

SCS125: new paddy rice cultivar

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Abstract: *SCS125 is a late-maturing cultivar with a normal plant type, good resistance to lodging, resistance to blast, high yield, grains with long-thin shape, and good sensory and cooking properties either for parboiling or white rice. SCS125 has better yield and milling quality than SCS116 Satoru and SCS122 Miura.*


Keywords: *Oryza sativa, breeding, variety, milled rice*

INTRODUCTION

The state of Santa Catarina is the second largest producer of irrigated rice in Brazil, with a cultivated area of 149,458 ha (19/20), providing large financial inputs with a significant economic role in the state. According to recent data, of the 8,030 rice-growing families in Santa Catarina two decades before, 5,916 remain and continue to produce rice in 86 municipalities of the state. This provides a notion of the rural structure, indicating that the average rice farm in Santa Catarina has about 25.26 ha of rice area. About 60% of the area is leased. The state of Rio Grande do Sul is the largest rice producer in Brazil (70% of total production), followed by Santa Catarina (9.3%) (Padrão 2018, 2021).

This situation places high market pressure on Santa Catarina's rice growing farmers and industry, and therefore, breeding new cultivars with good grain quality, better yield performance, and ability to grow under different soil and climatic conditions is important to ensure that the Santa Catarina rice industry and the local small farmers remain competitive with other states that have quite better farm size and production scale conditions.

The portfolio of Epagri (Santa Catarina State Agricultural Research and Rural Extension Agency) rice cultivars in Santa Catarina (Vieira et al. 2007) is continuously upgraded and ranges from normal cultivars, suitable for parboiled rice, to SCS124 Sardo, a high quality white rice variety, as well as some special varieties, like the first Brazilian cultivar suitable for preparing risotto (SCS123 Pérola) and varieties with a red or black pericarp (SCS119 Rubi/SCS120 Onix). To continue in this direction, Epagri has developed and released the cultivar SCS125, recommended for growing irrigated rice in the state of Santa Catarina. It is the 33rd rice cultivar released by Epagri, and the 25th for Santa Catarina. Its

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release is dedicated to Mr. Olimpio de Paula, who has been an Epagri extension agent in the municipality of Agronômica (SC, Brazil); he was a recognized rice technician in this region for years.

PEDIGREE AND BREEDING METHOD

SCS125 arose from a cross conducted at the Itajaí Experimental Station (Epagri) in 2008 involving 5 genotypes (P899//Epagri 108/Roxo///Epagri 108///Epagri 108)]/[Oryzica Llanos 5/Epagri 108//SCSBRS TioTaka///SCSBRS TioTaka]], followed by the pedigree method (Marschalek et al. 2008). Since the parents involved in the development of SCS125 have, in principle, somewhat different genetic origins, such as the japonica type “Roxo” (purple rice), it is expected that SCS125 will expand the genetic background of cultivated rice in Santa Catarina more than other Epagri rice cultivars released before. This could be especially useful for disease and insect management. The seeds obtained from the initial cross were sown, giving rise to the F₂ population. Selection through the generations started with traits, such as plant type, number of grains per panicle, panicle type, plant height, yield, grain type, culm thickness, and so on. Selected plants gave rise to F₃ families, which, in turn, formed the F₄ plots. Agronomic traits, such as tillering, yield, lodging resistance, heading grade, grain shattering, and so on, were evaluated beginning with the F₃ plots. Seeds of the F₄ selected plants formed the F₅ generation trial. All populations were grown under Epagri crop recommendations for paddy rice (Eberhardt and Schiocchet 2015). The occurrence of rice blast (*Pyricularia oryzae*) and other diseases was registered. In the F₆ generation (2013/2014), the new inbred line was called SC 790, and it was then evaluated once more for yield, plant height, lodging, blast resistance, tolerance to iron toxicity, and grain quality. The agronomic traits of the inbred line SC 790 were evaluated in the VCU (Value for Cultivation and Use) trials (of the Brazilian Ministry of Agriculture). Data from two seasons at 3 locations (Massaranduba, Itajaí, and Mirim Doce in SC, Brazil) were analyzed using “Genes” software and Tukey’s test (5%), comparing the seven inbred lines and four cultivars (Epagri 106, SCS124 Sardo, SCS116 Satoru, and SCS122 Miura) (Cruz 2006). The most important analyses are those comparing the new SCS125 (SC 790) cultivar with the two late maturing cultivars, SCS116 Satoru and SCS122 Miura. The SC 790 line showed good milling yield, uniformity, and agronomic performance, with suitability for parboiled and milled rice. The SC 790 line is resistant to lodging and blast. Based on VCU trials, the inbred line SC 790 was publicly released on February 19, 2021 as SCS125, and will be available to farmers for the 2021/2022 growing season.

