Study of the behavior of industrial tomato varieties under the conditions of the Gafsa region: Campaigns 2016 – 2021

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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 33 varieties were distributed in 8 trial stations located in the different regions of Gafsa, under normal salinity conditions (Table 1). To ensure the reliability of the results, we have categorized the varieties into three different groups, the first one gathers the varieties repeated in 4 or more trials, the second one gathers the varieties studied in 2 to 3 trials and a third group that gathers the remaining varieties that have recorded their presence only in one trial. The regions of the trial sites are Ouled Zid, Sned and Sidi Aich which belong to the lower arid bioclimatic stage with an

average annual rainfall of about 150 mm and an average annual evapotranspiration between 1400 mm and 1450 mm.

Table 1. Trial sites

Region	Ouled Zid	Sned	Sidi Aich
Soil texture	Sandy clay loam	Sandy clay loam	Sandy clay loam
Water salinity	2,4 – 2,8 g/ liter	2,7 g/ liter	1,2 - 1,9 g/ liter
Planting density/ha	26.000 plants	26.000 plants	22.000 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 Gafsa and with levels of salinity of irrigation water that do not exceed 3 g / l, showed ratios of yield per expected target, between 93.5% and 96.1% significantly highest in the varieties Perfectpeel, Heinz1423, Heinz5508 and CXD255. The significantly lower ratios of about 73.3% and 74.5% were recorded in the varieties Heinz1534 and Badria (Figure 1A).

Ratio of transformable yield to total yield

The significantly highest ratios of processable yields to total yields, in the range of 93.2%, are recorded in the variety Perfectpeel. This compares to significantly lower averages, between 81.9% and 83.8% net fruit (red and turning tomatoes) per total yield, observed in the varieties Farah, Heinz5508 and Jawad (Figure 1B).

Rate of green tomatoes

The significantly highest green tomato rate was found in variety Heinz5508 with 15.5% green tomatoes. While significantly lower rates of around 2.9% green fruit were recorded in variety Heinz9661 (Figure 2A).

Rate of rotten tomatoes

The significantly highest rates of rotten tomatoes, around 9%, were found in the Farah variety. Significantly lower rates were recorded in the varieties Perfectpeel, Heinz1015, Albatros and Heinz1534 with averages between 1.7% and 2.2% rotten fruit (Figure 2B).

Total waste rate

The significantly highest waste rates, between 16.2% and 18.1%, were found in Farah, Heinz5508, and Jawad varieties. The significantly lowest rates, around 6.8% total waste, were found in the Perfectpeel variety (Figure 2C).

Soluble sugars °Brix

The significantly highest levels of soluble sugars, in the range of 5.43 °Brix, were found in fruits of the variety Heinz1423. While the significantly lower levels, in the range of 4.74 °Brix and 4.77 °Brix, were recorded in the varieties Heinz9661 and Farah (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 Perfectpeel variety with an average of about 4.72 tons of Brix per ha of tomatoes. The lowest Brix yields were recorded for the varieties Badria, Heinz1534, Farah and Jawad with averages between 3.28 tons of Brix per ha and 3.40 tons of Brix per ha (Figure 4).

