Study of the attitude of industrial tomato varieties in the conditions of the Cap Bon region: Campaigns 2016 – 2021

A.ARBI

Canned Food Industries Group

Introduction

The cultivation of industrial tomato in Tunisia occupies each year 15 to 18 thousand ha. During the campaign 2021, we processed 935 thousand tons of fresh tomatoes against 955 thousand tons in 2020. These quantities have produced 144 thousand tons of DCT in 2021 against 147 thousand tons of DCT in 2020, or 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 (queue).

The regular monitoring of the data of the campaigns of transformation of tomato of industry, detected a progressive deterioration of the industrial output from one campaign to another. The latter has gone from 5.75 kg of fresh tomatoes fT to produce 1 kg of double concentrate DCT in 2009 to 6.5 kg fT / kg DCT for the period between 2016 and 2021. This represents an equivalent loss of earnings per campaign of at least 75 thousand tons of fresh tomatoes, or 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 tomatoes). This degradation of the industrial output is the result of the deterioration of the quality of the received batches of fresh tomatoes characterized by low contents of soluble sugars °Brix and / or high rates of waste (foreign bodies, green fruits and rotten tomatoes). These wastes have a negative impact on the production costs involving additional economic charges (maintenance costs, repair costs of materials, transport costs...). To remedy, it is essential to adopt a whole program of leveling of the agronomic link, which targeted until now only the research of the varieties ensuring a high productivity per ha with the minimum of the expenses while ignoring any qualitative varietal potential.

We have established an annual program of varietal trials of the seasonal tomato crop to quantitatively and qualitatively characterize the productive potential of available tomato varieties and to evaluate their processing abilities.

Goals

- To study the real productive potential and to characterize quantitatively and qualitatively the various varieties of seasonal tomatoes available on the Tunisian market;

- To study the suitability of tomato varieties for processing;

- To develop a database of the different criteria of productivity and quality of tomato varieties (to be updated every season).

Experimental design

In each site, the varieties are randomly distributed according to a randomized block design with three replications. These sites are managed, at the cultural level, in the same way as the production

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

Analyses of productivity and fruit quality

For each trial 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 substance rate is evaluated by the °Brix degree, measured with a digital portable refractometer.

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

In order to optimize the reliability of the results related to the parameters of yield in tons of °Brix per ha and revenue generated per ha, all the varieties studied were aligned to a common expected yield of 100 tons per ha.

The yield in °Brix per ha is the amount of juice that can be obtained by processing the production of one ha of healthy fruit after deducting the mass of waste.

The estimated revenue generated by one ha for each variety of tomato is based on the current price of the 2021 campaign (195 millimes per kg).

Statistical analysis

The statistical analysis of the data was carried out using the program "SPSS Version 20.0.0". Thus, we were able to verify each time the existence of significant differences, at the level of 5%, between the different treatments and the different blocks considered.

Experimental sites

A total of 38 varieties were divided into 10 test stations located in different regions of Cap Bon under normal salinity conditions (Table 1). To ensure the reliability of the results, we categorized the varieties in three different groups, the first one includes the varieties that were repeated in 4 or more trials, the second one includes the varieties that were studied in 2 to 3 trials and a third group that includes the remaining varieties that were recorded in only one trial.
The regions of the trial sites 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 Menzel Horr

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	Manzel Horr
Soil texture	Clay and sandy loam	Clay-silt sand	Silty clay	Clay and sandy loam
Water salinity	2,5 g/ liter	2,5 g/ liter	1,9 g/ liter	1,4 g/ liter
Planting density/ha	33.000 plants	33.000 plants	33.000 plants	33.000 plants

Ratio of total yield by objective

Referring to the productivity measurements, the monitoring of the average behavior of the different varieties, under the climatic conditions of CapBon and with irrigation water salinity levels that do not exceed 3 g/l, showed significantly higher ratios of yield per target in the order of 99.7% in the variety Savera. The significantly lowest ratios of about 75.2% were recorded in the variety Heinz1015 (Figure 1A).

