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Studies on screening of sweet sorghum cultivars for tender sweet sorghum (*Hurda*)

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Abstract
Sweet sorghum (*Sorghum bicolor* L. Moench) is used for the preparation of *hurda* in India particularly in Maharashtra. In present investigation, screening of different sweet sorghum varieties viz. *PVRSG-101, PVR SG-102, PVR SG-8-4 and Phule Madhur* was carried out to judge the most ideal variety and the results are compared to *Surti Latur* (which is considered ideal for *hurda* preparation due to its high threshability and sweet taste). Results revealed that genotype *PVR SG-101* produced highest grain (36.2 g/plant). Complete grain maturity was observed on 90 days for proper harvesting of all varieties of sweet sorghum, beyond that grains shown to become harden. Organoleptic evaluation reported that among all investigated samples, PVR SG-101 rated highest score (9) for taste compared to other samples. Hence, it is concluded that amongst investigated varieties PVR SG-101 cultivar of sweet sorghum is most suitable for preparation of *hurda*.

Keywords: sweet sorghum, harvesting stages, morphological properties, organoleptic evaluation

Introduction

Cereals are important, as they comprise single largest food group providing the bulk to human race particularly for poor people in the developing countries. Cereals form an integral part of daily food as the cheapest and primary source of calories. They form almost complete food when supplemented with pulses. Major cereals grown all over the world are rice, wheat, corn, barely, sorghum, oat and rye. These cereals have various food and industrial applications.

Sorghum (*Sorghum bicolor* (L.) Moench) out-performs other cereals under various environmental stresses, requires little input during growth and is thus generally more economical to produce (ICRISAT/FAO, 1996). It is a vital crop for millions of peoples in parts of Africa and Asia (Dicko *et al.* 2006; ICRISAT/FAO, 1996) [6]. Sorghum is an important cereal crop for food and fodder of Indians, next to rice, wheat and maize. Largest share of country's sorghum production is contributed by Maharashtra and Karnataka states. Due to its ability to grow in dry lands of tropical Africa, India and China it has become the staple diet of these countries also (Shobha *et al.* 2008) [17].

Sorghum (also known as jowar or milo) is a major cereal crop in the semi-arid and regions of Africa and Asia where it is used in the preparation of several traditional foods. It is heat and drought resistant than most other cereals (carcea *et al.* 1992) [4]. With increasing world population and decreasing water supplies, it is an important crop for future human use (ICRISAT, 2010) [9]. World's sorghum production was 57 million metric tons and more than 35% of sorghum is grown directly for human food (Dicko *et al.* 2006) [6].

In India, the major states where this cereal grain is produced are Maharashtra, Karnataka, Gujarat, Madhya Pradesh and Andhra Pradesh. 75% of sorghum area and 85% production are concentrated in Maharashtra, Karnataka and Andhra Pradesh. Sorghum is cultivated both during rainy season (*Kharif*) and post rainy season (*Rabi*). Only about 8% of sorghum area is irrigated. Karnataka is second only to Maharashtra with regard to area coverage in India (Vikas, 2003) [21]. Maharashtra produces the maximum sorghum in India, production being supported by the districts Solapur, Pune, Bijapur, Nanded, Akola and Mahbubnagar (ICRISAT, 2010) [9].

Sweet sorghums are sorghum varieties that accumulate high levels of sugars like sucrose, glucose and fructose in the parenchyma juicy stems (Rao *et al.*, 2013) [13]. Because of its multiple uses, sweet sorghum is cultivated in semi-arid to humid climates in about 100 countries on over 44 million hectares (Sakellariou-Makrantonaki *et al*. 2007) [15]. Sweet sorghum has wider adaptability (Reddy *et al.* 2005) [14]. Also, it is well adapted to sub-tropical and temperate regions of the world and it is water efficient. Sweet sorghum has many good characteristics such as a drought resistance (Tesso *et al.* 2005) [18], waterlogging tolerance, salinity resistance (Almodares *et al*. 2007; Almodares *et al*. 2008) [1, 2] and with a high yield of biomass, etc.

Most of the sweet sorghum variety is with low grain weight per spike and grain yield, and there

is a significant negative relationship between grain yield and stalk sugar (Junfeng, 1997) [10]. Studies based on the harvesting stage of sweet sorghum were only concerned with sugar accumulation in the cane but not maximization of the grain as well (Wang, *et al.* 2009; Tsuchihashi and Goto, 2004; Timilsina *et al.* 2012) [22, 20, 19]. Consequently, information on the appropriate stage of harvesting for sweet sorghum is limited. The knowledge on useful qualities of sweet sorghum genotypes and their stage of harvesting is necessary for farmers who may want to target economic and by products from the crop, therefore the present investigation was carried out to screen the ideal variety of sweet sorghum and judge the optimum harvesting stage.

Materials and Methods

Sweet Sorghum Grain: Sweet sorghum (*Sorghum bicolor* L.) variety *viz. PVRSG-101, PVR SG-102, PVR SG-8-4* and *Phule Madhur* was procured from Sorghum Research Station, VNMKV, Parbhani. *Surti Latur* is a traditional sweet sorghum variety considered ideal for preparation of Hurda, therefore it is considered as a check variety during the investigation.

Morphological properties: Determination of morphological characteristics where determined by the varietal trials were conducted as per the norms and recommended procedure (Chavan *et al.* 2013) [5].