Color index a/b

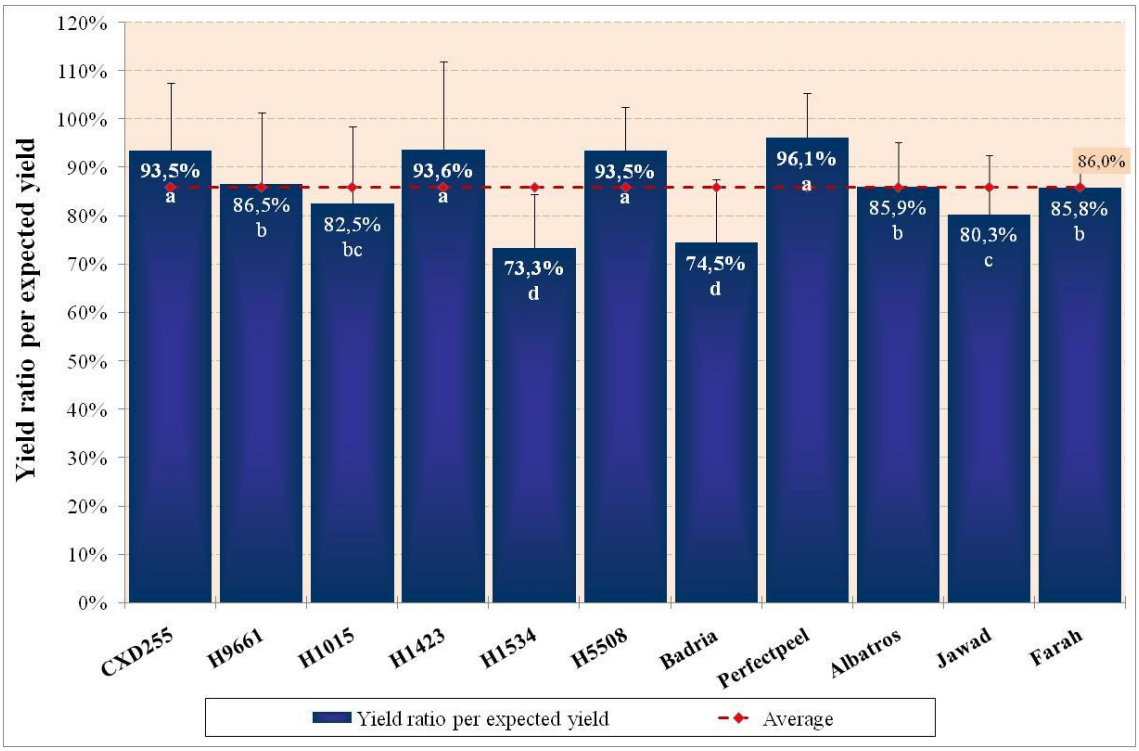
The significantly highest a/b color index measurements were recorded in the variety Heinz1423 with an average of about 2.24. The results of the analysis of the Farah variety showed average color indices in the order of 2.11 significantly the lowest compared to the other varieties (Figure 5).

