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Boron application in red clover (*Trifolium pratense* L.) seed production

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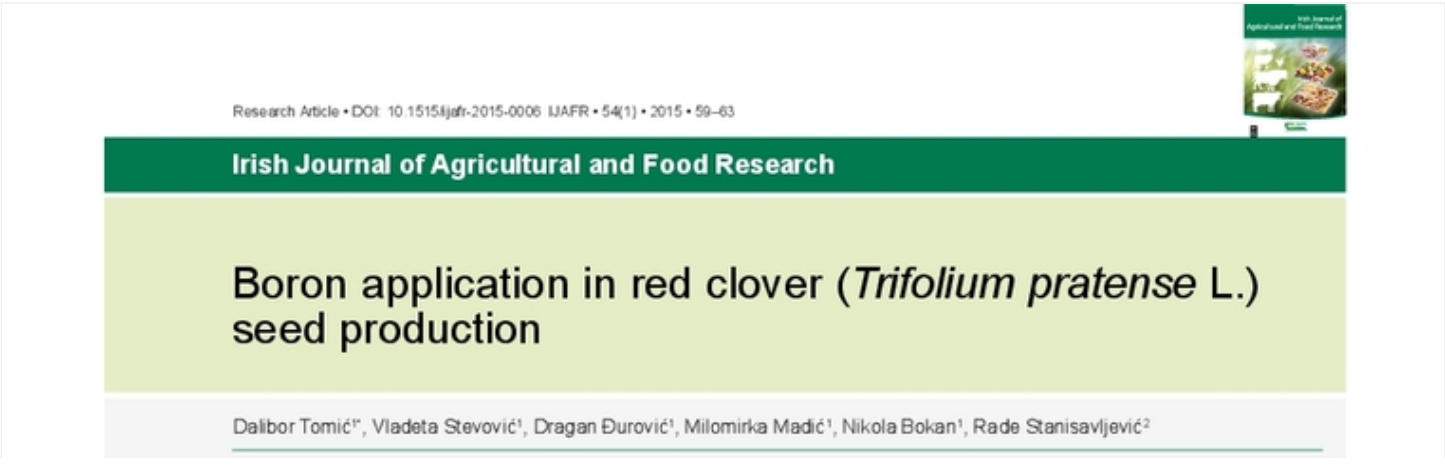

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Abstract

A field trial with four red clover cultivars was established on acid soil in order to evaluate the effect of foliar boron application on seed yield. The crop received foliar boron treatment during the second growth of the second year at two applications. Although seed yield showed a significant increase in boron-treated plants in 2011 compared with control (26.0%), its relative increase was far higher in 2010 (43.2%), which had increased total rainfall amounts during flowering. Sufficient level of boron supply to red clover plants for seed production has a remarkably positive effect under conditions hampering pollination and fertilisation.

Keywords

boron • red clover • seed yield • yield components

Introduction

In Southeastern Europe, red clover (*Trifolium pratense* L.) seed crops are often grown on acid soils where certain macro- and micronutrients are less available to plants (Dear and Lipsett, 1987).

As a micronutrient, boron (B) is vital to many cellular processes in plants (Hu and Brown, 1994; Matoh *et al.*, 2000; Dos Santos *et al.*, 2004). Sufficient B levels also enhance nitrogenase activity and nitrogen fixation by *Rhizobium*, thereby facilitating the growth of legume plants (Blevins and Lukaszewski, 1998).

Specifically, insufficient B supply has an unfavourable effect on the growth and development of generative organs of many plants. B deficiency generally leads to precocious flowering (Hanson, Chaplin and Breen, 1985) and poor quality fruit (Gupta, 1993). Positive effects of sufficient B levels include an increased number of fertile flowers (Dear and Lipsett, 1987; Noppakoonwong *et al.*, 1997), higher pollen viability (YIstra *et al.*, 1992) and improved seed and fruit growth (Rashid, Rafique and Bughio, 1994).

B is uptaken from the soil mostly as undissociated boric acid (Hening and Patrick, 1997). B uptake in acid soils is adversely affected by a high concentration of aluminium ions (Yang and Zhang, 1998; Matsumoto, 2000; Seguel *et al.*, 2012). Therefore, foliar B application in acid soils would be an efficient strategy to establish optimal B status in plants compared with its supplementation via soil. The objective of the present study was to evaluate seed yield and yield components in red clover cultivars when supplied with foliar application of boron, a micronutrient not readily available to plants in acid soils.

Materials and methods

Soil properties

A field experiment was set up at a trial field of the Veterinary Extension Service in Čačak (43°54'39.06" N, 20°19'10.21" E, 246 m a.s.l.) in 2009–2011. The trial was established on a fluvisol (IUSS Working Group WRB, 2014), pH_{KCl} 4.8, with 3.18% organic matter, 0% $CaCO_3$, 22.08mg P $100g^{-1}$ soil and 30.0mg K $100g^{-1}$ soil (Gupta 2008). The preceeding crop was natural meadow. In autumn, prior to seeding, 45 kg ha^{-1} N, 45 kg ha^{-1} P_2O_5 and 45 kg ha^{-1} K_2O were incorporated into the soil by primary tillage.

Weather conditions

Data on mean monthly temperatures and rainfall were recorded throughout the experiment at a weather station located near the experiment. The mean annual air temperature in 2010, 2011 and long-time period (1992–2002) was 12.57, 12.37 and 11.97°C, respectively. Monthly rainfall (Figure 1) showed large variations during the growing season (April–September).

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