FIRST-YEAR EFFECTS OF TREE SHELTERS AND MULCHING ON SURVIVAL AND GROWTH OF ZEEN OAK (*QUERCUS CANARIENSIS* LAMK.) SEEDLINGS PLANTED IN NORTH-WESTERN TUNISIA

Taher MECHERGUI[1*], Brahim HASNAOUI[2], Marta PARDOS[3] & Naceur BOUSSAIDI[2]

RÉSUMÉ. — *Effets à un an des abris-serres et du paillage sur la survie et la croissance des plantules de Chêne zéen (*Quercus canariensis *Lamk.) dans le Nord-Ouest de la Tunisie.* — Dans le Nord-Ouest de la Tunisie, les plantations forestières sont souvent associées à des taux de mortalité élevés ou montrent un ralentissement de croissance assez prononcé en cas de survie. L'objectif du présent travail est d'évaluer la survie et la croissance des plantules de Chêne zéen (*Quercus canariensis* Lamk.) plantés dans le Nord-Ouest de la Tunisie, en réponse aux abris-serres et au contrôle des mauvaises herbes à l'aide du paillage. Pour atteindre cet objectif, trois modalités d'abris-serres (abris-serres non aérés, aérés et témoins) ainsi que cinq modalités de paillage (Pin pignon, Lentisque, mélange de Pin pignon et de Lentisque (paillages organiques), gravier (paillage inorganique) et témoin) ont été ainsi testées. Un an après la plantation, le taux de mortalité des plants était très faible (2,36 %) et n'a été significativement affecté par aucun des facteurs étudiés. En revanche, les abris-serres ont permis d'améliorer de 50 % en moyenne la croissance en hauteur des plants par rapport aux témoins sans abris-serres. Cette forte croissance résulte d'un nombre plus élevé d'unités de croissance par pousse annuelle, ainsi que de plus longues pousses annuelles et unités de croissance. Le diamètre de la tige à la base a été cependant sévèrement réduit à l'intérieur des abris-serres, conduisant à l'obtention de plants étranglés, incapables de se tenir verticalement après le retrait des abris-serres. Les plants témoins étaient de petites tailles et robustes avec des diamètres bien développés en réponse au manque de support physique. Le paillage n'a eu aucune influence tant sur le taux de survie que sur la croissance en hauteur et celle du diamètre à la base des plants. Toutefois, une amélioration du nombre d'entre-nœuds et de la longueur de l'unité de croissance a été constatée chez les plants plantés avec le paillage inorganique, ce qui laisse à penser que les conditions de croissance sous ce paillage ont été légèrement améliorées et ce comparativement aux autres paillages utilisés. Les résultats obtenus suggèrent que les abris-serres, en particulier ceux de type aéré, pourraient améliorer la croissance des plants de Chêne zéen dans les conditions du Nord-Ouest de la Tunisie.

SUMMARY. — Forest plantations in North-western Tunisia suffer high early seedling mortality and slow growth. The objective of this paper is to evaluate the survival and growth of planted Zeen Oak (*Quercus canariensis* Lamk.) in response to tree shelters and mulching. Three tree shelters (non-vented tree shelter, vented tree shelter, and control with no shelters) and five mulch types (Italian Stone Pine, Lentisk, combination of Italian Stone Pine and Lentisk (organic mulches), gravel (inorganic mulch) and no mulch) were tested. One year after establishment, seedling mortality rate was very low (2.36 %) and was not significantly affected by any of the studied factors. Seedlings growing inside tree shelters responded with significant increases in height exceeding 50 % that of unsheltered seedlings. This enhanced growth is due to larger number of growth units per annual shoot, and longer annual shoots and growth units. In contrast, the stem diameter growth was severely reduced inside tree shelters, resulting in narrow stems with insufficient strength to support their weight. The unsheltered seedlings were shorter and sturdier, with significantly larger basal diameter in response to the lack of shelter. Mulching had no significant impact on early survival, basal

[1] Faculté des Sciences de Bizerte (FSB), Jarzouna–7021. Tunisie.

[2] Institut Sylvo-Pastoral de Tabarka, B.P. 345, Tabarka–8110. Tunisie.

[3] Instituto Nacional de Investigacion y Tecnologia Agraria y Alimentaria (INIA). Centro de Investigacion Forestal. Ctra. de La Coruña, Km. 7,5. 28040 Madrid. Spain.