Ratio of Processable Yield to Overall Yield

The significantly highest ratios of processable yields to overall yields, in the range of 91.1% and 90.2%, are recorded in the varieties Heinz9661 and Perfectpeel. This compares to a significantly lower average of about 80.2% net fruit (red and turning tomatoes) per total yield observed in the variety Heinz5508 (Figure 1B).

Rate of green tomatoes

The significantly highest rate of green tomatoes was found in the variety Heinz5508 with 17.5% green tomatoes. While significantly lower rates, in the range of 1.7% and 3.1% green fruit, were recorded in the varieties Topsport and Heinz9661 (Figure 2A).

Rate of rotten tomatoes

The significantly highest rates of rotten tomatoes, in the order of 10.7%, were found in the variety Topsport. Significantly lower rates were recorded in the variety Heinz1534 with averages of about 1.7% rotten fruit (Figure 2B).

Total waste rate

The significantly highest waste rates, in the range of 19.8%, were found in the variety Heinz5508. The significantly lower rates, on the order of 8.9% and 9.8% total waste, were recorded in Heinz9661 and Perfectpeel varieties, respectively (Figure 2C).

Soluble sugar levels °Brix

The significantly highest levels of soluble sugars, in the range of 5.22 °Brix, were found in fruits of the variety Heinz1015. While the significantly lowest levels, 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 4.20 tons of Brix per ha of tomatoes. The lowest Brix yields were recorded for the variety Heinz5508 with an average of 3.02 tons of Brix per ha (Figure 4).

Color index a/b

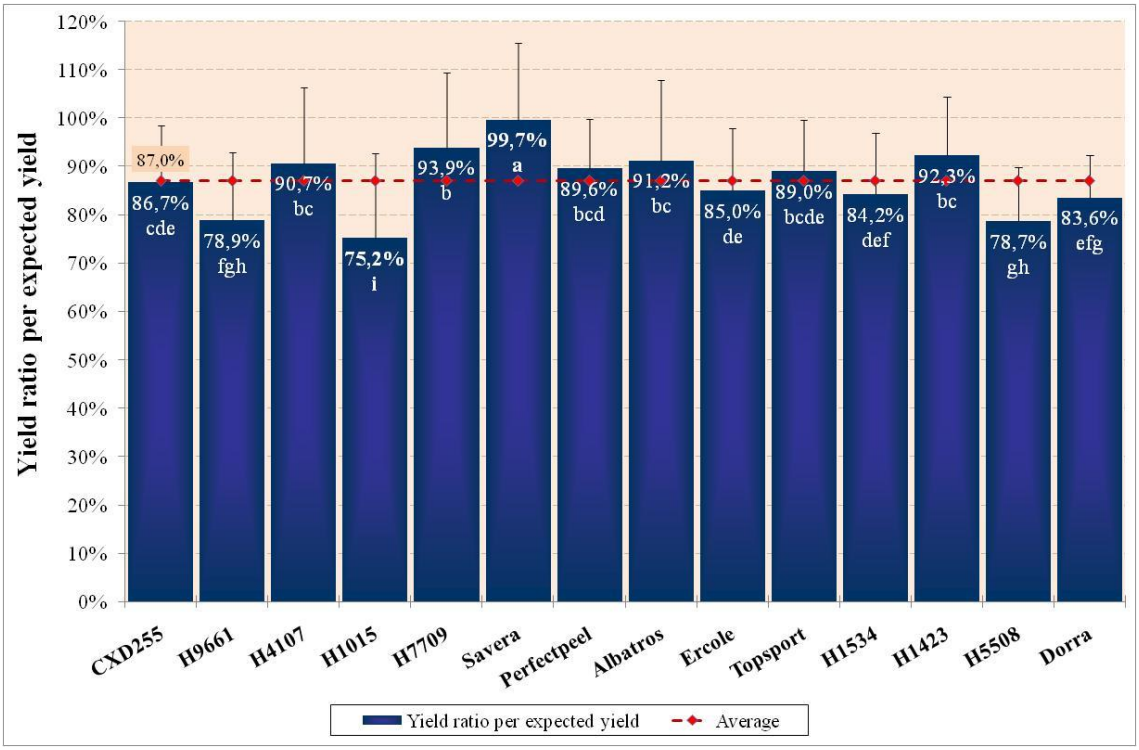
The significantly highest a/b color index measurements were recorded in the varieties Heinz1534 and Topsport with averages of about 2.23. The results of the analysis of the variety Heinz7709 showed average color indices of about 1.98 significantly lower than the other varieties (Figure 5).

