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Pomology/ Original Article

Behavior of *fusarium*-resistant pineapple hybrids in the extreme south of the state of Bahia, Brazil

Abstract – The objective of this work was to evaluate the agronomic performance and fruit quality of three new *fusarium*-resistant pineapple hybrids and one commercial cultivar, under the environmental conditions of the extreme south region of the state of Bahia, Brazil. The experiments were carried out in the Belmonte and Eunápolis municipalities, in a randomized complete block design with four replicates and four treatments. The evaluation of the performance of the genotypes was based on variables of plant vegetative growth and on fruit size and quality. 'BRS Diamante' and 'BRS Sol Bahia' present a good vegetative vigor and produce large-sized fruit, while 'BRS Real' and 'BRS Imperial' show a lower and similar vigor, which results in the formation of smaller fruit. The new genotypes are of late cycle, taking from 173 to 220 days from flower induction to fruit harvest, with 'BRS Diamante' standing out as having the latest cycle. Fruit of the new hybrids show good quality with a moderate to high soluble solids/titratable acidity ratio, indicating a good potential for consumer acceptance. The new genotypes show significant agronomic potential in the extreme south region of Bahia.

Index terms: *Ananas comosus* var. *comosus*, *Fusarium guttiforme*, fruit quality.

Comportamento de híbridos de abacaxi resistentes a fusário no extremo sul da Bahia, Brasil

Resumo – O objetivo deste trabalho foi avaliar o desempenho agronômico e a qualidade dos frutos de três novos híbridos de abacaxizeiro resistentes ao fusário e de uma cultivar comercial, nas condições ambientais do extremo sul do estado da Bahia, Brasil. Os experimentos foram realizados nos municípios de Belmonte e Eunápolis, em delineamento de blocos ao acaso, com quatro repetições e quatro tratamentos. A avaliação do desempenho dos genótipos foi feita com base em variáveis de crescimento vegetativo das plantas e no tamanho e na qualidade dos frutos. 'BRS Diamante' e 'BRS Sol Bahia' apresentam bom vigor vegetativo e produzem frutos grandes, enquanto 'BRS Real' e 'BRS Imperial' apresentam vigor menor e similar entre si, o que resulta na formação de frutos menores. Os novos genótipos são de ciclo tardio, demorando de 173 a 220 dias desde a indução do florescimento até a colheita dos frutos, com destaque para 'BRS Diamante', o mais tardio. Os frutos dos novos híbridos apresentam boa qualidade, com relação sólidos solúveis/acidez titulável de moderada a alta, o que indica bom potencial para aceitação pelo consumidor. Os novos genótipos mostram significativo potencial agronômico nas condições do extremo sul da Bahia.

Termos para indexação: *Ananas comosus* var. *comosus*, *Fusarium guttiforme*, qualidade do fruto.

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Introduction

Brazilian production of pineapple [*Ananas comosus* var. *comosus* (L.) Merril] is indeed significant, which makes it one of the top players in the global pineapple industry, with 1.6 billion fruit in 2022 (IBGE, 2023), equivalent to about 2.3 million tonnes (FAO, 2024). The MD-2 cultivar (Gold) dominates the international pineapple market for fresh consumption. The Brazilian pineapple industry is based on the 'Pérola' genotype, with about 85.5%, and on 'Smooth Cayenne', with about 9.5% of the national production; these two commercial cultivars are susceptible to fusariosis (*Fusarium guttiforme*), considered the most severe disease causing very significant losses of fruits, plants and planting material (Junghans & Souza, 2022). 'Pérola' has high vegetative vigor and great adaptability to different Brazilian ecosystems, its leaf margins are covered with spines and it shows a greater tendency toward natural flowering than other cultivars, such as 'Smooth Cayenne' (Reinhardt et al., 2002; Junghans & Souza, 2022). The use of resistant cultivars is considered the best method to control fusariosis, as this is ecologically correct by not requiring the large-scale use of fungicides, thus reducing the negative impacts on the environment, producers, and consumers.

