

PHULE ROHINI (RPASV 3): A SPECIAL RABI SORGHUM VARIETY SUITABLE FOR PAPAD PURPOSE

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Abstract: Phule Rohini (RPASV 3) a *rabi* sorghum variety suitable for *papad* purpose was developed from local land races through pure line selection at Rahuri found superior in better *papad* quality over the checks M 35-1, Dadar Local and local variety Chikani. Average of fourteen tests, it gave 1715 kg/ha grain yield and 4886 kg fodder yield. This is special purpose genotype for processing. There is no grain yield advantage over the M 35-1 and Dadar local but 75.4 % increase over Chikani local variety. Organoleptic studies revealed that the *papad* of RPASV 3 had more crispiness and very good test. Average number of *papad* per kg flour of RPASV 3 is 65 pieces (each piece weight average 14 to 15 gram). *Papad* quality studies revealed that *papad* prepared from RPASV 3 had red brown attractive colour with more expansion (34.54 %) and less oil absorption (17.9%). Nutritional constituent's of grains revealed that the genotype RPASV 3 had recorded higher Crude Protein (8.93%), soluble proteins (1.21 %), Total sugars (1.42%), Starch (42.6 %), zinc (4.02 mg /100g), iron (9.68 mg /100g) and calcium (21.83 mg /100g). The variety RPASV 3 is tolerant to charcoal rot (21.2%), shootfly (30.0 % Dead Heart) and stem borer (6.9 % Dead Heart). Beside, being the better *papad* qualities, it is characterized as Non-Tan plant pigment. Flowers in 73-75 days, matured in 116-118 days, mid -tall plant stature (170 to 190 cm). It had semi-compact oval shape panicle with red round grains at maturity. This variety was observed to be drought tolerant (higher in RLWC, Photosynthetic rate, stomatal conductance, ear head exertion and root traits and lower in Stomatal frequency and transpiration rate. The variety RPASV 3 was therefore released under the name Phule Rohini for special purpose suitable for *papad*.

Keywords: *Papad*, crispiness, red brown, organoleptic.

Introduction

Sorghum is nutritionally superior to other fine cereals such as rice and wheat .It is sustainable choice for dry land of Maharashtra during *rabi* season facing frequent drought. Because of its lower digestibility, sorghum is being recommended for diabetic and Jaundice affected and abase people. There is a need to popularize the sorghum food as sorghum with its high mineral and fiber content and with low or slow starch digestibility and makes an ideal food for diabetic and abase population in the urban and rural society. *Papad* is one of the popular *snac* items and it is very tasty so it is used in every Indian diet since older days. It is

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consumed either as such often frying or roasting or as adjunct along with vegetable soup and curries. The demand for papad is greater scope for introduction of varieties from cost effective raw ingredient such as grain sorghum.

Today consumption of *papad* from udid and mung are popular among the peoples in the day to day time. It is also popular in the restaurants and hotels. Preparation of *papad* from mung or udid are economically costlier than the *papad* made from sorghum. In the Kandesh tract viz, Jalgaon, Dhule and Nandurbar, the peoples are preparing the *papad* from local variety like Chikani and local Dadar. Among these Chikani is *kharif* adapted genotypes while Local Dadar is *rabi* adapted genotype. These *papads* prepared from above genotypes are popular among the Khandesh region. The special genotype can provide to end users and hence can make sorghum commercially viable in food enterprises provided their yield level and nutritional quality are comparable for better than existing popular local variety. In this view, to identify a suitable genotype for food processing like papad making special rabi sorghum variety RPASV was tested with local varieties for its field performance and nutritional analysis of grains and papad. The objective of this paper is to describe the development and characteristics of land race papad purpose variety.

Materials and Methods

The Sorghum Improvement Project, MPKV, Rahuri has collected the four local land races (Lal chikani, Dark red chikani, Pandhri Chikani and local dadar) during the year 2004-05 from the Shirpur local market (Dhule District). During the 2005-06, the above four local land race Lal Chikani, Dark Chikani, Pandhri Chikani and Local Dadar along with 21 IS lines i.e. total 25 genotypes were evaluated during *rabi* season. The purifications particularly in above four local land races were made during the year 2006-07. During the year 2007-08 to 2010-11, these local land races were purified and maintained and numbered as RPASV-3 (Lal Chikani), RPASV 5 (Dark Chikani), RPASV 24 (Pandhri Chikani) and RPASV 25 (Local Dadar). Among these, RPASV 3 is found promising for *papad* purpose during the rabi season. During the year 2011-12 the genotype RPASV 3 along with M 35-1, Dadar local and Chikani local variety were evaluated in station trial for grain and fodder yield. The genotype RPASV 3 was tested in station trials during the year 2011-12 and in University Multilocation trials during 2012-13 to 2014-15 at Rahuri, Mohol, Chas, Solapur and Jalgaon for grain and fodder yield potential. The varietal trials were conducted as per the norms and recommended procedure as per university programme (Anonymous. 2011). The observations were recorded viz., phenological, morphological, grain, fodder, shootfly, stem borer and charcoal rot data as

