# Pollination management of Tunisian self-incompatible table olive (*Olea europaea* L.) variety “Meski”

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**Abstract**

The cross-pollination of olive self-incompatible variety Meski (Tunisia) was accomplished by interplanting Picholine variety (France) in an irrigated field in the central and continental location of Sidi Bouzid with a density of 204 trees $ha^{-1}$ (7 m / 7 m). Olive production was averaged for each tree Meski for 2006-2015 period. Trees were grouped according to the minimum distance from the first pollenizer tree and to the number of pollenizers in the first three squares around the tree Meski. The relationships between olive production and the distance from Picholine pollenizer as well as the relationships of Meski olive production and the number of Picholine pollenizer were analyzed with regression models. No significant effects were observed. Thus, the first pollenizer could be placed in the second row (14 m). The pollenizer number might be 0 in the first square around Meski, 1 in the second square and 3 in the third square. In total, the three first squares should totalize a maximum of 4 pollenizer trees. Results showed an optimum olive production with 8% of pollenizers in Meski plantations. Thus, the low productive performance of Meski is not due to low autopollination but other factors could be involved.

**Key words:** Olive, Meski variety, Pollination, Tunisia.

**Résumé**

La pollinisation croisée de la variété d’olive auto-incompatible Meski (Tunisie) a été réalisée par l’interplantation de la variété Picholine (France) dans un champ irrigué dans la zone centrale et continentale de Sidi Bouzid avec une densité de 204 arbres $ha^{-1}$ (7 m / 7 m). La production d’olives moyenne a été calculée pour chaque arbre Meski sur la période 2006 à 2015. Les arbres ont été regroupés en fonction de la distance minimale par rapport au premier arbre pollinisateur et le nombre de polinisateurs dans les trois premières carrés autour de l’arbre Meski. Les relations de régression entre la production d’olives Meski et sa distance du pollinisateur Picholine d’une part, et entre la production d’olive Meski et le nombre de pollinisateurs Picholine d’autre part, étaient toutes non significatives. Ainsi, le premier arbre pollinisateur pourrait être placé dans le second carré (14 m). Le nombre de pollinisateurs pourrait être 0 dans le premier carré autour de Meski, 1 dans le deuxième carré et 3 dans le troisième carré. Au total, les trois premiers carrés devraient totaliser un maximum de 4 arbres pollinisateurs. Les résultats ont montré une production optimale d’olive avec 8% des polinisateurs dans les plantations Meski. Ainsi, la faible performance productive de Meski n’est pas seulement due à la faible autopollinisation mais d’autres facteurs seraient également impliqués.

**Mots clés**: Olive, variété Meski, Pollinisation, Tunisie

## INTRODUCTION

Self-incompatibility is widespread in different olive cultivars and results in a high degree of sterility (Ciampolini *et al*., 1983). All researchers highlighted the necessity of cross-pollination, especially in partial self-fertile and self-sterile cultivars (Lavee and Datt, 1978; Cuevas and Rallo, 1990; Mehri and Kamoun-Mehri, 1995; Cuevas and Polito, 1997; Daoud, 1997; Mehri*et al*.,2003). Such recommendation seems to be necessary in order to increase fruit set and to ensure satisfactory fruit production (Vidal, 1969; Tombesi, 1978). The most popular partial self-fertile varieties are Picholine Marocaine and Manzanille (COI, 2000).The self-incompatibility was reported for several olive varieties such as Lucques from France (Lavee *et al*., 1997), Chemlal from Algeria (COI, 2000)and Meski from Tunisia (Mehri *et al*., 2003). Lavee *et al*., (1997) reported a good productive behavior of Uovo di piccione variety as pollenizer for many cultivars such as Manzanille, Mission and Ascolana. In Tunisia, the variety Picholine from France was the most effective pollenizer for Meski (Mehri *et al*., 2003) and its pollen grain exhibited the highest germination rate on Meski pistil (Ben Amar *et al*., 2013).

Meski is the most important table olive variety in Tunisia (Khabou *et al*., 2009) which is suitable for green and black table olive processing (Mehri *et al*., 2003). Unfortunately, the cultivar fails to set satisfactory yields most likely due to self-incompatibility (Mehri *et al*.,2003).The fruit

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set in self-pollination of Meski did not exceed 0.83 % as reported by Mehri and Kamoun-Mehri (1995), while the cross-pollination with Picholine increase the fruit set percentage up to 2% (Mehri *et al*., 2003).

