

Characterization of seasonal tomato varieties and study of their suitability for processing in Tunisia

Cap Bon region

Introduction

The cultivation of industrial tomatoes occupies 15 to 18 thousand ha every year. During the campaign 2020, we processed 945 thousand tons of fresh tomatoes against 800 thousand tons in 2019. These quantities have allowed producing 145 thousand tons of DCT in 2020 against 123 thousand tons of DCT in 2019; that is to say an industrial yield of about 6.5. The extension in terms of sowing for this crop has shown its limit during the last decade where we experienced many problems related to the availability of irrigation water or saturation of processing units from the first week of July.

The regular monitoring of data from the industrial tomato processing campaigns, has detected a gradual deterioration of industrial yield from one campaign to another. The latter has gone from 5.75 kg of fresh tomatoes Tf to produce 1 kg of Double Concentrate DCT in 2009 to 6.92 in 2015 and 6.5 kg Tf / kg DCT for the period between 2016 and 2020. This represents an equivalent loss of earnings per campaign of at least 75 thousand tons of fresh tomatoes and an equivalent loss exceeding 14.6 million dinars (based on an annual production of 100 thousand tons of DCT and a reference price of 195 millimes / kg of fresh tomato). This deterioration of the industrial output is the result of the deterioration of the quality of fresh tomatoes received characterized by low contents in °Brix and high rates of waste (foreign bodies, green fruits and rotten tomatoes). This waste has a negative impact on the production costs involving additional economic charges (maintenance costs...). To remedy, it is essential to adopt a program of upgrading the agronomic link, which has targeted so far only the search for varieties ensuring high productivity per ha with the minimum costs while ignoring any potential varietal quality.

An annual program of varietal trials of the seasonal tomato crop has been established to quantitatively and qualitatively characterize the productive potential of available tomato varieties and to evaluate their suitability for processing.

Materials and methods

Experimental stations

Four test stations were set up in the different regions of Cap Bon (Table 1), with normal irrigation water salinity conditions not exceeding 3 g/l. The regions of the trial stations are Haouaria and ElGhorfa which belong to the sub-humid bioclimatic stage with warm winters and an average annual rainfall of about 568 mm per year and an average annual evapotranspiration of about 1250 mm; and the regions of Lebna and MenzelHorr characterized by an upper semi-arid bioclimatic stage and an average annual rainfall of about 500 mm.

Table 1. Trial sites

Region	Haouaria	ElGhorfa	Lebna	Menzel Horr
Soil texture	Clay and sandyloam	Clay-silt sand	Siltyclay	Clay and sandyloam
Water salinity	2,5 g/ liter	2,5 g/ liter	1,9 g/ liter	2,4 g/ liter
Expected yield	120 tons/ ha	120 tons/ ha	130 tons/ ha	120 tons/ ha
Planting density/ha	33.000 plants	33.000 plants	33.000 plants	33.000 plants
Transplanting date	March 25 th	March 24 th	March 21 st	April 5 th

Plant materials

11 varieties were studied: Perfectpeel, Albatros, Ercole, Topsport, CXD255, Savera, Heinz1423, Heinz1534, Heinz9661, Heinz1015 and Heinz5508.

Experimental design

At each site, varieties are randomly assigned to a randomized block design with three replications. These sites are conducted, at the cultivation level, in the same way as the production fields.

The recommended irrigation method is the drip system associated with a localized fertilization "La Fertigation". The fertilization program adopted is that of the farmer to evaluate the behavior of the varieties subject of the trials. Fertilization doses and irrigation water quantities vary according to the type of soil, the quality of the irrigation water and the climatic characteristics of the growing region.

Analysis of productivity and fruit quality

For each test plot, preliminary analyses were performed during an intermediate stage (10 to 15 days before harvest) followed by a second analysis phase at the final harvest date. During each phase of analysis, 5 samples were taken at random per block and per treatment (variety). Each sample consisted of all fruits (including green and rotten fruits) from the harvest of three randomly selected plants.

The processable yield per ha reflects the amount of healthy tomato per ha that can be processed after deducting the mass of waste (green and rotten fruits) per ha.

The dry matter content is evaluated by the °Brix degree, measured with a digital portable refractometer.

