

## ASIRPA

*Analysis of the Impacts of Public Agricultural Research*

# High quality tomato varieties for the fresh and processing markets: F1 GARANCE and F1 TERRADOU

25.6.2015

René Damidaux

Case study performed for the Plant Biology and Breeding department of INRA  
With methodological support from ASIRPA team



Research in genetics and disease carried out by INRA in close collaboration with the sector since the 1970s has led to the creation of two emblematic varieties:

The F1 GARANCE tomato was originally intended to explore other ways of producing fruit of excellent organoleptic quality while at the same time responding to demands from the sector (fewer treatments, good tolerance of handling). Two innovative points maximise the gustatory potential of F1 GARANCE: its harvest at full ripeness and its storage at ambient temperature.

Registration of the F1 TERRADOU tomato, with a very high dry matter content and multiple resistance to diseases, opened the way towards the development of a quality-based payment grid for producers. The impact on energy use in this sector is highly significant.

The qualities of these two tomatoes offer strong indicators for future opportunities to be explored by breeders and producers.

## Context

INRA's contribution to tomato breeding started during the 1950s at the Montfavet Experimental Farm in the Vaucluse. As early as 1963, breeding work led to the registration of the one of the first hybrids in the French catalogue: Montfavet H63-5. After several decades marked by the creation and distribution of numerous improved genitors and varieties registered in the Catalogue (fixed lines and hybrids), came the breeding of the most recent tomatoes by the Fruit and Vegetable Genetics and Breeding Unit (GAFL-UR, Montfavet) which belongs to the BAP Division: the GARANCE and TERRADOU hybrids. Although these two tomatoes target very differing markets, three of the four parents resulted from lengthy joint breeding efforts focused on fruit quality, notably relative to their soluble dry matter (SDM) content, colour, pH and firmness. These tomatoes, and the breeding work that gave rise to them, serve as foundations to study the socioeconomic impact of this research.

The origins of the programme on SDM go back to the 1970s and the convergence of two events:

- The development of mechanical harvesting in France, which was accompanied by a complete change to the range of varieties grown, to the benefit of American varieties with a low SDM content;
- The first oil crisis, which markedly drove up energy costs and hence those of manufacturing tomato concentrate. During the 1970s, the variety most widely cultivated in France for mechanical harvesting was EARLYMECH (obt. Petoseed - USA). Its SDM content was between 4 and 4.5 °Brix, while previous varieties harvested by hand had between 5 and 5.5 °Brix. Furthermore, this material bred for use in California was not well suited to the French climate and its biotic constraints (viruses, fungi, bacteria).

As from 1998, the goals for varietal creation were reoriented by the GAFL-UR towards tomatoes for fresh consumption, and most particularly those produced under short channel systems (organic and conventional modes) or by amateur gardeners. The two main objectives of this new programme centred on deploying genetic resistance to diseases and pests so as to provide an alternative to the programmed disappearance<sup>4</sup> of most pesticides, and on distributing tomatoes with high-quality fruits to respond to consumer expectations.

### Economic context

A few figures indicate the production and consumption of tomatoes. Each year, France produces between 600,000 and 800,000 tonnes of fresh tomatoes (80% under shelter), and exports nearly a quarter of its production. The French consume around 1.5 million tonnes of fresh tomatoes each year, a large proportion of which are imported, particularly in winter. Organic farmers produce between 10% and 20% of the fresh tomatoes consumed each year in France. Finally, although it is difficult to determine the share of tomatoes grown and eaten by amateur gardeners, this has been estimated at between 10% and 20% of total consumption.

Breeding for the fresh tomato market is very active in France. Private French or European breeders claim good quality for their new varieties without necessarily achieving it (introduction of a gene for long conservation in vine tomatoes or improving beef tomatoes in terms of firmness through backcrossing, in order to respond to the demands of retailers, to the detriment of their original quality). The challenge in terms of the quality of fresh tomatoes that public research is seeking to take up is based on the creation of plant materials that can explore other production and marketing channels.

The production of processing tomatoes (2013) reaches 140,000 tonnes, to be compared with our neighbours (Italy: 4.1 million tonnes; Spain: 1.7 million tonnes; Portugal: 1 million tonnes) (Source: SONITO-France AgriMer). A small proportion is

exported. The consumption of processed tomatoes is equivalent to 1.2 million tonnes of freshly-harvested fruits. The difference comes from imports. The share of the processing tomato market is between 15% and 20% of total French tomato production (fresh and processing). The French production of processing tomatoes has seen a very marked decrease (380,000 tonnes in 1980 versus 120,000 tonnes in 2000) for reasons of competitiveness (labour and energy, etc.). Industrial facilities have evolved considerably during the past 30 years, with the disappearance of numerous small production units that were not modernised. Today, there are three processing units in southeast France (including Provence Tomatoes which assures 46% of French processing), and three units in the southwest.

In France, around ten varieties are used each year for processing. Their renewal is quite rapid but over the years it has been seen that one variety tends to occupy between a third and a half of all land planted to tomatoes for a period of 5 to 8 years. Since the development of mechanical harvesting, the following varieties have been seen chronologically: EARLYMECH, CANNERY ROW, F1 PERFECTPEEL, F1 LEADER.

Private breeding for processing tomatoes is non-existent in France. Apart from materials created by INRA, most of the varieties planted in France originate from California and Italy.