In the last 20 years, Embrapa Mandioca e Fruticultura research center in Bahia state, Brazil, has developed and offered some *fusarium*-resistant pineapple cultivars, such as 'BRS Imperial', 'BRS Vitória', and 'BRS Ajubá'. Despite the excellent organoleptic qualities of these cultivars, they have reached up to now rather low production volumes in comparison to the traditional 'Pérola' (Caetano et al., 2015; Pereira et al., 2020; Arantes et al., 2024; Freitas et al., 2024), mainly due to their limitations, such as greater nutritional requirements and lower tolerance to drought. Embrapa's breeding program continues and has generated new *fusarium*-resistant genotypes, with different plant and fruit characteristics, whose agronomic performance and fruit quality (Viana et al., 2013, 2020, 2023) should be evaluated under the environmental conditions of the main pineapple growing regions in Brazil.

The objective of this work was to evaluate the agronomic performance and fruit quality of three new *fusarium*-resistant pineapple hybrids and one commercial cultivar, under the environmental conditions of the extreme south region of Bahia state, Brazil.

Materials and Methods

The experiments were installed in two localities in the extreme south of Bahia (BA) state, as following descriptions. One of them in the municipality of Eunápolis (16°18'21.1"S, 39°39'41.5"W, at 208 m altitude), whose climate is Aw according to the Köppen-Geiger's classification; and the other in the municipality of Belmonte (16°5'9.8"S, 39°12'59.3"W, at 90 m altitude), whose climate is Af, according to the Köppen-Geiger's classification. Climate data distribution are described for the experimental period from June 2019 to January 2022 (Figure 1).

The predominant soil in Eunápolis and Belmonte is Latossolo Amarelo (Oxisol) (Embrapa, 2006). Except for K and Mg levels in Belmonte, the chemical soil fertility is low in both locations (Table 1). Liming was carried out only in Belmonte (870 kg ha^{-1}), to increase base saturation up to 60%.

The experiments were carried out independently, using the physical structure, available labor, and the cultivation system employed by producers and institutions in distinct locations. In the dynamics of the experiments, the only variable included in the planting system in use were the cultivars. Furthermore, the new genotypes used in each experiment depended on the availability of plantlets at the time of planting.

The experiments were set up in a randomized complete block design with four treatments and four replicates. The treatments consisted of pineapple genotypes, three of which were represented by hybrids produced in the Embrapa's breeding program: 344 x (PE x SC-73)-15 ('BRS Real'), 344 x Gold-61 ('BRS Diamante'), and 344 x Gold-66 ('BRS Sol Bahia'), as well as the commercial cultivar 'BRS Imperial'. The three hybrids and the 'BRS Imperial' are resistant to fusariosis. As planting material, 25–40 cm long slips were used.

In Eunápolis, the experiment was set up in a producer's area, in Ponto Maneca district, using mini-sprinkler irrigation. Crop management was the same as that used by the grower in his commercial fields of 'BRS Imperial'. Planting was performed in June 2019, at 1.00x0.60x0.30 m spacing (25,641 plants ha^{-1}), and 20 plants were evaluated per plot; the forced flowering technique was applied in May 2020. Fertilization consisted of the application of solid sources containing 2.5 g P_2O_5 at planting, and 4.5 g N and 7.8 g K_2O per plant, at three months after planting. Thereafter sixteen liquid applications were performed with 0.334 g N and 0.412 g K_2O, spaced between the 4th and 17th months after planting.

In Belmonte, at Comissão Executiva do Plano da Lavoura Cacaueira (Ceplac) experimental station, in the Barrolândia district, the experiment was carried out without irrigation, as the local climate is characterized by a good rainfall distribution over the year. The planting date was July 2020, at 0.90x0.40x0.40 m spacing (38,461 plants ha^{-1}), with 12 plants evaluated per plot; and forced flowering was applied in May 2021. Fertilization was applied at planting with 0.5 L cattle manure and 13 g of simple superphosphate per plant. Thereafter, each month, until one month after forced flowering application, the fertilization was performed with 11.14 g of double sulphate of K and Mg, and 3.5 g urea per plant (11 applications, from August 2020 to June 2021).

At ten and eleven months after planting, in Belmonte and Eunápolis, respectively, ‘D’ leaves (the tallest ones in pineapple) were sampled, and their fresh mass and length were determined. A ‘D’ leaf, usually inserted at an angle of about 45º in relation to the plant stem, is easily pulled; it is used as indicator of plant growth and plant nutrient status. Plants of the experiments in Eunápolis and Belmonte were forced to bloom at 11 and 10 months after planting, respectively, by the application of 30 to 50 mL per plant of a solution obtained by diluting 20 mL Ethrel (24% a.i.), 400 g urea, and 7 g quicklime in 20 L of water.

