

PGR Management and Use – COMPONENT I
Annual Progress Report for the year 2015-16

1. **Name of the Crop:** Sorghum
2. **Name of the Lead Centre:** NBPGR, New Delhi
3. **Name of the Nodal person with designation:** Dr. M. Elangovan
4. **Name of the collaborating centres:** AICSIP centers – Akola, Udaipur
5. **Name of Nodal person with designation:** Dr. RB Ghorade and BR Ranwah
6. **Number of accessions received from ICAR-NBPGR:** 5000
7. **Number of accessions sown for characterization/multiplication:** 5000
8. **Number of accessions germinated as data were recorded:**
9. **Experimental design:** Augmented Design
10. **Checks used:** CSV 17, CSV 20, CSV 21F, CSV 27 (Kharif); M35-1 and CSV 29R (Rabi)
11. **Details of the characterization:**

Sl. No.	Name of the Centre	No. of accessions characterized/ multiplied	Date of sowing (From – to)	No. of descriptors *	Date of harvesting (From – to)	Date of dispatch of data and seed material to NBPGR	
						Seed	Data
1	AICSIP- Akola (K)	1700	2015	27			21/12/15
2	AICSIP- Udaipur (K)	1700	12 th July 2015	27			
3	IIMR- Hyderabad (R)	2500	2015-16	27			
4	IIMR-CRS-Solapur (R)	2500	2015-16	27			

*Please attach the list of descriptors/descriptor status

12. **Same descriptors were used at all the locations:** Yes/No : Yes
13. **Detailed report on salient achievements of characterization with details of promising lines identified for important characters:**

Phenotypic Characterization Sorghum Germplasm under CRP-Agro biodiversity

Germplasm characterization and documentation are the important activity in germplasm management. It eases data retrieval and short-listing accessions for genetic improvement. A set of 2459 sorghum germplasm accessions supplied by NBPGR, New Delhi under the CRP-Agro biodiversity are characterized at IIMR, Hyderabad for 27 agro-morphological traits during rabi 2015-16. In the present study only 10 pre-harvest trait data was used to assess the variability and identify the distinct genotypes. From the qualitative data it was found that dark green midrib colour appeared in very low frequency

(0.04%), only in one accession (EC 483674), followed by yellow midrib (1.0%). One accession (EC 484133) was found with 15 leaves and three accessions with 14. For clustering data on four quantitative traits days to 50% flowering, leaf length (cm), leaf width (cm) and plant height (cm) was used. There was wide range variation observed for leaf length (23.2 - 91.18 cm), leaf width (2.46 – 10.85 cm), days to flowering (44 - 97 days) and plant height (64 - 348 cm). The CV was highest for plant height 27.6%. Clustering was done using EM algorithm. Four clusters formed and the accession evenly distributed in the four clusters in the biplot. The attributes of clusters shows the difference in mean but with similar standard deviation. The trait relationship among the traits showed that the days to 50% flowering and plant height showed similar variation and are highly correlated.

Variability Study and Cluster Analysis of Sorghum Germplasm

A total of 2488 sorghum germplasm supplied by the NBPGR under CRP – Agrobiodiversity were characterized in Center for Rabi Sorghum, IIMR, Solapur during rabi 2015-16. The variability in four quantitative traits [days to 50% flowering, leaf length (cm), leaf width (cm) and plant height (cm)] was studied. Maximum variation was found in plant height (CV = 23.31) followed by leaf width (CV = 18.27). All the four traits were used as variables in cluster analysis using EM algorithm. In the present study three clusters were assigned *a-priori*. The number of cluster was decided based on the analyses performed by assigning cluster numbers starting from two to six. The analysis was repeated and the overlapping of clusters were observed to reduce the ambiguity and three cluster groups were assigned. The attributes of clusters showed that the differences in mean but with similar standard deviation. The relationship among the traits in the biplot differentiated days to 50% flowering from leaf length and width. The frequency classes in the qualitative traits were studied to identify the common and rare types in total set. It was found that 82.25% of accessions were with light green leaf colour and 0.2% with pale green. The maximum of 85.22% midrib colour were with white and 14.78% with green. The non-tan type was maximum (87.86%). In the leaf orientation 95.31% accessions were drooping while 4.69% with erect.



