ANALYSIS OF THE EDAPHIC REQUIREMENTS OF *J. oxycedrus L. subsp. macrocarpa (Sm) Ball.*

Amparo Hurtado Soler
Department of Vegetable Biology.
University of Valencia

INTRODUCTION

The importance of coastal ecosystems not only stems from the biodiversity they contain but also because they act as regulators of the water system preventing and controlling floods in autumnal rains and restraining the saltwater intrusion processes. Generally, the soil of natural coastal ecosystems can be classified as saline soils with primary salinity in those with a strong specialisation of the plants that are distributed by edaphic factors, being a predominantly *edafofila* vegetation. In these environments the salinity and humidity are differentiating characteristics and refuge for plant species of great interest, among which *J. oxycedrus* L. subsp. *macrocarpa* (Sm) Ball stands out (Costa, M. 1995, 1999; Pérez, R. et al. 1992). The most representative populations of marine juniper are in El Saler and Prat de Cabanes-Torreblanca (Laguna, 1998; Tirado, J. 1998; Boira, H, 1995; García, J.J. 1999).

Between 1999-2000 marine junipers were planted in El Saler, observing during the monitoring a great influence of the edaphic conditions on the chances for success of the final establishment of the seedlings (García, J. J. 1999, 2000). In order to optimise the selection of the plantation areas and to guarantee their success an exhaustive analysis of the soil where juniper grows was proposed, to identify the preferential edaphic characteristics of marine juniper.

MATERIAL AND METHODS

1.1 Localisation of populations

The existing specimens were located in the Nature Reserves of El Saler and Prat de Cabanes-Torreblance and their edaphic distribution recorded. In El Saler, the few remaining specimens of *J. oxycedrus subsp. Macrocarpa* occupy the post-dune area of the first large alignment as well as the most inland area of thicket, although greater growth with tree-like appearance is observed in the protected specimens of the inland area. The soil characteristics of the area are described as Psamments (Soil Taxonomy, 1998) belonging to the Entisoles order with sandy texture and less than 35% of rocky fragments. In some more depressed areas with the water table close to the surface, the Ustipsamments are developed, which have an ustic regime, the rest can be defined as Quartzipsamments as they have more than 90% of materials of a size >0.02mm comprising resistant minerals.

In the Prat de Cabanes-Torreblance Nature Reserve, on the line of sand dunes with pebbles, the few specimens of J*. oxycedrus* subsp*. macrocarpa* that exist in the area are established here. In this area there are two kinds of soil: Psamments (Entisoles order) and Typic sulfihemists (Histosoles order), the latter are typical of the depressed area with abundant marsh vegetation where the gradual accumulation of organic material occurs in a humid environment, causing the formation of a water-saturated organic horizon and the presence of sulphidic materials with a pH around 6.5 and permanent shallow reduction conditions. *J. oxycedrus* subsp. *macrocarpa* is found in the highest areas on the shoreline with sandy soil (Quartzipsamments) that have a large quantity of smooth pebbles, particularly on the surface. The location of the only population existing in Torreblanca is in the southern zone of the Nature Reserve next to La Sal Tower.

1.2 Profiles analysis

During the opening of the profiles, they were described according to the Soil Taxonomy, 1998 methodology. The sampling of the profiles was done by taking disturbed samples from two depths: 0-15cm and 0,30cm and unaltered samples using the cylinder method to analyse the hydraulic properties, the humidity of the field and the apparent density. In the El Saler area a total of 8 profiles distributed over two areas were characterised, the first in the most exposed area close to the beach behind the first lines of dunes with a total of 3 profiles and the second in the most protected area inside the pine forest, where 5 profiles were taken. Regarding Prat de Cabanes-Torreblanca, a total of 7 profiles were taken, all in the same area as the population is extremely scarce and only 7-8 specimens remain distributed over an area of approximately 1200m2.

In the laboratory the following physical properties were analysed: apparent density (unaltered cylinder method), real density (pycnometer method), porosity (from the real and apparent density), humidity of the field (gravimetric analysis), mechanical analysis (Boyoucos hydrometer), humidity curves (pressure cooker method), hydraulic conductivity (permeameter method). The chemical and physico-chemical properties analysed were: Obtaining the extract of the saturated paste (centrifugation) and extract according to Spurway, analysis of anions and cations (methods described in Cobertera, 1993), pH (pH meter), electrical conductivity (conductimeter), organic material (Walkley-Black) and carbonates (Bernard calcimeter). The capacity of cationic exchange was not measured as the presence of clays is very low and on occasion imperceptible. To complement the laboratory tests field annotations were taken describing the horizons and their characteristics; degree of hydromorphism, structure, consistency, presence and nature of clayskins, fastening, pores, roots, rocky fragments, nodules, biological activity and limits between horizons. Finally, some superficial samples were taken in a grid form recording the predominant species in each quadrant.

RESULTS AND CONCLUSIONS

Analysis of the results establishes a series of characteristics of the profiles and grids studied.