At “colored” (25% to 50% yellow skin) and “yellow” (more than 50% yellow skin) maturation points (Viana et al., 2023), fruit were harvested individually, and the following variables were evaluated: number of slips per plant (only in Belmonte); fruit mass with or without crown; crown mass; fruit middle diameter; fruit length; crown length; percentage of crown mass (crown mass percentage in relation to fruit mass with crown); percentage of crown length (crown length percentage in relation to fruit length with crown); cycle (days from planting until harvest); days to harvest (days from flowering induction to harvest); contents of soluble solids (SS); titratable acidity (TA); and SS/TA ratio. Juice samples for determining SS and TA were taken from four fruit and consisted of 2.0 cm thick disks extracted at the middle portion of each fruit. Firmness of fruit from the Belmonte experiment was also determined.

The data were subjected to joint variance analysis. The means of the cultivars were compared using the Tukey’s test, at a 5% probability. Means of the locations were compared using the F test, at a 5% probability. In

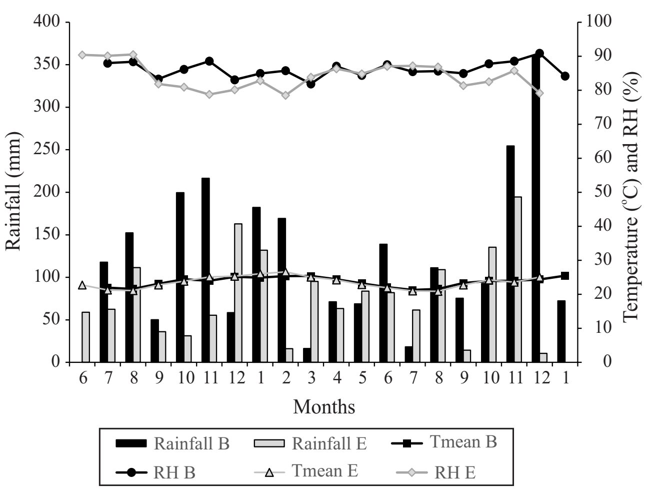

Figure 1. Meteorological data (provided by Veracel Celulose weather station) from June 2019 to December 2020, in Eunápolis (E), and from July 2020 to January 2022 in of Belmonte (B), both municipalities in Bahia state, Brazil. Data: Tmean, mean temperature; RH, relative air humidity.

Table 1. Soil analyses of the experimental areas in the Eunápolis and Belmonte municipalities, in the state of Bahia, Brazil, 2019.

Municipality	pH (water)	P ($mg\ dm^{-3}$)	K	Ca	Mg	Al	Na	H+Al	V (%)	SOM ($dag\ kg^{-1}$)
			($cmol_c\ dm^{-3}$)							
Eunápolis	5.7	4	0.08	0.80	0.20	0.0	3.00	2.50	62	1.5
Belmonte	5.4	2	0.16	1.51	0.59	0.1	0.04	2.53	48	2.1

SOM, soil organic matter.

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Belmonte, the late-harvested fruit of 'BRS Diamante' could not be sent for analysis at the post-harvest laboratory of Embrapa Mandioca e Fruticultura, therefore, their physicochemical variables were evaluated only in a reduced number of 6 fruit, which were not included in the statistical analysis.

Results and Discussion

Plant growth of all pineapple genotypes studied was similar at both locations (Table 2). Only 'BRS Diamante' presented longer leaves in Eunápolis. In Belmonte, 'BRS Sol Bahia' showed great plant vigor, which can be like to that of the traditional 'Pérola' genotype, known for its large leaf dimensions and weight, in comparison with other cultivars (Oliveira et al., 2021) (Table 2). 'BRS Diamante' formed long leaves, but with lower fresh masses than those of 'BRS Sol Bahia'. 'BRS Imperial' and 'BRS Real' showed lower vigor than the other studied genotypes, with shorter and lighter leaves.

Table 2. ‘D’ leaf parameters at the time of forced flowering treatment of hybrids of pineapple (*Ananas comosus* var. *comosus*) grown in the locations of Belmonte (B) and Eunápolis (E), in the state of Bahia, Brazil, 2022[(1)].