per the standard procedure. The organoleptic papad properties of RPASV 3 along with M 35-1, finger millets and Black gram were evaluated for various sensory quality parameters (colour and appearance, texture, flavor and taste and overall acceptability) was carried out by using the standard method of Amerine *et al* (1965). For this ten semi trained judges were used and one to nine points hedonic scale was used for rating the quality of papad. The mean of ten judges was consider for evaluating the quality at Rahuri during 2013-14. The nutritional composition of grain and fodder was analyzed at Sorghum Project, MPKV, Rahuri during the year 2012-13 and 2011-12, respectively (Amerine *et al*, 1965). The papad quality and its keeping quality (storage) studies was taken during the year 2013-14 at Rahuri .The drought tolerance studies of RPASV 3 with M 35-1, Dadar Local and Chikani local were conducted from 2012-13 to 2014-15 at Rahuri. The statistical analysis was done as per the methods of Panse and Sukhatme (1985). During the *rabi* 2014-15, 24 adaptive trials of the PPASV 3 and checks (M 35-1 and Chikani local) were evaluated on farmers field under rainfed condition in Ahmednagar, Pune, Solapur, Satara, Sangali, Kolhapur, Nashik, Nadurbar, Dhule and Jalgaon for grain and fodder yield.

Results and discussion

The genotype RPASV 3 was evaluated in station trial during the year 2011-12 and in university MLT from 2012-13 to 2014-15 with the checks M 35-1, Dadar local and Chikani local variety. Based on overall performance for four years over 14 tests (Table 1), RPASV 3 produced mean grain yield (1715 kg/ha) over M 35-1 (1819 kg/ha), Dadar local (1822 kg/ha) and Chikani local variety (978kg/ha). The results indicated that there were no grain yield increase over M 35-1 and Dadar local but 75.4 % increase over Chikani local variety. As regard fodder yield (Table 2), it yielded 4886 kg/ha fodder yield in 14 tests over M 35-1 (6973 kg/ha), Dadar local (6834 kg/ha) and Chikani local variety (4333 kg/ha). The results revealed that there were no fodder yield increase over M 35-1 and Dadar local but 12.8 % increase over Chikani local variety.

The data on 24 adaptive trial on farmers field (Table 3) indicated that the genotype RPASV 3 produced 934 kg/ha grain yield over M35-1 (1382 kg/ha) and Chikani local variety (781 kg/ha). The results revealed that there were no grain yield increase over M 35-1 and dadar local but 19.6 % increase over Chikani local variety. In respect of fodder yield, the genotype RPASV 3 exhibited 3470 kg/ha fodder yield over M35-1 (4490 kg/ha) and Chikani local variety (2900 kg/ha). The results revealed that there were no fodder yield increase over M 35-1 but 18.4 % increase over Chikani local variety.

The papad prepared from the genotype RPASV 3 along with M 35-1, Finger millet and Black gram were studied for organoleptic properties (Table 4). The result revealed that the 10 semi trained judge panel preferred papad prepared from RPASV 3 and Finger millet due to attractive colour, flavor, more crispiness and taste as compared to M 35-1 and Black gram papad. The result also indicated (Table 5) that the genotype RPASV 3 showed red brown attractive colour papad with less oil absorption (17.9 %) as compared the papad prepared from Finger millet and Black gram that gives additional benefit to the product. Therefore the papad prepared from RPASV 3 are far better than other papad which are available in the market.