Germplasm Characterization

First set of 2500 acc. characterized at IIMR-CRS-Solapur for 10 agro-morphological traits during Rabi 2015-16

- **2500 accessions characterized at IIMR – CRS - Solapur**
- **The pre-harvest data on 10 traits were observed**
- **The plant height was most variable character followed by leaf length and days to 50% flowering**
- **Plant vigour – Maximum frequency in good (1712 acc.)**
- **Leaf sheath colouration - Non-tan (2194 acc.)**
- **Leaf colour - Light green (2054 acc.)**
- **Leaf orientation - Drooping (2380 acc.)**
- **Leaf midrib colour - White (2128 acc.)**
- **Number of leaves - 8 leaves (650 acc.)**



M Elangovan, Prabhakar, Sushil Pandey, RK Tyagi and Parashuram



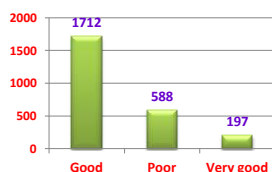


Descriptive statistics on 4 pre-harvest traits of 2500 acc. characterized at CRS - IIMR – Solapur

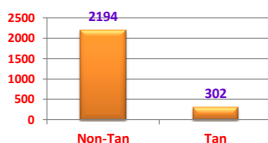


Traits	Minimum	Maximum	Mean	SD	SE	Variance	N	CV
Days to 50% flowering	40.00	78.00	54.75	6.64	0.13	44.05	2488.00	12.12
Leaf length (cm)	26.50	92.00	56.90	8.30	0.17	68.89	2497.00	14.59
Leaf breadth (cm)	2.70	12.50	6.35	1.16	0.02	1.35	2497.00	18.27
Plant height (cm)	50.00	266.00	149.30	34.81	0.70	1211.51	2497.00	23.31

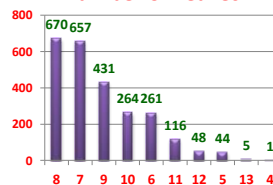
Plant vigour



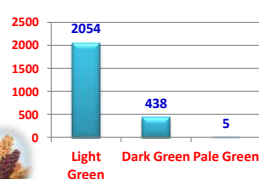
Leaf sheath pigmentation



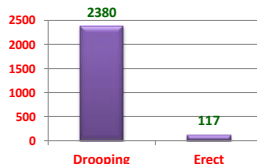
Number of Leaves



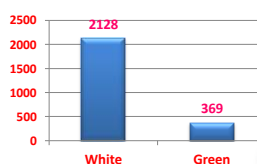
Leaf Colour



Leaf orientation



Leaf midrib colour



Second set of 2500 acc. characterized at IIMR-Hyderabad for 10 agro-morphological traits during Rabi 2015-16



- 2500 accessions characterized at IIMR – Hyderabad
- The pre-harvest data on 10 traits were observed
- The plant height was most variable character followed by leaf length and days to 50% flowering
- Plant vigour – Maximum frequency in good (1526 acc.)
- Leaf sheath colouration - Non-tan (2178 acc.)
- Leaf colour - Light green (1381 acc.)
- Leaf orientation - Drooping (2244 acc.)
- Leaf midrib colour - Colourless (978 acc.)
- Number of leaves - 8 leaves (584 acc.)
- M Elangovan, Avinash Singode, Annapurna, Sushil Pandey, RK Tyagi and Riyazaddin Mohammed



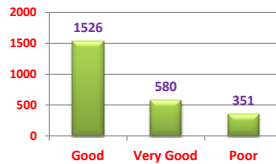


Descriptive statistics on 4 pre-harvest traits of 2500 acc. characterized at IIMR – Hyderabad

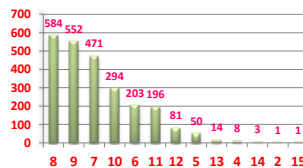


Traits	Minimum	Maximum	Mean	SD	SE	Variance	N	CV
Days to 50% flowering	44.00	97.00	64.00	8.29	0.16	68.73	2550	12.95
Leaf length (cm)	23.20	91.18	65.01	9.25	0.18	85.53	2555	14.23
Leaf width (cm)	2.46	10.85	6.94	1.26	0.02	1.59	2555	18.17
Plant height (cm)	64.00	348.00	189.75	52.49	1.04	2755.61	2556	27.66