Cultivar	Length ‘D’ leaf (cm)		Fresh mass ‘D’ leaf (g)	
	B	E	B	E
BRS Diamante	96aB	109aA	86bA	87bA
BRS Sol Bahia	95aA	98bA	121aA	101aA
BRS Imperial	80bA	84cA	62bA	59bA
BRS Real	74bA	74dA	75bA	69bA
CV (%)	4.3		14.6	

[(1)]Means followed by equal lowercase letters, in the columns, do not differ by Tukey’s test, at 5% probability; and means followed by equal uppercase letters, in the rows, do not differ by the F test, at 5% probability.

Similar results were observed in Eunápolis, confirming the greater plant development of 'BRS Sol Bahia' and 'BRS Diamante', in comparison with 'BRS Real' and 'BRS Imperial'. In Eunápolis, 'BRS Diamante' plants had slightly longer leaves and lower fresh mass than 'BRS Sol Bahia' (Table 2). Except for 'BRS Imperial' that shows short leaves (Oliveira et al., 2015a), as well as 'BRS Real' – which is a condition inherent to the genetics of these materials – the other genotypes had an average ‘D’ leaf fresh mass above 80 g. This value is considered the minimum necessary for 'Pérola' plants (subjected to forced flowering) to achieve a high probability of obtaining fruit of good commercial standard, such as fruit mass above 1.5 kg (Reinhardt et al., 2018). Among the *fusarium*-resistant genotypes, 'BRS Sol Bahia' showed the highest ‘D’ leaf fresh mass (Table 2), which indicates a great vegetative vigor (Bartholomew, 2018).

All evaluated genotypes in the two locations showed higher fruit mass and lower crown mass, except for 'BRS Imperial', in the Belmonte experiment (Table 3). This result emphasizes that the environmental conditions of Belmonte are very favorable for a good production of pineapple, even without irrigation. This location has an adequate volume and distribution of rain along the year (Figure 1). In addition, in comparison to Eunápolis, the soil in Belmonte has an improved fertility, mainly of K and Mg, which are macronutrients highly required in pineapple production (Vásquez-Jiménez & Bartholomew, 2018). In both locations, 'BRS Diamante' had higher fruit mass, with or without crown, than the others. These results place 'BRS Diamante' above and 'BRS Sol

Table 3. Mass of fruit with or without crown, and crown mass of hybrids of pineapple (*Ananas comosus* var. *comosus*) grown in the locations of Belmonte (B) and Eunápolis (E), in the state of Bahia, Brazil, 2022[(1)].

Cultivar	Mass of fruit with crown (g)		Crown mass (g)		Mass of fruit without crown (g)	
	B	E	B	E	B	E
BRS Diamante	2,055aA	1,915aB	256aB	352aA	1,799aA	1,563aB
BRS Sol Bahia	1,762bA	1,416bB	192bB	263bA	1,570bA	1,153bB
BRS Imperial	1,261dA	933dB	179bcA	180cA	1,082dA	754cB
BRS Real	1,535cA	1,119cB	140cB	211cA	1,395cA	908cB
CV (%)	5.1		11.2		6.8	

[(1)]Means followed by equal lowercase letters, in the columns, do not differ by Tukey’s test, at 5% probability; and means followed by equal uppercase letters, in the rows, do not differ by the F test, at 5% probability.

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Bahia' at almost the same level of 'Pérola' fruit mass – the most important Brazilian cultivar – obtained by different authors in different locations (Caetano et al., 2015; Freitas et al., 2024). For marketing purposes, according to the classification of 'Pérola' based on its mass, fruit of 'BRS Sol Bahia' fall into classes 8 and 10, while those of 'BRS Diamante' fall into class 8 (Ceagesp, 2021).

The lowest fruit mass with or without crown were observed for 'BRS Imperial' in both experiments, followed by 'BRS Real' (Table 3). However, there was a significant difference between the fruit masses without crown of these two genotypes in Belmonte, since 'BRS Real' showed a higher mass, which was not observed in Eunápolis. This difference may have been due to the good rainfall over the period of the experiment, combined with the greater fertilization applied to pineapple in Belmonte, than the growing conditions in Eunápolis. Despite the irrigation by mini-sprinklers during planting in Eunápolis, the volume of water provided by rainfalls during the planting period in Belmonte (128 mm per month, and 2,427 mm during the cycle) was significantly higher than that in Eunápolis (80 mm per month, and 1,516 mm during the plant cycle). It can be assumed that under conditions of a greater fertilizer supply (as in Belmonte), 'BRS Real' expresses its productive potential, as it showed a significant difference from 'BRS Imperial' for fruit mass with or without crown, which did not occur in the Eunápolis experiment. The fruit mass obtained from 'BRS Imperial' fruit in Eunápolis is in the range for this cultivar, as well as similar to those obtained by Freitas at al. (2024) and Caetano et al. (2015), using smaller (31,250 plants ha^{-1}) and higher (51,282 plants ha^{-1}) densities, respectively.

