

# Fertilization Practices in Tunisian High-Density Olive Planting Systems

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**Fertilization within high-density olive plantations** needs to be improved to help control tree vigor, reduce environmental impacts, lower cost of production, and increase productivity.

Tunisia is one of the largest olive producers in the world. Its olive production sector plays a strategic role in the national economy with its 1.8 million ha under olive representing 34% of the country's agricultural land. However, large portions of these olive orchards are old and poorly maintained. The government of Tunisia initiated in early 2000 a large program for the introduction and expansion of the hyper-intensive olive system in the irrigated area. In 2011, the intensive olive grove areas in Tunisia reached 50,000 ha, with 4,500 ha managed using a super high-density planting (SHD) system (Larbi et al., 2014). However, little information has been provided with regards to an improved technical production package for those wanting to transition to SHD plantations. Among the constraints that farmers are facing during this switch are the nutrient management practices required for SHD plantations. Little research has been conducted on fertilization management in high-density plantation systems and farmers are still using traditional fertilization practices based on the application of the same amount every year without taking into account the nutritional status of the trees. The development of a 4R Nutrient Stewardship strategy on right source, rate, time, and placement of fertilizer application in SHD olive production systems is key for improving both olive and oil production, as well as nutrient use efficiency.

For a better understanding of farmers' practices, a survey was conducted in 2011 to assess farmers' fertilization practices in new SHD systems. Farmers were selected in collaboration with the Ministry of Agriculture of Tunisia who compiled a list of 112 SHD olive farmers with plantations varying in density from 1,250 to 1,660 trees/ha (DGPA, 2010). A sample of 27 farmers, representing 12 regions of Tunisia (Figure 1), were selected to be interviewed. The survey showed that 67% of farmers were small farmers with an olive orchard area of less than 25 ha. Large farmers (more than 100 ha) represented 13% and medium (25 to 100 ha) represented 20% of surveyed farmers (Figure 2). The survey found that SHD farmers rely on three olive tree varieties. The variety Arbequina occupies 63% of SHD area, followed by Arbosana with 30%, and Koroneiki with 7%. All farmers in this study used drip irrigation.

## Fertilization Practices

Results of the survey showed that 85% of interviewed farmers use mineral and organic fertilization, while the rest (15%) do not apply any mineral or organic fertilization due mainly to the lack of awareness of the importance of fertilization in olive oil quality and production. Farmers that do not apply any fertilizer to their orchards are mainly small farmers with

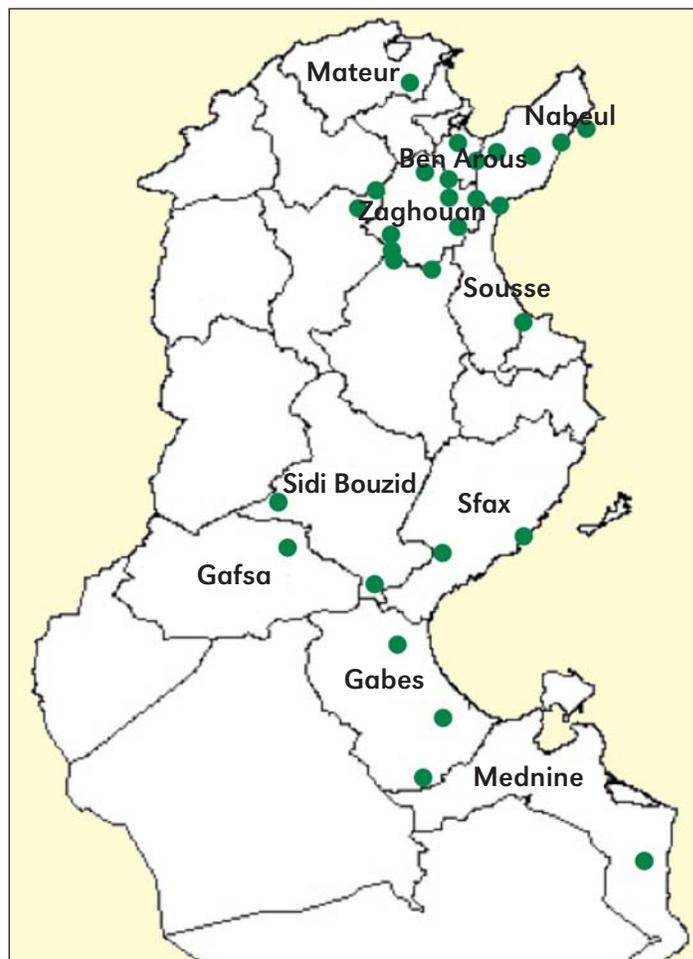


Figure 1. Location of the surveyed olive farmers in Tunisia.

