Study of the behavior of industrial tomato varieties in the conditions of the region of Beja: Campaigns 2016 – 2021

A. ARBI

Tunisian Group For Canned Food Industries

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 allowed to produce 144 thousand tons of DCT in 2021 against 147 thousand tons of DCT in 2020; that is to say an industrial yield of about 6.5. The extension in terms of sowing for this crop, showed its limit during the last decade when we experienced many problems related to the availability of irrigation water or the saturation of processing units from the first week of July (queue).

The regular monitoring of the data of the campaigns of transformation of industrial tomato, 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 the materials, transport costs...).

To remedy, it is essential to adopt a program of upgrading of the agronomic link, which has targeted so far only the search for varieties ensuring a high productivity per ha with the minimum of expenses while ignoring any qualitative varietal potential.

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

- ✓ Objectives

- 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 test plot, preliminary analyses were performed during an intermediate stage (10 to 15 days before harvest) followed by a second phase of analysis 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 threshold of 5%, between the different treatments and the different blocks considered.

Experimental sites

A total of 25 varieties were distributed in 6 trial stations located in the different regions of Beja, under normal salinity conditions (Table 1). To guarantee the reliability of the results, we have categorized the varieties in two different groups, the first one gathers the varieties repeated in 2 or more trials and a second one that gathers the remaining varieties that have recorded their presence only in one trial. The regions of the test sites are Medjez ElBab, El Herry and Goubellat which belong

to the upper semi-arid bioclimatic stage with mild winters with an average annual rainfall of about 420 mm and an average annual evapotranspiration of about 1432 mm.

Table 1. Trial sites

Region	Medjez ElBab	El Herry	Goubellat
Soil texture	Silty-clay	Silty-clay	Silty-clay
Water salinity	1,9 – 2,5 g/ liter	2,2 - 2,4 g/ liter	2,4 g/ liter
Planting density/ha	22.000 plants	22.000 plants	33.000 plants

Report of the total yield by objective

Referring to the productivity measurements, the monitoring of the average behavior of the different varieties, under the climatic conditions of Beja and with irrigation water salinity levels that do not exceed 3 g/l, showed yield ratios per expected target, between 94.8% and 96.4% significantly higher in the varieties Heinz1423, Heinz5508 and Heinz1015. The significantly lower ratios, between 83.7% and 84.7% were recorded in the varieties Heinz9661, Heinz1534 and Ercole (Figure 1A).

Ratio of transformable yield to total yield

The significantly highest ratios of processable yields to total yields, between 93.8% and 95.2%, are recorded in the varieties Heinz1423, Heinz1015, Heinz3402, Ercole, Heinz4107 and Perfectpeel. Against significantly lower averages, in the range of 81.9% and 84.5% net fruit (red and turning tomatoes) per total yield, observed in varieties CXD255 and Farah (Figure 1B).

Green tomato rate

The significantly highest green tomato rate was found in variety CXD255 with 15.1% green tomatoes. While significantly lower rates, in the range of 2.7% and 2.8% green fruit, were recorded in varieties Heinz1423 and Heinz9661 (Figure 2A).

Rotten tomato rate

Significantly higher rates of rotten tomatoes, in the order of 8.6% were found in the variety Farah. Significantly lower rates were recorded in the variety Heinz5508 with an average of 0.8% of rotten fruits (Figure 2B).

Total waste rate

The significantly highest waste rates, around 18.1%, were found in the variety CXD255. The significantly lower rates, between 4.8% and 6.2% total waste, were found in varieties Heinz1423, Heinz1015, Heinz3402, Ercole, Heinz4107, and Perfectpeel (Figure 2C).

Soluble sugar levels °Brix

The significantly highest levels of soluble sugars, in the range of 5.39 °Brix and 5.40 °Brix, were found in fruits of Heinz1423 and Heinz1015 varieties. While the significantly lowest levels, in the range of 4.58 °Brix and 4.72 °Brix, were recorded in the varieties Ercole and Heinz9661 (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 varieties Heinz1423 and Heinz1015 with averages of about 4.84 tons of Brix per ha and 4.96 tons of Brix per ha of tomatoes. The significantly lowest Brix yields are recorded in Heinz9661 and Ercole varieties with averages of 3.65 tons Brix per ha (Figure 4).