- Profiles
    - They have a sandy texture with a very low percentage of clay, so they have a very low capacity for cationic exchange and water retention.
    - In the La Sal Tower profiles, the presence of very large elements is observed in percentages above 70%, which increases in the macroporosity and, therefore, the infiltration and facilitates radicular development.
    - The average conductivity values range between 1-4 dS/m, however in some profiles from La Sal Tower much higher values were observed around 70dS/m. In this area some individual marine juniper plants are semi-dry, proving the saline stress. This fact may be related to the saltwater intrusion phenomenon that is being observed in the area due to the indiscriminate use of irrigation water.
    - The hydraulic conditions indicate that the soil has a very high saturated hydraulic conductivity and, therefore, good drainage where the water

table is deep. On the other hand, it has low retention capacity and a very low percentage of water that can be used by the plants.
  - The contents of mineralised organic material are very low, however, in La Devesa del Saler area a great accumulation of plant remains in semi-decomposition has been observed (organic horizon SJ006h) which retain water and prevent the losses of humidity caused by solar radiation as well as being a source of gradually released nutrients.
  - An abundance of carbonates is observed in all the profiles.
  - Regarding fertility, it is low. The majority of nutrients are below the suitable limits.

- Grids
  - In the transect formed by grids MJ2 and MJ3 we observed that conductivity increased in the highest areas, this is due to the increase of salts as an effect of evaporation-transpiration. The water table is over 50cm below the surface in the dry season.
  - The upper part of the dune (MJ1) is the area with less salinity as the water table has not affect here are it is too far away (>400cm).
  - In grid MJ4, the depressed area has the greatest conductivity. This is due to the presence of the water table just a few centimetres below the surface even during the dry season, observing permanent hydromorphic characteristics.
  - The conductivity values range between 1 and 10 dS/m in the areas where marine juniper is established, in the areas where the capillary rises or where the water table is permanently just below the surface, it can reach values greater than 300 dS/m.
  - The humidity of the field increased in the depressed areas.
  - The pH values range between 7.5-9.0, observing a link with the electrical conductivity so as the conductivity increased the pH decreases. The greatest pH values are in the higher areas (MJ1).
  - Regarding the vegetation, the transect formed by grids MJ1, MJ2 and MJ3 clearly describe the typical distribution of the Valencian coastal vegetation. On the upper part of the dune (MJ1) exposed to sea breezes there is *Elymus farctus, Ammophila arenaria, Lotus creticus, Othanthus maritimus, Malcomia littorea and Ononis natrix subsp. Ramosissima.* Behind the dune, less exposed, there is *Eryngium maritimum and Pancratium maritimum.* In the post-dune area (MJ2. MJ3) protected from the sea breeze, species are appearing on the semi-fixed dunes (MJ2): *Ephedra distachya, Launaea fragilis* and *Ipomea imperati* which are replaced by brush species in the fixed dune area (MJ3): *Quercus coccifera, Chamaerops humilis, Pistacia lentiscus, Pinus halepensis and Juniperus oxycedrus subsp. macrocarpa.* The latter is in the area with conductivity of less than 6 dS/m.

In conclusion it must be indicated that the ideal edaphic conditions for the establishment of new marine juniper plants are: sandy texture, with organic horizon, deep water table and electrical conductivity between 1-4 dS/m. Marine juniper is not demanding regarding specific nutrients. The presence of brush and/or tree vegetation facilitates the installation of the new juniper specimens, which reach greater development and height in semi-cleared areas. In these areas, the presence of an organic material accumulation area also facilitates the storage of water and the reduction of evaporation-transpiration, providing the juniper with a great quantity of nutrients and water. However, in these areas other factors must be borne in mind for the establishment of new plants in future repopulation programmes, such as: competition between species and the presence of some herbivores.

BIBLIOGRAPHY

Boira, H. (1995). Vegetation and gradients of salinity in west Mediterranean coastal salt marshes. International Symposium on Salt-affected Lagoon Ecosystems (ISSALE-95). Valencia.

Costa, M. (1995). Plant ecology of salt-affected lagoon ecosystems. International Symposium on Salt-affected Lagoon Ecosystems (ISSALE-95). Valencia.

Costa, M. (1999). La vegetación y el paisaje en las tierra valencianas. Editorial Rueda, sl. Madrid.

García, J.J. (1999). Plan de recuperación de juniperus oxycedrus l. Subsp. Macrocarpa (sm.) Ball en el parque natural de la albufera. Consellería Medio Ambiente. Generalitat Valenciana.

García, J.J. (2000). Informe del seguimiento de la plantación de enebro marino en el parque natural de la albufera. Consellería Medio Ambiente. Generalitat valenciana.

Laguna, E. & al. (1998). Flora endémica, rara o amenazada de la comunidad valenciana. Consellería de Medio Ambiente. Generalitat Valenciana. Valencia.

Pérez, R.; Soriano, P & Batlle-Sales, J. (1992). The natural vegetation of salt-affected soils in the east of Spain. Proceedings of the International Symposium on Strategies for Utilizing Salt Affected Lands. Bangkok, Thailand.

Soil Taxonomy. 1998. Soil taxonomy. United States Department of Agriculture. Natural Resources Conservation Services.

Szabolcs, I. 1979. Review of research on salt-affected soils. Natural Resources Research, VX. UNESCO. Paris.

Tirado, J. (1998). Flora vascular de la Comarca de la Plana Alta. Diputació de Castelló.