The yield in °Brix per ha is the quantity of juice that can be obtained from the transformation of the production of one ha of healthy fruit after deduction of the mass of waste.

The reference potential is the yield in °Brix that can be obtained under ideal production conditions (yield produced = 100% of the expected yield) and with average waste rates of about 10% and average soluble sugar contents of about 5°Brix.

The color is taken by direct reading of the a/b index on a colorimeter.

Statistical analysis

The statistical analysis of the data was carried out using the program "SPSS Version 20.0.0". It was possible to verify each time if significant differences, at the 5% level, exist between the different treatments and the different blocks considered.

Results

Total yield ratio by objective

Referring to the productivity measurements, the monitoring of the average behavior of the different varieties, in the climatic conditions of CapBon and with levels of salinity of irrigation water that do not exceed 3 g/l, showed significantly higher relations of yield by expected objective in the variety Savera. The significantly lower ratios of about 77.3% and 77.7% were recorded in Heinz5508 and Heinz1015 respectively (Figure 1A).

Ratio of transformable yield to total yield

The significantly highest ratios of transformable yield to total yield were recorded in the variety Heinz9661 with 92.7%. This compares to a significantly lower average of 79.9% net fruit (red and sunflower tomatoes) per total yield observed in the variety Heinz5508 (Figure 1B).

Rate of green tomatoes

The significantly highest green tomato rate was found in the variety Heinz5508 with 18.1% green tomatoes. While significantly lower rates, around 1.7%, were recorded in the variety Topsport (Figure 2A).

Rotten tomato rates

The significantly highest rates of rotten tomatoes, around 10.7%, were found with the variety Topsport. Significantly lower rates were recorded in the varieties Heinz1534 and Heinz5508 with respective rates of 1.7% and 2% of rotten fruits (Figure 2B).

Total waste rate

The significantly highest waste rates in the range of 16.4% and 15% were found with the varieties Savera and Heinz7709, respectively. The significantly lower rates of around 5.5% and 5.6% total waste were found with Perfectpeel and Heinz2206 varieties, respectively (Figure 2C).

Soluble sugar levels °Brix

The significantly highest levels of soluble sugars, in the range of 5.38 °Brix and 5.34 °Brix, were found in Heinz1015 and Heinz1423 varieties, respectively. While the significantly lowest rates, around 4.36 °Brix, were recorded in the variety Topsport (Figure 3).

Yield in tons of Brix

The assessment of the yield measurements in tons of Brix per ha shows significantly higher yields for the variety Heinz1423 with an average of about 5.21 tons of Brix per ha of tomatoes. The significantly lowest Brix yields are recorded in the variety Heinz5508 with an average of about 3.47 tons of Brix per ha (Figure 4).

Yield ratio in Brix by reference potential

Under ideal production conditions for each of the trial sites studied in CapBon (expected yield relative to each trial, average waste rate 10% and average sugar content 5 °Brix) the reference potential varied between 5.85 tons of °Brix per ha corresponding to the site of Lebna (expected yield 130 tons per ha) and 5.40 tons of °Brix per ha relative to the other trials (expected yield 120 tons per ha) The significantly highest average ratio of 98.6% was determined in the fruits of the variety Heinz1423 (yield/target 95.4% - waste 12.5% - 5.34 °Brix), thus justifying its superiority in terms of tomato juice production potential per ha. While an average rate of 66.1% expressed the significant minority of the variety Heinz5508 (yield/target 77.3% - waste 20.1% - 4.77 °Brix) (Figure 5).