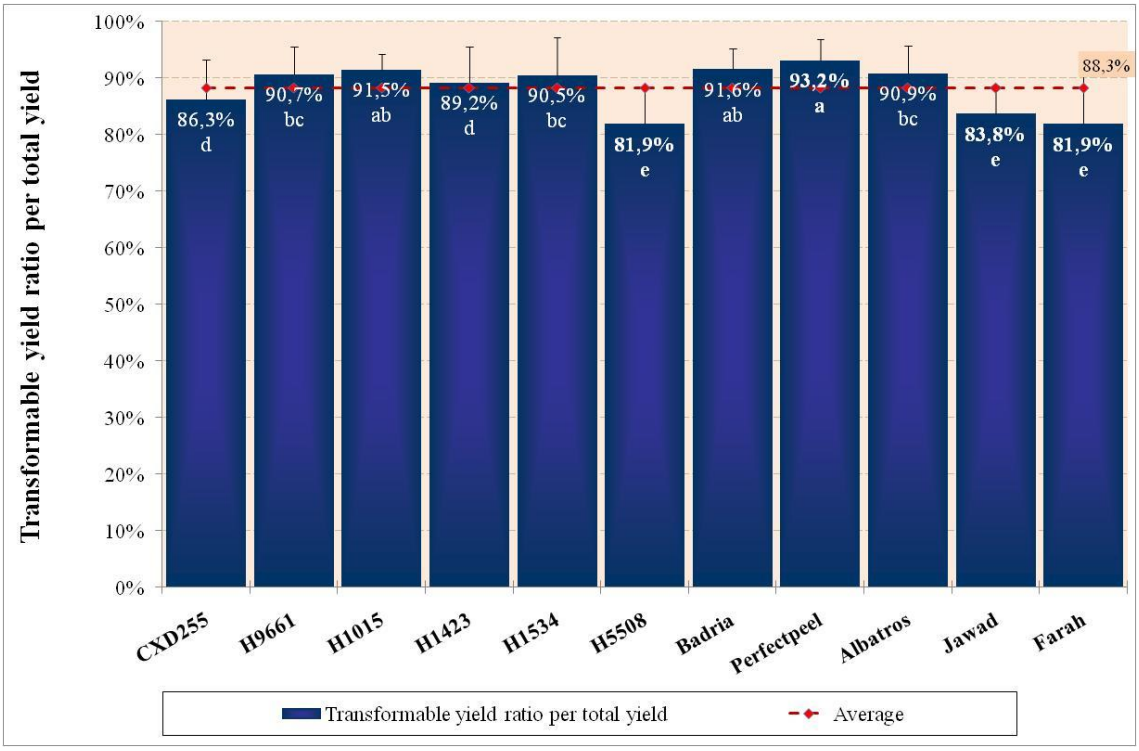
Economic benefit

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 4.4 thousand dinars between varieties. The revenues generated vary between maximums of the order of 18.7 thousand dinars in the Perfectpeel variety and minimums of the order of 14.3 thousand dinars in the Heinz1534 variety.

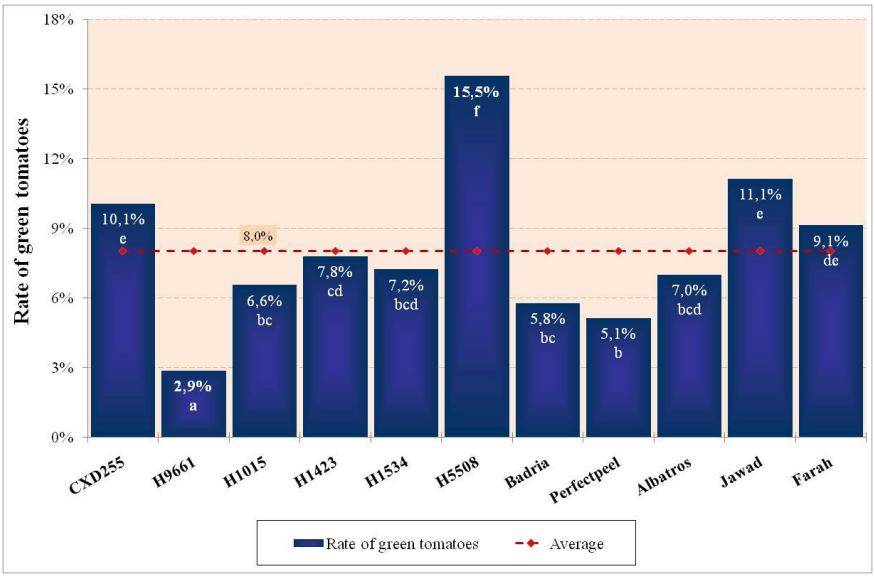
After deducting the weight of green fruit and rotten tomatoes we tried to estimate the revenue generated by one ha for each of the varieties of tomato studied. Thus, we distinguished a variable spectrum of economic revenue per ha, with a maximum difference of about 4.6 thousand dinars between varieties. The revenues generated vary from a maximum of 17.5 thousand dinars for the Perfectpeel variety to a minimum of 12.9 thousand dinars for the Heinz1534 variety (Figure 6).