TRAIT PERFORMANCE

The agronomic and morphological traits of the SCS125 cultivar are given in Table 1. The evaluations were based on the Handbook of Research Methods in Rice (Embrapa 1977) and standards of the Brazilian Ministry of Agriculture (MAPA) for DHS (distinguishability, homogeneity, and stability) evaluations (MAPA 2008). SCS125 has a late-maturity cycle in Santa Catarina (147 days), good tillering, a modern type of plant resistant to lodging, and upright and hairy leaves. The cultivar has low shattering and is considered moderately

Table 1. Morphological and agronomic traits of cv. SCS125 in VCU*/DHS** (MAPA) evaluations

Plant trait/descriptor	Description and Code (score) according to MAPA ¹	
Leaf color	**	Green (2)
Leaf pubescence	**	Medium (3)
Auricle color	**	Green (1)
Ligule color	**	Green or colorless (1)
Flag leaf angle	**	Upright (1)
Plant height (culm length)	*	83 cm at the DHE Trials (71.7 cm at VCU)
Culm width	**	4.6 mm
Tillering angle	**	Upright (1)
Internode color	**	Light Green (1)
Anthocyanin node color	**	Absent/Weak (1)
Panicle length	**	29.4 cm
Type of panicle	**	Intermediate (3)
Panicle exertion	**	Complete (1)
Shattering	**	Difficult (5)
Awns	**	Absent (0)
Awn length	**	----- (1)
Stigma color	**	Green (1)
Lemma/Palea pubescence	**	Weak (3)
Keel color (flowering)	**	Green (2)
Keel color (maturity)	**	Yellow (2)
Glume (Lemma and Palea) color	**	Golden/straw (1)
Sterile lemma color (glumes)	**	Straw (1)
Cycle to maturity	*	Medium (147 Days)
Disease resistance:		
Leaf blast	*	Moderately resistant
Panicle blast	*	Moderately resistant
Iron toxicity tolerance ²	***	Moderately resistant (5.5)
Tillering	*	High
Lodging	*	Resistant

¹ MAPA (2008). ² SES/IRRI (Standard Evaluation System) (IRRI 2013) www.cirri.org/ver2/uploads/SES_5th_edition.pdf. * VCU trials (Itajaí, Massaranduba, and Mirim Doce) in 2017/18 and 2018/19. ** DHS - distinguishability, homogeneity, stability (MAPA) evaluations 2016/17 to 2018/19.

Table 2. Average grain yield (kg ha⁻¹) of SCS125 compared to SCS116 Satoru and SCS122 Miura in VCU trials (Itajaí, Massaranduba, and Mirim Doce) in the 2017/2018 and 2018/2019 growing seasons

Cultivar	Itajaí		Massaranduba		Mirim Doce		Average ¹
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	
	(kg ha ⁻¹)						
SCS125	13.328	11.113	9.208	8.788	8.268	10.678	10.230a
SCS116 Satoru	10.673	10.334	7.358	8.504	7.689	9.160	8.953ab
SCS122 Miura	12.265	11.233	8.543	8.333	8.779	10.037	9.865ab

¹ Means with different letters are significantly different by Tukey's test at 5% probability (ANOVA, with CV of 8.6%).

resistant to iron toxicity, and it is currently resistant to blast for a while. SCS125 had an average yield of 10,230 kg ha⁻¹ in the VCU trials in Itajaí, Massaranduba, and Mirim Doce. That is a higher yield than the yields of the two best late-maturity control cultivars of Epagri: SCS116 Satoru (8,953 kg ha⁻¹) and SCS122 Miura (9,865 kg ha⁻¹) (Table 2).