To optimize fruit set in olive trees, Lavee *et al*. (1997) reported that about 10% of pollenizer trees in the field were recommended for interplanting with the olive varieties for cross-pollination. It is interesting to note that this rate might be affected by the land topography, the wind speed and the temperature, according to Lavee *et al*., (1997).

In Tunisia, no information is available on the pollenizer rate of Picholine in Meski plantations as well as on their spatial distribution. A wide range of pollenizer rate,up to 30% for Meski, is adopted by Tunisian farmers (Ben Amar, personal communication).

The objective of the present study was to investigate the management of cross-pollination of the Tunisian table olive variety Meski by French cultivar Picholine as pollenizer.

## MATERIALS AND METHODS

Pollination study for table olive Meski variety was carried out on 303 trees planted in an orchard during 1988-1989 with a density of 204 trees ha$^{-1}$ (7 m / 7m). The orchard is located in the central and continental department of Sidi Bouzid in Tunisia (35° 2' 25" North, 9° 29' 37" East).The olive trees were grown in similar pedoclimatic conditions and have received the same crop management practices. Thus, drip irrigation was used with two ramps and four drippers per tree giving 8 litres hour$^{-1}$ each.

Because of self-incompatibility, cross pollination needed for Meski variety and Picholine variety as pollenizer. In this field, 61 Picholine trees were planted at a frequency of approximately 1 to 5 or about 20 %.

The olive production per tree for each tree Meski was recorded in early maturity stage (yellow pale color of the fruit) for ten years (2006 to 2015). Average olive production per tree was calculated over the years as well as the standard error for the whole period.

The trees were grouped according to their linear distance far from the nearest pollenizer tree. In our case, these distances are 7.0 m, 9.9 m, 11.3 m, 14.0 m, 15.6 m and 19.8 m. Also, tree grouping was done according to the number of pollenizer trees around Meski tree in the first square, the two first squares and the three first squares, as shown in Figure 1. This number varies respectively from 0 to 5, from 1 to 9 and from 4 to 14.

For each group, average olive production per tree and the correspondent standard error were determined. Linear regression equation for each grouping method was established as well as the determination coefficient of the regression ($R^2$). The statistical significance of the regression was estimated by F test at 0.05 level.

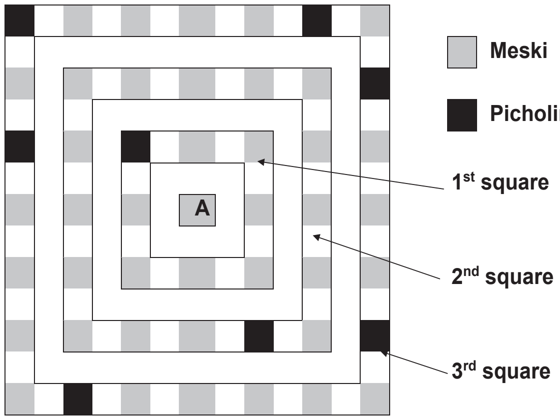


*Figure 1: An example of distribution of Picholine pollenizer trees in the first three squares around Meski tree A.*

## RESULT AND DISCUSSION

### Effect of pollenizer distance

Average olive production of trees with the same linear distance far from the first pollenizer was determined (Figure 2).

This parameter did not differ greatly among the different distances. Thus, average olive production per tree varies slightly from 10 to 14 kg (It is 40 % increase). Except for

