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Effect of culture extra-late flowering almond cultivars on soil protection in cold and sloping areas

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Abstract. The objective of this work is to demonstrate the viability of the cultivation of new extra-late flowering almond trees as an environmental approach to protect soil in cold and sloping areas of the Mediterranean basin. The plant material studied consisted of 240 trees, combining 12 new extra-late flowering almond genotypes obtained in CEBAS-CSIC with two commercial rootstocks (almond seedlings and GF677). These combinations were placed in three orchards with different slope (low, intermediate and high) and within each orchard, almonds were cultivated with or without organic compost. The vigour of the trees and the flowering time was scored. Selected physical, chemical, microbiological and biochemical properties, indicative of soil quality, have been monitored periodically in soil samples collected at the different sites under study. Results showed that almond tree cultivation improved soil characteristics, both under conventional and organic farming system. Soil microbial population growth and activity, which are of great importance for assuring a suitable ecosystem functioning, were particularly stimulated in soils under organic farming system. No differences in soil properties attributable to the different slopes of the studied orchards have been detected. These new extra-late almond cultivars can be grown in these hard conditions, where they escape to late frost, because their extra-late flowering time and produce a positive effect on soil quality.

Keywords. Almond – Extra-late flowering – Soil protection – Sloping areas.

Effet des cultivars d'amandiers à floraison ultra-tardive sur la protection des sols dans les zones froides et à forte pente

Résumé. *L'objectif de ce travail est de démontrer l'intérêt de la culture d'arbres d'amandier de variétés à floraison extra-tardive comme une approche environnementale de protection des sols dans des zones froides et à forte pente du bassin méditerranéen. Le matériel végétal étudié comprenait 240 arbres, se composant de 12 nouveaux génotypes à floraison extra-tardive obtenus au CEBAS-CSIC et de deux porte-greffes (semis d'amandier et GF677). Ces combinaisons étaient placées dans trois vergers à différentes pentes (faible, intermédiaire et forte) et dans chaque verger, les amandiers étaient cultivés avec ou sans compost organique. La vigueur des arbres et les dates de floraison ont été notées. Les caractéristiques physiques, chimiques, microbiologiques et biochimiques, indicatrices de la qualité du sol, ont été mesurées périodiquement à partir d'échantillons de sols collectés dans les sites étudiés. Les résultats ont montré que la culture d'amandiers améliorait les caractéristiques du sol, à la fois en culture conventionnelle et en culture biologique. L'activité et la croissance des populations microbiennes, qui sont très importantes pour assurer un fonctionnement durable de l'écosystème, étaient particulièrement stimulées dans les sols fertilisés avec du compost organique. Aucune différence dans les propriétés des sols, dues à l'effet des différentes pentes des vergers, n'a été détectée. Ces nouveaux cultivars extra-tardifs peuvent être cultivés dans ces conditions difficiles, parce qu'ils peuvent échapper au gel grâce à leur date de floraison tardive et peuvent produire un effet positif sur la qualité des sols.*

Mots-clés. *Amandier – Floraison extra-tardive – Protection des sols – Zones à forte pente.*

I – Introduction

Plants have an important effect on the soil characteristics due to the rhizosphere is a zone of enhanced microbial activity (García *et al.*, 2005). Plants excrete 10-20% of their photosynthates as root exudates (Lambers and Poorter, 1992), which can serve as substrates for the microbial community, thus increasing the number of microorganisms in this zone (Bastida *et al.*, 2007). The high microbial biomass and microbial diversity in plant rhizospheres increase the potential for xenobiotic degradation. The microorganism species that populate the rhizosphere depend on the species and age of plant, and on the type of soil. Due to the key role that microorganisms play in soil functioning, soil microbiological and biochemical parameters can be considered good biomarkers of soil quality (García and Hernández, 1997; Bastida *et al.*, 2006).

In cold and sloping Mediterranean areas almonds could be a profitable culture and a system to improve the soil quality, if we cultivate extra-late flowering cultivars, like "Penta" and "Tardona" almonds (Dicenta *et al.*, 2009), that escape to the frequent late frost in these areas (Egea *et al.*, 2003; Dicenta *et al.*, 2005).

The objective of this work is to demonstrate the viability of the cultivation of new extra-late flowering almond cultivars as an environmental approach to protect soil in cold and sloping areas of the Mediterranean basin.

II – Material and methods

The experimental orchards are located in Archivel (Murcia, SE Spain). The cultivation of plants was performed without utilization of pesticides or fertilizers.