Color index a/b

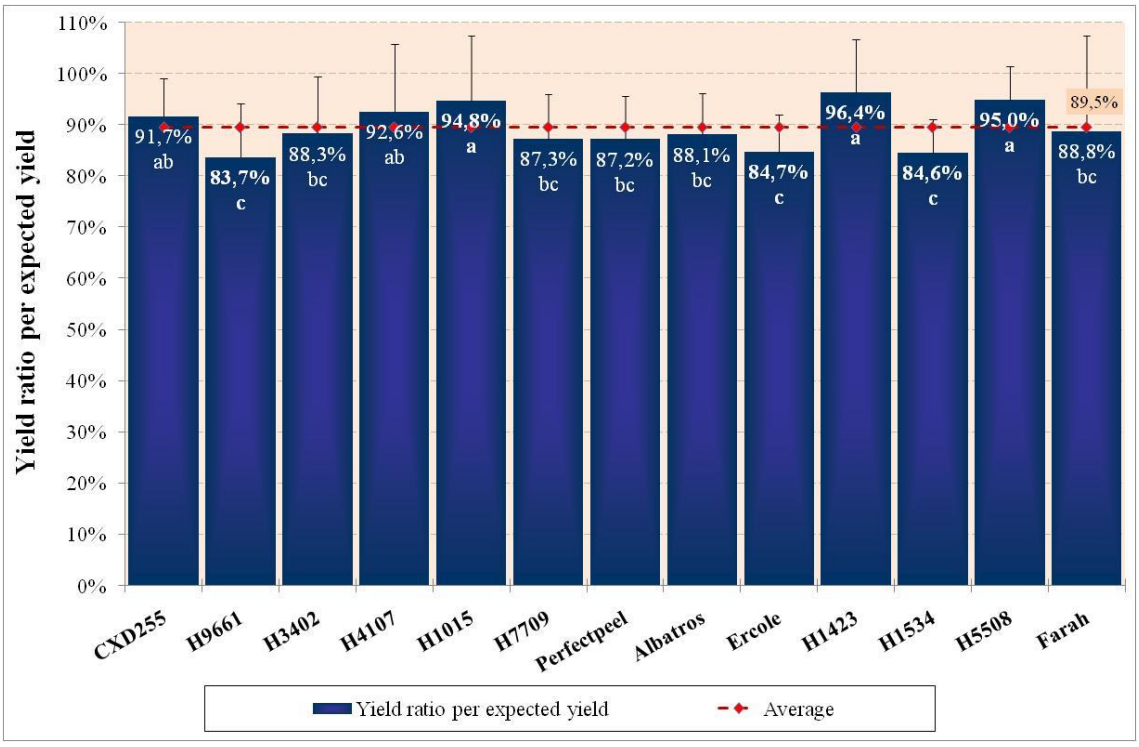
The significantly highest a/b color index measurements were recorded in the variety Heinz5508 with an average of about 2.28. The results of the analysis of the variety Heinz1534 showed average color indices in the order of 2.01 significantly lower than the other varieties (Figure 5).

