RESEARCH PROJECT

Utilization of crop wild relatives in eggplant pre-breeding for adaptation to climate change

Divulgation Manual

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INTRODUCTION

Climate change is a major concern of all the countries of the world and nowadays its negative impacts on the environment and particularly on agriculture are widely known. The effects of climate change are generally perceived by an increase of temperature and a decrease of rainfall. In Côte d'Ivoire, from 1960 to 2010, the temperature rose by an average of 1.6°C and rainfall decreased from 28.9% in the south to 7.7% in the north. There is also a shift and a reduction in the length of the rainy season associated with an increase of the duration of the dry season. The rain falls during the dry season and there are exceptional periods of aridity and heat wave during the rainy season. It is difficult to schedule sowing and harvest dates.

In order to adapt their farming practices to this new drought-predominant environment, farmers have modified the planting calendars, relying in particular on weather forecasts.

From a genetic point of view, this adaptation to drought for a given crop could be done using varieties that have been selected from wild relatives that grow naturally in arid regions.

It is this perspective that led the Polytechnic University of Valencia (Spain); The Horticultural Crops Research and Development Institute (Sri Lanka) and the Laboratory of Genetics (Biosciences Training and Research Unit) of the Félix Houphouët-Boigny University (Côte d'Ivoire) to initiate this research project entitled "**Utilization of crop wild relatives in eggplant pre-breeding for adaptation to climate change**"

OBJECTIVE OF THE PROJECT

The project aims to use the genetic diversity of wild relatives to improve the cultivated eggplant (*Solanum melongena*), with emphasis on the traits related to adaptation to climate change, particularly in South - East Asia and West Africa.

More specifically, the project plans, from different crosses, to transfer the resistance or drought tolerance abilities of wild species in the cultivated eggplant, *Solanum melongena*.

The material created and pre-selected may be used in different breeding programs by the breeders.

I – PLANT MATERIAL

The project is carried out with two types of plant material:

I.1 –Cultivated species

The cultivated species are *Solanum melongena*, and *Solanum aetiopicum*. *Solanum melongena* is represented by six accessions, three of which originate from Côte d'Ivoire (MEL1, MEL2, MEL3) and three from Sri Lanka (MEL4, MEL5, MEL6). Indeed, varieties of the species *S. melongena* cultivated in West Africa and in Southeast Asia are known to be genetically different.

Solanum aetiopicum is represented by an accession (AET1) which is a commercial variety sold by the seed company SEMIVOIRE.

CULTIVATED SPECIES

Name :*Solanum melongena*
Accession : BBS-118/B
Code : MEL1
Origin : Côte d'Ivoire


Name :*Solanum melongena*
Accession : BBS-146
Code : MEL2
Origin : Côte d'Ivoire


name :*Solanum melongena*
Accession : BBS-175
Code : MEL3
Origin : Côte d'Ivoire


Name :*Solanum melongena*
Accession : 7145
Code : MEL4
Origin : Sri Lanka

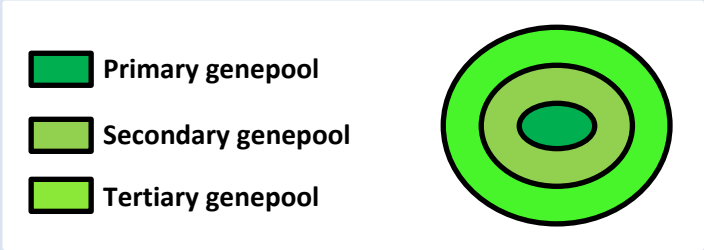

Name :*Solanum melongena*
Accession : 8104
Code : MEL5
Origin : Sri Lanka


Name :*Solanum melongena*
Accession : Ampara
Code : MEL6
Origin : Sri Lanka


Name :*Solanum aethiopicum*
Accession : Aub21NB
Code : AET1
Origin : Côte d'Ivoire (SEMIVOIRE)


I.2 – Wild relatives

Wild relatives are divided into three groups (genepools) depending on whether they are more or less easily crossed with the cultivated species *Solanum melongena*.



These wild relatives, consisted of 15 species, are represented by 27 accessions originating from different countries.

WILD RELATIVES, PRIMARY GENEPOOL

Name :*Solanum incanum*
Accession : MM664
Code : INC1
Origin : Israël

Name :*Solanum insanum*
Accession : SLKINS-1
Code : INS1
Origin : Sri Lanka

Name :*Solanum insanum*
Accession : SLKINS-2
Code : INS2
Origin : Sri Lanka

Name : *Solanum insanum*
Accession : MM498
Code : INS3
Origin : Japon

WILD RELATIVES, SECONDARY GENEPOOL

Name :*Solanum anguivi*
Accession : BBS119
Code : ANG1
Origin : Côte d'Ivoire


Name :*Solanum anguivi*
Accession : BBS125/B
Code : ANG2
Origin : Côte d'Ivoire


Name :*Solanum campylacanthum*
Accession : MM210
Code : CAM5
Origin : Ethiopia

Name : *Solanum campylacanthum*
Accession : MM670
Code : CAM6
Origin : Zambia


Name : *Solanum campylacanthum*
Accession : MM1430
Code : CAM7
Origin : Tanzania

Name : *Solanum campylacanthum*
Accession : MM695
Code : CAM8
Origin : unknown


Name :*Solanum dasyphyllum*
Accession : MM1153
Code : DAS1
Origin : Ouganda


Name :*Solanum lichtensteinii*
Accession : MM 674
Code : LIC1
Origin : South Africa


