Società Italiana di Agronomia
50° Convegno Nazionale

Evoluzione dei sistemi agronomici in risposta alle sfide globali
Udine, 15-17 settembre 2021

Mycorrhizal Inoculation Improves Organic Potato Quality Grown Under Calcareous Soil

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Introduction

The application of arbuscular mycorrhizal fungi (AMF) has been recently proposed as a valid tool to ameliorate soil minerals' availability and to increase potato yield, especially under low fertility soils such as calcareous ones. In this framework, our research aimed to evaluate if AMF application could also enhance the nutritional quality of potato tubers organically grown under two calcareous soils.

Materials and Methods

The trials were conducted in two locations (indicated as location I and II) sited on the coastal plain of Siracusa. Both soils had a high active limestone level (15.5 and 18.0% for location I and II, respectively), a medium organic matter content (2.2%, on average) and a high organic matter mineralization rate (C/N ratio equal to 7.5). A randomized split-plot design with 3 replicates, including 3 cultivars ('Arizona', 'Mondial' and 'Universa') and 2 soil mycorrhization treatments [mycorrhizal inoculated (AMF+) *vs*. not mycorrhizal inoculated-control (AMF-)], was adopted. Details of fertilization management under organic farming were summarized in Table 1. At harvest, at least 20 marketable tubers per replicate were used to evaluate the tuber quality traits reported in Table 2.

Results

- ✓ AMF+ was able to increase the total polyphenols content by ~12%, the DM level and antioxidant activity (by 5%, on average), and drastically reduced the nitrate content by ~30%.
- ✓ Within the studied cultivars, 'Universa' had the highest total polyphenols content and antioxidant activity, and 'Mondial' reported the highest DM level and the lowest nitrate level.
- ✓ Tubers collected at location II showed higher levels of DM, total protein, total polyphenols and antioxidant activity than those from location I, which had however a lower nitrate amount.

Table 1. Fertilization and soil mycorrhizal management of potato crop organically grown.

Phenological stage of application	Commercial product	Applications (n.)	Dose per application	Active ingredient	Source
At sowing	Ricin-Xed®	1	1.2 t ha^{-1}	4% of N	Castor seeds
"	Xedaneem Pel®	1	1.2 t ha^{-1}	3% of N	Neem seeds after oil extraction
"	Kalisop®	1	0.6 t ha^{-1}	50% of K_2O 45% of SO_3	Commercial granular product
"	Fosfonature 26®	1	0.4 t ha^{-1}	26% of P_2O_5 41% of CaO	'Pheoflore' algal origin
"	Xedaopen®[a]		40 kg ha^{-1}	7 active propagules g^{-1} of *Glomus* spp. and *Gigaspora* spp.	Commercial inoculant
After emergence	Biosin®	3	150 cc hL	7.7% of N	Commercial liquid product

[a] applied only in the mycorrhizal inoculated plots.

Table 2. Tuber nutritional traits as affected by the studied main factors. Different letters within the same parameter and main factor show significant differences among means (LSD test, $P \leq 0.05$).

Main factor	Dry matter (DM) (%)	Total protein (g kg^{-1} DM)	Total polyphenols (g kg^{-1} DM)	Antioxidant activity ($\%_{DPPHinhibition}$)	Nitrate (mg kg^{-1} DM)
Soil mycorrhization					
AMF-	18.0b	76a	4.0b	65.5b	641a
AMF+	18.8a	75a	4.5a	69.3a	443b
Cultivar					
Arizona	18.6b	77a	4.4b	66.8b	537ab
Mondial	19.6a	74b	3.4c	64.1c	480b
Universa	17.2c	76a	4.8a	71.2a	608a
Location					
I	18.1b	73b	3.6b	63.4b	467b
II	18.7a	79a	4.8a	71.3a	616a

Conclusions

Soil mycorrhization is a viable agronomic tool to improve the nutritional quality of potato tubers organically grown under calcareous soils, especially through a higher total polyphenols content and a lower nitrate level. However, further researches are still required in order to evaluate the effects of soil mycorrhization on potato yield and quality by studying other cultivars and locations.