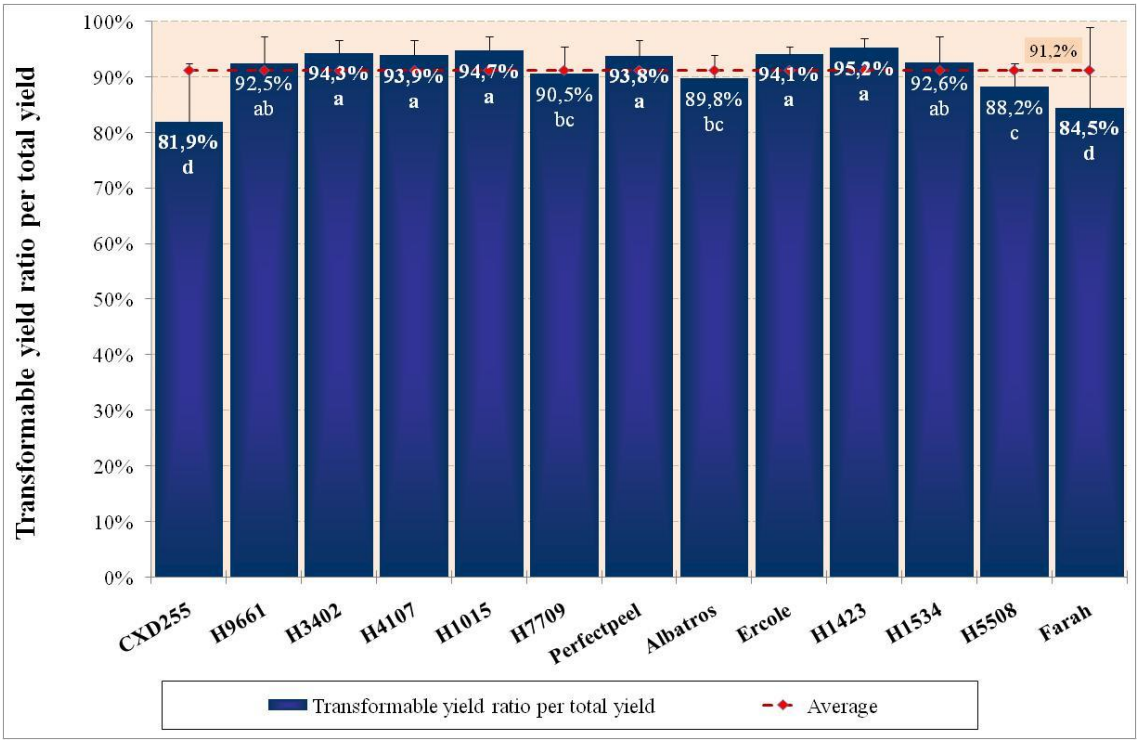
Economic profit

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 2.5 thousand dinars between varieties. The revenues generated oscillate between maximums of the order of 18.8 thousand dinars in the variety Heinz1423 and minimums of the order of 16.3 thousand dinars in the variety Heinz9661.

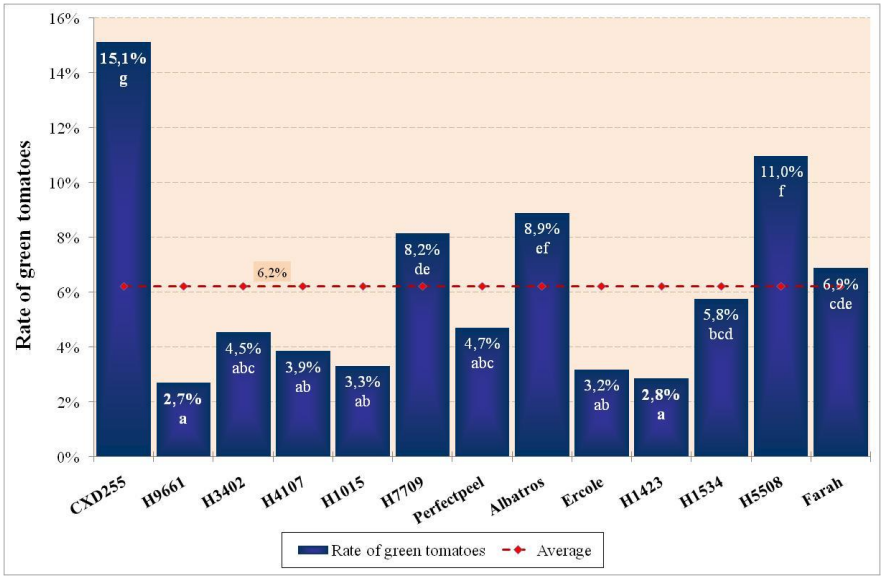
After deducting the weight of green fruit and rotten tomatoes we tried to estimate the revenue generated by one ha for each of the varieties of tomato studied. Thus, we distinguished a variable spectrum of economic revenue per ha, with a maximum difference of about 3.3 thousand dinars between varieties. The revenues generated vary from a maximum of 17.9 thousand dinars for the Heinz1423 variety to a minimum of 14.6 thousand dinars for the Farah variety (Figure 6).