For both types of production (processing and fresh tomatoes), the demands of all actors in the different sectors centre around fruit quality and lower inputs, and particularly pesticides. Some traits to be selected will be the same (SDM content, colour, resistance to certain diseases, etc.) while others are specific to each type of production (fruit shape and size, resistance to diseases specific to certain production modes, etc.).

## Inputs and productive configuration

Disease resistance and fruit quality are the principal objectives of research by the Fruit and Vegetable Genetics and Breeding Unit (GAFL-UR). Very naturally in the case of F1 TERRADOU and F1 GARANCE, work was initially based on the material present in Montfavet: not only improved lines but also material present among the genetic resources held by the unit.

Because both parents of F1 TERRADOU and one parent of F1 GARANCE originate from work on processing tomatoes, we should start by clarifying the early stages and course of this work.

### Processing tomatoes:

As early as 1978, a close collaboration was established between INRA and professionals in the processing tomato sector: the Société Nationale Interprofessionnelle de la Tomate Transformée (SONITO) and the Centre Technique de la Conservation des Produits Agricoles (CTCPA), to develop a programme for varietal creation. The aims of this programme were defined in close collaboration by all the partners.

In order to solve the problems that appeared because of the generalisation of mechanical harvesting and the shift towards appropriate varieties, all created in the USA, the principal areas chosen for research were improvements to fruit quality (SDM content and also colour, acidity and pH), resistance to diseases specific to France (bacterial spot, spotted wilt of tomato, corky root), and cold adaptation (germination, young plantlet growth and fruit setting).

The GAFL was responsible for the design (choice of breeding methods, choice of parents) and management of the breeding programme for processing tomatoes. This programme required the unit to mobilise human resources (experimentation and research technicians), the necessary scientific environment, facilities (laboratories, culture chambers, greenhouses and fields) and the biological resources available to it (cultivated tomatoes and related wild-type species) both internally or from other countries (Bulgaria, USSR, USA and South Africa).

The integration of an engineer from SONITO-CTCPA and a SONITO technician responsible for this programme within the GAFL tomato research team enabled the rapid assimilation of their most recent work, notably in terms of disease resistance (*Pto* and *Sw-5* genes).

Work on the SDM content was based on the creation of an improved population (coded Nif) based on the interspecific crosses performed by Henri LATERROT in 1982 for resistance to an insect. These crosses included several tomatoes adapted to mechanical harvesting (*Solanum esculentum*) and a wild-type tomato (*S. cheesmaniae*) with a very high SDM content (<sup>o</sup>Brix >10) originating from the Galapagos Islands. Work on recurrent selection lasted 16 years and was designed to gradually enrich this population in the genes implicated in both SDM content and disease resistance (improved lines resulting from INRA programmes) while at the same time preserving the agronomic traits adapted to mechanical harvesting. As from 1996, lines started to be extracted from the population by pedigree breeding. After five breeding cycles, the best of them started to be used in hybrid combinations.

Until 2001, the principal partners in this programme on processing tomatoes were:

---



### **La Société Nationale Interprofessionnelle de la Tomate (SONITO) - Avignon**

An interprofessional organisation

*Role:* initiator of programmes during the 1970s (with the CTCPA) and the principal partner in the processing tomato programme.

*Resources mobilised:* one research engineer then a research technician, together with an operating budget.

The SONITO allowed access to their breeding trials: 1) at the experimental farm (pre-collegial trials), 2) on-farm with farmers (multi-site collegial trials carried out in the south of France and managed by SONITO technicians).

### **Le Centre Technique de la Conservation des Produits Agricoles (CTCPA) - Montfavet**

Technical Institute for the industry.

*Role:* this Institute was a partner in the programme on processing tomatoes until 1998. It participated in the agronomic and technological evaluation of hybrid combinations created by INRA.

*Resources mobilised:* yield trials were carried out on its experimental plots and experimental manufacturing runs for concentrate were set up in its pilot workshop.

Until 2003, the CTCPA pilot workshop also served the SONITO for studies on the technological characteristics of all the new varieties being tested during its multi-site trials in France.

### **Graines VOLTZ**

Seed producer (multiplication and marketing)

*Role:* multiplication of hybrid parents and production of the F1 TERRADOU and F1 GARANCE hybrids. Responsible for market development.

*Resources contributed:* internal production structures (parental lines) and contracted production in other countries (F1 hybrids), controls and treatment of seeds.

Graines VOLTZ participated in the pre-development of F1 TERRADOU (pre-basic multiplication and experiments with producers at the French level).

#### **Fresh tomatoes:**

A varietal breeding programme for fresh tomatoes was restarted in 1998 with the recruitment by INRA of a SONITO engineer. This led to the creation of the second parent for the F1 GARANCE hybrid.

For this work on fresh tomatoes, the approach differed slightly from that adopted for processing tomatoes. This parent resulted from breeding for disease resistance of an INRA line (FERUM parent of the F1 hybrid FERLINE), acknowledged for the display quality of its fruit but benefiting from very little disease resistance.

Breeding work consisted in using back-crossing to introduce several types of disease resistance, as is necessary for modern tomatoes. This initial goal was designed to provide INRA with modern, multi-resistant lines that could be used as parents for future hybrids, and also for its future research programmes.

The sources of resistance used were of several origins: improved INRA lines, lines from genetic resource collections or commercial varieties.

As for processing tomatoes, the GAFL was responsible for the design (choice of breeding methods and parents) and management of the breeding programme. The same resources as for processing tomatoes were mobilised.

