CO-COMPOSTED BIOCHAR IMPROVES BARLEY YIELD, MANURE USE EFFICIENCY AND OFFSETS CHEMICAL FERTILIZER DEMAND IN ORGANIC AGRICULTURE UNDER LOW RAINFALL CONDITIONS

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Key Words: biochar, manure, co-composting, organic agriculture, barley, marginal land

Organic agriculture systems encompass a range of agronomic techniques mainly focused on maintaining and increasing soil health and its long-term fertility. The substitution of off-farm, synthetic inputs (e.g. fertilizers) is one of the main principles characterizing this agricultural production system. This work presents the results of an open field experiment which have investigated the effects of the application of co-composted biochar with manure (CB), compared with stabilized manure without biochar addition (MN), NPK-based inorganic fertilization (NPK) and control treatments (CK) (no fertilization or amendment) on spring barley growth and yield. In the present study, the choice fell on a portion of agricultural land which was abandoned for more than 10 years, in compliance with the EU definition of abandoned land. Before its use, biochar was previously characterized chemically, physically and toxicologically in order to verify its agronomic suitability in accordance with the Italian Legislative Decree n.75/2010 (Annex II, Category 16) setting limits for the use of biochar as a soil organic amendment. Also, the obtained co-composted material was characterized to assess its chemical, physical and toxicological conformity prior to incorporation into the soil. For comparison, the category of mixed composted soil was taken as a reference from a legislative point of view. Several soil chemical parameters were analyzed in soil to determine significant variations among treatments. Barley biomass was evaluated at the phenological stage of milky caryopsis ripening (May) and at the vitreous caryopsis stage (June). The growing season was characterized by low rainfall and prolonged dry spells. Significant effects have been observed on barley biomass and seed yield for co-composted biochar, compared to all other treatments, including NPK. Plants amended with CB showed the highest biomass value (Figure 1A) at harvest. Furthermore, the same statistical trend was observed for the grain yield parameter (Figure 1B). In detail, the grain yield of the plants cultivated with CB showed a significant increase of about 40% compared to CK, MN, and NPK treatments.

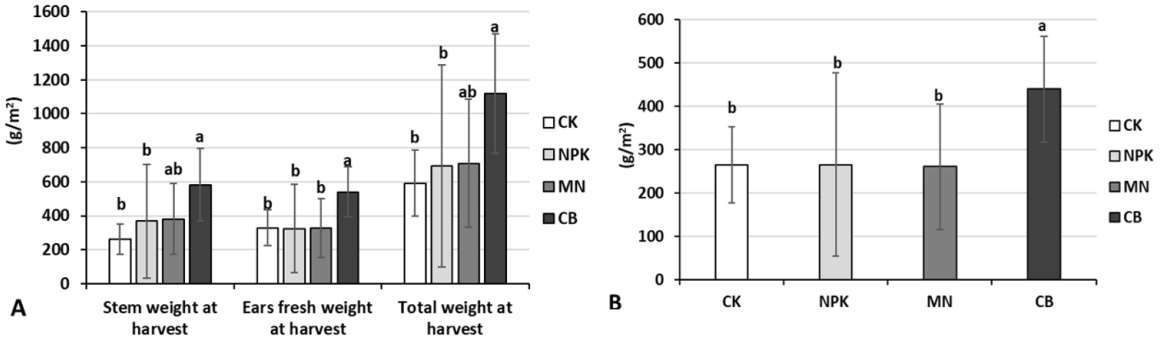

Figure 1 - Mean values (n=8) of the stem, ears and total biomass weight at harvest (A) and seed yield (B) of barley plants of treated with Control (CK), Manure (MN), Inorganic NPK (NPK) and Co-composted Biochar (CB) harvested on June at fully ripe stage. Error bars represent standard deviation. Different letters mean statistical significance ($p<0.001$).

Moreover, co-composted biochar and manure (CB) proved to be a valid treatment to preserve the initial soil organic carbon (final TOC=23.3), providing a common C/N value for agricultural soil. These findings suggest that biochar can improve the agronomic efficiency of manure, providing a valid alternative to common on-farm handling of manure, and contributing to the offsetting of inorganic fertilizer demand in organic agriculture with low rainfall.