | 82 | 127 | 36 | 44 | 70.44 | 26 | 5.38 |
| **GMU 6869** | 1735 | 31.60 | 548 | 85 | 128 | 43 | 28 | 84.44 | 21 | 3.99 |
| **GMU 7191** | 417 | 22.83 | 95 | 85 | 128 | 30 | 31 | 67.82 | 16 | 3.70 |
| **A-I** | 1712 | 26.64 | 456 | 139 | 129 | 41 | 46 | 75.00 | 28 | 4.23 |
| **PBNS-12** | 1285 | 23.83 | 306 | 86 | 129 | 42 | 46 | 76.11 | 31 | 5.68 |

Irrigared

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SY** | **OC** | **OY** | **D50%** | **DM** | **LPB** | **Plspread** | **PH** | **Effec.capitula** | **Swt** |
| 1840 | 25.99 | 478 | 102 | 137 | 46 | 65 | 86.53 | 26 | 4.39 |
| 996 | 25.26 | 252 | 103 | 137 | 49 | 57 | 89.50 | 23 | 6.46 |
| 1228 | 25.90 | 318 | 102 | 137 | 48 | 43 | 89.27 | 24 | 6.35 |
| 1527 | 26.29 | 401 | 101 | 137 | 40 | 52 | 90.13 | 22 | 5.46 |
| 1156 | 27.47 | 318 | 102 | 138 | 41 | 42 | 89.27 | 19 | 5.28 |
| 1388 | 25.83 | 359 | 103 | 139 | 42 | 47 | 87.33 | 28 | 5.63 |
| 1250 | 26.76 | 334 | 104 | 139 | 49 | 46 | 91.53 | 17 | 5.04 |
| 1289 | 27.56 | 355 | 103 | 139 | 51 | 61 | 91.40 | 23 | 5.35 |
| 898 | 26.90 | 241 | 103 | 138 | 52 | 48 | 93.33 | 19 | 5.61 |
| 1167 | 26.38 | 308 | 103 | 334 | 42 | 42 | 99.13 | 18 | 5.18 |
| 1210 | 26.77 | 324 | 102 | 138 | 40 | 45 | 85.60 | 16 | 5.06 |
| 976 | 27.98 | 273 | 106 | 138 | 48 | 67 | 100.73 | 22 | 4.65 |
| 1341 | 28.44 | 381 | 103 | 138 | 38 | 40 | 84.33 | 19 | 5.93 |
| 754 | 26.03 | 196 | 105 | 140 | 42 | 30 | 82.80 | 15 | 3.58 |
| 1452 | 26.17 | 380 | 102 | 137 | 35 | 30 | 87.27 | 26 | 4.49 |
| 958 | 29.08 | 279 | 99 | 138 | 38 | 31 | 90.07 | 15 | 4.94 |
| 1383 | 28.83 | 399 | 101 | 141 | 39 | 46 | 96.07 | 21 | 5.26 |
| 946 | 27.65 | 261 | 105 | 141 | 33 | 28 | 93.53 | 19 | 4.04 |
| 1377 | 27.10 | 373 | 99 | 138 | 39 | 42 | 85.87 | 30 | 5.50 |
| 1127 | 27.21 | 307 | 100 | 139 | 48 | 47 | 91.07 | 22 | 4.24 |
| 1305 | 28.63 | 374 | 101 | 140 | 43 | 52 | 90.87 | 26 | 4.52 |
| 1297 | 27.20 | 353 | 103 | 139 | 41 | 38 | 87.13 | 20 | 4.38 |
| 964 | 27.59 | 266 | 95 | 141 | 36 | 43 | 88.33 | 19 | 4.04 |
| 727 | 24.85 | 181 | 105 | 140 | 48 | 45 | 84.13 | 18 | 4.33 |
| 1142 | 24.72 | 282 | 105 | 141 | 36 | 33 | 98.67 | 17 | 3.94 |
| 861 | 25.35 | 218 | 104 | 142 | 31 | 39 | 93.80 | 13 | 3.89 |
| 1356 | 24.95 | 338 | 103 | 140 | 45 | 42 | 88.07 | 23 | 4.13 |
| 1191 | 27.12 | 323 | 101 | 140 | 40 | 34 | 85.73 | 14 | 5.51 |
| 1499 | 26.46 | 397 | 101 | 141 | 42 | 48 | 91.53 | 19 | 6.40 |
| 1455 | 28.32 | 412 | 101 | 141 | 41 | 49 | 89.87 | 24 | 5.23 |
| 1631 | 27.00 | 440 | 103 | 141 | 39 | 49 | 93.93 | 29 | 4.93 |
| 1454 | 27.27 | 396 | 100 | 140 | 43 | 41 | 91.00 | 27 | 5.49 |