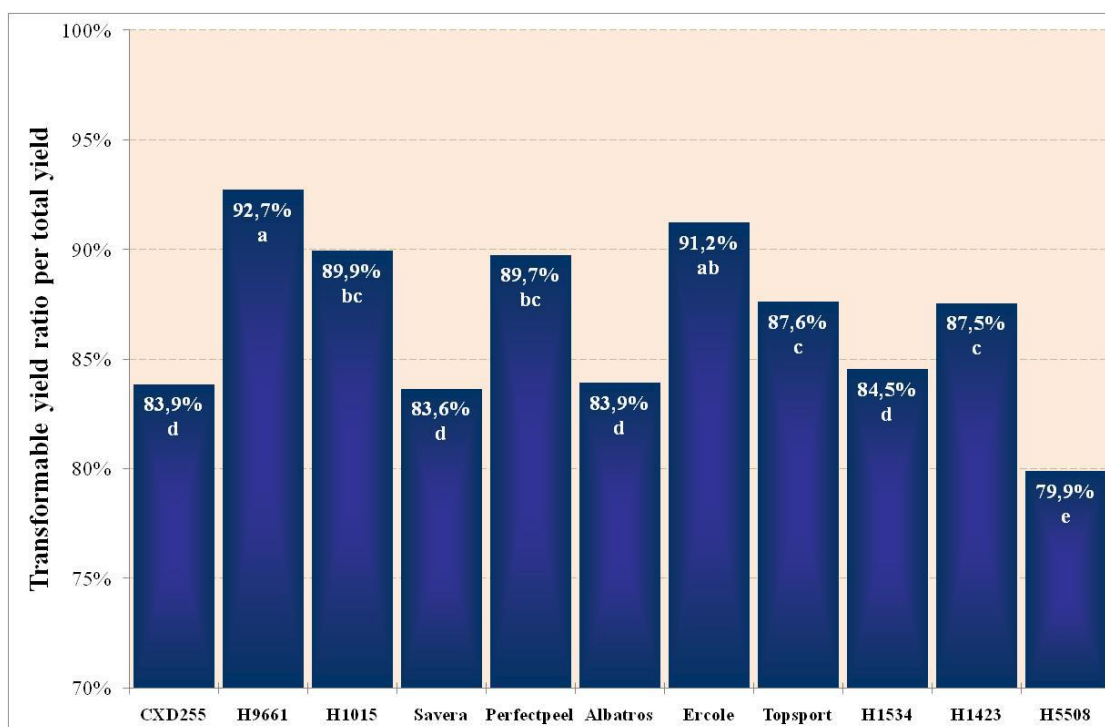
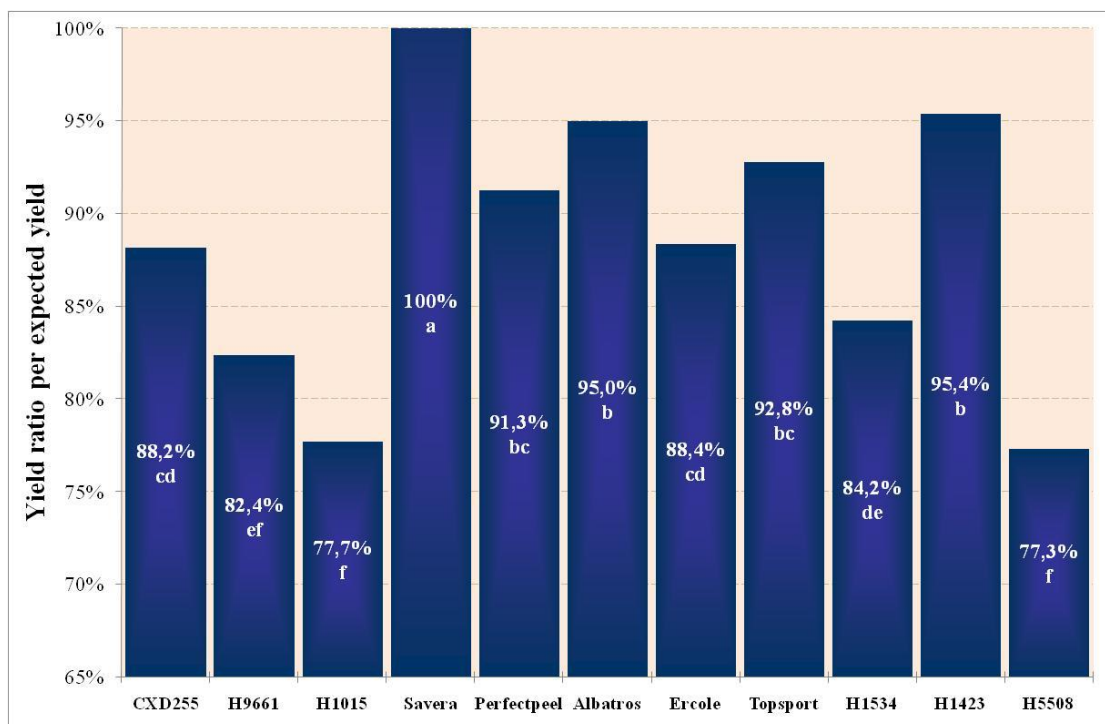
Color index a/b

The measurements of the color index a/b significantly higher were recorded in the varieties Heinz1534 and Topsport with respective averages of about 2.24 and 2.23. The results of the analysis of the variety Savera show average color indices of about 1.90 significantly lower than the other varieties (Figure 6).