Harvesting stages: Four sweet sorghum genotypes were planted at Sorghum research station (SRS) experimental plots VNMKV Parbhani. After heading, the panicles were covered using paper bags to protect from bird damage. Harvesting of sweet sorghum grains was done from the onset of flowering to maturity (Moses *et al*. 2017) [11].

Organoleptic evaluation: Tender sweet sorghum was further evaluated for its organoleptic characteristics with respect to colour and appearance, taste, texture, flavor and overall acceptability using 9-point hedonic scale by semi trained panellist in the college of Food technology VNMKV Parbhani.

Statistical analysis: Statistical analysis was carried out by using (CRD) for different treatments as per the methods given by Panse and Sukhatme (1967) [12].

Results and Discussion

Morphological properties of sweet sorghum

Studies on morphological and sweet sorghum yield contributing traits (Shinde *et al.* 2016) [16]. The results pertaining to Morphological properties of sweet sorghum are presented in Table-1.

Table 1: Morphological characteristics of sweet sorghum

S. No	Phenological traits	No. of trials	Check variety	Proposed varieties			
			Surti latur	PVR SG-101	PVR SG-102	PVR SG-8-4	Phule Madhur
1	Days to 50 % flowering	5	77	73	77	73	77
2	Days to dough stage	5	96	95	87	91	83
3	Days to maturity	5	124	120	123	117	127
4	Plant Height (cm)	5	201	197	203	199	209
5	Tender grain yield (g/plant)	5	36.2	31.7	29.8	32.1	32.3
6	Easy threshable grain %	5	87	81	68	73	92.7
7	Tender grain harvest index % (TGHI)	5	56.7	68.7	62.6	40.4	72.3
8	Tender grain number per panicle	5	2287	2178	1998	1767	1878
9	1000 tender grain weight (g)	5	32.2	32.6	31.5	31.8	32.4

* Each value is mean of five determinations

Studies on morphological and sweet sorghum yield contributing traits (Table-1) indicated that, the genotype flowered in 77 days, required 96 days for dough stage (it is a stage where grain is tender and milky) and matured in 124 days. It grows to the height of 201cm. As regards sweet sorghum yield and its contributing traits, revealed that genotype *PVR SG-101* produced 1000 tender grain weight (36.6 g/plant), followed by *Phule Madhur* (32.4 g/plant) and check *Surti Latur* (32.2 g/plant), while 1000 tender grain weight was produced by PVR SG-102 (31.5 g/plant). Highest tender grain panicle was observed in check variety followed by PVR SG-101. Phule Madhur was found most suitable in terms of its threshability followed by *Surti latur* and PVR SG-101.

Harvesting stages of sweet sorghum grains

Four sweet sorghum genotypes were planted at Sorghum research station (SRS) experimental plots, VNMKV Parbhani. After heading, the panicles were covered using paper bags to protect from bird damage. Harvesting of sweet sorghum grains was done from the onset of flowering to maturity (Moses *et al*., 2017) [11]. The results pertaining to Harvesting stages of sorghum are presented in Table 2.

Table 2: Harvesting stage, duration after intrusion, and description of crop appearance.

Stage of harvesting	Duration (days)	Description of the crops
Stage I	15	Panicles have no pollen but Plants are at 50% flowering
Stage II	30	All flowers and pollen shed in plants
Stage III	60	The milk stage of grain
Stage IV	90	Grains begin to harden: soft dough stage of grain
Stage V	120	Grains almost matured

* Each value is a mean of five determinations

From the data presented in above table, it is revealed that sweet sorghum on 15 days showed no any panicles and pollen but it was in flowering stage. The plant observed on 60 days found some milk stage grain which was further began to harden towards maturity upto 90 days at stage IV. The complete grain maturity can be observed beyond 120 days for proper harvesting of sweet sorghum where grain shown to become dry due to maturation.

Organoleptic evaluation of tender sweet sorghum

Considering the results of different harvesting stages, it is observed that 90 days period is ideal for sweet sorghum. Therefore, sensory evaluation of all sweet sorghum cultivars harvested at 90 days was carried out and the results are depicted in Table-3.

Table 3: Organoleptic evaluation of tender sweet sorghum

Sr. No.	Cultivars	Sensory parameters				
		Color and appearance	Flavor	Taste	Texture	Overall acceptability
1	Control	9.0	8.0	8.5	9.0	8.5
2	PVR SG-101	9.0	8.5	8.5	9.0	9.0
3	PVR SG-102	8.5	7.5	7.5	7.0	7.0
4	PVR SG-8-4	8.5	7.0	7.0	6.0	7.5
5	Phule Madhur	9.0	8.0	8.5	7.5	8.0
SE ±		0.074	0.167	0.124	0.062	0.068
CD @ 5%		0.223	0.504	0.374	0.187	0.205

* Each value is a mean of five determination

Organoleptic characteristics are the most important properties of sweet sorghum for its consumer acceptability. The data pertaining to organoleptic evaluation showed that colour and appearance and taste of PVR SG-101 and Phule Madhur was similar to that of control (*Surti Latur*). Highest flavour profile was observed in PVR SG-101 followed by control and *Phule Madhur*, while the texture of PVR SG-101 was found excellent and similar to control sample. Considering all sensory quality parameter the overall acceptability of PVR SG-101 was found highest followed by *Surti Latur* and *Phule Madhur*.

Conclusion

On the basis of results, it could be concluded that PVR SG-101 is ideal cultivar for hurda preparation which was found to be superior that control (*Surti latur*).

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