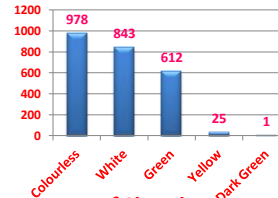
Plant vigour



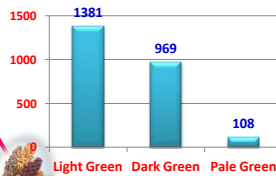
Number of Leaves



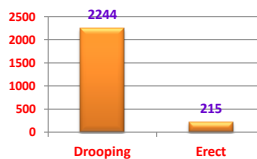
Leaf midrib colour



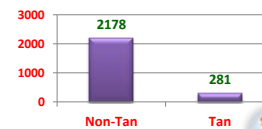
Leaf Colour



Leaf orientation



Leaf Sheath Pigmentation



1700 acc. characterized at AICSIP – Akola, Dr PDKV for 26 agro-morphological traits during Kharif 2015



- 1700 accessions characterized at AICSIP – Akola
- Data on 9 quantitative and 17 qualitative traits were observed
- The plant height was most variable character followed by leaf length and days to 50% flowering
- Plant vigour – Maximum frequency in good (1031 acc.)
- Leaf sheath colouration - Tan (1335 acc.)
- Leaf colour - Dark green (782 acc.)
- Leaf orientation - Drooping (1267 acc.)
- Leaf midrib colour - White (1106 acc.)
- Number of leaves - 12 leaves (270 acc.)
- Race – Bicolor (588 acc.)

M Elangovan and RB Ghorade

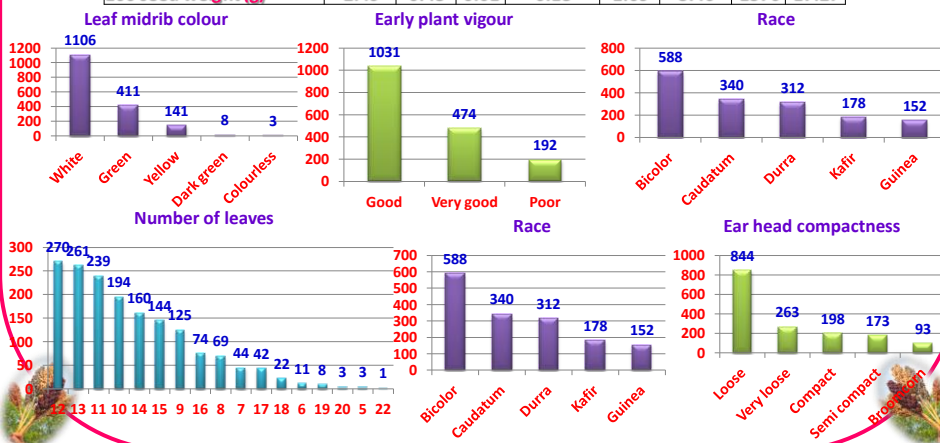




Descriptive statistics on morphological and agronomic traits of 1700 acc. characterized at AICSIP - Akola



Traits	Mean	SD	SE±	Variance	Min	Max	N	CV
Days to 50% flowering	85.99	12.40	0.31	153.78	10.00	118	1625	14.42
Leaf length (cm)	71.49	13.21	0.32	174.58	6.00	107.00	1670	18.48
leaf width (cm)	6.90	1.56	0.04	2.45	2.50	11.50	1670	22.67
Ear head length	18.04	5.59	0.14	31.25	6.00	39.60	1570	30.99
Ear head width (cm)	3.93	1.07	0.03	1.15	1.30	8.50	1570	27.23
Plant height (cm)	207.09	46.93	1.16	2202.54	24.80	342.00	1635	22.66
Grain weight (g)	24.90	7.54	0.19	56.86	7.00	53.00	1570	30.29
100 seed weight (g)	2.49	0.43	0.01	0.18	1.69	3.46	1570	17.27



Potential trait specific germplasm identified at AICSIP-Akola, Dr PDKV



- One accession IC-289251 was observed with 22 number of leaves and also found desirable for other traits viz., dark green leaf colour, tan plant pigmentation and stay green trait
- Three accessions viz., IC-288632, IC-289161, IC-289800 and IC-289806 were found superior for grain weight (> 45g per plant) and 100 seed weight (> 3.4g)
- Nineteen accessions viz., IC-288550, IC-288590, IC-288591, IC-288592, IC-288593, IC-288594, IC-288603, IC-288622, IC-288631, IC-288632, IC-288633, IC-288634, IC-288837, IC-288843, IC-289087, IC-289092, IC-289105, IC-289166 and IC-289217 were observed with plant height (>300 cm) and grain weight (>40 g per plant)



