EXECUTIVE SUMMARY

2020-2021 ORANGE CROP FORECAST FOR THE SÃO PAULO AND WEST-SOUTHWEST MINAS GERAIS CITRUS BELT

Fundecitrus
SCIENCE AND SUSTAINABILITY IN CITRICULTURE

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Crop Forecast Survey

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1 – 2020-2021 ORANGE CROP FORECAST

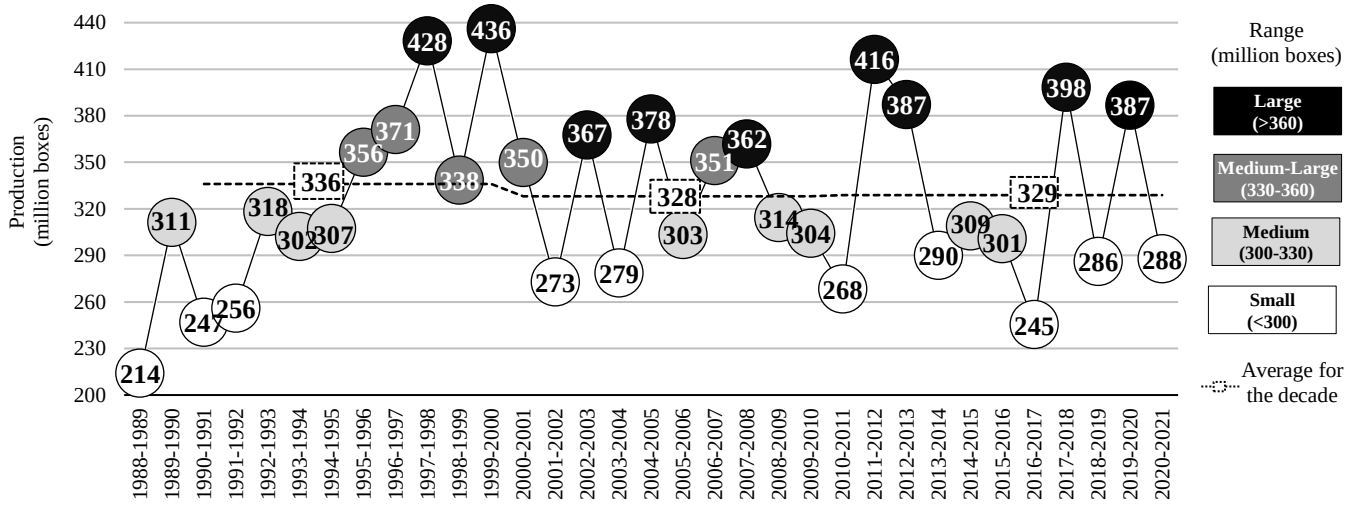
The 2020-2021 orange crop forecast for the São Paulo and West-Southwest Minas Gerais citrus belt, published on May 11, 2020 by Fundecitrus, in cooperation with Markestrat, FEA-RP/USP and FCAV/Unesp, is 287.76 million boxes (40.8 kg). Total orange production includes:

- 45.53 million boxes of the Hamlin, Westin and Rubi varieties;
- 13.05 million boxes of the Valencia Americana, Seleta and Pineapple varieties;
- 87.04 million boxes of the Pera Rio variety;
- 106.16 million boxes of the Valencia and Valencia Folha Murcha varieties;
- 35.98 million boxes of the Natal variety.

245.15 million boxes of the estimated production are of fruit from the first and second blooms (85.2% of the total), 34.64 million boxes are of fruit from the third bloom (12.0%) and 7.97 million boxes are of fruit from the fourth bloom (2.8%). Concerning the fourth bloom, 530 thousand boxes are of early varieties (6.6%), 4.80 million boxes of Pera Rio (60.2%), 1.52 million boxes of Valencia and Valencia Folha Murcha (19.1%) and 1.12 million boxes of Natal (14.1%).

Approximately 20.56 million boxes are expected to be produced in the Triângulo Mineiro.

The projected figure is 25.6% smaller than the previous crop of 386.79 million boxes, and 12.5% below the average crop size for the last 10 years. It is a small crop, considering the production potential of groves. Graph 1 shows the historical production series for the last 33 years.



Graph 1 – Orange production from 1988-1989 to 2019-2020 and 2020-2021 crop forecast
Sources: CitrusBR (1988-1989 to 2014-2015) and Fundecitrus (2015-2016 to 2020-2021)

Crop loss was caused by a significant reduction in the number of fruits per tree as compared to that in the previous crop. The large production in the last crop season increased the consumption of nutrient reserves in plants, which became scarce and triggered the phenomenon known as alternate bearing.

In addition to a lower energy availability for plants, the climate was also a negative influence. High temperatures in September and October 2019 affected the setting of newly formed fruit, from the so-called fruitlets (each the size of a pea) to those of approximately 3 cm of diameter.

Adverse climatic conditions were also seen in March and April 2020, affecting fruit at a more advanced stage of development. According to data from Somar Meteorologia, the accumulated rainfall volume in that period was not even half the historical average (1981-2010), which restricted fruit growth as shown by the

size of fruit stripped this season. Lower water availability reduced the immature fruit growth rate, which should also be observed in the next development stage, namely maturation.

Average yield per hectare this crop season is estimated at 790 boxes per hectare and 1,65 boxes per tree, as compared to 1,045 boxes per hectare and 2.22 boxes per tree harvested in the 2019-2020 crop. Early varieties, averaging 774 boxes per hectare, showed the highest yield drop in comparison to that of the previous crop, of 39.2%. The mid-season variety Pera Rio comes next: the 717 boxes expected per hectare this crop season represent a drop of 24.0% in relation to the previous crop. Next comes the Natal variety, with a drop of 22.3%% and an expected yield of 840 boxes per hectare. Lastly come the Valencia and Valencia Folha Murcha varieties with a drop of 14.6% and 853 boxes expected per hectare. Tables 1 and 2 present yields per variety and variations in relation to the previous crop season.

Table 1 – Yield per hectare and variety for the 2015-2016 crop to the 2020-2021 crop

Group of varieties	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021[e]
	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)
Hamlin, Westin and Rubi.....	865	744	1,235	833	1,319	772
Other earlies.....	784	744	1,008	810	1,121	779
Subtotal for earlies.....	847	744	1,184	828	1,273	774
Pera Rio.....	640	596	945	633	943	717
Valencia and V.Folha Murcha.	749	597	1,016	826	998	853
Natal.....	831	650	1,063	765	1,082	840
Total.....	**745**	**634**	**1,033**	**756**	**1,045**	**790**

[e] Estimate.