| 1302 | 27.78 | 362 | 96 | 141 | 38 | 47 | 85.27 | 27 | 5.52 |
| 1215 | 27.90 | 339 | 101 | 142 | 44 | 38 | 89.53 | 23 | 5.47 |
| 1376 | 28.30 | 390 | 100 | 140 | 37 | 31 | 92.07 | 28 | 5.16 |
| 1589 | 25.25 | 401 | 99 | 145 | 37 | 32 | 90.13 | 21 | 5.35 |
| 1361 | 26.67 | 363 | 102 | 143 | 40 | 39 | 87.93 | 27 | 5.09 |
| 1173 | 26.90 | 315 | 97 | 143 | 39 | 41 | 84.40 | 23 | 4.60 |
| 628 | 26.87 | 169 | 103 | 142 | 43 | 35 | 90.07 | 19 | 3.93 |
| 1413 | 28.80 | 407 | 100 | 144 | 35 | 37 | 99.87 | 23 | 4.46 |
| 1129 | 28.26 | 319 | 97 | 142 | 35 | 30 | 84.13 | 14 | 5.67 |
| 1085 | 26.67 | 289 | 100 | 145 | 39 | 41 | 85.87 | 19 | 5.65 |
| 1042 | 24.54 | 256 | 101 | 144 | 38 | 39 | 88.53 | 18 | 4.88 |
| 1452 | 27.11 | 394 | 104 | 144 | 45 | 36 | 84.33 | 24 | 5.56 |
| 1118 | 26.78 | 299 | 100 | 145 | 45 | 37 | 85.07 | 20 | 4.94 |
| 904 | 27.10 | 245 | 106 | 143 | 39 | 37 | 89.20 | 17 | 5.13 |
| 1560 | 26.79 | 418 | 102 | 144 | 39 | 40 | 97.00 | 14 | 5.72 |
| 1086 | 25.84 | 281 | 98 | 145 | 31 | 33 | 79.10 | 22 | 5.09 |
| 1453 | 28.73 | 417 | 99 | 144 | 46 | 36 | 94.53 | 43 | 5.16 |
| 1125 | 27.16 | 305 | 97 | 143 | 43 | 41 | 91.13 | 19 | 5.20 |
| 1318 | 26.62 | 351 | 100 | 143 | 41 | 38 | 87.73 | 18 | 5.08 |
| 1260 | 29.04 | 366 | 98 | 149 | 36 | 38 | 90.20 | 17 | 5.03 |
| 1237 | 26.95 | 333 | 97 | 142 | 39 | 34 | 89.80 | 26 | 5.04 |
| 1505 | 27.43 | 413 | 99 | 143 | 42 | 36 | 88.80 | 22 | 3.89 |
| 1376 | 27.83 | 383 | 103 | 146 | 41 | 38 | 86.07 | 26 | 4.86 |
| 1213 | 27.38 | 332 | 101 | 143 | 36 | 29 | 85.93 | 19 | 4.91 |
| 974 | 27.42 | 267 | 99 | 145 | 37 | 33 | 94.13 | 21 | 4.40 |
| 1092 | 25.74 | 281 | 99 | 144 | 42 | 30 | 88.20 | 16 | 5.12 |
| 1432 | 26.04 | 373 | 101 | 145 | 46 | 49 | 92.33 | 26 | 6.43 |
| 2037 | 27.40 | 558 | 101 | 146 | 40 | 40 | 89.20 | 29 | 5.85 |
| 1875 | 28.63 | 537 | 101 | 146 | 43 | 32 | 82.20 | 32 | 4.53 |
| 1332 | 28.46 | 379 | 102 | 148 | 49 | 33 | 86.07 | 26 | 5.32 |
| 1383 | 27.41 | 379 | 101 | 149 | 50 | 43 | 90.20 | 25 | 4.81 |
| 1706 | 27.98 | 477 | 98 | 148 | 44 | 50 | 93.47 | 27 | 4.51 |
| 1213 | 27.94 | 339 | 97 | 144 | 41 | 41 | 83.60 | 28 | 4.35 |
| 1371 | 27.88 | 382 | 96 | 145 | 38 | 43 | 93.60 | 25 | 4.83 |
| 1185 | 29.35 | 348 | 101 | 148 | 45 | 40 | 95.93 | 20 | 5.50 |
| 1451 | 28.89 | 419 | 98 | 148 | 45 | 32 | 88.27 | 23 | 5.11 |
| 1106 | 29.23 | 323 | 100 | 148 | 46 | 42 | 94.53 | 25 | 4.54 |
| 1159 | 28.73 | 333 | 100 | 148 | 42 | 33 | 90.33 | 19 | 4.77 |
| 982 | 25.41 | 249 | 98 | 146 | 37 | 32 | 85.07 | 19 | 4.52 |
| 1117 | 28.43 | 317 | 100 | 147 | 35 | 34 | 80.00 | 26 | 4.47 |