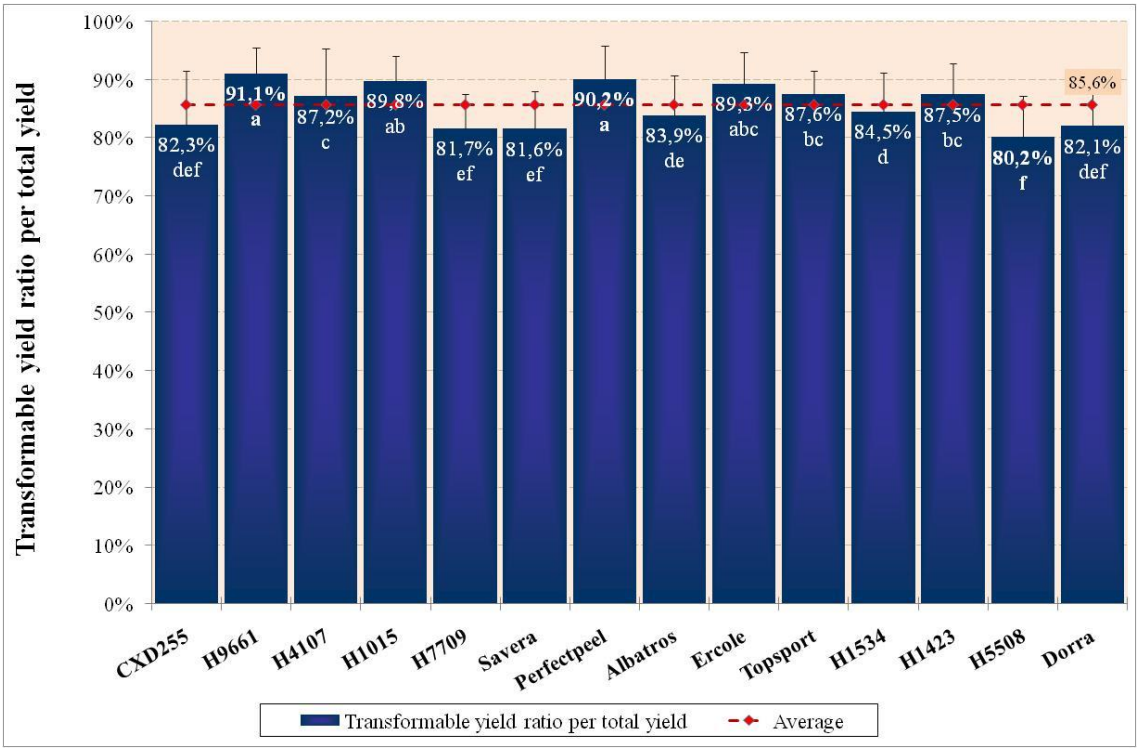
Economic gain

To study the revenue generated per ha of each of the varieties, we took into consideration the ratios of the yield produced to the expected yield and the waste rates (totally green fruit and rotten tomatoes).

Regarding the overall revenue, we noted a variable spectrum of economic revenue per ha, with a maximum difference of about 4.7 thousand dinars between varieties. The revenues generated vary between maximums of about 19.4 thousand dinars in the variety Savera and minimums of about 14.7 thousand dinars in the variety Heinz1015.