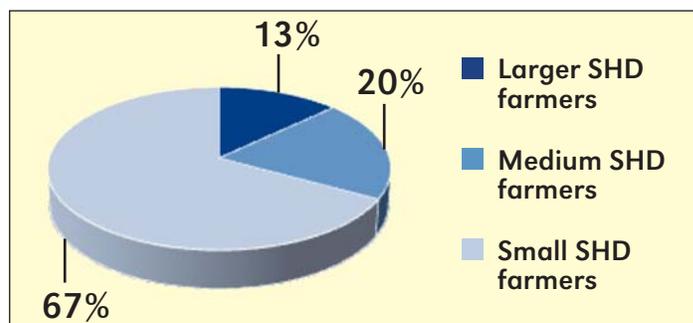


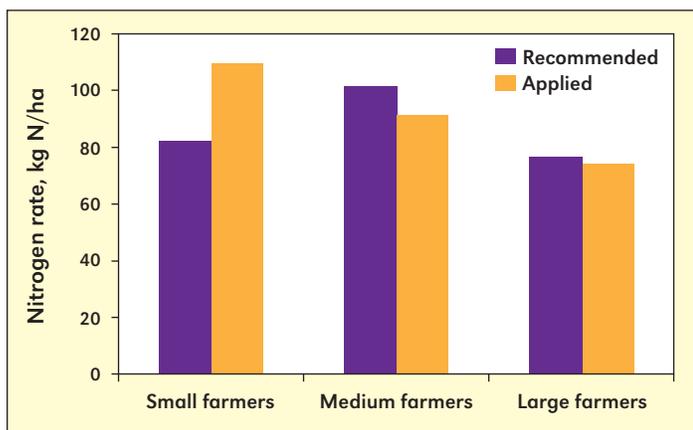
Figure 2. Distribution of surveyed super high-density (SHD) olive farm sizes.

an orchard area varying from 2 to 4 ha. All interviewed farmers who apply fertilizer reported the use of drip irrigation for mineral fertilizers application. The use of organic fertilization was confirmed only by three farmers who belong to the small

Abbreviations and notes: N = nitrogen; P = phosphorus; K = potassium; B = boron.



Super high-density olive plantation images from Tunisia.



**Figure 3.** Nitrogen rates compared to the recommended rates for each category of super high-density olive plantation.

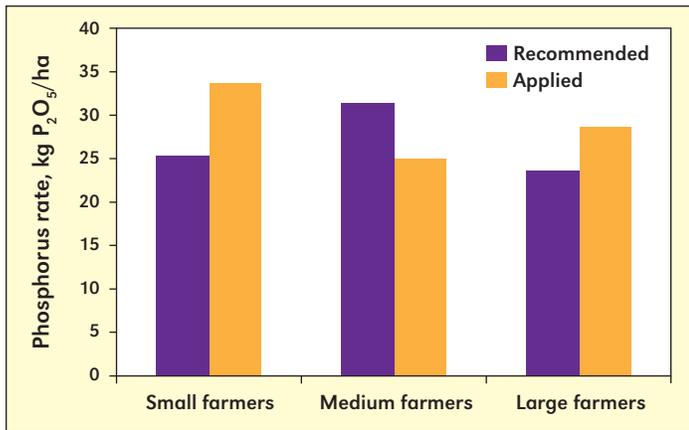
SHD group. The survey found that 56% of respondents have contact with regional agricultural extension centers. However this group of farmers indicated that technical staff of these centers did not provide any advice related to fertilization management.