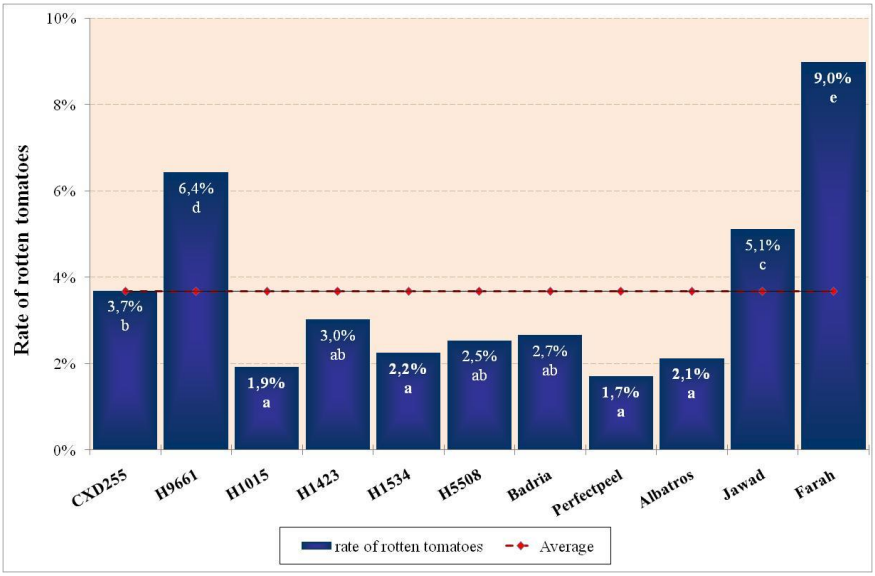


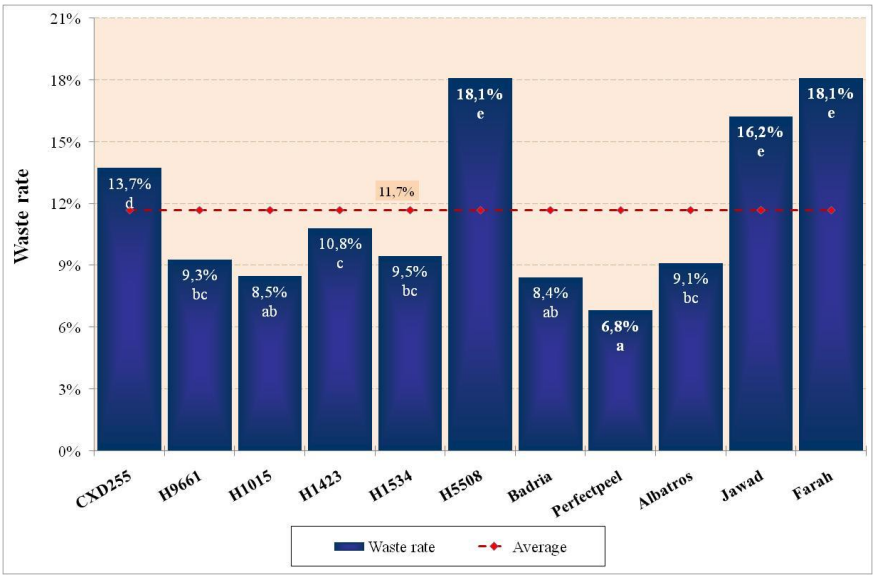


Note: Values assigned the same index are not significantly different at the 5% risk of error.