As from 1998, the principal partners in this programme on fresh tomatoes were:

### **The Mas Blanc Horticultural Experimental Farm (SAD - INRA) – Alenya**

*Role:* agronomic and sensory evaluation of new fresh tomato hybrids.

*Resources mobilised:* Human resources (experimentation agents, research technicians), unheated plastic tunnels.

The comparison between pure and grafted plants demonstrated the need to cultivate F1 GARANCE as a grafted plant for producers so as to ensure its yield and calibre, particularly in summer.

### **The Sensory Evaluation Laboratory of the European Innovation Cluster of Fruits and Vegetables (PEIFL) in Avignon, which has now become TERRALIA**

*Role:* hedonic study of new fresh tomato hybrids, including F1 GARANCE, in the context of the MAP QualitomFil contract.

*Resources mobilised:* panel of consumers.

During the organoleptic evaluations performed prior to registration, F1 GARANCE distinguished itself for the quality of its fruits. This was one of the factors that triggered the commercial launch of the GARANCE hybrid.

### **The Suscino Interprofessional Agrobiological Platform (Plateforme Agrobiologique Interprofessionnelle) (PAIS) belonging to Inter Bio Bretagne (an association of operators in the organic sector) and the Complexe Régional des Etablissements Publics Agricoles (CREPA) in Brittany**

*Role:* screening of experimental hybrids (2008 and 2009) and multi-site evaluation of F1 GARANCE

*Resources contributed:* greenhouse (PAIS) and plastic tunnels (five producers)

The choice to sell F1 GARANCE for the organic market owed much to the results obtained in Brittany.

### **Organic Farming Research Group (GRAB) in Avignon**

*Role:* evaluation of F1 GARANCE (2010 and 2012)

*Resources mobilised:* human resources (agents and experimentation technician), unheated plastic tunnel

With both partners, the good fruit quality of GARANCE was underlined. An absence of resistance to tomato leaf mould proved damaging in the south. Furthermore, these trials showed that it was obligatory to graft F1 GARANCE in order to achieve vigour and larger fruits under market gardening conditions.

## **Research outputs**

### **F1 TERRADOU**

For more than 20 years, this programme resulted in the creation of processing tomatoes that required less energy and were better adapted to French conditions. INRA breeds on the list of varieties recommended by the SONITO during this period clearly illustrated the sustained efforts made by INRA with respect to SDM. During each period, INRA varieties were those which achieved the greatest gain in SDM by comparison with controls (see ANNEX 1 – COMPARISON OF INDUSTRIAL VARIETIES - SONITO 1990 - 2002.pdf). The F1 CALADOU hybrid, resistant to TSWV and registered in the Catalogue in 2000, is still being commercialised in 2015.

The F1 TERRADOU hybrid was successfully evaluated between 2002 and 2004 by the SONITO during its varietal trials (see results in ANNEXES 2 and 3: SONITO - PRE-COLLEGIAL VARIETAL TRIALS 2003, SONITO - COLLEGIAL VARIETAL TRIALS 2004).

This tomato is designed for industrial processing (purée and concentrate) and is machine-harvested. It combines excellent agronomic yield with very good technological traits, and notably a high SDM content (Brix between 5.5 and 6), a high lycopene content (producing a very red concentrate) and a low pH that shortens the time required for appertisation, a guarantee of a very high quality end product.

The major problems that affected the processing tomato sector between 2004 and 2010, the lack of payment for quality (SDM content) until 2014 and the difficulties experienced by producers in adapting their cultivation practices to a more vigorous tomato (thus requiring lower planting densities), delayed the planting of this tomato until 2014.

As a hybrid variety in its second year of registration in the catalogue of new varieties in 2014, F1 TERRADOU was jointly bred by Agri-Obtentions and INRA. This hybrid has benefited from a two-year Provisional Sales Authorisation (*Autorisation Provisoire de Vente*, APV) since 2014.

### **High SDM lines**

Improved lines derived from the Nif population and rich in SDM, and which gave rise to the parents of the F1 hybrid TERRADOU, were distributed between 2004 and 2006 under an agreement with several seed firms (GAUTIER Semences (F), VILMORIN (F), ISI Sementi (It), ORSETTI Seeds Company (USA)) with a view to their use as hybrid parents. To date, all these companies state that they have not created commercial hybrids using this material. It was not possible to obtain any

information about their use in breeding schemes.

### **F1 GARANCE**

**This hybrid was registered in the catalogue of plant varieties in 2012 and was jointly bred by Agri-Obtentions and INRA.**

This fresh tomato is cultivated in the field under unheated shelter and in open fields in the summer. It is designed for short-channel selling in the organic or conventional sectors, and for amateur gardeners.

It is multi-resistant and its fruits have an excellent gustatory quality. It is distinctive from other tomatoes on the market because it is harvested at full ripeness and can be stored at ambient temperature for at least one week without losing its aptitude for handling or its organoleptic characteristics.

This is the first prototype to have demonstrated that it is possible to produce high quality tomatoes for consumers while ensuring marketing traits that can meet the requirements of the sector and thus open the way towards a different approach to quality.

