CROP BREEDING AND APPLIED BIOTECHNOLOGY

CULTIVAR RELEASE

‘BRS 421’ and ‘BRS 423’: high oleic peanut cultivars for production in Brazil

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Abstract: *‘BRS 421’ and ‘BRS 423’ are high-oleic runner type peanut cultivars, adapted to the main peanut-producing areas in Brazil and partially resistant to spotted wilt. ‘BRS 421’ has a medium cycle and large seed size, while BRS ‘423’ has a short cycle and regular runner seed size.*

Keywords: *Arachis hypogaea L., seed quality, spotted wilt, high yielding.*

INTRODUCTION

Peanut production and quality have been greatly improved over the last two decades in Brazil. In the beginning of 2000s, the implementation of peanut cultivars of the runner type, along with good agricultural and post-harvest practices and mechanization, resulted in continuous production increases (12% per year) (Martins 2018). In the cultivars released since 2009, one of the main improvements is a higher oleic/linoleic acid ratio, which extends the shelf-life and quality (Godoy et al. 2017). The better quality of the exceeding domestic production was important to meet the quality standards of the foreign market. In the 2017-18 growing season, 70% of the overall output of 551,000 tons was exported (Martins 2019).

Currently, more than 90% of the peanut production of Brazil is grown in the Southeast region, especially in the state of São Paulo. However, in the Southern region (Rio Grande do Sul and Paraná) and in the Brazilian savannah in Central Brazil (Mato Grosso do Sul, Mato Grosso, Goiás and Tocantins), the peanut growing areas were also expanded in the last years. This spread of the peanut production into the Brazilian South and Central regions called for the development of better adapted and higher-yielding cultivars.

Here we describe the development of two high oleic peanut cultivars, adapted to the Brazilian savannah biome (“cerrado” in the Central Region), as well as the main peanut-producing areas in São Paulo. ‘BRS 421’ and ‘BRS 423’ produce high yields, but are moderately susceptible to leaf spot, requiring a good foliar disease management. Both cultivars are partially resistant to spotted wilt, a disease caused by *Orthotospovirus* transmitted by thrips, which has regularly caused epidemics at some locations in western São Paulo in the last five years (Camelo-Garcia et al. 2014, Godoy et al. 2017).

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GENETIC ORIGIN AND DEVELOPMENT

The cultivars 'BRS 421' (breeding line 2013-374 OL) and 'BRS 423' (breeding line 2013-413 OL) were selected from two different populations, by a modified pedigree method. In the F_2-F_4 generations, plants with runner type peanut traits (decumbent growth habit, pod shape, seed size and testa color) were selected in the experimental area of Embrapa Rice and Beans, in Santo Antônio de Goiás, Goiás. The pedigree and selections applied to develop both cultivars are described below.

'BRS 421' was originated from a cross between 'IAC 503', a runner type peanut cultivar, donor of the high oleic acid trait, and 'BRS 151 L-7', a large-seeded, short-cycle and drought-tolerant cultivar (Santos 2000). The F_2 population was planted in the 2011/12 growing season, and one single $F_{2:3}$ plant numbered 043 was selected, originating the F_3 progeny 2012-043. This progeny was tested in the 2012/13 growing season and a $F_{3:4}$ plant named 2013-293 was selected from it. A 5-seed sample of this plant 2013-293 was analyzed to determine the fatty acid composition by near-infrared spectroscopy (Suassuna et al. 2015), allowing the selection of genotype 2013-293 with high oleic acid content (71%). In the second growing season of 2013, the high oleic F_4 progeny 2013-293 OL was tested under irrigation and a single $F_{4:5}$ plant was selected in the field. From this plant, named 2013-374 OL, the high oleic line 2013-374 OL was derived.

'BRS 423' was derived from a cross between 'IAC 505', a high oleic runner type peanut cultivar, and line 270 AM, a short-cycle genotype. In the 2012-13 growing season, the F_2 population was planted in the field, and progeny F_3 2013-245 was derived from one selected plant. This progeny was grown under irrigation in the second season, and an individual $F_{3:4}$ plant, 2013-413, within the progeny was selected. A 5-seed sample of plant 2013-413 was used for near infrared spectroscopy analysis of the fatty acid composition (Suassuna et al. 2015), allowing the selection of genotype 2013-413 with high oleic acid content (83%).

