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Performance of Selected Mini Core and Promising Varieties for Productivity and Grain Quality Traits in *Rabi* Sorghum

Ashwini Karadi[1*] and S.T. Kajjidoni[2]

[1]Indian Institute of Horticultural Research, Banglore, Karnataka, India
[2]University of Agricultural Science, Dharwad, Karnataka, India

**Corresponding author*

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A B S T R A C T

An investigation was carried out to assess the performance of selected mini core collection and promising varieties of sorghum for grain quality traits and productivity traits. Highly significant difference was observed among the selected mini core accessions and varieties of sorghum for all the traits except true density in selected mini core accessions. Mini core accessions found significantly superior over standard check M35-1 for all the traits except seed yield per plant and true density. IS-15931 was the tallest plant with highest panicle length, seed yield per plant and hundred seed weight with maximum seed size with highest seed protein content. IS-13459 and IS-1041were top performing accessions for seed protein and seed amylose content. Among varieties, SVD-803 was having highest seed yield per plant, hundred seed weight, seed size, seed volume, bulk density and seed amylose content. The top performing superior lines can be used as donar parent in crop improvement programme.

Introduction

Sorghum (*Sorghum bicolor* (L.) Moench) is an important staple food in several regions of Africa, China and Indian subcontinent particularly in the semi-arid tropics. It is a major food crop in sub-Saharan Africa and South Asia and is the staple food for the most food-insecure people in the world (Bibi *et al.*, 2010).Worldwide, it is cultivated on 41.07 million ha area with production of 58.42 million tonnes in the year approx., 2019-20 (Anonymous, 2019a). In India, sorghum having 5.00 million ha area with 4.5 million tonnes production and 900 kg/ha productivity in the year 2019-20 (Anonymous, 2019b). The grain productivity of *rabi* sorghum in India is lower (750 kg/ha) than *kharif* sorghum (1100 kg/ha) even though *rabi* sorghum is highly valued because of its excellent grain and fodder quality. The varieties and hybrids developed did not become popular because of poor grain quality and shoot fly susceptibility. In *rabi* sorghum, breeding for grain quality components like seed size, seed volume, density of seed and nutritional quality traits like amylose and protein content are as important as that of the breeding for higher yield. For many years *rabi* sorghum growing areas, the roti made

from Maldandi (M 35-1) is preferred for taste and softness, over the other genotypes. But now days some new genotypes of *rabi* sorghum are developed which gives better nutritional as well as grain quality than the M 35- 1.

Mini core collection (10% accessions of the core collection or 1% of entire collection) represents the whole range of variation of cultivated sorghum and is an ideal material for assessing the exact nature and magnitude of variability of the crop. Mini core collection is considered as a gateway for utilization of diversity present in large germplasm collection for crop improvement (Upadhyaya, *et al.,* 2009). Developing new sorghum genotypes with high yield potential coupled with nutritionally superior quality grains is the prime objective of the breeding programme. The present investigation deals with the details of grain and nutritional quality of mini core collection and sorghum varieties by systematic breeding programme and compared with the local check M35-1.

Materials and Methods

The plant material for this experiment comprised of (a) 24 selected mini core collection out of 208 mini core accessions based on grain hardness, grain colour and grain luster along with M 35-1 as check variety (Table-1). The mini core collection of sorghum obtained from DSR Hyderabad. (b) Sixteen selected released/promising varieties of *rabi* sorghum which are commonly grown in northern Karnataka (Table-2). The experiment was laid out in medium deep black soil under rain fed condition *was* carried out in two experiments at AICRP, UAS, Dharwad during *rabi* season of 2012-13.The randomized block design was followed separately with two replications and each entry was sown in four rows of 4 m length with inter row spacing of 45 cm and intra row spacing of 15 cm. Observations on all quantitative characters like plant height (cm), panicle length (cm), panicle width (cm), seed yield per plot (g), 100 seed weight (g), seed volume (ml), bulk density (g/ml), true density (g/ml), seed size (mm), seed protein (%), seed amylose (%) and seed yield/plot (kg).