#### **Scientific publications underpinning these outputs:**

Causse M, Buret M, Robini K, Verschave P (2003) Inheritance of nutritional and sensory quality traits in fresh market tomato and relation to consumer preferences. *Journal of Food Science* 68, 7, 2342-2350

Liu YS, Gur A, Ronen G, Causse M, Damidaux R, Buret M, Hirschberg J, Zamir D (2003) There is more to fruit colour than candidate carotenoid genes. *Plant Biotechnology J* 1: 195-207

Causse M, Damidaux R, Rousselle P (2007) Traditional and enhanced breeding for fruit quality traits in tomato in *Genetic Improvement of Solanaceous Crops, Vol.2: Tomato*. Eds: M.K.Razdan and A. K. Mattoo, Science Publishers, Enfield, USA

Arens P, Mansilla C, Deinum D, Cavellini L, Moretti A, Rolland S, van der Schoot H, Calvache D, Ponz F, Collonnier C, Mathis R, Smilde D, Caranta C, Vosman B. (2010) Development and evaluation of robust molecular markers linked to disease resistance in tomato for distinctness, uniformity and stability testing. *Theoretical and Applied Genetics*, 120(3):655-64

Causse M, Friguet C, Coiret C, Lépicier M, Navez B, Lee M, Holthuysen N, Sinesio F, Moneta E and Grandillo S (2010) Consumer Preferences for Fresh Tomato at the European Scale: A Common Segmentation on Taste and Firmness. *Journal of Food Science* 75, 9, 531–541

## **Knowledge flow and intermediaries**

### **Contribution of INRA scientists throughout the creation and dissemination of varieties**

+ For F1 TERRADOU, numerous informal exchanges with members of the processing tomato sector (crop managers, farmers) during the many years of this programme made it possible to adapt the SDM approach of different actors (changes in planting densities, introduction of penalties for unacceptable SDM levels, extension of the scoring grid for firmness in order to place value on very firm tomatoes) and also to reorient the goals of the breeding programme in order to respond to demands from the sector (introduction of resistance to TSWV into the SDM population currently being bred).

+ Technical expertise to support the launch of seed production for parental lines and hybrids, working with Graines VOLTZ

+ Participation in TV programmes on F1 GARANCE and its breeding, participation in the INRA stand at the Salon international de l'Agriculture in Paris in 2014 in order to present F1 GARANCE

+ Support for partner seed producers during the pre-development stage (hosting of farm consultants during INRA trials so as to acquaint them with the materiel).

+ Communication with the general public: Salon international de l'Agriculture 2014 Paris, meetings with the media: television, radio, written press.

+ Participation in commercial promotions in the form of interventions during two presentation days organised by Graines VOLTZ in Angers in 2013 ("Chef's Choice" campaign, targeting the general public horticultural press and food bloggers).

### **Contribution of Agri Obtentions to dissemination of the F1 GARANCE and F1 TERRADOU varieties**



The exploitation of both varieties was managed by Agri-Obtentions (agreement with the partner seed companies, pre-production of parental lines).

Support for dissemination of the material was limited until 2014. The recruitment of a sales engineers responsible for the development of market garden species should improve this situation.

#### **Contribution of SONITO to the dissemination of F1 TERRADOU**

The SONITO and its engineers responsible for agronomic experiments (varietal trials, cultivation techniques, etc.) and for advising producers and processing companies, has been a powerful intermediary in promoting and ensuring the acceptance of high-quality tomatoes (high SDM content) by industry. Initially rejected in 2003 because of excessive foliage that did not comply with standards at that time, tomatoes from the SDM programme (F1 TERRADOU) were finally accepted in 2012 when producers were advised to reduce their mean planting density by 15% and the same material was presented by other seed producers. Marketing functions just complied with demand.

The SONITO contributed to the development of a sorting grid used to evaluate the quality of tomato batches delivered to factories and thus determine their payment. Several grids have been tried during the past 20 years. The early versions had little impact on the range as they did not sufficiently favour quality over agronomic yield. The most recent version, used on a voluntary basis by the Provence Tomatoes factory, has had a real impact on the quality of the tomatoes delivered, particularly since the varieties involved need to be on a list approved by the factory. The varieties chosen combine agronomic yield and good technological traits, with notably a very high SDM content. Use of this sorting tool has enabled a very rapid evolution in the varieties used, with preference being given to better technological quality.

#### **Contribution of Provence Tomatoes to the dissemination of F1 TERRADOU**

This factory, which opened in 2009, has the largest capacity and is the most modern processing unit in France. After initial difficulties, it was taken over by the producers in 2011 after its previous owners had been declared bankrupt. Indeed, despite its optimum facilities for the production of concentrate, the industrial yields of the early years were not good, mainly because the varieties used presented very low SDM levels. Drastic measures were implemented in 2014 in terms of the varieties approved by the factory and the equipment used to sort fruits at entry, coupled with payment for quality. The sorting grid employed really favoured tomatoes with a high SDM content and markedly penalised batches with a low Brix value or fruits harvested before they were ripe. For the time being, this is the only factory in France to have implemented payment for quality. This involvement of producers in processing is indeed linked to growing awareness of the need to pay for quality.

