Current forecast update (variation regarding the February forecast): **April, 12 2021**
Total orange crop production forecast: 268.63 million boxes (decreased of 0.14%)
Hamlin, Westin and Rubi: 47.00 million boxes (unchanged)
Other early season: 13.85 million boxes (unchanged)
Pera Rio: 81.45 million boxes (decreased of 0.46%)
Valencia and Valencia Folha Murcha: 91.95 million boxes (increased of 0.25%)
Natal: 34.38 million boxes (decreased of 0.66%)

The orange production forecast of the 2021-2022 season will be released at 10:00 a.m. (BRT, GMT -3:00) on May 27, 2021.

Orange crop forecast update by sector and variety group – citrus belt

Month	Forecast components				Crop forecast update 2020-2021			Crop forecast update 2020-2021		
	February/2021 and April/2021 (strike-through values were presented in February, to their left are their respective values updated in April)				February/2021			April/2021		
Sector and variety group	Bearing trees	Fruit per tree at stripping	Fruit estimated per box	Estimated drop rate	Per tree	Per hectare	Total	Per tree	Per hectare	Total
	(1,000 trees)	(number)	(number)	(percentage)	(boxes/ tree)	(boxes/ hectare)	(1,000,000 boxes)	(boxes/ tree)	(boxes/ hectare)	(1,000,000 boxes)
CITRUS BELT										
Hamlin, Westin and Rubi....	26,889	620	278	12.80	1.75	797	47.00	1.75	797	47.00
Other early.....	7,892	565	255	11.50	1.75	827	13.85	1.75	827	13.85
Pera Rio.....	61,151 ~~61,520~~	506	263 ~~266~~	22.90 ~~22.20~~	1.33	674	81.83	1.33	671	81.45
Valencia and Folha Murcha	57,500 ~~58,166~~	588	247 ~~252~~	25.20 ~~24.70~~	1.58	737	91.72	1.60	739	91.95
Natal.....	19,464 ~~19,786~~	634	246 ~~249~~	23.70 ~~23.50~~	1.75	808	34.61	1.77	803	34.38
Total.....	**172,897** ~~**174,253**~~	**568**	**258** ~~**261**~~	**21.60** ~~**21.20**~~	**1.54**	**738**	**269.01**	**1.55**	**737**	**268.63**
NORTH SECTOR										
Hamlin, Westin and Rubi....	7,450	557	278	12.80	1.57	681	11.69	1.57	681	11.69
Other early.....	1,947	622	255	11.50	1.94	924	3.77	1.94	924	3.77
Pera Rio.....	12,549	414	263 ~~266~~	22.90 ~~22.20~~	1.09	581	13.66	1.09	582	13.67
Valencia and Folha Murcha	13,913 ~~13,951~~	499	247 ~~252~~	25.20 ~~24.70~~	1.34	609	18.69	1.36	617	18.92
Natal.....	3,866 ~~3,891~~	626	246 ~~249~~	23.70 ~~23.50~~	1.73	735	6.72	1.74	735	6.72
Subtotal.....	**39,725** ~~**39,789**~~	**502**	**258** ~~**261**~~	**21.60** ~~**21.20**~~	**1.37**	**645**	**54.53**	**1.38**	**648**	**54.77**
