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FIRST IDENTIFICATION OF DOWNY MILDEW ON QUINOA (*PERONOSPORA FARINOSA* F. SP. *CHENOPODII*) IN ROMANIA: PRELIMINARY RESEARCH

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ABSTRACT

With the expansion of quinoa cultivation (Chenopodium quinoa Willd.) into new areas, including Romania, it is expected that specific diseases will emerge. Currently, downy mildew is the most significant and studied disease affecting quinoa worldwide. This research was conducted in the experimental fields of the UASVM of Bucharest, under the climatic conditions of the 2024 growing season. Two quinoa varieties, supplied by Quinoa Quality ApS, Denmark, were evaluated for their response to the pathogen Peronospora farinosa f. sp. chenopodii. The first detection of downy mildew in quinoa in our country provides an important update to phytopathological research on this crop, which offers numerous economic advantages in the current climate context. The characteristic symptoms of the disease caused by the pathogen Peronospora farinosa f. sp. chenopodii are described. Vikinga was susceptible to downy mildew (AD 6.6%), while Puno showed an insignificant degree of leaf infection (AD 0.65%).

INTRODUCTION

Quinoa (*Chenopodium quinoa* Willd.) is a herbaceous annual pseudocereal botanically related to amaranth (*Amaranthus* spp.), originated in the Andean region of northwestern South America, whose seeds rich in protein, dietary fiber, B vitamins and dietary minerals use to feed livestock and for human consumption (Bojanic 2011, Fuentes et al. 2009). The nutritional value of quinoa leaves is given by their content in glutamic acid: 4.49 g/100g protein, aspartic acid: 2.98g/100g protein, alanine: 2.9 g/100g protein and glycine: 2.48 g/100g protein (Chiriță et al. 2022). Recently, quinoa has garnered significant interest for research, production, and consumption in the United States, Europe, Asia, and Africa. In Romania, however, quinoa remains relatively unknown and has yet to be fully explored by researchers and growers, despite its numerous benefits. It is available in the country, primarily in organic and natural food stores (Szilagyi & Jørnsgård 2014). Regarding diseases caused by different quinoa pathogens: *Ascochyta caulicola*, *Cercospora* sp., *Colletotrichum nigrum*, *C. truncatum* și *Pseudomonas syringae*, downy mildew, caused by the oomycete *Peronospora farinosa* f. sp. *chenopodii* Byford (1967), is the most dangerous (Colque-Little et al. 2021).

MATERIAL AND METHODS

Visual inspections of downy mildew attacks on quinoa were conducted in the spring of 2024 in the control variants (without fungicide application) in the experimental field (Figure 1) at the *UASVM of Bucharest*. Observations were made under natural infection conditions with the pathogen *Peronospora farinosa* f. sp. *chenopodii*. The experiments were of a monofactorial type, arranged in randomized blocks with three replications for each variant (10 m^2/plot). Plots size was 6 rows of 4 m, with an inter-row spacing of 0.5m and 3 cm sowing depth.

Climatic parameters influence the occurrence of diseases (Paraschivu et al. 2022; Zală et al. 2023). The main climatic parameters recorded in May 2024, which affected the appearance and development of the oomycete *Peronospora farinosa* f. sp. *chenopodii*, are shown in Figure 2.

The investigated varieties were Puno and Vikinga. Both varieties have a growing season of 120-150 days (https://www.quinoaquality.com/quinoa-seeds). Puno is a drought-resistant variety, high in quality protein, and resistant to downy mildew. Vikinga is drought-tolerant, high in quality protein, and low in saponins.

Figure 1. Images from the research field UASVM Bucharest, 2024

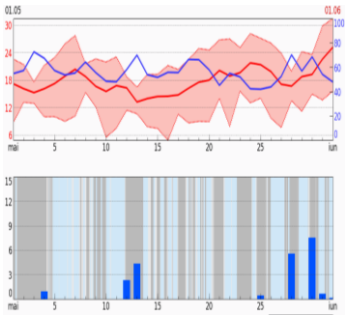

Figure 2. t°C, U(%), pp(mm) registered in May 2024 source: Meteoblue.com

Visual observation is the fastest method of identifying downy mildew based on the symptoms exhibited by the leaves of infected quinoa plants. The value of downy mildew attack on quinoa is represented in terms of frequency (F%), intensity (I%) and attack degree (AD%). Attack degree was calculated using the formula (Chester, 1950): AD (%)= F(%) x I(%)/100.

The microscopic preparation was visualized under the optical microscope.

RESULTS AND DISCUSSIONS

The appearance of symptoms of the disease

Against the background of favorable climatic conditions for the development of oomycetes: the average temperature of 14-20°C, a relative atmospheric humidity of 50-75% and the presence of water droplets resulting from the cool morning dew and due to the precipitation that occurred in the first half of May, the first symptoms of downy mildew appeared towards the end of the second decade of this month.

On some basal leaves of infected plants, irregularly shaped, chlorotic, or pink discoloration spots appeared on the upper leaf surface and gray spore masses on their lower surface (Figure 3.).

Presentation of the morphological characters of the pathogen

Figure 3. Leaf symptoms typical of quinoa downy mildew
(view from the experimental field)

The microscopic preparation revealed the presence of branched dichotomously, hyaline sporangiophores that produced ellipsoidal, light brown sporangia (Figure 4.).

Figure 4. *Peronospora farinosa* f. sp. *chenopodii*: dichotomously branched sporangiophores and sporangia (original)

Scoring the downy mildew attack

The assessment of downy mildew infection on quinoa was conducted on May 20, 2024, as detailed in Table 1.

The analysis revealed a disease prevalence of 100% in Vikinga plants, while the Puno variety exhibited a significantly lower prevalence of 10.0%.

In terms of disease intensity, the infection levels were nearly equivalent: 6.6% in Vikinga and 6.5% in Puno.

Consequently, the calculated disease severity index was 6.6% for Vikinga, directly correlating with the intensity value, whereas Puno demonstrated a markedly lower severity index of 0.65%.

Table 1

Scoring downy mildew attack on quinoa

Varieties	Frequency (%)	Intensity (%)	Attack degree (%)
Puno	10.0	6.5	0.65
Vikinga	100.0	6.6	6.6

CONCLUSIONS

Due to its high nutritional value and ability to adapt to abiotic stress, quinoa is of increasing interest to farmers today. As quinoa is introduced and cultivated in new areas, farmers may encounter diseases specific to this crop. One such disease, considered internationally to be the most significant, is downy mildew caused by the oomycete *Peronospora farinosa* f. sp. *chenopodii*.

The presence of *Peronospora farinosa* f. sp. *chenopodii* represents a risk to sensitive quinoa varieties when climatic conditions favor the pathogen. Symptoms of quinoa downy mildew appear solely on the leaves. The disease was observed on only 10.0% of Puno plants, whereas Vikinga is highly susceptible, with downy mildew affecting the leaves of the lower half of all Vikinga plants.

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