Sorghum Nucleus and Breeder Seed Production

1. The ‘seed system’ was developed at DSR for transparent and smooth functioning of production, purity testing, maintenance and distribution of breeder seed.
2. DSR coordinates the nucleus and breeder seed production program of grain sorghum at AICSIP centers in the national program (AICSIP).
3. The total breeder seed production during 2006-07 by AICSIP centers was 9.7 tones.
4. The guidelines for ‘nucleus seed production of sorghum’ were published by DSR.

DUS testing on sorghum:

1. DSR coordinates and conducts DUS testing the experiments at four centres (DSR, Hyderabad & MPKV, Rahuri for grain sorghum; GBPUA&T, Pantnagar & CCS HAU, Hisar for forage sorghum)
2. DUS test guidelines for sorghum (with 33 characteristics) were published by DSR during November 2006
3. The latest guidelines (with 33 characteristics) on sorghum submitted to PPV&FRA was corrected by the ‘Task Force (1/2005)’ and published by the PPV & FR Authority during February 2007.

Sorghum Genetic Resources Management

1. More than 18000 entries (germplasm, landraces, breeding stocks etc) are conserved at medium-term storage. 9244 accessions are submitted to the National Gene bank (NGB), NBPR, for long-term storage.
2. Sorghum diversity map was prepared to identify the unexplored area for future exploration.
3. A standard Material Transfer Agreement (MTA) is developed and documented since 2002. Exchange of germplasm is encouraged and increase their utilization in breeding.

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All-India Coordinated Sorghum Improvement Project (AICSIP)
an overview

Location of AICSIP Centres

Directorate of Sorghum Research (DSR)
Rajendranagar, Hyderabad—500 030, AP, India
www.sorghum.res.in
The All-India Coordinated Sorghum Improvement Project (AICSIP) came into existence in December 1969, with its coordinating centre at IARI, New Delhi. The AICSIP is a nation-wide network for co-operative, inter-disciplinary research linking ICAR Institutes with the SAUs to focus attention on sorghum. The AICSIP has succeeded in mobilizing country's scarce resources through inter-institutional and inter-disciplinary interaction and joint evaluation of new technologies to arrive at collective recommendation. The AICSIP also strengthens the research base in each agricultural university by supporting basic and strategic research on sorghum. The coordinating unit was shifted from IARI to the present location at DSR, Hyderabad in 1970. The project is supported by 61 scientists, 77 technical, 8 administrative and 9 auxiliary staff. Further strengthening of staff and facilities under XI plan is considered by ICAR.

Mission
Enhancing the productivity and profitability of sorghum on ecologically sustainable basis, and to popularize sorghum based technologies to benefit farmers.

Mandate
1. Develop hybrids and varieties combining high yield and acceptable quality of grain and fodder, wider adaptability and resistance to major stress factors.
2. Evolve appropriate crop management practices and formulate efficient sorghum-based cropping systems for sustainable sorghum production in each zone.
3. Conduct investigations on key or potential pests and diseases of sorghum and identify and evolve elite sources of resistance to develop suitable integrated plant protection strategies.
4. Promote research and extension to meet the local needs within each state through SAU and other partners.

Thrust areas
Crop improvement
1. Breed parent lines, hybrids and varieties having wider adaptability and resistance to major stress factors.
2. Organize and monitor trials/nurseries for different production conditions
3. Organize and produce breeder seed of recommended varieties for domestic and industrial usage
4. Augment, maintain and evaluate germplasm to identify and catalogue
### Centre-wise research priorities

