MANAGEMENT OF MINERAL FERTILISATION IN RELATION TO WHEAT CONTAMINATION WITH *FUSARIUM GRAMINEARUM*

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Abstract

Wheat is a basic product for consumption in Romania due to the food consumption model of the population and is the main raw material for manufacture of bakery products. In parallel it is used as animal feed.

For our country's economy is an important segment because it provides significant quantities for export.

Among the pathogens that affect the wheat crop stands out Fusarium graminearum, the pathogen that causes one the most devastating diseases of wheat (ear fusariosis) and reduces production by: inducing sterility of the inflorescences, poor seed filling and reducing grain size.

This paper presents the mineral nutrition status of winter wheat in relation with the risks of wheat contamination by Fusarium toxins in the conditions at ARDS Livada.

The plants selected for testing were 5 winter wheat cultivars:Glosa, Gruia, Delabrad, Faur and Dropia. The soil from the experiment was Haplic Luvisol.

In order to quantify the mineral nutrition status of plant with macro and micronutrients, the plant analyses have been carried out in the ear emergence-flowering phase.

The results has been interpreted in connection with the optimum limits of mineral contents in dry matter, mentioned in the specialty literature for these growing stages.

Key words: *Fusarium graminearum*, winter wheat, mineral nutrition

INTRODUCTION

Wheat is most important cereal crop in Europe (Soare and Chiurciu, 2016), being cultivated on 22,876.72 thousand ha and a production of 126,658.94 thousand tons in 2020 (Eurostat, 2021).

The wheat quality and consumer safety is affected by *Fusarium Head Blight (FHB)* caused by *Fusarium graminearum*. The winter wheat varieties cultivated in Europe are susceptible to this disease (Bunta et al., 2011; Taheri, 2018).

The *Fusarium* susceptibility of Europeans cultivars is the main cause of the occurring severe epidemics. Throught yield and quality loss, the toxin contamination is major threat in Europe (Humphreys et al., 2001; Liu and Anderson, 2003; Miedaner et al., 2003, Bunta et al., 2011; Kazan et al., 2017; Dana et al., 2017).

MATERIAL AND METHOD

In the experimental plot from ARDS Livada, the 5 wheat cultivars susceptible to *Fusarium graminearum* attack were tested on parcels fertilised with the following rates (kg of active ingredients/ha): N_{40} $P_{40}K_0$ and N_{120} $P_{40}K_0$.

From these parcels were collected and analyzed soil samples from ploughed layer and plant samples in the ear emergence-flowering stages.

The analyzes made at the soil samples were: soil reaction (pH), humus total (Ht), total nitrogen (Nt), available phosphorus (P_{AL}) and available potassium (K_{AL}).

In plants, following analyzes were carried out: the content of macronutrients (N, P, K, Mg) and the content of micronutrients (Cu, Zn, Fe, Mn) in dry matter of aerial parts. All analyzes were made according to RISSA methodology (1980, 1981) and the obtained results were compared with with the optimum limits from specialty literature (Bergmann, 1992).

RESULTS AND DISCUSSION

Soil characterization

The characterization of the soil from ARDS Livada is presented in Table 1. From the obtained data the soil shows a neutral-weakly alkaline reaction, the registered pH value being of 7.

The soil humus supply status is low and the nitrogen supply status is moderate. The mobile phosphorus content is high and the mobile potassium content is low.

Table 1

The agrochemical properties of soil from ARDS Livada

Soil fertilisation	Humus, %	Nt, %	pH $_{H2O}$	P_{AL}	K_{AL}
N_{40} $P_{40}K_0$	1.17	0.14	7.00	66.11	66.66
N_{120} $P_{40}K_0$	1.08	0.15	7.23	53.69	60.83

Source: own determinations

Characterization of the mineral nutrition status of plants

Normal values of the contents of N (Figure 1), P (Figure 2), Zn, Cu, Fe and Mn (Figures 5-8) were registered in plants.

