DATE PALM WASTE COMPOST IMPROVES THE PRODUCTION OF ORGANIC BARLEY IN AN OASIS ENVIRONMENT

EMNA GHOUILI (TUNISIA)

Centre of Biotechnology of Borj-Cedria (CBBC), Tunisia

GHASSEN ABID (TUNISIA)

Centre of Biotechnology of Borj-Cedria (CBBC), Tunisia

JIHENE BEN YAHMED (TUNISIA)

National Agronomic Institute of Tunisia (INAT), University of Carthage, Tunisia

MOEZ JEBARA (TUNISIA)

Centre of Biotechnology of Borj-Cedria (CBBC), Tunisia

YORDAN MUHOVSKI (TUNISIA)

Walloon Agricultural Research Centre (CRA-W), Belgium

KHALED SASSI (TUNISIA)

National Agronomic Institute of Tunisia (INAT), University of Carthage, Tunisia

Introduction

In Tunisia, date palm culture generates huge amounts of waste that can be valorized by composting. Composting is a simple, ecological, and low-cost way to recover and transform this waste into an organic amendment in biological oases. Renewable biomass waste allows re-incorporating the organic matter into the soil and improves soil fertility, promoting plant growth and increasing crop productivity. In the present study, we investigate the performance of compost on the growth and yield of organic barley in a Tunisian oasis.

Unique Approach

Date Palm Leaves Compost Preparation

The date palm leaves compost was prepared at a composting station of ASOC (Association for Saving Oasis of Chenini, Gabes, Tunisia) from cow manure and date palm leaves collected from local farmers in Chenini, Gabes, Tunisia. The date palm leaves were air-dried, mechanically chopped, and then mixed with the cow manure in a windrow of 5 t.

Photo 1: Composting process:

1. Collecting date palm leaves from local farmers; 2. Air-drying of leaves; 3. Chopping of leaves wood; 4. Mixing of cow manure and date palm material; 5. Windrowing of compost; 6-8 Packaging.

2. Experimental Site and Design

In an open-field trial, the experimental treatments were unamended soil and soil amended with 30 t/ha of compost and mixed in the upper 15–20 cm soil one day before seeding. The local barley (Hordeum vulgare L.) cultivar Sahli was used in this study as it represents the most grown cultivar in Tunisia's organic farming.

3. Grain yield and yield components estimation

At the harvest time, barley plants were collected, and yield component characters were determined, such as plant height (PH), spike length (SL), spike number per plant (SP), grain number per spike (GNS), thousand seed weight (TSW), grain yield (GY), biological yield (BY) and straw yield (SY). Then, mineral analysis was performed in order to determine grain nutrient constituents (N, P, K, Ca, Mg, Na, Fe, Mn, Zn and Cu).

Photo 2: Harvest stage of biological barley

4. Proteomic Analysis of Barley

The proteomic profile of barley leaves and roots in response to date palm waste compost application were analysed by LC-MS/MS and then validated based on qRT-PCR.

5. Metagenomic Analysis of Soil

High-throughput sequencing and quantitative real-time PCR (qPCR) were used to determine the effects of compost application on soil bacterial and fungal communities at the tillering, booting and ripening stages of barley plant growth.

Impact

1. General

Date palm waste compost allows farmers to transform oasis waste, which can provide a refuge for pests and predators of crops.

It permits also the re-incorporation of organic matter (OM) and nutrient into the soil characterized as poor in OM.

Thus, soil compost application can be an effective solution to improve soil properties, to boost plant development and increase crop yield.

2. Agronomic Benefits

The application of compost improves the main yield component traits including straw yield as well as biological yield.

Compost application enhanced the nutrient content of most elements (N, P, K, Ca, Mg, Na, Fe, Zn, Mn and Cu) in barley grain compared to untreated, whereas the concentrations of Cd, Cr, Ni and Pb were at low levels far below the limit.

Proteomic analysis of barley leaves and roots proved that barley responds to compost application by complex metabolism pathways.

In leaves, compost application altered abundance of several proteins related to abiotic stress, plant defense, redox homeostasis, transport, carbohydrate, amino acid, energy and protein metabolism, metabolic processes of phytohormone, DNA methylation and secondary metabolites.

In root, compost application activated the enzymes that are involved in redox homeostasis and the regulation of stress response proteins. These results suggest a protective effect of compost, consequently improving barley growth and stress acclimation.

Metagenomic analysis of soil proved that compost application increases soil microbial community diversity. Compost enriched the beneficial microorganisms and reduced the harmful microorganisms.

3. Economic Benefits

The production of compost is cost effective: The local farmers can make their compost since the inputs come from their own farms. Compost improves grain and straw yield, which could improve the income of local farmers.

Reference

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