Plant height (cm): Height of the plant from ground level to the tip of the matured panicle was measured and recorded in centimeters.

Ear head length (cm): Ear head length was recorded from the base of the panicle to the tip of the panicle and expressed in centimetres.

Ear head width (cm): Width of the ear head was measured at the broadest point.

100-seed weight (g): The weight of 100 seeds drawn randomly from randomly selected plants was recorded and expressed in grams.

Grain yield per plant (g): Grains harvested from the plants of each treatment were dried and weighed. The average grain weight of plants is expressed in grams as grain yield per plant.

Seed volume: Countable numbers of seeds were placed in a measuring jar and its volume was noted. Later seed volume per seed was recorded.

$$\text{Seed volume (ml)} = \frac{\text{Volume (ml)}}{\text{Number of seeds}}$$

7. Seed bulk density (g/ml): Hundred gram of seeds were weighed and volume was recorded in a measuring jars. It was calculated by using the formula:

$$\text{Bulk density (g/ml)} = \frac{\text{Weight (g)}}{\text{Volume (ml)}}$$

Seed true density: Known weight of seeds placed in a measuring jar containing known quantity of toluene. Increase in volume was recorded after pouring seeds in it. The seed true density was recorded by using the formula:

$$\text{True density} = \frac{\text{Weight (g)}}{\text{Volume (ml)}}$$

Seed size (mm): By using *Vernier Callipers,* length, breadth and thickness of seeds were recorded. Seed size was calculated using the formula.

$$\text{Seed size} = \sqrt[3]{\text{Length (mm)} \times \text{breadth (mm)} \times \text{thickness (mm)}}$$

Estimation of biochemical parameters

Seed protein (per cent): Protein content of selected genotypes was estimated by using Microkjeldhal method. Total nitrogen was estimated by using Kel-plus (digestion and distillation unit). Crude protein value was obtained by multiplying the total nitrogen by the conversion factor.

Amylose content (percent): Total amylose was estimated by following the method of Soubhagya and Bhattacharya (1979), 100 mg sample was taken in a 100 ml volumetric flask, disperse 1 ml of alcohol followed by 10 ml of 1 N NaOH leave it for overnight, make the volume upto 100 ml from distilled water. From this extract 2.5 ml was taken, add 20ml distilled water, add 3 drops of phenolphthalein indicator, it will change to pink color, add 0.1 N HCl, till it becomes colourless, now add 1 ml of 0.2 per cent iodine solution, make volume made up to 100 ml. The purple-blue was read at 590 nm.

Statistical analysis

All treatments were replicated twice and organized in a randomized complete block design (RCBD). Data acquired from the present investigation was subjected to ANOVA (Sheoran *et al.,* 1998). Significance between the treatments were calculated according to Duncan's Multiple Range Test at p=0.05 using GenStat 14th edition.

Results and Discussion

In the present investigation which included 25 mini core and 16 promising varieties were carried out in order to study the performance varieties of *rabi* sorghum for eleven quantitative characters. Highly significant difference was observed for all the yield traits like plant height, ear head length and ear head width, hundred seed weight and seed yield per plant in both selected mini core and selected promising varieties. However, highly significant result were observed for all productivity, grain quality and nutritional quality traits like seed volume, seed size, protein and amylose except bulk and true density in selected mini core and bulk density and seed size among the selected promising varieties (Table 3).

This indicates that the selected mini core collection indicating wide genetic variability and there is ample scope for selection of characters from these diverse sources for yield and its components. These findings were in accordance with the findings of Vedansh *et al.,* (2010) and Khandelwal *et al.,* (2016)

Performance of selected mini core and promising varieties for yield, grain and nutritional quality traits in *rabi* sorghum

Performance of selected mini core and promising varieties for yield traits in *rabi* sorghum in table 4 and 5. Selected mini core collection and selected varieties were having wide genetic diversity with tallest to shortest, having longer and wider panicle to shorter panicle.