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

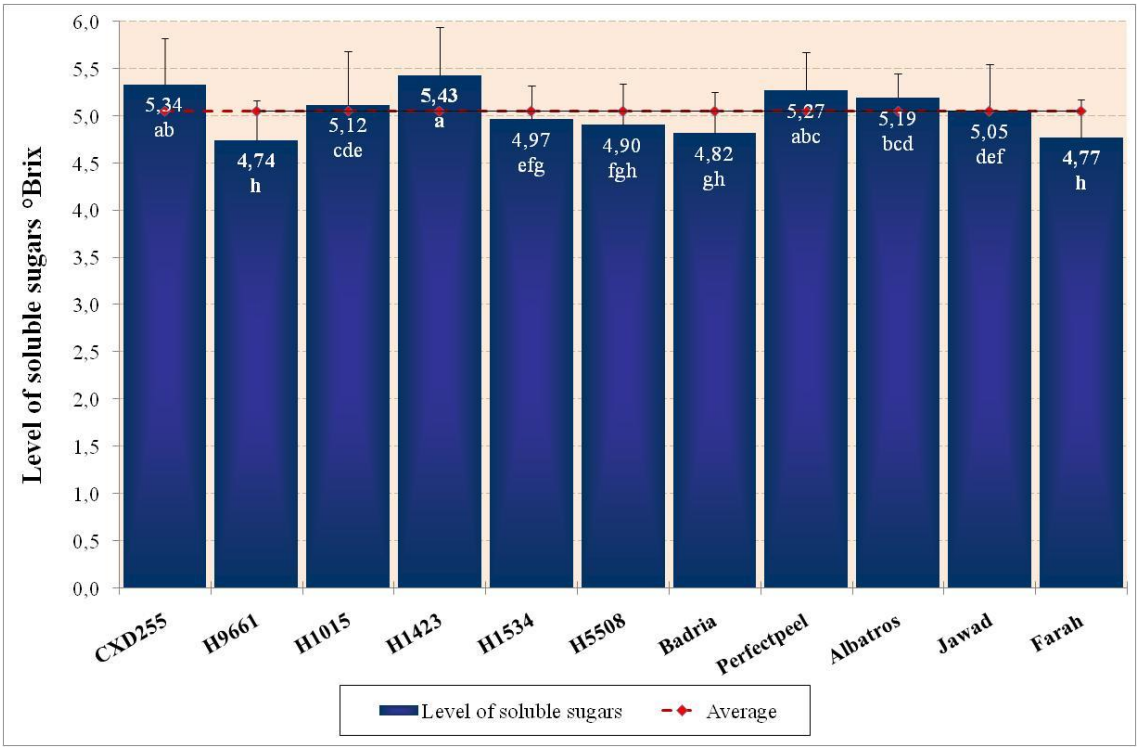






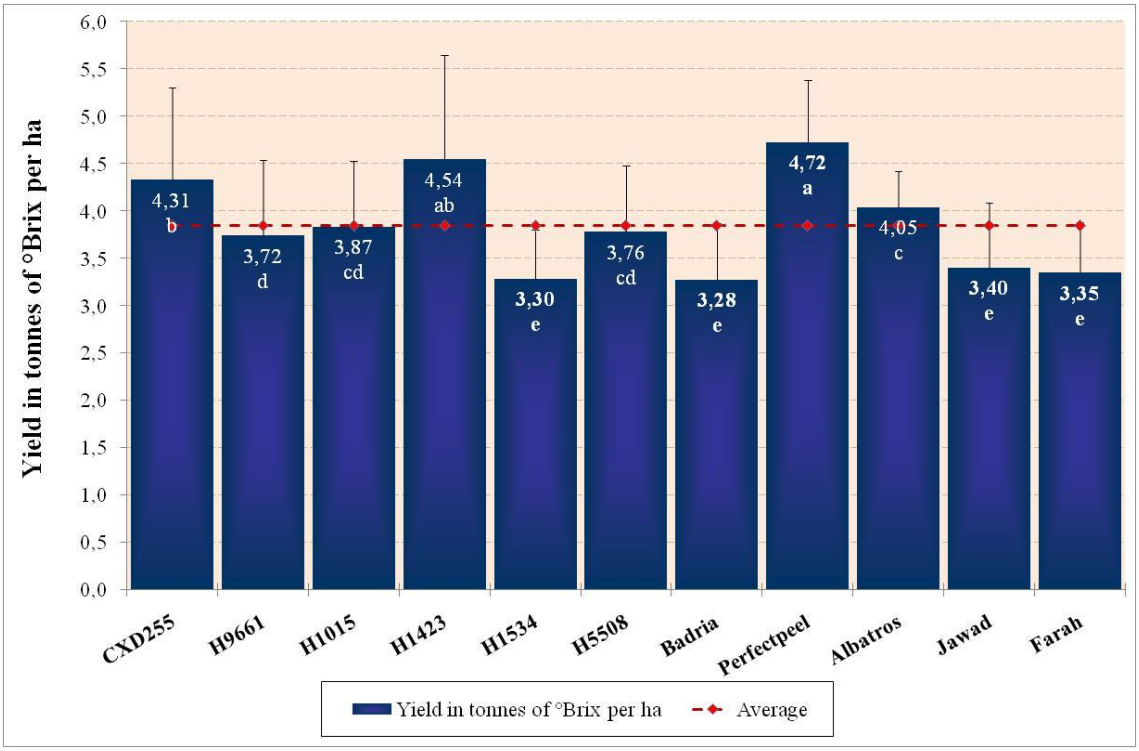
NB: Values assigned the same index are not significantly different at the 5% risk of error.

