EXECUTIVE SUMMARY

## 2022-2023 ORANGE CROP FORECAST FOR THE SÃO PAULO AND WEST-SOUTHWEST MINAS GERAIS CITRUS BELT

1 – 2022-2023 ORANGE CROP FORECAST

The 2022-2023 orange crop forecast for the São Paulo and West-Southwest Minas Gerais citrus belt, published on May 26, 2022 by Fundecitrus in cooperation with Markestrat, FEA-RP/USP and FCAV/Unesp, is 316.95 million boxes (40.8 kg). Total orange production includes:

- 59.48 million boxes of the Hamlin, Westin and Rubi varieties;
- 17.52 million boxes of the Valencia Americana, Seleta, Pineapple and BRS Alvorada;
- 93.95 million boxes of the Pera Rio variety;
- 106.78 million boxes of the Valencia and Valencia Folha Murcha varieties;
- 39.22 million boxes of the Natal variety.

Approximately 22.99 million boxes are expected to be produced in the Triângulo Mineiro.

The projected volume is 20.53% higher than the previous crop that totaled 262.97 million boxes and represents an increase of 1.11% in relation to last ten years' average, as presented in Graph 1.
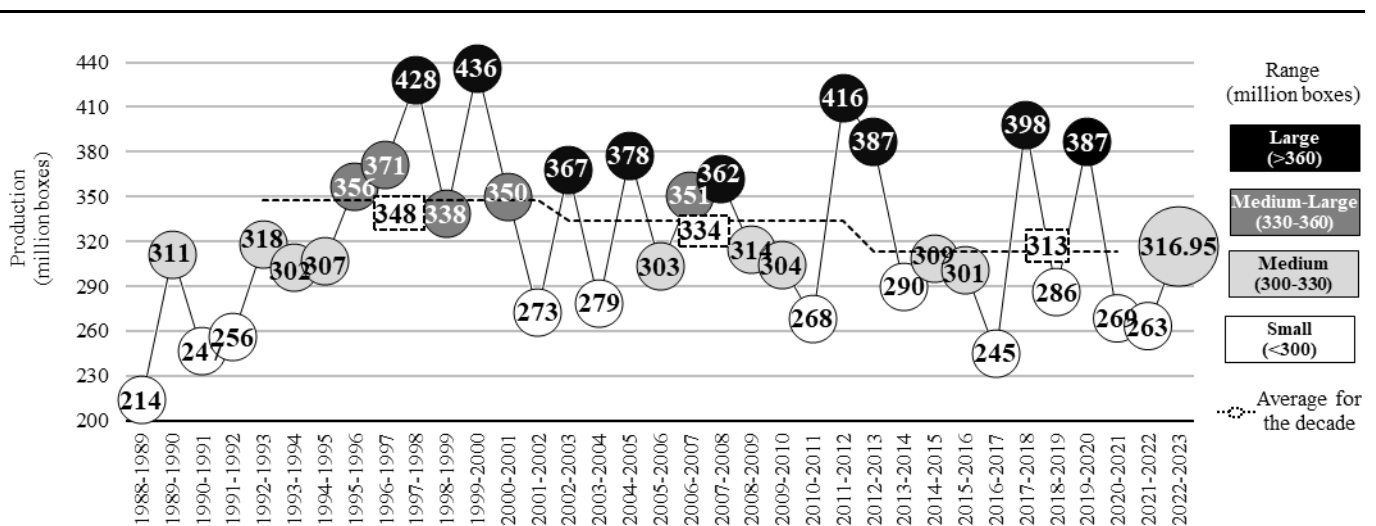
Graph 1 - Orange production from 1988-1989 to 2021-2022 and 2022-2023 crop forecast
Sources: CitrusBR (1988-1989 to 2014-2015) and Fundecitrus (2015-2016 to 2022-2023)

The prospect of a better crop indicates that, in general, groves could recover from adverse weather including the drought and frost that took place in 2020 and 2021 and caused two consecutive small crops, resulting in a discontinued biennial bearing cycle characterized by the yearly alternation of large and small crops. If the new production expectation holds, a change from negative to positive biennial production will eventually be observed.

Rains that resumed in early October 2021 and the still well-distributed rainfall since then with no occurrence of second summers and with air temperatures below historical average contributed to regularizing the soil moisture level. From October 2021 to April 2022, the accumulated average rainfall in the citrus belt was 923 millimeters, a volume that is 22% below the climatological normal but 16% higher than the accumulated rainfall in the same period the previous year.

That situation enabled plants in rainfed areas, that is, 61% of the production area, to flower in October, producing the "second bloom", as it is called due to its flowering time. Favorable weather allowed for high fruit setting after that bloom, which decreased the production of subsequent blooms, leading to a high concentration of fruit from the second bloom in this crop, as well as from the first bloom in irrigated groves. This higher crop homogeneity, in addition to optimizing harvest, also tends to produce better quality fruit. Overall, the first bloom accounts for 27.5% of the crop, the second bloom for 58.3%, the third bloom for 12.4%, and the fourth bloom for 1.8%.

Therefore, owing to better climate conditions, most orange trees in the citrus planted area show good fruit load and heavier oranges than those in the last crop, at the same development stage. This positive scenario as compared to the previous crop season should remain until this crop season ends. For that reason, the projected orange weight at harvest is 158 grams, which is 10.49% above the average weight of 143 grams observed last crop season, despite being 3.66% below the average weight in the last seven crops (164 grams). The increase in the irrigated area of mature groves, from de 31% in the 2018 inventory to 39% in the 2022 inventory, favored the growth of oranges. On the other hand, oranges produced in rainfed areas may suffer due to rainfall below historical average, should the La Niña phenomenon continue as expected until summer 2023, according to the weather forecast by Somar Meteorologia/Climatempo.