Low contents were registered in the case of potassium (Figure 3), below the optimal limit, explainable by the lack of potassium fertilisation and the low state of soil supply with this element. Low Mg contents in the plant were recorded on both fertilisation parcels (Figure 4). Lower values of macro and micronutrient content were recorded on parcel with N40 P40 K0, compared to parcel with N120 P40 K0. Glosa and Delabrad varieties showed the highest nitrogen content in the dry matter of plants.

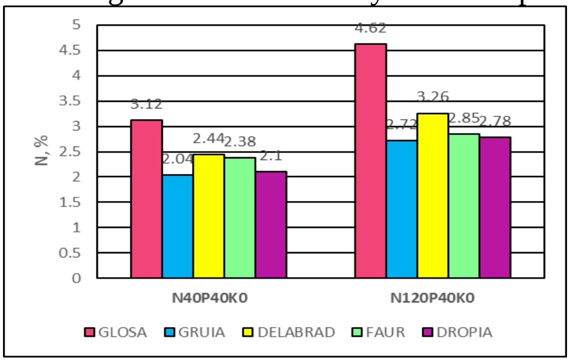

Fig. 1. The nitrogen content in the aerial parts of winter wheat plants, ear emergence-flowering stage, ARDS Livada
Source: own determinations

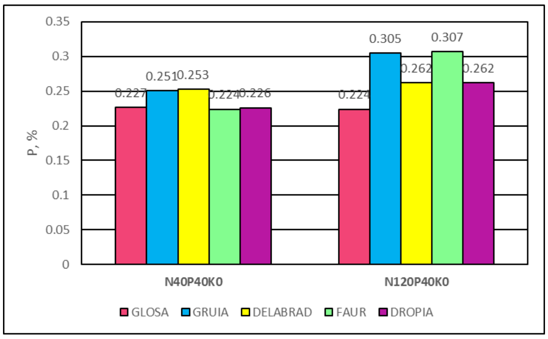

Fig. 2. The phosphorus content in the aerial parts of winter wheat plants, ear emergence-flowering stage, ARDS Livada
Source: own determinations

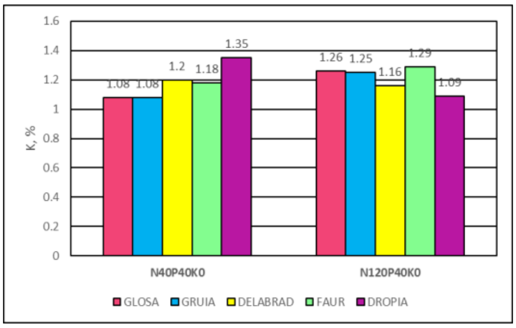

Fig. 3. The potassium content in the aerial parts of winter wheat plants, ear emergence-flowering stage, ARDS Livada
Source: own determinations

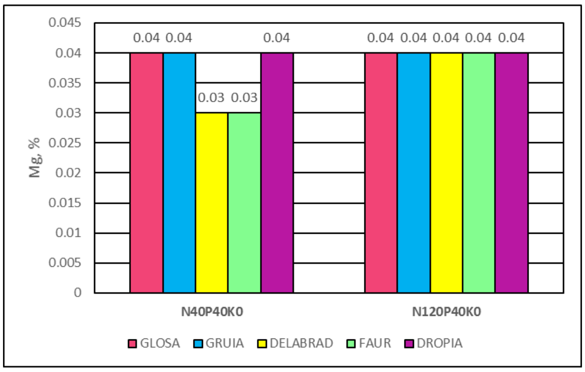

Fig. 4. The magnesium content in the aerial parts of winter wheat plants, ear emergence-flowering stage, ARDS Livada
Source: own determinations

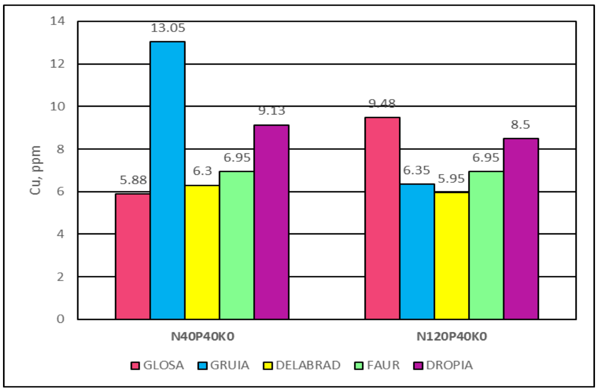

Fig. 5. The copper content in the aerial parts of winter wheat plants, ear emergence-flowering stage, ARDS Livada
Source: own determinations