Table 2 – Variation in yield per hectare for varieties as compared to previous season's

Group of varieties	2016-2017 in comparison to 2015-2016		2017-2018 in comparison to 2016-2017		2018-2019 in comparison to 2017-2018		2019-2020 in comparison to 2018-2019		2020-2021[e] in comparison to 2019-2020	
	(boxes/ hectare)	%	(boxes/ hectare)	%	(boxes/ hectare)	%	(boxes/ hectare)	%	(boxes/ hectare)	%
Hamlin, Westin and Rubi.....	-121	-14.0%	491	66.0%	-402	-32.5%	486	58.4%	-547	-41.5%
Other earlies.....	-40	-5.1%	264	35.5%	-198	-19.6%	311	38.4%	-341	-30.5%
Subtotal for earlies.....	-104	-12.2%	441	59.2%	-357	-30.1%	445	53.8%	-499	-39.2%
Pera Rio.....	-44	-6.9%	349	58.5%	-312	-33.0%	310	48.9%	-226	-24.0%
Valencia and V.Folha Murcha.	-153	-20.4%	420	70.3%	-190	-18.7%	172	20.9%	-145	-14.6%
Natal.....	-180	-21.7%	413	63.5%	-298	-28.0%	316	41.3%	-241	-22.3%
Total.....	**-111**	**-14.9%**	**399**	**62.9%**	**-278**	**-26.9%**	**290**	**38.3%**	**-256**	**-24.5%**

[e] Estimate.

Yield per sector this season as compared to that in the previous one shows significant variations among locations. The Northwest sector, encompassing the regions of Votuporanga and São José do Rio Preto, ranks first in yield drop in the current crop season as compared to the previous one, in a scale from high to low for all sectors. 492 boxes per hectare expected to be produced in the Northwest sector represent a drop of 46.7% in relation to the 2019-2020 crop. The North sector, comprising the regions of Triângulo Mineiro, Bebedouro and Altinópolis, ranks second with a yield drop of 35.9% and an expected yield of 686 boxes per hectare. The Central sector, encompassing the regions of Matão, Duartina and Brotas, ranks third with a yield drop of 30.1% and a yield of 721 boxes per hectare projected for this crop. The South sector, encompassing the regions of Porto Ferreira and Limeira, ranks fourth with a yield drop of 16.5% and 781 boxes expected per hectare. The Southwest sector, encompassing the regions of Avaré and Itapetininga,

ranks fifth with only 2.7% of yield drop and an expected harvest of 1,185 boxes per hectare. Tables 3 and 4 present yields per sector and variations in relation to the previous crop season.

Table 3 – Yield per hectare of sectors for the 2015-2016 crop to the 2020-2021 crop

Sector	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021[e]
	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)
North.....	792	495	1,108	606	1,070	686
Northwest.....	450	376	882	404	924	492
Central.....	613	616	984	707	1,032	721
South.....	779	664	989	770	936	781
Southeast.....	1,052	950	1,154	1,195	1,217	1,185
Total.....	**745**	**634**	**1,033**	**756**	**1,045**	**790**

[e] Estimate.

Table 4 – Variation in yield per hectare of sectors in relation to the previous crop season's

Sector	2016-2017 in comparison to 2015-2016		2017-2018 in comparison to 2016-2017		2018-2019 in comparison to 2017-2018		2019-2020 in comparison to 2018-2019		2020-2021[e] in comparison to 2019-2020	
	(boxes/ hectare)	%	(boxes/ hectare)	%	(boxes/ hectare)	%	(boxes/ hectare)	%	(boxes/ hectare)	%
North.....	-296	-37.4%	613	123.6%	-502	-45.3%	465	76.7%	-384	-35.9%
Northwest.....	-74	-16.4%	505	134.2%	-478	-54.2%	520	128.7%	-431	-46.7%
Central.....	3	0.4%	368	59.7%	-277	-28.1%	324	45.9%	-311	-30.1%
South.....	-116	-14.9%	325	49.0%	-218	-22.1%	165	21.5%	-155	-16.5%
Southwest.....	-102	-9.7%	204	21.5%	41	3.5%	22	1.8%	-32	-2.7%
Total.....	**-111**	**-14.9%**	**399**	**62.9%**	**-278**	**-26.9%**	**290**	**38.3%**	**-256**	**-24.5%**

[e] Estimate.

All positions held by varieties and sectors in the rankings, according to the criterion of yield variation expected for this crop in relation to the previous one, have been reversed this season, that is, the greater drop in yield expected for the current crop, the larger the increment observed in the previous crop. This is one evidence of the biennial production cycle of orange trees, showing that usually the fruit load one year is inversely proportional to the fruit load in the previous year, causing variations in yield per hectare that alternate with the crop seasons.

BEARING TREES

Bearing trees total 174.253 million, a 0.16% increase as compared to the previous inventory. Since the variation is positive, plants that started bearing fruit this crop season are more numerous than the total trees in groves that were accounted for as eradicated and abandoned in this new inventory.

Groves that reached bearing age this crop season were planted in 2017 and total 7.84 million bearing trees in 11,923 hectares, with an average density of 676 plants per hectare (calculation of density also considers non-bearing resets present in groves).

Conversely, groves accounted for as eradicated in this new inventory total 14,662 hectares and those accounted for as abandoned total 3,066 hectares, comprising a total loss of 17,728 hectares. Starting from this area and the estimated average density of eradicated groves of 418 plants per hectare as an assumption to estimate the number of eradicated and abandoned trees, a total of 7.41 million plants is calculated as being lost.

Since the number of eradicated and abandoned trees is an estimate and there are other variables influencing the total bearing trees, such as number of resets in plots that start bearing fruit the following year and tree mortality, the purpose of these calculations is to indicate that there is high consistency across the inventory

data, as well as to confirm that the density of new groves is higher than that of eradicated and abandoned groves. Consequently, despite the increased number of bearing trees, there is a decrease in the area of mature groves of 1.51%, totaling 364,444 hectares in this new inventory, as compared to the 370,048 hectares in the previous one.

