

'BRS 427 OL': a high-yield, large-seeded runner-type peanut cultivar with high oleic acid content

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Abstract: 'BRS 427 OL' is a high-yield, runner-type peanut cultivar with high oleic acid content. 'BRS 427 OL' is recommended for cultivation in the main peanut-producing regions in Brazil. This cultivar features an intermediate runner growth habit, medium maturity, and large seeds with a pink testa.

Keywords: *Arachis hypogaea L.*, seed quality, oleaginous crops

INTRODUCTION

Peanut production and quality in Brazil have improved significantly since the introduction of runner-type peanut cultivars in the early 2000s (Suassuna and Costa 2023). In the 2022-2023 crop season, Brazil produced 892,600 metric tons of peanuts, and most of which were classified as high oleic (over 70% oleic acid content), which have improved shelf life (CONAB 2023). Approximately 70% of the domestic surplus meets the stringent quality standards of the international kernel market, while oil exports continue to grow steadily (Sampaio 2023).

More than 90% of Brazil's peanut crop is produced in the southeastern region, especially in the state of São Paulo (FIESP 2021). Peanut cultivation is also expanding into the Southern region and the Brazilian savanna in Central Brazil. This growth has created an unprecedented demand for high-oleic runner peanut varieties that are well adapted to the Southern and Central regions of Brazil (Pereira et al. 2023, Suassuna and Costa 2023).

The Peanut Breeding Program of the Brazilian Agricultural Research Corporation (EMBRAPA) has developed cultivars to meet this growing demand. In 2017, the program registered three cultivars: 'BRS 421 OL,' 'BRS 423 OL,' and 'BRS 425 OL.' Initially selected for cultivation in the state of Goiás, these cultivars were later tested in other states through collaborations with cooperatives, processors, growers, and universities (Suassuna et al. 2019, Suassuna et al. 2020). These iterative, collaborative efforts enhanced technology transfer and facilitated the evaluation of new advanced lines developed by the Peanut Breeding Program of EMBRAPA in Brazil's major peanut and grain producing regions.


This study describes the development of a new high-oleic peanut cultivar specifically adapted to the main peanut-producing regions of the states of São Paulo and Paraná as well as the Brazilian savanna biome.

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GENETIC ORIGIN AND DEVELOPMENT

The cultivar ‘BRS 427 OL’ (breeding line ‘2018-2010 OL’) was developed using a modified pedigree method, as described by Suassuna et al. (2019) and Suassuna et al. (2020). During the F₂ and F₃ generations, peanut plants exhibiting runner-type traits—such as a decumbent growth habit, pods with two seeds and moderate constriction, and pink testa color - were selected in EMBRAPA’s experimental area in Santo Antônio de Goiás, Goiás. The pedigree and selection process applied in the development of ‘BRS 427 OL’ are detailed below.

‘BRS 427 OL’ originated from a cross made in 2016 between ‘Runner IAC 886’ - a runner-type peanut cultivar with regular oleic acid content (53.1%) and pink testa color - and ‘BRS 423 OL,’ a high-yielding cultivar with medium maturity, medium seed size, tan testa color, and high oleic acid content (80.8%) (Suassuna et al. 2020). A single F₂ plant, designated as line ‘2018-2010,’ was selected from the F₂ population during the 2017-2018 growing season. In 2018, the oleic acid content of ‘2018-2010’ was evaluated nondestructively by using a 5-seed sample analyzed by near infrared (NIR) hyperspectral imaging spectroscopy, which detected 75.3% oleic acid content. A subsequent analysis using nuclear magnetic resonance (NMR) on a 20-seed sample confirmed an oleic acid content of 81.1% (Colnago et al. 2021). The F₃ progeny, renamed ‘2018-2010 OL,’ was tested and selected in field conditions during the 2018/19 growing season for its uniform growth habit, pod and seed shape and size, and pink testa color. Additional NMR analyses of oleic acid content in 2019 and 2020 confirmed levels of 82.0% and 81.0%, respectively. Further confirmation of high oleic acid content came through gas chromatography analyses of 500 g samples collected in 2020 (81.7%) and 2022 (81.4%). The morphological traits of ‘BRS 427 OL’ are presented in Table 1, while its main fatty acid composition and oil content are detailed in Table 2.

