EFFECT OF ENDOPHYTIC FUNGI ON *CHENOPODIUM QUINOA* RESISTANCE TO INFECTION BY *PERONOSPORA FARINOSA*

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Abstract: *Chenopodium quinoa* Willd., known as quinoa, is a pseudocereal that has been cultivated in the Andean region for more than 4000 years. It has become very popular during last decades due to its high and balanced nutritional value. Quinoa grain has outstanding protein quality and contains a lot of vitamins and minerals. The grain protein is rich in amino acids like lysine and methionine that are deficient in cereals. Endophytic fungi live in various plant tissues without showing any symptoms. Some of them are known for their ability to induce resistance against various biotic and abiotic factors. This study is focused on thorough investigation of endophytic mycoflora associated with *Chenopodium quinoa* and its potential to induce systemic resistance against fungal pathogen *Peronospora farinosa* (Fr.) Fr.

Keywords: *Chenopodium quinoa*, *Peronospora farinosa*, resistance, fungi, endophytes

INTRODUCTION

Chenopodium quinoa Willd., commonly called quinoa, is a crop that was used by pre-Columbian cultures in South America for centuries. *Chenopodium* species played an important role in Tiahuanacotan and Incan cultures. Quinoa is often referred to as a pseudocereal, as it does not belong to the Gramineae family, but it produces seeds that can be milled into flour and used as a cereal crop. Besides its importance in animal and human nutrition, quinoa was also of sacred importance in these ancestral cultures (Bonifacio 2003).

Quinoa is considered to be one of the most nutritive grains used as human food and it has been selected by FAO as one of the crops destined to offer food security in this century (Food and agriculture organization 1998). It has outstanding protein content and essential amino acids composition. The nutritional value of quinoa protein is comparable to that of milk protein (Koziol 1992, Ranhotra et al. 1993). Quinoa is rich in lysine, methionine and cysteine that are insufficient in common cereals and legumes. Additionally, quinoa is very rich in oil, containing beneficial fatty acids and a high content of tocopherols (Repo-Carrasco-Valência et al. 2003). High quality of its oil together with the fact that some varieties show oil concentrations of up to 9.5%, quinoa could be considered as a potentially valuable new oil crop (Koziol 1992).

Peronospora farinosa (Fr.) Fr. is one of the most common pathogen infecting *Ch. quinoa* in the Czech Republic. Considering the increasing accent on organic production there is strong need to develop plant protection technologies that are environmentally-friendly and adjusted to local conditions. One promising possibility is represented by bioproducts based on living organisms, particularly fungi.

The term “endophytic fungi” has many definitions, but basically refers to group of fungi capable of symptomless occupation of apparently healthy plant tissues without causing any harm to the host. They can cause many various effects on the host plant, both negative and positive. They can provide their hosts with a number of benefits, such as protection against herbivory and pathogens. They can promote growth or induce resistance to different biotic and abiotic stressors. These properties make them potentially ideal for development of biofertilizers and biocontrol agents for pests and diseases.

Little is known about fungal endophytes associated with *Ch. quinoa*. This is the first study focusing on investigation of endophytic mycoflora of *Ch. quinoa* in the Czech Republic. Two main objectives of this research are:

a) To carry out a study of fungal endophytes in different tissues of *Ch. quinoa*
b) To analyze potential relationships between the presence and colonization frequency of fungal endophytes and the level of *P. farinosa* infection.

Results of this study can serve as a basis for further experiments and provide a factual framework for potential future development of bioproducts that are optimized for the conditions of the Czech Republic.

MATERIALS AND METHODS

Six genotypes of *Ch. quinoa* will be tested within the frame of this research. Forty *Ch. quinoa* individuals will be randomly selected in the field. From this selection ten plants will be chosen, five strongly affected by *P. farinosa* and five with no symptoms. Endophytic fungi will be isolated from leaves, stems and roots of these selected symptomatic and asymptomatic individuals. From each tissue type in total 12 pieces of approximately 1 cm in size will be cut, surface sterilised according to and put onto the PDA agar plates amended with streptomycin. Plates will be incubated in 25°C and checked every day for growing mycelia. QIAGEN DNeasy Plant Mini Kit and BIOLINE MyTaq 2x Mix will be used for DNA extraction and PCR, respectively.

Differences in species composition and frequency of colonization between healthy and diseased plants will be evaluated. These tests will be performed via GAMLSS, as well as PERMANOVA and SIMPER methods. Analyses will be carried out using R programming language, to a lesser extent STATISTICA and PAST software will be used.

RESULTS AND DISCUSSION

So far we have isolated and sequenced root endophytes from the first genotype. Preliminary results show that there is significant difference in species composition and frequency of colonization between healthy and diseased plants. However, additional data have to be collected to confirm and specify the results.

CONCLUSIONS

Endophytic fungi might play an important role in *Chenopodium quinoa* resistance to common pathogens, particularly *Peronospora farinosa*. Preliminary results of this study prove this hypothesis, even though more analyses have to be carried out to verify this finding.

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