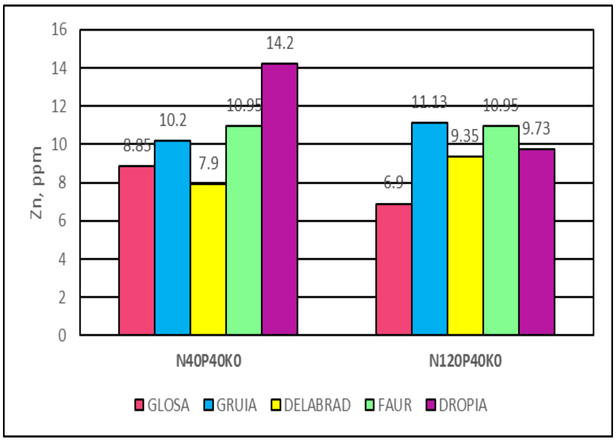

Fig. 6. The zinc content in the aerial parts of winter wheat plants, ear emergence-flowering stage, ARDS Livada
Source: own determinations

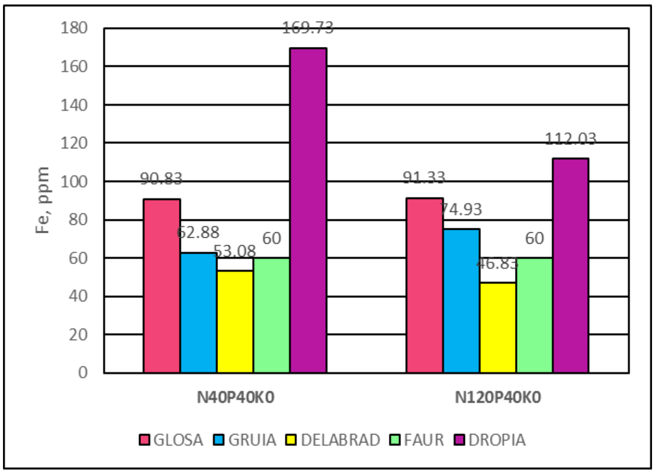

Fig. 7. The iron content in the aerial parts of winter wheat plants, ear emergence-flowering stage, ARDS Livada
Source: own determinations

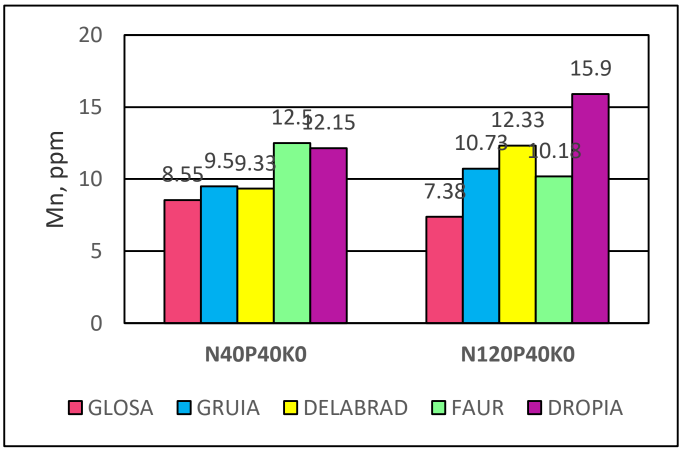

Fig. 8. The manganese content in the aerial parts of winter wheat plants, ear emergence-flowering stage, ARDS Livada
Source: own determinations

The relations between the N content and the contents of P, K, Cu, Zn, Fe and Mn, in the dry matter of the plants, are presented in Figures 9-11. Figure 10 shows that the Fe and Mn contents of plants decrease with increasing nitrogen content in plants, a relationship that can be explained by the low accessibility for plants that these micronutrients have in conditions of a neutral-weakly alkaline soil reaction.