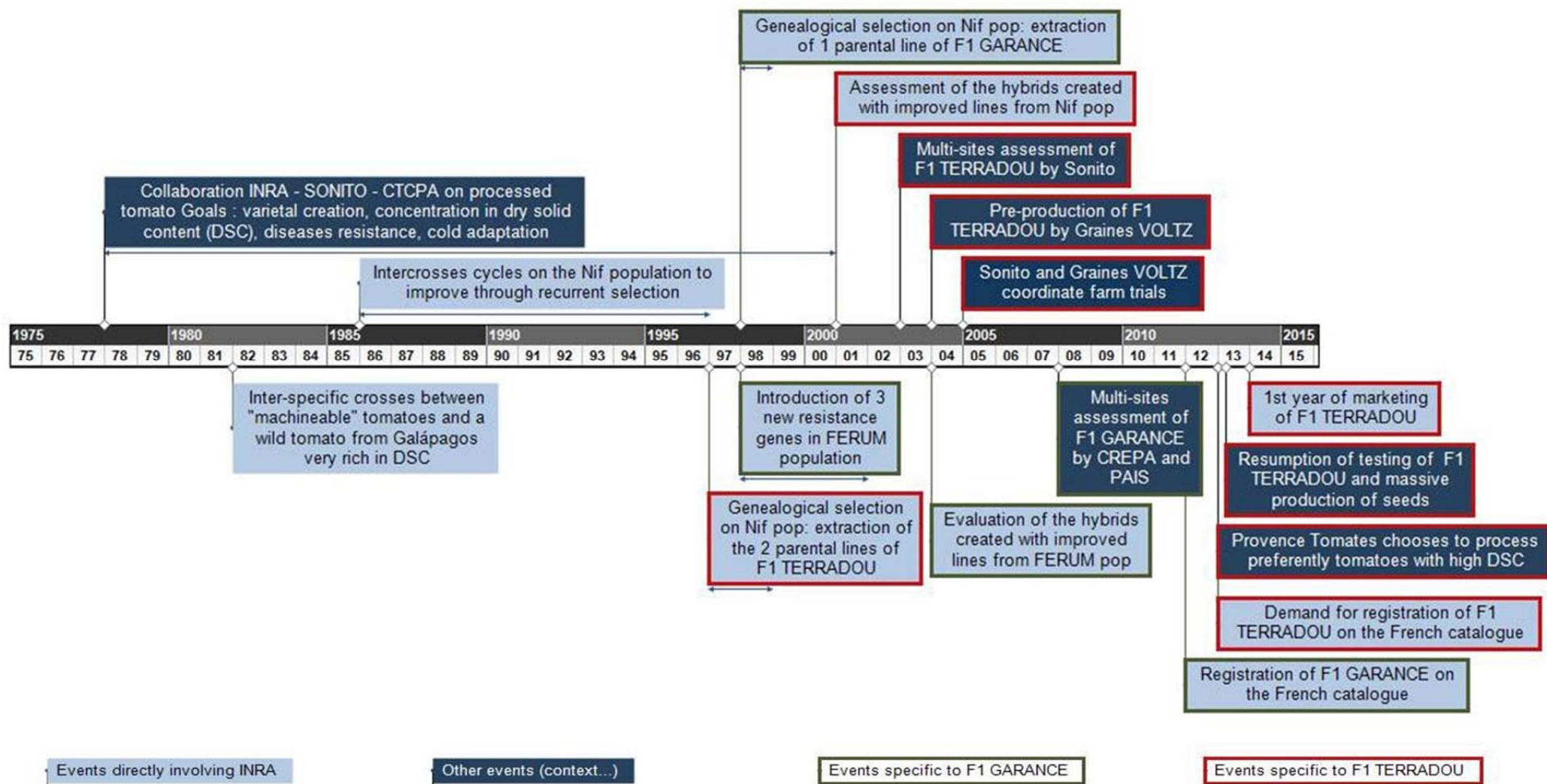
F1 TERRADOU, as well as F1 CALADOU (bred by INRA - Graines GAUTIER - SONITO and registered in 2000), which were bred for the SDM content, are naturally on the list approved by PROVENCE TOMATES.

#### **Contribution of Graines VOLTZ to the dissemination of varieties**

This SME, active in the market gardening and floral sectors, was chosen by Agri Obtentions to produce and disseminate INRA's most recent varieties, including F1 TERRADOU and F1 GARANCE. Exclusive rights to multiplication and commercialisation were granted to VOLTZ for these two varieties.

This company controls the production of F1 hybrids and is notable, to date, for not having its own tomato breeding activity. At a commercial level, this latter point has the advantage of preventing any conflicts with new, in-house varieties.

In 2012 and 2013, Graines VOLTZ organised the promotion of F1 GARANCE by including it in a communication campaign called the "Chef's Choice" ("*La Sélection du Chef*"). This campaign was based on the publication of simple, tomato-based recipes developed by a dozen leading chefs. Each recipe, specially designed for this campaign, was based on a tomato variety chosen for its good quality (puff-pastry tartlet with a trilogy of Cookie and Garance tomato pestos, oven-dried Garance tomatoes, etc.; *Tartelette feuilletée en trilogie de pesto aux tomates Cookie et Garance, Tomates Garance séchées au four...*).





## Impacts 1

### Economic

#### F1 TERRADOU

##### *- Impact on producers:*

In 2014, the Provence Tomates factory (46% of French production in 2014) pioneered the use of F1 TERRADOU. Approximately 10% of the land harvested for this factory was planted with F1 TERRADOU (which means that in 2014, 4% of processing tomatoes in France were Terradou). In 2015, some 300 hectares should be planted to F1 TERRADOU out of the 2500 ha planted for processing tomatoes in France, or 12% of the land. All will be produced for Provence Tomate, but this is also the only factory that will pay for SDM.

We have insufficient experience to evaluate changes in the rest of the sector. In 2015, the second largest factory in terms of the quantity produced (Louis MARTIN), and which does not pay for SDM, may benefit marginally from the qualities of F1 TERRADOU and other SDM-rich varieties, because often the producers supply both factories.

