CULTIVAR RELEASE

BRS 425: the first runner peanut cultivar related to wild ancestral species

Crop Breeding and Applied Biotechnology
19:3, 373-377, 2019
Brazilian Society of Plant Breeding.
Printed in Brazil
http://dx.doi.org/10.1590/1984-70332019v19n3c52

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Abstract: *BRS 425 is a high-oleic runner peanut cultivar related to wild ancestral parents, partially resistant to early and late leaf spot and spotted wilt. It is large-seeded and contains 46% oil. BRS 425 is adapted to the main peanut-producing regions of Brazil.*

Keywords: *Arachis hypogaea, A. ipaënsis, A. duranensis, disease resistance, tetraploid route.*

INTRODUCTION

In Brazil, peanut (*Arachis hypogaea* L.) has become an important crop, with successively increasing yield and quality over the last 20 years. Four major peanut types are cultivated: Runner, Valencia, Virginia and Spanish. Of these, the runner type has been improved for yield, uniform maturity, pod and seed shape and size, and tested for processing quality and sensory traits; its decumbent growth habit is well suited for mechanical harvesting. The preference of Brazilian peanut producers for the runner type has intensified the implementation of modern cultivation and post-harvest technologies, eventually increasing the country's participation in the national and international highly demanding peanut market (Sampaio 2016).

The peanut market is profitable and requires cultivars with a high oleic acid content, extending the shelf life of peanut-based foods. This trait is common in peanut cultivars released in Brazil since 2012 (Godoy et al. 2017). On the other hand, most of the recently released cultivars are susceptible to early leaf spot, caused by *Passalora arachidicola* (Hori) U. Braun (teleomorph: *Mycosphaerella arachidis* Deighton), late leaf spot, caused by *Passalora personata* (Berk. and M.A. Curtis) S.A. Khan & M. Kamal (teleomorph: *Mycosphaerella berkeleyi* W.A. Jenkins), and spotted wilt, a thrips-transmitted virus caused by different species of the genus *Tospovirus* (Camelo-Garcia et al. 2014, Suassuna et al. 2016).

The research progress over the last years has advanced the understanding of the origin of cultivated peanut. This allotetraploid crop (with an AABB genome)

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Received: 08 January 2019
Accepted: 06 April 2019

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is native to the lowlands of northwestern Argentina and southeastern Bolivia and has the putative ancestral species *A. ipaënsis* (BB) and *A. duranensis* (AA) (Bertioli et al. 2016). The development of a synthetic polyploid by colchicine doubling, combining *A. duranensis* and *A. ipaënsis* (Fávero et al. 2006) led to the generation of interspecific populations with variability for agronomic traits and resistance to leaf spots in Spanish peanut genotypes, in Senegal (Fonceka et al. 2012) and in a Runner peanut genotype in Brazil (Suassuna et al. 2015, Leal-Bertioli et al. 2018). These results reinforce the value of using wild species in peanut breeding particularly of wild ancestral parents, for peanut breeding programs. As a result, six early (90-day cycle) Spanish cultivars related to the wild parents were developed and released in Senegal, with moderate resistance to early leaf spot, diverging from the recurrent parent, cultivar Fleur 11, which is susceptible (Dr. Issa Faye/ISRA, personal communication).

In a BC_1 Runner IAC 886 x [*A. ipaënsis* x *A. duranensis*]^{4x} population, a partially leaf spot-resistant segregating line was selected (Suassuna et al. 2015) and crossed with high-oleic cultivars to generate new breeding populations. Using conventional breeding methods of selection for yield, pod and seed shape and size, high-oleic acid content and partial resistance to foliar diseases, we developed the first runner cultivar related with wild ancestral species of peanut.

GENETIC ORIGIN AND DEVELOPMENT

The peanut cultivar BRS 425 is related to wild ancestors through its male parent, the advanced line LPM 17-A (Figure 1), selected from the BC_1 Runner IAC 886 x (*A. ipaënsis* x *A. duranensis*)^{4x} progeny LPM 17 (Suassuna et al. 2015). The leaf spot resistance of LPM 17-A is higher than the recurrent parent, it has yellow flowers, a large seed size (100-seed weight = 84 g) and tan seed coat. The female parent was cultivar 'IAC 505', donor of the high-oleic acid trait.