In the 2014/15 growing season, the high oleic breeding lines 2013-374 OL and 2013-413 OL were selected for high yield, pod shape and seed size in trials with and without chemical leafspot control. Selection targeting the runner type resulted in peanut plants with similar morphological traits (Table 1): decumbent growth habit, moderate pod constriction, two seeds per pod with pale tan color, high oleic acid content and dormancy. Also, the main stem of 'BRS 421' and 'BRS 423' is not apparent, the lateral branches have curved tips, the canopy is medium and flowering alternate. However, 'BRS 421' is a medium cycle cultivar (135-140 days to maturity), with prominent pod reticulation and beak, long seeds with a very high 100-seed weight (90 g) and a low oil content (45%). 'BRS 423' has a short cycle (125-130 days to maturity), slight pod reticulation and beak, regular seed shape, high 100-seed weight (77 g) and medium oil content (48%).

Table 1. Descriptors* for 'BRS 421' and 'BRS 423'

Descriptor	BRS 421	BRS 423
Growth habit	Decumbent	Decumbent
Main stem	Not apparent	Not apparent
Lateral branches	Upward curved tips	Upward curved tips
Canopy	Medium	Medium
Flowering	Alternate	Alternate
Days to maturity	135-140	125-130
Pod (constriction)	Moderate	Moderate
Pod (reticulation)	Prominent	Slight
Pod (number of seeds)	Two	Two
Pod (beak)	Prominent	Slight
Seed (color)	Pale tan	Pale tan
Seed (shape)	Long	Regular
100-seed weight	Very high (90 g)	High (77 g)
Oil content	Low (45%)	Regular (48%)
Oleic acid content	High (> 70%)	High (>70%)
Dormancy	Present	Present

* Adapted from IBPGR and ICRISAT (1992).

Table 2. Genotypic value (GV) of peanut pod yield (kg ha^{-1}) across 20 field performance tests and ranking of cvs. BRS 421, BRS 423 and checks (REML/BLUP analysis)

Cultivar	Rank	GV (kg ha^{-1})
BRS 423	1	5084
BRS 425	2	4987
BRS 421	3	4813
IAC 503	4	4692
OL 3	5	4520
IAC 505	6	4451
IAC Runner 886	7	4435
Granoleico	8	4271
Overall mean	-	4638
CV	-	17.7
Accuracy	-	0.83

PERFORMANCE AND DESCRIPTION

The performance of 'BRS 421' and 'BRS 423' was evaluated in the growing seasons 2015/2016, 2016/2017, and 2017/2018, in 20 field trials, at the following locations: Santo Antônio de Goiás, Cristianópolis, Hidrolândia, Bela

Table 3. Genotypic value (GV) of peanut pod yield (kg ha^{-1}) at locations with good and intermediate disease management (REML/BLUP analysis)

Cultivar	Good disease management							Intermediate disease management			
	2015-16	2016-17		2017-18				2015-16	2016-17		2017-18
	SAG[1]	CRI[3]	JAB[8]	FRU[4]	PRI[5]	LEM[6]	PAL[7]	HID[2]	SAG[1]	*HER[9]	*TUP[10]
BRS 421	6523.7	6367.1	7076.7	6728.8	7968.9	7351.3	6142.4	4969.7	5085.5	5153.8	4807.9
BRS 423	7004.3	6646.2	6857.2	6838.4	8112.2	7645.0	6271.0	4717.2	5348.6	5205.9	5238.4
IAC 503	-	5979.8	7028.4	-	-	-	-	4646.7	4575.5	5108.1	4711.2
IAC OL 3	-	5568.8	7153.4	-	8058.6	7440.8	6004.7	-	4492.0	-	4666.4
IAC 505	6205.6	-		6550.6	-	-	-	-	-	-	-
IAC Runner 886	6296.0	-		-	-	-	-	4589.4	-	-	-
GRANOLEICO	-	5432.3	6930.3	6352.4	-	-	-	-	4415.1	4840.3	4754.2
Mean average	5972.8	5379.4	6564.8	6269.1	7755.7	7077.0	5791.5	4259.2	4362.2	4766.0	4585.6
CV	19.6	15.7	11.6	8.6	10.4	16.0	11.7	27.2	17.21	12.7	15.6

[1] Santo Antônio de Goiás, [2] Hidrolândia and [3] Cristianópolis, Goiás; [4] Frutal, Minas Gerais; [5] Primavera do Leste, Mato Grosso; [6]Luís Eduardo Magalhães, Bahia; [7]Palmas, Tocantins; [8]Jaboticabal, [9]Herculândia and [10]Tupã, São Paulo. *locations with severe epidemics of spotted wilt.

