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Gujarat Jowar-103 (Surati Ponk-1): A high-yielding Ponk sorghum variety with superior tender grain quality

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Abstract

Gujarat Jowar-103 (Surati Ponk-1), tested as SRP-5, is a newly developed ponk sorghum [*Sorghum bicolor* (L.) Moench] variety derived from the cross GJ-41 x Wani Local-15-1-1 at the Main Sorghum Research Station, Navsari Agricultural University, Surat. The genotype was advanced through pedigree selection with the objective of developing a rabi-season sorghum variety combining high tender grain yield with desirable ponk quality. SRP-5 was evaluated in a preliminary evaluation trial during late kharif 2020 and subsequently in small/large scale varietal and multilocation trials from rabi 2021-22 to rabi 2023-24 at Surat and Tanchha. Across state trials, SRP-5 recorded mean grain yield of 1544 kg/ha, dry fodder yield of 9174 kg/ha and tender grain yield of 2465 kg/ha, showing 19.6, 11.6 and 19.9 per cent improvement, respectively, over the better local check Wani Local. The entry also surpassed Phule Madhur by 60.0 per cent for grain yield, 21.4 per cent for dry fodder yield and 45.1 per cent for tender grain yield. It produced dark green, soft, sweet tender grains with 11.00 per cent protein and 17.3 brix value at tender grain stage. Morphologically, the variety is characterized by white midrib, symmetric panicle, very long neck of panicle, waxy bloom, grayed red glumes and very long glume length. The genotype showed comparable disease reaction and relatively low incidence of shoot fly and stem borer under field screening. Based on yield, quality and consumer preference, GJ-103 (Surati Ponk-1) is suitable for rabi season cultivation in the sorghum-growing areas of South Gujarat for profitable ponk production.

Keywords: Ponk, tender grain, hurda, specialty sorghum, grain quality, rabi sorghum

Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is a climate-resilient C4 cereal of the semi-arid tropics and is important for food, feed, fodder and emerging specialty food uses. In India, rabi sorghum is valued for grain quality, roti preparation, stover utility and resilience under moisture-limited production systems. Recent sorghum breeding literature emphasizes the need to combine field performance with nutritional quality, sensory preference, climate adaptation and farmer-oriented traits rather than selecting only for grain yield (Anbazhagan *et al.*, 2022; Baloch *et al.*, 2023) [2, 9].

Tender grain sorghum, locally known as ponk in South Gujarat and hurda in parts of Maharashtra, is a specialty product harvested at the dough or tender grain stage and consumed after roasting. Its market value depends on tender grain yield, ease of grain separation, grain colour, texture, sweetness, brix value, and consumer acceptability. Therefore, a ponk variety should be evaluated as a distinct food-purpose ideotype with simultaneous emphasis on tender grain yield, dry fodder yield, grain biochemical composition, organoleptic quality and pest-disease reaction.

The nutritional relevance of sorghum has received renewed attention because whole grain sorghum contains dietary fibre, slowly digestible starch, resistant starch, phenolic compounds and minerals that support its role in functional foods and diversified millet-based diets (Tanwar *et al.*, 2023; Stefoska-Needham, 2024; Singh *et al.*, 2024) [29, 28, 27]. For tender grain sorghum, sweetness and soft texture are particularly important because consumer preference is strongly

linked with the eating quality of the roasted product. A genotype combining higher brix, higher protein, desirable colour and soft texture can therefore add value to the existing ponk production system.

In South Gujarat, farmers commonly use local material such as Wani Local for ponk production. However, local cultivars often lack a balanced combination of high tender grain yield, good fodder yield, uniform quality and wider scientific characterization. Phule Madhur (RSSGV-46) provided a reference model for tender grain sorghum research by documenting development, yield, quality, sensory parameters and stress-related traits in a research-paper format (Shinde *et al.*, 2016) [26]. The present study was therefore prepared in a similar scientific structure for Gujarat Jowar-103 (Surati Ponk-1), tested as SRP-5, a new ponk sorghum variety developed by Main Sorghum Research Station, Navsari Agricultural University, Surat.

Materials and Methods

Breeding material and pedigree. The ponk sorghum genotype SRP-5 was developed at the Main Sorghum Research Station, Navsari Agricultural University, Surat from the cross GJ-41 x Wani Local-15-1-1. GJ-41 is a kharif grain sorghum variety released by NAU, Surat, while Wani Local-15-1-1 is a selection from landraces. The segregating generations were advanced by hybridization followed by pedigree selection with the breeding objective of developing a high-yielding ponk sorghum variety possessing good tender grain quality.