Sorghum Germplasm Field Day at IIMR – Hyderabad

Indian Institute of Millets Research (IIMR) organized sorghum germplasm field day on 7th January 2016 at Hyderabad. This programme is sponsored by National Bureau of Plant Genetic Resources (NBPGR), New Delhi. IIMR is regenerating 2500 accessions under the Consortium Research Platform (CRP) on Agrobiodiversity. A total of 70 participants attended this field visit which includes 30 from All India Coordinated Sorghum Improvement Centres (AICSIP), 10 NBPGR Scientists, 10 other ICAR scientists and 20 IIMR scientists. This programme has facilitated the sorghum researchers to familiarize with the available diverse sorghum germplasm at IIMR – Hyderabad and enable them to make desirable trait specific germplasm selection and utilization in their crop improvement program.

Dr TG Nageswara Rao, Director (Acting), IIMR chaired the inaugural session and briefed achievements of sorghum genetic resources management at IIMR. The field day was inaugurated by the chief guest Dr KS Varaprasad, Director, Indian Institute of Oilseeds Research (IIOR). He also delivered inaugural address on “Plant Genetic Resources – Free flow to Benefit Sharing”. He emphasized on sharing the benefit from the utilization of germplasm to farmers who is the primary custodian of genetic resources. He also briefed about the objectives and functioning of National Biodiversity Authority (NBA) and State Biodiversity Boards (SBB). He also complimented the sorghum genetic resources management at NRCS/DSR/IIMR especially the database management and GIS mapping.

The guest of honour Dr V Ravindrababu, Director, Indian Institute of Rice Research (IIRR) has requested the NBPGR to fasten the germplasm exchange between the NGB and ICAR institutes and make use of all the available genetic resources to the scientists in crop improvement programme and benefits to the farmers.

The guest of honor Dr RK Tyagi, Head Germplasm Conservation Division, NBPGR appreciated the contribution of NRCS/DSR/IIMR during the National Agricultural Technology Project (NATP). He also delivered a special lecture on “Guidelines for Registration of Genetic Stocks”.

Dr B Sarathbabu, Officer In-charge, NBPGR (RS) Hyderabad and his colleague Dr Anitha delivered a lecture on “Plant Quarantine for Safe Exchange of Germplasm”. They have briefed the participants on the possible interventions of pest or diseases during the exchange of genetic resources from other countries.

Millet's Rock Garden - A new landmark in the GTC field was inaugurated by the guests and dignitaries of the sorghum germplasm field day.

During the field visit the mentioning of Indigenous or Exotic Collection numbers in the label and publications, screening of resistance source material for pest and diseases, plan for evaluation

of potential germplasm, photo image of individual accessions and uniformity in data recording were discussed. The procedure for buying the digital image for recording the data was also emerged for handling the large accessions.

During the inaugural session the following publications were released by the dignitaries on the dais.

1. Elangovan, M., and Vilas A Tonapi, 2015. Genetic Resources Management in Sorghum and Millets. Indian Institute of Millets Research (IIMR), Rajendranagar, Hyderabad 500030, Telangana, India. 471 pp. ISBN: 81-89335-53-7. *(Released by Dr K Varaprasad, Director - IIOR, Hyderabad)*
2. Elangovan, M., Vilas A Tonapi, Avinash Singode, KV Raghavendra Rao, Raghunath Kulakarni, A Annapurna and TG Nageswara Rao, 2016. Potential Sorghum Genetic Resources Identified for Utilization. ICAR – Indian Institute of Millets Research (IIMR), Rajendranagar, Hyderabad 500030, Telangana, India, 201 pp. ISBN: 81-89335-56-1. *(Released by Dr V Ravidrababu, Director - IIRR, Hyderabad)*
3. Elangovan, M., 2016. Sorghum Genetic Resources Management 2000-2015, 2016. ICAR – Indian Institute of Millets Research (IIMR), Rajendranagar, Hyderabad 500030, Telangana, India, IIMR Technical Report – 007/2015-16. 70 pp. *(Released by Dr TG Nageswara Rao, Director (Acting) - IIMR, Hyderabad)*

During the valedictory sessions the AICSIP centres were asked to inform the status of sorghum genetic resources available with them. Specific request for germplasm import was discussed. AICSIP centres were requested to strengthen the registration of trait-specific genetic stocks which are very good and dropped in AVT II. We also discussed the status of harvest and data collection for the preparation report for Annual Group Meeting 2016.

