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SVT 55: A High Yielding Rabi Sorghum Variety with Multiple Pest Tolerance

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

SVT 55 is a high yielding Rabi sorghum culture identified at Agricultural Research Station, Tandur, Professor Jayashankar Telangana State Agricultural University, Telangana and released by State Varietal Release Committee during 2023 in the name of Tandur Jonna 55 for the state of Telangana. It matures in 115-120 days and is adapted specifically to Rabi season. The culture recorded an average seed yield of 3245 kg/ha, with a mean grain yield advantage of 26 % over the popular check M 35-1and 12.3 % over the local check SVT 68 in the trials conducted during 2016-2022. The culture is moderately resistant to charcoal rot, recorded on par pest reaction score with respect to resistant checks for the insect pests of shoot fly, stem borer, aphids and fall army worm. It has high crude protein content (10.96 %) and good roti quality.

Keywords: Sorghum bicolor; shootfly; stem borer; fall army worm.

1. INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench] is one of the important cereal crop cultivated globally for food, fodder, feed and fuel. It ranks fifth after wheat, rice, maize and barley in area and production. The area under sorghum in the world is 39.95 million hectares with production of 58.06 million metric tones and productivity of 1.45 metric tonnes/ha. In India, it is grown over an area of almost 4.82 million ha, with a production of over 4.77 million tonnes and a productivity of 989 kg/ha. [1]. In India, Rabi Sorghum is extensively grown in Deccan Plateau, in the states of Maharashtra, Karnataka, Andhra Pradesh and Telangana. In Telangana, it is majorly cultivated in the districts of Adilabad, Nizamabad, Mahabubnagar, Vikarabad, and Sangareddy as a rainfed crop by marginal farmers in residual soil moisture conditions to meet the demand of grain for consumption and dry fodder for animal feed. The productivity is low in Rabi sorghum as it is cultivated by farmers in poor soils under limited input and management conditions. Apart from soils and limited inputs the other production constraints are charcoal rot, shootfly, aphids, shootbug and recently fall army worm which is causing severe losses since last 4-5years. In order to improve productivity under medium to low input conditions it is essential to identify and cultivate high yielding genotypes which have considerable level of tolerance/resistance to the above pests and diseases. Keeping this in view, AICRP on Sorghum scheme at Agricultural Research Station, Tandur attempted to develop high yielding dual purpose Rabi sorghum varieties with considerable level of tolerance to the major pests and diseases suitable for the state of Telangana.

2. MATERIALS AND METHODS

SVT 55 is derived from the cross between the parents M 35-1, a selection from Maldandi land race and SPV 1359 (CSV 216 R or PhuleYashoda) which is a selection from Dhulia germplasm from Maharashtra. Crossing, F_1 selfing and single plant selections were made from F_2 to F_6 generations following pedigree breeding at ICRISAT from 2009 to 2015. The selections were based on tall plant height (180-200cm), sturdy stem, dark green leaves, large semi compact panicles, bold lustrous grains, high per se plant yield and non lodging habit. The promising F_6 lines were identified by ARS, Tandur during field day and seed material was shared by ICRISAT for further evaluation. The uniform F_6 progenies were evaluated in station trials (Observation yield trial (OYT), Preliminary yield trial (PYT) and Advanced yield trial (AYT) at ARS, Tandur for three years from Rabi 2016-2018 and the promising culture SVT 55 was identified. The culture was tested in All india coordinated trials (IVT, AVT I and AVT II) from 2019-2022 in the name of SPV 2644 and its performance with respect to grainyield, fodderyield, pest/disease score(through natural infestation) were assessed at several locations in the country. Standard package of practices and recommended plant protection measures were followed to raise a good crop and to maintain proper plant stand in order to get reliable data during field evaluation. Minikits (OFTs) were conducted in farmers fields in the state covering 11 districts namely Komarambheem Asifabad, Nizamabad, Nagarkurnool, Nirmal, Vikarabad, Medak, Sangareddy, Rangareddy, Mancherial, Jangaon and Bhongir. Data pertaining to grain and fodder yields were recorded based on uniform plot size of 11.10 sqmt in station trials,

Table 1. DUS Characteristics of SVT 55 (SPV 2644)

