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Acetylene-reducing activity and nitrogen inputs in a bluff of *Elaeagnus angustifolia* L.

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Key words: ARA, *Elaeagnus angustifolia*, *Frankia*, litter, nitrogen fixation.

Abstract. Daily and annual variations in acetylene-reducing activity (ARA) and nitrogen input through litterfall in an *Elaeagnus angustifolia* stand near Madrid were determined. Maximum ARA was found at 6 a.m. and in September for daily and monthly measurements, respectively. Total nitrogen input in litter fall was 34.5 kg ha^{-1} $year^{-1}$.

Resumen. *Actividad reductora del acetileno en Elaeagnus angustifolia L.* Se estudia la actividad reductora de acetileno (ARA) y las entradas de nitrógeno por descomposición de la hojarasca en un bosquete de *E. angustifolia* cerca de Madrid. El máximo diario de ARA se obtiene a las 6 horas y el anual, en el mes de septiembre. El nitrógeno total que retorna al suelo del bosquete con la caída de hojarasca es 34.5 kg ha^{-1} $año^{-1}$.

Introduction

Soil microorganisms involved in the nitrogen cycle play a very important part in the retraining of nutrients, especially those forming symbiotic systems fixing atmospheric nitrogen with angiosperms. *Elaeagnus angustifolia* L. is an actinorhizal plant commonly used as an amenity plant and for land reclamation purposes (Fessenden 1979), developing root nodules with *Frankia elaeagni* (Becking 1974). Its ability to fix nitrogen has been recognized for long (Nobbe & Hiltner 1904), but there is little research on its fixation rates and on the actual extent of its contribution to the nitrogen economy of the soil where its grows.

The acetylene-reducting activity (ARA) and the nitrogen input through litter fall in a sub-spontaneous 20 year-old *E. angustifolia* stand (Ron 1971) were determined. Location of the stand is on coordinates UTM 30TUK448492, mentioned by Rodríguez-Barrueco (in Bond 1976) and described previously (Esteban et al. 1987). The bluff is on a gypsaceous alkaline gley solonchack with soluble salts efflorescing to the surface in summer and the under-growth is a Mediterranean *Juncus* sedge (Rivas Goday & Rivas Martínez 1963). The sampled area is 1 ha with 258 trees and several shrub *Elaeagnus* specimens. Nodulation was more abundant in the shrubs and less so in the trees.

Materials and methods

Nodules collection was carried out in bluff shrubs. Three random samples were collected every two months between 11 and 12 a.m. in order to study the seasonal variation, and every 4 hours to study the daily one. Litter collection was made in November-December. Ten squares, 1 m long each side, were placed at random and the litter placed on the soil surface was collected. Plant litter not belonging to *E. angustifolia* was removed and then the remaining *Elaeagnus* leaves were dried at 60 °C until constant weight.

The ARA was measured by the methods of Hardy et al. (1973) in a gas chromatograph KONIK KNK 2000 C-series, manufactured by KONIK Instruments S.A., Barcelona, Spain, with a H_2 flame ionization detector and column of Porapak R 80/100, 150 cm long and 3.2 mm diameter, using nitrogen as carrier gas.

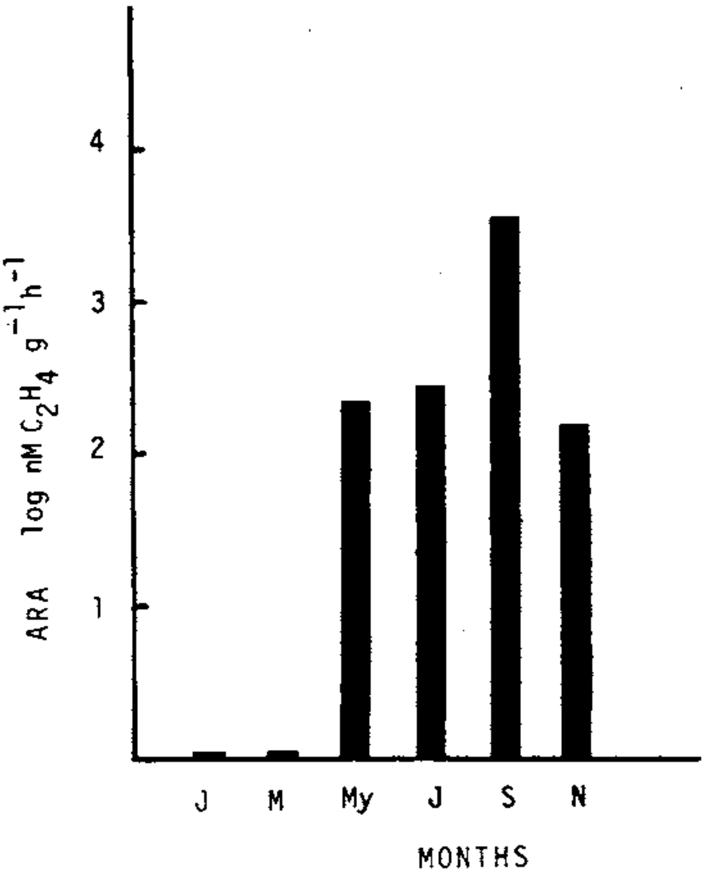

Figure 1. Annual acetylene-reducing activity (ARA) fluctuation in an *Elaeagnus angustifolia* stand.