Name :*Solanum lichtensteinii*
Accession : MM677
Code : LIC2
Origin : Iran


Name : *Solanum lidii*
Accession : 4788
Code : LID1
Origin : Spain

Name : *Solanum linneanum*
Accession : JPT0028
Code : LIN1
Origin : Spain

Name : *Solanum linneanum*
Accession : 51191
Code : LIN3
Origin : Unknown (source: Germany)

Name : *Solanum pyracanthum*
Accession : SOLN-66
Code : PYR1
Origin : Unknown (source: Germany)

Name : *Solanum tomentosum*
Accession : MM992
Code : TOM1
Origin : South Africa

Name : *Solanum vespertilio*
Accession : 4601
Code : VES1
Origin : Spain

Name : *Solanum vespertilio*
Accession : BGV63218
Code : VES2
Origin : Spain

Name : *Solanum violaceum*
Accession : SLKVIL-1
Code : VIO1
Origin : Sri Lanka

WILD RELATIVES, TERTIARY GENEPOOL

Name : *Solanum eleagnifolium*
Accession : MM1627
Code : ELE1
Origin : Senegal


Name : *Solanum eleagnifolium*
Accession : Agora
Code : ELE2
Origin : Greece


Name : *Solanum sisymbriifolium*
Accession : SOLN-78
Code : SIS1
Origin : Unknown (source: USA)


Name : *Solanum sisymbriifolium*
Accession : 1180
Code : SIS2
Origin : Unknown (source: United Kingdom)


Name : *Solanum torvum*
Accession : SKLTOR-2
Code : TOR2
Origin : Sri Lanka


I.3 –Introgression Lines

Thirty (30) accessions of eggplant, known as introgression lines, are also used. The genome of each of these introgression lines consists essentially of that of the cultivated species *S. melongena* to which a portion of the genome of the wild relative *Solanum incanum* has been integrated following different successive crosses according to the following scheme::

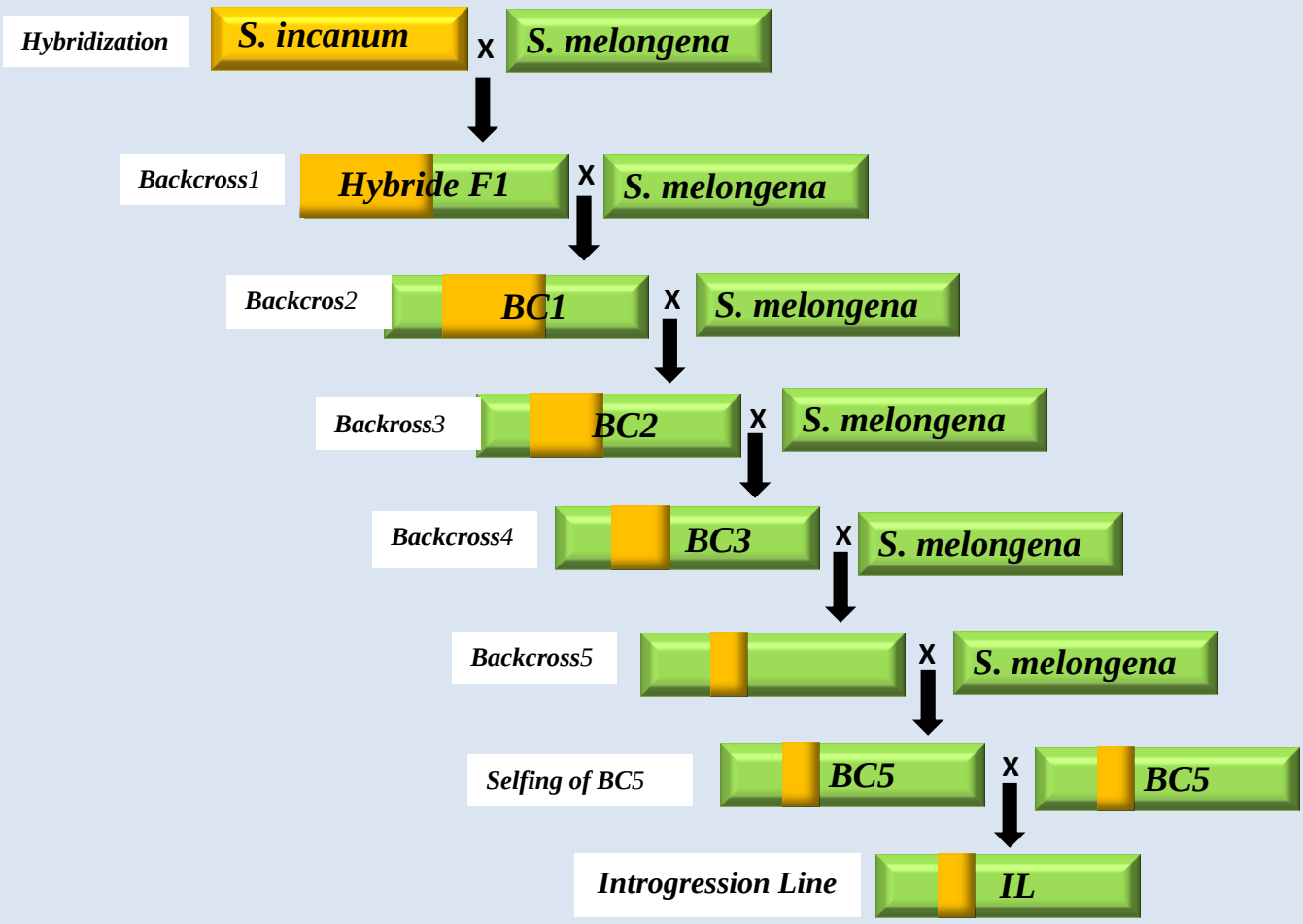
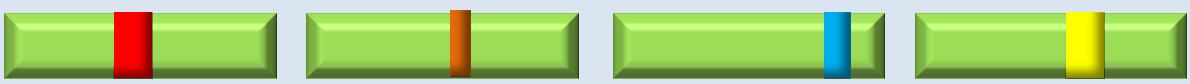


