Expected characters in GM of plants

Resistance (to infections, insects, chemical compounds, etc.) is one of the chapters with a higher interest in these proceedings, as well as the modifications to certain processes in the biological cycle of the fruit and its seed, or other changes that produce an added value to the crop[8].

Plants resistant to virus: the strategy typically followed has been to transfer a gene (or several genes) to the attacking virus itself that it is expected to be resistant to or even to other related viruses (for example a gene that codifies for a protein of viral capsids) acting like a vaccine. That is how, plants like tobacco, tomato, alfalfa, potato or rice have been transformed making them resistant to certain studied virus[3].

Plants resistant to bacteria: Just like before, the transformation of vegetable cells caused by the transfer of genes from other plants and even from insects or animals, allows the expression of proteins (of defensins type or equivalent substances like cercopine B or sarcotoxin, etc.) that give resistance to some type of bacteria[9].

Plants resistant to insects: Insects attacks represent one of the most important aspects to cultivate vegetables. There are many types of plagues in all types of plants produced by larvae or adult insects. There is a great interest for them from an economic perspective (there are annual losses of millions of dollars including not just a crop loss but also the expenses for its control and prevention, normally of a chemical type). Also, the social effect must not be forgotten as there is a reduction in food supply for citizens, particularly in developing countries[9]. Some of the obtained results through the use of these techniques have been incorporated and traded by big multinational companies. Bacteria genes that express proteins toxic for insects have been used. Plant genes expressing proteins that inhibit digestive enzymes of insects (generally proteases and amylases), have also been used[7]. A good example of this type of resistance to insects is mediated by a protein produced by the Bacillus thuringiensis bacteria, called δ-toxina or toxina Bt, which results toxic, selectively, for many insects. There are different variants and each one has a different action, like the Cry I, which is only toxic for lepidopterous (butterflies), the Cry III for coleopterous (beetles) or the Cry IV for dipterous (flies). Genetically modified plants that incorporate these genes are called Bt Plants. A variety of Bt corn resistant to "drills" is one of the examples known around the world[7].

Plants resistant to herbicides: Unwanted weed represent a negative factor in vegetable production with a great economic impact, as it has been estimated that up to 10% of the world's crops are lost because of their contamination with bad weed. There is also a loss of significant amount of money in combating and controlling the weed (according to some authors, more than ten million dollars per year, only for chemical herbicides), with the added inconvenience that the majority of these products do not distinguish between good crops and bad weed, leading to unavoidable "collateral" damages[9]. Given these facts, for years, the recombinant DNA technology suggested to obtain GM plants resistant to the active substances of some chemical herbicides. So it is expected that, through genetic manipulation, genes are transferred from other sources capable of providing the plant with resistance to herbicides; although other strategies have also been applied[9,1].

Plants resistant to fungus: The same strategy is followed and genes from different sources capable of expressing proteins, are introduced (they are called response proteins, RP) with enzymatic activity (chitinases or glucanases) degrading the fungus wall causing its death. Trials with genes capable of producing proteins with a toxic activity for the fungus, as it is the case of tionines or osmotines, have also been performed[8].

Controlled maturation by GM fruits

The process of maturation of the majority of fleshy fruits depends on the production of hormones (ethylene gas) inducing, therefore, the production of enzymes (like the polygalacturonase), pigments and scents that are characteristic of ripe fruit. Ethylene gas is used for the artificial maturation of fruits collected green because of the time imposed by trading channels and the shelf life of the fruit itself[1]. Through a technique that uses a synthetic antisense RNA (a sequence of RNA in opposite direction-3'-5'- that pairs up with the normal sequence and prevents its translation into ribosomes), it has been possible to suppress the expression of polygalacturonase, delaying the natural softening of tomatoes (the enzyme is the one responsible for the softening and senescence of the ripe fruit). The first commercialized GM tomato, the Flavr-Savr tomato (MacGregor tomato), belongs to this group and its commercialization was the first one authorized by the FDA in the United States, in May of 1994[8]. This same technique has also been used to get soy that contains 80% or even more oleic acid (the normal one contains 20%) by inhibiting the oleate desaturase enzyme[8].