Table.1 Selected genotypes of mini core collections of sorghum (Experiment-a)

SI. No.	Accession number	Origin	Seed hardness	Seed lustre	Seed color
1	IS-473	USA	Very hard	Lustrous	White
2	IS-1041	India	Hard	Lustrous	White
3	IS-2379	South Africa	Very hard	Non lustrous	Light brown
4	IS-3971	India	Very hard	Intermediate	Creamy straw
5	IS-4515	India	Hard	Lustrous	White
6	IS-5295	India	Very hard	Intermediate	Chalky white
7	IS-5301	India	Very hard	Lustrous	White
8	IS-12697	Australia	Hard	Intermediate	Brown
9	IS-12937	Ethiopia	Very hard	Lustrous	Light red
10	IS-12945	Nicaragua	Very hard	Lustrous	White
11	IS-13294	Venezuda	Very hard	Intermediate	Light brown
12	IS-13459	Mexico	Hard	Lustrous	Brown
13	IS-13971	South Africa	Very hard	Intermediate	Light brown
14	IS-15931	Cameroon	Hard	Lustrous	Chalky white
15	IS-19153	Sudan	Very hard	Lustrous	White
16	IS-22720	Somalia	Hard	Lustrous	White
17	IS-24139	Tanzania	Very hard	Intermediate	White
18	IS-28849	Yemen	Hard	Intermediate	White
19	IS-29358	Lesotho	Very hard	Intermediate	Light yellow
20	IS-30443	China	Very hard	Lustrous	Chalky white
21	IS-30450	China	Very hard	Non lustrous	Brown
22	IS-30572	Cameroon	Very hard	Intermediate	Yellow
23	IS-13893	South Africa	Hard	Intermediate	Reddish brown
24	IS-13782	South Africa	Very hard	Intermediate	Red
25	M35-1	India	Hard	Lustrous	White

Table.2 List of selected released/promising varieties of *rabi* sorghum (Experiment-b)

SI. No.	Varieties name
1	DSV-4
2	SPV-86
3	SPV-1829
4	BJV-44
5	DSV-5
6	A-1
7	CSV-216R(Phuleyashoda)
8	PhuleVasudha
9	PhuleRevathi
10	M35-1 (Akola source)
11	M35-1 (Bijapur source)
12	BarsiJowar
13	Kodmurki (popular local)
14	SVD-803(Advanced breeding lines)
15	SVD-808 (Advanced breeding lines)
16	SVD-770(Advanced breeding lines)

Table.3 Analysis of variance for yield and yield attributing traits in selected mini core collections of sorghum

Parameters	Plant height (cm)	Ear head length (cm)	Ear head width (cm)	100 seed weight (g)	Seed yield/plant (g)	Seed volume (ml)	Bulk density (g/ml)	True density (g/ml)	Seed size (mm)	Protein content (%)	Amylose content (%)
Selected mini core collection of sorghum											
P value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.036	0.799	<0.001	<0.001	<0.001
Vr	131.63	547.77	145.9	22.78	48.36	97.01	2.11	0.71	15.17	54.31	37.93
Mean	223.84	25.58	9.06	2.85	20.09	0.04	0.96	1.24	3.42	10.64	29.64
Range	163.6-334.2	6.4-42.5	4.4-21.50	1.97-4.34	2.63-44.68	0.02-0.07	0.94-0.98	1.17-1.34	2.79-3.82	7.66-13.78	17.5-36.84
SE±	3.68	0.41	0.42	0.14	2.12	0	0.01	0.05	0.08	0.23	1.03
LSD (P 0.05)	10.75	1.21	1.22	0.42	6.19	0	0.02	0.16	0.24	0.68	3.01
CV (%)	2.3	2.3	6.5	7.1	14.9	4.5	0.9	6.2	3.4	3.1	4.9
Selected varieties of sorghum											
P value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0088	<0.001	0.009	<0.001	<0.001
Vr	928.8	55.75	26.88	21.98	28.62	19.88	3.7	13.88	3.56	11.17	8.56
Mean	251.13	19.51	6.78	3.6	32.45	0.04	0.92	1.32	3.73	9.66	23.95
	191.6-289.5	12.2-23.9	5.4-6.3	3.15-4.4	10.98-29.2	0.04-0.05	0.71-0.98	1.12-1.54	3.4-4.1	8.09-8.86	20.85-26.67
SE±	0.84	0.39	0.13	0.08	1.69	0	0.08	0.02	0.06	0.23	0.7
LSD (P 0.05)	2.53	1.17	0.4	0.23	5.08	0	0.23	0.07	0.18	0.69	2.12
CV (%)	0.5	2.8	2.8	3	7.3	3.5	2.9	3.7	6.4	3.3	4.1