Figure I : Graphical representation of the crosses for the production of an introgression line

BC = Descendants of backcrosses
IL = Introgression Line

Depending on the portion of *S. incanum* genome integrated into that of *S. melongena*, different introgression lines, as illustrated below, can be obtained:



II – METHODOLOGICAL APPROACH

II.1. – Crosses "Wild relatives X *Solanum melongena*"

To ensure a permanent availability of their seeds, the 34 accessions of wild and cultivated eggplant are self-fertilized.

Accessions of cultivated eggplants (MEL1 to MEL 6) are crossed with wild accessions to obtain first generation hybrid progenies (Hybrid F1).

The F1 hybrids are then crossed with the cultivated accessions (MEL1 to MEL 6) to obtain first generation backcross descendants (BC1).

The BC1progenies are crossed with the cultivated accessions (MEL1 to MEL 6) to obtain second generation backcross progenies (BC2).

The F1hybrids, descendants of crosses between different wild species and accessions (MEL1 to MEL6) of the cultivated species, *Solanum melongena*, are crossed to obtain second generation hybrid progenies (Hybrids F2). The aim is to group together, in the F2 hybrids, the resistance or drought tolerance abilities of the different wild relatives.

II.2 – Crosses " introgression lines X *Solanum melongena*"

Each of the 30 introgression lines are crossed with the accessions MEL1 and MEL5 of eggplant, *Solanum melongena*, used as female parents, to obtain first generation hybrid introgression lines. These first generation hybrid introgression lines are then crossed with accessions MEL1 and MEL5 to obtain second generation hybrid introgression lines. The aim is to bring into the introgression lines the specific characteristics of West African (MEL1) and Southeast Asia (MEL5) eggplant varieties that are known to be genetically different.

II.3 – Evaluation of drought tolerance or resistance

Accessions of cultivated species and wild relatives and all their hybrid offspring are cultivated in the field under natural conditions of rainfall and drought and in greenhouse under controlled watering conditions. Their agro-morphological characteristics are measured in order to assess their tolerance or resistance to drought.

III –EXPECTED RESULTS

Introgression lines allow rapid use of genes of wild relatives in breeding programs for present and future purposes. They are of particular interest for pressing plant material selection needs, adapted to unforeseen climate changes.

At the end of this study, the plant material containing genes of wild species, of interest for the improvement of varieties of cultivated eggplant, particularly from South-East Asia and West Africa, will be obtained, kept appropriately in gene banks, and made available to researchers.

IV – SOME ILLUSTRATIVE RESULTS

Name :*Solanum melongena*
Accession : BBS-118/B
Code : MEL1
Origin : Côte d'Ivoire


✖

Name :*Solanum anguivi*
Accession : BBS125/B
Code : ANG2
Origin : Côte d'Ivoire


↓

Name : First generation hybrid offspring (F1)

Code : MEL1 x ANG2

✖

Name :*Solanum melongena*
Accession : BBS-118/B
Code : MEL1
Origin : Côte d'Ivoire


↓

Nom : Offspring of first backcross (BC1)

Code : (MEL1 x ANG2) x MEL1




Name :*Solanummelongena*
Accession : 8104
Code : MEL5
Origin : Sri Lanka

Name :*Solanum insanum*
Accession : MM498
Code : INS3
Origin : Japon

Name : First generation hybrid offspring (F1)
Code : MEL5 x INS3

Name : *Solanum melongena*
Accession : 8104
Code : MEL5
Origin : Sri Lanka

Name : Offspring of first backcross (BC1)

Code : (MEL5 x INS3) x MEL5