During the 2019-2020, 2020-2021, 2021-2022, and 2022-2023 crop seasons, the breeding line ‘2018-2010 OL’ was evaluated in value for cultivation and use (VCU) field trials conducted in the Southeast and Central regions of Brazil. These trials confirmed its high yield, medium maturity (130-135 days), and large seeds with a pink testa color. Based on these results, the line was officially released as the cultivar ‘BRS 427 OL.’

PERFORMANCE AND DESCRIPTION

The agronomic performance of ‘BRS 427 OL’ was evaluated over three growing seasons across 18 multilocation

Table 1. Morphological traits* for ‘BRS 427 OL’

Trait	Description
Growth habit	Decumbent
Main stem	Apparent
Lateral branches	Upward curved tips
Canopy	Medium
Flowering	Alternate
Size of leaflet	Medium**
Days to maturity	130-135
Pod (constriction)	Moderate
Pod (reticulation)	Prominent
Pod (number of seeds)	Two
Pod (beak)	Prominent
Seed (color)	Pink
Seed (shape)	Long
Dormancy	Present

* Adapted from IBPGR/ICRISAT (1992); ** Similar to BRS 423 OL

Table 2. Main fatty acid composition of ‘BRS 427 OL’ (analyzed by gas chromatography) as a percentage of total fatty acids, and oil content (determined by Soxhlet) as a percentage of total kernel weight

Fatty acid	Content (%)
Palmitic acid (C16:0)	5.6
Stearic acid (C18:0)	2.6
Oleic acid (C18:1)*	81.4
Linoleic acid (C18:2)	2.2
Arachidic acid (C20:0)	1.4
Eicosenoic acid (C20:1)	1.8
Behenic acid (C22:0)	2.8
Oil content (dry weight base)	46.0

*values higher than 70% are classified as high oleic acid content.

Table 3. Genotypic value for peanut pod yield (kg ha⁻¹) across 18 field performance tests* and ranking of ‘BRS 427 OL’ and check cultivars** (REML/BLUP analysis)

Cultivar	Rank	Genotypic value (kg ha ⁻¹)
BRS 427OL	1	6222.2
BRS 421 OL	2	5867.2
BRS 423 OL	3	5753.4
BRS 425 OL	4	5718.7
...
IAC OL3	22	5591.5
Granoleico	33	4995.9
IAC 503	42	5294.1
Overall mean	-	5226.6
Accuracy	-	0.9

* Santo Antônio de Goiás GO and Iturama MG (2019/2020); Santo Antônio de Goiás GO (2 trials), Getulina and Parapuã SP, Cassilândia MS, Palmas TO, Campo Verde and Santo Antônio do Leste MT (2020/2021); Piraju, Parapuã (2 trials) and Tupã SP, Maringá (PR), Palmas (TO) (2021/2022); Maringá PR and Iturama MG (2022/2023). ** Other genotypes included in the analysis are not shown in the ranking.

'BRS 427 OL': a high-yield, large-seeded runner-type peanut cultivar with high oleic acid content

field tests conducted in Goiás (GO), Minas Gerais (MG), São Paulo (SP), Paraná (PR), Mato Grosso (MT), Mato Grosso do Sul (MS), and Tocantins (TO). Pod yield (kg ha⁻¹) and the mass of 100 seeds were measured at all locations. The Selegen-Reml/Blup software was used for restricted maximum likelihood/best linear unbiased prediction (REML/BLUP) analysis (Resende 2016). Genotypic values of 'BRS 427 OL' and commercial checks were ranked based on a combined analysis across all locations. The mean genotypic pod yield for 'BRS 427 OL' across the 18 trials was 6222.2 kg ha⁻¹, outperforming the checks: 'BRS 421 OL' (5867 kg ha⁻¹), 'BRS 423 OL' (5753.4 kg ha⁻¹), 'BRS 425 OL' (5718.7 kg ha⁻¹), 'IAC OL-3' (5591.5 kg ha⁻¹), 'Granoleico' (4995.9 kg ha⁻¹), and 'IAC 503' (5294.1 kg ha⁻¹). The general mean yield across all trials was 5226.6 kg ha⁻¹, with an accuracy of 0.89 (Table 3). Results from the most representative field trials are summarized in Tables 4 and 5.