NORTHWEST SECTOR										
Hamlin, Westin and Rubi....	2,405	572	278	12.80	1.61	716	3.88	1.61	716	3.88
Other early.....	1,339	320	255	11.50	0.99	436	1.33	0.99	436	1.33
Pera Rio.....	7,159 ~~7,197~~	367	263 ~~266~~	22.90 ~~22.20~~	0.96	439	6.94	0.97	437	6.91
Valencia and Folha Murcha	3,982	361	247 ~~252~~	25.20 ~~24.70~~	0.97	471	3.86	0.98	479	3.92
Natal.....	1,800 ~~1,866~~	190	246 ~~249~~	23.70 ~~23.50~~	0.53	254	0.98	0.53	246	0.95
Subtotal.....	**16,685** ~~**16,788**~~	**372**	**258** ~~**261**~~	**21.60** ~~**21.20**~~	**1.01**	**468**	**16.99**	**1.02**	**468**	**16.99**
CENTRAL SECTOR										
Hamlin, Westin and Rubi....	7,121	516	278	12.80	1.45	692	10.35	1.45	692	10.35
Other early.....	2,922	566	255	11.50	1.76	836	5.14	1.76	836	5.14
Pera Rio.....	18,426 ~~18,640~~	475	263 ~~266~~	22.90 ~~22.20~~	1.25	642	23.27	1.25	636	23.03
Valencia and Folha Murcha	15,723 ~~16,090~~	545	247 ~~252~~	25.20 ~~24.70~~	1.46	685	23.55	1.49	679	23.35
Natal.....	4,588 ~~4,787~~	509	246 ~~249~~	23.70 ~~23.50~~	1.41	625	6.73	1.41	601	6.48
Subtotal.....	**48,780** ~~**49,559**~~	**512**	**258** ~~**261**~~	**21.60** ~~**21.20**~~	**1.39**	**674**	**69.04**	**1.40**	**667**	**68.35**
SOUTH SECTOR										
Hamlin, Westin and Rubi....	4,748	589	278	12.80	1.66	757	7.88	1.66	757	7.88
Other early.....	379	766	255	11.50	2.37	918	0.90	2.37	918	0.90
Pera Rio.....	12,859 ~~12,976~~	548	263 ~~266~~	22.90 ~~22.20~~	1.44	695	18.70	1.44	689	18.54
Valencia and Folha Murcha	11,986	608	247 ~~252~~	25.20 ~~24.70~~	1.63	724	19.55	1.66	735	19.86
Natal.....	3,163 ~~3,176~~	594	246 ~~249~~	23.70 ~~23.50~~	1.64	751	5.20	1.65	752	5.21
Subtotal.....	**33,135** ~~**33,265**~~	**582**	**258** ~~**261**~~	**21.60** ~~**21.20**~~	**1.57**	**723**	**52.23**	**1.58**	**725**	**52.39**
SOUTHWEST SECTOR										
Hamlin, Westin and Rubi....	5,166	907	278	12.80	2.56	1,199	13.20	2.56	1,199	13.20
Other early.....	1,305	669	255	11.50	2.08	1,091	2.71	2.08	1,091	2.71
Pera Rio.....	10,158	722	263 ~~266~~	22.90 ~~22.20~~	1.90	1,012	19.26	1.90	1,014	19.30
Valencia and Folha Murcha	11,896 ~~12,157~~	799	247 ~~252~~	25.20 ~~24.70~~	2.14	1,077	26.07	2.18	1,070	25.90
Natal.....	6,047 ~~6,065~~	895	246 ~~249~~	23.70 ~~23.50~~	2.47	1,236	14.98	2.48	1,239	15.02
Subtotal.....	**34,572** ~~**34,852**~~	**804**	**258** ~~**261**~~	**21.60** ~~**21.20**~~	**2.19**	**1,107**	**76.22**	**2.20**	**1,106**	**76.13**

