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## ‘VTP Hayashi’: New cultivar of the Prata subgroup

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**Abstract:** The aim of this study was to describe the main characteristics of development, production, and postharvest of the new cultivar of the Prata subgroup, ‘VTP Hayashi’, that is a natural mutation originating from ‘SCS451 Catarina’. The plants of VTP Hayashi showed greater height and diameter of the pseudostem and the fruits are longer, heavier, and more uniform in the cluster, characteristics that differ from ‘SCS451 Catarina’. The development and production cycles and the susceptibility to fungal diseases resemble those of ‘SCS451 Catarina’. At maturity stage 6, it presented average contents of soluble solids of 28.2°Brix and titratable acidity of 0.69% of malic acid, higher than ‘SCS451 Catarina’. The selection of this cultivar was due to the position of the inflorescence in the vertical direction, giving it a better fruit development.

**Index Terms:** *Musa spp.*, genetic improvement; production.

## ‘VTP Hayashi’: Nova cultivar do subgrupo Prata

**Resumo:** O objetivo deste estudo foi descrever as principais características de desenvolvimento, produção e pós-colheita da nova cultivar do subgrupo Prata, a VTP Hayashi, mutação natural originada da cv. SCS451 Catarina. As plantas da VTP Hayashi apresentaram altura e diâmetro do pseudocaulo maiores, e as frutas são mais longas, pesadas e uniformes no cacho, características que diferem da SCS451 Catarina. Os ciclos de desenvolvimento e de produção e a suscetibilidade às doenças fúngicas assemelham-se aos da cv. SCS451 Catarina. No estágio 6 de maturação, apresentou médias dos teores de sólidos solúveis de 28,1°Brix e de acidez titulável de 0,69% de ácido málico, superior à SCS451 Catarina. A seleção desta cultivar foi devido ao posicionamento da inflorescência no sentido vertical, conferindo melhor desenvolvimento dos frutos.

**Termos para indexação:** *Musa spp.*, melhoramento genético, produção.

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Brazil stands out among the world's leading producers of bananas with a production of 6.6 million tons and cultivated on about 455,000 hectares in the year 2020, highlighting the states of Bahia, São Paulo, Minas Gerais, Santa Catarina, Pará, Ceará, and Pernambuco (IBGE, 2022). In the state of São Paulo, the largest area in extent with banana plantations is concentrated in the southern region of the state (Vale do Ribeira and southern coast), with approximately 33,000 hectares (68% of the state) and production of 728,000 tons of the fruit (73% of the state) in 2020 (IBGE, 2022).

The cultivation area of the banana subgroup Prata has grown in recent years in Brazil, and the most prominent cultivars are Prata-Anã or Enxerto, SCS451 Catarina or Prata Catarina, and Pacovan, but all have at least one unfavorable characteristic for cultivation and commercialization. One of the strategies to solve this problem is the selection of superior cultivars through genetic improvement, traditionally used in banana breeding. Among the techniques, the most used is the selection of superior plants, as was the case of 'VTP Hayashi'.

This new cultivar was selected by the producer and agronomist Edson Akira Hazome Hayashi in a production area of 'Prata Catarina' banana in the municipality of Sete Barras, SP. Within this production area, he observed in a clump that the banana tree presented a different characteristic concerning the positioning of the inflorescence at the time of its emission, in the vertical direction (Figure 1A). Following its development, he also observed longer and more uniform fruits between the bunches (Figures 1B and 1C). Based on these observations, the grower decided to send rhizomes to a micro-production laboratory to multiply them, and these characteristics were maintained in the cloned plants. Together with the company

"Vitroplan", the new cultivar was registered in the Ministry of Agriculture, Livestock and Supply with the name 'VTP Hayashi' and registration number 47,780.

Micropropagation seedlings were used to evaluate this new cultivar for registration purposes which were properly acclimatized, and planted on 11/14/2019, when they had 5 to 6 leaves and were 30 cm tall in the spacing of 2.5 m x 2.0 m (1,667 plants per hectare) at the APTA - Regional Research and Development Unit of Pariquera-Açu, SP (hill) and 2.5 x 3.0 m (1,333 plants per hectare) on a property in the municipality of Sete Barras (floodplain). As a comparison standard, the cultivar SCS451 Catarina, also from APTA, was planted concomitantly. The cultural treatments of the crop were done according to the recommendations of Moreira (1999). The thinning of children was done by keeping the one with the greatest development.