S.No.	Character	Remarks
1	Leaf sheath: Anthocyanin pigmentation	Present
2	Leaf: Midrib colour (5th fully developed leaf from bottom)	Yellow green
3	Plant: Time to 50% flowering (50% of the plants with 50% anthesis)	Medium
4	Flag leaf: Colouration of midrib	White
5	Lemma: Arista formation	Present
6	Stigma: Yellow colouration	Present
7	Stigma: Length (mm)	Medium
8	Flower with pedicel: Length of flower	Medium
9	Anther: Length (mm) S	Medium
10	Stem/leaf sheath: Waxy bloom (epicuticular wax at upper one-third height of plant)	Present
11	Stigma: Anthocyanin colouration	Present
12	Anther: Colour of dry anther	Greyed orange
13	Glume :Colour	Greyed orange
14	Plant: Total height (cm) at maturity (including panicle)	Tall
15	Stem : Diameter (at lower one-third height of plant) (cm)	Small
16	Leaf: Length of blade (the third leaf from top including flag leaf) (cm)	Long
17	Leaf: Width of blade (the third leaf from top including flag leaf) (cm)	Broad
18	Panicle : Length without peduncle (cm)	Medium
19	Panicle : Length of branches (middle third of panicle) (cm)	Medium
20	Panicle : Density at maturity (ear head compactness)	Semi loose
21	Panicle : Shape	Symmetric
22	Neck of panicle : Visible length above sheath (cm)	Very long
23	Glume : Length	Medium
24	Plant: Pigmentation (at lower one-third height of plant)	Non tan
25	Grain: Threshability	Freely threshable
26	Grain: Colour after threshing	Greyed orange
27	Grain : Weight of 1000 grains (g)	Medium
28	Grain: Shape (in dorsal view)	Circular
29	Grain: Size of mark of germ	Medium
30	Grain: Texture of endosperm (in longitudinal section)	¾ farinaceous
31	Grain: Colour of vitreous albumen	Greyed yellow
32	Grain :Lustre	Lustrous

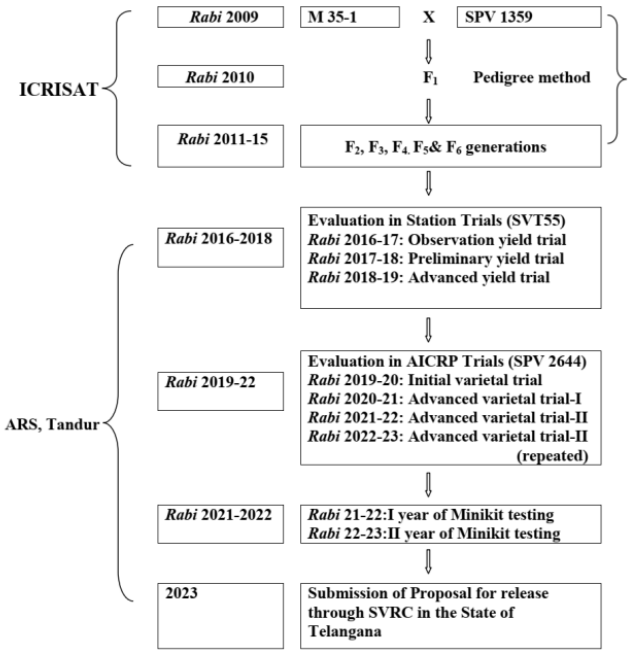

Fig. 1. Pedigree flow chart of SVT 55(SPV 26+44 development and evaluation

Fig. 2. Field view, panicles and grain of SVT55 (SPV 2644)

AICRP trials and 0.5 acre area of test entry and 0.5 acre area of check in minikits. Thenutritional constituents, organoleptic quality parameters and roti quality were estimated at quality lab, MPKVRahuri, Maharashtra during 2019-21using standard protocols. The flow chart depicting the process of development and field evaluation of the culture was shown in Fig. 1. Crop phenology was presented in Fig. 2 and DUS descriptors of the culture were presented in Table 1.

3. RESULTS AND DISCUSSION

3.1 Grain and Fodder Yield Performance

The culture was tested in station trials during Rabi 2016-18. SVT 55 recorded a mean grain yield of 3470 kg/ha with a yield increase of 40 % over the popular check M 35-1(2489 kg/ha) and dry fodder yield of 7154 kg/ha with a yield advantage of 8.8 %over M 35-1(6567 kg/ha) (Table 2).