| 1065 | 26.97 | 287 | 102 | 149 | 41 | 33 | 91.73 | 25 | 4.45 |
| 876 | 27.03 | 237 | 99 | 149 | 44 | 35 | 100.00 | 18 | 4.90 |
| 1690 | 28.29 | 478 | 103 | 150 | 53 | 56 | 96.87 | 34 | 4.80 |
| 1218 | 28.29 | 345 | 97 | 148 | 38 | 38 | 83.40 | 21 | 4.67 |
| 1234 | 29.56 | 365 | 102 | 148 | 43 | 42 | 83.73 | 24 | 4.63 |
| 1330 | 28.92 | 385 | 102 | 151 | 46 | 46 | 87.80 | 19 | 4.73 |
| 1152 | 28.67 | 330 | 100 | 150 | 38 | 35 | 88.73 | 21 | 5.01 |
| 990 | 29.63 | 293 | 101 | 150 | 39 | 43 | 66.13 | 21 | 4.76 |
| 1038 | 28.12 | 292 | 101 | 150 | 47 | 39 | 99.47 | 20 | 3.87 |
| 756 | 28.04 | 212 | 104 | 152 | 39 | 42 | 87.93 | 18 | 3.97 |
| 1506 | 29.98 | 451 | 101 | 150 | 32 | 36 | 96.67 | 20 | 5.03 |
| 1185 | 28.90 | 342 | 102 | 151 | 38 | 32 | 97.13 | 13 | 5.15 |
| 1168 | 26.66 | 311 | 105 | 155 | 46 | 31 | 88.13 | 17 | 4.43 |
| 1108 | 31.68 | 351 | 104 | 154 | 44 | 31 | 92.87 | 17 | 3.95 |
| 1439 | 28.13 | 405 | 100 | 152 | 39 | 44 | 89.80 | 31 | 4.66 |
| 960 | 29.45 | 283 | 98 | 152 | 32 | 33 | 79.27 | 23 | 3.83 |
| 1223 | 28.47 | 348 | 104 | 153 | 32 | 37 | 92.07 | 24 | 4.88 |
| 2239 | 28.37 | 635 | 101 | 152 | 39 | 37 | 82.33 | 33 | 6.24 |
| 2099 | 29.06 | 610 | 101 | 153 | 43 | 30 | 86.67 | 24 | 4.65 |
| 1057 | 29.12 | 308 | 101 | 151 | 41 | 35 | 84.53 | 23 | 3.87 |
| 1710 | 26.78 | 458 | 99 | 151 | 42 | 34 | 82.00 | 36 | 5.12 |
| 1085 | 28.60 | 310 | 102 | 152 | 39 | 34 | 89.80 | 15 | 4.95 |
| 962 | 25.77 | 248 | 99 | 151 | 40 | 34 | 89.07 | 18 | 4.49 |
| 1151 | 27.54 | 317 | 100 | 153 | 46 | 45 | 81.93 | 21 | 5.28 |
| 1109 | 26.26 | 291 | 99 | 152 | 41 | 45 | 88.80 | 24 | 3.94 |
| 1844 | 29.89 | 551 | 99 | 151 | 49 | 45 | 85.13 | 27 | 6.13 |
| 1056 | 27.65 | 292 | 99 | 151 | 40 | 42 | 91.53 | 24 | 5.28 |
| 1223 | 29.14 | 356 | 101 | 155 | 48 | 38 | 101.60 | 16 | 5.09 |
| 1223 | 27.11 | 332 | 96 | 153 | 36 | 42 | 91.67 | 18 | 4.88 |
| 1568 | 30.15 | 473 | 99 | 153 | 45 | 40 | 87.33 | 16 | 6.44 |
| 1233 | 28.77 | 355 | 98 | 153 | 42 | 46 | 91.87 | 20 | 4.73 |
| 1065 | 30.42 | 324 | 101 | 155 | 40 | 36 | 89.87 | 17 | 5.35 |
| 1196 | 29.75 | 356 | 102 | 155 | 41 | 32 | 97.73 | 22 | 5.17 |
| 1030 | 29.82 | 307 | 101 | 159 | 41 | 38 | 84.80 | 19 | 4.07 |
| 1217 | 28.32 | 345 | 104 | 159 | 45 | 34 | 101.40 | 12 | 6.29 |
| 1122 | 27.73 | 311 | 100 | 155 | 43 | 37 | 97.40 | 19 | 4.26 |
| 1443 | 29.13 | 420 | 98 | 154 | 36 | 37 | 86.87 | 28 | 4.77 |
| 934 | 25.54 | 238 | 100 | 156 | 40 | 53 | 106.60 | 27 | 3.61 |
| 1350 | 27.73 | 374 | 99 | 153 | 53 | 43 | 96.33 | 28 | 5.11 |
| 1318 | 28.59 | 377 | 96 | 153 | 46 | 32 | 96.00 | 23 | 5.95 |