Trial evaluation. The genotype was evaluated in a Preliminary Evaluation Trial during late kharif 2020. After its promising performance, it was tested in small/large scale varietal trials and large scale varietal trials under the Gujarat state programme during rabi 2021-22, 2022-23 and 2023-24 at Surat and Tanchha. Surat trials represented irrigated conditions, whereas Tanchha represented residual moisture conditions with protective irrigations. In addition, the entry was tested under AICRP IASSVT-II (Hurda) during rabi 2023-24 as SPV 3135.

Crop management and observations. Recommended agronomic practices for rabi sorghum were followed. The crop was grown at 45 cm x 15 cm or 60 cm x 10 cm spacing with a seed rate of 8-10 kg/ha and fertilizer dose of 80:40:00 kg N:P₂O₅:K₂O per hectare. Observations were recorded on days to flowering, days to maturity, plant height, panicle traits, 1000 grain weight, tender grain stage, grain yield, dry fodder yield and tender grain yield. Distinguishing morphological characters were recorded as per DUS descriptors.

Quality and sensory evaluation. Tender grain quality was assessed for grain colour, texture, shape, taste, biochemical parameters and brix value. Fodder quality was evaluated on dry matter basis for crude protein, ether extract, crude fibre, total ash, calcium and phosphorus. Organoleptic and consumer preference observations were recorded using a preference scale and descriptive attributes for grain softness, colour, sweetness and overall acceptability. Standard procedures were followed for biochemical estimation as per AOAC (1990), and the sensory approach was aligned with the principles described by Amerine *et al.* (1965) [1].

Statistical analysis. Yield data from different trials were compiled as mean values and percentage increase over checks. Statistical comparisons were interpreted using standard procedures for agricultural experiments, including standard error, critical difference at 5 per cent level and coefficient of variation as described by Panse and Sukhatme (1985) [19].

Results and Discussion

Development and adaptation. SRP-5, released as GJ-103 (Surati Ponk-1), represents a specialty sorghum genotype selected specifically for ponk production in South Gujarat. It is suited to rabi season cultivation under irrigated or residual moisture conditions with protective irrigation. The variety reaches tender grain stage at about 103 days and physiological maturity at about 114 days, thereby fitting well into the existing rabi ponk production window.

Grain yield performance. Across seven state trial environments, SRP-5 recorded an overall mean grain yield of 1544 kg/ha compared with 1291 kg/ha in Wani Local and 965 kg/ha in Phule Madhur. The increase was 19.6 per cent over Wani Local and 60.0 per cent over Phule Madhur. The genotype appeared in the top non-significant group in five out of seven environments, indicating good consistency under state testing.

Dry fodder yield performance. Sorghum ponk growers also value dry fodder because it supports the dairy-based farming systems of South Gujarat. SRP-5 recorded an overall mean dry fodder yield of 9174 kg/ha over seven state trial environments, compared with 8223 kg/ha in Wani Local and 7558 kg/ha in Phule Madhur. Thus, the genotype provided 11.6 per cent improvement over Wani Local and 21.4 per cent over Phule Madhur. Higher dry fodder yield improves the total economic value of the crop after tender grain harvest.

Tender grain yield performance. Tender grain yield is the primary trait for ponk purpose. Across six state trial environments during rabi 2021-22 to 2023-24, SRP-5 recorded 2465 kg/ha tender grain yield against 2055 kg/ha in Wani Local and 1698 kg/ha in Phule Madhur. The variety showed 19.9 per cent improvement over Wani Local and 45.1 per cent over Phule Madhur. It remained in the top non-significant group in five out of six environments, reflecting its usefulness for stable ponk production.

AICRP performance. In the AICRP IASSVT-II (Hurda) trial during rabi 2023-24 at Surat, SRP-5 recorded 1837 kg/ha grain yield, which was higher than CSV 29R, M35-1, Phule Uttara and Phule Madhur by 12.2, 6.89, 5.3 and 14.28 per cent, respectively. For dry fodder yield at Surat, it recorded 6381 kg/ha and exceeded CSV 29R, M35-1, Phule Uttara and Phule Madhur by 20.65, 79.29, 1.89 and 9.32 per cent, respectively. Across six AICRP locations, SRP-5 recorded 2231 kg/ha grain yield and 8387 kg/ha dry fodder yield.