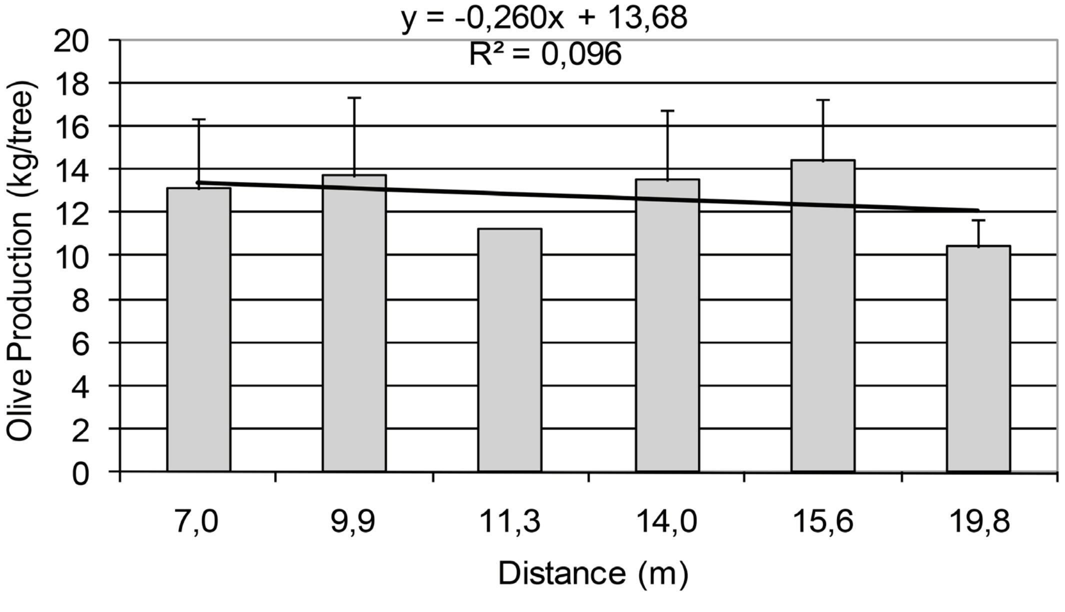


*Figure 2: Average olive production (kg/tree) of Meski trees for the period 2006-2015, as affected by distance from the first pollenizer and the corresponding regression equation*

distances 11.3 m and 19.8 m where olive production per tree is lower than 11.5 kg, trees in all the other distances had practically similar olive production and higher than the obvious distances, ranging from 13.1 to 14.5 kg.

We failed to find significant linear regression between production and distance since the equation slope is not significant at 5% level ($p = 0.46$) as shown in Figure 2. In fact, the coefficient of determination (0.096) means that only 10% of the olive production variation can be explained by its relationship to pollenizer distance. Obviously, many other factors could affect the olive production of Meski trees. According to Figure 2, optimal and similar olive production was given even by distances 7.0 m, 9.9 m, 14.0 m and 15.6 m. This regression suggests that the first pollenizer position might be in the second row,14.0 m far from Meski. Some authors have proposed 30 to 40 m as the maximum distance from pollenizers (Griggs *et al*., 1975; Lavee and Datt, 1978).

**Effect of the number of pollenizers**

The equation of the regression line for the olive production and the number of pollenizers in the first square data (Figure 3) is as follows: $y = -0.391 x + 14.211$. The slope of this line indicates that for an increase in the number of pollenizer by one, the expected decrease in olive production is 0.391 kg. Therefore, pollenizer number accounts for only 27 % of the total variation in olive production. This means that 73 % of the variation in olive production is not due to pollenizers number differences. This may be due to other unknown factors that affect the level of olive production.

According to the linear regression, olive production decrease was not significant with increasing pollenizer number in the first square since the probability at 5 % level is 0.46. This indicates that optimal olive production can be equally obtained by pollenizer number ranging from 0 to 5 without serious loss of production. Although, olive production differed widely from 11.1 (5 pollenizers) to 14.6 kg (2 pollenizers) (Figure 3), an olive production decrease of 0.4 kg is noted by the addition of one pollenizer (slope = -0.391). This would imply that the non presence of pollenizers in the first square can optimized the olive production of Meski.

In the first two squares around Meski, the number of pollenizers contributes with only 2% in the total variation of olive production (Figure 4).

Although olive production varied widely from 11.56 (1 pollenizer) to 15 kg (7 pollenizers), a slight non significant increase of only 0.063 kg in olive production was estimated by the addition of one pollenizer. Thus, the increase of pollenizer number from 1 to 9 had no significant increase in olive production (probability at 5% equal to 0.71).

The linear regression showed that optimum olive production could be obtained by the presence of only one pollenizer in the two first squares around Meski. Consequently, olive production is slightly affected by pollenizer number and many other factors might have a pronounced effect on olive production of Meski. These factors should explain the rest of production variation estimated around 98%.