Economic gain

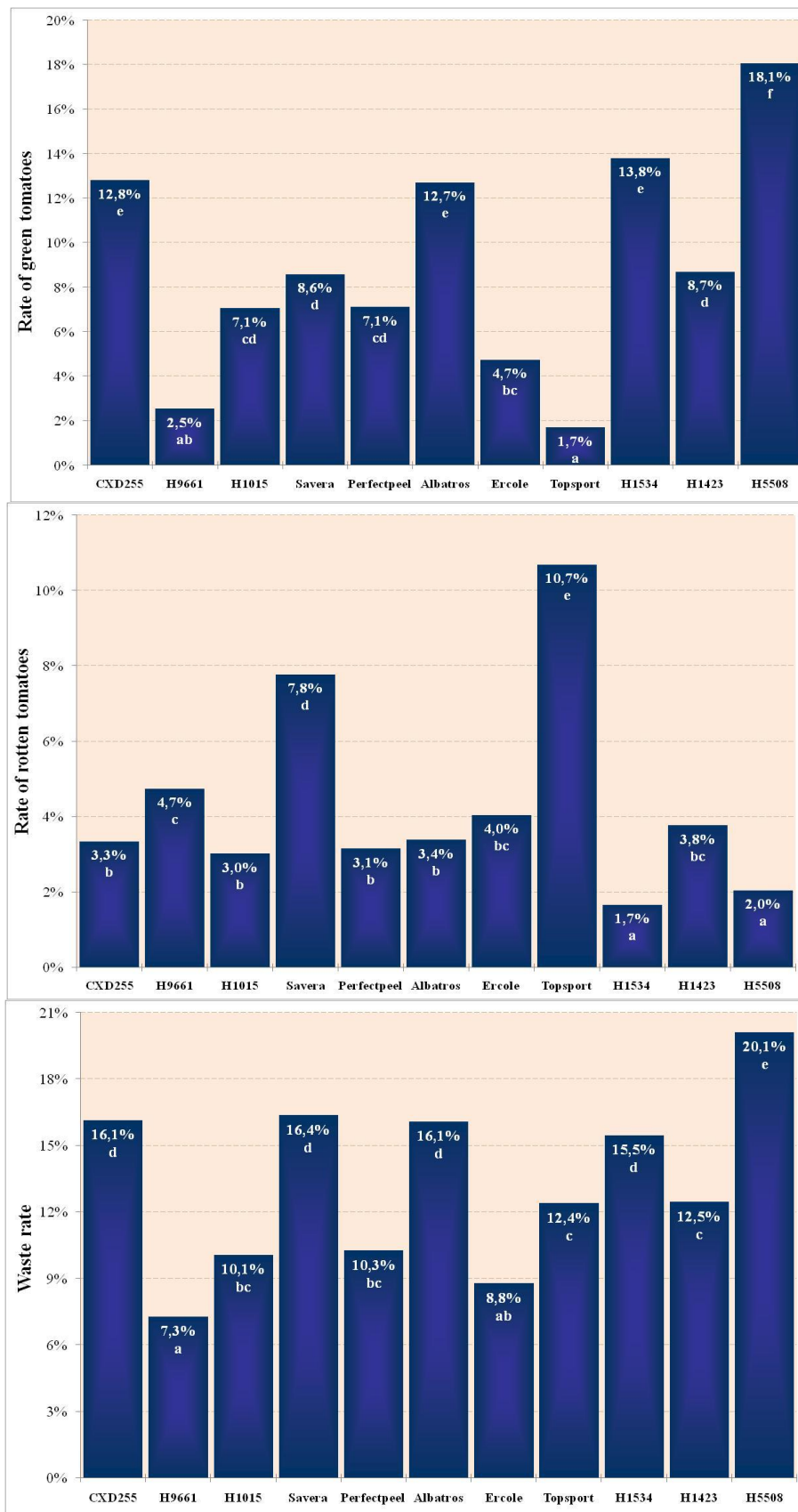
To study the revenue generated per ha of each of the varieties (price of one kg of tomato = 195 millimes), the ratios of the yield produced to the expected yield and the waste rates (totally green fruits and rotten tomatoes) were taken into consideration. All varieties were realigned to a common expected yield of about 120 tons per ha.