Preventive applications with fungicides were made at intervals defined by monitoring according to the State of Evolution (SE) method, adapted by Fouré and Ganry (2008) and modified by Moraes et al. (2011). According to the results of soil analysis, the doses and timing of application followed the recommendations of Teixeira et al. (2022).

The growth characteristics evaluated were: the height and diameter of the pseudostem; the number of active leaves at flowering, the interval between flowering and harvest, and between cycles. The production parameters evaluated were the fresh mass of the marketable clusters obtained by the difference between the fresh mass of the cluster and the stalk; potential productivity estimated from the fresh mass of the marketable clusters, planting density and interval between cycles; the total number of fruits on the cluster; the number of clusters and fresh mass of the 2<sup>nd</sup> cluster; fresh mass, fruit length, and diameter. Fruit samples were collected



**Figure 1** - Inflorescence (A), bunches (B), hand (C) and fruit (D) of 'VTP Hayashi', the new banana cultivar of the Prata subgroup, Pariquera-Açu, SP, 2022.

from VTP Hayashi and Prata Catarina in four seasons of the year for evaluation of pH, titratable acidity (TA), soluble solids (SS), and ripening index (SS/AT).

The experimental design was a randomized block with three treatments, five repetitions, and plots subdivided in time (cycles). The plots consisted of four rows with four plants, with the central four being used as useful plants. Data were submitted to variance analysis using the F test and the means were compared using the Tukey test at 5% probability when significant using the statistical package SISVAR (FERREIRA, 2011).

Table 1 shows that the new cultivar VTP Hayashi showed greater height and diame-

ter of the pseudostem than Prata Catarina in both growing conditions. The number of active leaves at flowering was greater in Prata Catarina, but all cultivars presented a sufficient number of leaves to achieve fruit caliber adequate for the cluster harvest. The average interval between flowering and harvest was similar for both cultivars (Table 2). The interval between cycles was greater in the Pariquera-Açu growing condition. This was possibly due to better soil fertility conditions in Sete Barras, as it is located on the banks of the Ribeira de Iguape River in more fertile soil. The average of the two cycles, the total cycle was higher in VTP Hayashi grown in Pariquera-Açu possibly due to the lower soil fertility.

**Table 1** - Averages of pseudostem height and diameter and number of active leaves at the flowering of the cultivars VTP Hayashi and Prata Catarina, Pariquera-Açu and Sete Barras, SP, 2021.

Cultivars/locations	Pseudostem height (cm)			Pseudostem diameter (cm)			Number of leaves		
	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means
VTP Hayashi P. açu	307 b A	365 a B	333 a	21.6 a B	30.0 a A	25.8 b	14.9 b A	10.9 c B	12.9 b
VTP Hayashi 7 Barras	300 b A	391 b B	349 b	25.4 b B	28.9 ab A	27.1 a	10.4 c B	14.3 b A	12.4 b
SCS451 Catarina P. açu	276 a A	361 a B	318 a	22.7 b B	27.4 b A	25.0 b	18.1 a A	15.5 a B	16.8 a
<b>Means</b>	<b>295 A</b>	<b>372 B</b>		<b>23.2 B</b>	<b>28.7 A</b>		<b>14.5 A</b>	<b>13.6 B</b>	
<b>C.V. % (cultivars)</b>		<b>3.5</b>			<b>3.3</b>			<b>4.2</b>	
<b>C.V. % (cycles)</b>		<b>3.7</b>			<b>3.5</b>			<b>4.6</b>	

Means followed by different letters, lowercase between cultivars/locations (columns) and uppercase between cycles (rows), differ by Tukey's test ( $p>0.05$ )

**Table 2** - Averages of the interval between flowering and harvest (IFH) and between cycles (IC) of the cultivars VTP Hayashi and Prata Catarina, Pariquera-Açu and Sete Barras, SP, 2021.

