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BRS Araçari and BRS Biguatinga: Embrapa´s new habanero pepper cultivars

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ABSTRACT

Embrapa Vegetables´ *Capsicum* breeding program has contributed significantly with several nonpungent and pungent pepper cultivars and hybrids released to the Brazilian market, focusing mainly on disease resistance and superior industrial and nutritional quality of fruits. The habanero chile pepper cultivars BRS Araçari and BRS Biguatinga were developed by Embrapa´s breeding program to meet both the market for fresh fruit and processing agroindustry of mashes and sauces. 'BRS Araçari' pods are rectangle-shaped, turn from dark green to bright yellow when mature, and are 4.3 cm long by 4.2 cm wide and have 1.8 mm in wall thickness. Fruits have a pungency of circa 5,000 SHU (Scoville Heat Unit) and high vitamin C content (177.4 mg/100 g). 'BRS Biguatinga' pods are campanulate-shaped, the standard shape of habaneros, turn from light green to red when ripe, 6.6 cm long by 3.4 cm wide and 1.9 mm in wall thickness. Fruit pungency is circa 150,000 SHU and fruits have 149 mg/100 g fruit of vitamin C and 221 µg/g fruit of carotenoids. Both cultivars are resistant to important chile pepper diseases, present high yield, uniformity and fruit quality, and have been successfully cultivated in conventional and organic production systems in Brazil. 'BRS Araçari' and 'BRS Biguatinga' were registered and protected by the Brazilian Ministry of Agriculture and Livestock, and seeds of cultivar BRS Araçari are being marketed by Isla Sementes. 'BRS Biguatinga' basic seeds are being offered to the production sector through Public Call for Tenders for interest parties in becoming Embrapa's partners for the production and sale of commercial seeds.

Keywords: *Capsicum chinense*, resistance, fresh market, processing, capsaicinoids.

RESUMO

BRS Araçari e BRS Biguatinga: Novas cultivares de pimenta habanero da Embrapa Hortaliças

O programa de melhoramento de *Capsicum* da Embrapa Hortaliças tem contribuído significativamente no desenvolvimento e disponibilização de cultivares de pimentas com diferentes níveis de pungência no mercado brasileiro, tendo como foco principal a resistência a doenças e frutos com qualidades industrial e nutricional superiores. As cultivares de pimenta habanero BRS Araçari e BRS Biguatinga foram desenvolvidas pela Embrapa Hortaliças visando tanto o mercado de frutos frescos como a indústria processadora de pastas e molhos. 'BRS Araçari' apresenta frutos de formato retangular, de coloração verde quanto imaturo e amarela quando maduro, com 4,3 cm de comprimento por 4,2 cm de largura e 1,8 mm de espessura de parede. Os frutos têm pungência média de 5.000 SHU (unidade de calor Scoville) e elevado conteúdo de vitamina C (177,4 mg/100 g). Os frutos de 'BRS Biguatinga' são de formato campanulado, forma típica das pimentas do grupo habanero, de coloração verde clara quando imaturos e vermelha quando maduros, com 6,6 cm de comprimento por 3,4 cm de largura e 1,9 mm de espessura de parede. A pungência média dos frutos é de cerca de 150.000 SHU, com 149 mg/100 g de vitamina C e 221 µg/g fruto de carotenoides. As duas cultivares são resistentes a doenças importantes que afetam a cultura da pimenteira e apresentam elevadas produtividade, uniformidade e qualidade de frutos, ademais, ambas as cultivares têm sido cultivadas com sucesso em sistemas de produção convencional e orgânico no Brasil. 'BRS Araçari' e 'BRS Biguatinga' foram registradas e protegidas pelo Ministério da Agricultura e Pecuária, e sementes comerciais da cultivar BRS Araçari estão sendo produzidas e comercializadas pela empresa Isla Sementes. Sementes básicas de 'BRS Biguatinga' estão sendo ofertadas ao setor produtivo por meio de Edital Público para interessados na produção e comercialização de sementes comerciais da referida cultivar.

Palavras chave: *Capsicum chinense*, resistência, mercado fresco, processamento, capsaicinoides.