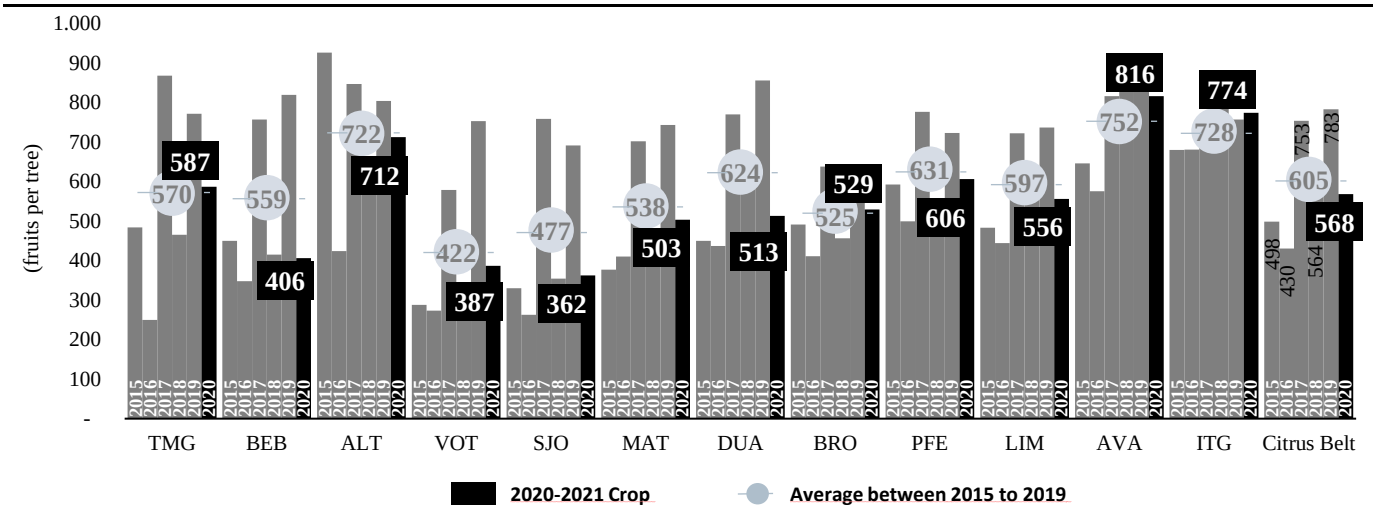
Varieties included in this forecast comprise 97% of trees and also 97% of the area of orange groves in the citrus belt.

Information on bearing trees was obtained from the Tree Inventory of the São Paulo and West-Southwest Minas Gerais Citrus Belt: Snapshot of Groves in March 2020, taken from the 2018 primary base – created by mapping groves from September 08, 2017 to January 29, 2018 – and from counting existing trees in 5% of orange plots, from January 07 to March 06, 2020. Plots for counting were drawn through stratified random sampling.

FRUITS PER TREE

The average number of fruits per tree in April 2020, disregarding fruit drop throughout the crop season, is calculated at 568. Flowering in groves was less intense than last years', which may be explained by the heavy fruit load in the last crop season, as well as by a shorter drought that therefore caused a lower water stress on plants.

Graph 2 shows the number of fruits per tree stripped in 2015 to 2020 in the citrus belt and separately for each of the twelve regions. Except for Itapetininga, all other regions present a decreased average number of fruits per tree as compared to the previous crop season. However, in terms of the average for the 2015 to the 2019 crop seasons, eight regions present a decrease.



Graph 2 – Number of fruits per tree stripped by region in 2015 to 2020

Distinct climatic conditions among regions of the citrus belt caused a lack of uniformity in the bloom profile. Drought, necessary to produce water stress and induce flowering in the São Paulo and West-Southwest Minas Gerais citrus belt, did not start at the same time in all regions and varied in terms of duration and intensity. For most regions, it lasted approximately 30 days. The drought lasted more than 90 days only in the Triângulo Mineiro. In some regions drought took place in June while in others it occurred later, in the month of August.

Rainfall picked up unevenly among regions. Rain to break the drought fell in July in Porto Ferreira and Limeira, in August in the region of Votuporanga, and in the first week of September 2019 in the other regions. Although flowering was favored by conditions established by rainfall in non-irrigated groves, it

was affected by an Indian Summer that lasted two weeks and hit most of the citrus belt in September. Associated to that phenomenon, temperatures were high, of up to 41ºC (105.8ºF) in several cities in the regions of the Triângulo Mineiro, Bebedouro and São José do Rio Preto.

Temperatures remained high during the month of October 2019, with highs of at least 35ºC (95ºF) in all other regions of the citrus belt, according to data from Somar Meteorologia. The region of Bebedouro presented the highest frequency of days with maximum temperatures above 35ºC (95ºF), for 23 days in October.

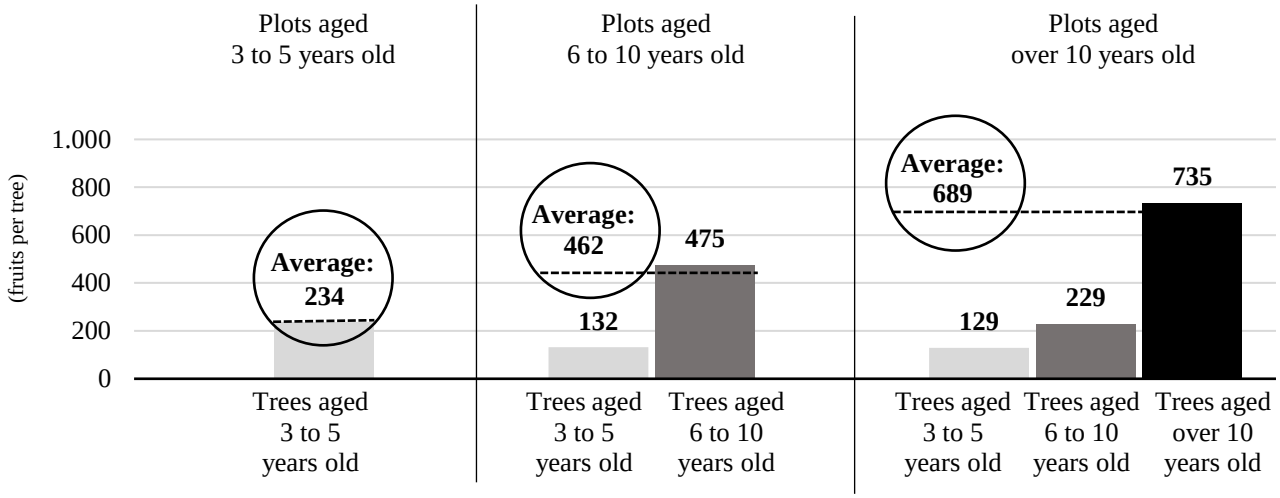
Heat was less intense in the regions of Altinópolis, Brotas, Porto Ferreira, Limeira, Avaré and Itapetininga, which favored the setting of newly formed fruit. In those locations, there were days with temperatures above 35ºC (95ºF) throughout October, although they were alternated with days of milder temperatures. Contrarily to the rest of the citrus belt, in those regions no more than three consecutive days recorded temperatures above 35ºC (95ºF).

In order to advance flowering, irrigation was started notably in July 2019, which was seen in many groves in the Triângulo Mineiro, where 80% of the area is irrigated.

Adverse climatic conditions resulted in a high loss of fruits from the first bloom. However, due to a compensatory effect of this low setting there was a significant increase in the number of fruits from the second bloom.

