Effect Of Foliar Application Of Fertilizers And Biostimulants On The Growth And Seed Production Of A Male-Sterile Inbred Line Of Maize

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Introduction

Inbred maize lines are highly specialized crops cultivated to obtain hybrid seeds. Soil fertilization is the most widespread method to supply nutrients to the crop. However, plants can uptake mineral nutrients also by leaves whean applied at appropriate concentration (Fageria et al., 2009). Foliar fertilization aims at providing nutrients under limiting soil nutrient availability and to sustain the plants during critical phases for nutrients requirement (Fernández et al., 2013). Foliar fertilization has many advantages, such as the possibility to provide small nutrients quantity, satisfy specific plant needs in different growth stages, and stimulate roots to absorb nutrients from the soil solution by systemic internal signals. Although foliar fertilization cannot replace soil fertilization, it can be used as a supplement/complement in sustainable production systems (Kannan, 2010). There are many factors affecting the dynamics of foliar nutrient absorption, such as leaf size, shape and age, the presence of trichomes, the chemical composition of cuticle and foliar waxes, as well as some environmental factors, like temperature, relative humidity and wind speed, and intrinsic characteristics of the commercial products such as nutrient concentration, solubility, pH, point of deliquescence (POD) and molecular weight of dissolved compounds (Fernández et al., 2013). While foliar fertilization has been initially developed for horticulture, it is becoming important for cereals such wheat and maize. In this study, various fertilizers/biostimulants were applied in open field to a female imbred maize line at early stages by foliar application in order to verify whether plant growth and seed production were improved, for better sustainability.

Materials and Methods

The trial was conducted at the Ca' Corniani farm in Caorle (Venice, NE Italy, 2 m a.s.l.) during the 2020 growing season. The field trial considered an inbred female male-sterile line of maize for a FAO-700 hybrid seed production. The experimental set-up consisted of a latin-square with four replicates (n=4). Each plot was 4,5 m wide (6 rows of seedbearing plants) and 10 m length (45 m^2). Among the plots, there were two rows of male line that are spaced out 0,50 m each one. The foliar treatment was carried out on 16 June in the middle of the day at V5 stage (5 true leaves extended). The organic-mineral fertilizers applied by foliar spraying are commercial products, consisted of at least two macro-nutrients with organic carbon deriving from different matrices: a) Organic-mineral fertilizer 10.5.7 hydrolyzed animal epithelium and micro-elements (NPK + Ei + micro); b) Organic-mineral fertilizer in suspension 13.0.5 with humified peat (NK + Tu); c) Organic-mineral fertilizer 0.13.5 together with brown algae *Ascophyllum nodosum* extracts (PK + An). The investigated parameters regarded both physiological (SPAD, Net CO_2 assimilation), and morphological (plant height, root growth) traits, and productive/qualitative traits for commercial purposes (grain dry weight and number of bags per Gross hectare – field surface divided into 84% and 16% of female and male lines, respectively – kernel caliber, waste kernels, germination rate, etc.). Statistical analysis was carried out with Costat software (Cohort software, Manugistics, Rockville, MD-USA; ver. 6.204). Separation of means was set at $P \leq 0,05$ with the Newman-Keuls test.

Results

As regards plant physiology, foliar fertilization did not lead to benefits on shoot growth of maize and leaf chlorophyll content (SPAD), while at stage V10-V11 the root system was improved mainly in the shallow soil layers (0-20 cm) by the PK + An treatment (and somewhat by the NPK+Ei), as referred to diameter, root length and root area densities (Figure 1). The root dry biomass was also increased by PK + An. As regards the qualitative parameters of the grains, the application of these products allowed slight improvements compared to controls (NT) in terms increased number of kernels per spike and reduced percentage of waste kernels. The production of seed commercial bags (80 k seeds each) was not significantaly affected by foliar application, although slight improvements were recorded for all the treatments (Figure 1). On average, the proportion of kernels with medium caliber was higher than the larger one.

Germination was not affected by any foliar fertilization.

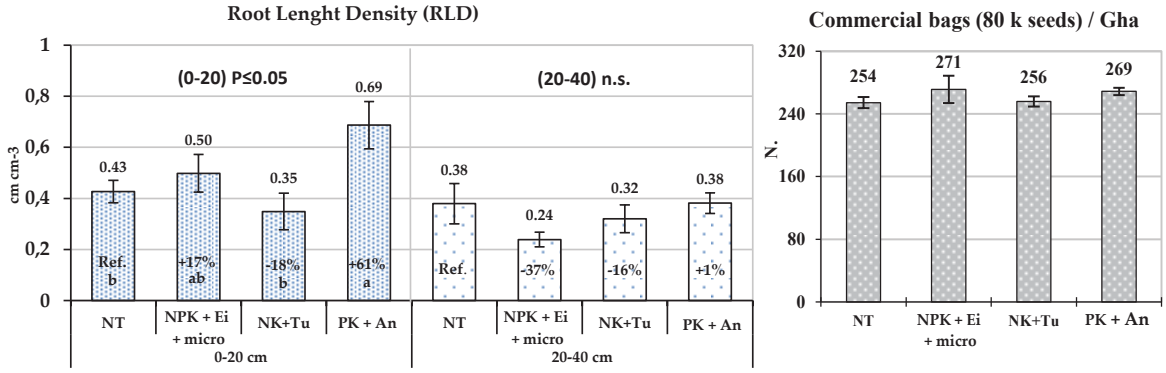

Figure 6. Root Lenght Density (RLD) in two soil layers (0-20 and 20-40 cm) (left) and number of commercial bags product per Gross hectare (right) in a male-sterile seedbearing line under different foliar

Conclusions

This study demonstrates that it is essential to pursue a research and development model aimed to strengthening agronomic knowledge on the impacts of foliar fertilization on crops such as seed maize, with the aim at tuning the agronomic technique and developing increasingly productive and sustainable practices. In addition to greater economic sustainability for the seed company, producing more seeds on a smaller surface allows to obtain more basic material for future crops, in line with current needs of a constantly growing population. It can be concluded that foliar fertilization with specific fertilizers and biostimulants is agronomically interesting in seed maize production, even if further studies are necessary in order to consider different doses and application timing (possibly later, at the 7-8-leaf stage, at the spike differentiation).

Literature

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