The keeping quality (storage) studies (Table 6) indicated that the papad of RPASV 3, M 35-1, Finger millet and Black gram stored up to 12 months in plastic bags and card board box at room temperature was observed very good. The nutritional constituent of grain revealed that (Table 7), the genotype RPASV 3 recorded higher crude protein (8.93%) and comparable soluble protein (1.21%), total sugar (1.42%), starch (42.64%), zinc (4.02 mg /100g), iron (9.68 mg /100g) and calcium (21.83 mg /100g) and lower phenolics (1.94%) as compared to the checks. As regard fodder quality (Table 8) it recorded higher crude protein (7.81%), comparable crude fiber (31.54 %), NDF (62.12%), ADF (42.37%) and IVDMD (49.37%) as compared to the checks. The variety RPASV 3 (Table 9) had tolerance to charcoal rot (21.2%), Shoot fly (30% Dead Heart) and stem borer (6.9% Dead heart) as compared to the checks. The variety of RPASV 3 was found drought tolerant (Table 10) due to its higher RLWC (83.0 %), photosynthetic rate (32.9 μ moles $\text{CO}_2/\text{m}^2/\text{sec}$), stomatal conductance (26.2 μ moles m^2/sec), lower transpiration rate (1.44 μ moles $\text{H}_2\text{O}/\text{m}^2/\text{sec}$), stomatal frequency on adaxial (148) and abaxial (159), higher ear head exertion percentage (83%) and better root traits (number (39), width (55 cm), volume (40 ml) and root mass (43 g/plant)). The rabi sorghum variety RPASV 3 has medium maturity of 116-118 days with plant height 170 to 190 cm. It had semi compact oval panicle with red colour round grain. Because of better quality papad with high grain and fodder yield over the Chikani local variety, tolerant to drought, shoot fly, charcoal rot and good fodder quality, it was recommended for release for commercial cultivation during the year 2015 in the name of Phule Rohini for papad only.

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Table 1: Grain yield (kg/ha) of *rabi* sorghum variety for papad purpose RPASV 3 (Phule Rohini) in various trials

Name of the trials	Year	No. of trial	Proposed variety RPASV 3	Checks varieties (kg/ha)		
				M 35-1	Dadar Local	Chikani (Local)
Station trial	2011-12	1	1346	1720	-	-
University MLT	2012-13	3	2041	2700	2424	2248
University MLT	2013-14	6	1636	1458	1437	874
University MLT	2014-15	4	1682	1725	1947	1306
Over all mean		14	1715	1819	1822	978
% Increase Over		-	-	-	-	75.4

Table 2: Fodder yield (kg/ha) of rabi sorghum variety for papad purpose RPASV 3 (Phule Rohini) in various trials

Name of the trials	Year	No. of trial	Proposed variety RPASV 3	Checks varieties (kg/ha)		
				M 35-1	Dadar Local	Chikani (Local)
Station trial	2011-12	1	4031	6587	-	-
University MLT	2012-13	3	5433	7159	6950	4715
University MLT	2013-14	6	4327	5625	6006	3910
University MLT	2014-15	4	5255	7116	7930	4490
Over all mean		14	4886	6973	6834	4333
% Increase Over		-	-	-	-	12.8

Table 3. Grain and fodder yield of rabi sorghum variety for papad purpose RPASV 3 (Phule Rohini) in adaptive trials on cultivars field during the year 2014-15.

Sr. No	Location of trials at farmers fields	No. of trials	Grain yield (kg/ha)			Fodder yield (kg/ha)		
			RPASV 3	M 35-1	Chikani Local	RPASV 3	M 35-1	Chikani Local
1.	Ahmednagar	5	875	1302	662	2970	4110	2370
2.	Solapur	2	685	1050	565	2325	3450	1950
3.	Pune	2	925	1175	800	3650	4200	2975
4.	Satara	2	930	1350	785	3000	3845	2595
5.	Sangali	2	845	1165	680	2895	3735	2370
6.	Kolhapur	1	910	1650	790	3150	5100	2640
7.	Nashik	2	940	1370	815	3180	4382	3180
8.	Dhule	3	843	1333	730	2850	4300	2450
9.	Nandurbar	2	1015	1400	865	3225	4500	2850
10.	Jalgaon	3	990	1496	860	3470	4490	2900
Mean (Total 24 trials)		-	934	1382	781	3178	4365	2685
% increase over		-	-	-	19.6	-	-	18.4

Table 4. Organoleptic studies of sorghum papad with Finger millet and Black gram papad for general consumer acceptance during the year 2013-14 at Rahuri

Sr. No.	Name of the papad	Papad quality parameters				
		Color and appearance	Texture	Flavour	Taste	Overall acceptance
1.	Sorghum papad (RPASV 3)	8.5	8.2	8.0	8.2	8.23
2.	M 35-1	7.10	7.6	7.3	7.5	7.38
3.	Nachani Papad	8.8	8.4	8.3	8.5	8.50
4.	Black gram papad	8.0	7.8	7.6	7.8	7.80

Table 5. Papad quality traits of RPASV 3 with Finger millet and Black gram papad during 2013-14 at Rahuri

Sr. No.	Physical characters	Papad genotypes			
		Sorghum		Nachani (Finger millet)	Black Gram
		RPASV 3	M 35-1		
1.	No of papad/kg	65	65	Market sample	Market ample
2.	Color of papad	Red brown	Faint yellow	White faint brown	Yellowish
3.	Thickness of papad (mm)	0.059	0.057	0.058	0.57
4	Diameter of papad (mm)				
a.	Before Frying	16.5	15.8	11.2	13.6
b.	After frying	22.2	20.1	23.2	15.1
c.	Expansion %	34.54	27.21	107.14	11.03
5	Weight of papad (gm)				
a.	Before Frying	16.2	19.4	3.6	6.7
b.	After frying	19.1	23.4	14.6	10.1
c.	Increase in weight %	17.9	20.6	30.35	50.75