Regarding the overall revenue, a variable spectrum of economic revenue per ha was noted, with a maximum difference of about 6.3 thousand dinars between varieties. The revenues generated oscillate between maximums of the order of 24.4 thousand dinars in the variety Savera and minimums of the order of 18.1 thousand dinars in the variety Heinz5508. After deducting the weight of green fruit and rotten tomatoes we tried to estimate the revenue generated by one ha for each variety of tomato studied. Thus, we distinguished a variable spectrum of economic revenue per ha, with a maximum difference of about 5.9 thousand dinars between varieties. The revenues generated oscillate between maximums of the order of 20.4 thousand dinars for the variety Savera and minimums of the order of 14.5 thousand dinars for the variety Heinz5508 (Figure 7).



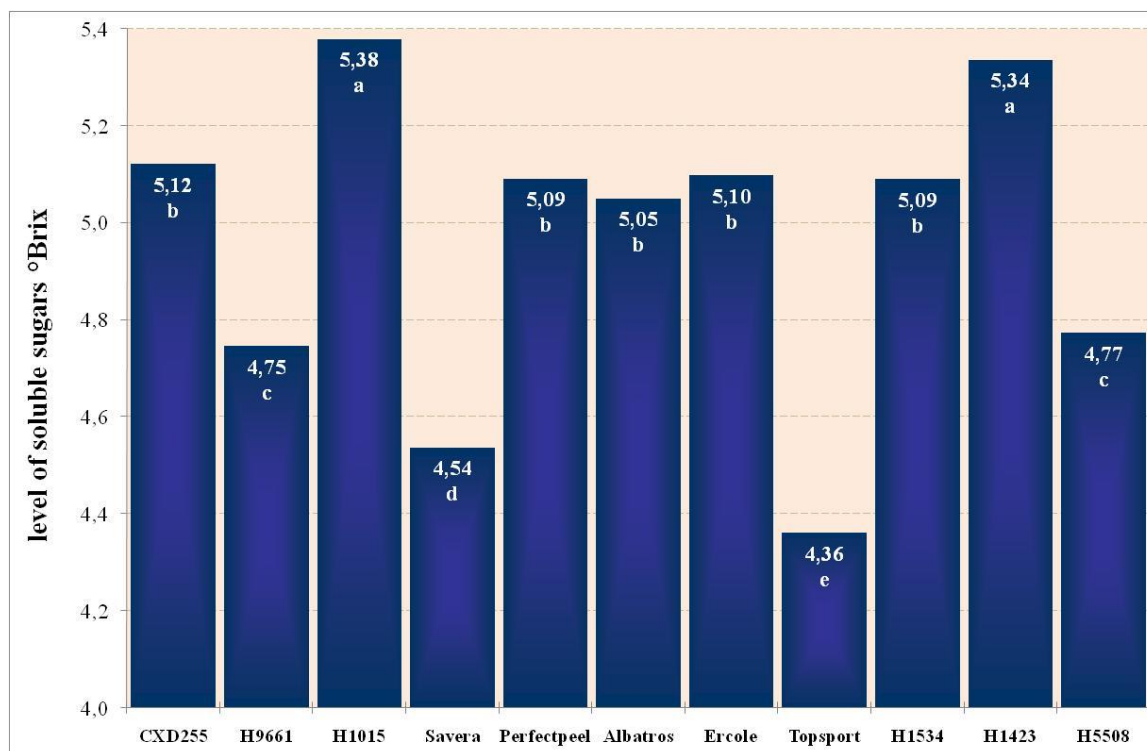
Note: Values assigned the same index are not significantly different at the 5% risk of error.