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In 2016, the Embrapa Vegetables announced the release of cultivars BRS Juruti and BRS Nandaia, the first habanero pepper cultivars developed for Brazilian growing conditions (Ribeiro *et al*., 2015), which are commercialized by Isla Sementes. Habanero-type peppers have high popularity around the world not only for their pungency levels but also for their unique aroma and flavor (Bosland & Coon, 2015). The habanero group belongs to the species *Capsicum chinense*, and its fruits can present a great diversity of color, shape, and pungency. Its pod is lantern-shaped and is green in color when immature and red, orange, yellow, brown or white color when ripe. The plant of habanero group is a bush with about 1 m in height and present intermediate or erect growth habit.

The cultivation of habanero is mainly carried out in tropical and subtropical regions, but this type of pepper is not yet well known in Brazil. The growth of international demand for this type of pepper has aroused the interest of the Brazilian farmers and processing industries in supplying part of this demand with high quality products, particularly the habanero pepper mash (Ribeiro *et al*., 2015; Soares *et al*., 2020).

Embrapa's *Capsicum* program has contributed significantly with several nonpungent and pungent pepper cultivars and hybrids released to the Brazilian market, enabling the expansion of production and the occupation of market niches, focusing on multiple disease resistance and superior industrial and nutritional quality of the new materials (Ribeiro *et al*., 2020). Capsaicinoids are specialized secondary metabolites found only in *Capsicum* species and are responsible for chile pepper pungency, or heat (Bosland & Coon, 2015). Pungency is a feature of great appeal and importance to pepper consumers, and in addition to being quite variable, it is directly associated with the type or group of peppers (Ribeiro *et al*., 2020). There are bell peppers and sweet chillies ranging from 0 SHU (Scoville heat units) to extremely hot peppers as new Pepper X, which is three times spicier than the Carolina Reaper pepper (over 2,000,000 SHU).

'BRS Juruti' (red ripe fruit) and 'BRS Nandaia' (orange ripe fruit) are highly pungent, 260,000 SHU and 200,000 SHU, respectively. However, in Brazil there are consumers that appreciate chili peppers with low-heat, yet rich in aroma and flavor. Mild or low pungency *C. chinense* cultivars have been released around the world, including 'NuMex Trick-or-Treat', a no-heat habanero pepper developed by the New Mexico State University breeding program (Bosland & Coon, 2015).

'BRS Araçari' (Figure 1) and 'BRS Biguatinga' (Figure 2) habanero-type pepper cultivars, selected from a base population with broad genetic variability established by Embrapa´s breeding program (Nass *et al*., 2015), provide ripe yellow and red fruits, respectively. These cultivars have been developed to meet both the fresh fruit market as well the pepper paste and sauce industry and have different capsaicin content (5,000 SHU and 150,000 SHU, respectively). Despite having been developed for growing in a conventional production system, both cultivars are being successfully evaluated in organic production system in the Federal District (DF) and in the state of São Paulo.

PEDIGREE

Cultivars BRS Araçari and BRS Biguatinga are the advanced endogamic lines CNPH 15,744 and CNPH 15,740, respectively, which derived from a base population of habanero CNPH 15,469, after fifth generation of plant selection and self-pollination. Thirty-one accessions of habanero-type pepper from different origins present in the *Capsicum* Active Germplasm Bank (AGB) of Embrapa Vegetables were intercrossed to establish a base population. The base population of habanero CNPH 15,469 (Figure 3) was formed by an equal mixture of F_2 seeds from all crosses obtained (hybrids), using a fixed weight (1 g), which is close to 150 seeds per genotype (Nass *et al*., 2015). This originated 1000 individual plants that were evaluated in the field and 17 genotypes were selected and advanced using the breeding method selection of individual plants with progeny test (Nass *et al*., 2015; Soares *et al*., 2020). The selections were based on morpho-agronomic characteristics, such as plant architecture and height, shape and fruit size, mature fruit color and pungency, high yield, and disease resistance. 'BRS Araçari' was registered (RNC 44032) and protected (Certified No. 20210112) by the Ministry of Agriculture and Livestock (MAPA) and its seeds are being marketed by Isla Sementes. 'BRS Biguatinga' was registered (RNC 46651) by MAPA and protected (Certified No. 20230075) by the National Plant Variety protection Service (SNPC/MAPA) in 2023. Cultivar BRS Biguatinga basic seeds are being offered to the production sector through Public Call for Tenders, which gives broad aiming to reach all the segments of seed producers and look for interested parties in becoming Embrapa's partners for the production and sale of commercial seeds.