Table.4 Mean performances of selected mini core collection of sorghum for yield, grain and nutritional quality traits

Parameters	Plant Height (cm)	Ear head length (cm)	Ear head width (cm)	Hundred seed weight (g)	Seed yield per plant (g)	Seed volume (ml)	Bulk density (g/ml)	True density(g/ml)	Seed size (mm)	Protein (%)	Amylose (%)
IS-473	214.00 efg	38.30 k	21.50 k	2.65 cde	5.91 abc	0.03 cdef	0.96 bcde	1.34 a	2.93 a	8.09 ab	31.67 f
IS-1041	193.50 c	22.50 f	7.70 f	3.45 fg	25.78 hi	0.05 h	0.95 ab	1.17 a	3.61 ef	12.47 i	34.17 fg
IS-2379	215.50 efg	31.10 ij	14.00 i	2.62 bcde	7.03 abc	0.03 cdef	0.95 abcde	1.24 a	3.01 ab	10.28 fg	31.67 f
IS-3971	165.10 a	9.80 b	5.10 ab	2.61 bcde	5.71 abc	0.03 def	0.96 bcde	1.24 a	3.04 ab	11.16 h	34.17 fg
IS-4515	243.50 jlm	18.30 de	7.30 ef	3.94 hij	44.68 k	0.06 k	0.96 bcde	1.20 a	3.73 f	9.86 ef	35.84 g
IS-5295	210.00 def	31.70 ij	11.60 gh	1.97 a	5.48 abc	0.02 a	0.97 de	1.27 a	2.79 a	8.53 bc	35.84 g
IS-5301	236.00 ijkl	12.20 c	5.80 bcd	3.51 fgh	34.30 j	0.05 h	0.97 cde	1.27 a	3.68 f	9.41 de	35.84 g
IS-12697	221.00 fgh	27.30 h	10.90 g	2.50 bcde	3.21 a	0.03 def	0.96 bcde	1.34 a	3.05ab	8.09 ab	34.01 fg
IS-12937	225.00 ghi	22.40 f	6.60 cdef	2.46 bcde	31.83 ij	0.03 def	0.97 cde	1.26 a	3.28 bcd	8.97 cd	31.67 f
S-12945	204.50 cde	25.30 g	6.90 def	2.75 e	11.82 cdef	0.03 fg	0.97 de	1.24 a	3.59 ef	12.03 i	31.67 f
IS-13294	259.50 n	30.70 ij	7.70 f	2.16 ab	3.77 ab	0.03 bcd	0.96 bcde	1.21 a	3.54 ef	7.66 a	35.84 g
