Effect of mineral and organic soil amendments on maize biomass productivity

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In recent decades agriculture systems have tried to increase productivity at the same level of fertilization or even with reduced fertilization. It is justified by environmental and economic approaches. Thus, it is very promising to use soil amendments alone or in a mixture with fertilizers (Eprikashvili et al., 2019; Chatzistathis et al., 2021). Zeolite and vermiculite are important inorganic soil amendments from an agricultural point of view due to their large surface areas, high cation exchange capacity, and high water retention. It makes these minerals widely used in agriculture to increase fertilizers efficiency, slow release of herbicides, water and gas absorption, and antifungal activity (Jarosz et al., 2022; Szerement et al., 2021). Connecting mineral and organic soil amendment features with mineral fertilizers is promising in modern agronomy systems. One of the advantages of mineral-organic mixtures is a sequential release of nutrients according to the demand for plants. The addition of functionalized materials to fertilizers can increase the efficiency of the use of nutrients while reducing their losses.

This study aimed to determine the effect of different zeolite composites and mixtures with lignite or leonardite on the biomass production of maize. The following treatments were applied in a pot experiment: zeolite/carbon and zeolite/vermiculite composites mixed with lignite or leonardite, and a control treatment without any amendments.

The root morphometric parameters and aboveground production of maize were determined. The maize was harvested in September 2020 and 2021. Aboveground biomass samples were taken from each pot and dried for 48 hours at 65 °C to calculate the dry matter yield. The root morphometric parameters were calculated by methods described by Głąb et al. (2020), i.e., root length density (RLD), mean root diameter (MRD, root surface area density (RSAD), specific root length (SRL), and root volume density (RVD). The roots were dried at 80 °C to determine the root dry matter density (RDMD).

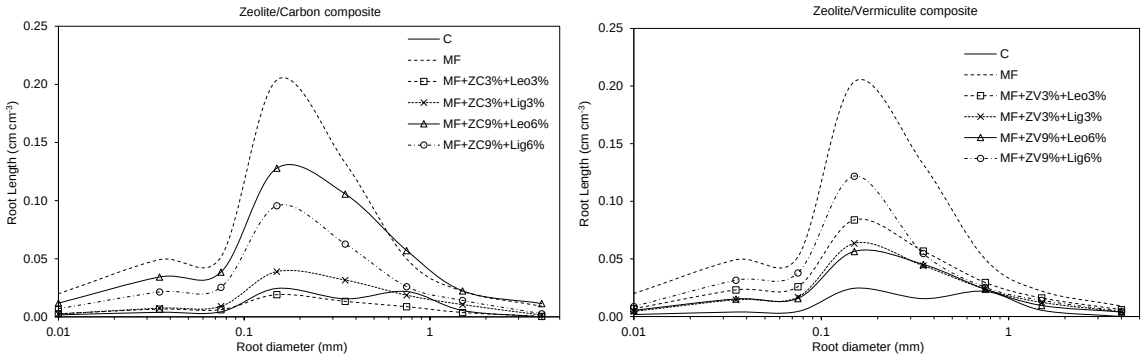

Figure 1. Root length density (RLD) distribution at the different root diameter values for treatments with different soil amendments. Treatments: control (C), mineral fertilization (MF), zeolite/vermiculite composite (ZV), zeolite/carbon composite (ZC), lignite (Lig), and leonardite (Leo).

Our investigation shows that zeolite composites with organic amendments affect maize biomass production, both aboveground and root systems. The lowest productivity was characterized for maize without any fertilizers and amendments. The highest aboveground biomass of maize straw was obtained when only mineral fertilization was applied. Both aboveground and root biomass were at the same level, notwithstanding the soil amendments, zeolite composites or organic amendments. Root morphological parameters were modified by zeolite/carbon and zeolite/vermiculite composites. Zeolite/vermiculite composite application increased root surface area and root volume.

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