The entry recorded a mean grain yield of 3025 kg/ha with an advantage of 11.7% over the check M 35-1(2708 kg/ha) in AICRP trials conducted at 64 locations during 2019-2022.The culture recorded an average dry fodder yield of 9541 kg/ha with a yield advantage of 9.71% over M 35-1 (8696 kg/ha) in AICRP trials conducted at 68 locations during 2019-2022. (Tables 3-7).

SVT 55 recorded a mean grain yield advantage of 40 % over the check M 35-1 in station trials and a mean grain yield advantage of 12.1 % over the check M 35-1 in AICRP trials. Hence the pooled grain yield advantage of 26 % was recorded by the culture over the check M 35-1 in the trials put together during 2016-2022 (Table 9a).SVT 55 recorded a mean fodder yield advantage of 8.8 % over the check M 35-1 in station trials and a mean fodder yield advantage of 9.71 % over M 35-1 in AICRP trials. Hence the pooled grain yield advantage of 9.25 % was recorded by the culture over the check M 35-1 in the trials put together during 2016-2022 (Table 9b).

Table 2. Summary of Grain yield and fodder yield performance of Sorghum culture SVT 55 in Station trials conducted during Rabi 2016-19

S. No	Trial	Year	Grain yield (kg/ha)			Fodder yield (kg/ha)		
			SVT55	Check M 35-1	% Superiority	SVT 55	Check M 35-1	% Superiority
1	OYT	2016-17	3605	2330	54.7	6741	6272	7.5
2	PYT	2017-18	3023	2655	13.8	6813	6406	6.4
3	AYT	2018-19	3782	2482	52.3	7908	7022	12.6
	Mean		3470	2489	40.2	7154	6567	8.8

Table 3. Grain and Fodder yield performance of Sorghum culture SVT 55 in IVT-All India Coordinated trials during Rabi 2019-20

S. No.	Locations	Grain yield (kg/ha)		Fodder yield (kg/ha)	
		SVT 55	Check M 35-1	SVT 55	Check M 35-1
1	Nandyal	3139	3000	12037	8951
2	Tancha	1503	1461	5706	5646
3	Bagalkot	2213	2592	-	-
4	Bheemarayangudi	1824	1412	10417	8333
5	Bijapur	2550	1882	8203	7325
6	Chamrajnagar	5757	4305	11128	8215
7	Dharwad	2513	1762	5598	3188
8	Gulberga	3819	3574	13953	13079
9	Hagari	3538	3391	13889	9969
10	Raichur	2320	2695	17125	15894
11	Aurangabad	3501	2975	12406	10915
12	Ekarjuna	3138	3327	8138	8919
13	Parbhani	-	-	9636	8732
14	Rahuri	1176	965.5	6244	4933
15	Solapur	-	-	7057	6456
16	Madhira	3258	3198	12012	12462
17	Tandur	4686	2562	6677	6350
	All India Mean	2996	2607	10014	8710

Table 4. Grain and Fodder yield performance of Sorghum culture SVT 55 in AVT1-All India Coordinated trials during Rabi 2020-21

S.No.	Locations	Grain yield (kg/ha)		Fodder yield (kg/ha)	
		SVT 55	**Check M 35-1**	**SVT 55**	**Check M 35-1**
1	Nandyal	5009	3120	17221	11638
2	Tancha	2051	1187	-	-
3	Chamrajnagar	6502	7060	4876	5515
4	Dharwad	3739	438	5247	864
5	Gulberga	2422	2096	14537	15926
6	Hagari	3644	3144	15741	18519
7	Aurangabad	2925	2623	8859	7267
8	Ekarjuna	2695	3066	7207	7973
9	Karad	2559	2293	6430	5667
10	Nanded	2009	2042	7132	9384
11	Parbhani	2009	2042	7132	9384
12	Rahuri	2634	1291	7956	3806
13	Solapur	815	765	3649	3979
14	Washim	2724	3156	7324	8150
15	Adilabad	4414	2746	13243	7854
16	Madhira	3704	3357	13189	12617
17	Tandur	-	-	**3555**	**2388**
18	Raichur	2102	1829	**-**	**-**
	All India Mean	3239	2952	9512	9341

Table 5. Grain and fodder yield performance of sorghum culture SVT 55 in AVT-2 of All India coordinated trials during Rabi 2021-22

