



## OWC 2020 Paper Submission - Science Forum

*Topic 4 - Innovation in Organic farming: "thinking out of the Box"*

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### TESTING MICROBIAL INOCULANTS AND PRECROP EFFECT ON ORGANIC POTATO IN HUNGARY

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**Preferred Presentation Method:** Oral or poster presentation

**Full Paper Publication:** No

#### Abstract

In frame of the SolACE Horizon 2020 research project the effects of different pre-crop and inoculation treatments on organic potato varieties under combined stress conditions were examined. In the rotational trial rye and soy pre-crop treatments were applied, and four potato varieties were examined under optimal vs. no irrigation and nitrogen treatments, and their combinations. In the inoculation trial another four varieties with three microbial inoculant treatments, under optimal vs. no irrigation and phosphorous supply, along with the combinations of these treatments were tested. The first year's results showed no major effects of pre-cropping and microbial inoculants on potato performance under combined stress. Thus, further investigations are required to strengthen our understanding of these agrotechnical innovations.

#### Introduction

Cultivated crops often face a combination of abiotic and biotic stresses. Their response to combined stresses differs from one caused by any individual component (Kissoudis et al., 2014). European agriculture today is challenged by tackling increasing fertilizer prices (nitrogen) (Erisman et al., 2011) and, in the near future, also by reduced fertilizer availability (phosphorus) (Nedelciu et al., 2019). Combined with reduced or more variable precipitation patterns (IPCC, Hov et al., 2012), this may cause severe risks for agricultural production. The objective of the currently ongoing SolACE Horizon 2020 research project is to investigate and improve crop performance of potato exposed to such difficulties by the use of different agrotechnical innovations, amongst them microbial inoculants and crop rotations.

In this paper, we present the results of the first field trials that were set up at the organic research fields of the Szent István University at Soroksár, Hungary over the growing season in 2019, using a randomized block design.

#### Material and Methods

The size of the field used was approx. 3500 m<sup>2</sup>, which was divided into two parts. A crop rotational and an inoculation trial. For the crop rotation trial four different potato varieties were tested: *Cara*, *Pentland Dell*, *Agria* and *Charlotte* with four

*replications*. Two different pre-crops (soy and rye), irrigation (drop-irrigated and non-irrigated) and soil applied nitrogen (Green Active N28, FOMET SpA, Verona, Italy) (no N and optimal N) were applied as treatments.

For the inoculation trial only two replications could be carried out due to the number of treatments and the limited experimental area available. Four different potato varieties were tested: *Desirée*, *Sarpo Mira*, *Pentland Dell* and *Maris Piper*. Microbial consortium 1 (*Rhizophagus irregularis* and *Pseudomonas brassicacearum*), microbial consortium 2 (*Rhizophagus irregularis* and *Paraburkholderia phytofirmans*), microbial consortium 3 (*Rhizophagus irregularis*, *Paraburkholderia phytofirmans* and *Trichoderma asperrelloides*), formulated using the Minigran® technology, irrigation (drop-irrigated and non-irrigated) and soil applied phosphorous (P) (GreenSoil Micro H+P+Ca, Pannon-Trade Kft., Győr, Hungary) (no P and optimal P) were applied as treatments.

A meteorological station was installed at the trial site using the *Metagro* system (MetAgro, Metagro Kft., Debrecen, Hungary) to monitor climatic and soil moisture data and to provide a precise calculation of necessary water quantities for optimal potato irrigation. Weeds were removed by rototiller and by hand and a *Bacillus thuringiensis*-based insecticide (Novodor FC, Valent BioSciences Corp., Libertyville, Illinois, USA) was used against Colorado potato beetle (*Leptinotarsa decemlineata*) four times during the growing period.