Figure 1: Variation of the ratios of total yield per expected target (A) and of the ratios of transformable yield per total yield produced (B) according to varieties



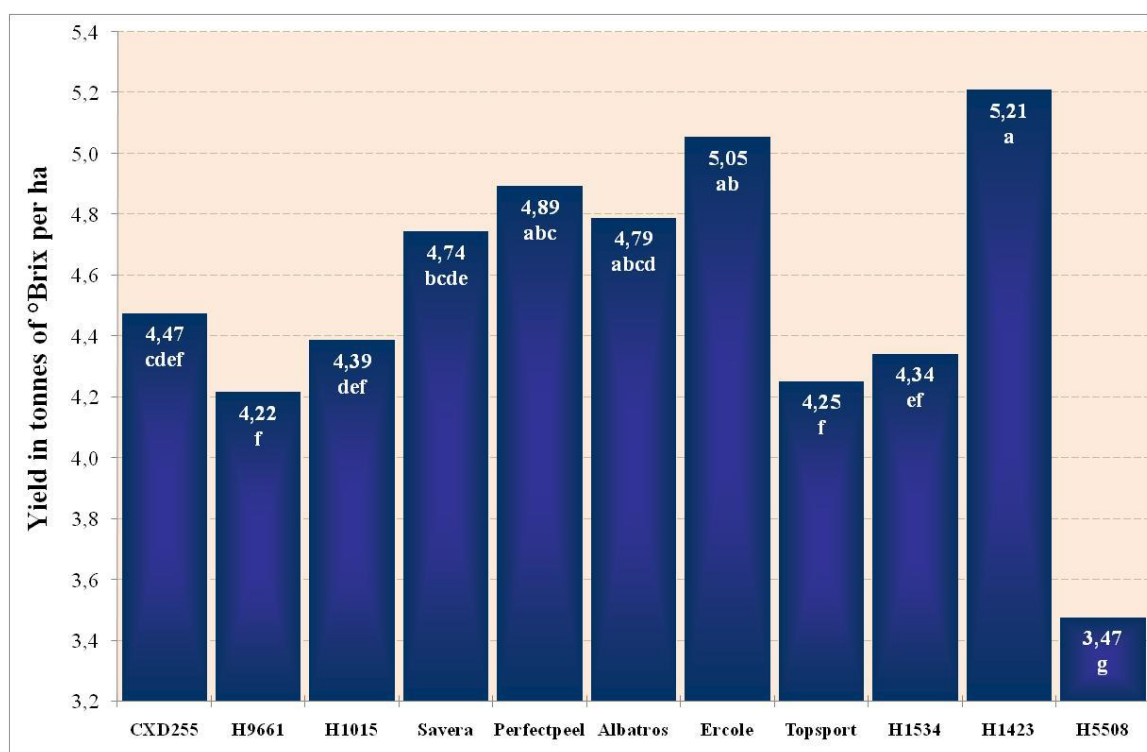
NB: Values assigned the same index are not significantly different at the 5% risk of error

Figure 2. Variation of green tomato rates (A), rotten tomato rates (B) and waste rates (C) according to varieties