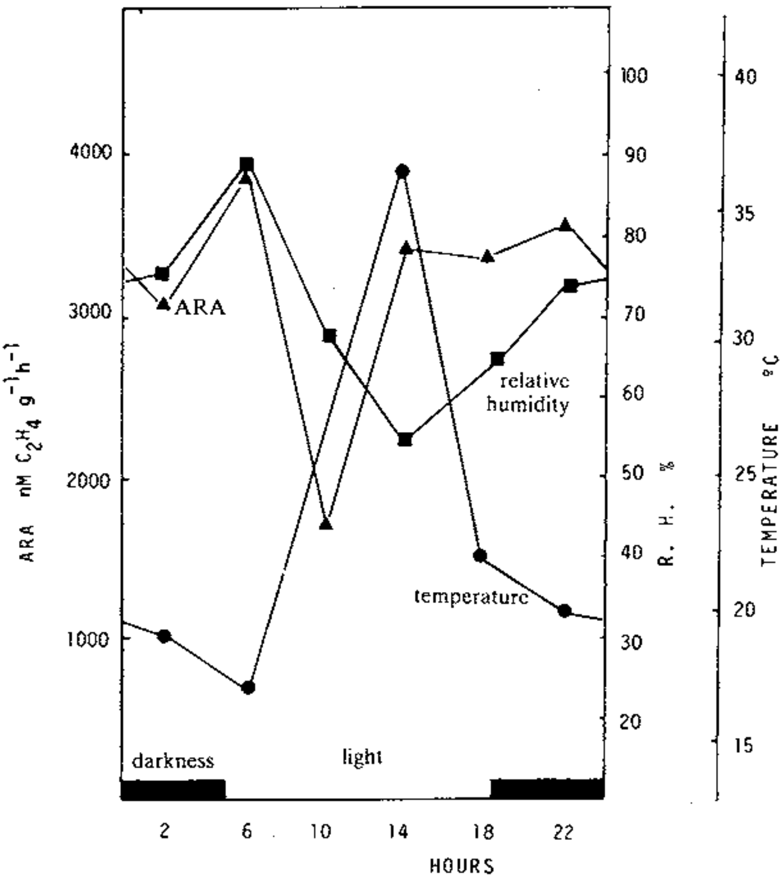

Figure 2. Daily acetylene-reducing activity (ARA) fluctuation in an *Elaeagnus angustifolia* stand.

Total nitrogen was measured by an electrode specific for amonium ORION 95-10.00 connected to a mV/pH-meter CRISON digit 501, after a Kjeldahl digestion. Nitrate was analysed by the method of Humphries (1956) modified by García Criado & García Ciudad, (1972).

Results and discussion

The maximum ARA was obtained in September, 3403.0 nM $C_2H_4h^{-1}g^{-1}$ d.w. and there was none when *E. angustifolia* had no leaves (Fig. 1). The daily oscillation was measured at the end of September. The results are compared with the temperature and the relative air moisture and with photoperiod in Figure 2. A maximum was obtained at dawn, 3807.0 nM $C_2H_4h^{-1}g^{-1}$ d.w. and another one after sunset, 3531.9 nM $C_2H_4h^{-1}g^{-1}$. There was a minimum ARA of 1714.2 nM $C_2H_4h^{-1}g^{-1}$ at 10 a.m.

E. angustifolia litter on the soil averaged 121.1 ± 5.1 kg ha^{-1} with a content of 3.08% of N-total and 0.57% of NO_3-N that provides 34.50 kg and 6.36 kg ha^{-1} $year^{-1}$ of N-total and NO_3-N respectively.

The ARA in *E. angustifolia* shrubs is of the same order as in shrublike actinorhizals *Myrica gale* from the central area of the Iberian Peninsula and in *Colletia spinosissima* and *Discaria serratifolia* (Bermúdez de Castro & Alonso 1983). It is lower than in *C. paradoxa, Alnus glutinosa* and *Coriaria myrtifolia* growing in different soil and climates and in the greenhouse (Bond 1976, Bermúdez de Castro & Alonso 1983).

Although the annual fluctuation of ARA in *E. angustifolia* is similar to other actinorhizals like *A. glutinosa* (Pizelle 1975, Bermúdez de Castro & Schmitz 1981), in our case the daily maximum occurs at 6 a.m., inmediately after dawn, instead that at noon as found by McNiel & Carpenter (1979). This pattern of daily oscillation in *E. angustifolia* shrubs is similar to the one found when the ARA was measured every two hours in shrublike alders in spring, summer and autumn.

It seems, therefore, that this ARA circadian rhythm is characteristic of shrubs and recalls the pattern of grasses adjusted to grow in areas with high hydric stress (Balandreau et al. 1978). Although the litter has not been measured throughout the year, observations of plant phenology for 3 years indicated that leaf-fall is minimal outside the period November-December when the leaves have been collected, except for some casual storms in summer. The litter amount and its high nitrogen content correspond with the values obtained from other actinorhizal plants both in the field and the greenhouse (Rodríguez-Barrueco 1971, Silvester 1977) and they represent and important input of organic material and nitrogen to soils of low fertility.

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