Average yield this crop season is estimated at 920 boxes per hectare and 1.86 boxes per tree as compared to the 760 boxes per hectare and 1.58 boxes per tree harvested in the 2021-2022 crop. The yield increase that stands out refers to groves planted with the Natal variety, expected to be 37% above that in the last crop season and the highest among all varieties. Tables 1 and 2 present yields by variety and variations in relation to the previous crop season.

Table 1 - Yield per hectare and variety for the 2017-2018 crop to the 2022-2023 crop

Group of varieties	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023[e]
	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)
Hamlin, Westin and Rubi…	1,235	833	1,319	797	819	1,047
Other earlies........................	1,008	810	1,121	827	804	971
Subtotal for earlies..............	1,184	828	1,273	804	815	1,029
Pera Rio.............................	945	633	943	671	653	791
Valencia and V.Folha Murcha.	1,016	826	998	739	838	955
Natal...................................	1,063	765	1,082	803	734	1,006
Total...................................	**1,033**	**756**	**1,045**	**737**	**760**	**920**

[e]   Estimate.

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

Group of varieties	2018-2019 in comparison to 2017-2018		2019-2020 in comparison to 2018-2019		2020-2021 in comparison to 2019-2020		2021-2022 in comparison to 2020-2021		2022-2023 in comparison to 2021-2022	
	(boxes/ hectare)	%	(boxes/ hectare)	%	(boxes/ hectare)	%	(boxes/ hectare)	%	(boxes/ hectare)	%
Hamlin, Westin and Rubi…	-402	-32.5%	486	58.4%	-522	-39.6%	22	2.8%	228	27.8%
Other earlies........................	-198	-19.6%	311	38.4%	-294	-26.2%	-23	-2.8%	167	20.8%
Subtotal for earlies..............	-357	-30.1%	445	53.8%	-469	-36.9%	11	1.4%	213	26.2%
Pera Rio.............................	-312	-33.0%	310	48.9%	-272	-28.8%	-18	-2.7%	138	21.2%
Valencia and V.Folha Murcha.	-190	-18.7%	172	20.9%	-259	-26.0%	99	13.4%	117	14.0%
Natal...................................	-298	-28.0%	316	41.3%	-279	-25.8%	-69	-8.6%	272	37.0%
Total...................................	**-278**	**-26.9%**	**290**	**38.3%**	**-308**	**-29.5**%	**23**	**3.1**%	**160**	**21.1**%

[e]   Estimate.

Regarding yield per sector, the Southwest, which includes the regions of Avaré and Itapetininga, should present the highest rate, at 1,107 boxes per hectare, having recovered from the drop of 21.4% that took place last crop season. Encompassing the regions of Porto Ferreira and Limeira, the South sector ranks second at 948 boxes per hectare, which is a significant improvement after two years of low yields and negative deviations. Following that are the sectors that had an increase in yield last crop season and keep a positive bias in this new cycle. In that situation are the Central sector, comprising the regions of Matão, Duartina and Brotas, at 844 boxes per hectare, the Northwest sector, comprising the regions of Votuporanga and São José do Rio Preto, at 845, and lastly the North sector, where the regions of Triângulo Mineiro,

Bebedouro and Altinópolis are, at 856 boxes per hectare. Tables 3 and 4 present yields by sector and variations in relation to the previous crop season.

Table 3 - Yield per hectare of sectors for the 2017-2018 crop to the 2022-2023 crop

| Sector	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023[e]
	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)	(boxes/ hectare)
North............................	1,108	606	1,070	648	804	856
Northwest......................	882	404	924	468	646	845
Central..........................	984	707	1,032	667	729	844
South............................	989	770	936	725	699	948
Southeast.......................	1,154	1,195	1,217	1,106	869	1,107
Total............................	**1,033**	**756**	**1,045**	**737**	**760**	**920**

[e] Estimate.

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

Sector	2018-2019 in comparison to 2017-2018		2019-2020 in comparison to 2018-2019		2020-2021 in comparison to 2019-2020		2021-2022 in comparison to 2020-2021		2022-2023[e] in comparison to 2021-2022	
	(boxes/ hectare)	%	(boxes/ hectare)	%	(boxes/ hectare)	%	(boxes/ hectare)	%	(boxes/ hectare)	%
North.........................	-502	-45.3%	464	76.6%	-422	-39.4%	156	24.1%	52	6.5%
Northwest..................	-478	-54.2%	520	128.7%	-456	-49.4%	178	38.0%	199	30.8%
Central......................	-277	-28.1%	325	46.0%	-365	-35.4%	62	9.3%	115	15.8%
South.........................	-218	-22.1%	166	21.6%	-211	-22.5%	-26	-3.6%	249	35.6%
Southwest..................	41	3.5%	22	1.8%	-111	-9.1%	-237	-21.4%	238	27.4%
Total.........................	**-277**	**-26.9%**	**289**	**38.2%**	**-308**	**-29.5%**	**23**	**3.1%**	**160**	**21.1%**

[e] Estimate.