The first bloom, from July to September 2019, accounts for 32.9% of the total fruits. The second bloom, in October and November 2019, is estimated at 52.3%. Together, these blooms correspond to 85.2% of the production and should be harvested at the same time. The third bloom, in December 2019 and January 2020, corresponds to 12.0% of the total, and the fourth bloom, as of February 2020, to 2.8%. For the forecast, all fruits from the first, second and third blooms were considered as a whole. A fruit set rate of 20% was applied to fruits from the fourth bloom, since it was a late bloom and because the physiological drop of small and weak fruits had not taken place before stripping ended this year. In the separation of fruits per bloom, off-season fruits were also identified as a result from late and sporadic flowers from the previous crop season, not accounted for in the current crop forecast.

Three to five-year-old plots present yield of 234 fruits per tree this crop season. For six to 10-year-old plots, an average of 462 fruits per tree is estimated, with 475 fruits per tree for original plantings and 132 fruits per tree for three to five-year-old resets. Plots over 10 years old have an expected average of 689 fruits per tree and a yield of 735 fruits per tree for original plantings, 229 fruits per tree for six to 10-year-old resets and 129 fruits per tree for three to five-year-old resets. Yields are presented in Graph 3.



Ages and planting years: 1 – 2 years (2017 and 2018), 3 – 5 years (2014 to 2016), 6 – 10 years (2009 to 2013) and over 10 years (2008 and previous years)
Graph 3 – Age-stratified number of fruits per tree in the plot

The subsequent blooms to compensate the low setting of the first blooms is a more marked characteristic in late and mid-season varieties than in the earlies, which was observed this year. The Natal variety presented the highest number of fruits per tree, surpassing the early varieties Hamlin, Westin and Rubi, that usually stand out as the most productive ones.

When trees were stripped in April 2020, an average of 634 fruits per tree were counted for the late variety Natal; 620 fruits per tree for the group of early varieties Hamlin, Westin and Rubi; 588 fruits per tree for the late varieties Valencia and Valencia Folha Murcha; 565 fruits per tree for other earlies and 506 fruits per tree for the mid-season Pera Rio variety.

The method used consists of tree stripping, that is, the advanced harvest of all fruits in the tree, regardless of the bloom they are from. This crop season, trees were stripped from March 12 to April 13, 2020. Fruits harvested were taken to a tree stripping laboratory in Araraquara, where each sample was separated into the different blooms it was from. Fruits were quantified by automatic counting equipment and then weighed.

When tree stripping started in this crop season, the same number of samples of previous years was expected to be taken. However, with the onset of the Covid-19 pandemic in the first week of the survey, strategic decisions were made together with the PES technical committee, aiming at a reduced possibility of contagion and transmission of the new coronavirus, while still continuing to carry out the survey even in face of countless challenges that arose, such as closing of borders and interrupted service at restaurants and hotels in several cities.

Measures taken included the use of masks and alcohol-based hand sanitizer, quarantine for employees in the high risk group or those presenting symptoms of cold or flu, disinfection of surfaces and floors at the tree stripping laboratory and distribution of posters with information on the disease. Sample size was reduced from 2,560 to 1,590 trees selected by a drawing. An initial drawing by the method of stratified random sampling included 1,000 trees distributed proportionally to the total orange trees in the citrus belt and stratified according to their region, variety and age. For increased estimate precision, 230 more trees that were original to plots were stripped. An additional drawing included 360 resets of ages lower than those in the age groups of the groves they were part of. These resets correspond to replacements made mainly to offset tree losses caused by greening, citrus canker and other diseases. The tree population in this last drawing comprises plots that were counted in full to update the inventory and that meet the stratification criteria.

The stratification factor "region" is comprised of 12 groups encompassing the 320 cities where there are farms with mature orange groves. In addition to the subdivision into the 12 regions, the following charts present the five subdivisions of the factor "variety" and the six subdivisions of the factor "age". Combinations of these factors result in 360 strata.

Chart 1 – Regions of the citrus belt included in the drawing, by sector

Sector	Region	Abbreviation
North	Triângulo Mineiro	TMG
	Bebedouro	BEB
	Altinópolis	ALT
Northwest	Votuporanga	VOT
	São José do Rio Preto	SJO
Central	Matão	MAT
	Duartina	DUA
	Brotas	BRO
South	Porto Ferreira	PFE
	Limeira	LIM
Southwest	Avaré	AVA
	Itapetininga	ITG

Chart 2 – Variety groups included in the drawing, by maturity time

Maturity time	Variety group
Early	Hamlin, Westin and Rubi
Other early	Valencia Americana, Seleta and Pineapple
Mid-season	Pera Rio
Late	Valencia and Valencia Folha Murcha
	Natal

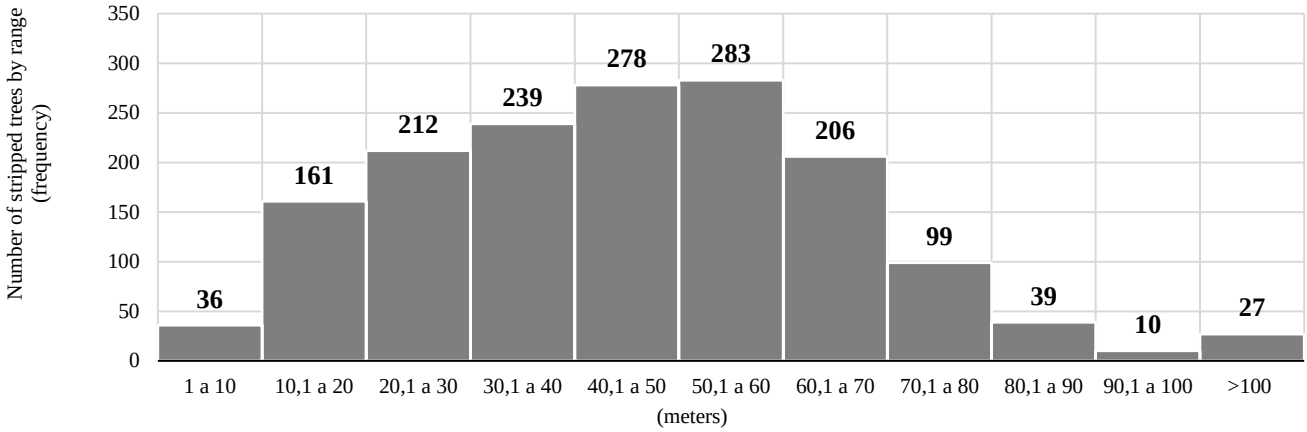
Chart 1 – Age groups from the combined age of plots and age of trees

Age of plots[1]	Age of trees[2]
3 to 5 years	3 to 5 years
6 to 10 years	3 to 5 years
6 to 10 years	6 to 10 years
Over 10 years	3 to 5 years
Over 10 years	6 to 10 years
Over 10 years	Over 10 years

[1] Ages and planting years: 3 to 5 years (2015 to 2017), 6 to 10 years (2010 to 2014) and over 10 years (2009 and previous years).
[2] Estimated from information provided by growers on years resets were planted in the plot and from visual aspects of plants such as trunk circumference, height and shape of canopy, among other factors.