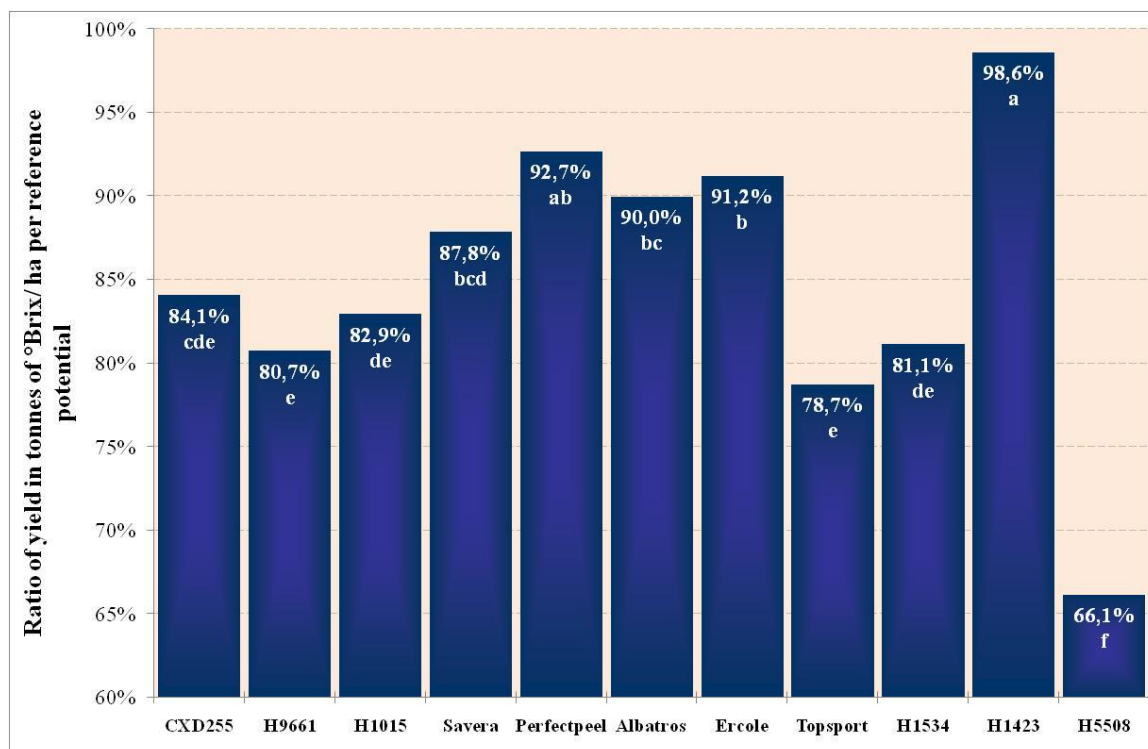
NB: Values assigned the same index are not significantly different at the 5% risk of error.

Figure 3. Variation in soluble sugar content according to variety



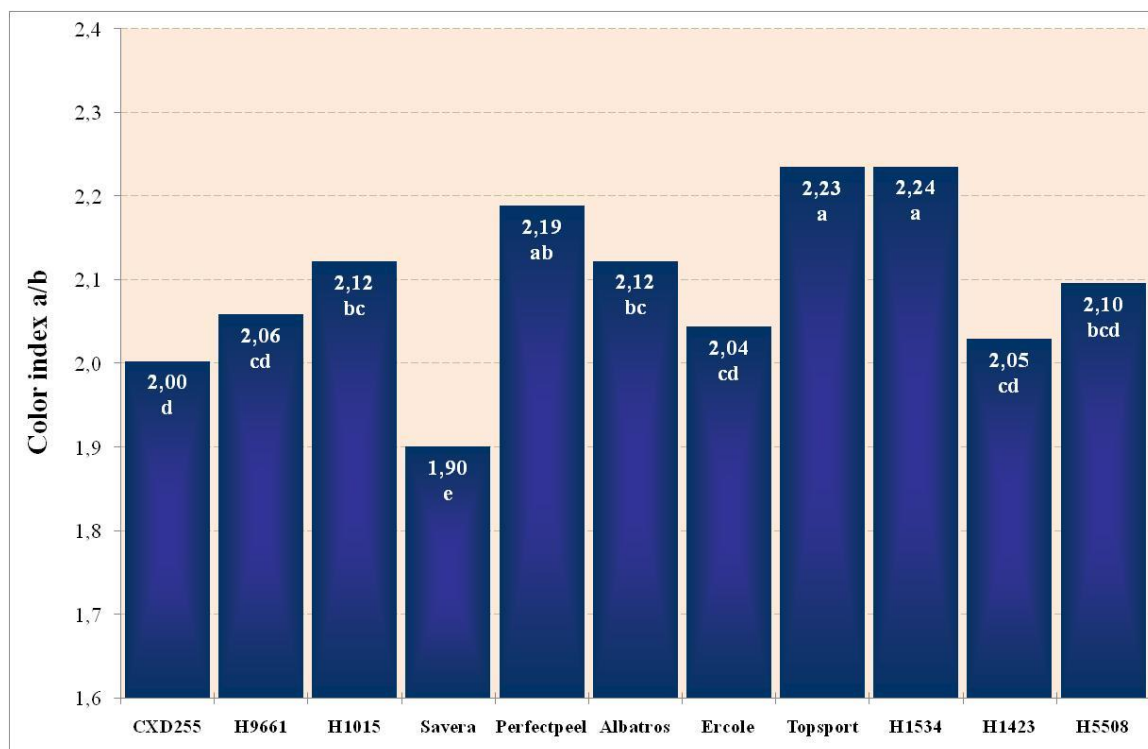
NB: Values assigned the same index are not significantly different at the 5% risk of error.