For the first three squares around Meski, the linear regression was presented in Figure 5 for olive production vs pollenizer number. A very low correlation was noted between the olive production and the number of pollenizers since $R^2$ was equal to $2.10^{-7}$. Thus, non significant increase in olive production ($2.10^{-4}$ kg) was recorded by adding one pollenizer with a probability of 0.99 at $p<0.05$.

The total number of pollenizers in the three first squares ranged from 4 to 14 and for each group, the olive production varied from 11 to 15 kg. These data proved that the number of pollenizers in this area can be limited to 4 since the olive production will not increase significantly with more pollenizers.

The above results demonstrated that the olive production of cultivar Meski was not mainly associated with the number of pollenizers. Thus, optimum olive production

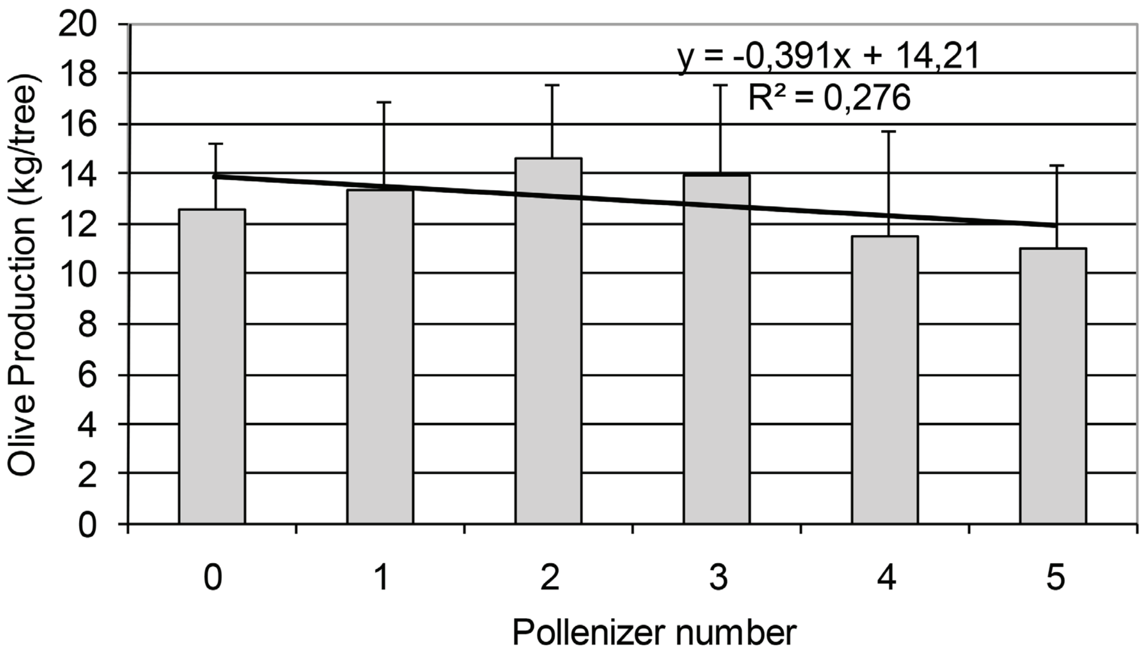


***Figure 3: Olive production as affected by the number of pollenizers in the first square around Meski with the regression equation***

could be achieved through the interplanting of pollenizers in the second square around the Meski tree. In Meski plantations, it is reasonable to do not plant pollenizers in the first square and a maximum of one pollenizer in the second square and 3 in the third square. Thus, the total number of pollenizers in the three squares around Meski should not exceed 4 out of 49, making a percentage of about 8 %. The optimal arrangement of these pollenizer trees in the field could be as shown in Figure 6.

The optimum rate of pollenizers in this study was in accordance with Lavee *et al*., (1997) who suggested 10 % but lower than that in Tunisian fields (until 30 %). This fact may be explained by the migration power of pollen grain in the space by the wind, as reported by Lavee *et al*. (1997) and olive pollen may flow over kilometers according to Pinillos and Cuevas (2009).