| 1202 | 28.04 | 337 | 98 | 154 | 38 | 38 | 82.20 | 23 | 4.52 |
| 1435 | 26.46 | 380 | 99 | 156 | 43 | 27 | 104.27 | 25 | 5.53 |
| 1087 | 27.83 | 303 | 94 | 157 | 43 | 30 | 96.43 | 16 | 5.52 |
| 1463 | 29.23 | 428 | 100 | 154 | 46 | 36 | 103.33 | 34 | 5.26 |
| 1345 | 26.57 | 357 | 101 | 356 | 44 | 34 | 92.53 | 23 | 5.04 |
| 1297 | 29.08 | 377 | 100 | 155 | 44 | 39 | 86.60 | 21 | 4.96 |
| 1338 | 28.57 | 382 | 98 | 155 | 45 | 45 | 73.53 | 26 | 5.97 |
| 2053 | 28.46 | 584 | 100 | 156 | 39 | 35 | 76.03 | 24 | 4.39 |
| 1815 | 28.85 | 523 | 102 | 158 | 39 | 41 | 77.73 | 29 | 4.01 |
| 1646 | 29.22 | 481 | 101 | 157 | 49 | 44 | 81.67 | 27 | 4.52 |
| 1785 | 30.56 | 546 | 100 | 157 | 44 | 36 | 83.60 | 39 | 3.96 |
| 1223 | 27.09 | 331 | 103 | 160 | 45 | 34 | 92.87 | 23 | 3.98 |
| 1580 | 28.78 | 455 | 100 | 157 | 44 | 40 | 83.27 | 28 | 4.15 |
| 1785 | 26.94 | 481 | 102 | 160 | 47 | 39 | 86.53 | 27 | 5.18 |
| 1159 | 28.69 | 333 | 103 | 158 | 42 | 38 | 87.33 | 31 | 4.45 |
| 1324 | 27.52 | 364 | 101 | 159 | 48 | 43 | 91.93 | 26 | 5.80 |
| 2268 | 27.88 | 632 | 100 | 160 | 42 | 44 | 87.13 | 34 | 4.42 |
| 1425 | 28.15 | 401 | 99 | 158 | 42 | 42 | 91.80 | 23 | 5.01 |
| 1011 | 27.57 | 279 | 98 | 158 | 40 | 33 | 99.67 | 19 | 4.68 |
| 1511 | 29.06 | 439 | 96 | 162 | 42 | 33 | 78.67 | 27 | 4.57 |
| 2175 | 30.70 | 668 | 101 | 161 | 46 | 39 | 89.20 | 31 | 4.47 |
| 1200 | 27.20 | 326 | 98 | 159 | 41 | 36 | 88.07 | 25 | 5.26 |
| 912 | 762.42 | 6957 | 100 | 159 | 33 | 33 | 76.33 | 24 | 4.72 |
| 1638 | 30.43 | 498 | 100 | 159 | 44 | 34 | 85.13 | 25 | 5.35 |
| 1304 | 28.36 | 370 | 99 | 159 | 35 | 33 | 79.53 | 20 | 3.61 |
| 1571 | 29.29 | 460 | 100 | 160 | 39 | 37 | 85.67 | 20 | 4.13 |
| 1608 | 29.09 | 468 | 104 | 161 | 43 | 44 | 93.27 | 24 | 5.37 |
| 1186 | 27.92 | 331 | 99 | 159 | 39 | 37 | 85.33 | 27 | 3.75 |
| 1386 | 30.05 | 416 | 98 | 159 | 40 | 38 | 82.40 | 22 | 5.14 |
| 1086 | 29.62 | 322 | 101 | 160 | 42 | 38 | 81.90 | 26 | 3.69 |
| 1230 | 30.35 | 373 | 102 | 160 | 37 | 28 | 83.93 | 19 | 4.57 |
| 1184 | 28.46 | 337 | 100 | 160 | 44 | 37 | 83.20 | 23 | 4.37 |
| 1086 | 29.24 | 318 | 100 | 161 | 42 | 33 | 79.67 | 19 | 5.04 |
| 1243 | 28.61 | 355 | 99 | 162 | 39 | 39 | 76.33 | 17 | 5.06 |
| 1212 | 30.36 | 368 | 101 | 162 | 40 | 35 | 86.87 | 22 | 4.03 |
| 1177 | 722.79 | 8510 | 104 | 161 | 41 | 37 | 85.60 | 22 | 5.38 |
| 1211 | 30.96 | 375 | 102 | 162 | 46 | 24 | 96.93 | 13 | 3.72 |
| 1799 | 25.90 | 466 | 102 | 163 | 37 | 32 | 82.40 | 23 | 4.29 |
| 1724 | 26.59 | 458 | 104 | 150 | 44 | 32 | 92.75 | 27 | 4.35 |
| 1511 | 27.66 | 418 | 101 | 150 | 45 | 33 | 95.01 | 25 | 5.68 |