Individual analyses of variance for pod yield and the mass of 100 seeds at six locations in Goiás and São Paulo State is summarized in Table 4. 'BRS 427 OL' consistently ranked among the highest-yielding genotypes at Santo Antônio de Goiás, Parapuã (in both the 2020-2021 and 2021-2022 seasons), Piraju, and Getulina. At Tupã, however, it ranked within the second group due to severe spotted wilt epidemics combined with extremely high temperatures and drought. Despite similar challenging conditions at Getulina and Parapuã during the 2021-2022 season, 'BRS 427 OL' remained among the top-yielding genotypes. The mass of 100 seeds across these locations ranged from 75.7 g to 85.0 g.

Individual analyses of variance for pod yield and the mass of 100 seeds at six locations with optimal conditions in Minas Gerais, Mato Grosso do Sul, Paraná, Tocantins, and Mato Grosso is summarized in Table 5. The highest yield

Table 4. Analysis of variance for 'BRS 427 OL' and control varieties for pod yield (kg ha⁻¹ of peanuts in shell) and mass of 100 seeds (M100S) in sites with effective disease management and those affected by spotted wilt epidemics in the states of Goiás and São Paulo

Cultivar	Optimal conditions						Spotted wilt epidemics, high temperatures and drought					
	SAG ¹ 2019/2020		PAR ² 2020/2021		PIR ³ 2021/2022		GET ⁴ 2020/2021		PAR ⁵ 2021/2022		TUP ⁶ 2021/2022	
	Pod yield	M100S	Pod yield	M100S	Pod yield	M100S	Pod yield	M100S	Pod yield	M100S	Pod yield	M100S
BRS 427 OL	7785.4 a	80.0 b	7367.8 a	80.4 a	6702.1 a	82.7 a	3822.0 a	78.1 a	5669.5 a	85.0 a	4040.7 b	75.7 b
BRS 421 OL	8001.8 a	86.7 a	-	-	-	-	-	-	-	-	-	-
BRS 423 OL	8360.6 a	75.3 d	6126.8 b	75.0 b	-	-	3325.8 a	75.9 b	5422.5 a	75.5 c	4651.6 a	72.6 b
BRS 425 OL	7776.1 a	75.3 d	-	-	6437.2 a	74.3 b	-	-	5460.3 a	75.6 c	3786.9 b	73.7 b
...
Granoleico	4829.5 b	78.0 c	5955.2 b	75.6 b	-	-	1827.0 b	71.9 e	-	-	-	-
Mean	6280.6	77.5	6148.8	74.3	6050.7	74.9	2827.5	75.0	4889.8	74.3	3580.4	73.3
F value	8.1 **	29.8 **	6.9 **	50.2 **	4.1 *	33.4 **	14.3 **	52.0 **	6.15 **	127 **	15.4 **	17.2 **
CV	15.0	1.5	8.3	1.5	9.3	2.1	12.2	0.7	11.7	1.3	8.3	1.9

1 Santo Antônio de Goiás, 2 Parapuã, São Paulo; 3 Piraju, São Paulo; 4 Getulina, São Paulo; 5 Parapuã, São Paulo; 6 Tupã, São Paulo. * Significant at 5% and ** Significant at 1% by the F test; Means followed by the same letter in the same column belong to the same group by the Scott-Knott test at 5% of probability. – not evaluated at this location; --- data not shown for other genotypes.