As presented in Graph 2, the Central sector accounts for 25% of the production, the Southwest for 25%, the North for 22%, the South for 19% and the Northwest for 9%.
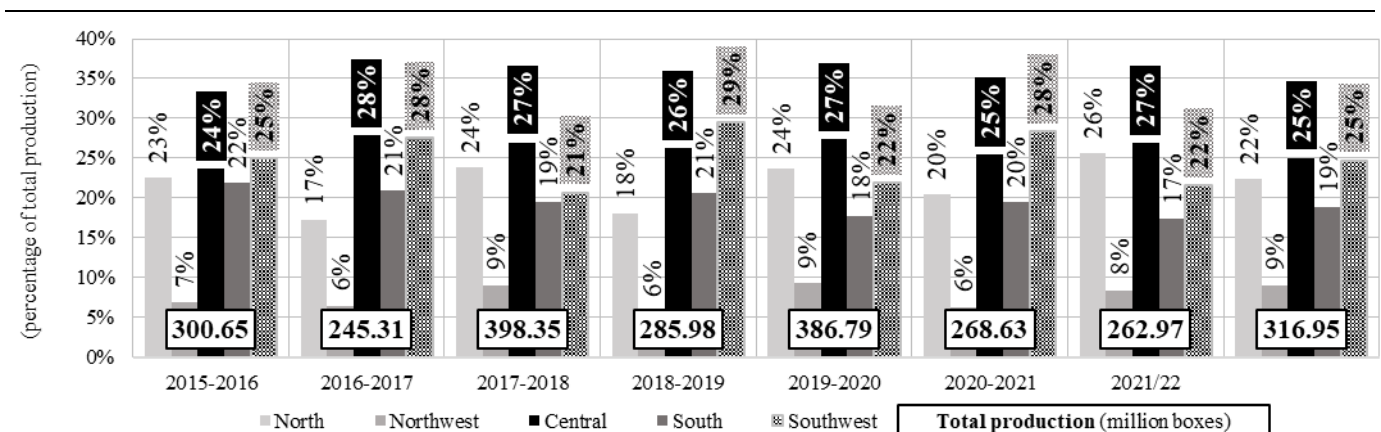
Graph 1 - Share of sectors in total orange production in the 2015-2016 to 2022-2023 crops

BEARING TREES

Bearing trees total 169.97 million and occupy an area of 344,389 hectares in this crop season. These figures represent an increase of 3.41 million trees, equivalent to 2% above the 2021 inventory and a decrease in the production area of 0.50%, evidencing the effect of the higher planting density in the last years.

Varieties included in this forecast are present in 97% of the area of orange groves in the citrus belt. Orange trees of the BRS Alvorada variety were included in this crop in the category "Other earlies" that encompasses 300 hectares of mature groves and 248 thousand bearing trees. Information on bearing trees

was obtained from the "Tree inventory of the São Paulo and West-Southwest Minas Gerais citrus belt: Snapshot in March 2022", taken from the 2022 primary base – created by mapping groves from August 16, 2021 to January 28, 2022 – and from counting existing trees in approximately 5% of orange plots from January 31 to March 29, 2022.

The georeferenced mapping performed for the first time in 2015 and renewed in 2018 was completely updated in this 2022 Inventory. New high-definition orthorectified images were obtained by the satellites SPOT 6&7 from European Airbus Defence and Space between May and August 2021. In August 2021, those images were made available to survey agents, together with drawings of plots identified in previous mappings, which were superimposed to the images for easier visualization of areas that should be visited for the collection of *in loco* data. Scanning or visual inspection of images was also employed by survey agents before they went to the field to pre-identify citrus groves planted after 2017, which should also be visited.

No information relative to plots other than their outlines was supplied to survey agents, which required all new data to be collected on variety, planting year, spacing, visual aspect of plants and irrigation system, when present. Recently collected data relative to the variety and planting year that differed from the previous register were audited for validation. Outlines of plots were redrawn to correspond to their present area, whenever their area was changed after plots having been registered in the previous mapping. Field visits identified plots that were abandoned or eradicated after the 2018 Inventory and those identified in that mapping as being in that situation, so that they were also revisited for data updating.

As for orange groves, data for 90% of the mapped area were collected in plots by survey agents; data on 7% of the area were supplied by citrus growers; 2% of the area used data from previous mappings and data for 1% of the area were estimated by statistical inference from average data for the region. All data were encrypted and saved to the Fundecitrus Geographic Information System upon the adoption of technical and organizational safety measures to protect individual data from unauthorized accesses and accidental or illicit situations of destruction, loss, alteration, communication or any other form of improper or illicit treatment.

For the tree inventory to be taken, 5% of mapped orange plots were drawn to be visited again and have their planting holes classified and quantified. Each tree present in the plot was classified into one of four age categories: zero (up to two years old), one (from three to five years old), two (from six to ten years old) and three (over ten years old). Dead and missing trees were also accounted for. Plots were chosen through a random drawing that employed the proportionate stratified sampling technique. Stratification variables were: 12 regions, five orange varieties groups and four age groups, totaling 240 strata.

Due to the Covid-19 pandemic, the necessary prevention measures were taken to mitigate the risk of coronavirus contamination and transmission so that all activities could be carried out in a safe manner.

FRUITS PER TREE

The average number of fruits per tree in May 2022, without considering the drop that occurs throughout the season, is 668, which represents an increase of 4,5% in relation to the previous crop. The average number of fruits per tree may have a variation of plus or minus 19 units, which is equivalent to $\pm 2.82\%$ of the average number of fruits per tree at stripping. This figure is within the expected error of 2% to 3% used in sizing the sample.

Graph 3 shows the number of fruits per tree at stripping from 2015 to 2022, separately for the 12 regions. Data precision for regions is smaller than that of the general average due to a lower number of samples per stratum. The error in the average number of fruits per tree is $\pm 9.2\%$ in the Triângulo Mineiro, $\pm 10.1\%$ in Bebedouro, $\pm 12.5\%$ in Altinópolis, $\pm 9.4\%$ in Votuporanga, $\pm 11.2\%$; in São José do Rio Preto, $\pm 9.5\%$ in