S.No.	Locations	Grain yield (kg/ha)		Fodder yield (kg/ha)	
		SVT 55	Check M 35-1	SVT 55	Check M 35-1
1	Nandyal	-	-	15028	8646
2	Tancha	2965	3355	14890	18041
3	Bijapur	2223	1886	4471	6156
4	Dharwad	2838	2051	-	-
5	Gulberga	1424	1698	9322	9650
6	Hagari	2550	3048	40436	28948
7	Aurangabad	1259	1206	5931	6379
8	Ekarjuna	2778	2578	8730	7941
9	Mohol	1713	1069	4085	3540
10	Nanded	4764	4387	15196	14924
11	Parbhani	1485	1514	6613	5464
12	Rahuri	3106	1646	11414	8771
13	Solapur	1836	1442	5340	4880
14	Washim	2787	2671	8672	8047
15	Adilabad	5330	2590	7029	4860
16	Madhira	4011	3779	12173	11489
17	Tandur	4742	2517	6316	4169
	All India Mean	2868	2404	11146	9560

Table 6. Grain and fodder yield performance of Sorghum culture SVT 55 in AVT-2 All India Coordinated trials during Rabi 2022-23

S.No.	Locations	Grain yield (kg/ha)		Fodder yield (kg/ha)	
		SVT 55	Check M 35-1	SVT 55	Check M 35-1
1	Nandyal	-	-	10957	9877
2	Deesa	2765	2571	6907	7207
3	Tancha	2296	2525	8670	9309
4	Bijapur	2884	3226	5479	5054
5	Chamrajnagar	5636	6187	5667	6480
6	Dharwad	3027	3121	5315	3634
7	Gulberga	1076	983	6093	6064
8	Hagari	2963	2654	18568	18392
9	Aurangabad	2529	2621	6564	6263
10	Ekarjuna	3194	3021	9538	9102
11	Mohol	1726	1156	5265	4344
12	Parbhani	2324	1724	6967	6517
13	Nanded	-	-	11688	9970
14	Solapur	1773	1463	5225	4474
15	Solapur(ADR)	-	-	2750	2579
16	Washim	3210	3108	8799	8926
17	Rahuri	-	-	7423	6285
18	Adilabad	4453	3753	6734	7629
19	Madhira	3047	3408	13033	10691
20	Tandur	4788	4036	6122	6935
	All India	2981	2847	7902	7477

Table 7. Abstract of Grain and fodder yield performance of Sorghum culture SVT 55 inAll India Coordinated trials during Rabi 2019-2022

Year of Testing	SVT55	Check M 35-1	SVT 55	Check M 35-1
	Grain yield (kg/ha)		**Fodder yield (kg/ha)**	
2019-20, IVT	2996	2607	10014	8710
2020-21, AVT-1	3239	2952	9512	9341
2021-22, AVT-2	2868	2404	11146	9560
2022-23, AVT-2	2981	2847	7902	7477
Weighted Mean	**3025**	**2708**	**9541**	**8696**
2019-20, IVT	% increase or decrease over weighted mean	14.92	% increase or decrease over weighted mean	14.97
2020-21, AVT-1		9.72		1.83
2021-22, AVT-2		19.30		5.68
2022-23, AVT-2		4.70		
	Mean	11.70	Mean	9.71

SVT 55 recorded a mean grain yield of 4765kg/ha and a grain yieldadvantage of 14.5% over the check SVT 68 (4164 kg/ha) in AICRP trials conducted during 2021-2023 and a mean grain yield of 1963 kg/ha and a grain yield advantage of 10.1 % over SVT 68 (1783 kg/ha) inminikits during 2021-2023 (Table 8). Hence the pooled grain yield advantage of 12.3 % was recorded by the culture over the check SVT 68 in all the trials put together during 2016-2022 (Table 10).

3.2 Pest Resistance

3.2.1 Shoot fly

The culture SVT 55 was evaluated from Rabi 2019 to 22 along with resistant and susceptible checks for pest reaction of shoot fly, stem borer, shoot bug, aphids and fall army worm at different locations in the country.SVT 55 recorded shoot fly dead heart % of 19.8 at 28 days of emergence as compared to popular check M 35-1 (26.9), resistant check IS18551 (13.8) and susceptible check DJ 6514 (52.1) (Table 11). Sorghum is attacked by nearly 150 insect pests [2,3]. sorghum shoot fly, *Atherigona soccata*, is a serious pest which affects the crop from 5-30 days after sowing, In India, shoot fly causes damage to the extent of 80–90% loss in grain yield and 68% loss in fodder yield in kharif season [4,5]. Host plant resistance is the most economical and practical means of its control [6,7]. As per standard shoot fly scoring system, (Table 13).[8,9] the culture SVT 55 (19.8%) was considered as resistant to shoot fly. Cultivated germplasm has low to moderate levels of resistance which is inherited quantitatively, and controlled by additive gene action [10]. The culture SVT 55 identified in the present study can thus be used as a donor in shoot fly improvement resistance breeding programmes.