During the experiment, the following measurements were taken. Soil phosphorus (P) content pre-planting and post-harvest (Lakanen-Erviö method), plant phenology and height, stomatal conductance (LI-6800 Portable Photosynthesis System, LI-COR Biosciences GmbH, Bad Homburg, Germany), multispectral and thermal aerial imaging (Parrot Sequoia 4.9 4608x3456 (RGB) multispectral camera, Parrot Drones SAS., Paris, France. Optris PI450 infrared camera, Optris GmbH, Berlin, Germany. GigaRotor 6 drone, Rotors & Cams Ltd., Veresegyház, Hungary), yield, tuber size classification, tuber starch content (Commission Regulation (EC) No 97/95 of 17 January 1995 – Annex II), tuber P content (Lakanen-Erviö method) and tuber quality assessment including the monitoring of *Streptomyces* spp, *Rhizoctonia solani* and *Helminthosporium solani* infection rate. The data gained from these measurements were analyzed using IBM SPSS Statistics 25 using General Linear Model, Multivariate/Univariate Analysis.

## Results

For the first year, results of the crop rotation trial show statistically significant benefits of N, and irrigation treatments on SPAD ( $p < 0,05$ ) plant height ( $p < 0,05$ ) and yield ( $P < 0,05$ ) along with differences between varieties in characteristics such as SPAD, plant height and yield. In regards to pre-cropping there was a minor positive effect of rye pre-cropping on SPAD ( $p < 0,05$ ). In addition, the prevalence of plant diseases investigated (*Streptomyces* spp, *Rhizoctonia solani* and *Helminthosporium solani*) varied with pre-cropping, irrigation and varieties.

Results of the inoculation trial show expected statistically significant benefits of irrigation on yield and plant height ( $p < 0,05$ ) together with differences between varieties in characteristics such as plant height, yield, and disease tolerance ( $p < 0,05$ ). Microbial inoculation treatment 1 and 3 had a minor positive effect on plant height ( $p < 0,05$ ). Tuber infection rates varied between irrigation treatments and varieties. Analyses of further data, such as tuber quality are currently in progress.

## Discussion

In conclusion there were no major effects of pre-cropping and microbial inoculants detected on potato performance under combined stress in 2019. Experienced yield differences between the varieties could partly be explained by the different vegetation lengths of the varieties, as late harvest varieties such as *Sarpo Mira* were harvested together with earlier cultivars such as *Charlotte*. Moreover, the P level of the soil was high at the trial site (415 mg/kg EDTA-P on average), thus the effect of the P treatment was not visible.

For 2020, P treatments were substituted with four replications instead of two in the inoculation trial, thus increasing statistical power. In addition, new measurements were added to the experiment such as the molecular monitoring of single microbial strains' presence in the soil after planting. SolACE Horizon 2020 will continue for 2020 with the hopes of shedding light on the effects of microbial inoculants and optimized rotations on potato performance under combined stress treatments.