Matão, ± 9.3% in Duartina, ± 7.8% in Brotas, ± 9.0% in Porto Ferreira, ± 9.7% in Limeira, ± 9.2% in Avaré, and ± 7.9% in Itapetininga.
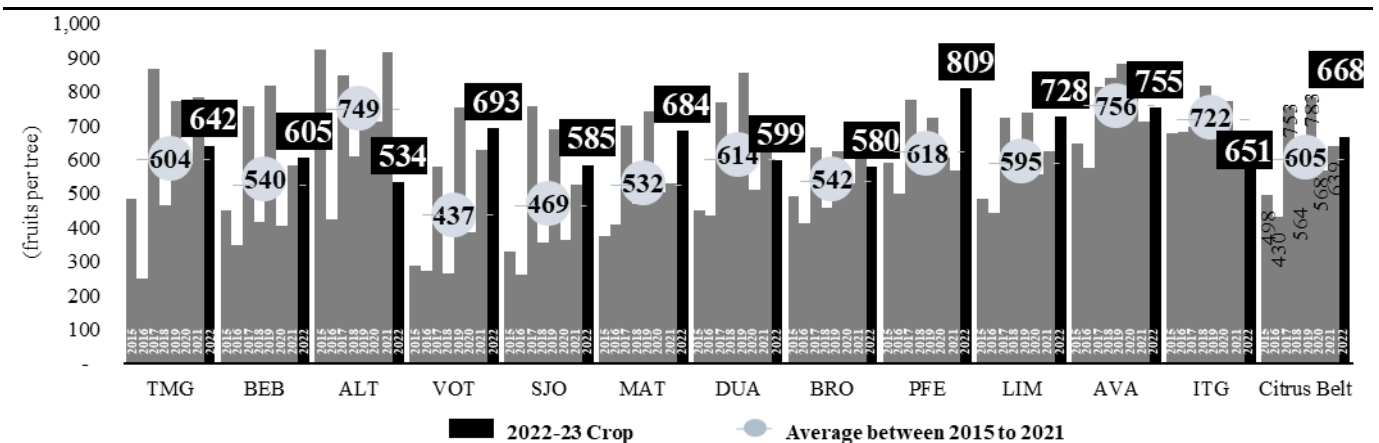
Graph 3 - Number of fruits per fruit-stripped tree by region from 2015 to 2022

For the forecast calculation, fruits from the first, second and third blooms were considered in full. A setting rate of 65% was applied to fourth bloom fruits because of their rather small amount and the favorable climate conditions at present that should help in fruit retention. In the separation of fruits per bloom, off-season fruits were also identified and resulted 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 300 fruits per tree this crop season. For six to 10-year-old plots, an average of 534 fruits per tree is estimated, with 548 fruits per tree for original plantings and 193 fruits per tree for three to five-year-old resets. Plots over 10 years old have an average of 830 fruits per tree and a yield of 880 fruits per tree for original plantings, 356 fruits per tree for six to 10-year-old resets and 150 fruits per tree for three to five-year-old resets. Yield rates are presented in Graph 4.
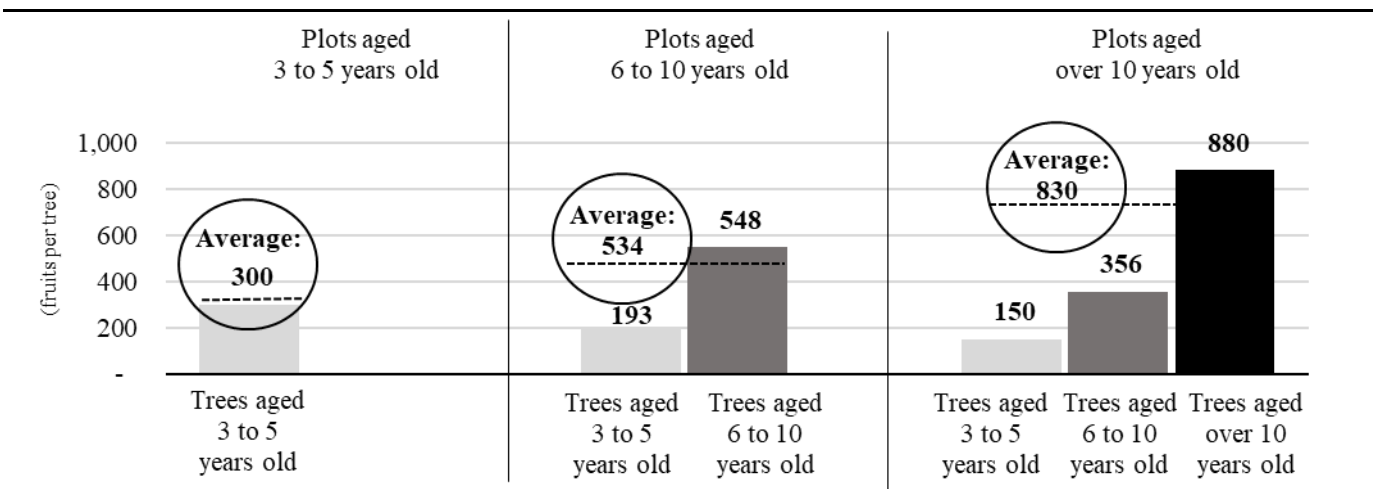
Ages and planting years: 3 – 5 years (2017 to 2019), 6 – 10 years (2012 to 2016) and over 10 years (2011 and previous years)
Graph 4 - Age-stratified number of fruits per tree in the plot

An average of 859 fruits per tree were counted for the group of earlies Hamlin, Westin and Rubi, 722 fruits per tree for the late season Natal variety, 686 fruits per tree for the late Valencia and Valencia Folha Murcha varieties, 638 fruits per tree for other earlies, and 560 for the mid-season Pera Rio variety.

The method used consists in fruit stripping, that is, the advanced harvest of all fruits in the tree, regardless of the bloom they are from. In this crop season, fruits were stripped from trees from March 28 to May 11, 2022. Fruits harvested were taken to a fruit 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.