The change in the mode of payment to producers was only made possible by the existence of new, productive and high SDM varieties.

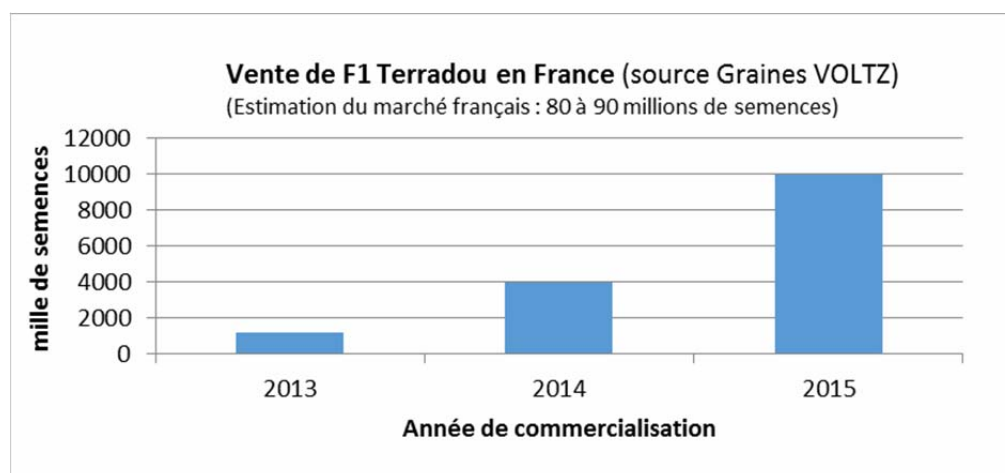
F1 TERRADOU could enable an increase of up to 15% on the price per tonne paid to producers when compared with the prices applied under the old system. The increase in income for Terradou producers could thus reach up to €130,000 in 2014 and €300,000 in 2015. Based on the price paid by hectare produced, this gain may fluctuate depending on whether the producer tends towards agronomic yield or SDM content, because of the inverse correlation between these two parameters. Overall, the agronomic yield of Terradou is near the mean of processing varieties (ranking second for agronomic value).

##### *- Impact for Provence Tomates:*

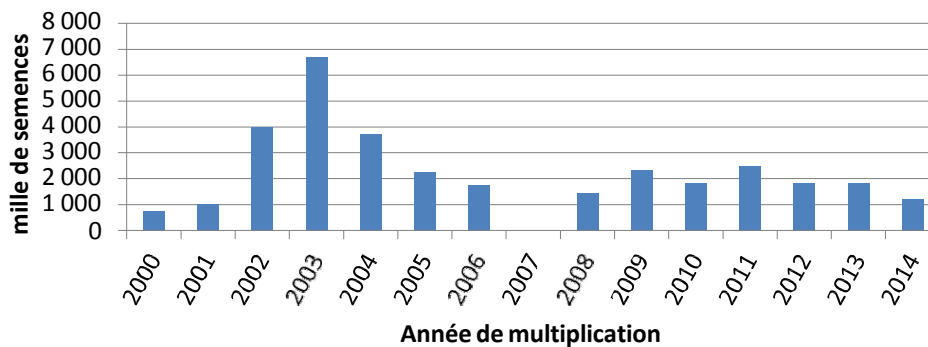
The Provence Tomates factory in Tarascon processed 79,000 tonnes of tomatoes in 2014. In 2015, F1 TERRADOU should represent 25-30% of supply to this factory. Working with a raw material with a higher SDM content causes a mechanical reduction in the energy necessary to produce concentrate as there is less water to be evaporated. Another gain, for the same quantity of fresh tomatoes entering the factory is that more concentrate will be produced. The use of a variety such as F1 TERRADOU markedly improves industrial yields, but detailed figures are not available.

##### *- Impact for Graines VOLTZ:*

Within the range of varieties sold by Graines VOLTZ, F1 TERRADOU accounts for 20% of sales in south-eastern France and has replaced other varieties, including F1 LEADER, which perform less well in terms of SDM content. This hybrid is thus sustaining the market share held by Graines VOLTZ. In 2015, sales forecasts in France for F1 TERRADOU are 10 million seeds, sold almost solely to producers contracted to Provence Tomates. In the south west, varieties are chosen by factories and by producer organisations; individual producers do not have any power over this choice. As a result, and for the purposes of equality, payment is the same for all producers. The deployment of high SDM varieties will be initiated by factories, on conditions that these varieties are mildew-resistant. Demand is being seen for a mildew-resistant version of F1 TERRADOU.



**Quantité de semences produites de F1 CALADOU** (source Agri-Obtentions)  
(Estimation du marché français : 80 à 90 millions de semences)



- Impact on the entire processing tomato sector:

Evolutions in the sector (reduction in planting density, sorting grid favouring SDM, success of F1 TERRADOU) had a driving effect on calls for proposals concerning the private-sector seed breeding of new varieties. In 2015, HEINZ 1293 was registered on the list of varieties approved by Provence Tomates for its characteristics close to F1 TERRADOU. There is no known genetic link between these two tomato varieties.

In the face of international competition, the production of new, SDM-rich varieties will provide the French sector with valuable gains in productivity and enable the maintenance of this type of production throughout southern France, where it is an important crop for many farms.