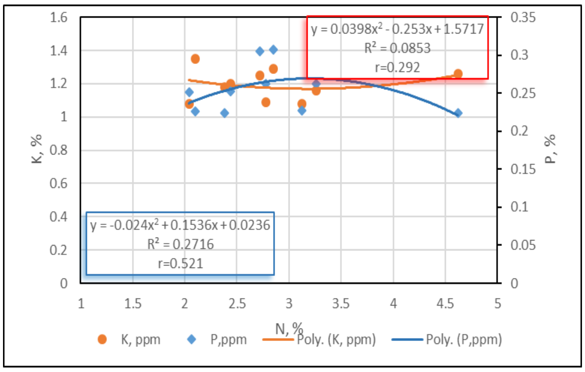

Fig. 9. Data on the relationship between the N content and the P and K content in the aerial parts of winter wheat plants, ear emergence-flowering stage, ARDS Livada
Source: own determinations

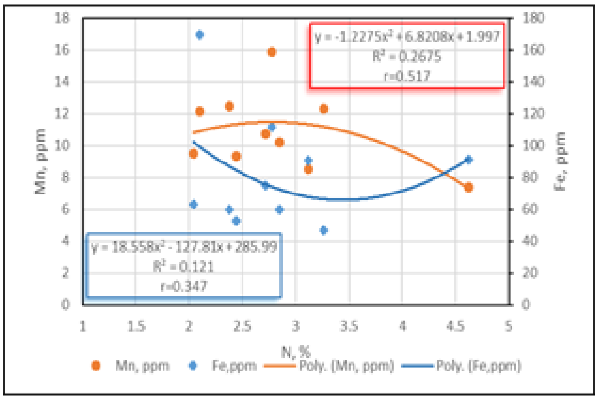

Fig. 10. Data on the relationship between the N content and the Mn and Fe content in the aerial parts of winter wheat plants, ear emergence-flowering stage, ARDS Livada
Source: own determinations

The zinc and copper content of the plants (Figure 11) decreases with the increase of the nitrogen content of the plants over the optimal limits.

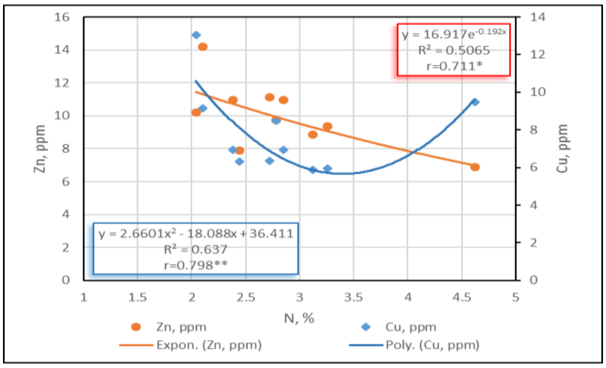

Fig. 11. Data on the relationship between the N content and the Zn and Cu content in the aerial parts of winter wheat plants, ear emergence-flowering stage, ARDS Livada
Source: own determinations

Excess nitrogen can induce imbalances in Cu and Zn nutrition of plants, the low contents of these micronutrients favoring the attack of *Fusarium graminearum.*

The application of potassium fertilizers and the supplementation of plant nutrition with micronutrients, especially Cu and Zn, are agricultural measures to reduce the incidence of *Fusarium graminearum* attack in the studied area.

Agrochemical means of optimizing plant nutrition seem to be important ways to control the attack of *Fusarium graminearum*, especially since they can reduce the susceptibility of some varieties to the attack of *Fusarium graminearum*, by correcting some nutritional deficiencies.

ACKNOWLEDGEMENTS

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CONCLUSIONS

The soil shows a neutral-weakly alkaline reaction with pH values between 7.00-7.23.

The nutrient content in winter wheat plant were within the optimum range for N, P, K, Fe, Cu, Zn, Mn and were below the optimum range for K and Mg.

The application of potassium fertilizers and the supplementation of plant nutrition with micronutrients, especially Cu and Zn, are agricultural measures to reduce the incidence of *Fusarium graminearum* attack in the studied area.

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