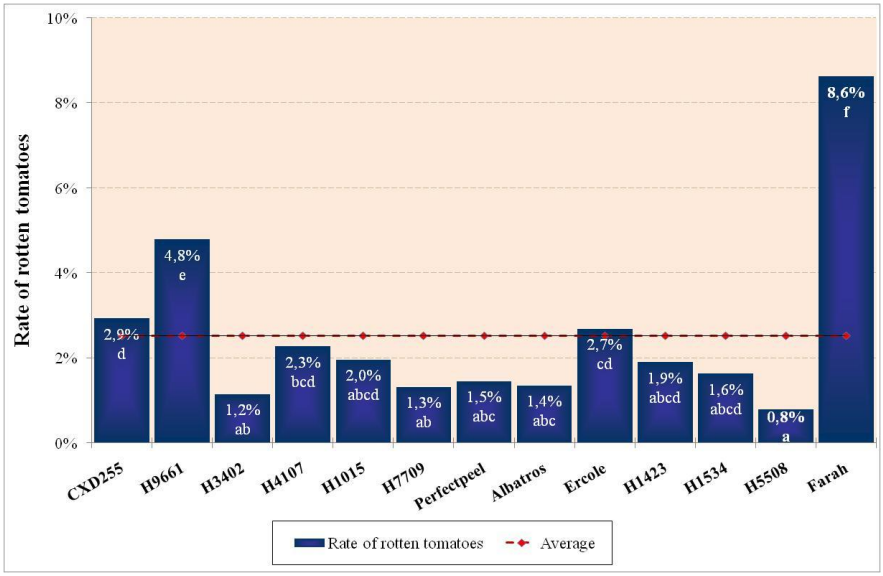


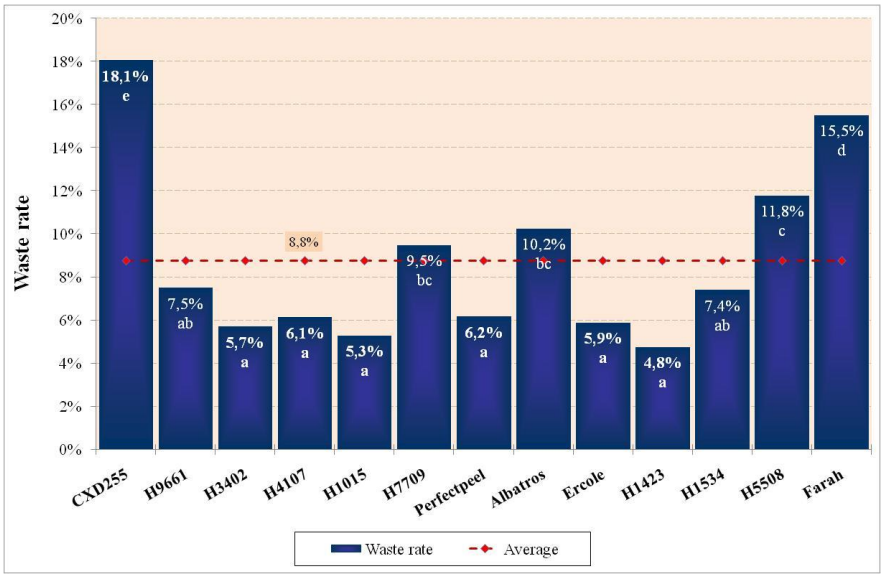


Note: Values assigned the same index are not significantly different at the 5% risk of error.