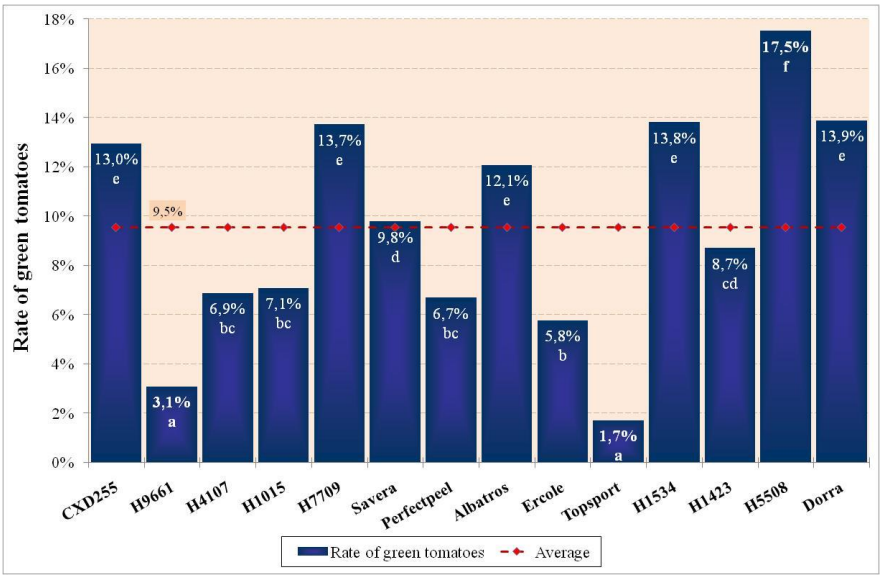
After deducting the weight of green fruit and rotten tomatoes we tried to estimate the revenue generated by one ha for each of the varieties of tomato studied. Thus, we distinguished a variable spectrum of economic revenue per ha, with a maximum difference of about 3.6 thousand dinars between varieties. The revenues generated vary from a maximum of 15.9 thousand dinars for the variety Savera to a minimum of 12.3 thousand dinars for the variety Heinz5508 (Figure 6).

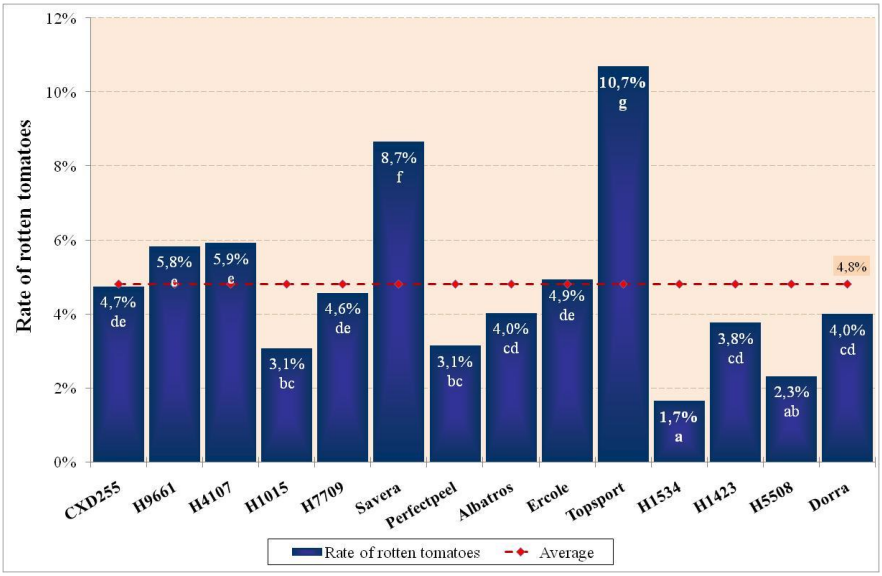




Note: Values assigned the same index are not significantly different at the 5% risk of error.