By the pedigree method, in the 2012/2013 growing season, in Santo Antônio de Goiás - GO, plant '256' was selected from the segregating F_2 population. The progenies (F_3) of the selected plant (2013-256) were evaluated in the second growing seasons of 2013 under irrigated conditions. From this progeny, plant '425' was selected, and the preliminary line 2013-425 (F_4) was subjected to evaluations in the main growing season of 2014/15. The plants in the F_2-F_3 generations were selected for decumbent growth habit, pod shape, seed size and seed coat color to develop runner market a type

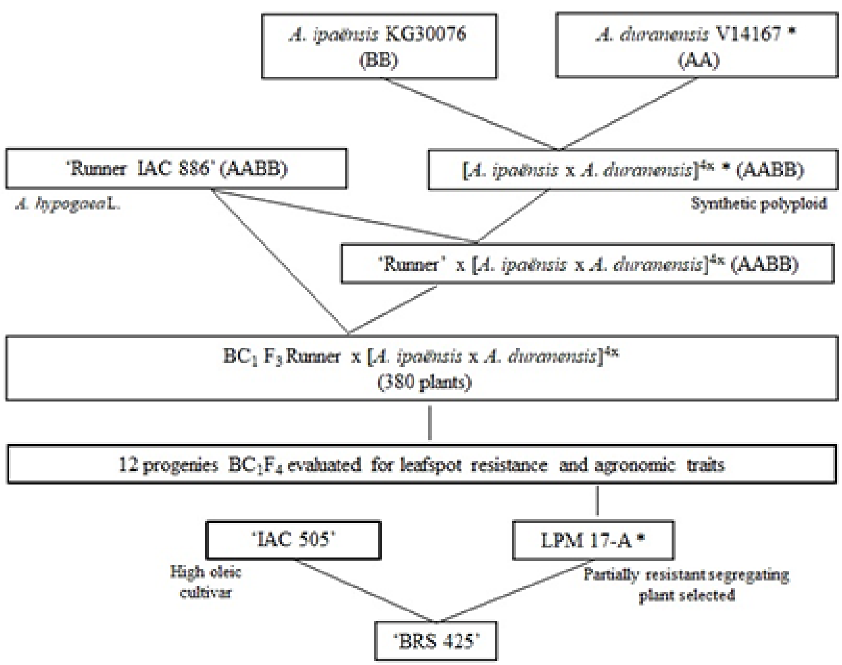

Figure 1. Pedigree of BRS 425, showing the tetraploid route (the synthetic polyploid is derived from the wild ancestrals of peanut, *A. ipaënsis* and *A. duranensis*). * yellow flower, a morphological marker inherited from *A. duranensis*, observed in LPM 17-A, the male parent of BRS 425.

with a high-oleic acid content (> 70%). In the F_4 generation, line 2013-425 was selected in trials with and without fungicide spraying. Oil and oleic acid content were assessed in the F_3 and F_4 generations by Near Infrared (NIR) equipment, as described by Suassuna et al. (2015), at Embrapa Cotton. Using the NIR, oil and oleic acid content were assessed in the F_5 generation by nuclear magnetic resonance (NMR), at Embrapa Instrumentation. A sample of breeder seed was also evaluated by gas chromatography for oil content and composition.

TRAIT PERFORMANCE

Cultivar BRS 425 was evaluated in the main growing seasons of 2015/2016, 2016/2017, and 2017/2018, resulting in a total of 20 field trials. In the 2015/16 growing season, the cultivar performance was tested (Table 1) at five locations: Santo Antônio de Goiás - GO, Bela Vista - GO, Hidrolândia - GO, Jataí - GO, and Pelotas - RS. In the 2016-17 growing season (Table 1), BRS 425 was tested at six locations: Herculândia – SP, Jaboticabal – SP, Santo Antônio de Goiás - GO, Cristianópolis – GO, Palmas – TO, and Petrolândia – PE; and in 2017-18 (Table 2), at nine locations: Tupã – SP, Frutal – MG, Palmas – TO, Luís Eduardo Magalhães – BA, Primavera do Leste – MT, Jataí – GO, Santo Antônio do Leste – MT, Barbalha – CE, and Santo Antônio de Goiás – GO.