Mean and variances for 13 quantitative characters

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Subcore  Field data | | | | | | | Subcore | | | | |
| Variable | Min | | Max | | Mean | Var | | | Min | Max | Mean | Var | |
| Days to 50% flowering | 39 | | 85 | | 78.86 | 0.01 | | | 65.0 | 102.0 | 79.6 | 43.7 | |
| Days to physiological maturity | 63 | | 147 | | 124 | 59.946 | | | 99.0 | 151.0 | 119.7 | 130.4 | |
| Plant height (cm) | 34 | | 85 | | 69 | 48.2 | | | 22.0 | 114.0 | 69.0 | 323.1 | |
| Seed yield per plant (g) | 1.1 | | 31.21 | | 8.68 | 28.22 | | | 1.3 | 60.0 | 13.5 | 95.3 | |
| 100 seed weight (g) | 1.1 | | 5.8 | | 3.96 | 65.5 | | | 2.0 | 8.5 | 4.5 | 1.2 | |
|  | | Coefficient of variation(%) | | | | |
|  | |  | | | | |
| rait | | Sub core | | Field core | | |
| Days to 50% flowering | | 4.7 | | 8.0 | | |
| Days to physiological maturity | | 6.26 | | 9.1 | | |
| Plant height (cm) | | 10.02 | | 25.2 | | |
| Seed yield per plant (g) | | 61.2 | | 73.1 | | |
| 100 seed weight (g) | | 23.69 | | 28.9 | | |