Morphological and quality features. The genotype had a mean plant height of 267 cm, panicle length of 24.6 cm and 1000 seed weight of 32.7 g. Its distinguishing characters include white leaf midrib, symmetric panicle, very long neck of panicle, waxy bloom on stem and leaf sheath, grayed red glumes and very long glume length. Tender grains were dark green, oval and soft with extremely liked taste. Biochemical analysis of tender grains showed 36.71 per cent carbohydrates, 0.09 per cent fat, 11.00 per cent protein, 1.20 per cent ash and 17.3 brix value. These attributes support its acceptability as a specialty ponk variety.

Disease and pest reaction. At Surat and Tanchha during rabi 2023-24, SRP-5 showed resistant to moderately resistant reaction to anthracnose, leaf blight and sugary disease, comparable with the checks. The genotype also recorded lower shoot fly and stem borer incidence than the susceptible check Bulky-Y and comparable incidence relative to Wani Local and Phule Madhur. These reactions suggest that GJ-103 can be cultivated under recommended protection practices without additional risk compared with existing checks.

Consumer preference. Consumer evaluation revealed higher

preference for SRP-5 because of soft grains, attractive dark green colour and sweet taste. The average preference scale of SRP-5 was 9, described as very good, compared with 8 for Wani

Local and 6 for Phule Madhur. The combination of high tender grain yield and superior marketable quality is the major advantage of GJ-103 for South Gujarat ponk growers.

Table 1: Overall yield performance of SRP-5 (GJ-103, Surati Ponk-1) in Gujarat state trials

Trait	No. of environments	SRP-5	Wani Local (LC)	Phule Madhur (NC)	Increase over Wani Local (%)	Increase over Phule Madhur (%)
Grain yield (kg/ha)	7	1544	1291	965	19.6	60.0
Dry fodder yield (kg/ha)	7	9174	8223	7558	11.6	21.4
Tender grain yield (kg/ha)	6	2465	2055	1698	19.9	45.1

Source: Compiled from Gujarat state PET, S/LSVT and LSVT trials.

Table 2: Year-wise tender grain yield performance of SRP-5 in state varietal trials

Year/season	Trial	Location	SRP-5	Wani Local	Phule Madhur	CV (%)	Remarks
Rabi 2021-22	S/LSVT	Surat	3738	3201	1986	10.3	Superior to both checks
Rabi 2021-22	S/LSVT	Tanchha	2596	2103	1749	17.0	Superior to Phule Madhur
Rabi 2022-23	LSVT	Surat	2418	2008	1834	11.3	Superior to both checks
Rabi 2022-23	LSVT	Tanchha	1644	1341	1247	8.0	Superior to both checks
Rabi 2023-24	LSVT	Surat	2628	2250	2012	11.1	Superior to Phule Madhur
Rabi 2023-24	LSVT	Tanchha	1763	1428	1360	12.4	Superior to both checks
Overall mean	-	6 environments	2465	2055	1698	-	19.9 and 45.1% higher than Wani Local and Phule Madhur

Yield values are in kg/ha. Statistical superiority is based on original trial notation.

Table 3: AICRP IASSVT-II (Hurda) performance of SRP-5 during rabi 2023-24

Trait/location	SRP-5	CSV 29R	M35-1	Phule Uttara	Phule Madhur	Important comparison
Grain yield, Surat (kg/ha)	1837	1637	1719	1744	1607	12.2, 6.89, 5.3 and 14.28% higher over respective checks
Grain yield, India mean (kg/ha)	2231	2702.7	2713.8	2204	2047.5	1.2% higher over Phule Uttara and 8.96% over Phule Madhur
Dry fodder yield, Surat (kg/ha)	6381	5289	3559	6263	5837	20.65, 79.29, 1.89 and 9.32% higher over respective checks
Dry fodder yield, India mean (kg/ha)	8387	8560	7764	8382	8337	7.37% higher over M35-1; comparable with Phule Uttara and Phule Madhur

Table 4: Important morphological and ancillary observations of SRP-5

Character	SRP-5	Wani Local	Phule Madhur
Days to 50% flowering	65 (61-67)	68 (63-70)	71 (70-73)
Days to maturity	114 (110-117)	117 (113-122)	120 (118-123)
Days to tender grain stage	103	105	103
Plant height (cm)	267 (232-287)	255 (240-282)	247 (198-265)
Panicle length (cm)	24.6 (21.6-28.3)	22.7 (21.1-24.9)	16.6 (15.5-18.1)
1000 seed weight (g)	32.7 (31.0-33.4)	28.4 (25.7-32.6)	23.9 (21.9-26.0)