Pod yield (kg ha^{-1}) was evaluated across all locations. Software Selegen-Reml/Blup was used for Restricted Maximum Likelihood/Best Linear Unbiased Prediction (REML/BLUP) analysis (Resende 2016). The genotypes (BRS 425 and the commercial checks) were ranked, based on the genotypic values of all individual trials and on a combined analysis involving all locations (Resende and Duarte 2007). Cultivar BRS 425 was ranked as the highest-yielding genotype at the locations where the disease management using fungicides (leaf spots) or thrips control with insecticides was inefficient or not applied (e.g., in trials with: high leaf spot severity, as observed in Santo Antônio de Goiás – GO in 2016/17; severe spotted wilt and leaf spot epidemics in Herculândia - SP 2016/17; no chemical management in Jataí - GO and Pelotas - RS 2015-16, Palmas – TO 2016-17; Table 1). 'BRS 425' was also evaluated under optimum management conditions, ranking among the highest yielding genotypes (Table 2). In the 2017/18 trials, BRS 425 produced the highest pod yield in Frutal – MG (6825.0 kg ha^{-1}) and in Luís Eduardo Magalhães - BA (7440.8 kg ha^{-1}), and yield performance was highest in Primavera do Leste – MT (8131.3 kg ha^{-1}), indicating a yield potential of > 8000 kg ha^{-1}. Across all 20 trials, the mean genotypic value for pod yield of BRS 425 was 4987 kg ha^{-1}, exceeding the checks IAC 503 (4692 kg ha^{-1}), IAC OL-3 (4520

Table 1. Genotypic value (GV) of peanut pod yield (kg ha^{-1}) and ranking (Rank) of the cultivars obtained by the REM/BLUP methodology in 11 performance tests in the 2015-16 and 2016-17 growing seasons

2015-2016 growing season			
Location	**Cultivar**	**GV**	**Rank**
Santo Antônio de Goiás – GO	BRS 425	6769.0	2
	Runner IAC 886	6296.0	8
	IAC 505	6205.6	9
Hidrolândia – GO	BRS 425	4963.0	2
	IAC 503	4646.7	7
	Runner IAC 886	4589.4	8
Bela Vista de Goiás – GO	IAC 505	3229.8	3
	BRS 425	3157.6	5
	IAC 503	3013.6	9
Jataí – GO	BRS 425	3530.3	1
	IAC 505	3350.3	4
	Runner IAC 886	3106.8	8
Pelotas – RS	BRS 425	1440.6	1
	IAC 503	1316.4	5
	Runner IAC 886	1220.5	8
	IAC 505	1133.9	10
Petrolândia – PE	IAC 503	5819.9	2
	IAC OL-3	5790.2	5
	BRS 425	5763.3	6
	Granoleico	5645.5	9

2016-2017 growing season			
Location	**Cultivar**	**GV**	**Rank**
Santo Antônio de Goiás - GO	BRS 425	5361.9	1
	IAC 503	4575.5	7
	IAC OL-3	4492.0	8
	Granoleico	4415.1	9
Herculândia - SP	BRS 425	5297.4	1
	IAC 503	5108.1	4
	Granoleico	4840.3	8
Cristianópolis - GO	BRS 425	6250.7	3
	IAC 503	5979.8	5
	IAC OL-3	5568.8	8
	Granoleico	5432.3	9
Jaboticabal - SP	IAC OL-3	7153.4	1
	IAC 503	7028.4	3
	Granoleico	6930.3	4
	BRS 425	6736.5	7
Palmas - TO	BRS 425	2138.3	1
	Granoleico	1972.4	4
	IAC 503	1940.8	5
	IAC OL-3	1916.7	6

Table 2. Genotypic value (GV) of peanut pod yield (kg ha^{-1}) and ranking (Rank) of the cultivars obtained by the REM/BLUP methodology in nine performance tests in the 2017-18 growing season