For the 1,230 trees in the first drawing, the location in the plot of the tree to be stripped is predetermined and varies every crop season. This makes the selection of the tree to be unbiased, that is, free from interference of the survey agent. Otherwise the choice could be skewed towards trees with more or less fruit. For the 2020-2021 crop, the tree in the drawn plot is the one located in the 21st planting hole in the 13th row. In case there is a vacancy or dead tree in that position, or yet a tree of an age different from that of trees originally planted in the plot, the third plant down is selected. Should that situation repeat itself, three more plants down are counted, until a tree of the drawn age is found. If the plot does not have 13 or more planting rows, the counting restarts in the existing rows until number 13 is reached. For the second drawing, of 360 resets, the stripped tree is found in the plot after visual aspects are considered, such as trunk circumference and size of canopy.

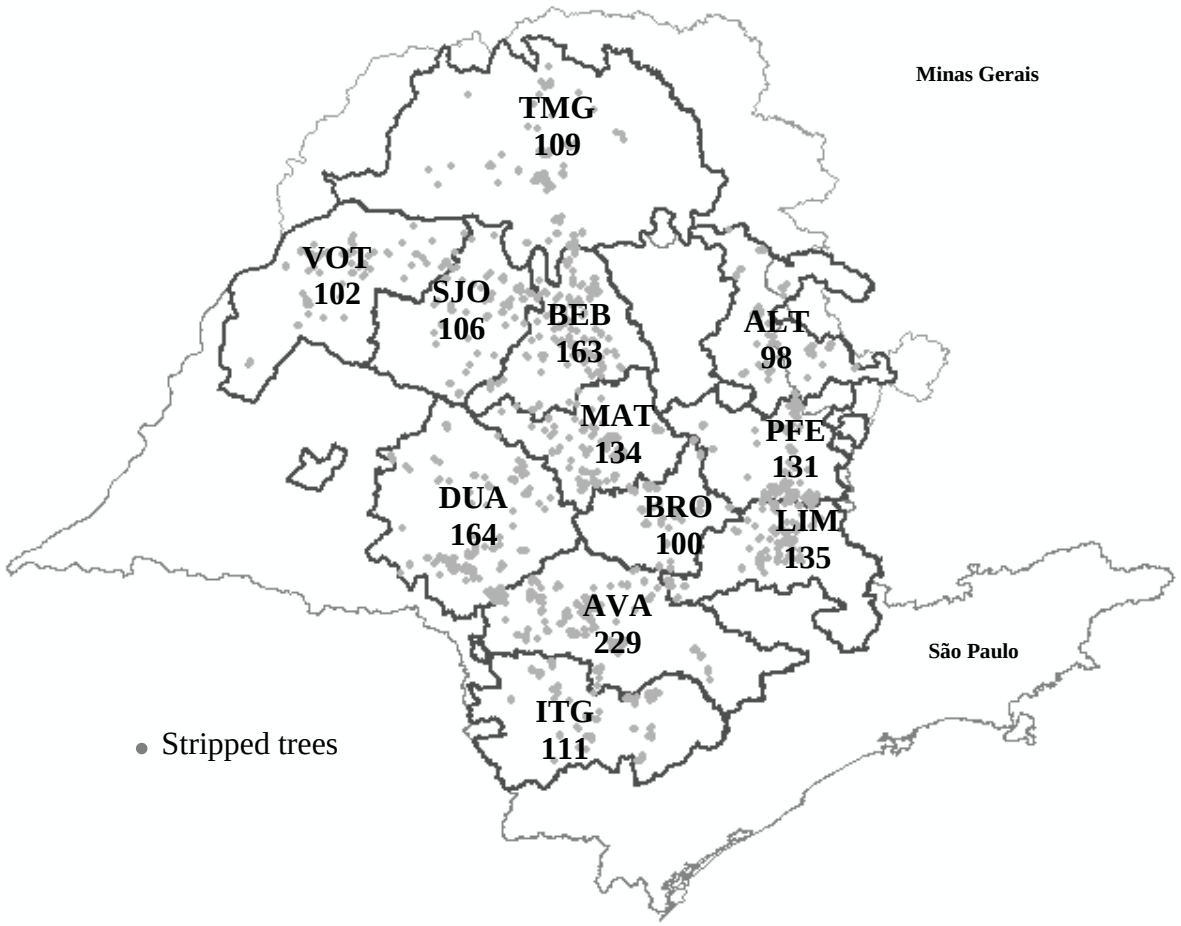
Graph 4 presents the distance (in meters) from the stripped tree to the nearest border of the plot, which shows the majority of classes with similar frequencies, with a central figure between 50 and 60 meters of distance from the stripped tree to the nearest border. Most of the 36 plots with the shortest distances, from one to ten meters, are small – approximately 80% of them have up to four hectares.



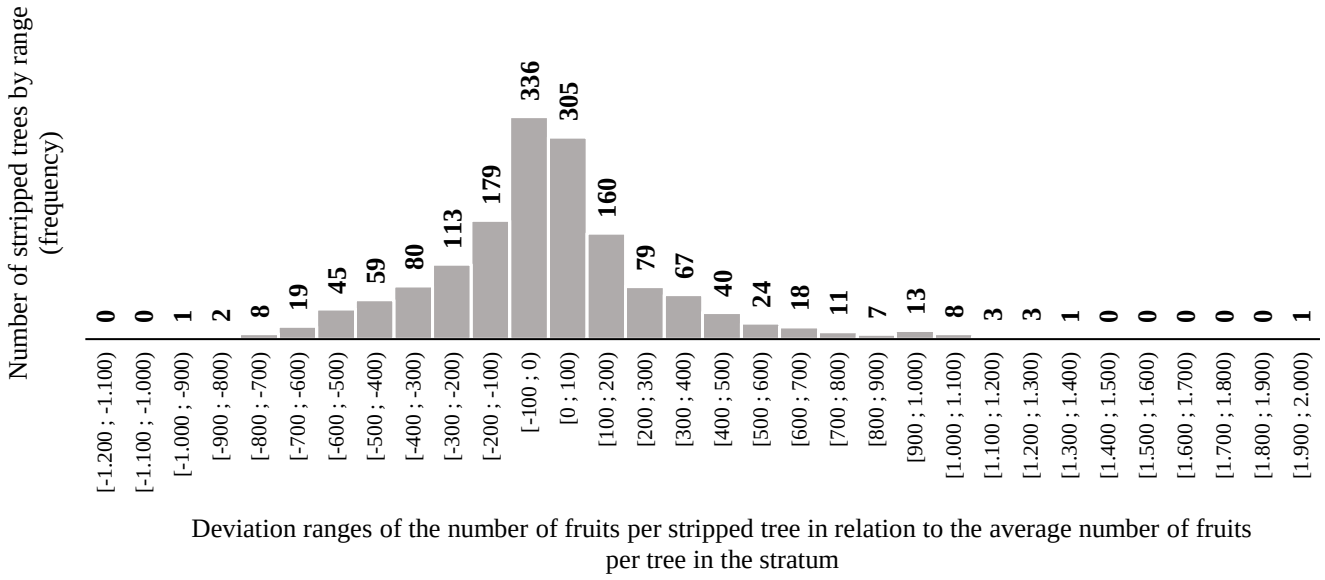
Graph 4 – Histogram of distances from the stripped tree to the nearest border of the plot

Figure 1 shows the location and number of stripped trees in each sector of the citrus belt.

