Geophysical Research Abstracts,
Vol. 11, EGU2009-2892, 2009
EGU General Assembly 2009

Understanding plant-to-plant interactions for soil resources in multilayered Iberian dehesas

G. Moreno, V. Rolo, E. Cubera, and L. López-Díaz
Forestry School, University of Extremadura. Plasencia 10600. Spain. (gmoreno@unex.es)

Iberian dehesa is usually defined as two-layered silvopastoral system, where native grasses cohabit with a scattered widely-space tree layer. In the last two decades, an intense debate has been developed on the sustainability of this simplified type of dehesa. While some authors argue that that the forest cycle has been disrupted in most dehesas, where the lack of regeneration is an inherent problem to their exploitation, other authors have showed that dehesa degradation is easily reversible if certain abandonment is periodically exerted.
The coexistence of two-layered plots with multilayered plots (encroached open woodlands) and mono-layered plots (either closed forest or mono-pasture/monocrops) has been a common feature of dehesas, as result of a systematic combination of agricultural, pastoral, and forestry uses. Different structures of vegetation depend on land use, giving a mosaic at both estate and landscape scales. These mosaic-type systems allow finding several scenarios of plant-to-plant interactions, mostly at belowground level. A key issue for sustainable management of oak woodland is to understand the complexity of the plant-to-plant relationships and their consequences in the ecosystem functioning in terms of productivity and stability.
The competitive abilities of component systems are modified by the environment conditions. Dehesas, as most savanna systems, exhibit a low rainfall with high variability within and between years as well as a high evaporative demand during the summer. Indeed, water availability is one of the major ecological factors influencing either natural savannas or man-made open woodlands. Although most of the available studies have focused different aspects of the mature tree-grass interactions, we also present here some recent results on tree-tree, tree-shrub, shrub-seedling and seedling-grass interactions, explained mostly in terms of competition for soil water and nutrients.
Trees can modify the soil and microclimate environment much more than understorey usually can, but tree characteristics often confer them a clear competitive advantage and they can strongly out-compete understorey. The net balance of positive-negative interactions varies with the age of trees: while the balance can favor grasses face to seedlings, the contrary can be expected when tree grows. Similarly, while shrubs could favor seedling recruitment, shrubs could affect negatively tree growth and productivity. These changes should be taken into account for defining dehesa structure and determining management practices in order to optimize the use of physical and chemical resources that are spatially and temporally patchy.
From our results, it is described how generally holm-oak trees favor understorey forage production through a direct positive effect of shade and improved soil fertility (facilitation). The rooting system together the slow-growing attitude of many oak species could determine a low competitive potential of oaks with herbaceous layer. Its low competitiveness together with its capacity to thrive in poor soils make oaks genre very suitable for long-term agroforestry systems in Iberian Peninsula.
However, although a certain complementary uses of soil resources seems occur for trees and native grasses (very distinct root system profile), the potential benefit of trees has a small actual facilitative effect because the competitive use of soil water by trees overrides its positive effects, especially under semi-arid conditions. As consequence, the net balance of trees on pasture yield is very variably with situations where pasture yield is widely increased in the vicinity of the trees and others where the contrary is found.
Tree clearance practiced in dehesas affects positively the development of the understory pasture, but also the single tree functions which take advantage of the low tree density characteristic of dehesas. Tree roots access water through a large volume of soil resources (especially water) unused by pasture layer. As a consequence, lower stand density is, better tree water status, grow and acorn production is. This dependence of tree functioning

of tree density is increase with the intensity of summer drought.

Although oak seedlings have physiological adaptations to overcome pasture competition during summer drought, effort made by farmers to favor pasture yield could play some negative role for oak seedling establishment. By contrast, dehesa shrub encroachment has been shown as a way to increase dramatically the rate of oak seedling recruitment. Apart of a better protection against herbivores and the preferential acorn dispersal towards shrubs, different Mediterranean shrubs seem to play multiple positive effects on microclimate and soil that favor trees seedling establishment (nurse shrubs). Nevertheless, the nurse effect of shrubs is shown to be a species-specific phenomenon.

Although dehesa shrubs compete with trees for soil resources stronger than herbaceous plants do, the nutritional and hydric status of mature trees is not substantially affected. Hence, dehesa encroachment can be recommended as mechanism to favor dehesa sustainability without compromising the short term productivity of trees. Nevertheless, these findings should not be generalized and further studies focusing specific combination of tree-shrubs species will be needed. These studies should consider a better knowledge of the root system of different shrub species.