This germplasm field day was coordinated by Drs M Elangovan, Vilas A Tonapi and Avinash Singode and facilitated by Mrs A Annapurna and Dr KV Raghavendra Rao. The programme also supported by Sri Vilas Aghav, Sri J Bhagwantham and various committee members.



Book release by dignitaries on the dais



Participants during inauguration



Active participants in the sorghum germplasm field



Discussion on germplasm management among IIMR and NBPGR scientists



Sorghum Germplasm Field Day – Group Photo

Sorghum Germplasm Field Day at CRS - IIMR – Solapur

Indian Institute of Millets Research (IIMR) organized sorghum germplasm field day on 28th January 2016 at Cent for Rabi Sorghum (CRS) – IIMR, Solapur. This programme is sponsored by National Bureau of Plant Genetic Resources (NBPGR), New Delhi. IIMR is regenerating 2500 accessions under the Consortium Research Platform (CRP) on Agrobiodiversity. A total of 50 participants attended this field visit which includes 25 from All India Coordinated Sorghum Improvement Centres (AICSIP), 5 from KVK, 5 other ICAR scientists and 15 IIMR scientists and Technical Officers. This programme has facilitated the sorghum researchers to familiarize with the available diverse sorghum germplasm at CRS - IIMR – Solapur and enable them to make desirable trait specific germplasm selection and utilization in their crop improvement program.

Dr TG Nageswara Rao, Director (Acting), IIMR chaired the inaugural session and briefed achievements of sorghum genetic resources management at IIMR. The field day was inaugurated by the chief guest Dr RK Pal, Director, National Research Centre for Pomegranate (NRCPG).

The guest of honour Dr Sushil Pandey, Senior Scientist, National Bureau of Plant Genetic Resources (NBPGR) briefed about the objectives of the Consortium Research Platform (CRP) on Agrobiodiversity and exchange of germplasm.

The diversity of sorghum genetic resources was displayed to know its importance along with the publications on Biodiversity, IPR, Plant Variety Protection and DUS testing.

During the valedictory sessions the AICSIP centres were asked to inform the status of sorghum genetic resources available with them. Specific request for germplasm import was discussed. AICSIP centres were requested to strengthen the registration of trait-specific genetic stocks

which are very good and dropped in AVT II. We also discussed the status of harvest and data collection for the preparation report for Annual Group Meeting 2016 to be held at Udaipur during April 2016.

This germplasm field day was coordinated by Drs M Elangovan, Prabhakar and Parashuram Patroti and facilitated by Dr MY Samdur and Shri AR Limbore. The programme also supported by Mrs A Annapurna, Dr KV Raghavendra Rao and Sri HS Gawali.



Discussion on PGR management



Participants during sorghum germplasm field day at Solapur



Briefing the diversity and publication of sorghum germplasm



Sorghum Germplasm Field Day at Solapur – Group Photo



Briefing the sowing plan to the participants



Active participants during sorghum germplasm field day

14. Details of monitoring:

Sl. No.	Name of the Centre	Date of monitoring	Crop stage at the time of monitoring	Monitoring team members
1	AICSIP- Akola (K)	25th September 2015	Maturity	Dr Dixit, NBPGR (RS), Akola Dr M Elangovan, IIMR, Hyderabad Dr MY Samdur, IIMR – CRS, Solapur
2	AICSIP- Udaipur (K)	30 th October 2015	Maturity	Dr Omvir Singh, NBPGR (RS), Jodhpur Dr TGN Rao, IIMR, Hyderabad Dr Ranwah, AICSIP - Udaipur
3	ICAR-IIMR Hyderabad (R)	7 th January 2016	Maturity	Dr RK Tyagi, NBPGR, New Delhi Dr Sushil Pandey, NBPGR, New Delhi Dr M Elangovan, IIMR, Hyderabad
4	CRS Solapur ICAR-IIMR (R)	28 th January 2016	Maturity	Dr Sushil Pandey, NBPGR, New Delhi Dr Prabhakar, CRS-IIMR, solapur Dr M Elangovan, IIMR, Hyderabad

15. Papers Published:

- (i) Papers published in peer reviewed journal (NAAS rating may be given)
- (ii) Papers presented at scientific meetings:
- (iii) Manuscripts under preparation: Two abstracts submitted to IAC2016

16. Patents/varieties and products developed or in pipeline: Nil

Signature:

Name: M ELANGO VAN

Designation: Principal Scientist

Principal Investigator: Dr. M. Elangovan

Date: 07th June 2016

Director/Project Director / Project Coordinator