3.2.2 Stem borer

SVT 55 recorded stemborer dead heart % of 11.2 at 45 days of emergence compared to popular check M 35-1 (10.5), Resistant check IS 2205 (9.2) and susceptible check Swarna (17.4). (Table 11),[11]. It was reported as a serious pest in Indian and African subcontinent [12]. Resistance to stem borer is conferred by several morphological and biochemical traits [13]. The nature of resistance is additive and partially dominant over susceptibility [14]. The nocturnal habit of the adults and the cryptic behaviour of the larvae residing inside plant stem make stem borers difficult to control. The use of insecticides for its control is uneconomical and beyond the reach of resource poor farmers. Hence Host plant resistance offers the best option for minimizing losses due to stem borers [12].

3.2.3 Shoot bug

Shoot bug (*Peregrinus maydis*) is a minor pest earlier but becoming more severe under Rabi situations [15]. SVT 55 recorded shoot bug score of 3.3 compared to popular check M 35-1 (4.1), resistant check (4.2) and susceptible check (5.4) (Tables 11 and 13).

3.2.4Sugarcane aphid

SVT 55 recorded aphid score of 3.1 compared to popular check M 35-1 (3.3), Resistant check TAM 428 (3) and susceptible check Swarna (5.1) (Table11,13) [16]. Sugarcane aphid (*Melanaphis sacchari*) occurs more severely in Rabi season under extreme drought conditions when the sugar content in the sap increases due to moisture stress in the soil. Aphid infestation in sorghum is high during the flowering and grain-filling stages. Insecticides are costly and, at times, beyond the reach of resource-poor farmers in the semi-arid tropics. The application of chemical insecticides for aphid control under subsistence farming conditions is not economically viable. Therefore, it is important to identify sorghum cultivars that are resistant or less susceptible.

3.2.5 Fall army worm

Fall army worm (*Spodoptera frugiperda*) is a new pest causing severe losses since last 3-4 years threatening the food security and livelihoods of millions' smallholder farmers and consumers worldwide. High reproductive rate, strong flier, polyphagous feeding behavior and overlapping generations are the reasons for its faster spread and severe infestation [17,18]. In the present study the culture SVT 55 recorded fall army worm damage of 10 % compared to M 35-1 (13.2), resistant check (9.8) and susceptible check (15.2) (Table 11) [19].In order to avoid the losses caused by these pests and reduce the cost of cultivation incurred by the farmer through pesticide sprays, it is necessary to identify sorghum genotypes which are not only high yielding but also have considerable level of resistance/tolerance. The culture SVT 55 recorded lower pest damage and on par pest reaction values when compared to resistant checks for the insect pests of Shoot fly, Stem borer, Aphids, Shoot bug and fall army worm.

Table 8. Abstract of grain yield performance of sorghum culture SVT 55 in minikts during Rabi 2021-2023

S.No.	Year	DAATTC/ KVK	No. of locations	Yield (kg/ha)		% increase over check SVT 68
				Minikit entry SVT 55 (kg/ha)	Check SVT 68 (kg/ha)	
1.	2021-22	KVK,Bellampalli	15	1092	1021	7
2.		KVK,Rudrur	2	2438	2063	18
3.		KVK,Palem	8	2250	2050	9.7
4.		DAATTC, Mudhole	9	1029	942	9.2
5.		DAATTC, Tandur	3	2447	2210	10.7
6.		DAATTC, Sangareddy	3	1316	1193	10.3
		Mean	40	1762	1579	11.5
	2022-23	KVK,Rudrur	5	2515	2430	3.4
1		KVK,Palem	10	2053	1873	9.6
2		KVK,Bellampalli	27	1071	993	7.8
3		DAATTC, Mudhole	5	2715	2437.5	11.3
4		DAATTC, Bhongir	5	2034	1748	16.36
5		DAATTC, Malthummeda	4	2710	2484	9.09
6		DAATTC, Tandur	5	2050	1950	5.1
7		Mean	61	2164	1987	8.90
	2021-23	Total	101	1963	1783	10.1