IS-13459	270.50 o	21.20 f	7.10 def	16.88 a	10.73 bcde	0.03 ab	0.95 abcd	1.23 a	2.90 a	13.78 j	34.17 fg
IS-13971	253.20 mn	30.40 i	6.50 bcdef	2.52 bcde	16.03 defg	0.03 efg	0.96 abcde	1.19 a	3.37 cde	9.41de	34.17 fg
IS-15931	303.50 p	40.00 l	12.80 hi	4.11 ij	33.58 j	0.06 k	0.96 bcde	1.25 a	3.75 f	12.47 i	33.34 fg
S-19153	167.20 a	17.90 d	6.00 bcde	3.36 fg	31.65 ij	0.05 hi	0.95 abcde	1.24 a	3.71 f	10.50 fgh	25.84 e
IS-22720	204.90 cde	6.40 a	4.40 a	3.80 ghi	17.54 efg	0.05 ij	0.95 abcde	1.21 a	3.68 f	11.16 h	20.83 b
IS-24139	334.20 q	40.80 l	11.00 g	2.26 abcd	12.44 cdef	0.03 bc	0.97cde	1.24 a	3.54 cef	12.03 i	20.83 b
IS-28849	193.00 c	17.50 d	5.40 abc	4.34 j	9.20 abcd	0.07 l	0.96 bcde	1.24 a	3.67 f	10.72 gh	17.50 a
IS-29358	180.70 b	22.00 f	5.70 abcd	2.74 de	20.70 gh	0.04 g	0.97cde	1.27 a	3.60 ef	10.28 fg	20.84 bc
IS-30443	277.50 o	42.50 m	20.80 k	2.53 bcde	28.52ij	0.03 def	0.96 abcde	1.27 a	3.00 a	12.03 i	24.17 bde
IS-30450	198.50 cd	19.40 e	5.40 abc	2.31 abcde	2.63 a	0.03 cdef	0.95 abc	1.18 a	3.28 bc	13.78 j	22.50 bcd
IS-30572	197.50 c	30.70 ij	19.30 j	2.20 abc	18.00 fg	0.03 bcde	0.94 a	1.22 a	3.68 f	12.36 i	20.84 bc
IS-13893	232.00 hij	31.80 j	5.30 abc	2.57 bcde	28.15 ij	0.03 cdef	0.96 bcde	1.26 a	3.55 ef	10.28 fg	34.17fg
IS-13782	163.60 a	31.90 j	5.80 bcd	2.63 bcde	33.45 j	0.03 fg	0.97 bcde	1.22 a	3.69 f	11.16 h	36.84 g
M35-1	232.00hijk	17.40 d	6.00 bcde	3.30 f	60.19 l	0.05 jk	0.98 e	1.34 a	3.82 f	9.41 de	22.50bcd