Sample size was 1,560 trees selected by a drawing. An initial drawing by the method of stratified random sampling included 1,200 trees distributed proportionally amongst all orange trees in the citrus belt and stratified according to their region, variety and age. An additional drawing included 360 resets of ages lower than the age groups of their groves. These resets correspond to replacements made mainly to offset tree losses caused by citrus greening, citrus blight, gomosis 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, Pineapple and BRS Alvorada
Mid-season....................................	Pera Rio
Late...	Valencia and Valencia Folha Murcha
	Natal

Chart 3 - 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 (2017 to 2019), 6 to 10 years (2012 to 2016) and over 10 years (2011 and previous years).

For the 1,200 trees in the first drawing, the location in the plot of the tree to have fruit stripped from is predetermined and varies every crop season. This makes the selection of the tree 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 2022-2023 crop, the tree in the drawn plot was the one located in the 23rd planting hole in the 14th row. If there was 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 was selected. Should that situation repeat itself,

three more plants down were counted, until a tree of the drawn age was found. If the plot did not have 14 or more planting rows, the counting restarted in the existing rows until number 14 was reached. For the second drawing of 360 resets, the tree was found in the plot after visual aspects were considered, such as trunk circumference and size of canopy.

Graph 5 presents the distance (in meters) from the fruit-stripped tree to the nearest border of the plot, which shows the majority of classes with similar frequencies, with a central figure between 40 and 50 meters of distance from the fruit-stripped tree to the nearest border.
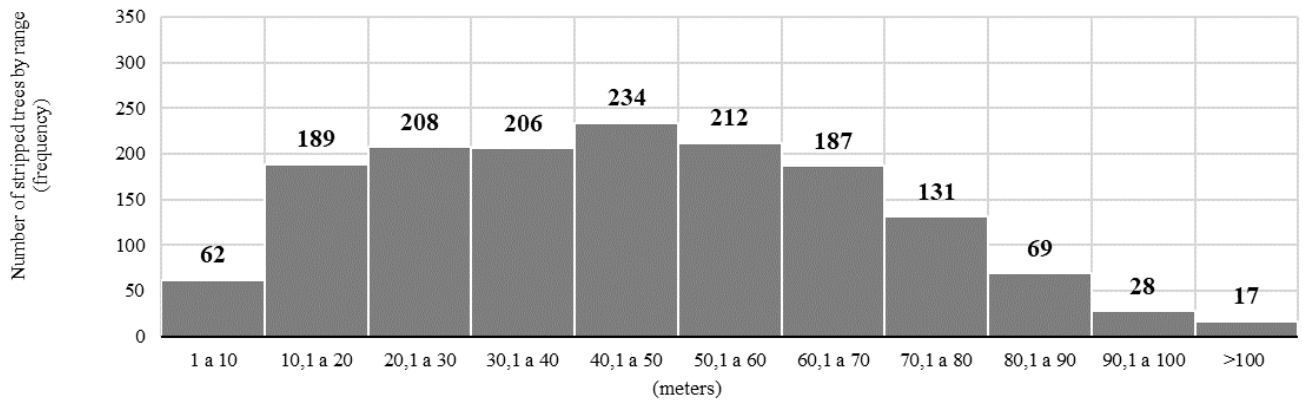
**Graph 5 - Histogram of distances from the fruit-stripped tree to the nearest border of the plot**