### Fertilizer Sources

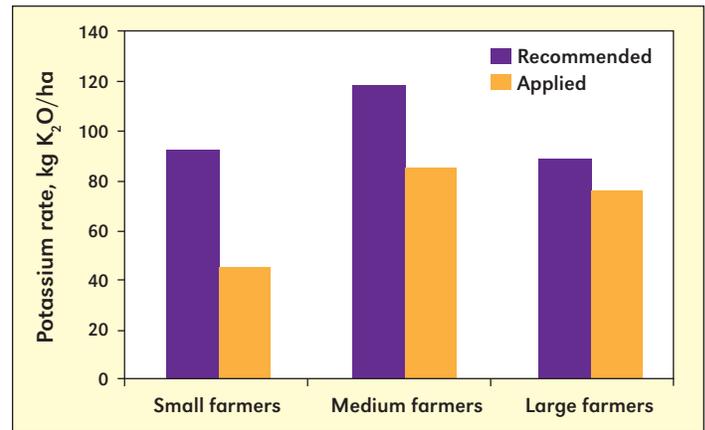
Of the farmers who use nutrients, 100% of them use N and P, while 82% apply N, P and K. The main source of N and P are ammonium nitrate (91%) and urea (9%) for N and phosphoric acid (100%) for P. Farmers reported that the limited use of urea was a reflection on the high salt content of the irrigation water source. For K, the main sources are potassium sulfate (75%) and potassium nitrate combined with potassium sulfate (25%). It has also been reported that 30% of farmers who apply fertilizers use foliar application of B (mineral boron) and K (potassium sulfate and NPK products with high K content).

### Fertilizer Rates

The survey showed that the amount of fertilizers applied varied significantly according to the olive orchard's age and yield. A high percentage of small farmers (95%) applied fertilizers without any structured plan. Indeed, N and P fertilizers are applied excessively as compared to recommended rates (**Figure 3** and **4**). Average N and  $P_2O_5$  rates were about 109 and 33 kg/ha, respectively, while the recommended amounts based on fruits uptake are about 82 and 25 kg, for N and  $P_2O_5$ , respectively. However, for K, small farmers often applied



**Figure 4.** Phosphorus rates compared to the recommended rates for each category of super high-density olive plantation.



**Figure 5.** Potassium rates compared to the recommended rates for each category of super high-density olive plantation.

less K fertilizers as compared to recommended rates (**Figure 5**). Contrary to small farmers, most of the medium and large farmers are using foliar fertilizers and soil analysis for their fertilization management. Fertilizer rates applied by these medium and large farmers range from 74 to 91 kg N/ha, 25 to 28 kg P<sub>2</sub>O<sub>5</sub>/ha and 76 to 85 kg K<sub>2</sub>O/ha (**Figure 3, 4 and 5**). These rates varied slightly as compared to the recommended rates that are about 77 to 102 kg N/ha, 23 to 31 kg P<sub>2</sub>O<sub>5</sub>/ha and 88 to 118 kg K<sub>2</sub>O/ha (Pastor Muñoz-Cobo et al., 2015). From the survey, we noted that K rates applied by all three groups of farmers are often less than the tree requirements (**Figure 5**).

### Fertilizers Application Time

About 70% of the respondents reported that the time of application of N, P and K is based on the tree requirements, which is related to the vegetative stage and reproductive cycle. Only 55% of small farmers take into account the time of application as an important factor in their fertilization management. However, all medium and large SHD farmers consider application timing as an important nutrient management factor. Farmers interviewed revealed that 80% of N needed is applied between March and July, and the rest is applied between September and October. Phosphorus is applied equally between March to July, and after that only small amounts are applied for the chemical maintenance (cleaning fertigation lines) of drip irrigation systems. With regard to K, farmers revealed that K fertilizers are applied mainly from June (after fruit set) until October.

### Summary

In Tunisia's SHD olive plantation orchards, 85% of farmers use fertilizers. However a large number (about 66%) apply fertilizers without any plan. Rates of N and P are applied in excess of crop requirements, while K is applied at suboptimal rates. The main sources of N, P and K are ammonium nitrate, phosphoric acid and potassium sulfate. The role of regional agricultural extension centers should be improved to assist SHD farmers (mainly small farmers) in fertilization management. 

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