## References

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**Image:**

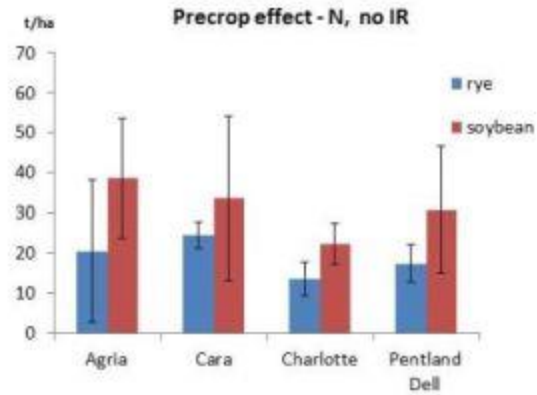
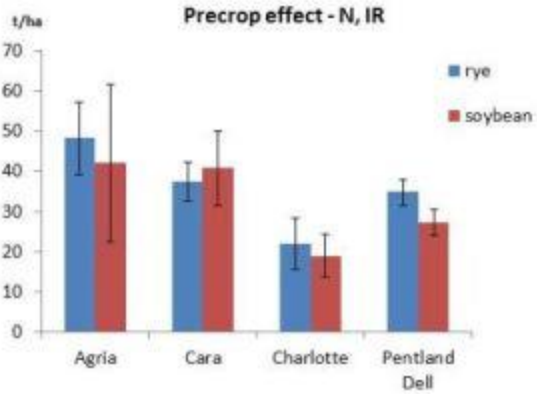
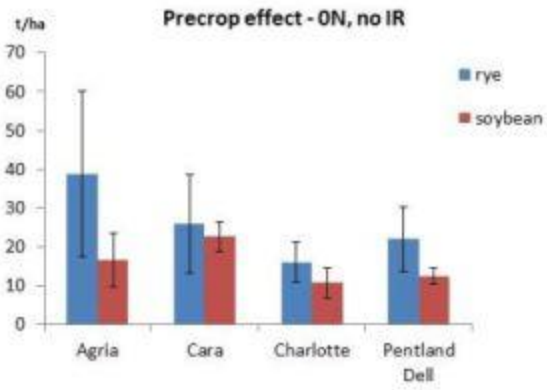
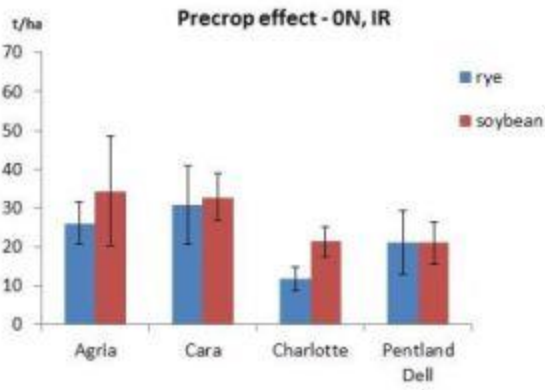
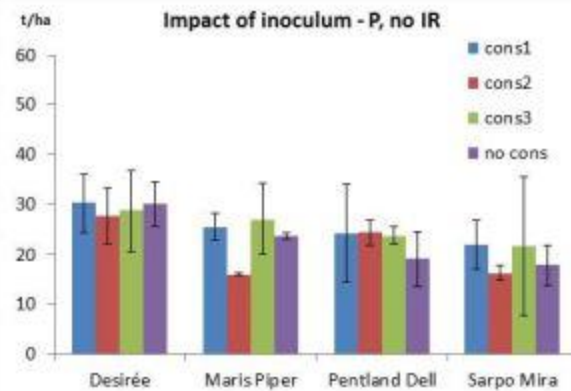
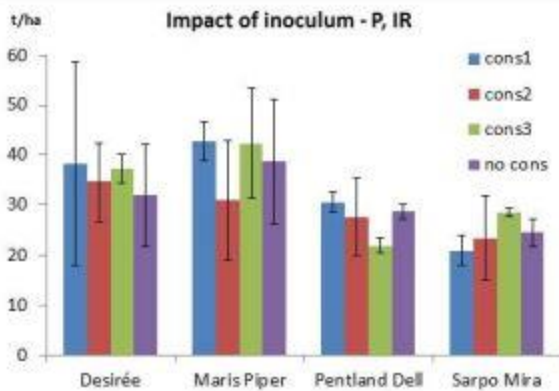
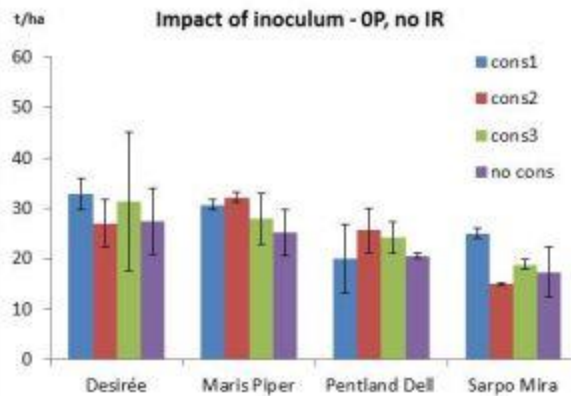
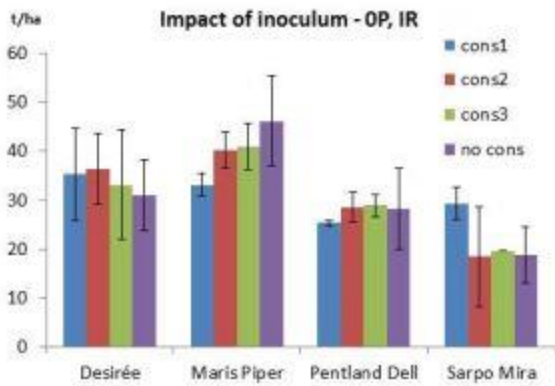


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**Disclosure of Interest:** None Declared

**Keywords:** microbial communities, potato, precrop effect, SolACE