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# Assessment of control pollinated progenies as almond rootstocks

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**Abstract.** In order to select almond seedling rootstocks, many trials were conducted, at the Agricultural Experimental Unity located at the north east of Tunisia, to study the value as rootstocks of open pollinated almond genotypes. More vigorous and more developed seedlings with branched root system progenies were obtained. This study aimed to assess growth characteristics of almond seedlings obtained from controlled pollination. Thus, eight local genotypes: 'G12-2', 'Tozeur 3', 'G12-4', 'G24-12', 'G24-10', 'G23-15', 'G25-6', 'G25-8' and one foreign almond variety 'Fasciuneddu', were used as parentages in several controlled crosses. The fruit set was followed, but only two out of seven crosses carried out yielded fruits. Seeds harvested from the two crosses and a mixture of bitter almond seeds, the most popular rootstock in Tunisian nursery, used as control, were germinated and sown in plastic bags. Plant height, stem diameter at the ground level, number of shoots and distance up to the first shoot, were determined during vegetative dormancy. Statistical analysis showed significant differences between progenies derived from cross pollination and those from bitter almond seeds. A great vegetative growth was recorded on the progenies of 'G25-6' x 'G25-8'. The average plant height and stem diameter at the ground level was 103.88cm and 8.95mm respectively. Moreover, these progenies showed the higher distance up to the first shoot, which facilitate the grafting. The cross made between 'G12-2' and 'Tozeur 3' has also provided homogeneous and vigorous seedlings. So these results showed that cross pollination may be used to select almond rootstock seedlings.

**Keywords.** Rootstocks – Almond – Progenies – Crosses – Vigorous – Pollination.

***Evaluation de la valeur comme porte-greffe de descendants d'amandiers issus de pollinisation contrôlée***

***Résumé.*** *Plusieurs études de la valeur comme porte-greffe de semis d'amandiers ont été menées à l'Unité d'Expérimentation Agricole située au nord est de la Tunisie. Des descendants issus de pollinisation libre très vigoureux et à système radiculaire très développé et ramifié ont été obtenus. Cette étude a pour objectif l'évaluation des caractéristiques de croissance de descendants issus de pollinisation contrôlée. Ainsi, 8 génotypes locaux: 'G12-2', 'Tozeur 3', 'G12-4', 'G24-12', 'G24-10', 'G23-15', 'G25-6', 'G25-8' et une variété introduite d'Italie 'Fasciuneddu' ont été utilisés comme parents pour la réalisation de 7 croisements. Le taux de nouaison a été suivi et seul deux croisements ont donné des fruits. Après stratification, le semis des amandes obtenues et d'un mélange d'amandes amères, principal porte-greffe utilisé en Tunisie pour l'amandier, a été réalisé en sachets. La hauteur, le diamètre de la tige au niveau du sol, le nombre d'anticipés et la distance d'insertion du premier anticipé ont été déterminés au cours de la dormance végétative. Des différences significatives ont été obtenues entre les descendants issus de pollinisation contrôlée et ceux issus du mélange d'amandes amères. Ceux issus du croisement 'G25-6' x 'G25-8' se sont distingués par leur grande vigueur. Leur hauteur moyenne a été de 103.88cm et le diamètre moyen au sol de la tige a été de 8.95mm. De plus, ils se sont caractérisés par la plus grande distance d'insertion du premier anticipé. Le croisement 'G12-2' x 'Tozeur 3' a également fourni des descendants vigoureux et homogènes. Ces résultats montent que la pollinisation contrôlée peut être utilisée pour la sélection de porte – greffes francs d'amandier.*

***Mots-clés.*** *Porte-greffe – Amandier – Descendants – Croisement – Vigoureux – Pollinisation.*

## I – Introduction

Almond is the second stone fruit specie cultivated in Tunisia, for that reason a research for new almond seedling rootstock was undertaken by the National Institute of Agronomic Research since the seventies. A large phenotypic diversity of local and foreign almond varieties was collected (Dumont *et al.*, 1970). Collections were established in the north, center and the south of the country, with a project supported by FAO, the Ministry of Agriculture and GREMPA coordination.

The observation along 2002 until 2005 of the *Prunus* rootstock collection located at the Agricultural Experiment Unity, allowed the selection of several local and foreign almond genotypes. The behavior of their open pollinated progenies as almond seedling rootstocks seems to be promising in comparison with those derived from bitter almond seed mixtures of unknown origin. Vigorous seedlings with expanded and ramified root system were obtained in pots in 2002 (Mselmi *et al.*, 2014).

Thereafter, the possibility to produce progenies from concurring flowering period in almond varieties proposed by Bernhard and Grasselly (1969) and applied by Simard *et al*. (1997), became our main objective since 2006. Thus, the aim of this study was first to cheek pollinators for five selected mother almond genotypes and to evaluate their control pollinated offspring as almond rootstocks. Almond progenies arising from artificial pollination were assessed for growth characteristics. Seedlings derived from mixture of bitter almond seeds, were used as control.

## II – Materials and methods

This study was carried out at the Agricultural Experimental Unity situated at the northeast Tunisia at an altitude of 44 meters during 2006-2008. Eight local genotypes and one foreign almond variety: 'Fasciuneddu' (Table 1), selected in *Prunus* rootstock collection for their good production in a rainfed orchard, were used as parents.