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

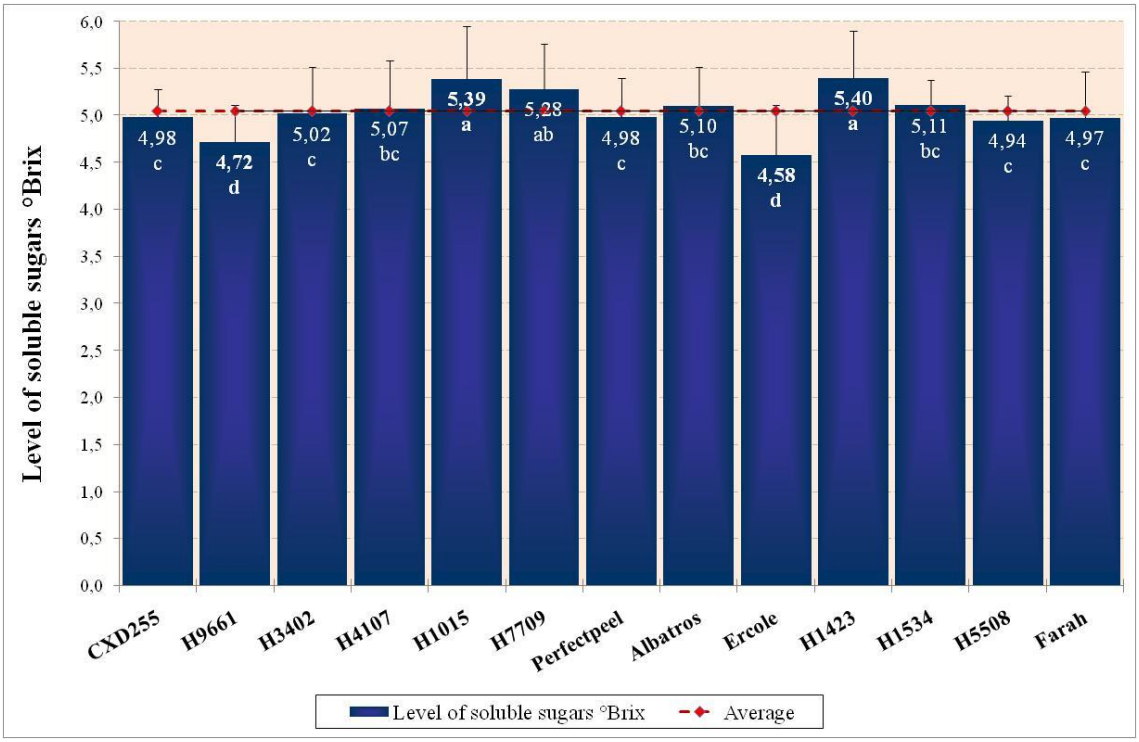






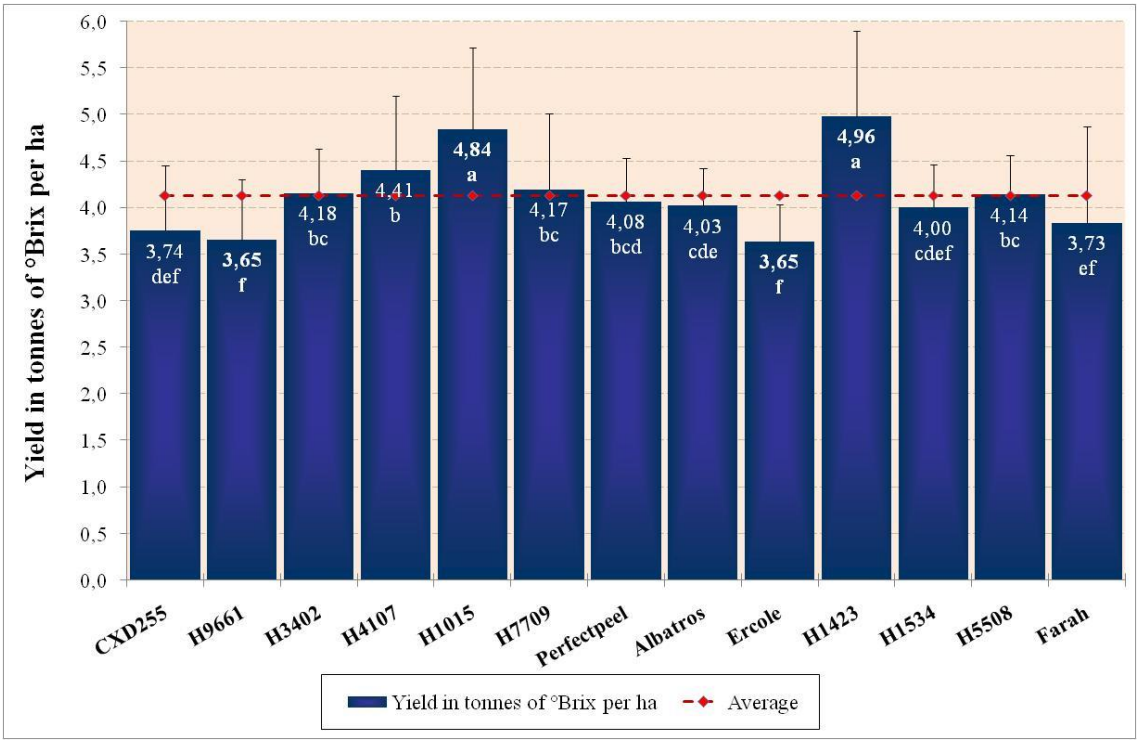
NB: Values assigned the same index are not significantly different at the 5% risk of error.

