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Yield and nitrogen uptake of sunflower as influenced by nitrogen sources and rates

Larissa AC Moraes, Adonis Moreira

National Soybean Research Center of EMBRAPA, Londrina, Brazil, e-mail:larissa.moraes@embrapa.br

Abstract
A greenhouse experiment was conducted to evaluate the shoot dry weight (SDW) and achene yield, and nitrogen (N) concentration in leaves and achene as influenced by N sources. The N sources was urea and ammonium sulfate (AS), and the N rates were 0, 50, 100, and 200 mg kg^{-1}. SDW and achene yield and N concentration in leaves and achene were significantly influenced by N sources. The maximum SDW and achene yield were 200 mg N Kg^{-1} of urea, and 147 and 100 mg N kg^{-1} of AS application. Regardless of the N source, there was a significant linear effect with increasing N rates.

INTRODUCTION

Nitrogen (N) is one of the most production limiting nutrient in crop yield in all agroecological regions of the world (Fageria et al. 2011). The main reasons of N deficiency in annual crops are its low recovery efficiency. For the efficient management of N in the cropping systems, adequate rate, appropriate source and timing of application during crop growth cycle play an important role (Fageria et al. 2014). Ammonium sulfate and urea are the main sources of N for annual crop yield in developing countries (Fageria et al. 2011). The objective of this research was to evaluate ammonium sulfate and urea in sunflower achene yield and N concentration in the leaves and achene in an Organic soil of Brazil.

MATERIAL AND METHODS

The greenhouse experiment was conducted at the National Soybean Research Center of EMBRAPA to evaluate ammonium sulfate and urea as sources of N in sunflower yield and nutritional status under greenhouse conditions. The N rate applied was 0, 50, 100, and 200 mg kg^{-1} of soil. The soil used was an Organic soil having following chemical and physical characteristics before the application of N treatments: pH in $CaCl_2$ was 7.0, calcium (Ca) 9.5 $cmolkg^{-1}$, magnesium (Mg) 1.5 $cmolkg^{-1}$, aluminum (Al) 0.0 $cmolkg^{-1}$, phosphorus (P) 30.6 mg kg^{-1}, potassium (K) 145.0 mg kg^{-1}, and organic matter (OM) content 25.1 g kg^{-1}. Experiments were conducted in plastic pots with 3 kg of soil in each pot. At the time of sowing, each pot received 5 mg Zn kg^{-1}, and 100 mg K kg^{-1} of soil. Completely experimental design with three replicates was used. Cultivar shown was BRS 323 and there were two plants in each pot. Pots were watered every day to maintain soil moisture at about field capacity during growth cycle. Achene, aerial part, and diagnostic leaves were dried in an oven at 65±5°C to a constant weight. Dried material was grounded and N concentration (grain and leaves) was determined by the micro-Kjeldahl method (Malavolta et al. 1997). Data were analyzed by analysis of variance (ANOVA), and regression analysis was performed. Appropriate regression model was selected on the basis of R^2.

RESULTS AND DISCUSSION

Nitrogen source × N rates interaction for shoot dry weight (SDW) and achene yield were significant, indicating variability between urea and ammonium sulfate (AS) for SDW and achene yield. Hence, values of these characteristics are presented at two N sources at different N rates (Figure 1). SDW yield increase significantly in a linear (urea) and quadratic (AS) fashion. Based on regression equation, maximum SDW yield estimated was obtained with 200 mg N kg^{-1} (urea) and 147 mg N kg^{-1} (AS), while the achene yield, the urea application was similar and maximum yield estimated with AS application was 100 mg N kg^{-1} (Figure 1). There was significant linear effect in the N concentration in the leaves ($p \leq 0.05$) and interaction source × rates in N concentration in achene that varied from 44.3 to 46.2 g kg^{-1} and 26.2 to 33.1 g kg^{-1} under urea, and under SA from 44.3 to 46.5 g kg^{-1} and 21.0 to 37.8 g kg^{-1}, respectively (Figure 2). On average, the values of N concentration in the leaves were similar 44.8 g kg^{-1} (urea) and 44.9 g kg^{-1} (AS), while in the achene were 23.7 g kg^{-1} (urea) and 23.1 g kg^{-1} (AS) (Figure 2). The values of N concentration in the leaves are within the considered appropriate for sunflower cultivation in tropical and subtropical conditions (Malavolta et al. 1997).