Table 6. Keeping quality/ shelf life of sorghum papad stored in plastic bags and card board box at room temperature with nachani (Finger millet) and Black gram papad during 2013-14 at Rahuri

Sr. No.	Packing material	Papad genotypes			
		Sorghum		Nachani (Finger millet)	Black Gram
		RPASV 3	M 35-1		
1.	Plastic bags Storage period in month				
	0	Very good	Very good	Very good	Very good
	6	Very good	Very good	Very good	Very good
	12	Very good	Very good	Very good	Very good
2	Card board box Storage period in month				
	0	Very good	Very good	Very good	Very good
	6	Very good	Very good	Very good	Very good
	12	Very good	Very good	Very good	Very good

Table 7. Nutritional constituents of grain of sorghum varieties during 2012-13

Sr. No.	Genotypes	Nutritional constituents (%)					Minerals (mg / 100 g)		
		Crude Protein	Soluble Protein	Total sugars	Starch	Phenolics	Zinc	Iron	Calcium
1.	RPASV 3	8.93	1.21	1.42	42.64	1.94	4.02	9.68	21.83
2.	M 35-1	8.47	1.87	2.64	49.23	1.82	3.87	7.35	31.66
3.	Dadar Local	8.28	2.00	1.57	51.92	1.74	--	-	--
4	Chikani (Local)	7.07	1.68	1.61	42.8	1.68	3.63	7.11	34.20
	SE ₊	0.26	0.63	0.73	2.34	0.27	-	-	-
	CD at 5 %	0.84	1.98	2.27	7.02	0.82	-	-	-

Table 8. Nutritional constituents of fodder of sorghum varieties during 2011-12

Sr. No.	Genotypes	Crude Protein %	Crude fibre %	NDF %	ADF %	IVDMD %
1.	RPASV 3	7.81	31.54	62.12	42.37	49.67
2.	M 35-1	7.38	33.75	64.13	41.32	53.36
3.	Dadar Local	7.68	30.31	54.03	43.65	47.89
4.	Chikani (Local)	7.51	29.80	55.91	42.71	46.90
	SE \pm	0.20	2.06	3.63	1.11	1.83
	CD at 5 %	0.60	6.20	10.90	3.32	5.51

Table 9. Incidence of charcoal rot disease, shoot fly and stem borer pest in the rabi sorghum variety for papad RPASV 3 (Phule Rohini) and checks (mean of three years i.e. 2012-13 to 2014-15)

Sr. No.	Variety	Charcoal Rot %	Shoot fly (Dead Heart %)	Stem borer (Dead Heart %)
1.	RPASV 3	21.2	30.0	6.9
2.	M 35-1	23.8	35.5	7.7
3.	Dadar Local	24.4	36.5	8.5
4.	Chikani Local variety	22.8	40.0	7.8

Table 10. Drought tolerant studies of sorghum genotypes' under moisture stress during 2012-13 to 2014-15 at Rahuri (Mean of three years)

Sr. No.	Physiological traits	Proposed variety RPASV 3	Check varieties		
			M 35-1	Dadar Local	Chikani (Local)
1.	LAI at 50 % Flowering	4.05	4.76	4.42	3.72
2.	RLWC (%) at 50 % Flowering	80.7	73.7	75.3	75.3
3.	SPAD at 50% flowering	57.8	48.6	53.0	48.9
4.	Leaf temperature ($^{\circ}$ C)	-5.2	-4.8	-4.2	-4.9
5.	Photosynthesis rate (u moles $\text{CO}_2/\text{m}^2/\text{sec}$)	32.9	23.9	31.2	32.4
6.	Stomatal cond. (u moles/ m^2/sec .)	26.2	18.5	23.6	25.2
7.	Transpiration rate (u moles $\text{H}_2\text{O}/\text{m}^2/\text{sec}$)	1.44	1.28	1.60	1.47
8.	PAR (u moles/ m^2/sec)	460	618	435	460
9.	Stomatal frequency (mm^2) Adax.	148	150	145	152
10.	Stomatal frequency (mm^2) Abax.	159	168	170	174
11.	Ear head exertion (%)	83	79	83.5	83
12.	No. of roots	39	34	36	35
13.	Root length (cm)	55	53	54	45
14.	Root volume (ml)	40	40	35	42
15.	Root mass (g/plant)	43	43	40	39



Papad of Phule Rohini



Phule Rohini