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



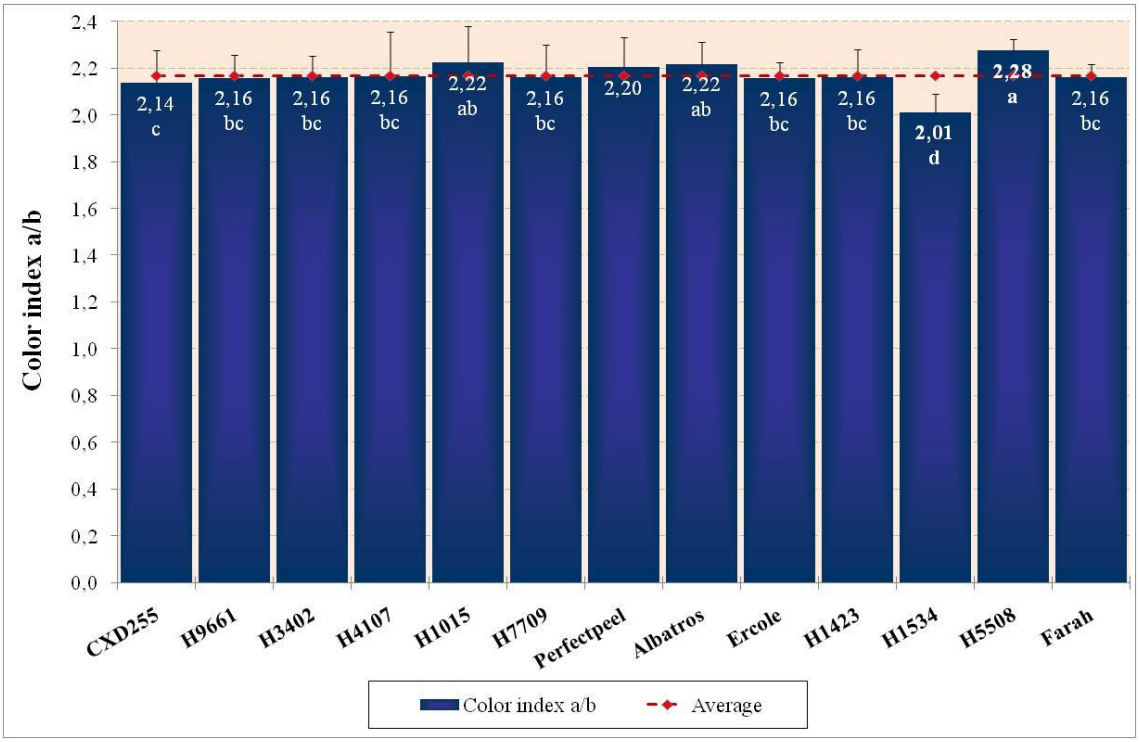
NB: Values assigned the same index are not significantly different at the 5% risk of error.