Table.5 Mean performances of selected released varieties of sorghum for grain quality and biochemical characters

Parameters	Plant height (cm)	Ear head length (cm)	Ear head width (cm)	Hundred seed weight (g)	Seed yield per plant (g)	Seed volume	Seed size	Bulk density	True density	Protien	Amylose
DSV-4	253.00 g	23.50 i	6.90 cde	4.05 g	37.64 c	0.05 def	3.63 abc	0.94 c	1.55 e	9.84 def	20.85 a
SPV-86	191.60 a	20.90 fgh	6.30 b	3.38 abc	29.00 b	0.04 b	3.82 bc	0.78 a	1.34 bcd	8.09 a	20.85 a
SPV-1829	280.50 i	19.80 ef	6.30 b	3.21 a	28.04 b	0.05 cde	3.71 bc	0.72 a	1.21 ab	10.55 fg	20.85 a
BJV-44	271.00 h	21.00 fgh	7.10 def	3.49 bc	30.99 b	0.05 cde	3.71 bc	0.98 c	1.50 de	9.84 def	22.50 ab
DSV-5	271.00 h	20.60 fg	5.40 a	3.48 bc	10.98 a	0.05 bc	3.40 a	0.86 b	1.13 a	9.84 def	24.17 bcd
A-1	249.00 f	12.20 a	6.25 b	3.19 a	42.61 c	0.04 a	3.67 bc	0.96 c	1.25 abc	10.28 ef	24.19 bcd
Phule Yashoda	289.50 j	21.80 gh	7.15 ef	3.22 a	26.85 b	0.05 bcd	3.68 bc	0.97 c	1.40 bcde	10.06 def	22.50 ab
Phule Vasudha	279.00 i	23.90 i	8.45 h	3.15 a	31.38 b	0.05 cde	3.70 bc	0.97 c	1.24 abc	11.15 g	25.84 de
Phule Revathi	270.50 h	22.00 h	7.35 fg	3.32 ab	40.35 c	0.05 bcd	3.68 bc	0.98 c	1.31 abcd	9.40 cd	22.50 ab
M35-1 (Akola)	249.50 f	18.50 cd	6.70 bcd	3.57 bcd	26.31b	0.05 gh	3.71 bc	0.74 a	1.34 bcd	9.41 cd	23.34 bc
M35-1 (Bijapur)	224.50 b	17.70 c	6.60 bc	3.85 efg	42.21 c	0.05 cdef	3.58 ab	0.98 c	1.44 cde	9.63de	25.84 de
Barsi Jowar	230.50 c	18.70 cde	6.50 bc	4.40 h	28.07 b	0.06 i	3.77 bc	0.96 c	1.25 abc	9.40 cd	25.84 de
Kodmurki	240.50 d	16.10 b	6.30 b	3.61cde	29.20 b	0.05 efg	3.90 cd	0.94 c	1.22 ab	8.86 bc	26.67 e
SVD-803	247.00 ef	17.90 cd	6.65 bc	3.96 fg	49.68 d	0.06 h	3.84 bc	0.95 c	1.32 abcd	9.40 cd	25.84 de
SVD-808	245.50 e	18.50 cd	6.85 cde	3.78 def	28.46 b	0.05 fgh	4.09 d	0.95 c	1.40 bcde	8.53 ab	25.86 de
SVD-770	225.50 b	19.10 de	7.60 g	3.90 fg	37.38 c	0.05 efg	3.74 bc	0.97 c	1.26 abc	10.28 ef	25.55 cde

Table.6 Top five superior performing genotypes identified for seed yield and grain quality traits in selected mini core collections of sorghum

Traits	Plant height	Panicle	Panicle width	Seed yield per plant	100 seed weight	Seed size (mm)	Protein (%)	Amylose
	(cm)	length (cm)	(cm)	(g)	(g)			(%)
1	IS-24139	IS-30443	IS-473	IS-4515	IS-28849	IS-15931		IS-4515
	(334.20)	(42.50)	(21.5)	(44.68)	(4.34)	(3.75)	IS-13459	IS-5295
							IS-30450	IS-5301
							(13.78)	IS-13294
								(35.84)
2	IS-15931	IS-24139	IS-30443	IS-15931	IS-15931	IS-4515	IS-1041	IS-1041
	(303.50)	(40.80)	(20.80)	(33.58)	(4.11)	(3.73)	IS-15931	IS-3971
							(12.47)	IS-13459
								IS-13971
								IS-13893
								(34.17)
	IS-30443	IS-15931	IS-30572	IS-13782	IS-4515	S-19153	IS-30572	IS-12697
	(277.50)	(40.00)	(19.30)	(33.45)	(3.94)	(3.71)	(12.36)	(34.01)
Mean	223.84	25.58	9.06	20.09	2.85	3.42	10.64	29.64
C.D. at 5%	10.75	1.21	1.22	0.28	0.43	0.24	0.68	3.01
C.D. at 1%	18.25	4.09	1.26	0.38	0.58	0.39	0.93	4.15

Table.7 Top five superior performing genotypes identified for seed yield and grain quality traits in selected promising varieties of sorghum