According to the classification of fruit mass for marketing (Ceagesp, 2021), in Belmonte, fruit of 'BRS Real' and 'BRS Imperial' fell into classes 8 and 10, respectively; in Eunápolis, they fell into class 12. This means that the pineapple producers in Eunápolis would need more fruit to complete a box, since fruit from their productions are smaller than those from Belmonte. Because of its smaller fruit mass, 'BRS Imperial' produced commercially caters for the “baby pineapple” market of fresh fruit, for people with greater purchasing power. 'BRS Imperial' fruit mass is similar to that of 'BRS Real'. Therefore, it is expected the 'BRS Real' will also cater for this market, with the advantage of easier harvesting, since the upper slips do not stick to the base of the fruit, as is the case with 'BRS Imperial'.

In Eunápolis, all cultivars showed a higher percentage of crown mass than that for total fruit mass in Belmonte (Table 4). Similar results were observed for crown length in relation to total fruit length (Table 5), except for 'BRS Imperial', which showed a higher percentage of this variable in Belmonte than in Eunápolis. Fruits and crowns of all genotypes attend the United Nations standards for pineapple commercialization, which requires crown/fruit length relations lower than 150% (United Nations, 2017). Paull & Chen (2014) suggested an acceptable relation from 0.3 to 1.5. Plant arrangement in the spacings, or differences in fertilizations may have influenced the differences between locations observed for these variables, as reported for the effect of fertilization by Guarçoni & Ventura (2011) and Oliveira et al. (2015b), who evidenced that nitrogen fertilization significantly affected the fruit mass of 'Gold' and 'BRS Imperial' pineapples, respectively.

Table 4. Crown mass percentage in relation to fruit mass, length of fruit without crown, and crown length of hybrids of pineapple (*Ananas comosus* var. *comosus*) grown in the locations of Belmonte (B) and Eunápolis (E), in the state of Bahia, Brazil, 2022[(1)].

Cultivar	Crown mass (%)		Length of fruit without crown (cm)		Crown length (cm)	
	B	E	B	E	B	E
BRS Diamante	12.3abB	19aA	28.3aB	32.5aA	19.1aA	17.0aB
BRS Sol Bahia	10.8abB	19aA	21.7bB	25.5bA	18.2abA	14.8abB
BRS Imperial	14.5aB	20aA	22.7bA	19.0cB	13.3cA	14.0bcA
BRS Real	9.3bB	20aA	17.3cB	21.8cA	16.3bA	12.0cB
CV (%)	16.6		8.1		6.1	

[(1)]Means followed by equal lowercase letters, in the columns, do not differ by Tukey’s test, at 5% probability; and means followed by equal uppercase letters, in the rows, do not differ by the F test, at 5% probability.

'BRS Diamante' was the genotype with the longest crown (Table 4). However, when looking at the share of the crown for total fruit length (percentage of crown length), 'BRS Diamante' did not differ statistically from the other genotypes, except for 'BRS Imperial' in Eunápolis and 'BRS Real' in Belmonte (Table 5). Smaller crowns are desirable, especially to make fruit packing and transport easier. However, consumers usually prefer pineapple with fresh looking and not too small crowns (Paull & Chen, 2014). Fruit without crowns are mostly not accepted. In addition to the genetics of the variety, crown sizes are strongly influenced by cultivation practices, such as forced flowering treatments, as well as by the environmental conditions during fruit development (Bartholomew & Sanewski, 2018). The search for cultivation practices that increase fruit mass inversely to crown mass should be a premise for adjusting production systems for the new genotypes, especially for 'BRS Diamante'. Shorter crowns would also help to make fruit packing easier in boxes and transportation.

Fruit diameter was proportional to the fruit mass, with larger values for 'BRS Diamante' and lower ones for 'BRS Imperial', and higher values were obtained for fruit harvested in Belmonte (Table 5). The fruit length/diameter ratios of the studied genotypes ranged from 1.1 to 1.5 (Table 5), which denotes a flatter shape than the conical fruit of the traditional 'Pérola', as reported by Reinhardt et al. (2002) in their review comparing 'Pérola' and 'Smooth Cayenne' pineapples. These differences are probably due to the characteristics of the parents of the new hybrids.

