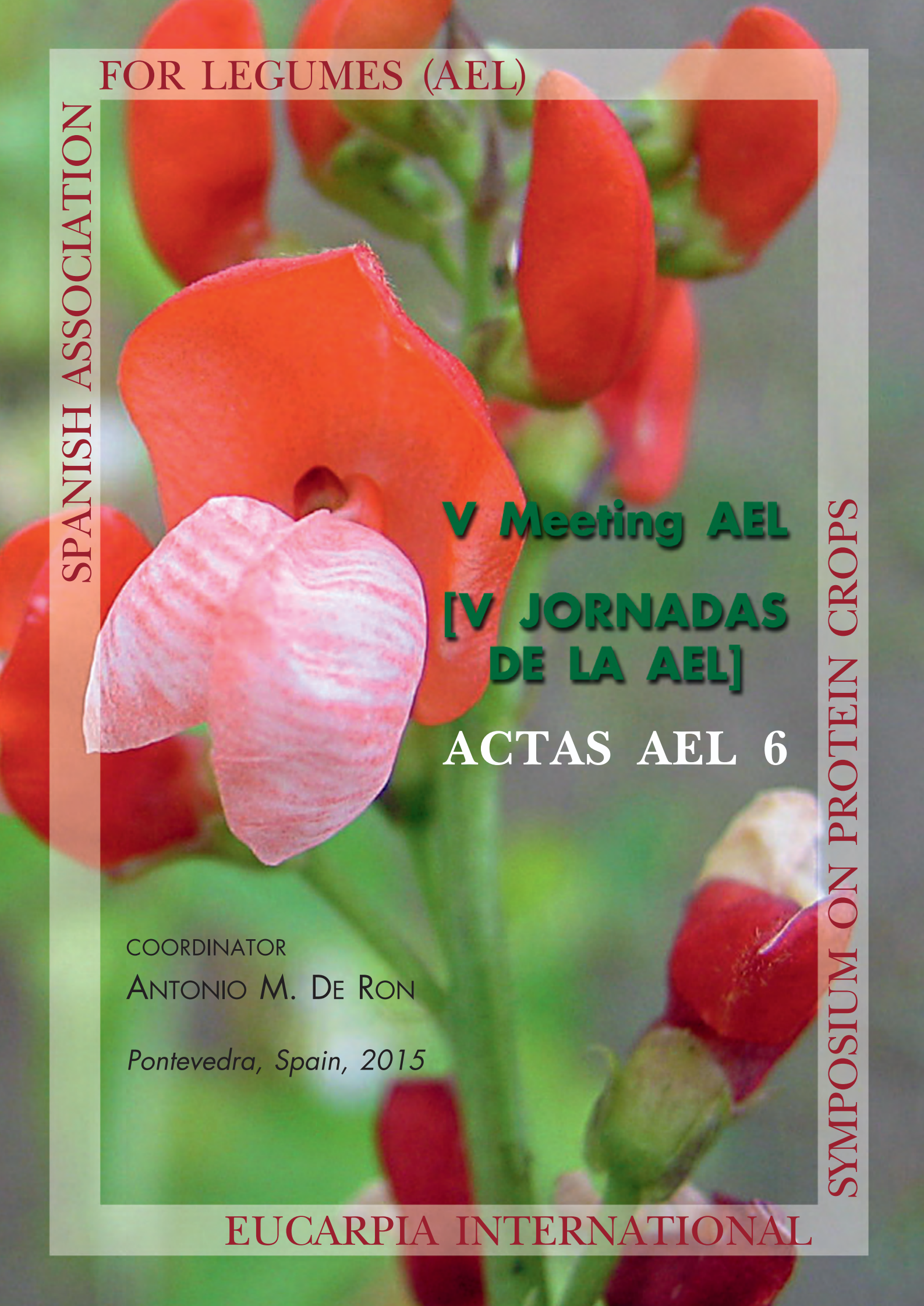

SPANISH ASSOCIATION FOR LEGUMES (AEL)

V Meeting AEL

[V JORNADAS DE LA AEL]

ACTAS AEL 6

SYMPOSIUM ON PROTEIN CROPS

COORDINATOR

ANTONIO M. DE RON

Pontevedra, Spain, 2015

EUCARPIA INTERNATIONAL

SPANISH ASSOCIATION FOR LEGUMES (AEL)

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UTILIZATION OF A NOVEL BIOFERTILIZER FOR IRON DEFICIENCY CHLOROSIS PREVENTION IN COMMON BEAN AND SOYBEAN PLANTS

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Introduction

Iron (Fe) is an essential nutrient for plant growth and development. Despite being abundant in soils, it is very often unavailable for uptake by plants, leading to Iron Deficiency Chlorosis (IDC). IDC is generally associated with high pH calcareous soils, leading to severe plant yield losses. The utilization of biofertilizers is a promising eco-friendly approach for IDC control as they improve soil fertility status and enhance crop production. Moreover, the potential to increase nutrient availability to plants by P and K based biofertilizers combined with a fungal chitosan (PNPK), have already been described (Felix, 2011). The objective of this work was to analyze the effect of the application of a bioprotector-biofertilizer in the alleviation of IDC symptoms in common bean and soybean at morphological and physiological levels.