Figure 1 – Location and total number of trees stripped per region

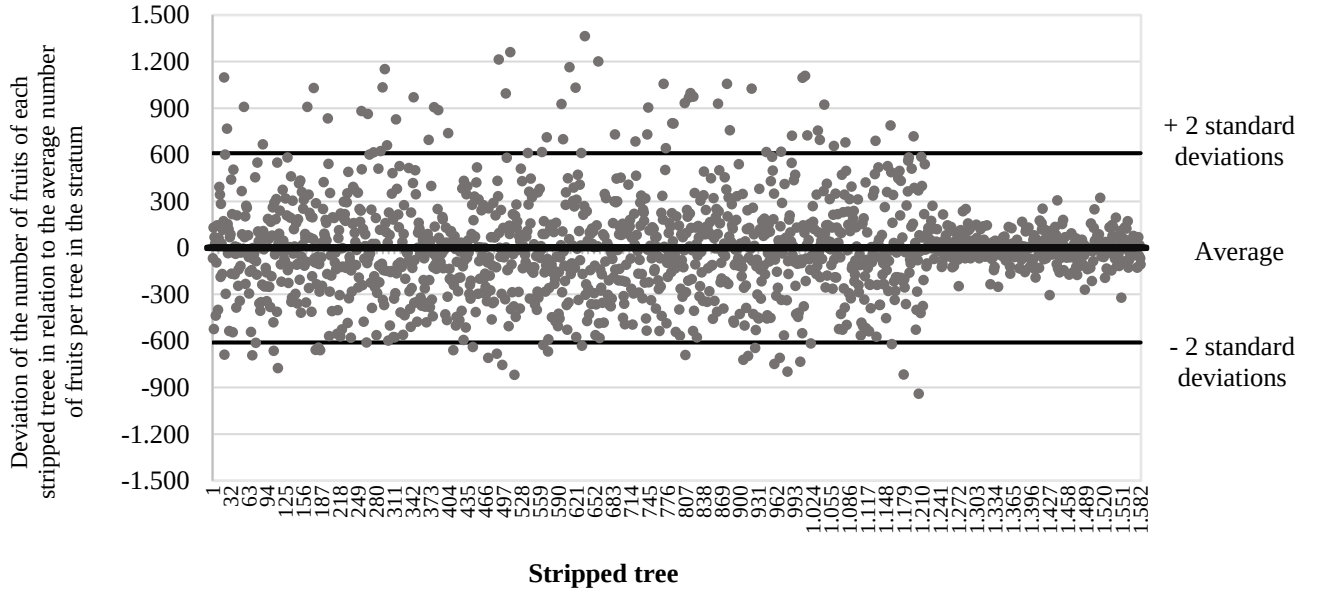


The average number of fruits per tree may vary plus or minus 15 fruits, which corresponds to ± 2.65 of the average number of fruits per tree obtained at stripping. This figure is within the expected error of 2% to 3% always used in sizing the sample. The yield deviation distribution analysis for each stripped tree in relation to the stratum average shows that sample data is randomly distributed according to a normal distribution, as presented in Graph 5. Out of the total samples, eight were discarded upon showing great discrepancy in relation to the others.



Graph 5 – Histogram of deviations of fruits per tree at stripping

Graph 6 shows the dispersion of deviations of each stripped tree in relation to the stratum average. It is observed that 95% of samples fall within the average (568 fruits) ± 2 standard deviations.



Graph 6 – Deviation on the number of fruits at each stripping in relation to the stratum average

The tree harvested upon permit from citrus growers is indemnified at R$ 42.00 through an online payment system where citrus growers can register and redeem the amount due.

DROP RATE – fruit drop index, from tree stripping to final plot harvest

The projected average drop rate is 17.00%, distributed as follows: 10.50% for the early Hamlin, Westin and Rubi varieties; 11.50% for other early varieties; 16.50% for the mid-season Pera Rio variety; 20.00% for the late Valencia and Valencia Folha Murcha varieties; and 21.00% for the late Natal variety. This rate is applied to the number of fruits in the tree in April 2020, when trees are stripped. The result of this calculation is the estimate of the number of fruits that will be available in the tree at harvest, since part of the oranges in the tree in the beginning of the crop season will fall due to physiological drop, damage caused by machines, pests and diseases, and adverse climatic conditions.

Should this fruit drop rate hold, it will be slightly above the rate of 16.70% observed in the 2018-2019 crop season, when the volume of boxes produced (285.98 million) and the distribution of blooms were similar to the estimate for this crop season. The top reason for this projection above historical baseline is the increased intensity of greening, the main disease that caused fruit drop observed in the previous crop season, as shown in Table 5.

Table 5 – Fruit drop rates by causes from the 2015-2016 crop to the 2019-2020 crop

Causes	Drop rate				
	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020
	(percentage)	(percentage)	(percentage)	(percentage)	(percentage)
Physiological and mechanical…….....	N/A	5.99	7.45	5.16	5.15
Greening.....	N/A	1.37	4.06	2.70	4.39
Fruit borer and fruit fly.....	N/A	2.34	2.70	5.70	4.29
Black spot.....	N/A	3.75	2.16	2.02	2.12
Leprosis.....	N/A	0.25	0.62	0.82	1.30
Canker.....	N/A	0.03	0.31	0.30	0.38
Total.....	**17.49**	**13.73**	**17.31**	**16.70**	**17.63**

N/A – Non-available data, as survey of causes for fruit drop started in the 2016-2017 crop.

Monthly and continuous monitoring by Fundecitrus as of May 2020 in 1,200 orange plots visited up to their complete harvest serves as basis to correct the drop rate projected at the time of this publication and consequently to correct the production estimate as well.

FRUITS PER BOX – fruit size, i.e., number of oranges to reach the weight of 40.8 kg (90 lb box) at harvest

The final fruit size projection is 257 fruits per 40.8 kg box (90 lb), namely 294 fruits per box for the group of early varieties comprising Hamlin, Westin and Rubi; 271 fruits per box for the group of other early varieties; 268 fruits per box for the mid-season variety Pera Rio; 231 fruits per box for the late varieties Valencia and Valencia Folha Murcha; and 247 fruits per box for the late variety Natal.