'BRS Diamante' had the longest production cycle, with a period from two to four weeks longer from flower induction to harvest, in comparison with the other *fusarium*-resistant genotypes (Table 6). This characteristic distinguishes 'BRS Diamante' as a late cultivar, with a longer reproductive period, due to a longer fruit maturation. This longer period may also be important for an additional photoassimilation contributing to a higher fruit mass. For the traditional 'Pérola', the period from flower induction to fruit harvest usually takes no longer than 150 to 165 days,

Table 5. Crown length percentage in relation to fruit length, fruit diameter, and length/diameter ratios of hybrids of pineapple (*Ananas comosus* var. *comosus*) grown in the locations of Belmonte (B) and Eunápolis (E), in the state of Bahia, Brazil, 2022[(1)].

Cultivar	Crown length (%)		Fruit diameter (cm)		Fruit length /diameter	
	B	E	B	E	B	E
BRS Diamante	60abB	66aA	12.9aA	12.5aB	1.5aA	1.4aA
BRS Sol Bahia	54bcB	63abA	12.6abA	11.0bB	1.5aA	1.3abA
BRS Imperial	63aA	58bB	11.9cA	10.3bB	1.1bB	1.4aA
BRS Real	52cB	64abA	12.4bA	11.0bB	1.3abA	1.1bB
CV (%)	5.8		1.8		8.5	

[(1)]Means followed by equal lowercase letters, in the columns, do not differ by Tukey's test, at 5% probability; and means followed by equal uppercase letters, in the rows, do not differ by the F test, at 5% probability.

Table 6. Crop cycle, fruit formation period, and number of slips per plant of hybrids of pineapple (*Ananas comosus* var. *comosus*) grown in the locations of Belmonte (B) and Eunápolis (E), in the state of Bahia, Brazil, 2022[(1)].

Cultivar	Cycle (days)		Days to harvest		Number of slips
	B	E	B	E	B
BRS Diamante	522aB	553aA	220aA	199aB	8a
BRS Sol Bahia	487bcB	534bA	185bcA	180bB	9a
BRS Imperial	484cB	531bA	182cA	177bB	8a
BRS Real	489bB	527cA	187bA	173cB	9a
CV (%)	0.3		0.9		8.6

[(1)]Means followed by equal lowercase letters, in the columns, do not differ by Tukey's test, at 5% probability; and means followed by equal uppercase letters, in the rows, do not differ by the F test, at 5% probability.

depending on the local environmental conditions (Reinhardt et al., 2018). The other genotypes – 'BRS Sol Bahia', 'BRS Imperial', and 'BRS Real' – showed a fruit formation period from 173 to 185 days, in both locations. These periods are longer than those mentioned in the literature for 'Pérola', but shorter than that observed for the late 'BRS Diamante'. These differences in the periods of fruit formation and maturation can be used by the growers as a strategy to extend the pineapple production period.

The influence of local environmental conditions on the fruit maturation period was also evidenced by the differences observed between the two locations. For all four studied genotypes, this period was longer in Belmonte (Table 6). However, the duration of the plant cycle from planting to fruit harvest was smaller in Belmonte, due to the earlier flower induction treatment, which was carried out when plants were just 10 months old, whereas in Eunápolis this practice was done at 11 months after planting.

All genotypes produced a high number (8 to 9) slips per plant (Table 6), which is considered a good production, as it is equivalent to that usually obtained for the traditional 'Pérola' (Reinhardt et al., 2018) and 'Imperial' (Oliveira et al., 2015a). Therefore, it is expected that new pineapple cultivars will be easily multiplied by producers, expanding the supply of shoots in successive cycles.

Fruit quality of the genotypes evaluated was influenced by the local environmental conditions (Table 7). Fruit harvested in Belmonte had lower titratable acidity (TA) and higher soluble solids (SS) content than those harvested in Eunápolis, resulting in higher SS/TA ratios. This variation observed for TA and SS levels for the same genotype, in distinct locations, may be due to different climatic conditions during fruit maturation and to cultural treatments. Viana et al. (2019) reported increasing TA values and decreasing SS/TA ratios, in response to increasing doses of organic fertilization of 'Pérola' pineapple plants, which is an example of the impact of just one cultural practice on fruit quality. The ripening stage also affects the soluble solids content. As fruit ripening advances, there is a tendency towards increasing SS contents and reducing TA in the pulp, as shown for pineapples by George et al. (2016) and Ogawa et al. (2018). More recently, Viana et al. (2023) reported that 'BRS Sol Bahia' harvested in the colored and yellow ripening stages had higher values of soluble solids than when harvested at the green ripe stage.