Vista de Goiás and Jataí (Goiás); Herculândia, Jaboticabal and Tupã (São Paulo); Frutal (Minas Gerais); Palmas (Tocantins); Primavera do Leste (Mato Grosso); Luís Eduardo Magalhães (Bahia); Barbalha (Ceará); Petrolândia (Pernambuco); and Pelotas (Rio Grande do Sul). In Barbalha and Petrolândia, the trials were planted in the dry season, with supplementary irrigation. Pod yield (kg ha^{-1}) was evaluated at all locations. Software Selegen-Reml/Blup was used for Restricted Maximum Likelihood/ Best Linear Unbiased Prediction (REML/BLUP) analysis (Resende 2016). The genotypic values of 'BRS 421' and 'BRS 423' and the commercial checks were ranked based on all individual trials (Resende and Duarte 2007), as well as in a combined analysis involving all locations. Across all 20 trials, the mean genotypic values for pod yield of 'BRS 421' and 'BRS 423' were 4813 kg ha^{-1} and 5084 kg ha^{-1}, respectively, i.e., higher than the checks 'IAC 503' (4692 kg ha^{-1}), 'IAC OL-3' (4520 kg ha^{-1}), 'IAC 505' (4451 kg ha^{-1}), and 'Granoleico' (4271 kg ha^{-1}); the general mean was 4638 kg ha^{-1}, accuracy 0.82 and CV 17.7 (Table 2).

Table 4. BRS 421 and BRS 423 oil content (%), determined by Nuclear Magnetic Resonance (NMR) and composition (%) determined by gas chromatography

Fatty acids	**BRS 421** (%)	**BRS 423** (%)
Palmitic acid (C16:0)	6.07	6.30
Margaric acid (C17:0)	0.13	0.12
Heptadecanoic acid (C17:1 cis-10)	0.13	0.09
Stearic acid (C18:0)	2.66	2.34
Oleic acid (C18:1 cis-9)	80.79	80.77
Linoleic acid (C18:2 cis-9-12)	2.45	2.66
Arachidic acid (C20:0)	1.24	1.25
Eicosenoic acid (C20:1 cis-9)	1.88	1.78
Behenic acid (C22:0)	2.65	2.82
Erucic acid (C22:1 cis-9)	0.17	0.15
Lignoceric acid (C24:0)	1.58	1.46
Total fatty acids	45	48

At locations with good disease management and early planting date, 'BRS 421' and 'BRS 423' were ranked among the highest-yielding genotypes in the West Central and Southeast regions (Table 3). In Primavera do Leste, 'BRS 421' and 'BRS 423' achieved the highest yields (7968.9 and 8112.2 kg ha^{-1}, respectively). Other locations with very high yields were Luís Eduardo Magalhães, Palmas, Jaboticabal and Frutal.

The trials in Herculândia and Tupã, western São Paulo State, were planted in the beginning of December, and severe spotted wilt epidemics were observed at both locations (Table 3). The performance of 'BRS 421' and 'BRS 423' exceeded the overall means and checks, as observed for 'BRS 425' (Suassuna et al. 2019).

'BRS 421' is indicated for the market of large-seeded peanut, as a percentage of 70% of the seeds are classified as Jumbo runner (38/42 grains per ounce) and 21% as medium runner (40-50 grains per ounce). The oil quality is good and the total oil content 45% (Table 4).

'BRS 423' is indicated for the market of regular runner peanut, since 62% of the seeds are classified as Jumbo runner (38/42 grains per ounce) and 26% as medium runner (40-50 grains per ounce). The oil quality and total oil content (48%) are also good (Table 4).

SEED MAINTENANCE AND DISTRIBUTION

'BRS 421' and 'BRS 423' were catalogued by the Ministry of Agriculture, Livestock and Food Supply as no. 37301 and 37302, respectively. Basic seed is produced by Embrapa Products and Markets (Embrapa SPM), in partnership with peanut seed companies, for certified seed production.

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