SCS125 has long-thin translucent grain (Figure 1), with a lower percentage of chalked grain and chalked grain area, and good milling quality (70.2%) for white milled rice (Table 3); these are desirable traits for acceptance as white milled rice, as well as parboiled rice. All grain physical analyses were carried out with 100 g rough rice samples that were hulled and milled by the Suzuki model MT.08 laboratory rice mill (Suzuki, Santa Cruz do Rio Pardo, SP, Brazil) at the Epagri Rice Breeding Laboratory (LAMGEN). The milled rice samples were then analyzed by the Selgron/Epagri digital platform of images from the Image Rice Grain Scanner (Marschalek et al. 2017) (Table 3). Sensory and cooking analyses were carried out using grain samples of SCS125 stored for three months (equalization time). The sensorial traits of SCS125 are comparable to or better than the control cultivars, since the grain has soft texture and good aroma and taste (Table 4). Cooking and sensory tests were conducted according to ABNT (1998) (analysis number RA-025, July 2017, in accordance with ABNT NBR 14140) by the quality laboratory of

**Figure 1.** Rough (below) and milled (above) rice grains of the Epagri SCS125 cultivar**Table 3.** Grain traits of SCS125 milled rice grain in 3 VCUs (2017/18 to 2018/19): Itajaí, Massaranduba, Mirim Doce (SC, Brazil)

Trait	Cultivar		
	SCS125	SCS116 Satoru	SCS122 Miura
Total milled grain (%)***	70.2	63.1	66.5
Whole grain (%)***	60.0	56.9	57.4
Broken grain (%)***	6.2	6.2	9.2
Amylose content (%)*	24.3	26.5	24.7
Gelatinization temperature**	2.8	2.8	2.7
Grain chalked area (%)***	4.0	3.9	2.4
Chalked grain (%)***	6.3	6.8	4.8
Grain length (mm)***	7.2	7.1	7.3
Grain width (mm)***	2.1	2.2	2.1
Grain thickness (mm)***	1.7	1.7	1.7
Length-width ratio***	3.4	3.3	3.5
Thousand grain weight****	28.7	28.8	28.7

* LabGrãos/UFPEL; McGrane et al. (1998). * Embrapa/CNPAF (International Standard Method ISO 6647, 2007). ** Embrapa/CNPAF; Martínez C and Cuevas F (1989). *** Analyzed through the Image Rice Grain Scanner (Selgron-Epagri) at LAMGEN (Rice Breeding Laboratory - Epagri - Itajaí Experimental Station). **** LAMGEN (Rice Breeding Laboratory - Epagri - Itajaí Experimental Station).

Table 4. Means of SCS125 sensory traits of the grain from two growing seasons (2017/2018 and 2018/2019) tested at the Quality Laboratory of Urbano Agroindustrial.

Cultivars	Texture	Color	Grain lability	Characteristic odor	Characteristic taste
SCS125	4.8	1.8	5.5	0.3	0.8
SCS116 Satoru	4.8	1.8	5.5	0.3	0.8
SCS122 Miura	4.5	2.3	6.8	0.5	1.0

Scale ranges from 0 (best value) to 10 (worst value) according to ABNT NBR14140 (1998)