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



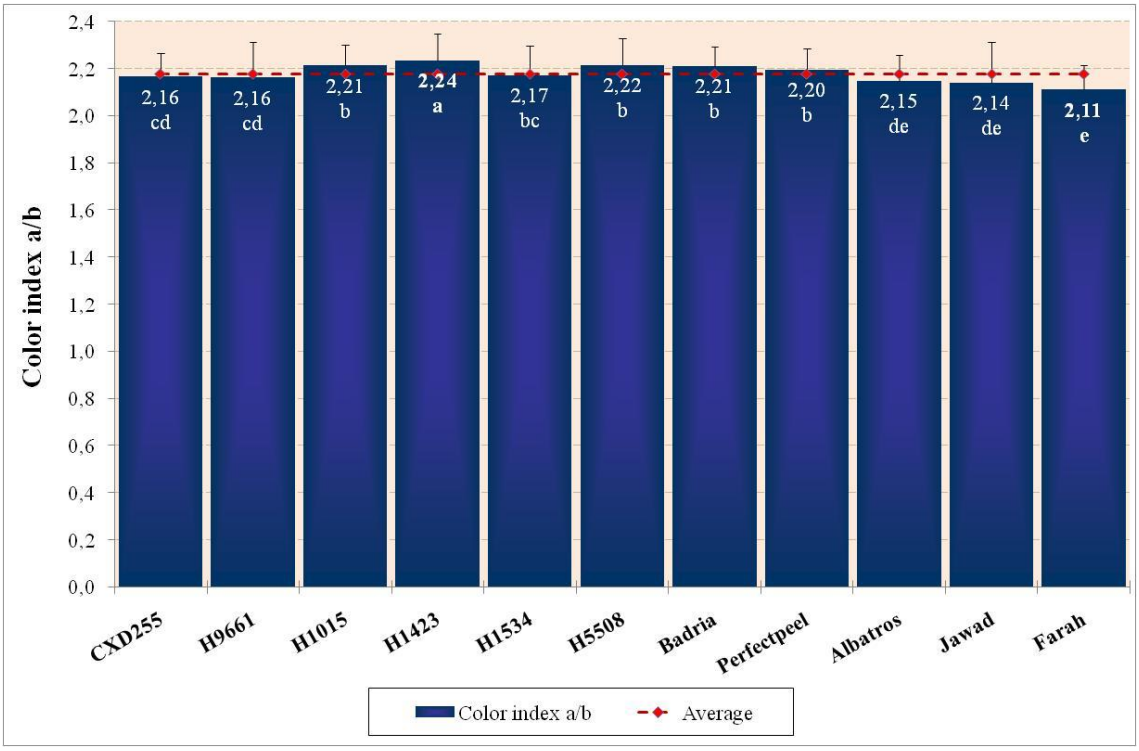
NB: Values assigned the same index are not significantly different at the 5% risk of error.