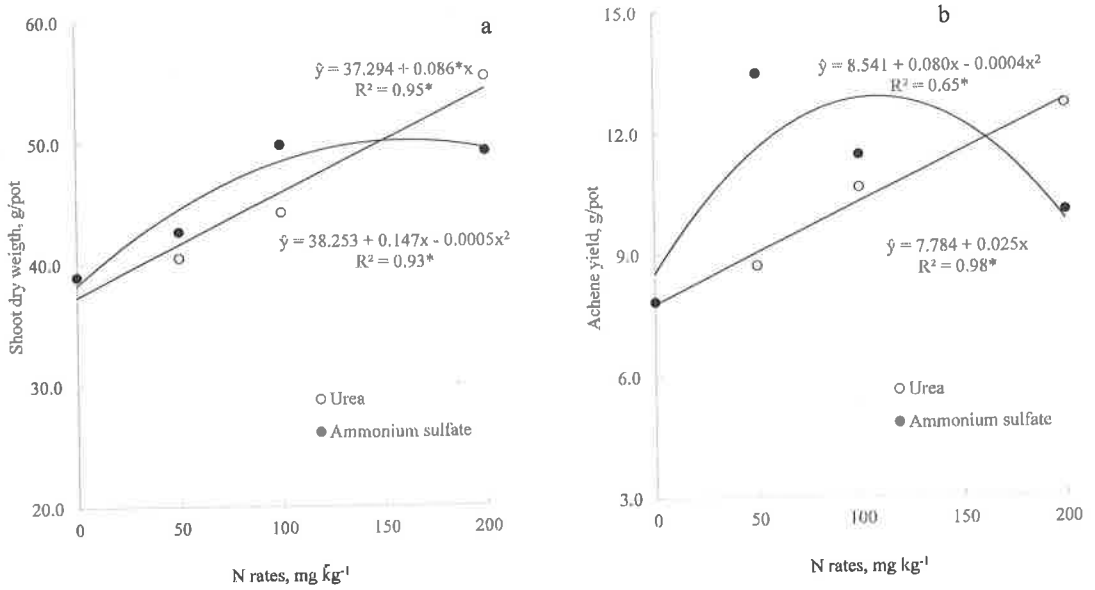

Figure 1. Relationship between N application rate by urea and ammonium sulfate and shoot dry weight (a), and achene (b) yield of sunflower. *significant at 5% probability level

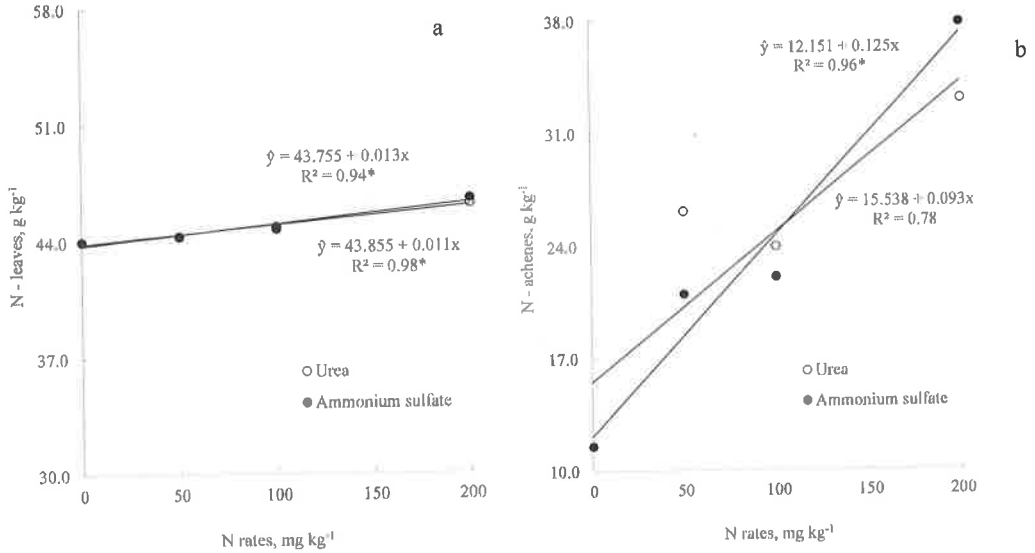

Figure 2. Relationship between N application rate by urea and ammonium sulfate and N concentration in leaves and achene of sunflower. *significant at 5% probability level.

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