The average size of 257 fruits per box is equivalent to oranges weighing approximately 159 grams (5.61 oz) at harvest. The final fruit size was estimated by a regression model that considered the final fruit size (fruits per box at harvest) as the dependent variable and the number of fruits per tree counted at stripping, the initial fruit size (fruits per box at stripping), the sum of the production percentages from the first and second blooms in relation to the total production and the rainfall accumulated from May to July as independent variables. Data from the last 11 crops, 2009-2010 to 2019-2020, was used in the regression and is presented in Table 6. The result obtained shows an adjusted R^2 of 0.91 that means the four independent variables together explain 91% of the variation in the final fruit size (fruits per box at harvest), which shows how important these variables are for the final fruit size. The comparison between the final fruit size estimated by this model and the final fruit size observed in the last 11 crops presents an average absolute error of 2.95%.

Data relative to final fruit size (fruits per box at harvest), number of fruits per tree counted at stripping, initial fruit size (fruits per box at stripping), the sum of the production percentages from the first and second blooms in relation to the total production for the series from 2009-2010 to 2014-2015 was provided by orange juice companies associated to Fundecitrus – Citrosuco, Cutrale and Louis Dreyfus, which separately have estimated the production for the citrus region since 1988, with the use of objective methodology. Data was supplied individually and under a formal confidentiality agreement to an independent consulting firm for the determination of the average. Individual data supplied by each company was kept confidential. Data relative to the 2015-2016 to 2019-2020 crops comes from results of estimates performed by Fundecitrus. Data on rainfall accumulated from May to July was supplied by Somar Meteorologia.

Data used in the model to estimate the final fruit size in this crop comprises figures from the 2020 stripping and the rainfall predicted for May to July 2020 in volumes equivalent to the climatological average (1981 – 2010) calculated with information from the Climatempo website. Final fruit size estimated by the regression is 261 for the 2020-2021 crop. This size was corrected by the regression that used the observed size as the dependent variable and the estimated size as the independent variable. The size projected by this other regression is 257 fruits per box for the 2020-2021 crop.

Table 6 – Data for the 2009-2010 crop to the 2019-2020 crop and data used to estimate the final fruit size in the 2020-2021 crop

Crop	Fruits per tree at stripping	Initial fruit size at stripping	Sum of productions from first and second blooms	Accumulated rainfall from May to July	Final fruit size observed at harvest	Final fruit size estimated by the model	Error	Absolute error
	(number)	(fruits/box)	(%)	(millimeters)	(fruits/box)	(fruits/box)	(%)	(%)
2009-2010…	624	431	77%	143	250	239	-4%	4%
2010-2011…	532	457	97%	64	271	254	-6%	6%
2011-2012....	859	401	96%	116	269	266	-1%	1%
2012-2013....	764	439	95%	268	250	243	-3%	3%
2013-2014....	515	338	87%	247	224	216	-3%	3%
2014-2015....	646	373	92%	102	256	250	-2%	2%
2015-2016....	498	391	90%	204	226	235	4%	4%
2016-2017....	430	358	90%	214	222	224	1%	1%
2017-2018....	753	393	91%	184	246	250	2%	2%
2018-2019....	564	446	82%	36	259	265	2%	2%
2019-2020....	783	411	94%	95	261	268	3%	3%
2020-2021....	568	511	85%	133[ha]	(X)	261	(X)	(X)

Sources: Fundecitrus (2015-2016 crop to 2019-2020 crop), CitrusBr (2008-2009 crop to 2014-2015 crop), Somar Meteorologia and Climatempo.
(X) Not applicable.
ha Historical average.

The result of the equation used in the crop estimate is corrected by the application of a correction factor. That is necessary because of variables not considered in the calculations, such as harvested fruits that wind up not being used, diverse planting densities that are not included in the stratification of groves, and losses of trees throughout the crop season caused by eradications, abandonments or deaths. The correction factor of 0.10 applied in this crop is the same used since the 2017-2018 crop and represents the average of the indexes of the 2015-2016 and 2016-2017 crops estimated by Fundecitrus.

2 – OBJECTIVE SURVEY METHOD FOR THE ORANGE CROP FORECAST

In order to perform this estimate, the objective method used in previous crop seasons was maintained, which is based on quantitative data – field measurements, counting and weighing of fruit – applied to the equation represented below.

$$\text{Forecast production} = \frac{\text{Bearing trees} \times \text{Fruit per tree} \times (1 - \text{Drop rate \%}) \times (1 - \text{CF \%})}{\text{Fruit per box}}$$

where CF is the correction factor

Results from the inventory and tree stripping were obtained throughout the survey, then compiled and restricted until the date of this publication to the following professionals: Antonio Juliano Ayres (Fundecitrus general manager); Fernando Alvarinho Delgado (technical supervisor); Roseli Reina (specialist); Vinícius Gustavo Trombin (executive coordinator linked to Markestrat); Marcos Fava Neves (political-institutional and methodological coordinator linked to FEA-RP/USP and Markestrat); and José Carlos Barbosa (methodology analyst linked to the department of math and science of FCAV/Unesp). All of them were subject to confidentiality obligations with regard to PES information before its announcement was made public, according to agreements signed between each of them and Fundecitrus. As for antitrust practices, they were all complied with through the adoption of measures necessary to prevent any communication or sharing of individual information with competitive content among the orange juice companies that collaborate with Fundecitrus in this project or between these and citrus growers.

This team, together with Fundecitrus president Lourival Carmo Monaco in remote attendance, finalized the crop forecast on May 11, 2020, at 9:30 a.m., in a closed meeting at Fundecitrus, with no external communication channel beyond participants. Following that, at 10 a.m., Fundecitrus president began the public announcement of the crop forecast by videoconference, broadcast live on the website www.fundecitrus.com.br. Next, Fundecitrus general manager Antonio Juliano Ayres presented the detailed data at the Fundecitrus auditorium in Araraquara-SP, with no in-person attendance. After the crop forecast announcement, the Executive Summary of the 2020-2021 orange crop forecast was made available on the Fundecitrus website. The complete report, including the 2020 tree inventory and the 2020-2021 orange crop forecast, will be available in Portuguese on May 25, 2020 on www.fundecitrus.com.br. and in English at a later date.

3 – TABLES OF DATA

The following tables present the 2020-2021 orange crop forecast per sector, age, bloom and variety. The margin of error of the production estimate in the strata is higher than that of the production estimate in the citrus belt as a whole. Possible subsequent variations in fruit size and fruit drop rate may change the forecast and will be accounted for throughout the crop season by ongoing field monitoring for production estimate updates.