Material and Methods

Plants were grown for 5 weeks in alkaline soil (pH 8.4) with 0%, 4% (B1) or 8% (B2) of a biofertilizer (PNPK) produced from powdered rocks with phosphate (P), potassium (K), earthworm compound enriched in nitrogen (N) and free-living diazotrophic bacteria *Cunninghamella elegans*. SPAD readings (Minolta, Japan) were taken in the youngest trifoliate leaves. Total chlorophyll and carotenoids were quantified as in Abadía *et al.* (1984) and Sims and Gamon (2002). Mineral accumulation was measured by ICP-OES. Student's *t*-test corrected for multiple comparisons using the Holm-Sidak method was used for statistical analysis.

Results and Discussion

Soybean plants treated with both PNPK concentrations had significantly higher SPAD values (47%), compared to control (Fig. 1A) ($P < 0.05$). Also, total chlorophyll and carotenoid concentrations significantly increased (*P. vulgaris*: 45% for B1 and 65% for B2; *G. max*: 70% for both PNPK treatments), compared to the control (Figure 1B, C), suggesting stimulation in the production of photosynthetic pigments by PNPK application. A significant improvement (of about 45%) in shoot dry weight (DW) was

verified in *P. vulgaris* treated with both PNPK concentrations (Table 1), once again indicating that PNPK application affects positively yield of common bean. Increased shoot DW by the addition of PNPK has already been described in cowpea (Berger *et al.*, 2013) and lettuce (Felix, 2011).

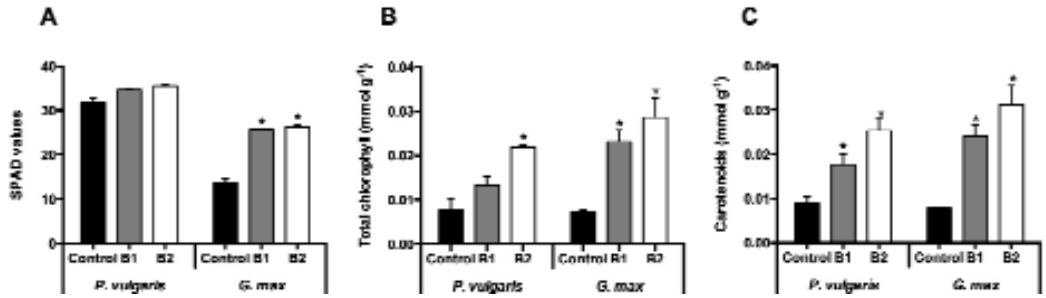

Figure 1: SPAD values (A), total chlorophyll (B) and carotenoids (C) concentration in *P. vulgaris* and *G. max* plants with no PNPK treatment (Control) and treated with 4% (B1) or 8% (B2) PNPK. Data are means ± SEM. Asterisks denote statistical difference compared to control ($P < 0.05$).

Root dry weight also increased significantly with PNPK treatment in *P. vulgaris* (42%) and *G. max* (17%) plants with treatment B1 (Table 1). With regards to root length, there was a significant increase in this parameter in *P. vulgaris* plants treated with both PNPK concentrations; although a significant decrease was verified in the length of *G. max* roots (49% for B1 and 32% for B2). A general trend was observed for an increase in plant height, although not significant ($P > 0.05$). *P. vulgaris* treated with B2 accumulated significantly more Fe and P in shoots and more K in roots than those from the control treatment (data not shown), suggesting a positive effect of PNPK application in accumulation of these minerals. Berger *et al.* (2013) and Felix (2011) observed a significant increase in P and K in plants grown with PNPK, and suggested a possible release of PO_4^{3-} by the metabolic activity of the fungus. We can thus conclude that the use of biofertilizers produced from organic matter and powdered rocks with P and K and the protective fungi-produced chitosan (PNPK) could be an alternative to the utilization of conventional fertilizers in the alleviation of IDC symptoms in common bean and soybean.

Table 1: Morphological traits of *P. vulgaris* and *G. max* plants with no PNPK treatment (Control) and treated with 4% (B1) or 8% (B2) PNPK. Data are means ± SEM. Asterisks denote statistical difference compared to control ($P < 0.05$).

	PNPK treatment	Shoot dry weight (g)	Root dry weight (g)	Root lenght (cm)	Plant height (cm)
P. vulgaris	Control	1.186±0.164	0.292±0.061	29.640±3.766	69.920±5.258
	B1	1.997±0.117*	0.499±0.039*	42.360±2.347*	79.970±5.558
	B2	2.317±0.208*	0.473±0.058	39.800±2.041*	84.000±5.008
G. max	Control	0.905±0.028	0.181±0.008	38.068±1.958	61.250±5.362
	B1	1.078±0.031*	0.217±0.015*	25.540±1.147*	64.920±5.586
	B2	1.146±0.115	0.260±0.047	28.860±2.451*	60.120±5.037

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