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ROOT-ZONE SOC AND TN AS AFFECTED BY DW GENOTYPE AND MANAGEMENT, AND SILICON EFFECTS ON DROUGHT TOLERANCE OF BW GENOTYPES.
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[1] International Center for Agricultural Research in Dry Areas (ICARDA). Rabat, Morocco.

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Foreword

This research activity titled “ROOT-ZONE SOC AND TN AS AFFECTED BY DW GENOTYPE AND MANAGEMENT, AND SILICON EFFECTS ON DROUGHT TOLERANCE OF BW GENOTYPES” was funded as part of the Project titled “Sustainability and Operationalization of Established Regional Agricultural Research Centers in Five Arab Countries”, granted by the Arab Fund for Economic & Social Development (AFESD) and implemented by ICARDA.

The research was started in 2016 as a response to the perceived need to launch interdisciplinary research linking soil and water researchers, crop breeders, and physiologists of ICARDA. The goal of the research is to activate novel research lines to understand if i) soil-improvement traits can become a target in crop breeding, and ii) bio-available Silicon can contribute to increase drought tolerance of cereals. The research was launched on own funds during fall 2016, and recommended for funding by AFESD in 2017.

This is the first progress report of the SOC-related component of the research, on the effects of Durum Wheat genotypes on soil organic carbon and total nitrogen in the root-zone.

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1. Rationale and objective

Limited research has been conducted on the short term turn-over of soil organic carbon as affected by crop genotypes with different rooting properties. This research, by exploring the carbon-related implications of the genotype variability in rooting behavior, could potentially drive the identification of climate-smart selection traits and have a significant influence on future breeding strategies. Recent results obtained by ICARDA researchers in Morocco showed that durum wheat (DW) genotypes can be characterized based on their root features, notably root biomass and root angle. The experiment established in 2016/2017 was aimed at investigating the effects that this different rooting behavior of DW can have on soil organic carbon (SOC) and total nitrogen (N) over a single growing-season.

To this aim, field experiments have been designed and implemented in selected experimental stations in Morocco. Collaboration agreements will be set-up with international laboratories to support high precision analyses of the soil samples collected. The main objective was to develop field methods to quantify the effects of DW genotypes with different rooting features (depth, angle, and biomass) on soil OC and N.

2. : Methods

Recent results obtained by ICARDA researchers in Morocco showed that durum wheat (DW) genotypes can be characterized based on their root features, notably root biomass and root angle. Building on these findings, and in collaboration with ICARDA's DW breeder, the following genotypes were selected for this experiment:

Name	ID	Root angle	Root biomass
Omrabi5	4	Narrow	Medium
Margherita 2	162	Medium	Medium
Icamoram7	192	Medium	Low
Bellaroi	295	Wide	Medium
Karim	363	Narrow	Medium
CRESO	391	Medium	High

Two field experiments were launched, respectively in Guich and Merchouch experimental stations. In Guich the experiment was a small exploratory trial purposely established under partially controlled conditions, in Merchouch the research was conducted in open field, in a trial established by breeders to compare genotype performance.

Scientific collaboration was established with a highly qualified laboratory in Italy. A Technical Support Contract was signed with the Department of Agricultural Sciences of the University of Sassari (Italy) for the execution of highly accurate soil carbon and nitrogen analyses.

Informal scientific collaboration was also established with with INRA (Institut National De Recherche Agronomique, Département de l'Environnement et des Ressources Naturelles), which provided information for the evaluation of the baseline properties of the soils of the trials and offered technical support for the preparation (grinding, sieving) of the soil samples.

2.1. Guich station

In Guich, 4 of out 6 genotypes (ID 4, 192, 363, and 391) were planted in the same type of plastic mesh baskets used in previous experiments to evaluate the average biomass and angle of roots. Baskets had top internal diameter of 18 cm, bottom diameter of 11 cm, height of 11 cm, and mesh size of 3 mm. They were filled with topsoil previously collected at the same site, and sieved to 2 mm and mixed by using wide plastic basins. It has to be noted that the texture of the used soil is sand, and its structure is very weak small crumby, so the main aim of sieving was removal of fresh organic fragments, and homogenization of organic matter content. Soil was fertilized with a standard dose of 15N:15P:15K fertilizer before planting and with 2 gr of 33.5% nitrogen three times until flowering (Jan,10th Feb 10th and March 10th 2017). The baskets were buried in the field topsoil (keeping their upper edge at surface) with a spacing of 20x17.5 cm between baskets, in a randomized design with 6 replications. In November 2016 three seeds were sown in each basket, and plants were thinned to one per basket after seedling establishment. Six pots were not seeded (but fertilized as well) to become the control.

At harvest time (June 2017), above ground biomass (AB) was measured after cutting stems 2 cm above ground, along with spike number (SN). The soil and root were then extracted from the basket paying attention not to disrupt the block formed by the soil and the root mesh. The latter was turned upside down and an undisturbed 50 ml soil core was extracted from the center of the basket, just below the root crown, by using a cylindrical laboratory plastic box (around 4 cm in diameter and 6 cm in height). Root biomass was also collected (RB). The latter included roots plus above-ground part of crown up to ca 2 cm above soil surface, plus the fine adhering fine soil particles and millimetric aggregates. Roots were not cleaned before measure due to the indicative purpose of the measurement. Soil samples in boxes were air-dried, shacked for mixing, and shipped to a collaborating laboratory (Sassari, Italy) for immediate analyses of soil organic carbon (SOC) and total nitrogen (NT).

2.2. Merchouch station

In Merchouch the experiment was conducted in a trial established by DW breeders to compare genotype performance, where the six selected genotypes were present, along

with several others, as two replicate plots under conventional tillage (CT) and two replicate plots under no tillage (NT). The size of each plot was approximately 3.25 m^2 (3m x 1.75m). The experiment was thus conducted in 4 plots per each genotype (2 NT plus 2 CT, by 6 G), which were randomly located in the large fields among several tens of other plots of the same size.

Before seeding (November 2016), baseline sampling for determination of SOC and TN was performed in both fields (NT, CT). After harvest (June 2017), soil sampling was done as paired sampling, within each plot (in soil root zone, between 0 and 20 cm) and outside it (control, between 0 and 20 cm). Soil samples were air-dried, grinded and sieved, and shipped (Sassari, Italy) for immediate analyses of soil organic and inorganic carbon (SOC, SIC) and total nitrogen (NT).

Residual soil moisture after harvest was determined in the experimental plots during the dry season. Data about soil moisture during the growing season was available from a different experiment conducted nearby.

A Moroccan male field technician was trained in Merchouch on methods to sample and treat soil for accurate determination of organic carbon in wheat root zone.

3. The way forward

The experiment is proceeding according to the schedule. The data are being analyzed. Preliminary elaborations provided encouraging indications about the effectiveness of the experiments conducted.

The experiment was concluded in Guich during summer. It will completed in Merchouch station with final (year 1) sampling at the end of the dry season to estimate the carbon losses due to mineralization.