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

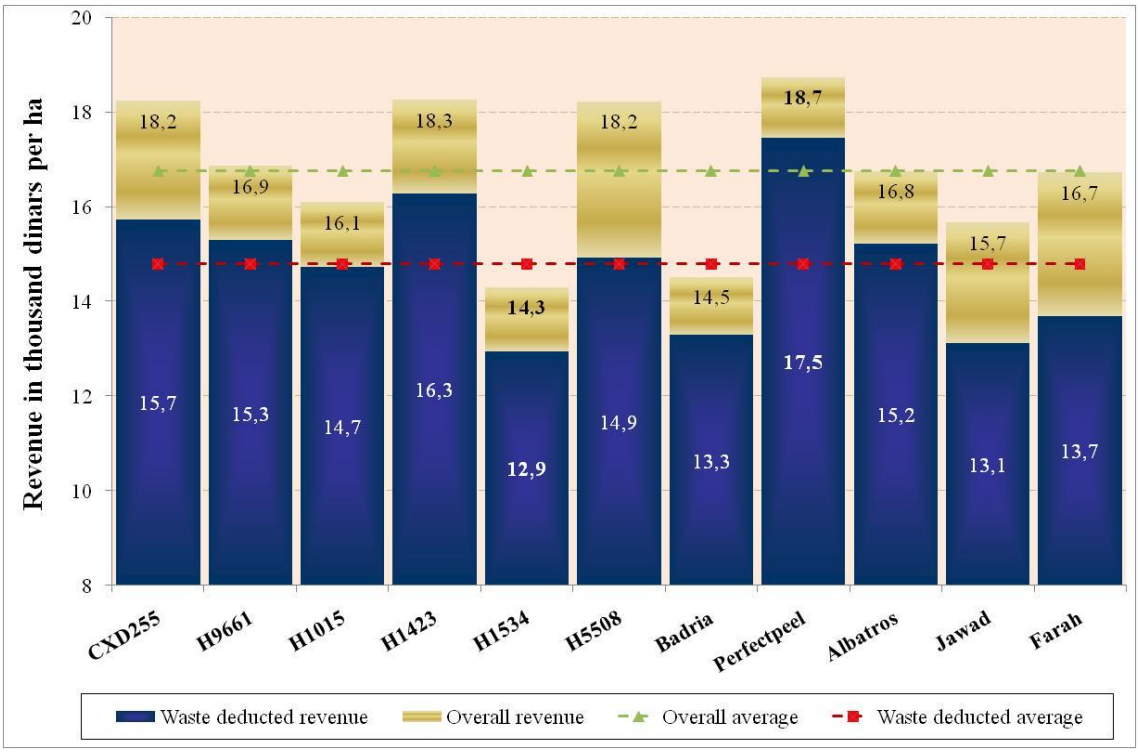


Figure 6. Variation in revenue per ha by variety

Conclusion

Six campaigns allowed us to set up 8 trials in the main tomato production regions of Cap Bon, where we studied the behavior of 33 varieties under salinity conditions of irrigation water. According to the results obtained, the most suitable varieties for processing are Heinz1423, CXD255, Perfectpeel, Heinz4107, Albatros and Dorra.

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 - Gafsa region

Potential	Productivity(1)	Transformable Yield(2)	Brix(3)	Yield in Brix in tons/ha(4)	Adaptability(5)
Excellent potential	Savera - Perfectpeel	-	H1423 - Wally red -CXD255 - H1292	-	Savera - Wasco
Très bon potentiel	CXD255 - H1423 - H5508 - H2206 - Wasco - H7709 - H4107 - Dorra	Perfectpeel - H3402 - H1879 - H2206 - H4107 - H1015 - Gladis - Elba - H1292 - Albatros - Badria - H9661 - H1534 - Axel	Perfectpeel - Albatros - H2206 - H4107 - H1015 - H1293 - Jawad - Elba	Perfectpeel - H1423	Dorra - CXD255 - Albatros - H5508 - H1534 - Badria - Jawad - H1879 - H1884 - H1886 - Gladis - Sabra
Good potential	H1292 - H1879 - H9661 - Saada - Elba - Farah -Albatros	Wally red - H1423 - H1293 - Dorra - Ercole - CXD255 - H7709 - Firenze	H1534 - Axel - H7709 - H5508 - Dorra - Ercole - H1879 - Wasco - Badria - Gladis - Firenze - Sabra - Farah - H3402 - H9661 - H1886	H2206 - H4107 - H1292 - CXD255 - Albatros - Dorra - H1879	Perfectpeel - H7709 - H3402 - Ercole - Farah - H2206 - Axel - H1292 - H1293 - Firenze - H1423 - Saada - Wally red - Noura - Topsport - Elba
Average potential	H1886 - H1015 - H3402 - H1884 - Gladis - Noura - Jawad	Wasco - H1886 - H5508 - Jawad - Saada - Farah - Noura - Savera	Noura - H1884 - Savera - Topsport	Elba - H7709 - H1015 - H5508 - H3402 - H9661 - Wasco - Gladis - Wally red - Savera	H9661 - H4107 - H1015 - Axel - H1292 - H1293
Limited potential	Firenze - Topsport - Sabra - Ercole - Badria - H1293 - Axel - H1534 - Wally red	H1884 - Topsport	Saada	H1534 - Jawad - H1886 - Axel - H1293 - Farah - Ercole - Badria - Firenze - Sabra - Saada - Noura - H1884 - Topsport	-

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