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

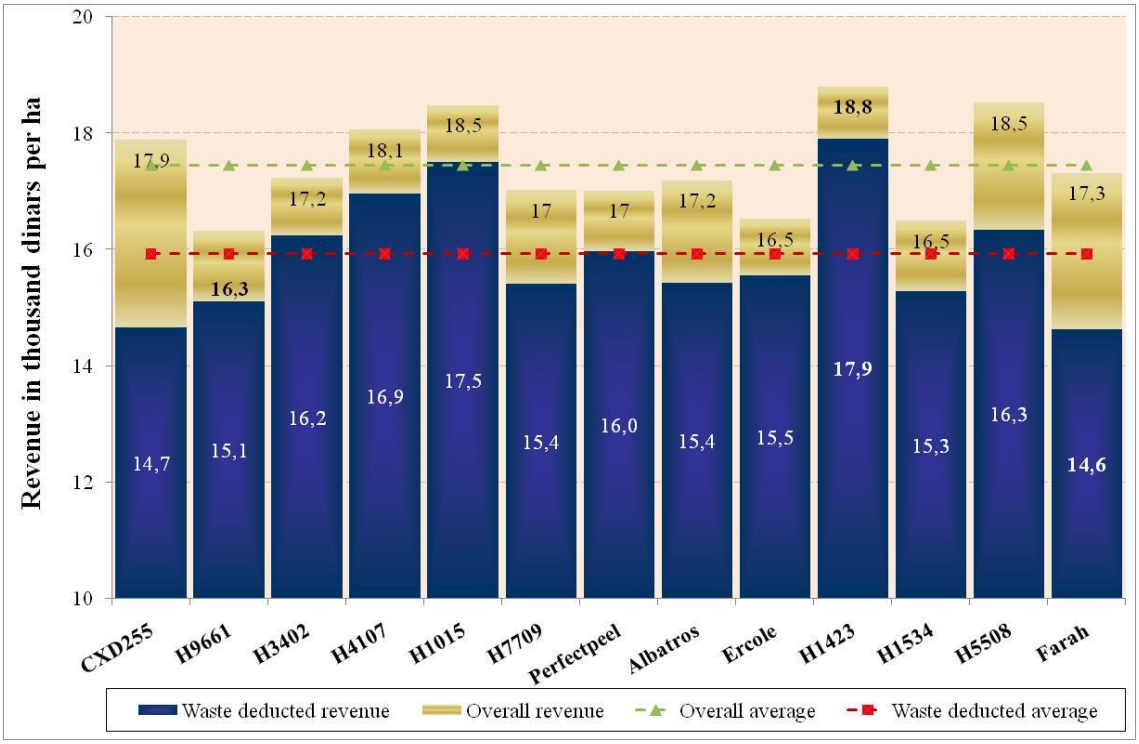


Figure 6. Variation in revenue per ha by variety

Conclusion

6 campaigns have allowed us to set up 6 trials in the main tomato production regions of Beja where we studied the behavior of 25 varieties under salinity conditions of irrigation water. According to the results obtained, the most suitable varieties for processing are Heinz1423, Heinz1015, Albatros, Heinz4107, Heinz3402, Perfectpeel, Heinz5508 and Heinz7709.

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 - Beja region

Excellent potential	H1301 - Savera - H1423	H9997 - H1423 - H1879	H1879 - H1423 - H1015 - H1301	-	-
Very good potential	H5508 - H1015 - H4107 - CXD255 - Badria - H9036	H3402 - H1301 - H1015 - Ercole - H4107 - Perfectpeel - H9661 - H1886 - H1534 - Nemageant - Axel - Badria - H2206 - H1884 - H7709	H7709 - H1886 - Dorra - H2206 - H1534 - H1884 - H4107 - Albatros - H9997 - H3402	H1423 - H1301 - H1015	CXD255 - Albatros - Savera - H1884 - Dorra - H1886 - Nemageant
good potential	Farah - H2206 - H3402 - Dorra - Perfectpeel - Albatros - H7709 - H1884 - H9997	Albatros - H5508 - Dorra - H9036 - Savera	CXD255 - Perfectpeel - Farah - H5508 - Badria -Axel - H9036 - H9661	H4107 - H3402 - H2206 - H7709 - H1879 - H5508 - H9997 - Albatros - Perfectpeel - Dorra - Badria - H1534	Perfectpeel - H4107 - H7709 - H5508 - H3402 - H1534 - Ercole - Badria - H2206 - Farah - H9997 - H1879 - H9036
Average potential	Ercole - H9661 - H1534 - Nemageant - Axel - H1886	Farah - CXD255	Ercole	H1886 - H1884 - CXD255 - H9661 - Ercole - Axel - Farah - H9036 - Savera	H1423 - H1301 - H9661
Limited potential	H1879	-	Savera - Nemageant	Nemageant	H1015 - Axel
Potential	**Productivity(1)**	**Transformable Yield(2)**	**Brix(3)**	**Yield in Brix in tons/ha(4)**	**Adaptability(5)**

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