Orange production for the 2020-2021 crop season totaled 268.63 million boxes[1]

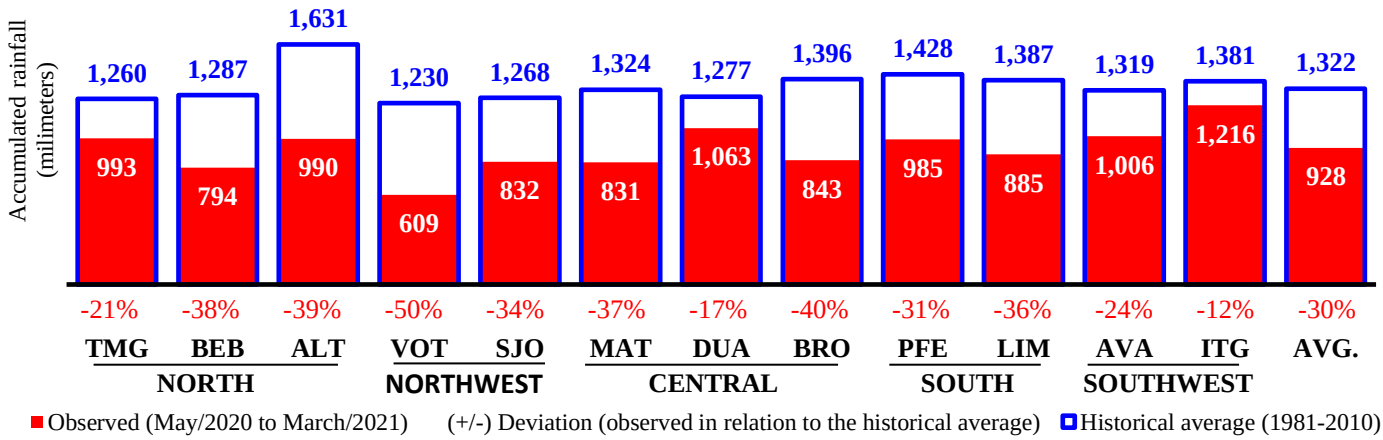
The final 2020-2021 orange crop for the São Paulo and West-Southwest Minas Gerais citrus belt, published on April 12, 2021 by Fundecitrus – performed in cooperation with Markestrat, FEA-RP/USP and FCAV/Unesp[2] – was 268.63 million boxes of 40.8 kg each (90 lb), which represents a decrease of 6.65% in relation to the first crop forecast published in May 2020, accounting for a reduction of 19.13 million boxes. This crop had a decrease of 118.16 million boxes in comparison to the previous season, which is equivalent to a volume 30.55% smaller than that of the 2019-2020 cycle, confirming a record crop loss for all the years in which the crop suffered the physiological effects of the negative biennial production cycle of orange trees since the beginning of the historical series in 1988. Total orange production included:

- 47.00 million boxes of the Hamlin, Westin and Rubi early-season varieties;
- 13.85 million boxes of the Valencia Americana, Seleta and Pineapple early-season varieties;
- 81.45 million boxes of the Pera Rio mid-season variety;
- 91.95 million boxes of the Valencia and Valencia Folha Murcha late-season varieties;
- 34.38 million boxes of the Natal late-season variety.

Approximately 19.33 million boxes were produced in West Minas Gerais.

One of the reasons that explains this substantial crop loss is the fact that orange trees started flowering in the spring of 2019, when reserves were lower because they had been used in the previous crop season when there was a significant yield increase. Decreased reserves led to a significant reduction in the number of fruits per tree in this season, a phenomenon known as alternate bearing. The other reason is the strong negative influence of the climate throughout the season. Adverse climate conditions started as early as 2019, in the months of September and October, with an Indian Summer and high temperatures that impaired the setting of newly formed fruits, resulting in a lower concentration of oranges from the main bloom. During fruit development, drought and heat became more intense as a result of the climate event La Niña and other simultaneous phenomena, such as the Atlantic Multidecadal Oscillation.

From May 2020 to March 2021, the accumulated average rainfall in the citrus belt amounted to 928 millimeters, which is 404 millimeters or 30.33% below the historical average of 1,332 millimeters, according to data from Somar Meteorologia. In all regions, the accumulated rainfall volumes for that period were below the climatological normal (1981-2010). In absolute values, the lowest accumulated volumes were recorded in the regions of Votuporanga (609 millimeters), Bebedouro (794 millimeters), Matão (831 millimeters), São José do Rio Preto (832 millimeters), Brotas (843 millimeters), Limeira (885 millimeters), Porto Ferreira (985 millimeters), Altinópolis (990 millimeters), and Triângulo Mineiro (993 millimeters). Accumulated rainfall was above 1,000 millimeters only in three regions: Avaré (1,006 millimeters), Duartina (1,063 millimeters), and Itapetininga (1.216 millimeters), as presented in Graph 1.



Graph 1: Accumulated rainfall from May 2020 to March 2021 in citrus belt regions.
Source: Fundecitrus, from data supplied by Somar Meteorologia.