Cultivars/locations	IFH (days)			Total cycle (years)		
	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means
VTP Hayashi P. açu	129 a A	145 c B	137	1.15 b B	0.91 c A	1.03 b
VTP Hayashi 7 Barras	150 b B	116 a A	133	1.02 a B	0.85 b A	0.94 a
SCS451 Catarina	135 a	132 b	133	1.03 a B	0.81 a A	0.92 a
<b>Means</b>	<b>138 B</b>	<b>131 A</b>		<b>1.07 B</b>	<b>0.85 A</b>	
<b>C.V. % (cultivars)</b>		<b>3.4</b>			<b>3.8</b>	
<b>C.V. % (cycles)</b>		<b>3.9</b>			<b>2.4</b>	

Means followed by different letters, lowercase between cultivars/locations (columns) and uppercase between cycles (rows), differ by Tukey's test ( $p>0.05$ )

The fresh mass of marketable fruit was higher for the cultivar VTP Hayashi in both growing conditions that reflected in productivity, especially when cultivated in Pariquera-Açu, with higher productivity due to the greater plant densification (Table 3). The total number of fruits in the cluster and the fresh mass of the second cluster were also higher for VTP Hayashi cultivated in Sete Barras. The number of fruits in the second cluster had small variation with an average of 16 fruits in both cultivars and growing conditions (Table 4).

The average fresh mass of the fruit in two production cycles was higher for VTP Hayashi when grown in Pariquera-Açu. However, this only happened because of the delay in harvesting the bunch, represented by the larger diameter of the fruit (39.4 mm). The greatest differential of VTP Hayashi was in the length of the fruit, with averages greater than 20 cm (Table 5). As for post-harvest characteristics, VTP Hayashi presented higher values of titratable acidity and soluble solid in ripe banana, when compared with Prata Catarina in different seasons of the year (Table 6).

**Table 3** - Averages the fresh mass of marketable fruit (FMMF), potential yield, and the number of bunches of the cultivars VTP Hayashi and Prata Catarina, Pariquera-Açu and Sete Barras, SP, 2021.

Cultivars/locations	FMMF kg			Potential yield (t.ha <sup>-1</sup> .year <sup>-1</sup> )			Number of bunches		
	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means
VTP Hayashi P. açu	17.4 a B	20.1 b A	18.8 a	36.3 a	34.6	35.4 a	6.8 b B	10.4 A	8.6
VTP Hayashi 7 Barras	17.0 a B	23.9 a A	20.5 a	22.2 b B	37.3 A	29.7 b	8.3 a B	9.7 A	9.0
SCS451 Catarina	13.8 b B	16.2 c A	15.0 b	22.3 b B	33.9 A	28.1 b	8.0 a B	9.1 A	8.6
<b>Means</b>	<b>16.1 B</b>	<b>20.0 A</b>		<b>26.9 B</b>	<b>35.3 A</b>		<b>7.7 B</b>	<b>9.7 A</b>	
<b>C.V. % (cultivars)</b>		<b>8.2</b>			<b>10.7</b>			<b>4.3</b>	
<b>C.V. % (cycles)</b>		<b>7.7</b>			<b>9.6</b>			<b>4.4</b>	

Means followed by different letters, lowercase between cultivars/locations (columns) and uppercase between cycles (rows), differ by Tukey's test ( $p>0.05$ )

**Table 4** - Average of the total number of fruits on the cluster and on the 2<sup>nd</sup> cluster and fresh mass of the 2<sup>nd</sup> cluster of the cultivars VTP Hayashi and Prata Catarina, Pariquera-Açu and Sete Barras, SP, 2021.

Cultivars/locations	N° total fruits			N° fruits 2 <sup>nd</sup> bunch			Fresh mass 2 <sup>nd</sup> bunch		
	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means
VTP Hayashi P. açu	84 b B	133 b A	109 c	14.0 b B	16.9 ab A	15.5 b	2.9 a A	2.5 b B	2.7 a
VTP Hayashi 7 Barras	128 a B	155 a A	142 a	14.7 b B	17.5 a A	16.1 a	2.5 b B	3.1 a A	2.8 a
SCS451Catarina	122 a B	134 b A	128 b	16.4 a	16.1 b	16.3 a	2.0 c	2.1 c	2.1 b
<b>Means</b>	<b>111 B</b>	<b>141 A</b>		<b>15.0 B</b>	<b>16.8 A</b>		<b>2.5</b>	<b>2.5</b>	
<b>C.V. % (cultivars)</b>		<b>5.3</b>			<b>3.1</b>			<b>8.6</b>	
<b>C.V. % (cycles)</b>		<b>5.4</b>			<b>3.3</b>			<b>5.9</b>	