Percentage of the trait differences between the subcore collections and the core collection

|  |  |  |
| --- | --- | --- |
| **Statistic** | **SubCore** | **The sub core collection is considered to be the representative of the**  **Core under the following situations** |
| MD% | 0 | <20% |
| VD% | 60.1 | Higher values |
| CR% | 87.8 | >80% |
| VR% | 98.4 | Higher values |

Table 1 Range of variation for agronomic traits of IIOR core subset (150 accessions)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Mean | Min | Max | SD | CV |
| sy | 1222 | 276 | 2823 | 408.7 | 33.45 |
| oc | 27.91 | 21.19 | 32.31 | 1.6 | 5.88 |
| oy | 342 | 73 | 867 | 119.3 | 34.83 |
| D50 | 92.75 | 78.00 | 106.33 | 8.3 | 8.94 |
| DM | 138.79 | 123.67 | 163.33 | 11.7 | 8.44 |
| lpb | 39.04 | 24.11 | 52.79 | 5.6 | 14.30 |
| pl spread | 39.13 | 19.40 | 67.00 | 7.2 | 18.33 |
| ph | 78.16 | 50.27 | 106.60 | 12.7 | 16.22 |
| Cap | 24.44 | 12.13 | 53.40 | 6.0 | 24.47 |
| swt | 4.79 | 2.69 | 6.82 | 0.7 | 14.56 |

Clustering pattern based on agronomic traits under rainfed situations (3 centres)

|  |  |  |
| --- | --- | --- |
| Cluster No. | No. of accessions | Accession number (rainfed) |
| I | 10 | GMU 40, GMU 224, GMU 1078, GMU 2198, GMU 2718, GMU 3968, GMU 4502, GMU 5032, GMU 5081, GMU 5728 |
| II | 13 | GMU 95, GMU 216, GMU 330, GMU 599, GMU 774, GMU 1059, GMU 1339, GMU 2136, GMU 3256, GMU 4966, GMU 5044, GMU 5295, GMU 6851 |
| III | 30 | GMU 473, GMU 593, GMU 671, GMU 744, GMU 878, GMU 1047, GMU 1137, GMU 1485, GMU 1765, GMU 1824, GMU 2240, GMU 2472, GMU 2749, GMU 3607, GMU 3639, GMU 3703, GMU 3707, GMU 3740, GMU 3780, GMU 4234, GMU 4507, GMU 4558, GMU 5163, GMU 5361, GMU 5668, GMU 5923, GMU 6057, GMU 6192, GMU 6312, GMU 6556 |
| IV | 13 | GMU 638, GMU 1626, GMU 1695, GMU 1748, GMU 2594, GMU 2944, GMU 2969, GMU 3386, GMU 3436, GMU 3629, GMU 4038, GMU 4688, GMU 5075 |
| V | 11 | GMU 707, GMU 1185, GMU 1250, GMU 3189, GMU 3822, GMU 4201, GMU 4429, GMU 4812, GMU 5335, GMU 5935, GMU 7191 |
| VI | 24 | GMU 765, GMU 819, GMU 821, GMU 864, GMU 1287, GMU 1409, GMU 1812, GMU 2860, GMU 3047, GMU 3491, GMU 3537, GMU 4010, GMU 4066, GMU 4381, GMU 4400, GMU 4549, GMU 4646, GMU 4693, GMU 4773, GMU 4839, GMU 4972, GMU 5701, GMU 5841, GMU 6252 |
| VII | 20 | GMU 1315, GMU 1855, GMU 1871, GMU 1875, GMU 2413, GMU 2616, GMU 3084, GMU 3095, GMU 3177, GMU 4223, GMU 4305, GMU 4420, GMU 4623, GMU 4934, GMU 5133, GMU 5848, GMU 6119, GMU 6424, GMU 6663, **PBNS-12** |
| VIII | 28 | GMU 1354, GMU 1603, GMU 1638, GMU 1708, GMU 2016, GMU 2129, GMU 2432, GMU 2437, GMU 2985, GMU 2987, GMU 3208, GMU 3281, GMU 3617, GMU 3852, GMU 3929, GMU 4109, GMU 4627, GMU 4696, GMU 5046, GMU 5170, GMU 5239, GMU 5825, GMU 5908, GMU 6306, GMU 6506, GMU 6548, GMU 6869, **A-I** |
| IX | 3 | GMU 659, GMU 5663, GMU 6026 |