SI. No.	Plant height (cm)	Ear head length (cm)	Ear head width (cm)	Seed yield/plant (g)	100 seed weight (g)	Seed	Seed Protein	Seed Amylose
						Size (mm)	(%)	(%)
1	Phule Yashoda	Phule	SVD-770	SVD-803	Barsi Jowar	SVD-808	Phule	Kodmurki
		Vasudha					Vasudha	
	(289.50)	(23.9)	(7.6)	(49.68)	(4.4)	(4.09)	(11.15)	(26.67)
2	SPV-1829	DSV- 4	Phule	A-1	DSV-4	Kodmurki	SPV-1829	SVD-808
			Revathi					
	(280.50)	(23.5)	(7.35)	(42.61)	(4.05)	(3.9)	(10.55)	(25.86)
3	Phule Vasudha	Phule Revathi	BJV-44	M35-1 (Bijapur)	SVD-803	SVD-803	A-1	SVD-803
								Barsi Jowar
	(279.00)	(22)	(7.1)	(42.21)	(3.96)	(3.84)	(10.28)	(25.84)
Mean	251.91	19.61	6.78	32.45	3.60	3.73	9.66	23.95
C.D. at 5%	2.53	1.17	0.4	0.55	0.23	0.18	0.69	2.12
C.D. at 1%	9.39	2.01	1.4	0.76	1.01	0.32	0.95	2.93

The seed yield per plant and hundred seed weight having wide range variability compared to standard commercial check M35-1. The selected mini core and selected varieties were having huge variation for seed volume, bulk density and seed size. These materials were good source of nutritional quality traits like seed protein and seed amylose

Plant height (cm)

Highly significant difference was observed among the mini core accessions for plant height. Significant superior accessions were found for the plant height compared to standard check M35-1 presented in Table 3. The tallest plant observed was IS-24139 (334.2 cm) and shortest plant observed was IS-13782 (163.6 cm). The average plant height was 223.84cm in selected mini core accessions. Among selected promising varieties, highly significant difference was observed among varieties. The tallest plant recorded was phule yashoda (289.50cm) and shortest plant was observed as SPV-86 (191.60cm).The average plant height noticed that 251.13cm in Table 4.

Ear head length (cm)

For ear head length, highly significant difference was observed among the mini core accessions. Significant superior accessions were found for ear head length over standard check M35-1. The longest ear head length observed was IS-30443 (42.5cm) and shortest ear head length recorded was IS-22720(6.4cm). The average ear head length was 25.58cm.Wheras, among released varieties, highly significant difference was observed for ear head length. Variety A1(12.2cm) was recorded as longest and Phule vasudha (23.9cm) was observed as shortest for ear head length. Mean of the ear head length was 19.15cm.

Ear head width (cm)

Significant superior accessions were found for ear head length over standard check M35-1 and highly significant difference was observed among the selected mini core accessions for ear head width. The widest ear head width observed was IS-473 (21.50cm) and narrowest ear head width recorded was IS-22720 (4.4cm). Average ear head width was 9.06cm. Among varieties also highly significant difference was observed whereas, the maximum ear head width recorded in Phule vasudha (8.45cm) and minimum was DSV-5(5.4cm). The average ear head width in varieties was 6.78cm.

Hundred seed weight (gm)

Highly significant difference was observed among the mini core accessions for hundred seed weight. Significant superior accessions were found for the hundred seed weight compared to standard check M35-1(3.30gm) such as IS-4515 (3.94gm), IS-15931(4.11gm), IS-22720 (3.80gm) and IS-28849 (4.34gm). The maximum hundred seed weight was observed was IS-28849 (4.34gm) and minimum noticed was IS-5295 (1.97gm). The mean of the hundred seed weight was 2.85gm. Among selected varieties, highly significant difference was observed among varieties but some of the varieties were non-significant or on par with each other which was shown in the table 4. The maximum hundred seed weight was observed was Barsi Jowar (4.4gm) and minimum was recorded in phule vasudha (3.15gm). The average hundred seed weight was 3.6gm.