DESCRIPTION AND PERFORMANCE

'BRS Araçari' plant presents erect growth habit and is around 1.0 m high by 80 cm wide and height of first bifurcation above 30 cm, plant characteristics that can facilitate fruits harvesting, whether manual or mechanized. However, lodging can be an issue under windy conditions. In a protected environment, this factor is minimized. Pods are rectangle-shaped, turn from dark green to bright yellow when mature, are 4.3 cm long by 4.2 cm wide and 1.8 mm in wall thickness.

Fruits have a pungency of *circa* 5,000 SHU (Scoville Heat Unit) and high content of vitamin C (177.4 mg/100 g) (Soares *et al*., 2020). In general, 80-90% of the total capsaicinoid content in chile pepper is represented by capsaicin and dihydrocapsaicin, and the remaining part is represented by nordihydrocapsaicin, homodihydrocapsaicin, and

homocapsaicin. Fruits of 'BRS Araçari' have presented very high levels of nordihydrocapsaicin, around 14%, 40% higher than the highest level reported by Zewdie & Bosland (2001). Nordihydrocapsaicin is considered the least irritating of the capsaicinoids, and the burning was located in front of the mouth and palate, causing a "mellow warming effect". Capsaicinoid profiles are very important for the consumer, including the industry, due to the sensory properties and its importance to food quality and cultural preference (Gusmán & Bosland, 2017).

Figure 1. Immature and mature fruits of habanero pepper 'BRS Araçari'. Brasília, Embrapa Hortaliças, 2019.

Figure 2. Immature and mature fruits of habanero pepper 'BRS Biguatinga'. Brasília, Embrapa Hortaliças, 2019.