Table 7 – 2020-2021 Orange crop forecast by sector

Sector	Mature groves area	Average density[1] of mature groves	Bearing trees	Fruit per tree at stripping[2]	2020-2021 Orange crop forecast		
					Per tree	Per hectare	Total
	(hectares)	(trees/ hectare)	(1,000 trees)	(number)	(boxes/ tree)	(boxes/ hectare)	(1,000,000 boxes)
North.....	84,556	476	39,789	502	1.46	686	58.02
Northwest.....	36,324	466	16,788	372	1.07	492	17.88
Central.....	102,484	494	49,559	512	1.49	721	73.87
South.....	72,230	479	33,265	582	1.70	781	56.41
Southwest.....	68,850	519	34,852	804	2.34	1,185	81.58
Total.....	**364,444**	**489**	**174,253**	**568**	**1.65**	**790**	**287.76**

[1] Calculation considers the total number of trees in the plot, that is, bearing and non-bearing trees (2018 and 2019 resets).
[2] Weighted average per total stratum fruit.

Table 8 – 2020-2021 Orange crop forecast by tree age group (continues below)

Age of plots	Mature groves area	Average density[1] of mature groves	Bearing trees by age group				Fruit per tree at stripping by age group of trees[2]			
			3 – 5 years	6 – 10 years	Over 10 years	Total	3 – 5 years	6 – 10 years	Over 10 years	Total
	(hectares)	(trees/ hectare)	(1,000 trees)	(1,000 trees)	(1,000 trees)	(1,000 trees)	(fruit/ tree)	(fruit/ tree)	(fruit/ tree)	(fruit/ tree)
3 – 5 years.....	34,183	653	21,644	-	-	21,644	**234**			234
6 – 10 years.....	87,790	579	1,841	47,543	-	49,384	132	**475**		462
Over 10 years…..	242,471	433	2,921	5,840	94,464	103,225	129	229	**735**	689
Total.....	**364,444**	**489**	**26,406**	**53,383**	**94,464**	**174,253**	**215**	**448**	**735**	**568**

[1] Calculation considers the total number of trees in the plot, that is, bearing and non-bearing trees (2018 and 2019 resets).
[2] Weighted average per total stratum fruit.

Table 8 – 2020-2021 Orange crop forecast by tree age group (continued)

Plots age	2020-2021 Orange crop forecast by tree age group				2020-2021 Orange crop forecast by tree age group			
	3 – 5 years	6 – 10 years	Over 10 years	Total	3 – 5 years	6 – 10 years	Over 10 years	Total
	(boxes/ tree)	(boxes/ tree)	(boxes/ tree)	(boxes/ tree)	(1,000,000 boxes)	(1,000,000 boxes)	(1,000,000 boxes)	(1,000,000 boxes)
3 – 5 years.....	0.67	-	-	0.67	**14.50**	-	-	14.50
6 – 10 years.....	0.39	1.37	-	1.34	0.71	**65.34**	-	66.05
Over 10 years…..	0.38	0.66	2.14	2.01	1.10	3.84	**202.27**	207.21
Total.....	**0.62**	**1.30**	**2.14**	**1.65**	**16.31**	**69.18**	**202.27**	**287.76**

[1] Calculation considers the total number of trees in the plot, that is, bearing and non-bearing trees (2018 and 2019 resets).

Table 9 – 2020-2021 Orange crop forecast by bloom

Bloom	2020-2021 Orange crop forecast	Percentage of the orange crop forecast by bloom
	(1,000,000 boxes)	(percentage)
1st.....	94.67	32.9%
2nd	150.48	52.3%
3rd.....	34.64	12.0%
4th	7.97	2.8%
Total.....	**287.76**	**100.00%**

Table 10 – 2020-2021 Orange crop forecast in percentage of bloom by region

Bloom	North[1]				Northwest[2]			Central[3]				South[4]			Sothwest[5]			Total
	TMG	BEB	ALT	**AVE**[6]	VOT	SJO	**AVE**[6]	MAT	DUA	BRO	**AVE**[6]	PFE	LIM	**AVE**[6]	AVA	ITG	**AVE**[6]	
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1st.....	50.6	51.4	32.7	**47.6**	46.0	43.3	**44.4**	36.4	19.2	21.1	**25.4**	39.0	25.4	**32.8**	30.6	20.9	**28.0**	**32.9**
2nd.....	42.7	36.9	56.8	**42.7**	34.0	47.2	**41.8**	44.1	61.4	58.3	**54.9**	46.9	61.9	**53.7**	55.9	57.8	**56.4**	**52.3**
3rd.....	5.6	10.9	8.9	**8.6**	17.8	7.8	**11.9**	18.1	12.7	19.7	**15.7**	11.1	10.7	**10.9**	10.3	17.2	**12.2**	**12.0**
4th.....	1.1	0.8	1.6	**1.1**	2.2	1.7	**1.9**	1.5	6.7	0.9	**3.9**	3.0	2.0	**2.5**	3.2	4.2	**3.5**	**2.8**

[1] North: TMG – Triângulo Mineiro, BEB – Bebedouro, ALT – Altinópolis.
[2] Northwest: VOT – Votuporanga, SJO – São José do Rio Preto.
[3] Central: MAT – Matão, DUA – Duartina, BRO – Brotas.
[4] South: PFE – Porto Ferreira, LIM – Limeira.
[5] Southwest: AVA – Avaré, ITG – Itapetininga.
[6] AVE – Weighted average per total stratum fruit.

Table 11 – 2020-2021 Orange crop forecast and its components by variety group

Variety group	Mature groves area	Average density[1] of mature groves	Components of May/2020 forecast				2020-2021 Orange crop forecast		
			Bearing trees	Fruit per tree at stripping[2]	Fruit estimated per box	Estimated drop rate	Per tree	Per hectare	Total
	(hectares)	(trees/ hectare)	(1,000 trees)	(number)	(number)	(%)	(boxes/ tree)	(boxes/ hectare)	(1,000,000 boxes)
Early:									
Hamlin, Westin and Rubi.....	58,964	468	26,889	620	294	10.50	1.69	772	45.53
Other early:									
Valencia Americana, Seleta, Pineapple.....	16,744	483	7,892	565	271	11.50	1.65	779	13.05
Mid-season:									
Pera Rio.....	121,450	520	61,520	506	268	16.50	1.41	717	87.04
Late:									
Valencia and VFolha Murcha[3]	124,459	475	58,166	588	231	20.00	1.83	853	106.16
Natal.....	42,827	473	19,786	634	247	21.00	1.82	840	35.98
Total.....	**364,444**	**489**	**174,253**	**568**	**257**	**17.00**	**1.65**	**790**	**287.76**

(X) Not applicable.
[1] Calculation considers the total number of trees in the plot, that is, bearing and non-bearing trees (2018 and 2019 resets).
[2] Weighted average per total stratum fruit.
[3] V.Folha Murcha – Valencia Folha Murcha.

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