Seed yield per plant (gm)

Among the selected mini core accessions, highly significant difference was observed for seed yield per plant. None of the accessions found as significant superior compared to standard check M35-1 (60.19gm). The highest

seed yield per plant was observed in IS-4515 (44.68gm) and lowest yield was recorded in IS-30450 (2.63gm).The average seed yield per plant was 20.09gm. In case of selected varieties, highly significant difference was noticed. The highest seed yield per plant was observed was SVD-803 (49.68gm) and lowest was DSV-5 (10.98gm).The mean of the seed yield per plant was 32.45gm.Most of the varieties are on par with each other for seed yield.

Seed volume (ml)

In the present study, highly significant difference was observed for seed volume. IS-28849 (0.07 ml) was recorded for maximum seed volume and significantly superior than standard check M35-1(0.054 ml). The lowest seed volume was observed in IS-5295 (0.02 ml) and average was 0.04 ml.Whereas, highly significant difference was noticed among varieties and highest observed was Barsi Jowar (0.06 ml) and SVD-803 (0.06 ml). The lowest was A-1 (0.03 ml) and mean was 0.04 ml.

Seed size (mm)

Most of the accessions were on par with each other with M35-1 and also shown highly significant difference was observed among the accessions. The average seed size was 3.42 mm. Among varieties, significant superior SVD-808 (4.09mm) recorded for maximum seed size and lowest was DSV-5 (3.97mm).The average seed size was 3.73mm.

Bulk density (g/ml)

None of the accession found as significant superior than M35-1 but they highly significant difference was found for bulk density. Mean of the bulk density was 0.96g/ml. Most of the varieties were on par with each other. Varieties were significantly different for bulk density and average bulk density was 0.92g/ml.

True density (g/ml)

All the accessions were on par with each other and also with standard check M35-1 recorded in selected mini core collections. The average value was observed was 1.24g/ml. Among selected varieties, highly significant difference was found for this trait and mean value was recorded was 1.32g/ml.

Seed protein (%)

Highly significant difference was found among the selected mini core accessions. Most of the accessions were found as significant superior than M35-1 (9.41%). Average seed protein content was recorded was 10.64% in selected mini core accessions. Among selected varieties, highly significant difference was found for this trait.

The highest seed protein content was recorded was in Phule Vasudha (11.15%) and found as significantly superior than M35-1. The lowest seed protein was recorded was SPV-86 (80.9%). The mean value was recorded was 9.66%. Most of the varieties were on par with each other having same seed protein content.

Seed amylose (%)

Most of the accessions were found as significantly superior for seed amylose content compare to M35-1(22.5%).Highly significant difference was found among selected mini core accessions and several accessions were on par with each other for seed amylose content.

The accession with highest seed amylose content was recorded was IS-13782 (36.84%) which was on par with most of the accessions. The lowest seed amylose content was recorded was IS-28849 (17.50%) and average seed amylose content was 29.64%. Whereas, among selected varieties highly significant difference was observed for seed amylose. Kodmurki was having highest seed amylose content 26.67% with lowest was 20.85%. DSV-4, SPV-86 and SPV-1829 were on par with each other having seed amylose content (20.85%).

The average seed amylose content was 23.95% in the selected varieties. Most of the varieties

were on par with each other having same seed amylose content.

Mean performance of top five superior selected mini core accessions were identified for seed yield and grain quality traits in *rabi* sorghum (Table 6 and 7). IS 15931 was the tallest plant with highest panicle length, seed yield per plant and hundred seed weight with maximum seed size with highest seed protein content.IS-15931 which is hard, lustrous and chalky white which can be used as donor parent in breeding programme. IS-13459 and IS-1041 were top performing accessions for seed protein and seed amylose content. IS-1041 which is hard, lustrous and white in colour which is having superior grain and nutritional quality.

Among varieties, SVD-803 was recorded highest for seed yield per plant, hundred seed weight, seed size, seed volume, bulk density and seed amylose content. Most of the varieties are superior more than one trait which was presented in Table

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