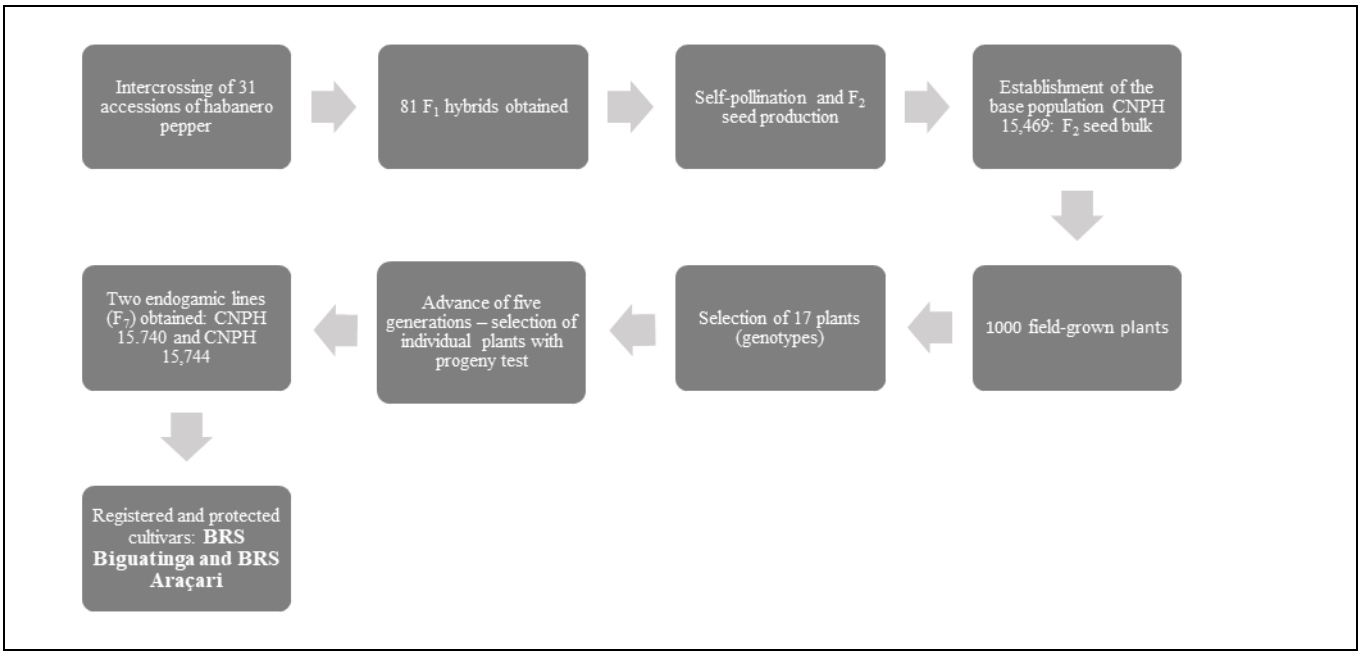

Figure 3. 'BRS Araçari' and 'BRS Biguatinga' pedigree. Brasília, Embrapa Hortaliças, 2023.

In growing conditions of Central Brazil during the dry season, harvest of ripe fruit of 'BRS Araçari' begins around 78 days after seedlings transplanting. In GO state and DF, 'BRS Araçari' yielded around 13 t/ha (25,000 plants/ha) in open-field cultivations and 36 t/ha (25,000 plants/ha) in protected environment, over a three-month harvest period. The yield of no-heat cultivar NuMex Trick-or-Treat, an orange habanero release by New Mexico State University, averaged 7.8 t/ha (Bosland & Coon, 2015). 'BRS Araçari' was also evaluated in organic production system, in São Carlos-SP, and demonstrated good adaption and yield, estimated in 10.7 t/ha (8,400 plants/ha). This cultivar presents resistance to the root-knot nematodes *Meloidogyne incognita* and *M. javanica*, and moderate resistance to *Ralstonia pseudosolanacearum* (Soares *et al*., 2019).

An outstanding feature of BRS Araçari is that it is highly aromatic and lightly pungent in addition to presenting yellow fruits, which make it a strong candidate for table consumption and occupying a new niche within the habanero peppers.

'BRS Biguatinga' plant presents intermediate habit and is around 50 cm high by 1.0 m wide. Pods are campanulate-shaped, the standard shape of habaneros, turn from light green to red when ripe, 6.6 cm long by 3.4 cm wide and 1.9 mm in wall thickness. Fruit pungency is *circa* 150,000 SHU and fruits have high content of vitamin C (149 mg/100 g fruit) and carotenoids (221 µg/g fruit) (Soares *et al*., 2020).

Grown in Central Brazil during the dry season, the harvest of BRS Biguatinga's ripe fruit begins around 90 days after seedlings transplanting and yields around 30 t/ha (25,000 plants/ha) in open-field cultivation, over three-month harvest period. The open pollinated cultivar BRS Biguatinga has had yield above the American habanero hybrid 'Caro-Tex-312' (28.9 t/ha, 32,600 plants/ha) (Crosby *et al*., 2013). Although 'BRS Biguatinga' and 'BRS Juruti' have ripe red fruits and have presented similar average yields in field trials in DF (30 t/ha and 27 t/ha, respectively), the capsaicinoids contents of their fruits are different, 'BRS Biguatinga' is less pungent than 'BRS Juruti'.

'BRS Biguatinga' was evaluated in organic production system, in São Carlos-SP, where also demonstrated good adaption and yield, estimated in 10.3 t/ha (8,400 plants/ha). Plants of 'BRS Biguatinga' are highly resistant to PVY (*potato virus Y*), *R. pseudosolanacearum* and *M. javanica*, and present intermediate resistance to *Phytophthora capsici* and *M. incognita* (Soares *et al*., 2019).

'BRS Biguatinga' was developed to meet both the fresh fruit market and the processing industries, particularly to produce mashes and sauces, in addition to the potential use for the dehydration of whole fruit to obtain spicy paprika. Many gourmet products use habanero pepper for aggregating pungency, flavor, and taste, such as fruit jellies, flavored vinegars, and different kinds of seasoning powder, nuts, potato chips, cookies, cheeses, and sausages.

SEED MAINTENANCE AND DISTRIBUTION

'BRS Araçari's seeds are being marketed by the seed company Isla Sementes. Embrapa Vegetables will provide seeds of 'BRS Biguatinga' under contract to interested companies producing seeds.

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