Transnational Access Report

1. General Information

Project Acronym (ID):	ShootMaize
Project Title	Analysis of a maize introgression library for traits related to light interception under water deficit
Installation used	PhenoArch, Montpellier
Name of Group Leader	Prof. Roberto Tuberosa
Name of organization	Dipartimento di Scienze Agrarie (DipSA), University of Bologna

2. Project summary (max. 250 words)

Soil water availability is one of the main factors affecting crop performance. One of the common response of plants to water deficit is the reduction of their growth rate. This adaptive response is aimed to reduce the evaporative demand reducing the leaf area involved in the transpiration process. Unfortunately even the growth of reproductive organs like flowers and seeds is affected. As consequence of that, the agronomical performances of the crops are compromised.
The objective of the experiment is to test if a larger number of traits have a common genetic determinism with those already identified for root and individual leaf traits, in particular total leaf area, phyllochron, expansion rate of the stem, biomass accumulation rate, radiation use efficiency and water use efficiency, and the responses of all these variables to a soil water deficit.
The phenotyping platform PhenoArch (INRA, Montpellier) provides the opportunity to daily measure both growth rate and evapotranspiration of up to 1,680 plants; these features, coupled with accurate environment and soil monitoring make it one of the most advanced tools to study the plants response to water stress.

3. Description of work (max. 250 words)

Plant material: a maize Introgression Library (IL) of 74 lines derived from the cross between Gaspé Flint (an early line) and B73 used as donor and recurrent genotypes, respectively plus the two parents.
Growing conditions: plants were grown into a greenhouse in 15-Liter pots filled with peat based substrate. A photoperiod of 16/8 light/dark hours has been kept. Atmospheric temperature has been maintained at 24 ^{o}C during the day and 18 ^{o}C at night.
Drought treatment: the maize IL lines were tested under well-watered (WW) and water-deficit (WD) conditions (soil water potential approx -1 and -4 Bar, respectively).
Water deficit started at the appearance of the 5th leaf. The experiment stopped when the maize plants reached leaf 13th. For each treatment, eight replicates (one rep = one pot. 1 plant per pot) for genotype has been evaluated.
Phenotyping: we recorded two main types of phenotypic data: i) Image based: every night, digital images were collected for 50% of the plants. From these images, several growth related phenotypes like biomass, leaf expansion, plant height etc, will be recovered and/or estimated. ii) Weight measurements: every plant was weighted to estimate the evapotranspiration at least once per day. Combining these data, is possible to evaluate key physiological parameters like water use efficiency (WUE) and evaporative demand. Additional phenotypes (eg. phyllochron) were collected manually. At the end of the experiment, samples has been collected to evaluate the ABA content of the leaves
Data Analysis: the following pipeline was applied. i) correction of the data based on estimation of non-random environmental effects (including shadowing, light scattering, cooling system etc); ii) removing of outliers; iii) contrast with reference genotype (recurrent parent B73) by Dunnett's statistical test; iv)

investigation of chromosome regions involved in relevant lines identified after Dunnett's test.
Additional analysis of dynamical parameters like biomass accumulation and phyllochron, are undergoing.

4. Main achievements (max. 250 words)

The set of data collected during the experiment has been partially analyzed and the following results emerged:

i. BIOMASS ACCUMULATION: alleles with negative and positive effect were identified both in WW and WD conditions; 7 introgressed fragments (chr. 1, 2, 4, 8, 9 and 10) confer an increase in biomass in WW while 5 (chr. 2, 3, 5, 8) cause final weight reduction; in WD condition, just two fragments confer highest final biomass (chr. 3 and 9) while 6 (chr. 2, 3, 5, 7, 8, and 9) reduce the final weight of the plants carrying them.
ii. WATER USE EFFICIENCY: both negative and positive effects QTL has been observed (chr. 3, 5, 8 and chr1, 2, 6, 8, 9 respectively) while the positive ones (chr. 1 in WW and chr. 2 in WD), are carried by lines not showing an above average biomass.
iii. PHYLLOCHRON: both negative and positive effects QTL detected on chr. 2, 3, 5, 8 and chr. 1, 4, 8, 9

5. Publications related to the access granted, acknowledging the support by EC.

A poster summarizing the analyzed results has been presented at the annual congress of the Italian Society of Agricultural Genetics (SIGA):
Sciara G., Salvi S., Cané M.A., Bovina R., Welcker C., Cabrera L., Grau A., Tardieu F., Tuberosa R.
High-throughput phenotyping of a maize introgression library and durum wheat near-isogenic lines under water deficit conditions
http://www.geneticagraria.it/congress_comunication.asp?a_pag=4&id=58&Indice=241