The plant material consisted of 240 trees, combining 12 new extra-late flowering almond selections from CEBAS-CSIC with two commercial rootstocks (almond seedlings and GF677). Furthermore, these combinations were placed in three orchards with different slope (low, intermediate and high) and within each orchard almonds were cultivated with or without organic compost.

Vigour of tress (diameter of trunk) and date of full flowering (when 50% of flowers were open) of each tree were recorded. Full flowering of Ferràgnes cultivar was also recorded in order to compare the delay of flowering of our new extra-late flowering cultivars.

Selected physical, chemical, microbiological and biochemical properties, indicative of soil quality, have been monitored periodically in soil samples collected at the different sites under study.

III – Results and discussion

1. Full flowering time of new extra-late flowering cultivars

In 2007, Ferragnès flowered around the 11 of March, while our new cultivars flowered between the 21 of March and the 10 of April, what means between 10 and 30 days after than Ferragnès. This year there were frosts the 21, 22 and 23 of March and Ferragnès (and the other late flowering almonds cultivated in this area) lost their production. However, all the new extra-late CEBAS selections flowered later, and so they were not affected by the frosts. This fact shows the huge advantage of cultivation extra-late flowering cultivars in cold areas.

2. Vigour of trunk as function of the slope, rootstock and organic compost adition

A negative effect of the slope on the vigour of the tree was observed. The higher was the slope the smaller was the vigour of trees. Regarding the rootstock, the GF677 was more vigorous than the almond seedling. The differences were higher when the slope was lower, and vice versa. Finally, the addition of organic compost did not affect the diameter of the trunk. In the low slope orchard, the more vigorous plants were those cultivated without organic compost.

3. Soil parameters

The different almond varieties assayed did not influence soil nutrient content at any experimental site.

Soil microbial population growth and activity, were particularly stimulated in soils under organic farming system, but no differences in soil properties attributable to the different slopes of the studied orchards have been detected.

Soil pH values were similar in the different experimental sites, no differences being observed due to the different rootstocks, varieties or farming system used. The pH values ranged from 8.0 to 8.4, which are compatible with a good almond tree growth.

Electrical conductivity (EC) increased with the addition of composts, soils under organic farming showing higher EC than the respective soils under conventional farming. However, EC values in the former soils were in the range of 400-800 µs/cm. This increase in EC is attributable to the salt and nutrients incorporated with the organic amendment.

Soils under organic farming showed higher water holding capacity than those uncultivated or under traditional cultivation, which can be explained by the increase in the level of soil organic matter with the compost addition.

Total organic carbon and organic matter showed not differences between samples analysed. However, when compost is added to the soil organic carbon increases, indicating that physical, chemical and biological properties can be positively affected.

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References

Bastida F., Moreno J.L., Hernández T. and García C., 2006. Microbiological degradation index of soils in a semiarid climate. In: *Soil Biology and Biochemistry*, 38, p. 3463-3473.

Bastida F., Moreno J.L., Hernández T. and García C., 2007. The long-term effects of the management of a forest soil on its carbon content, microbial biomass and activity under a semi-arid climate. In: *Applied Soil Ecology*, 37, p. 53-62.

Dicenta F., García-Gusano M., Ortega E. and Martínez-Gómez P., 2005. The possibilities of early selection of late flowering almonds as a function of seed germination or leafing time of seedlings. In: *Plant Breeding*, 124, p. 305-309.

Dicenta F., Ortega E., Martínez-Gómez P., Sánchez-Pérez R., Gambín M. and Egea J., 2009. Penta and Tardona: Two new extra-late flowering self-compatible almond cultivars. In: *Acta Horticulturae*, 814, p. 189-192. http://www.actahort.org/books/814/814_24.htm

Egea J., Ortega E., Martínez-Gómez P. and Dicenta F., 2003. Chilling and heat requirements of almond cultivars for flowering. In: *Environmental and Experimental Botany*, 50, p. 79-85.

García C. and Hernández T., 1997. Biological and biochemical indicators in derelict soils subject to erosion. In: *Soil Biology and Biochemistry*, 29, p. 171-177.

García C., Rodán A. and Hernández T., 2005. Ability of different plant species to promote microbiological processes in semiarid soil. In: *Geoderma*, 124, p. 193-202.

Lambers H. and Poorter H., 1992. Inherent variation in growth rate between higher plants: A search for physiological causes and ecological consequences. In: *Adv. Ecol. Res.*, 23, p. 187-250.