Location	Cultivar	GV	Rank
Tupã - SP	BRS 425	5238.4	2
	Granoleico	4754.2	8
	IAC 503	4711.2	9
	IAC OL-3	4666.4	10
Santo Antônio de Goiás - GO	BRS 425	4733.2	3
	IAC 503	4586.7	5
	IAC OL-3	4222.0	9
	Granoleico	4114.4	10
Frutal - MG	BRS 425	6825.0	2
	IAC 505	6550.6	4
	Granoleico	6352.4	5
Palmas - TO	BRS 425	6381.2	1
	IAC OL-3	6004.7	4
Primavera do Leste – MT[1]	BRS 425	4027.1	3
	IAC OL-3	3915.7	4
Primavera do Leste – MT[2]	BRS 425	8131.3	1
	IAC OL-3	8058.6	3
Jataí - GO	BRS 425	2433.7	1
	IAC OL-3	2113.6	6
Barbalha - CE	BRS 425	4724.0	4
	IAC 503	4614.3	7
	Granoleico	4550.6	9
	IAC OL-3	4519.0	10
Luís Eduardo Magalhães - BA	IAC OL-3	7440.8	2
	BRS 425	7290.2	4

[1] Second growth season, late planting; [2] Main growth season, early planting.

kg ha^{-1}), IAC 505 (4451 kg ha^{-1}), and Granoleico (4271 kg ha^{-1}), with an accuracy of 0.82 and CV of 17.7.

In Santo Antônio de Goiás, GO (lat 16º 30.2' S, long 49º 17.2' W, alt 823 m asl), cultivar BRS-425 has an alternate branching pattern and decumbent growth habit; the main stem is not apparent. Flowers are orange, the seed coat light tan and the kernels were classified as large runner type, with a mean 100-seed weight of 75.8 g. (ranging from 74.0 to 77.4 g) and a seed/pod weight ratio of 76%. The cultivar has a medium cycle length and is indicated for the Central-Southeast region (135 days). However, when grown at higher latitudes, e.g., in the Northeast region, it can reach maturity at 125 days after planting. The total oil content (46%) and fatty acid composition (81.2% of oleic acid) meet the Brazilian market requirements (Table 3).

Table 3. 'BRS 425' oil content and composition determined by gas chromatography

Fatty acid	Content (%)
Palmitic acid (C16:0)	6.15
Margaric acid (C17:0)	0.10
Heptadecanoic acid (C17:1 cis-10)	0.07
Stearic acid (C18:0)	2.56
Oleic acid (C18:1 cis-9)	81.2
Linoleic acid (C18:2 cis-9-12)	2.27
Arachidic acid (C20:0)	1.34
Eicosenoic acid (C20:1 cis-9)	1.71
Behenic acid (C22:0)	2.80
Erucic acid (C22:1 cis-9)	0.13
Lignoceric acid (C24:0)	1.46
Total fatty acid	46.00

'BRS 425' is a medium cycle high-oleic acid runner cultivar, with high yield and partial resistance/tolerance to the main foliar diseases of peanut (leaf spots and spotted wilt) in Brazil. It is a high-yielding runner peanut cultivar for optimum environments but can also be recommended for low input farming or under higher disease pressure.

SEED MAINTENANCE AND DISTRIBUTION

BRS 425 was catalogued (no. 37303) by the Brazilian Ministry of Agriculture, Livestock and Food Supply. Foundation seed is produced by the Secretariat of Innovation and Business (SIN) of Embrapa, in partnership with peanut seed companies, to produce certified seed.

ACKNOWLEDGEMENTS

The authors thank for partnership in field trials: the students Kennedy Brunno de Brito Martins, Lucas Correia Costa, Ramon Guedes Matos, Eloene Rodrigues Godoy and Jorge Luis Souza Ferreira; Rafael Matos (Goiás state); Romildo Contelli, Nilson Contelli, Pablo Rivera and Rodolfo Pires Ribeiro (Beatrice Peanuts, west region of São Paulo state); Walter Souza, José Antônio de Souza Rossato Jr., Guilherme Salis Uitdewilligen, Talita Reisch and Natália Buzinaro Caporusso (Coplana, northwest of São Paulo state); Marco Aurélio Campos and Marcos Guido Domenici (Frutal/MG), Cristian Luarte Leonel (Primavera do Leste/MT). The Peanut Breeding Program was supported by grants from Embrapa (SEG 02.12.010.00).

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