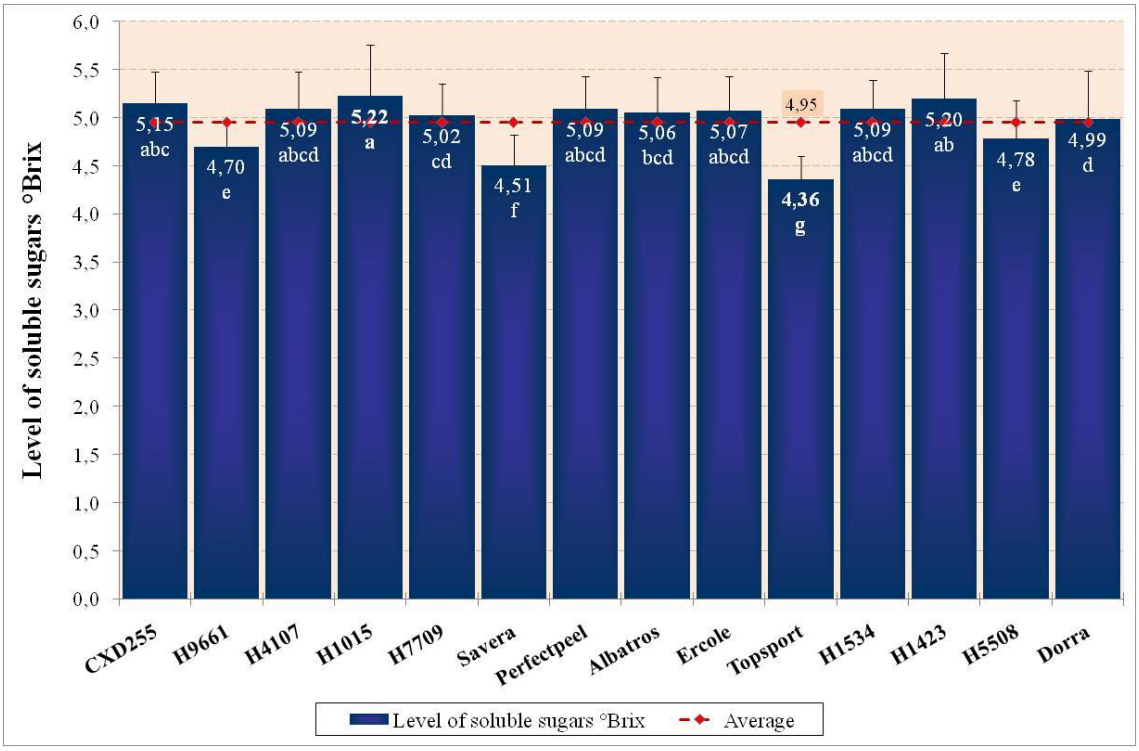
Figure 1: Variation of the ratios of total yield per expected target (A) and of the ratios of transformable yield per total yield produced (B) according to varieties.