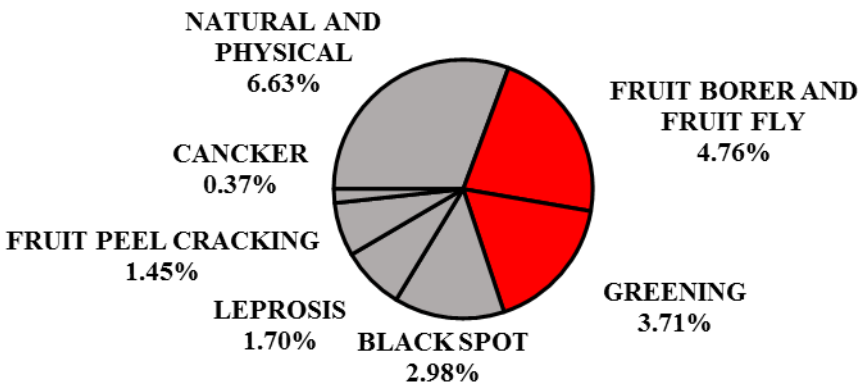
The most critical period was from May through October 2020, marked by a long drought that ranged from 55 to 145 consecutive days without significant rainfall, depending on the region. When rains resumed, they were isolated and scattered: more than half of the accumulated rainfall in the crop season was concentrated in only three months (December 2020, January and February 2021). With the dry spell, an extreme heat wave prevailed over the citrus belt and registered maximum average temperatures were above historical averages in all months of the assessed period, with the exception of August 2020, when there was no significant variation. The hottest months were September and October 2020, when maximum average temperatures reached 4.4ºC and 3.1ºC above the historical maximum averages, respectively.

Water shortage combined with high temperatures hindered physiological functions of plants, such as respiration, photosynthesis and nutrient absorption. That condition not only affected fruit production, with reduced growth and increased drop rate, but also caused the death of trees in the whole citrus belt, especially of the most susceptible ones such as those grafted on Swingle citrumelo and trees that were diseased or weakened by nutritional deficiencies. A loss of 1.356 million plants that were not harvested is estimated for the total number of bearing trees that had been included in the initial crop forecast. Only the loss of trees of the Pera Rio mid-season variety and of late-season varieties were considered, since most of the early-season varieties had already been harvested when climate conditions worsened. Therefore, the final number of bearing trees in this crop season was reduced from 174.253 to 172.897 million.

The loss of bearing trees was estimated from the comparison between the number of dead and missing trees found in March 2021 in groves included in this crop forecast and their respective number in March 2020. This difference, in turn, was subtracted from the total number of bearing trees in the beginning of this season to obtain the final number of bearing trees at the end of the crop season. This update was based on sample survey data collected from 5% of all plots of the citrus belt, whose total holes were counted in February and March of this year in order to determine the number of bearing trees, resets, dead and missing plants which are currently in those plots. The result of this survey showed a significant rise in the number of dead trees and also an increase in missing trees in the citrus belt. The regions of Votuporanga and São José do Rio Preto evidenced the highest rates of dead plants that still remain in the groves. In the other regions, the number of missing plants surpassed the number of dead trees, suggesting that the loss of trees in those locations may have resulted from mortality or eradication of diseased plants, whose onset of symptoms was favored by water shortage and high temperatures.

The average fruit drop rate for the citrus belt, accumulated from the beginning of the crop season, totaled 21.60%, which is within the margin of error of plus or minus 0.88 percentage point, with 95% confidence. The final rate reached 4.60 percentage points above the rate projected in May 2020. The increase was mainly caused by the drought stress on plants, which made them more vulnerable to pests and diseases, thereby contributing to a greater fruit drop.

The key reason for fruit drop at a rate of 6.63% has still been the category which encompasses physiological drop (5.55%) and mechanical drop (1.18%), whose main causes are pruning and machinery traffic. Fruit peel cracking, caused by loss of peel plasticity arising from the extremely severe drought, accounted for 1.45% of the drop of premature fruits. Ranking first among the key pests and diseases that caused fruit drop was fruit borer together with fruit fly, at a rate of 4.76% and as a result of the increased population of these insects, which has been observed since the 2018-2019 crop. Greening ranked second, at 3.71%, because of the high intensity of the disease that continued to spread in the citrus belt. Black spot ranked third, at 2.98%. Onset of symptoms was favored by the occurrence of multiple blooms that made the disease harder to control. Leprosis ranked fourth, at 1.70%, in that more injuries were noticed in fruits due to a larger infestation of mites in plants that experienced water deficit. Leprosis ranked fourth, at 1.70%, in that a higher number of injuries were observed in fruits because of the greater infestation of mites in plants which suffered from water shortage. Citrus canker ranked last, at a rate of 0.37%, as shown in Graph 2.