Figure 4. Variation of the yield in tons of Brix according to the varieties at the end of the harvest



NB: Values assigned the same index are not significantly different at the 5% risk of error.

Figure 5. Variation of the yield ratio in tons of Brix per reference potential according to the varieties at the end of the harvest



NB: Values assigned the same index are not significantly different at the 5% risk of error.

Figure 6. Variation of the color index a/b according to the varieties

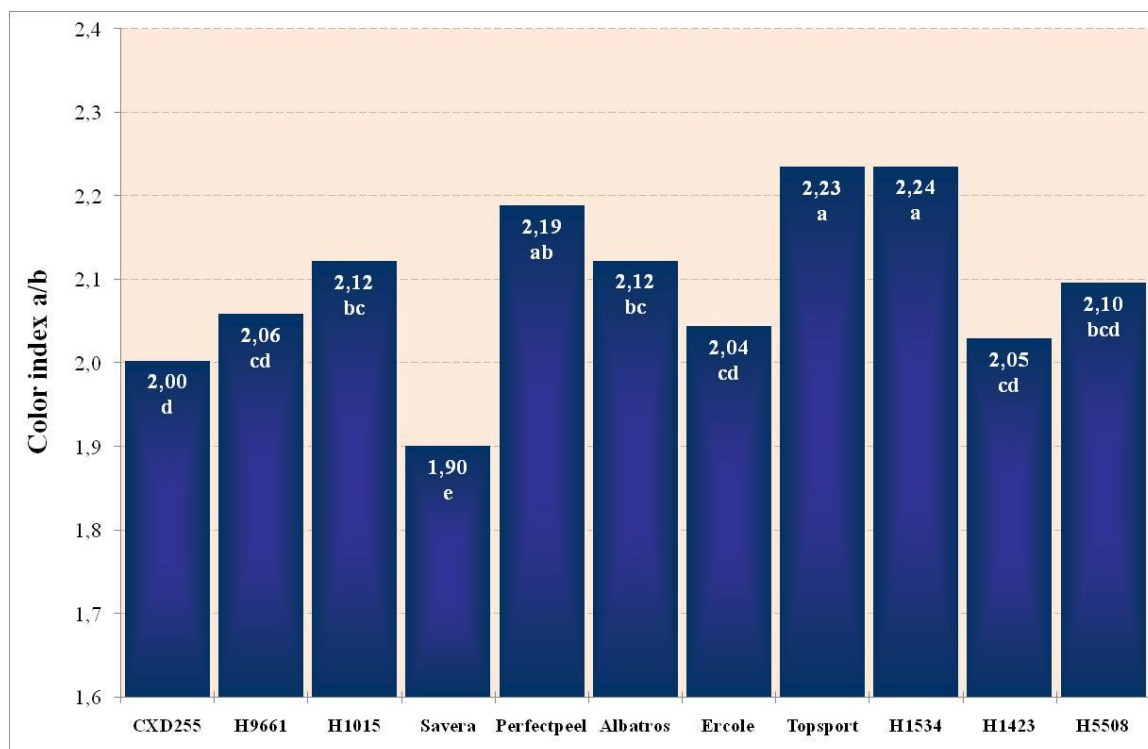


Figure 7. Variation in revenue per ha by variety

CONCLUSION

The varietal trials conducted in 2020 have consolidated the results of the study of tomato varieties for processing started in 2016, which allows characterizing varieties according to different criteria. It allows us to study the varieties of seasonal tomatoes available on the market, with the objective of finding the varieties that ensure the best compromise for tomato growers as well as for processors: productivity, fruit quality, suitability for processing and economic gain.

We invite you to consult our detailed reports which are at your disposal.