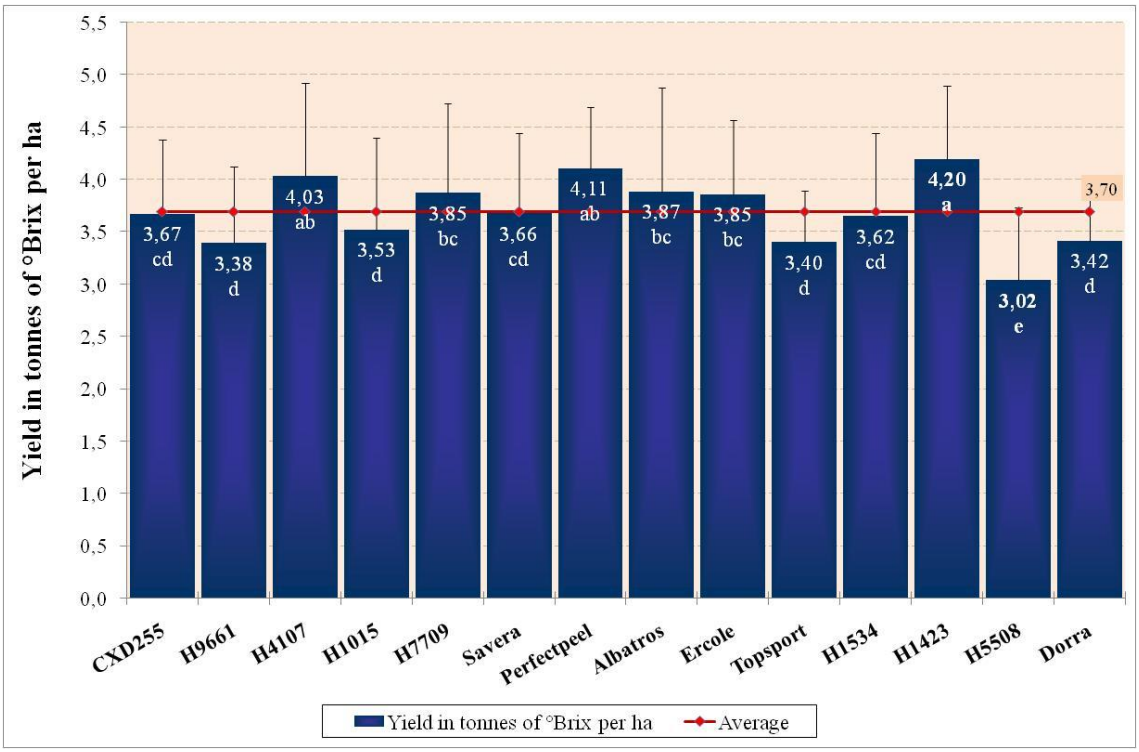
NB: Values assigned the same index are not significantly different at the 5% risk of error.