Table 9a. Abstract of performance of the sorghum culture, SVT 55 for grainyield in the trials from Rabi *2016-23* in comparison with M 35-1

S.No.	Trial	Season/ Locations	SVT 55(kg/ha)	M 35-1(kg/ha)	% increase in grain yield
1	Station trials (2016-2018)	Rabi*/1*	3470	2489	40
2	AICRP trials	Rabi */16*	2996	2607	15
	IVT(2019-20)				
	AVT I (2020-2021)	Rabi */16*	3239	2952	9.7
	AVT II (2021-2022)				
	AVT II(2022-23)	Rabi */16*	2868	2404	19.3
		Rabi */16*	2981	2847	4.7
	Mean		3021	2702	12.1
	Overall Mean		3245	2595	26.0

Table 9b. Abstract of performance of the sorghum culture, SVT 55 for fodderyield in the trials from Rabi *2016-22* in comparison with M 35-1

S.No.	Trial	Season/ Locations	SVT 55(kg/ha)	M 35-1(kg/ha)	% increase in fodderyield
1	Station trials (2016-2018)	Rabi/*1*	7154	6567	8.8
2	AICRP trials	Rabi */16*	10014	8710	15
	IVT(2019-20)	Rabi */16*	9512	9341	9.7
	AVT I (2020-2021)	Rabi */16*	11146	9560	19.3
	AVT II (2021-2022)	Rabi */20*	7902	7477	4.7
	AVT II(2022-23)				
	Weighted mean		9541	8695	9.71
	Overall Mean		8347	7631	9.25

Table 10. Abstract of performance of the sorghum culture, SVT 55 for grain yield in AICRP trials and minikits conducted from Rabi *2021-23* in comparison withSVT 68

S. No.	Trial	Season/ Locations	SVT 55 (kg/ha)	SVT 68 (kg/ha)	% increase in grain yield
1	AICRP trials AVT II (2021-2022) AVT II (2022-2023)	Rabi */16* Rabi */16*	4742 4788	4293 4036	10.4 18.6
	Mean		4765	4164	14.5
2	Minikits (2021-2023)	Rabi */101*	1963	1783	10.1
	Overall Mean		3364	2973	12.3

Table 11. Abstract of reaction of sorghum culture SVT 55 against various pestsin AICRP trials conducted during Rabi *2019-2022*

Pest	Year	Proposed Variety SVT 55	Check M 35-1	Resistant check	Susceptible Check	CD (0.05)
1. Shoot fly Dead heart % at 28 DAE	2019-20	27.4	37.3	18.9	52.5	11.4
	2020-21	17.2	23.9	10.2	54.3	17.3
	2021-22	9.2	13.5	10	45	12.78
	2022-23	25.4	33	16	56.4	11
	Mean	19.8	26.9	13.8	52.1	
2. Stem borer Deadheart % at 45 DAE	2019-20	10.8	11.3	3.9	14.3	4.2
	2020-21	9.6	8	11.2	17.7	11.5
	2022-23	13.1	12.1	12.4	20.2	4.3
	Mean	11.2	10.5	9.2	17.4	
3. Shoot bug damage (1-9 Score)	2019-20	3.7	4.8	4.8	6	0.8
	2020-21	2.8	3.3	3.5	4.7	1.2
	Mean	3.3	4.1	4.2	5.4	
4. Aphids damage (1-9 Score)	2019-20	4.3	4.8	3.9	5.3	1.6
	2021-22	2.7	2.4	3.3	6.1	1.7
	2022-23	2.3	2.8	1.9	3.9	1.14

Pest	Year	Proposed Variety SVT 55	Check M 35-1	Resistant check	Susceptible Check	CD (0.05)
	Mean	3.1	3.3	3.0	5.1	
	2020-21	9.5	18.2	12.4	23.2	6.2
5. Fall Army Worm damage (%)	2022-23	10.5	8.2	7.1	7.2	2.87
	Mean	10	13.2	9.8	15.2	

Table 12. Abstract of reaction of Sorghum culture SVT 55 against various diseases inAICRP trials conducted during Rabi 2019-2022