Table 5. Means and summary of Anova for 'BRS 427 OL' and control varieties for pod yield (kg ha⁻¹) and mass of 100 seeds (M100S) in sites with effective disease management in the states of Minas Gerais, Paraná, Mato Grosso do Sul, Mato Grosso, and Tocantins

Cultivar	Optimal conditions											
	ITU ¹ 2019/2020		CAS ² 2020/2021		MAR ³ 2021/2022		PAL ⁴ 2021/2022		ITU ⁵ 2022/2023		SAL ⁶ 2020/2021	
	Pod yield	M100S	Pod yield	M100S	Pod yield	M100S	Pod yield	M100S	Pod yield	M100S	Pod yield	M100S
BRS 427 OL	9609.6 a	77.9 c	5718.0 a	80.4 c	7354.2 a	89.1 b	6871.9 a	7001.2 a	80.3 b	6343.9 b	75.8 c	
BRS 421 OL	-	-	4651.7 b	86.7 a	6140.2 c	94.4 a	-	5815.8 c	85.6 a	7193.6 a	85.5 a	
BRS 423 OL	6814.0 b	75.2 d	5624.8 a	76.2 e	5435.8 d	77.7 d	5419.8 b	5699.4 c	77.1 c	-	-	
BRS 425 OL	-	-	-	-	6773.5 b	77.5 d	-	6318.4 b	74.2 d	-	-	
...	
Granoleico	-	-	4789.3 b	71.2 f	-	-	-	-	-	-	-	
Mean	6830.2	77.3	5279.0	78.4	6229.6	86.7	5488.2	6277.3	77.3	6397.2	75.4	
F value	3.7 **	58.4 **	2.9 *	164.5 **	38.2 **	868.8 **	3.4 *	6.4 **	23.3 **	12.4 **	204.6 **	
CV	19.3	1.2	11.2	0.7	3.8	0.6	17.6	7.5	2.3	4.3	0.8	

1 Iturama, Minas Gerais; 2 Cassilândia, Mato Grosso do Sul; 3 Maringá, Paraná; 4 Palmas, Tocantins; 5 Iturama, Minas Gerais; 6 Santo Antônio do Leste, Mato Grosso. * Significant at 5% and ** Significant at 1% by the F test; Means followed by the same letter in the same column belong to the same group by the Scott-Knott test at 5% of probability. – not evaluated at this location; --- data not shown for other genotype

(9,609.6 kg ha⁻¹) was recorded at Iturama during the 2019/2020 season. Near 7,000 kg ha⁻¹ yields were observed at Maringá and Palmas during the 2021-2022 season, as well as at Iturama in the 2022-2023 season. At Santo Antônio do Leste, the yield was high (6,343.9 kg ha⁻¹) but lower than that of 'BRS 421 OL'. Conversely, at Cassilândia, the yield surpassed 'BRS 421 OL' and equaled that of 'BRS 423 OL'. The mass of 100 seeds across these locations ranged from 75.8 g to 89.1 g. These results supported the recommendation of 'BRS 427 OL' for these key regions, where peanut cultivation is expanding. In all these states, 'BRS 427 OL' is recommended as a high-yielding cultivar with medium maturity, large seeds, and pink testa color.

The performance of 'BRS 427 OL' in locations affected by spotted wilt epidemics was comparable to other checks, such as 'BRS 423 OL' and 'BRS 425 OL'. Moderate to severe symptoms were observed in both plants and seeds (data not shown). Spotted wilt, a disease caused by *Orthotospovirus* and transmitted by thrips, has become epidemic in some locations in western São Paulo over the past decade (Camelo-Garcia et al. 2014, Michelotto et al. 2019). Given the potential damage observed in experimental and commercial fields in the northwest region of São Paulo State, we recommend cultivating 'BRS 427 OL' during early planting times. This timing promotes better plant development and yield under spotted wilt epidemic conditions. 'BRS 427 OL' is also susceptible to late leaf spot (caused by *Nothopassalora personata*), requiring up to eight fungicide applications during the crop season to manage the disease effectively.

SEED MAINTENANCE AND DISTRIBUTION

'BRS 427 OL' is registered under catalog number 53994 by the Ministry of Agriculture and Livestock. Foundation seed production is carried out by EMBRAPA in collaboration with peanut seed companies to support certified seed production.

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DATA AVAILABILITY

The datasets generated and/or analyzed in this study are available from the corresponding author upon reasonable request.

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