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 final harvest

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

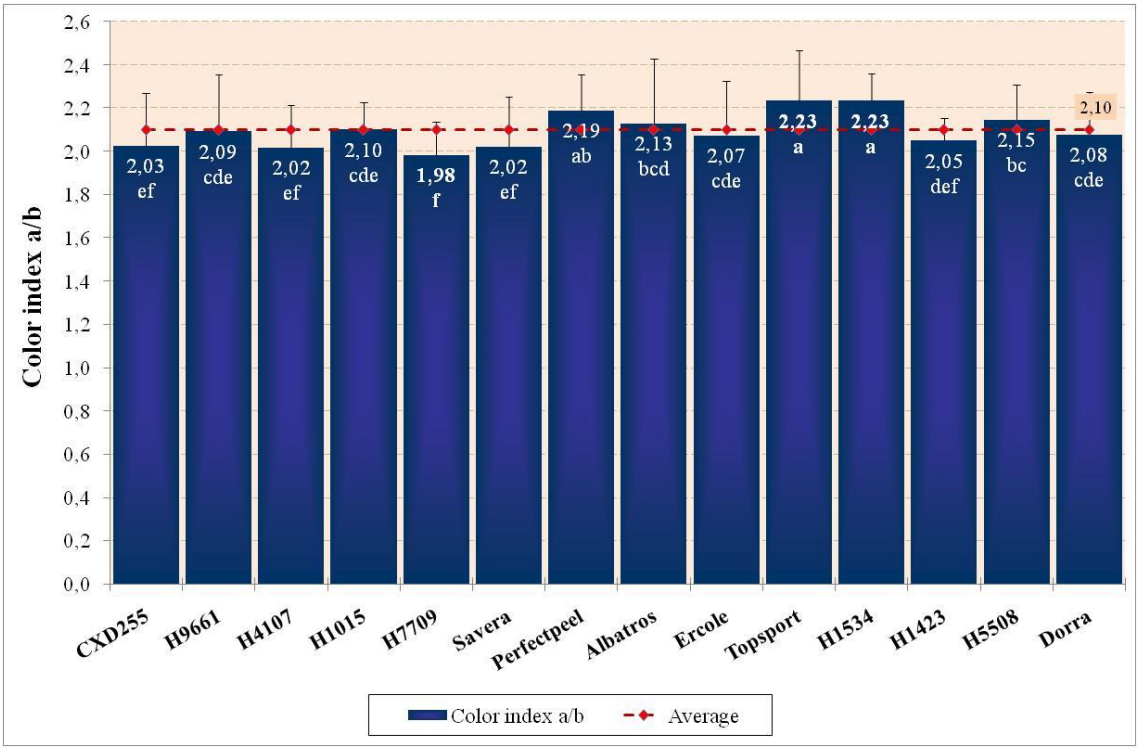


Figure 5. Variation of the color index a/b according to the varieties

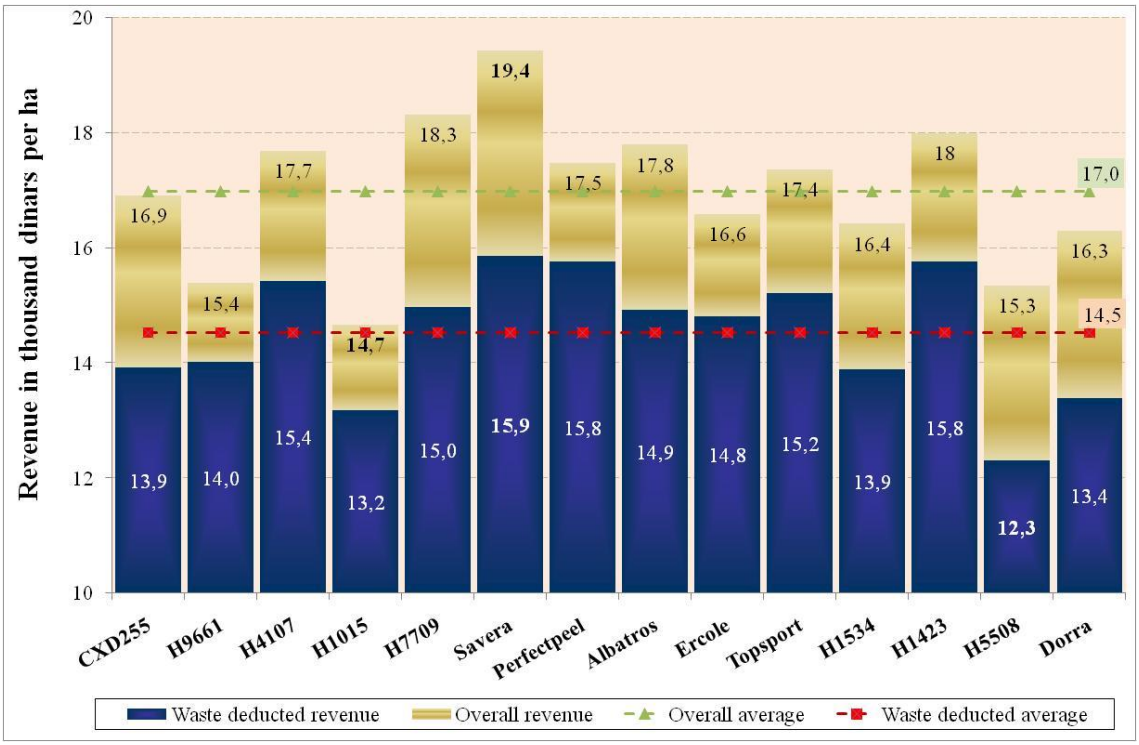


Figure 6. Variation in revenue per ha by variety

Conclusion

In six campaigns, 10 trials were set up in the main tomato production regions of Cap Bon, where we studied the behavior of 38 varieties under conditions of irrigation water salinity lower than 3 g per liter. Results showed that the most suitable varieties for processing were Heinz1423, Albatros,

Heinz1534, CXD255, Heinz4107, Perfectpeel and Ercole. The database, the result of this work, will be updated each season to be available to manufacturers, nurseries, collectors and producers. It represents a useful tool for the varietal choice to select the most productive varieties and the most adapted to the transformation (grouped maturation, °Brix...) especially that the sector tends towards the adoption of a structure of payment to the quality of the tomato fruits.