Disease	Year	SVT 55	Check M 35-1	Rcheck	S Check	CD (0.05)
1. Charcoal rot Index (%)	2019-20	26.9	17.5	8.1	31.0	5.4
	2020-21	22.9	16.9	12.0	32.0	5.6
	2021-22	19.1	19.5	8.7	32.0	5.2
	2022-23	19.5	20.7	10.0	31.0	6.8
	Mean	22.1	18.7	9.70	31.5	
2. Leaf blight (1-9 score)	2019-20	5	5.2	4.8	5.3	1.5
	2020-21	5.1	4.6	4.3	5.8	1.6
	2021-22	3.8	3.8	2.4	4.1	1
	2022-23	4.6	4.8	4.5	5.4	0.9
	Mean	4.6	4.6	4.0	5.2	
3. Rust (1-9 score)	2019-20	3.3	4.1	1.7	4.2	1.7
	2020-21	5.4	5.1	4.8	6	2.7
	2021-22	3.7	4	3	4.1	1.4
	2022-23	5.1	4.5	3	5.1	1.2
	Mean	4.4	4.4	3.1	4.9	
4. Viral diseases (%)	2019-20	1	3	1	3	3.3
	2020-21	3	3.7	2.3	6.3	1.4
	Mean	2.0	3.4	1.7	4.7	
5. Downy mildew (%)	2019-20	20	25	31	14	12.9
	2021-22	11	16	29	7	8.3
	Mean	15.5	20.5	10.5	30	

Table 13. Standard evaluation/Scoring system followed for pests and disease screening through natural infestation in the present study

S.No	Pest/disease	Standard evaluation/Scoring system	Reference
1	Shoot fly	Interlard-fish meal technique Highly resistant 0-10% dead hearts, Resistant (10-20% dead hearts), Moderately resistant (20-30% dead hearts), Susceptible (30-50% dead hearts) Highly susceptible (> 50% dead hearts).	[8,9]
2	Stem borer	1 – 9 score 1<10 %leaf area damaged. 2. 11-20 % 3. 21-30 % 4. 31-40 %. 5. 41-50 %. 6. 51-60 % 7. 61-70 % 8. 71-80 %. 9. > 80 %	[11]
3	Sugarcane aphids	1 – 9 score. 1- no damage to the leaves. 2. 10-20% 3. 20-30 % 4. 30-40%. 5. 40-50%. 6. 50-60% 7. 60-70% 8. 70-80%. 9. > 80%	[16]
4	Shoot bug	1 – 9 score 1- no damage to the leaves. 2. 10-20%. 3. 20-30 % 4. 30-40%. 5. 40-50%.	[11]

S.No	Pest/disease	Standard evaluation/Scoring system	Reference
		6. 50-60% 7. 60-70% 8. 70-80%. 9. > 80% leaf area damaged and plants with a twisted appearance and no panicle emergence	
5	Fall army worm	1–9 score (<40% score resistant, 50-60%moderately resistant, >70% susceptible 1.<10%of leaf area damaged 2. 10-20 %. 3. 20-30 % 4. 30-40 %. 5. 40-50 %. 6. 50-60 % 7. 60-70 % 8. 70-80 %. 9. > 80 %	[19]
6.	Charcoal rot	< 10 % of Charcoal rot index index-resistant, 11-25%-moderately resistant 26-40% -susceptible > 40% -highly susceptible	[20]
7	Leaf blight	1-5 score (1-No visible symptoms/chlorotic Flecks,-highly resistant) 2-Up to 10% leaf area covered with small restricted lesions -resistant) 3-11−25% leaf area covered with small restricted lesions-moderately resistant) 4-26−50% leaf area covered with large coalescing lesions-susceptible) 5->50% leaf area covered with large coalescing lesions-highly susceptible)	[23]
8	Rust	0-No symptoms seen on the leaf and perfectly healthy 1-0.1-5% of the leaf area is affected-immune or highly resistant 3- 5.1-20% of the leaf area is affected, resistant) 5- 20.1-40% of the leaf area is affected, moderately resistant	[24]

S.No	Pest/disease	Standard evaluation/Scoring system	Reference
		7-40.1-75% of the leaf area is affected, moderately susceptible 9- >75% of the leaf area is affected, highly susceptible	
9	Downy mildew	1-5 scale <5% systemically infected plants are regarded as resistant	[25]
10	Viral diseases	< 10% infection is resistant/tolerant >10% is susceptible	[26]

Table 14. Mean data on Nutritional constituents and Organoleptic quality parameters in AICRP trials conducted during *Rabi* 2019-21(MPKV, Rahuri)