Table 5: Distinguishing morphological features of SRP-5 as per DUS description

Character	Expression in SRP-5
Leaf midrib colour (5th fully developed leaf)	White
Panicle shape	Symmetric
Neck of panicle: visible length above sheath	Very long
Waxy bloom on stem/leaf sheath	Present
Glume colour	Grayed red
Glume length	Very long
Grain colour after threshing	Yellow white
Grain shape in dorsal view	Elliptic

Table 6: Tender grain and fodder quality of SRP-5 and checks

Quality character	SRP-5	Wani Local	Phule Madhur
Tender grain colour	Dark green	Medium green	Faint green
Tender grain texture	Soft	Medium	Hard
Tender grain shape	Oval	Oval	Oval
Hurda/Ponk taste	Like extremely	Like moderately	Like slightly
Carbohydrate in tender grain (%)	36.71	37.68	42.00
Protein in tender grain (%)	11.00	9.80	8.00
Brix value of tender grains	17.3	14.3	12.5
Crude protein in dry fodder (%)	5.79	5.20	4.94
Ether extract in dry fodder (%)	1.58	1.50	0.98
Calcium in dry fodder (%)	1.74	1.57	1.48
Phosphorus in dry fodder (%)	0.17	0.12	0.15

Table 7: Disease and insect-pest reaction of SRP-5 under field conditions

Parameter	SRP-5	Wani Local	Phule Madhur	Resistant check B-58586	Susceptible check Bulky-Y
Anthracnose, Surat	3.3 (R)	3.7 (R)	3.3 (R)	2.3 (R)	5.3 (MR)
Leaf blight, Surat	4.0 (MR)	4.7 (MR)	4.0 (MR)	3.3 (R)	6.0 (S)
Sugary disease, Surat	3.7 (R)	4.0 (MR)	3.7 (R)	3.0 (R)	6.0 (S)
Shoot fly, Surat 28 DAE	31.28	32.72	34.84	24.50	41.70
Stem borer, Surat 45 DAE	32.32	32.96	33.86	24.54	41.85
Shoot fly, Tanchha 28 DAE	32.16	33.10	34.65	24.98	43.05
Stem borer, Tanchha 45 DAE	33.10	34.30	34.65	24.76	44.42

Disease reactions: R = resistant, MR = moderately resistant, S = susceptible. Insect values are arcsine transformed values from field observations.

Table 8: Consumer preference of SRP-5 for ponk quality

Genotype	Consumer description	Average preference scale
SRP-5 (GJ-103)	Soft grains, attractive dark green colour and sweet taste; overall very good	9
Wani Local	Soft to medium soft grains, green colour and sweet to medium sweet; overall good	8
Phule Madhur	Hard to medium grains, light green/green colour and sweet; overall medium	6

Scale interpretation: 9-10 = very good; 7-8 = good; 5-6 = medium.

The superiority of SRP-5 for ponk purpose is scientifically meaningful because it integrates yield, quality and adaptation components. The genotype recorded higher tender grain yield while retaining acceptable dry fodder yield, a key requirement in mixed crop-livestock systems where sorghum stover contributes to dairy-based farm income. The dark green tender grain colour, soft texture and higher brix value indicate a favourable eating-quality profile, while the higher protein content of tender grains and better fodder protein support its nutritional advantage. The results agree with the current breeding direction that specialty sorghum cultivars should be evaluated through multi-trait selection involving productivity, sensory quality, biochemical traits, pest-disease reaction, and end-user preference (Anbazhagan *et al.*, 2022; Baloch *et al.*, 2023; Singh *et al.*, 2024) [2, 9, 27]. Recent further support the importance of combining seed quality, early seedling establishment, yield and quality traits while developing specialty sorghum varieties (Kanjariya and Patil, 2025) [34].

Conclusion

GJ-103 (Surati Ponk-1), tested as SRP-5, is a specialty rabi sorghum variety developed for ponk production in South Gujarat. It combines high tender grain yield with good grain yield and dry fodder yield. The variety recorded 2465 kg/ha tender grain yield with 19.9 per cent improvement over Wani Local and 45.1 per cent over Phule Madhur. Its dark green, soft and sweet tender grains, higher protein content, good brix value, acceptable disease and pest reaction and strong consumer preference make it suitable for commercial ponk cultivation. The variety is recommended for rabi season cultivation in South Gujarat under irrigated or residual moisture conditions with protective irrigation.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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