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Production and management of stone pine (*Pinus pinea*) for early nut production: grafted plantations as an alternative for restoring degraded areas and generating income in rural communities of Tunisia

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Abstract. We introduce a four years project (2008-2012), supported by the Program of Scientific Cooperation and Interuniversity Research (PCI), funded by the Spanish Agency for International Development Cooperation (AECID), and implemented in Tunisia and Spain. The objective of the project was to establish a systematic methodology for producing grafted plant using two types of stock: *Pinus pinea* and *Pinus halepensis*, from known provenances from Spain and Tunisia and to implement field trials in both countries, on different hydric and edaphic conditions, for evaluating the development of the plantations. Due to *Pinus pinea* interest for nut production, grafted *Pinus pinea* plantations for early and abundant cone yield can be an interesting alternative for restoring and revalorize some Mediterranean areas, generating both economic and ecological benefits (soil protection).

Keywords. Cooperation project – *Pinus halepensis* root-stocks – Nursery – Spain.

Production et gestion du pin pignon (*Pinus pinea* L.) pour une production précoce de pignons : les plantations greffées comme alternative pour la restauration de zones dégradées et pour la création de revenus chez des communautés rurales de Tunisie

Résumé. Nous présentons ici un projet quadriennal (2008-2012), mené avec l'appui du Programme de Coopération Interuniversitaire et de Recherche Scientifique (PCI), financé par l'Agence Espagnole pour la Coopération Internationale au Développement (AECID), et mis en place en Tunisie et en Espagne. L'objectif de ce projet était d'établir une méthodologie systématique pour produire des plants greffés en utilisant deux types de porte-greffe : *Pinus pinea* et *Pinus halepensis*, de provenances connues d'Espagne et de Tunisie, et de mettre en place des essais de terrain dans ces deux pays, sous différentes conditions hydriques et édaphiques, afin d'évaluer le développement des plantations. Dû à l'intérêt de *Pinus pinea* pour la production de pignons, les plantations greffées de *Pinus pinea* pour une production précoce et abondante de cônes peuvent constituer une alternative intéressante afin de restaurer et de revaloriser certaines zones méditerranéennes, créant ainsi des bénéfices autant économiques qu'écologiques (protection du sol).

Mots-clés. Projet de coopération – Porte-greffe *Pinus halepensis* – Pépinière – Espagne.

I – Introduction

Pinus pinea is one of the most appreciated species in the Mediterranean basin due to the multiple products and functions it offers (timber and fruit production, soil protection, biodiversity, or landscape). Between them the most interesting from the economic point of view is the pine

nut production. In Spain and Tunisia there is a great interest from forest managers in how to improve *Pinus pinea* cones production.

In this sense, the grafted plantations can be a good chance for restoring degraded areas and generating income in rural communities in both countries. Moreover, grafting *Pinus pinea* on *Pinus halepensis* rootstocks can result interesting for their use in semiarid calcareous sites where their root system is supposed to be better adapted – one of the objectives of the presented project was the establishment of field trials about this question.

In Tunis, *Pinus pinea* has been planted since 1907 in reforestation programs, being the most important specie after *Pinus halepensis*, occupying about 20,000 ha. To the present, the potential of grafted plantations for cone production has not been evaluated, though its interest motivated the preparation of a project, for resolving questions about grafting techniques and plantation management.

The main objectives of the project were:

- (i) to strengthen institutionally INRGREF in order to promote its research and training capacities with regard to production and management of grafted stone pine,
- (ii) to establish a systematic methodology for producing grafted plant using two types of stock: *Pinus pinea* and *Pinus halepensis*, from known provenances from Spain and Tunisia,
- (iii) to assess grafting success on both rootstock types and grafting techniques,
- (iv) to evaluate the adaptation of different rootstocks to different water and soil conditions at nursery,
- (v) to produce grafted stone pines from selected Spanish and Tunisian vegetative materials for the establishment of new plantations,
- (vi) to implement field trials in both countries, under different water and soil conditions, evaluating the development of the plantations,
- (vii) to share and transfer techniques and results.