Clustering pattern based on agronomic traits under irrigated situations (3 centres)

|  |  |  |
| --- | --- | --- |
| Cluster No. | No. of accessions | Accession number (irrigated) |
| I | 7 | GMU 40, GMU 2987, GMU 4502, GMU 5170, GMU 5295, GMU 5663, GMU 7191 |
| II | 24 | GMU 95, GMU 638, GMU 707, GMU 819, GMU 864, GMU 1137, GMU 1287, GMU 1875, GMU 2136, GMU 2860, GMU 3436, GMU 3537, GMU 3607, GMU 3740, GMU 3780, GMU 4066, GMU 4234, GMU 4400, GMU 4507, GMU 4646, GMU 4693, GMU 4839, GMU 5935, GMU 5841 |
| III | 54 | GMU 216, GMU 330, GMU 659, GMU 593, GMU 671, GMU 1047, GMU 1250, GMU 1339, GMU 1638, GMU 1765, GMU 1855, GMU 1871, GMU 2129, GMU 2240, GMU 2432, GMU 2472, GMU 2594, GMU 2749, GMU 2944, GMU 3177, GMU 3208, GMU 3281, GMU 3386, GMU 3491, GMU 3629, GMU 3639, GMU 3707, GMU 3929, GMU 3968, GMU 4010, GMU 4109, GMU 4381, GMU 4420, GMU 4429, GMU 4549, GMU 4558, GMU 4627, GMU 4688, GMU 4696, GMU 4773, GMU 4972, GMU 5044, GMU 5335, GMU 5668, GMU 5923, GMU 6252, GMU 6312, GMU 6424, GMU 6506, GMU 6851, GMU 6548, GMU 6556, GMU 6663, GMU 6869 |
| IV | 44 | GMU 224, GMU 473, GMU 599, GMU 744, GMU 774, GMU 821, GMU 878, GMU 1059, GMU 1078, GMU 1315, GMU 1354, GMU 1409, GMU 1603, GMU 1626, GMU 1695, GMU 1748, GMU 1824, GMU 2016, GMU 2413, GMU 2437, GMU 2616, GMU 2718, GMU 2969, GMU 3047, GMU 3084, GMU 3189, GMU 3256, GMU 3703, GMU 3852, GMU 4038, GMU 4812, GMU 4934, GMU 4966, GMU 5032, GMU 5046, GMU 5075, GMU 5081, GMU 5133, GMU 5701, GMU 5825, GMU 5848, GMU 6057, GMU 6306, **PBNS-12** |
| V | 4 | GMU 765, GMU 1185, GMU 1812, GMU 3822 |
| VI | 13 | GMU 1485, GMU 1708, GMU 2198, GMU 3095, GMU 3617, GMU 4305, GMU 4623, GMU 5239, GMU 5361, GMU 6026, GMU 6119, GMU 6192, **A-I** |
| VII | 6 | GMU 2985, GMU 4201, GMU 4223 , GMU 5163, GMU 5728, GMU 5908 |

Cluster means (Rainfed )

