SUMMARY

Eggplant (*Solanum melongena* L.) is one of the vegetables with highest content in phenolic compounds, giving eggplant a high antioxidant power and other bioactive beneficial health properties. This means that there is a growing demand among consumers concerned about a healthy diet. However, despite being a crop with a great economic importance worldwide, it is one of the least-studied *Solanaceae* (much less than tomato, pepper and potato), so it is necessary to carry out studies that contribute to the genetic improvement of eggplant to the commercial level so that the genetic diversity is increased and that is adapted to the demands of producers and consumers.

The work carried out in this Thesis aims to obtain relevant information for the breeding programmes of eggplant through the study of genetic diversity and development and use of tools for the morphological characterization as well as increasing genetic diversity in élite germplasm for the development of programs aimed at obtaining high-value hybrids. For achieving this objective, commercial eggplant (semi-larga) black type, as well as other types, origins and varieties of local material are used.

In the first part of the Thesis, we rely on the study of genetic diversity in *S. melongena* and the application of new tools to perform accurate morphological characterization and improve the process of selection of the breeding programs. This diversity studies have been conducted in three centres of origin side in different regions (Spain, Sri Lanka and China), in local materials of eggplant with different typologies, and new phenomic tools have been used for the morphological characterization of the fruit of the eggplant.

For most of the morphological characters there were no significant differences between the accessions of Spain, Sri Lanka and China, so that with the use of few characters accessions could be assigned correctly to their centre of diversity, which indicates a high degree of morphological differentiation. The morphological

differentiation is accompanied by a considerable differentiation at the molecular level, determined by SSR markers. On the other hand, the use of a few genomic SSRs molecular markers has made it possible to detect a considerable genetic variation in a collection of traditional varieties of different types (long, Semi-larga, Round and Listada de Gandía), confirming that Spain is a secondary center of diversity. To conclude this first part, the phenomic study phenomic of fruit shape using Tomato Analyzer software, allows a considerable improvement in the characterization with respect to conventional descriptors, since we have been able to study 23 quantitative characters and comparisons have been possible to find significant differences between materials both inside and between varietal groups. This is very useful for the characterization of germplasm and genetic resources as well as for the selection and improvement programmes of eggplant.

In the second part of this work, we deal with the development of plant material to increase the genetic base of eggplant cultivars and with the implementation of various programmes for genetic improvement. For this we plan and develop different breeding programs according to different objectives, including the implementation of a programme of improvement of a local variety with protected geographical indication (IGP), and increasing the diversity and new "elite" material of black type eggplant through a program of genetic improvement.

On one side, given that *S. incanum*, one of the species wild closer phylogenetically to *S. melongena*, presents phenolics amounts up to three times higher than those found in *S. melongena*, we have initiated a program for developing introgression lines (ILs) of *S. incanum* in the genetic background of *S. melongena*. The development of these ILs is very important for eggplant breeding, since it will allow that traits of interest of this species become introgressed in the genetic background of the eggplant. In addition, these lines will be a useful tool for the study of the evolution and domestication of this crop.

Regarding the work done with the local variety "Almagro Eggplant" with IGP status, and knowing that the variety is genetically heterogeneous, it was necessary to

rely on a program of individual selection. The material was selected both for its good performance in field and for their low prickliness. In order to improve the prickliness character in Almagro eggplant as main objective, we have performed a backcross program in which we used the H15 selection as recurrent parent and non-prickly eggplants (a black type and other morphologically similar to the Almagro) as donor parents.

To conclude this second part, a breeding programme in collaboration with a private company was performed in order to increase the genetic diversity, so that it may allow obtaining new genetic combinations and exploiting heterosis. The previous knowledge of the eggplant case creates the need to study the variability that exists today in the market through the use of molecular markers. After analyzing 30 commercial varieties with SSRs we could separate 3 large groups of black eggplant materials. The molecular characterization together with the morphological, indicate that there is a wide genetic diversity in the semi-long black type of eggplant, outside the materials typically used by breeders, which have a common genetic background to have been derived from the same sources. The materials obtained may be of interest to increase the heterosis of F_1 hybrids.

In summary, our work that shows that the study of the genetic diversity and the use of phenomics tools for morphological characterization, as well as the development of new plant material, is very useful for obtaining new varieties of eggplant as well as scientific and technical information of interest to other researchers and breeders. We have also found that "public-private research" interaction allows a synergistic collaboration in obtaining plant material and information of interest for vegetables breeding.