II – Stages of the project

During the first year of the project (2008) the research teams from both countries came together to update available knowledge, revise the methodology and reinforce capacities for vegetative materials collection. In Spain, a first grafting trial in nursery was established (Fig. 1).



Fig. 1. Left: *Pinus halepensis* and *Pinus pinea* stocks prepared for grafting. Right: Scion selection for grafting in Spanish clone banks.

In 2009, we focused on the selection and characterization of vegetative materials and stock production under controlled nursery conditions. Experimental grafting experiences in Spain made possible to transfer this technique during a visit of the Spanish team to Tunisia (Fig. 2). A field trial under controlled conditions with Spanish grafted material was also done.



Fig. 2. Left: *Pinus halepensis* and *Pinus pinea* stock production in Tunisia. Right: Grafting in Tunisia using selected Spanish scions.

In 2010, the trials implemented in Spain during the previous years were followed and further selection of vegetative materials and new nursery experiences were performed (Fig. 3).



Fig. 3. Left: Scion collection for grafting. Right: Stocks production for nursery experiences (water stress trial) in Spain.

Also in 2010, in Tunisia a greenhouse was built and equipped, in order to implement further trials and to produce suitable grafted materials. Despite a low grafting success, the systematic methodology was consolidated and the Tunisian team could start training local staff (Fig. 4). Another visit to Tunisia for grafting transfer was done.



Fig. 4. Left: Grafting technique transfer in Tunisia. Right: Stocks production for nursery experiences (test of soil conditions) in Tunisia.

During 2011, field trials under natural conditions were implemented in Spain and Tunis (Fig. 5) and the data obtained from the experiences were processed. A planned trip of the Spanish team to Tunisia in March was postponed one year due to the political situation in Spring 2011.



Fig. 5. Grafted plantations installed in Spain (left) and Tunisia (right).

In March 2012 finally, the trip to Tunisia was done for grafting selected Spanish and Tunisian material for the establishment of new plantations at the end of the year, continuing the instruction of Tunisian grafters (Fig. 6). Also, during the visit we worked in the preparation of a final conference, for sharing experiences and results emerging from the project, which may enhance research and transfer capacities.



Fig. 6. Grafted material in Tunisia (2012).

In the project several coordination meetings, techniques transfer and information exchange have been done in both countries (Fig. 7).



Fig. 7. Left: Meeting in Solsona, November 2008. Right: Final conference in Tunis, March 2012.

In the final meeting conference, held in June 2012 at the National Gene Bank in Tunis, main results of the project were presented, in relation to:

(i) The adaptation of the different provenances of *Pinus pinea* and *Pinus halepensis* stocks, from Tunisia and Spain, to different water stress conditions.

(ii) Success of *Pinus pinea* grafting on *Pinus pinea* and *Pinus halepensis* root-stocks from Tunisia and Spain.

(iii) Experiences of *Pinus pinea* grafted plantations installed in Tunisia and Spain (planted material: *Pinus pinea* grafted on *Pinus pinea* and *Pinus halepensis* root-stocks from Tunisia and Spain).

Part of these results have been presented also at the AGROPINE2011 Meeting on Mediterranean stone pine for Agroforestry held in Valladolid, and in the present issue of Options Méditerranéennes.

III – Conclusions

The collaboration between both countries has resulted very interesting and beneficial. Despite some logistic problems and delays in some phases of execution, as the building and equipment of a nursery in Tunisia or the field plantations, the main objectives of the project has been obtained successfully.

We hope that the result of this technical and scientific collaboration will promote research and training capacities with regard to production and management of grafted stone pine, in order to promote its plantations as an alternative for restoring degraded areas and generating income in rural communities of Mediterranean basin, especially in Tunisia.

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