We invite you to consult the detailed reports available at the GICA headquarters.

For more information, please contact Mr. Ahmed Arbi (ahmed.arbi@gica.tn).

Classification of varieties by potential of each parameter - Cap Bon Region

Potential	Productivity(1)	Transformable Yield(2)	Brix(3)	Yield in Brix in tons/ha(4)	Adaptability(5)
Excellent potential	**Savera**	-	-	-	-
Very good potential	H7709 - Saada H1293 – H1423 – Albatros - H4107	H2206 - H9997 - H1301 – Vespro - H9661 - Wally red - H1879 - H9036 - H1292 - Perfectpeel - Barnum	H1423 – H1879 - H2206 - H1015 – H1293 - CXD255 – Kero – H1301 - Dorra - H1534 – H1884 – H1886 - Wally red – H3402 – H4107 – H7709 – Perfectpeel – Albatros – Ercole – Barnum – H1292 – Axel	-	Savera - H1884 - Dorra
Good potential	Perfectpeel – Topsport - Wally red - Vespro - H9997 - H2206 - CXD255 – Barnum - H3402 – Ercole – Kero – H1301 – H9036	H1293 - Vulcan - Ercole - Saada - H1015 - Axel - H3402 - H1423 - Kero - Firenze - Topsport - H4107 - Badria	H9036 – Jawad – Noura - H9997 - Badria – Farah - Vulcan – Vespro - Firenze - H9661 – H5508 - Alysse	H1293 - H2206 - H1423 - Perfectpeel - Wally red - H4107 - H1301	CXD255 - Albatros - H5508 - H1886 - Firenze - Vespro - H1423 – H1534 - Vulcan - Saada - Barnum - Ercole - Badria - Noura - Topsport - Wally red - H1301 - Alysse - Pietrarossa
Average potential	H1534 - H1879 - Dorra - Badria - H1886 - Firenze - Vulcan - Alysse - Noura	H1534 - Albatros - Dorra - CXD255 - Noura - Savera - H7709 - Pietrarossa - H5508 - Alysse	Pietrarossa - Savera - Saada	H9997 - H1879 - H7709 - H1884 - H3402 - Albatros - Ercole - Vespro - Kero - Barnum - H9036 - CXD255 - Savera - Saada - H1534 - H1015 - H1292	H7709 - H9997 - H9036 - H4107 - H2206 - H1879 - Perfectpeel - H1015 - H3402 - Farah - Jawad - Axel - H1292 - H1293
Small potential	**Farah - Pietrarossa - H9661 - H5508 - H1292 - Jawad - H1015 - Axel - H1884**	**H1884 - H1886 - Jawad - Farah**	**Topsport**	**Vulcan - Firenze - Dorra - Badria - Topsport - H9661 - H1886 - Noura - H5508 - Axel - Jawad - Farah - H1884 - Pietrarossa - Alysse**	**Kero - H9661**

Parameter x	Designation	Parameter x	Designation
(1). Productivity (2). Transformable yield	x ≥ 95%	(4). Yield in Brix in tons/ha with an expected agricultural yield of 100 tons/ha	x ≥ 5
	90% ≤ x < 95%		4,5 ≤ x < 5
	85% ≤ x < 90%		4 ≤ x < 4,5
	80% ≤ x < 85%		3,5 ≤ x < 4
	x < 80%		x < 3,5
(3). Soluble sugar content °Brix	x ≥ 5,30	(5). Adaptation potential = Σ of scores for fruit cover, vigor, and disease tolerance parameters.	x ≥ 25
	5,00 ≤ x < 5,30		20 ≤ x < 25
	4,85 ≤ x < 5,00		15 ≤ x < 20
	4,70 ≤ x < 4,85		10 ≤ x < 15
	x < 4,70		x < 10