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

Figure 1 - Location and total number of fruit-stripped trees per region
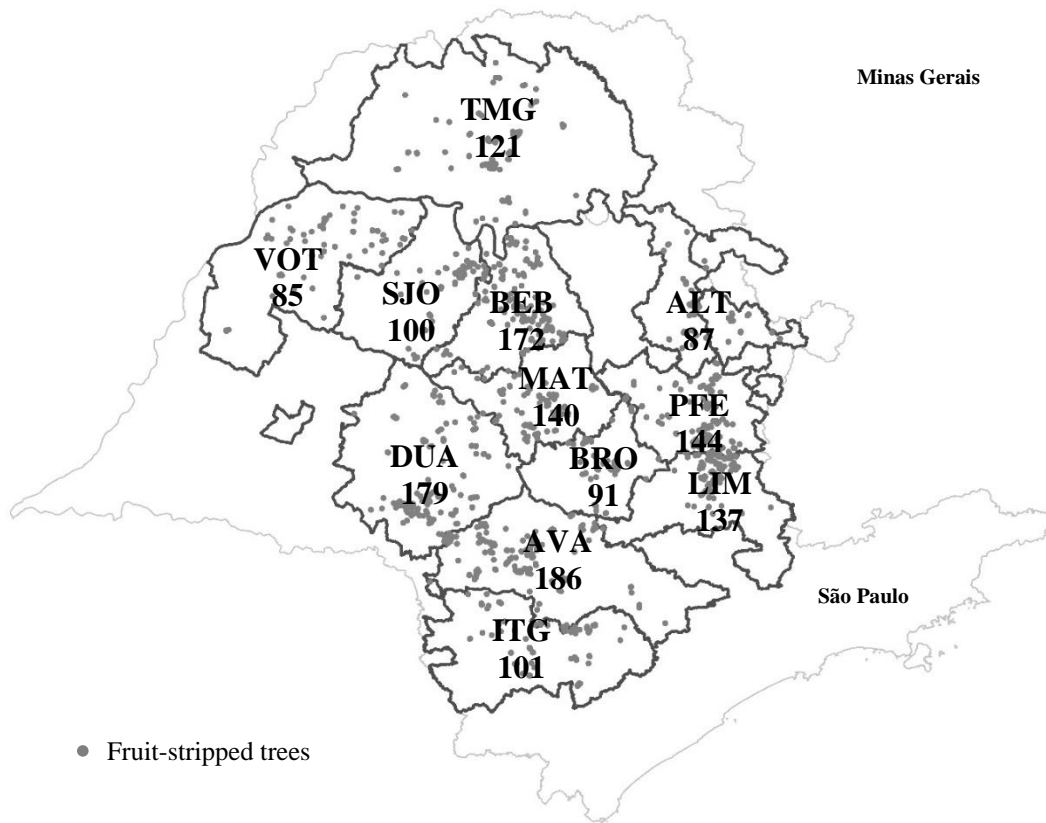
The yield deviation distribution analysis for each fruit-stripped tree in relation to the stratum average shows that sample data are randomly distributed according to a normal distribution, as presented in Graph 6. Out of the total samples, 17 were discarded upon showing great discrepancy in relation to the others.
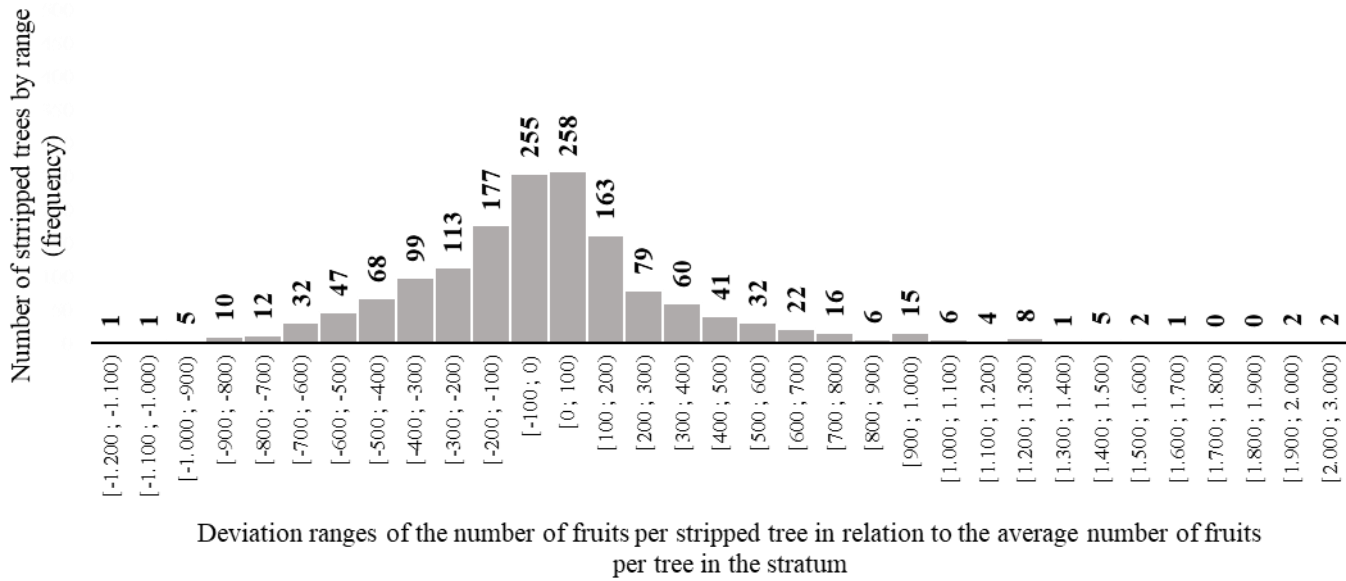
Graph 6 - Histogram of deviations of fruits per tree at stripping

Graph 7 shows the dispersion of deviations of each fruit-stripped tree in relation to the stratum average. It is observed that 95% of samples fall within the average (639 fruits) $\pm$ 2 standard deviations.
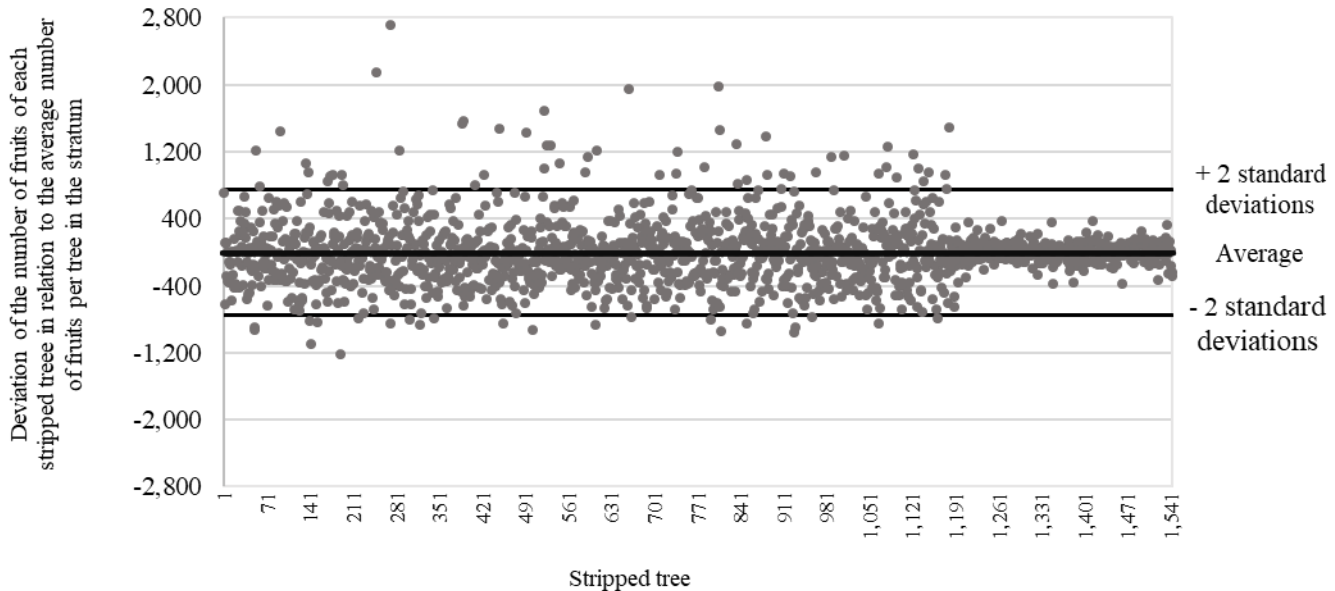
Graph 7 - Deviation on the number of fruits at each stripping in relation to the stratum average