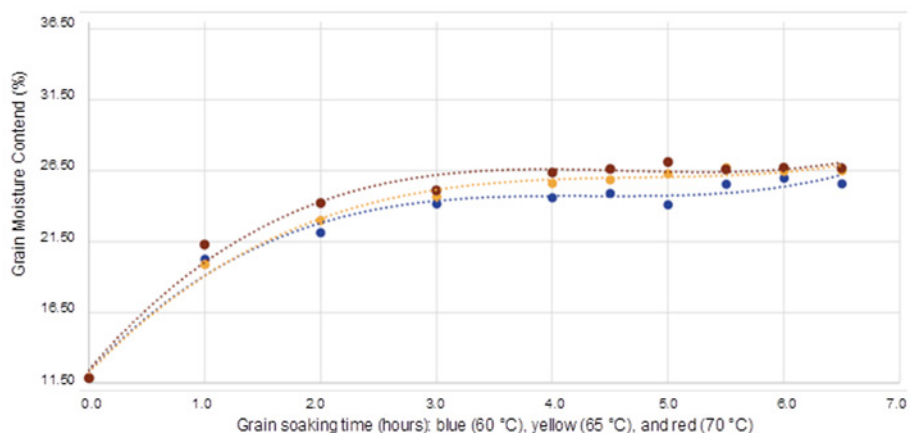


Figure 2. Hydration curves of the SCS125 grains (Technical report certificate number 18M, 10 Jan 2019), LabGrãos/UFPel – Pelotas, RS, Brazil)

Urbano Agroindustrial, Ltda. (Jaraguá do Sul, SC, Brazil). Due to its length/width ratio of 3.4 and grain dimensions, it can be processed as white milled rice with grain from other Epagri varieties traditionally grown in Santa Catarina.

The SCS125 grain is suitable for parboiled rice and, based on laboratory analysis, the soaking time during the parboiling process should preferably be 6 hours at temperatures not exceeding 70 °C (Figure 2) (Technical report certificate number 18M, 10/1/2019; LabGrãos/UFPel – Laboratório de Pós-colheita, Industrialização e Qualidade de Grãos – Pelotas, RS, Brazil). Results indicate that SCS125 has a parboiling response very similar to other main Epagri cultivars, which enables easy processing in the Santa Catarina rice industry.

Due to its good agronomic traits, industrial performance, and sensory performance for white milled and parboiled rice, this new rice variety is recommended to rice-farmers and the rice industry for growing in all rice production areas in Santa Catarina.

MOLECULAR BACKGROUND

To obtain the genetic profile (DNA fingerprinting), 26 accessions among rice cultivars and rice lines were genotyped at the Molecular Biology Laboratory (Itajaí Experimental Station) using 26 microsatellite markers recommended by Gramene (<http://www.gramene.org>). The 26 SSR loci amplified 81 alleles, of which 21 were exclusive to certain cultivars. Relations between individuals were based on the Jaccard coefficient and the UPGMA clustering method using the NTSYS-PC 2.1 software. Comparing the new SCS125 cultivar with the main cultivars currently used in Santa Catarina, this study showed that it has 50% genetic similarity with the cultivar SCS122 Miura, and 65% similarity with the cultivars SCS116 Satoru, SCS121 CL, Epagri 109, and SCSBRS Tio Taka. SCS125 differs from the others by the set of alleles obtained, without exhibiting any of the 21 exclusive alleles detected in this study. The genetic difference between the most common rice varieties in Santa Catarina and the new SCS125 cultivar is important because it contributes to increase the diversity of the genetic base of the Epagri rice breeding program.

FOUNDATION SEED PRODUCTION

SCS125 is registered by the Brazilian Ministry of Agriculture (MAPA) under number 42451 (of 22 Jan. 2020) and under the cultivar protection number 20200115 (of 16 Dec. 2019). Genetic seeds are kept at the Epagri - Itajaí Experimental Station (Itajaí, SC, Brazil). Certified seeds of the variety SCS125 are produced by the Santa Catarina Irrigated Rice Seed Producers Association (Acapsa) and will be available for commercial crop fields for the 2021/2022 growing season.

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