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cluster No. | Seed yield (kg/ha) | Oil content  (%) | Oil yield (kg/ha) | Days to 50% flowering | Days to maturity | Length of longest branch (cm) | Plant spread (cm) | Plant height  (cm) | No. of  effective capitula/plant | 100-seed weight (g) |
| I | **1917** | **27.14** | **521** | **86** | **128** | **41** | **47** | **71** | **32** | **4.89** |
| II | 1424 | 28.26 | 402 | 85 | 129 | 38 | 43 | 68 | 28 | 5.02 |
| III | **876** | **28.17** | **247** | **85** | **128** | **34** | **37** | **65** | **25** | **4.64** |
| IV | 1045 | 28.05 | 293 | 84 | 128 | 35 | 40 | 65 | 26 | 4.91 |
| V | 401 | 25.72 | 103 | 85 | 128 | 32 | 32 | 66 | 19 | 4.13 |
| VI | 600 | 27.40 | 164 | 86 | 129 | 35 | 34 | 69 | 22 | 4.22 |
| VII | 1214 | 28.29 | 343 | 84 | 128 | 38 | 41 | 67 | 28 | 4.82 |
| VIII | 1625 | 28.88 | 469 | 86 | 128 | 39 | 45 | 69 | 29 | 4.96 |
| IX | 2486 | 28 | 701 | 87 | 128 | 41 | 51 | 71 | 32 | 5.61 |

**Cluster means irrigated**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cluster No. | Seed yield (kg/ha) | Oil content  (%) | Oil yield (kg/ha) | Days to 50% flowering | Days to maturity | Length of longest branch (cm) | Plant spread (cm) | Plant height  (cm) | No. of  effective capitula/plant | 100-seed weight (g) |
| I | 1820 | 28.11 | 512 | 101 | 153 | 43 | 41 | 83 | 29 | 4.64 |
| II | 977 | 27.47 | 269 | 101 | 148 | 40 | 39 | 90 | 20 | 4.60 |
| III | 1173 | 28.03 | 329 | 100 | 150 | 41 | 37 | 89 | 20 | 4.84 |
| IV | 1396 | 27.85 | 389 | 100 | 147 | 42 | 40 | 90 | 25 | 5.14 |
| V | 1256 | 26.47 | 333 | 102 | 345 | 43 | 38 | 96 | 20 | 5.11 |
| VI | 716 | 26.45 | 189 | 104 | 143 | 43 | 38 | 86 | 18 | 3.95 |
| VII | 1632 | 28.13 | 459 | 101 | 152 | 43 | 41 | 89 | 25 | 4.98 |
| VIII | 2145 | 28.64 | 615 | 101 | 155 | 42 | 37 | 85 | 29 | 5.00 |

Conclusion :

The large size of germplasm collection presents problems in its management and accessibility for breeding purposes. The use of collections is limited by lack of knowledge of genetic diversity in the collection. To overcome these problems the core was developed for better utilization and accessibility to vast collection of germplasm material. Safflower germplasm consists of 6374 accessions belonging to 57 countries. The data on 13 qualitative traits was standardized each variable to eliminate scale differences. A total of 6201 safflower germplasm accessions were used for development of core after elimination of missing and blank values from 6374 accessions. A core was developed based on 13 quantitative descriptors. The total accessions arrayed into 20 distinct clusters using Wards minimum variance method. From each cluster stratified sampling has been carried out to establish core subset of 620 (10%) accessions. Differences among means of the entire collection and core subset for the 13 quantitative descriptors used in developing the core subset were not significant, and the variances of the entire collection and core subset were homogeneous for all the traits. The zero mean difference per cent and more than 80 coincidence rate per cent indicated the representativeness of core with total collection.

Safflower sub core accessions were evaluated at 2 centres DOR and Solapur. Alpha design was followed at 2 centres. 150 sub core accessions were laid out in 2 replications in an incomplete block design. A sub core set of 150 (25% of core set) accessions was established using wards minimum variance method. These 155 accessions arrayed into 25 distinct clusters. Differences among means of the entire collection and core subset for the 13 quantitative descriptors used in developing the core subset were not significant, and the variances of the entire collection and core subset were homogeneous for all the traits. The core subset captured 100% range variation for 13 descriptors and The differences among means and variances, of the entire collection and core subset for the 13 agronomic descriptors were also not significantly different. However, this core subset captured over 70% range variation.