* Corresponding author: Tel. +216 97 450 185. E-mail address: mecherguit@yahoo.fr (T. Mechergui).

stem diameter or height growth. However, a small beneficial effect, resulting in an increase in the number of internodes and the GU (growth units) length was observed under inorganic mulch suggesting that growth conditions under inorganic mulch were slightly improved. Our results suggest that tree shelters, especially the vented type, could improve the growth of Zeen Oak seedlings planted in North-western Tunisia.

Zeen Oak forests (*Quercus canariensis* Lamk.) are mainly located in N.-W. Tunisia, where they form a wooded area with a great ecological and socio-economical interest. They are aesthetically agreeable and provide food for wildlife and are used by local inhabitants for grazing. Traditionally, Zeen Oak stands in Tunisia are regenerated naturally. Unfortunately, regeneration is not achieved due to several factors including high seed predation, aging, Zeen Oak decline and adverse climatic conditions. The planting alternative has not been either successful because of high mortality in the early years, slow growth, mainly due to overgrazing (Hasnaoui, 1992) and inability of newly planted seedlings to successfully compete for available resources. Such situation demands specific research in order to improve seedling's survival by using new techniques or improving the traditionally used methods of afforestation. Among the available techniques that are presently becoming a common practice in afforestation works is the use of tree shelters (Navarro *et al.*, 2005).

Tree shelters are polypropylene tubes of different shapes and colours, originally developed in Great Britain to shield newly transplanted seedlings from browsing animals (Sharpe *et al.*, 1999). It was observed that tree shelters also increased seedling survival and promoted increased height growth (Tuley, 1985; Potter, 1991; Burger *et al.*, 1992). These benefits have been attributed to microclimate changes inside tree shelters in relation to temperature, air humidity, radiation, vapor pressure deficit, CO_2 concentration and wind (Kjelgren *et al.*, 1997; Dupraz & Bergez, 1999). However, tree shelters often had negative effects in both diameter growth and the seedling's ability to support itself without a stake (Burger *et al.*, 1996; Mayhead & Boothman, 1997). These effects were often interpreted as a result of a lack of ventilation inside tree shelters, thereby the use of ventilated tree shelters was described as a key issue (Bellot *et al.*, 2002).

In Tunisia, weed control is often limited to cultivation; mulching is not done and herbicides are not used for environmental reasons. However, weed control by mulching is proved to be equally or more efficient than weed control with mechanical cultivation (Bowersox & Ward, 1970). Mulches are known to buffer soil temperature (Greenly & Rakow, 1995), inhibit weed germination and suppress weed growth, prevent evaporative water loss from the soil and reduce erosion (Mayhead, 1992; Haywood *et al.*, 1997) which in turn enhances plant growth and survival (Davies, 1988a; Greenly & Rakow, 1995). Mulches can be either organic or inorganic (Duryea *et al.*, 1999). Organic mulches are very heterogeneous in both the type of tree species (i.e., eucalyptus, cypress, pine, and melaleuca) and plant parts used (leaves, branches, wood, and bark), while inorganic mulches include polyethylene film, pebbles or gravel.

Studies investigating the growth response of oak seedlings to either tree shelters or vegetative competition control (e.g., Burger *et al.*, 1992, 1996; McCreary & Tecklin, 1997; Navarro Cerrillo *et al.*, 2005) were often limited to height, diameter and biomass measurements. However, like other oak species (Reich *et al.*, 1980; Champagnat *et al.*, 1986; Harmer, 1990), Zeen Oak has a typically rhythmic pattern of height growth (Hasnaoui, 1992). Multiple shoot growth flushes can occur in the same growing season in response to favourable growth conditions (Chaar *et al.*, 2008). During each shoot flush, a distinct shoot portion called the growth unit (GU) is established along the main stem (Chaar & Colin, 1999). The study of the periodic height growth pattern of Zeen Oak allows the main stem to be divided on other morphological entities (GUs) and gives useful information on this growth response characterization. On the other hand, most previous experiments examining the growth response of oak seedlings to tree shelters, except Navarro Cerrillo *et al.* (2005), did not study the impact of the ventilation of tree shelters on seedlings growth. In addition, a few studies have included the combined effect of tree shelters and mulching on tree establishment (Dubois *et al.*, 2000).