<table>
<thead>
<tr>
<th>State</th>
<th>Center</th>
<th>University</th>
<th>Major constraint dealt with</th>
<th>Major product types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tamil Nadu</td>
<td>Coimbatore</td>
<td>TNAU</td>
<td>Diseases, drought</td>
<td>Dual purpose, and forage</td>
</tr>
<tr>
<td></td>
<td>Kovilpatti</td>
<td>TNAU</td>
<td>Insects, esp. of panicle</td>
<td>Dual purpose, and sweet &amp; forage</td>
</tr>
<tr>
<td>Karnataka</td>
<td>Dharwad</td>
<td>UAS</td>
<td>Insects, foliar diseases, mold</td>
<td>Hybrids and varieties, dual purpose</td>
</tr>
<tr>
<td></td>
<td>Bijapur</td>
<td>UAS</td>
<td>Shoot fly, charcoal rot, drought</td>
<td>Rabi hybrids and varieties</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>Palem</td>
<td>ANGRAU</td>
<td>Insects, mold</td>
<td>Dual purpose, forage</td>
</tr>
<tr>
<td></td>
<td>Tandur</td>
<td>ANGRAU</td>
<td>Rabi adaptation</td>
<td>Varieties</td>
</tr>
<tr>
<td></td>
<td>Warangal</td>
<td>DSR</td>
<td>Borer, storage pests</td>
<td>Forage</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>Parbhani</td>
<td>MAU</td>
<td>Mold, shoot fly, borer, shoot bug</td>
<td>Hybrid and varieties, sweet stalk</td>
</tr>
<tr>
<td></td>
<td>Rahuri</td>
<td>MPKV</td>
<td>Shoot fly, charcoal rot, Food quality</td>
<td>Hybrid, variety, sweet sorghum, forage</td>
</tr>
<tr>
<td></td>
<td>Akola</td>
<td>PDKV</td>
<td>Shoot fly, borer, mold</td>
<td>Hybrids and varieties</td>
</tr>
<tr>
<td>Gujarat</td>
<td>Surat</td>
<td>NAU</td>
<td>Shoot fly, borer, panicle pests and mold</td>
<td>Dual purpose and forages</td>
</tr>
<tr>
<td></td>
<td>Deesa</td>
<td>SDAU</td>
<td>Shoot fly, borer, foliar diseases</td>
<td>Forages single- and multi-cut</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>Indore</td>
<td>JNKVV</td>
<td>Shoot fly, borer, leaf diseases</td>
<td>Hybrids and varieties</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>Udaipur</td>
<td>MPUAT</td>
<td>Shoot fly, borer, leaf diseases</td>
<td>Dual-purpose varieties, single-cut forage</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>Mauanipur</td>
<td>CAUAT</td>
<td>Shoot fly, borer, leaf diseases</td>
<td>Dual purpose varieties, single-cut forage</td>
</tr>
<tr>
<td></td>
<td>Hisar</td>
<td>CCSHAU</td>
<td>Stem borer</td>
<td>Forage, single-and multi-cut</td>
</tr>
<tr>
<td>Uttarakhand</td>
<td>Pantnagar</td>
<td>GBPUAT</td>
<td>Borer, leaf diseases</td>
<td>Forage, single- and multi-cut</td>
</tr>
</tbody>
</table>

### genetic resources, and contribute to management of IPR

#### Crop management
1. Increase Productivity through optimization of resources (soil, water and other inputs)
2. Sustain productivity advances under intensive agriculture
3. Water-use efficiency and weed control

#### Crop health management
1. Conduct surveillance on major diseases/pests
2. Identify new sources of resistance and their effective utilization in cultivar development
3. Integrated Pest Management under sorghum based cropping systems

#### Extension and marketing
1. Demonstrating production potentials of recently released cultivars and providing feedback to researchers through conduct of demonstrations, field days, collection of relevant socio-economic data and market intelligence.

### Achievements

#### Cultivar development

<table>
<thead>
<tr>
<th>Product type</th>
<th>Cultivar</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Kharif</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain</td>
<td>CSH 16</td>
<td>Medium duration kharif hybrid for All-India cultivation Developed by NRCS</td>
</tr>
<tr>
<td></td>
<td>CSH 17</td>
<td>Early maturing hybrid released for kharif growing areas at MP, TN, Gujarat and Rajasthan. Developed by NRCS</td>
</tr>
<tr>
<td></td>
<td>CSH 18</td>
<td>Medium duration for all kharif areas in India. Developed by Indore center</td>
</tr>
<tr>
<td>Grain and dual purpose</td>
<td>CSH 21</td>
<td>Relatively less susceptible hybrid to shoot fly and stem borer. Released for cultivation in states of Maharashtra, Karnataka, AP, MP, Gujarat, Rajasthan, and UP. Developed by Mahindra hybrid seeds.</td>
</tr>
<tr>
<td></td>
<td>CSH 23</td>
<td>Medium duration hybrid, less susceptible to shoot fly and stem borer. Released for cultivation in the states of Maharashtra, Karnataka, AP, MP, Gujarat, Rajasthan, and UP. Developed by NRCS</td>
</tr>
<tr>
<td><strong>Rabi</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain</td>
<td>CSH 19 R</td>
<td>Medium duration hybrid, suitable for medium to deep soils and irrigated areas of rabi sorghum growing regions. Developed by Akola centre.</td>
</tr>
<tr>
<td>Variety</td>
<td>CSV 216</td>
<td>Rabi variety released for all India basis. Developed by Raheja center</td>
</tr>
<tr>
<td></td>
<td>CSV 18</td>
<td>Rabi Variety developed by Parbhani center</td>
</tr>
<tr>
<td>Forage</td>
<td>CSH 20 MF</td>
<td>Forage hybrid, has less HCN content and resistant to leaf- diseases. This hybrid is released at all India level. Developed at Pantnagar centre.</td>
</tr>
</tbody>
</table>
Some of the important state-level releases are: GJ 40, 41 (Gujarat), DSV 4, DSV 5 (Karnataka), PSH 1, NTJ 3 (Andhra Pradesh), JJ 1041 (Madhya Pradesh), RSLG 262, Parbhani Swetha, Mahabeej 7 (Maharashtra)