## CONCLUSION

This study showed that the auto-incompatibility of cultivar Meski was not responsible of the low and irregular production as suggested by many authors. Consequently, there is a need to further investigation on many other factors such as fertilization, irrigation, pruning, phytosanitary status,…etc.

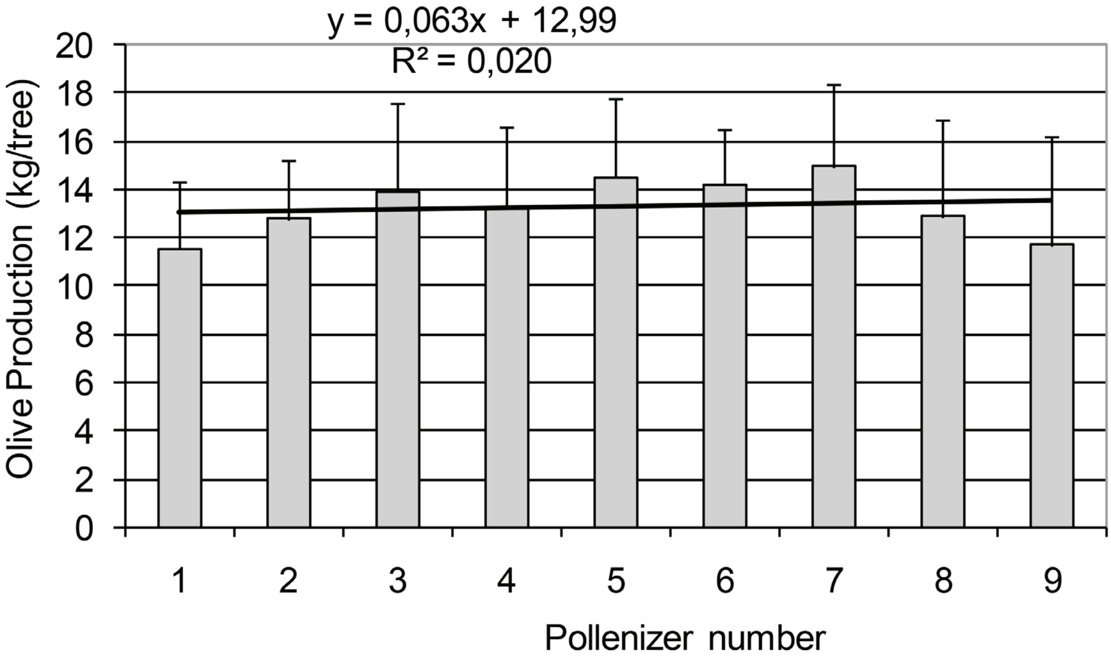


***Figure 4: Olive production as affected by the number of pollenizers in the first two squares around Meski with the regression equation***