The tree harvested upon permit from citrus growers is indemnified at R$ 46.00 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 20.00%, distributed as follows: 11.50% for the early Hamlin, Westin and Rubi varieties, 12.00% for other early varieties, 21.70% for the mid-season Pera Rio variety, 23.50% for the late Valencia and Valencia Folha Murcha varieties, and 23.50% for the late Natal variety. This rate is applied to the number of fruits in the tree in May 2022, when fruits were 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. As shown in Chart 5, the South sector has the highest drop rate at an average 24.80%, whereas the Southwest sector has the lowest one at 16.90%.

Table 5 – Projected fruit drop rates by sector and variety

Group of varieties	Sector					
	North	Northwest	Central	South	Southwest	Total
	(percentual)	(percentual)	(percentual)	(percentual)	(percentual)	(percentual)
Hamlin, Westin and Rubi……..	10.70	13.00	12.50	13.60	8.90	**11.50**
Other earlies..............................	9.40	17.00	13.80	20.00	6.00	**12.00**
Pera Rio.....................................	18.10	16.80	23.80	26.40	19.70	**21.70**
Valencia and V. Folha Murcha..	21.80	27.00	25.40	27.90	18.70	**23.50**
Natal..	21.00	24.70	22.50	29.80	21.50	**23.50**
Total...	**17.70**	**19.20**	**21.10**	**24.80**	**16.90**	**20.00**

Should this fruit drop rate hold, it will be below only the ones observed in the last two crops, when climate conditions were severe. The main reason for this projection is the intensified phytosanitary problems such as the increased incidence of orange trees with greening symptoms in the citrus belt, which rose from 20.87% in 2020 to 22.37% in 2021, associated to serious problems with fruit borer, fruit fly, black spot and leprosis. The projected drop rate is smaller than those observed in 2020 and 2021 due to the blooming homogeneity in this crop season, in addition to the higher rainfall volume and its better distribution. Last two years were extremely dry in comparison to history, which contributed to much greater fruit drop levels. Monthly and continuous monitoring carried out by Fundecitrus as of June 2022 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 258 fruits per 40.8 kg box, namely 300 fruits per box for the group of early varieties comprising Hamlin, Westin and Rubi, 260 fruits per box for the group of other early varieties, 260 fruits per box for the mid-season Pera Rio variety, 237 fruits per box for the late Valencia and Valencia Folha Murcha varieties, and 240 fruits per box for the late Natal variety. Table 6 presents projected fruit sizes by variety and sector.

Table 6 – Projected fruit sizes by sector and variety

Group of varieties	Sector					
	North	Northwest	Central	South	Southwest	Total
	(Fruits estimated per box)	(Fruits estimated per box)	(Fruits estimated per box)	(Fruits estimated per box)	(Fruits estimated per box)	(Fruits estimated per box)
Hamlin, Westin and Rubi……..	304	291	294	304	302	**300**
Other earlies..............................	253	257	257	265	276	**260**
Pera Rio.....................................	249	244	274	265	255	**260**
Valencia and V. Folha Murcha..	224	236	249	247	232	**237**
Natal..	229	255	239	253	239	**240**
Total...	**247**	**250**	**265**	**263**	**252**	**258**

The average size of 258 fruits per box is equivalent to oranges weighing approximately 158 grams (5.57 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 of the first and second blooms in relation to the total production and the rainfall accumulated from May to July as independent variables. Data from eleven crops, 2010-2011 to 2020-2021, were used in the regression and are presented in Table 6. Data from the 2021-2022 crop were not used because that was a period of totally atypical climate conditions, with the worst drought in almost a century and high-intensity frosts. The result obtained shows an adjusted R^2 of 0.93. This means that the four independent variables together explain 93% 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 these eleven crops presents an average absolute error of 2.5%.

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 were 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 were 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 were kept confidential. Data relative to the 2015-2016 to 2020-2021 crops come from results of estimates developed by Fundecitrus. Data on rainfall accumulated from May to July were supplied by Somar Meteorologia/Climatempo.

Data used in the model to estimate the final fruit size in this crop comprise figures from the 2022 stripping and the rainfall from May to July 2022 in a volume equivalent to 80% of the climatological average (1981-2010), disregarding the rainfall observed in May. This size (261) was corrected by the regression that used the observed size as the dependent variable and the estimated size as the independent variable.

Table 7 – Data for the 2010-2011 crop to the 2020-2021 crop used to estimate the final fruit size in the 2022-2023 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)	(%)	(%)
2010-2011....	532	457	97%	64	271	257	-5%	5%
2011-2012....	859	401	96%	116	269	268	-1%	1%
2012-2013....	764	439	95%	268	250	239	-4%	4%
2013-2014....	515	338	87%	247	224	215	-4%	4%
2014-2015....	646	373	92%	102	256	252	-2%	2%
2015-2016....	498	391	90%	204	226	234	4%	4%
2016-2017....	430	358	90%	214	222	225	2%	2%
2017-2018....	753	393	91%	184	246	248	1%	1%
2018-2019....	564	446	82%	36	259	253	-2%	2%
2019-2020....	783	411	94%	95	261	269	3%	3%
2020-2021....	568	511	85%	96	258	261	1%	1%
2022-2023....	668	462	86%	80[ha]	(X)	261	(X)	(X)

Sources: Fundecitrus (2015-2016 crop to 2022-2023 crop), CitrusBr (2008-2009 crop to 2014-2015 crop), Somar Meteorologia/Climatempo.
(X) Not applicable.
[mh]   80% of the historical average for May to July (disregarding rainfall observed by May 20, 2022).