### **F1 GARANCE**

Several markets are targeted:

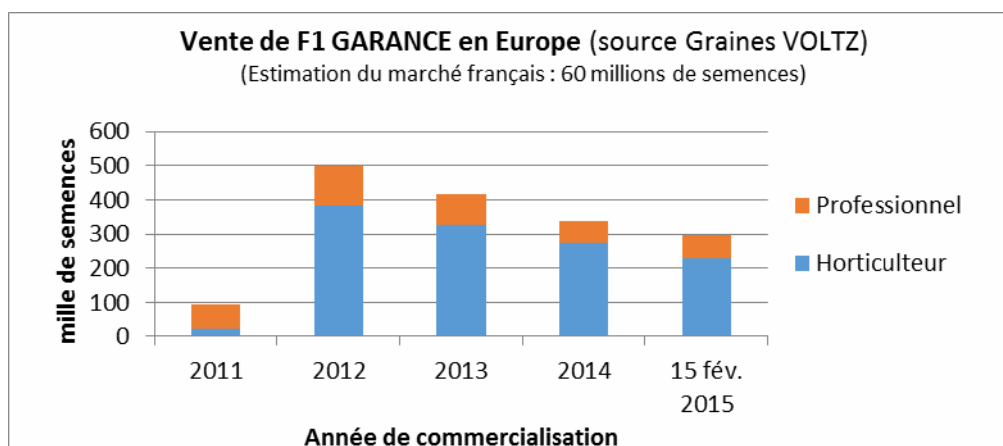
- + Professionals (nurseries, market garden producers)
- + Horticultural sector (garden centres via nurseries and the sale of seed in sachets to amateurs via the internet).

- *Impact on the fresh tomato sector:*

The marketing of F1 GARANCE is too recent to attempt to evaluate its impact on the sector, notably relative to the quality of fruits offered to consumers. The recommendations that accompany F1 GARANCE (harvest at ripeness, storage at ambient temperature) in order to fully exploit its quality potential have overturned practices in the sector, both during production and marketing. A period of adaptation is necessary.

Discussions are ongoing, particularly with organic distributors and major retailers, to exploit the fruit quality of F1 GARANCE. This approach will only develop if quality such as that of F1 GARANCE (organoleptic and storage) is supported by the introduction of new varieties with the same qualitative traits. This implies a change in direction for both breeders and those carrying out varietal trials. Indicators for this evolution could be the development of more qualitative ranges proposed to consumers and registration in the catalogue of new varieties claiming the same qualities as F1 GARANCE.

- *Impact for Graines VOLTZ:*



Any analysis of the early years of selling F1 GARANCE will differ depending on the market targeted.

In the professional sector, errors were made in the communication campaign that accompanied its launch; i.e. the lack of any recommendations regarding the obligatory grafting of this tomato. This resulted in the variety having a weakened image among producers in terms of yield, not compensated for by fruit quality. A business model still needs to be developed with marketing specialists in order to place value upon this quality.

For the horticultural sector (garden centres and amateurs), the development of a new variety requires a longer time step (around ten years). One explanation for the relatively marked fall in the volumes sold could be a reduction in the efforts made by Graines VOLTZ to invest in this market, notably with garden centres. Although it is easy to obtain F1 GARANCE seeds over the internet (Graines BAUMAUX), it is almost impossible to find plants in some regions, except in large garden centres.

## Environmental

### **F1 TERRADOU**

This hybrid has an important environmental impact in terms of energy. There are two ways to determine these energy gains, either in terms of the quantity of tomatoes delivered to the factory versus its production, or the need to grow fewer tomatoes to achieve the same production of concentrate (see Annex: Calculation of gain on SDM improvement.pdf).

F1 TERRADOU (5,5B) corresponded to an increase of 1°Brix regarding SDM versus the control used during collegial trials, F1 PERFECTPEEL (4.5°Brix). In the field, 1°Brix enables a 22% improvement in SDM production.

For the factory, the gain will vary slightly depending on the choice made: either an additional 18% of concentrate produced per tonne of processed tomatoes, or approximately 22% less tomatoes delivered to the unit. In both cases, there are important energy savings relative to operation of the industrial facilities.

To this can be added a gain in transport costs: under the first hypothesis it is small (1%) but under the second it is greater (22%).

It is more difficult to refine this estimation because energy savings depend on the type of machines used for concentration and the methods employed (cold break, hot break, etc.).