Graph 2: Causes comprising the average fruit drop rate, with emphasis on the pests and disease that caused the most fruit drop.
Source: Fundecitrus.

As far as the drop rate distribution among varieties is concerned, Hamlin, Westin and Rubi totaled a rate of 12.80% and margin of error of ± 1.39 percentage point; other early-season varieties totaled a rate of 11.50% and margin of error of ± 1.54 percentage point; Pera Rio totaled 22.90% and margin of error of ± 1.67 percentage point; Valencia and Valencia Folha Murcha totaled 25.20% and margin of error of ± 1.94 percentage point; and Natal totaled 23.70% and margin of error of ± 2.26 percentage point.

In general, the reduced rainfall volume in comparison with the historical average affected the growth of oranges, which presented a slightly lower weight than that of the forecast of May 2020. Data collected during the crop season showed that the average weight of harvested fruits was 158 grams (5.57 oz), whereas the initial forecast was 159 grams (5.61 oz) at harvesting. In view of this average weight, 258 fruits were required to fill a box of 40.8 kg, a number that is 0.39% smaller than the initial forecast of 259 fruits

per box. This means that the average weight of each orange in this crop was 6.51% lower than the average for the last five crops (169 grams or 5.96 oz). This final result confirms the high accuracy level of the regression model used to project fruit size, which took into account the following variables for the last 11 crops: final fruit size, number of fruits per tree, initial fruit size, sum of percentages of production from first and second blooms in relation to total production, and accumulated rainfall from May to July.

In the analysis by variety, a projected average weight of 294 fruits per box (139 grams or 4.90 oz per fruit) in May 2020 for the group that includes Hamlin, Westin and Rubi was updated at the end of the crop season to 278 fruits per box (147 grams or 5.19 oz per fruit). The projected average weight of 271 fruits per box (151 grams or 5.33 oz per fruit) for oranges of other early varieties in May 2020 was updated to 255 fruits per box (160 grams or 5.64 oz per fruit). The initial projection of 268 fruits per box (152 grams or 5.36 oz per fruit) for Pera Rio was updated to 263 fruits per box (155 grams or 5.47 oz per fruit). The average fruit size projection for Valencia and Valencia Folha Murcha in May 2020 of 231 fruits per box (177 grams or 6.24 oz per fruit) was updated to 247 fruits per box (165 grams or 5.82 oz per fruit) at the end of the crop season. The initial projection for Natal of 247 fruits per box (165 grams or 5.82 oz per fruit) was updated to 246 fruits per box (166 grams or 5.86 oz per fruit) at this final crop forecast.

Data collected in the field survey and used for forecast updates were obtained by stratified sampling according to region, variety, and age. The survey started in May 2020 on 1,200 plots, which were visited and sampled on a monthly basis until harvest was complete. Other data used in this study was size of fruit received throughout the crop season by orange juice companies associated to Fundecitrus – Citrosuco, Cutrale and Louis Dreyfus – for industrial processing. Each processing company supplies individual data under confidentiality to the independent consulting firm for the calculation of the average size of processed fruit.

2021-2022 crop forecast

Exceptionally this year, owing to restrictions imposed by the pandemic in the state of São Paulo and to the lockdown declared in Araraquara, the 2021-2022 orange crop forecast announcement and the tree inventory update will be held at 10:00 a.m. on May, 27. Presentation of data will once again only be streamed live on the Fundecitrus YouTube channel.

[1] Hamlin, Westin, Rubi, Valencia Americana, Seleta, Pineapple, Pera Rio, Valencia, Valencia Folha Murcha and Natal.
[2] Department of math and science, FCAV/Unesp Jaboticabal Campus.