**Table 1. List of selected almond genotypes**

| Genotypes | Origin | Peak production kg almond shell /tree |
|---|---|---|
| 'Fasciuneddu' | Italy | 6 |
| 'G12-2' | Unknown origin | 6 |
| 'Tozeur 3' | Oasis Tozeur Tunisia | 8 |
| 'G23-15' | Chance cultivar North (Tunisia) | 5 |
| 'G24-10' | Chance cultivar North (Tunisia) | 9.8 |
| 'G24-12' | Chance cultivar North (Tunisia) | 13 |
| 'G12-4' | Unknown origin | 5 |
| 'G25-8' | Chance cultivar North (Tunisia) | 4 |
| 'G25-6' | Chance cultivar North (Tunisia) | 6 |

Five selected genotypes ('Tozeur 3', 'G12-2', 'G24-12', 'G25-6' and 'Fasciuneddu') were used as mother parents and seven crosses were carried out in 2006 between mid – February and early March. Hand pollination was done on emasculated flower buds, at stage D (Felipe, 1977). The fruit setting was observed two months after pollination and fruit set rate was determined on July.

At the end of 2006, all harvested seeds together with a mixture of bitter almond seeds, were stratified in a moist perlite in plastic bags and kept at 7°C in a fridge. The germinated seeds were sown in February 2007, in a 3:1 (v/v) mixture of peat and perlite in ten liter plastic bags and kept in shaded greenhouse. Heights, diameters at the ground level, number of shoots of the progenies and the distance up to the first shoot were recorded at vegetative dormancy. One way analysis of variance was done using SAS-98 (version 2008) and means values were compared using Duncan's test.

## III – Results and discussion

### 1. Fruit set percentage

In total we have pollinated 874 flower buds; a total fruit setting rate of 13% was obtained. Similar fruit rates setting ranging from 4% to 11% were reported on 64 crosses made two years at INRA Avignon (French) (Simard *et al*., 1997), although a higher number of flowers were pollinated in this last trial.

The fruit setting obtained two months after pollination showed that in four crosses we did not observed fruit setting (Table 2). A large number of flowers should be carried out to verify their incompatibility. The fruit set rate ranged from 2.2% to 60% and the two crosses: 'G12-2'x'Tozeur 3' and 'G25-6'x'G25-8' gave 16.7% and 60% respectively. Almonds obtained from these two crosses were harvested respectively at mid – July and late August to assess their agronomic trait as an almond rootstock.

**Table 2. Fruit set of seven crosses carried between eight almond genotypes**

| Crosses | No. of pollinated flowers | No. of fruits two months after pollination | Fruit set rate (%) | No. of fruits harvested |
|---|---|---|---|---|
| 'Tozeur 3'x'G12-4' | 95 | 0 | 0 | 0 |
| 'G12-2'x'Tozeur 3' | 280 | 47 | 16.7 | 47 |
| 'G24-12'x'G24-10' | 77 | 0 | 0 | 0 |
| 'Fasciuneddu'x'G12-2' | 150 | 0 | 0 | 0 |
| 'G12-2'x'Fasciuneddu' | 72 | 0 | 0 | 0 |
| 'G12-2'x'G23-15' | 90 | 2 | 2.2 | 2 |
| 'G25-6'x'G25-8' | 110 | 66 | 60 | 47 |

No: Number.

### 2. Growth characteristics

A high emergence rate, at about 88% was recorded one month after planting germinated seeds, which also showed high percentage. The height, the ground diameter of the stem, the number of shoot and the distance up to the first shoot of the progenies recorded at vegetative dormancy are reported on Table 3.

**Table 3. Growth characteristics of controlled and open mixture bitter almond progenies**

| Crosses | No. of seedlings | Height (cm) | Stem diameter (mm) | No. of shoots | Distance up to the first shoot (cm) |
|---|---|---|---|---|---|
| 'G25-6'x'G25-8' | 34 | 103.88a† ± 26.99 | 8.95a ± 1.0 | 24.5a ± 8.47 | 15.69a ± 3.23 |
| 'G12-2'x'Tozeur 3' | 32 | 94.28a ± 18.7 | 8.14b ± 0.97 | 20.5a ± 8.20 | 9.92b ± 3.12 |
| Control: bitter almond | 15 | 69.32b ± 11.54 | 6.60c ± 0.64 | 21.9a ± 3.01 | 5.72c ± 2.46 |

†: Mean values followed by the same letters within a column are not significantly different at the 0.05 level according to Duncan's test.

The progenies derived from control pollinated seeds were significantly ($P \leq 0.05$) more vigorous than those obtained from an unknown mixture of bitter almond. The height ranged from 94.2cm on the progenies of 'G12-2'x'Tozeur 3' cross to 103.8cm on those obtained from the crossing of 'G25-6' by 'G25-8'. Statistical analysis showed high significantly differences ($P \leq 0.01$) among stem diameters at the ground, showing the highest value by the crossing 'G25-6'x'G25-8'. All seedlings

were sufficiently branched; the mean number of shoots ranged from 20.5 to 24.5 and was significantly similar. Similar rate of branching in stem seedlings, were obtained in open pollinated progenies of 'Garrigues' and 'Tozeur 3' almond varieties (Simard *et al*., 1997). An average shoot number of 17.7, 19.7, 20.1 and 22.9, was also recorded on respectively open pollinated seedlings of 'G25-8', 'G25-6', 'Tozeur 3' and 'G12-2' almond genotypes planted in nursery in 2004 (Unpublished data). The mean distance up to the first shoot was significantly ($P \leq 0.01$) higher on the offspring of 'G25-6'x 'G25-8' cross (15.69cm). The highest distance is the better; since it facilitates the grafting. Homogeneity was observed on progenies of 'G12-2' crossed by the local almond 'Tozeur 3'. This genotype might be a good pollinator for 'G12-2' particularly as their open pollinated offspring showed good graft compatibility in orchard with 'Tuono' variety (unpublished data).

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