S.No.	Parameter	SVT 55	M 35-1
1	Hectolitre weight (Kg/hl)	76.97	77.47
2	Crude Protein (%)	**10.96**	**10.70**
3	Soluble proteins (%)	1.03	1.15
4	Total sugars (%)	1.92	2.06
5	Starch (%)	48.99	50.88
6	Free amino acids (mg/100g)	71.70	74.96
7	Phenolics (%)	2.02	1.91
8	Water required for dough (ml)	83.35	79.47
9	Kneading quality	1	1
10	Spreading quality	1	1
11	Colour & appearance	7.05	4.83
12	Texture	7.25	7.31
13	Taste	7.02	7.03
14	Overall acceptability	7.06	7.26

(Kneading quality of dough score: Good = 1, Fair = 2, Poor = 3.
Spreading quality of roti score: Easy spreading without crack = 1, Slightly difficult to spread with minute cracks = 2, Difficult to spread with cracks =3.
Sensory score:Like extremely (Excellent) - 9, Like very much (Very good) - 8, Like moderately - 7, Like slightly-6, Neither like nor dislike - 5, Dislikes lightly - 4, Dislike moderately - 3, Dislike very much - 2, Dislike extremely)

3.3 Disease Resistance

3.3.1 Charcoal rot

The culture SVT 55 was evaluated from Rabi 2019 to 22 along with resistant and susceptible checks for the diseases charcoal rot, leaf blight, rust, viral diseases and downy mildew and scored as per standard evaluation system (Table 13). SVT 55 recorded a charcoal rot index % of 22.1 when compared to the resistant check E 36-1 (9.7) and Susceptible check (31.5) (Table 12).Thus the culture SVT 55 (CRI of 22.1) is found to be moderately resistant to charcoal rot [20]. Charcoal rot disease caused by the fungus (*Macrophomina phaseolina*) is a great concern in Rabi season in tropical and subtropical regions as the most of the crop is grown on residual soilmoisture after cessation of rainfall. The indirect loss computed due to charcoal rot alone amounts to 23-64 % [21]. Due to complex quantitative inheritance of resistance, very little progress has been made in breeding for charcoal rot resistance. Selection of stiff-stalk and non-senescent (stay-green) types with high productivity is considered important in breeding for charcoal rot resistance [22]. Development and cultivation of resistant cultivars is the only feasible option for the management of the disease as it is soil borne.

3.3.2 Other diseases

SVT 55 recorded a leaf blight score of 4.6 when compared to the resistant check (4) and susceptible check (5.2). The culture recorded a rust score of 4.4 when compared to the resistant check (3.1) and susceptible check (4.9). SVT 55 recorded a downy mildew % of 15.5 when compared to the resistant check (10.5) and susceptible check (30). SVT 55 recorded a viral disease score of 2 when compared to the resistant check (1.7) and susceptible check (4.7) [26]. (Table 12) [23,24,25,26] . SVT 55 recorded intermediate values of disease score when compared to resistant and susceptible checks indicating presence of considerable tolerance to leaf blight, rust, viral diseases and downy mildew. Moreover these diseases are considered as minor diseases as their incidence during the Rabi season is meagre owing to the cultivation of crop in dry conditions in the absence of rainfall and humidity.

3.4 Nutritional Quality

The culture recorded higher crude protein content (10.96 %) when compared to the check M 35-1 (10.7) in AICRP trials conducted during 2019-21. The other nutritional, organoleptic/ sensory parameters with respect to roti quality were on par with M 35-1 (Table 14).

4. CONCLUSION

Since Rabi sorghum is a dual purpose crop grown for food for human consumption and dry fodder for animals, the grain yields and fodder yields are equally important in identifying promising cultures. The culture SVT 55 recorded superior grain and fodder yield gain of 26 % and 9.25 % respectively over the most popular check M 35-1 which is very popular among the farming community as maldandi. The culture recorded a grain yield advantage of 12.3 % over SVT 68 (local check) the Rabi sorghum variety which was released prior to SVT 55in 2021 for the state of Telangana.Ithas higher protein content in the grain when compared to M 35-1 and has acceptable roti quality. The pest and disease reaction is optimal with moderate resistance to charcoal rot and considerable degree of tolerance to shootfly, stemborer, aphids, shoot bug and fall army worm. Hence, the culture SVT 55 was released by State Varietal Release Committee and notified (S.O. 1560(E) 26.03.2024) during the year 2023 as Tandur Jonna 55 for general cultivation in Telangana.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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