Entomology
1. Identified multiple resistance in elite sources of resistance to shoot fly, stem borer, and head bugs (PFGS 97, PFGS 98, PFGS 100) in the kharif season
2. Identify promising sources in elite lines for resistance to shoot fly in sweet sorghums in kharif season
3. Application of wheat or rice bran in the sorghum plots had considerable impact on the reduction of infestation and population buildup of aphids, besides using it as a soil moisture conserving practice in rabi season

Pathology
1. Harvesting of sorghum at physiological maturity stage reduced the incidence of grain molds.
2. Sugary disease of sorghum was managed by 2 sprays of propaconazole (TILT 25 EC) @ 5.0 ml/lit at flowering and 15 days later on
3. Downy mildew of sorghum was managed by seed treatment with meta- layl in liquid formulatic (APRONXL) @ 3 ml / kg seed
4. Multiple Disease Resistant lines identified
5. Isolates of Macrophomina phaseolina collected from different places exhibited differential cultural and morphological characteristics.

Physiology
RSLG 262 has been released as Maulee for scarcity zone of Western Maharashtra. It is the drought tolerant genotype and a substitute for Sel. 3 in shallow soils. This cultivar matures 7 days earlier then M 35-1, has High photosynthesis rate at PI and anthesis in terminal drought and exhibits low chlorophyll degradation under drought

Extension and Marketing
Demonstration in farmers fields lead to adoption of improved cultivars different states by 45%. Feedback has resulted in the creation of 3 major sorghum zones for research during the kharif
1. Seed replacement rate in different states ranged between 5 to 25 % with improved high yielding cultivars of sorghum.
2. New niche areas such as sorghum after rice in Andhra Pradesh, summer cultivation of sorghum in Maharashtra identified leading to research for development of suitable technologies for sorghum cultivation.

Forage
Forage sorghum variety HC 308 was developed and released at national level. HC 308 is tall (223 cm), sweet, leafy and resistant to foliar diseases. It matures in 113 days and gave 12.5 q/ha seed yield. It is also better in quality and nutritive value. Thos variety is developed by Hisar center.

CSH 20 MF, forage hybrid, has less HCN content and resistant to leaf- diseases. This hybrid is released at all India level. It was developed at Pantnagar centre.
Multicut varieties / hybrids for getting maximum forage yield the crop should be harvested at an interval of 55 days after first cut.
The multicut forage sorghum varieties / hybrids should be fertilized with 150 kg N/ha for getting maximum forage yield.

Harvesting at 75% flowering produced significantly higher green forage yield over other stage of harvesting (Boot, and maturity stage) but higher dry matter yield was recorded at maturity stage.

Three new pests, particularly grasshopper (Hieroglyphus nigrorrepletus Bol.) sugarcane leafhopper (Pyrrula perpusilla Walker) and corn leaf aphid (Rhopalsiphum maidis Fitch) have been found infesting sorghum are considered as sporadic and occasional pests.

Sweet sorghum
Two sweet sorghum cultivars with high biomass, green cane yield and juice yield have been recently released for cultivation

CSH22 SS : The hybrid is superior for green cane yield, juice extraction, juice yield. This is the first sweet sorghum hybrid developed by public institutions (DSR) for which there is an increasing demand. The hybrid is recommended for release for all Zones, in the states of Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Rajasthan and Gujarat.

CSV 19 SS: This is a sweet sorghum variety; Tan, purple coleoptiles, dull green midrib, pearly white medium seed, high green cane yield, juice yield and tolerant to shoot fly. This variety for Zone II is superior for green cane yield, grain yield, juice extraction, juice yield, non-reducing sugars, total sugars and CCS. The varieties shows tolerant to shoot fly incidence. This variety has been developed by Rahuri center.