Means followed by different letters, lowercase between cultivars/locations (columns) and uppercase between cycles (rows), differ by Tukey's test ( $p>0.05$ )

**Table 5** - Averages of fresh mass, length, and diameter of the fruit of the cultivars VTP Hayashi and Prata Catarina, Pariquera-Açu and Sete Barras, SP, 2021.

Cultivars/locations	Fresh fruit mass (g)			Fruit length (cm)			Fruit diameter (mm)		
	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle	Means
VTP Hayashi P. açu	209 a A	145 b B	177 a	21.8 a A	19.3 b B	20.5 b	39.4 a A	35.4 b B	37.4 a
VTP Hayashi 7 Barras	150 b B	176 a A	163 b	21.0 b B	23.3 a A	22.1 a	35.2 b B	37.7 a A	36.5 a
SCS451 Catarina	123 c	128 c	126 c	17.1 c	17.2 c	17.2 c	34.6 b	35.1 b	34.8 b
<b>Means</b>	<b>161 A</b>	<b>150 B</b>		<b>20,0</b>	<b>19,9</b>		<b>36.4</b>	<b>36.1</b>	
<b>C.V. % (cultivars)</b>		<b>6.5</b>			<b>3.4</b>			<b>2.7</b>	
<b>C.V. % (cycles)</b>		<b>5.2</b>			<b>1.8</b>			<b>3.4</b>	

Means followed by different letters, lowercase between cultivars/locations (columns) and uppercase between cycles (rows), differ by Tukey's test ( $p>0.05$ )

**Table 6** - Postharvest characteristics of cultivars 'VTP Hayashi' and 'Prata Catarina' at different times of the year, Pariquera-Açu and Sete Barras, SP, 2022.

Season	pH		Titratable acidity (% malic acid)				Soluble Solids (°Brix)		Ripening index (SS/AT)			
	unripe		ripe		unripe		ripe		ripe			
	Hayashi	P. Cat.	Hayashi	P. Cat.	Hayashi	P. Cat.	Hayashi	P. Cat.	Hayashi	P. Cat.		
March	3.3 A	3.0 b B	2.0 b	1,9 b	0.29	0.26	0.58 b	0.59 b	28.7 a A	26.2 b B	49.7 a A	45.3 b B
July	3.4 A	2.7 c B	1.9 b	1,9 b	0.28	0.27	0.65 b A	0.57 b B	26.2 b	25.9 c	40.2 bc B	45.7 b A
Setember	3.2	3.2 a	1.6 c	1,7 c	0.30	0.26 B	0.76 a A	0.69 a B	28.5 a	26.8 b B	37.5 c	38.8 c
December	3,3 A	3.0 b B	2.2 a	2,1 a	0.29	0.26	0.65 b A	0.52 b B	29,1 a A	27.9 a B	45.3 ab B	53.8 a A
<b>Means</b>	<b>3.3 A</b>	<b>3.0 B</b>	<b>1,9</b>	<b>1,9</b>	<b>0.29 A</b>	<b>0.26 B</b>	<b>0.69 A</b>	<b>0.59 B</b>	<b>28.1 A</b>	<b>26.9 B</b>	<b>43.2 B</b>	<b>45.9 A</b>
<b>C.V. (%)</b>		<b>2.4</b>		<b>3.2</b>		<b>6.2</b>		<b>5.4</b>		<b>1.2</b>		<b>5.5</b>

Means followed by different letters, lowercase between season (columns) and uppercase between cultivars (rows), differ by Tukey's test ( $p>0.05$ )

Besides this, the cluster presented less compactness (greater distance between clusters). Due to the emission of the inflorescence in the vertical position, it promoted less deformation of the fruits in its filling

compared to Prata Catarina. Besides this, it also favors the development of the fruits, with less deformed fruits and with more uniform fruits, favoring the packing of the bananas in boxes.

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