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 accounted for in the calculations, such as harvested fruits that wind up not being used, diverse planting densities that are not considered 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, which represents the average of the indexes for 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 fruit 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, finalized the crop forecast on May 26, 2022, 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 at the Fundecitrus auditorium in Araraquara - SP, broadcast live at the Fundecitrus channel on YouTube (www.youtube.com/fundecitrus). Next, Fundecitrus general manager Antonio Juliano Ayres presented the detailed data. After the crop forecast announcement, the Executive Summary of the 2022-2023 orange crop forecast was made available on the Fundecitrus website. The complete report including the 2022 tree inventory and the 2022-2023 orange crop forecast will be available on June 30, 2022, at www.fundecitrus.com.br.

3 – TABLES OF DATA

The following tables present the 2022-2023 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 8 - 2022-2023 Orange crop forecast by sector

Sector	Mature groves area	Average density[1] of mature groves	Bearing trees	Fruit per tree at stripping[2]	2022-2023 Orange crop forecast		
					Per tree	Per hectare	Total
	(hectares)	(trees/ hectare)	(1,000 trees)	(number)	(boxes/ tree)	(boxes/ hectare)	(1,000,000 boxes)
North...........................	82,706	483	39,183	607	1.81	856	70.83
Northwest...................	33,846	470	15,721	630	1.82	845	28.59
Central.......................	93,931	519	47,739	624	1.66	844	79.32
South.........................	63,095	503	30,388	772	1.97	948	59.79
Southwest..................	70,811	535	36,942	721	2.12	1,107	78.42
Total.......................	**344,389**	**506**	**169,973**	**668**	**1.86**	**920**	**316.95**

[1] Calculation considers the total number of trees in the plot, that is, bearing and non-bearing trees (2020 and 2021 resets).
[2] Weighted average per total stratum fruit.

Table 9 - 2022-2023 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............	51,509	615	30,188	-	-	30,188	**300**	-	-	300
6 – 10 years..........	67,294	594	1,540	37,502	-	39,042	193	**548**	-	534
Over 10 years…...	225,586	455	2,586	5,952	92,204	100,742	150	356	**880**	830
Total....................	**344,389**	**506**	**34,314**	**43,454**	**92,204**	**169,972**	**284**	**522**	**880**	**668**

[1] Calculation considers the total number of trees in the plot, that is, bearing and non-bearing trees (2020 and 2021 resets).
[2] Weighted average per total stratum fruit.

Table 9 - 2022-2023 Orange crop forecast by tree age group (continued)

Plots age	2021-2022 Orange crop forecast by tree age group				2021-2022 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............	0.84	-	-	0.84	**25.34**	-	-	**25.34**
6 – 10 years..........	0.53	1.53	-	1.49	0.82	**57.26**	-	**58.08**
Over 10 years…...	0.42	0.99	2.46	2.32	1.08	5.90	226.55	233.53
Total....................	**0.79**	**1.45**	**2.46**	**1.86**	**27.24**	**63.16**	**226.55**	**316.95**

[1] Calculation considers the total number of trees in the plot, that is, bearing and non-bearing trees (2020 and 2021 resets).

Table 10 - 2022-2023 Orange crop forecast by bloom

Bloom	2022-2023 Orange crop forecast	Percentage of the orange crop forecast by bloom
	(1,000,000 boxes)	(percentage)
1st..	87.31	27.5%
2nd	184.77	58.3%
3rd..	39.15	12.4%
4th	5.72	1.8%
Total..	**316.95**	**100.00%**

Table 11 - 2022-2023 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.........	12.4	25.1	41.1	**29.5**	27.2	36.5	**31.5**	27.2	41.7	35.3	**37.9**	22.3	37.1	**26.8**	16.1	13.1	14.4	27.7
2nd.........	60.2	60.6	51.2	**57.3**	64.5	45.0	**55.6**	61.9	47.9	56.9	**52.5**	62.3	51.5	**59.1**	58.2	69.7	64.7	**58.3**
3rd.........	26.4	9.8	6.2	**10.1**	8.1	18.1	**12.7**	9.4	9.6	4.9	**8.0**	14.3	11.1	**13.4**	22.4	15.8	18.7	**12.4**
4th.........	1.0	4.4	1.5	**3.1**	0.2	0.4	**0.3**	1.5	0.8	2.9	**1.6**	1.0	0.3	**0.8**	3.3	1.3	2.2	**1.8**

[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 12 - 2022-2023 Orange crop forecast and its components by variety group

Variety group	Mature groves area	Average density[1] of mature groves	Components of May/2022 forecast				2022-2023 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.....	56,824	475	26,151	859	300	11.50	2.27	1,047	59.48
Other early:									
Valencia Americana, Seleta, Pineapple and BRS Alvorada……………………	18,034	514	9,044	638	260	12.00	2.88	971	17.52
Mid-season:									
Pera Rio................................	118,771	538	62,037	560	260	21.70	1.51	791	93.95
Late:									
Valencia and VFolha Murcha[3]	111,764	490	53,741	686	237	23.50	1.99	955	106.78
Natal.....................................	38,996	496	18,999	722	240	23.50	2.06	1,006	39.22
Total...................................	**344,389**	**506**	**169,972**	**668**	**258**	**20.00**	**1.86**	**920**	**316.95**

(X) Not applicable.
[1] Calculation considers the total number of trees in the plot, that is, bearing and non-bearing trees (2020 and 2021 resets).
[2] Weighted average per total stratum fruit.
[3] V.Folha Murcha – Valencia Folha Murcha.