In the Belmonte experiment, 'BRS Imperial' and 'BRS Real' did not differ significantly from each other for fruit firmness, while BRS Sol Bahia’ had a lower value for this parameter (Table 7). Fruit firmness depends on the fruit maturation stage, as shown by Martins et al. (2012) in their postharvest conservation study with 'Pérola' fruit; these authors reported initial fruit firmness values like those obtained for 'BRS Imperial' and 'BRS Real' of the present study. The force needed to rupture the peel tends to reduce with advancing ripening stage of the fruit (Shamsudin et al., 2009).

'BRS Imperial' had the lowest TA and the highest pH values at both sites. The values obtained are lower than those usually determined for the traditional 'Pérola' (Reinhardt et al. 2004; Viana et al. 2013; Caetano et al., 2015). 'BRS Real' stood out with the highest TA in Eunápolis. In general, fruit produced in Belmonte had lower TA than those harvested in Eunápolis. This was probably due to the difference in fertilization, as fruit produced in Belmonte received more nitrogen. According to Silva et al. (2015, 2020) and Bonomo et al. (2020), larger fruit are produced as increasing doses of nitrogen are applied, resulting in the dilution of TA and

Table 7. Fruit quality variables of hybrids of pineapple (*Ananas comosus* var. *comosus*) grown in the locations of Belmonte (B) and Eunápolis (E), in the state of Bahia, Brazil, 2022[(1)].

Cultivar	Firmness	Titratable acidity (TA, % citric acid)		Soluble solids (SS, °Brix)		SS/TA		pH	
	B	B	E	B	E	B	E	B	E
BRS Sol Bahia	58.5c	0.42bB	0.53bA	20.3aA	15.3aB	53bA	30bB	4.0bA	4.0bA
BRS Imperial	82.2a	0.24cB	0.37cA	18.1aA	16.9aA	80aA	48aB	4.6aA	4.3aB
BRS Real	72.9ab	0.52aB	0.74aA	19.1aA	14.9aB	37cA	20bB	4.0bA	3.8cB
CV (%)	14.1	11.5		8.0		12.9		1.5	

[(1)]Means followed by equal lowercase letters, in the columns, do not differ by Tukey’s test, at 5% probability; and means followed by equal uppercase letters, in the rows, do not differ by the F test, at 5% probability. Firmness: only fruit from the Belmonte experiment.

reaching a minimum point. 'BRS Sol Bahia' showed intermediate TA, in comparison with the other cultivars.

'BRS Imperial', 'BRS Sol Bahia', and 'BRS Real' showed high levels of SS in both locations, ranging from 14.9 to 20.3°Brix, and high SS/TA ratio reaching 80 for 'BRS Imperial' in Belmonte (Table 7). The higher is the SS/TA ratio, the better will be the quality of the fruit, which is an indicator that favors the acceptance of the fruit because it tends to be tastier. To obtain high-quality pineapple fruit, cultivars with an SS/TA ratio from 20 to 40 are recommended (Basumatary et al., 2022). Thus, the studied cultivars in these experiments had a ratio above the recommended minimum, for which 'BRS Imperial' and 'BRS Sol Bahia' produced in Belmonte and 'BRS Imperial' produced in Eunápolis stand out.

Conclusions

1. 'BRS Diamante' and 'BRS Sol Bahia' *fusarium*-resistant pineapple (*Ananas comosus* var. *comosus*) hybrids have good vegetative vigor and form large fruit, while 'BRS Real' and 'BRS Imperial' are of similar lower vigor, resulting in the formation of smaller fruit.
2. The new resistant genotypes are late, taking 173 to 220 days from flower induction to fruit harvest, with 'BRS Diamante' being the latest one.
3. Fruit of the new cultivars show good quality with a moderate to high soluble solids/titratable acidity ratio, in which 'BRS Imperial' and 'BRS Sol Bahia' produced in Belmonte and 'BRS Imperial' produced in Eunápolis stand out, suggesting good potential for consumer acceptance.
4. The new genotypes display a significant agronomic potential for the extreme south region of Bahia state, Brazil.

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