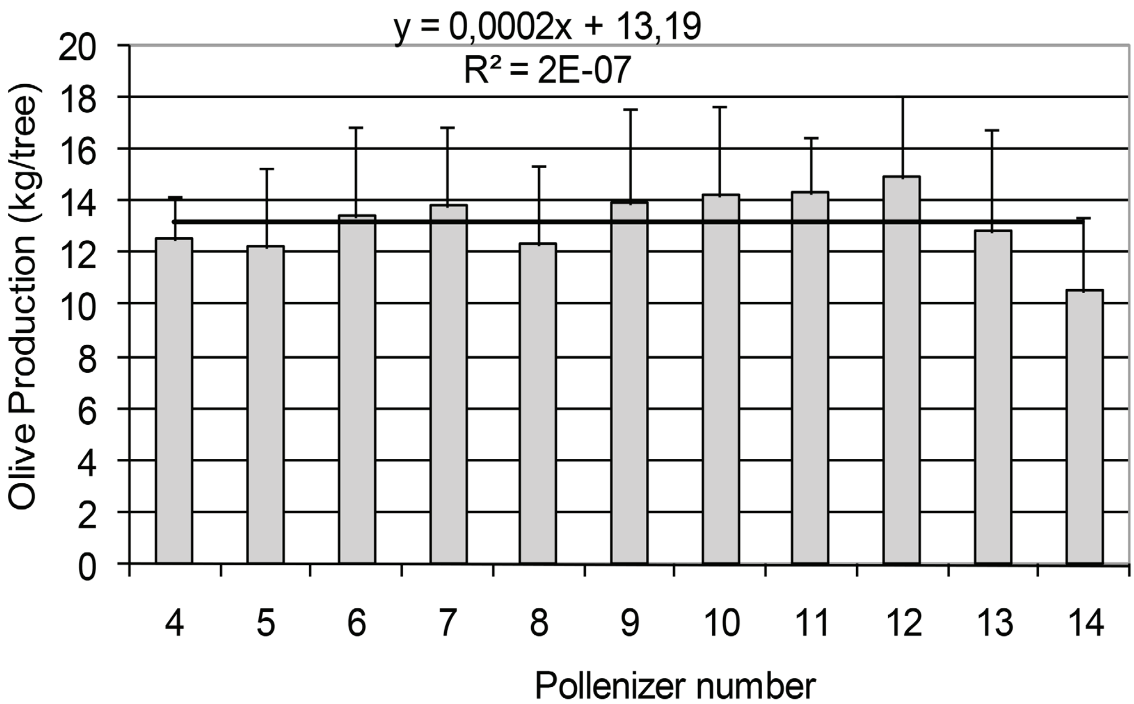


***Figure 5: Olive production as affected by the number of pollenizers in the first three squares around Meski with the regression equation***

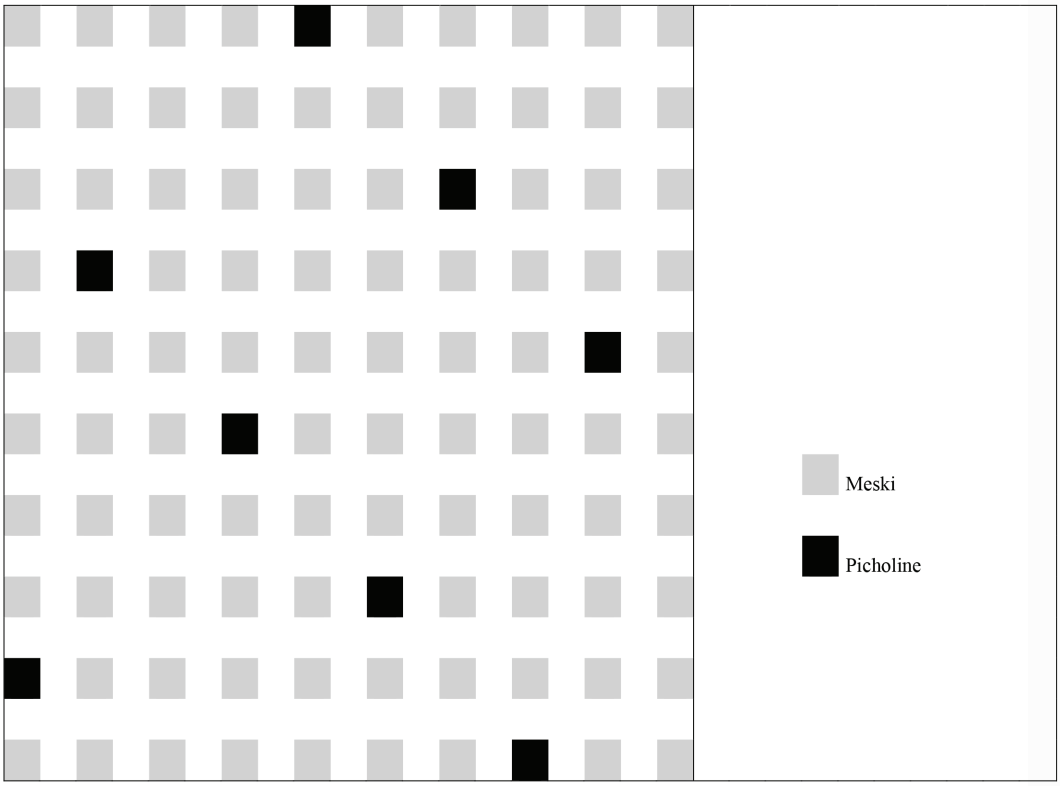


***Figure 6: Optimal distribution of the 8 % Picholine pollenizer trees in the Meski plantation***

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