### **F1 GARANCE**

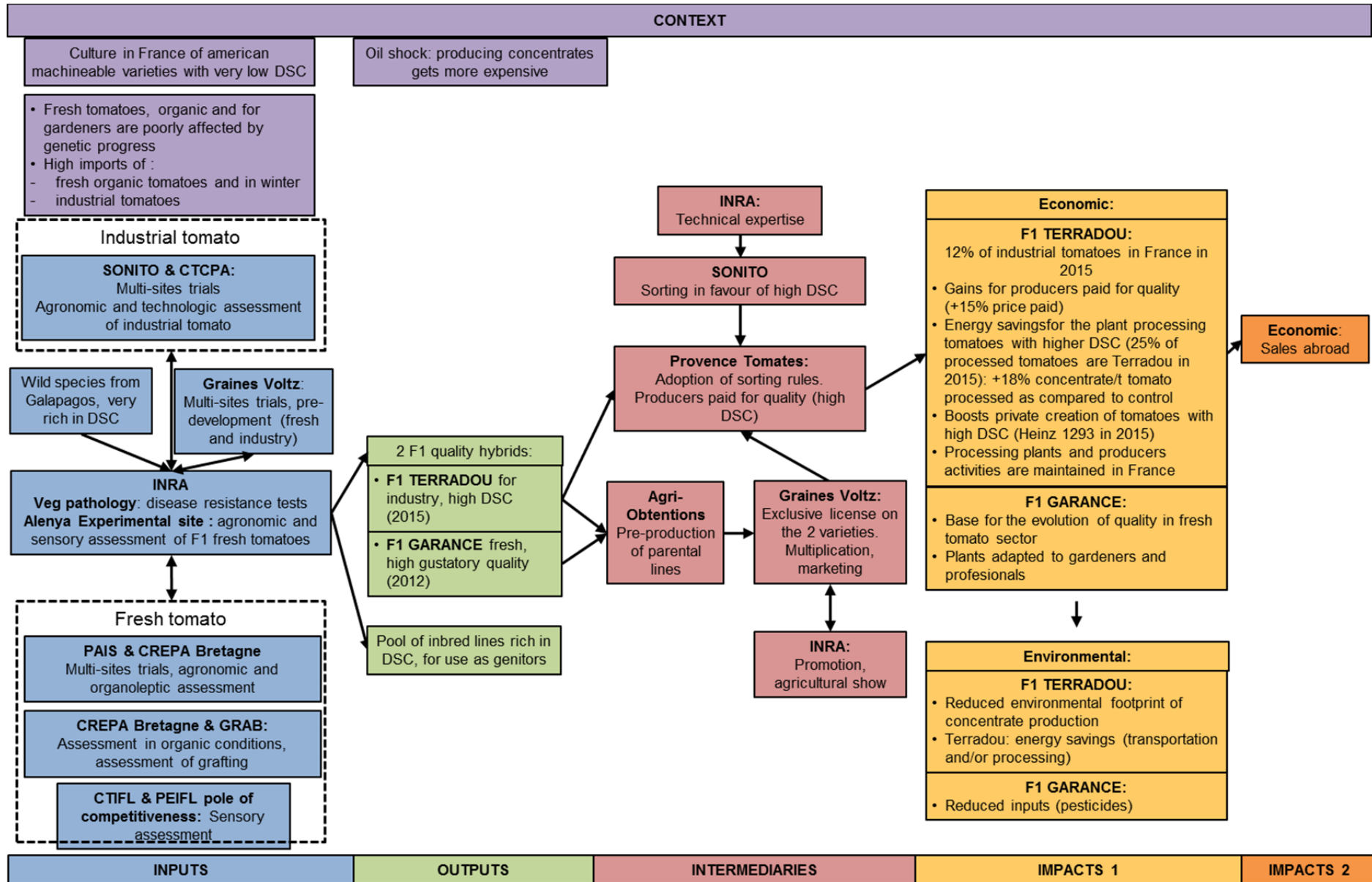
This hybrid is resistant to numerous diseases, which means a reduction in the use of pesticides and hence in the environmental impact of its cultivation. This use of genetic resistance has a favourable impact on the health value of the fruits.

If the recommendations concerning storage at ambient temperature are adopted by the sector, this will certainly enable a reduction in energy expenditure on refrigeration throughout the marketing chain. But it is much too early to evaluate these savings.

## **Impacts 2**

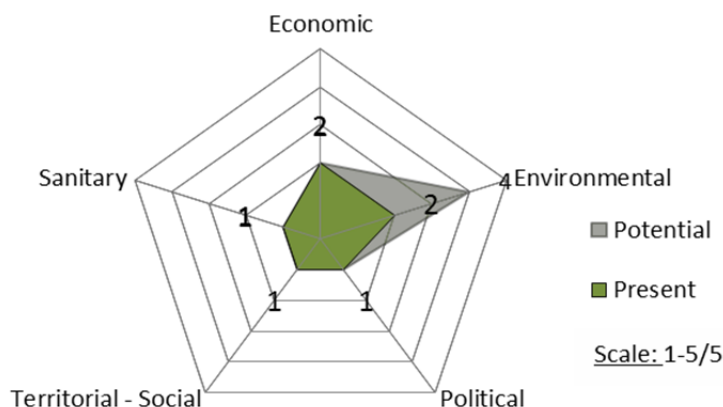
In Europe, it is still too early to assess the development of these two varieties. For F1 TERRADOU, large-scale trials will be carried out in 2015 by Graines VOLTZ in northern Italy. The high SDM content interests the processing industry. For F1 GARANCE, sales were made in 2015 by Graines VOLTZ in Germany (16-18%) and northern Spain (8%).

# Impact pathway



## Impact vector

Impact dimension	Importance	
Economic	2/5	<p>F1 TERRADOU: Up to +15% increase in income for producers of Terradou (+ €450,000 since 2014) Up to +18% concentrate/tonne of tomatoes processed. The processing of tomatoes with a higher SDM content will enable the pursuit of processing operations by Provence Tomates</p>
Environmental	2/5 Potentially 4/5	<p>F1 TERRADOU: Energy savings during the production of concentrate (up to -22% saved in transport or +18% in concentrate production) F1 GARANCE: Multi-resistant variety: reduction in pesticide use If the recommendations regarding storage at ambient temperature are adopted, major energy savings linked to post-harvest refrigeration can be achieved.</p>



## Data sources

- GIOVINAZZO Robert – SONITO – Avignon, Technical Manager
- BOS Hervé – Graines VOLTZ – Colmar, Développement Sud France
- LIVET Julien – Agri-Obtentions – Guyancourt, Marketing Development Engineer, Market Garden Species