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THE INFLUENCE OF SEED TREATMENT ON GRAIN YIELD AND THEIR QUALITY IN SOME VARIETIES AND LINES OF WINTER WHEAT (*Triticum aestivum* L.)

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Abstract

Wheat crops are affected by various pathogens and pests, which can cause considerable production losses, therefore it is essential to carry out seed treatments. In our study, the biological material was represented by the Trivale variety, being an older variety, resistant and adapted to specific soil conditions, and two new wheat lines. This paper presents results obtained during one year, regarding the effect of seed treatment and additional fertilization on the production and quality of the Trivale wheat variety and lines A4-10 and A44-13. The use of fertilizers is important because it causes qualitative and quantitative changes. The experimental factors studied, the genotype, the seed treatment and the fertilization, generated statistically assured interactions.

Key words*: quality, fertilization, wheat, production, seed, treatment.*

INTRODUCTION

The production capacity is a complex and fundamental property of any wheat variety, largely determined by the genetic material, the applied cropping technology, but also by the influence of climatic conditions (Leonte, 2011). One of the main problems encountered is related to the ability to adapt winter wheat genotypes to a complex of factors that are constantly changing (Shah et al., 2018).

In general, tillage, crop rotation, sowing date and nitrogen fertilization are considered very important tools in the control of crop plant diseases, and they must be optimized in relation to climatic conditions (Cotuna et al., 2018). Low soil fertility and increased incidence of diseases and pests pose a threat to food security (Mubeen et al., 2006). The wheat crop is affected by a large number of pathogens, which leads to huge production losses, up to 40% (Cardozo et al., 2024). Among these diseases, *Blumeria graminis* f. sp. *tritici* stands out, which is one of the most important and widespread diseases (Basandrai et al., 2022).

Wheat seeds need optimal moisture and positive soil temperatures to germinate and to develop during the early growth stages (Abendroth et al., 2017). Seeds chemical treatments is a technological sequence with great effectiveness against the attack of diseases and pests (Racz et al., 2016). Sowing at the optimal time leads to increased yield and helps to avoid unjustified delays, while if sowing is done later than the optimal time, low soil temperatures affect the ability of seed germination and root growth. The amount and availability of water in the soil and the appropriate temperatures during the sowing period are also the limiting factors that affect the optimal plant density and, last but not least, the yield of the wheat crop and the quality of the production (Donatelli et al., 2012).

Climate change, the multiplication and spread of invasive species, biotic and abiotic stress, have over time had an impact on natural systems and continue to represent increasing threats to agriculture, leading to a decrease in crop production (Cotuna et al., 2021). The health status of wheat crops is a permanent concern for research (Iosub et al., 2021). Hatfield and Beres in 2019, showed that thanks to technological advances in genetics and agronomic practices it was possible to increase the yield. The main limiting factor being the favorable conditions during the growing season. Addressing these challenges requires

new solutions, both technological and genetic, that contribute to obtaining large and good quality productions (Săulescu et al., 2010).
Within the Agricultural Development Research Station (ARDS) Pitesti from Romania there is a continuous concern regarding the improvement of the production of wheat lines and varieties, as well as their characteristics related to resistance to pathogens. Considering the above, this paper presents a small part of the results obtained during one year regarding the effect of seed treatment and additional fertilization on the yield and production quality of wheat lines A4-10 and A44-13 compared to the Trivale variety in experimental field conditions.

MATERIALS AND METHODS

The research was carried out in the 2022-2023 agricultural year at ARDS Pitești on luvosol type soil, with a low content of nutrients available for plants. This type of soil is characterized by a high content of mobile aluminum ions (0.92-1.39 mg/exchangeable Al/100 g soil) in the arable layer, which causes blocking of mobile phosphorus. That is why calcium carbonate-based amendments were applied (Neutrosol, $CaCO_3$ > 95%; Holcim.ro), 9.2 t/ha. Chemical weed control was carried out at the end of wheat twining using the systemic product Axial One (45 g/l pinoxaden + 5 g/l + florasulam + 11.25 g/l cloquintocet - mexil; Syngenta.ro), 1 l/ha . The seed treatment (for the treated variants) was carried out with the insecto-fungicide Austral Plus (40 g/l tefluthrin + 10 g/l fludioxonil; Syngenta.ro), 5 l/t. The biological material used in the experiments: the Trivale wheat variety, line A4-10 and line A44-13, all belonging to ARDS Pitesti. The experiment was organized according to the method of randomized blocks, in 4 repetitions, the harvestable plot being 6 m^2. The protein content (P%) was determined using the Inframatic IM 9500 device. The obtained data were statistically processed using the PoliFact program.

RESULTS AND DISCUSSIONS

The 2022-2023 agricultural year began with the month of September, whose average temperature was lower than the multiannual average, with a negative thermal deviation of -0.4 °C. The following 5 months had positive thermal deviations: October +1.8°C; November +2.8°C; December +2.4°C; January +5.3°C; February +3.4°C; March 2.4°C. In the months of April and May, the temperatures were colder, the average temperature being lower than the multiannual average with negative thermal deviations, and in the month of July a positive thermal deviation of +0.5°C was registered. The average temperature of the period recorded a positive thermal deviation of 1.8°C, compared to the multiannual average of the period (Figure 1). The precipitation values recorded in the months of September-June, with the exception of January, were below the multi-year average. The month of January was very rainy, with an excess of 75.6 mm compared to the multiannual average of the month (Figure 2).
The period September 2022-June 2023 was characterized as a warm period, with a positive thermal deviation of 1.8°C compared to the 40-year multiannual average and a precipitation deficit of -71.3 mm. Wheat is a cereal rich in nutrients that are necessary for human food, carbohydrates, proteins, lipids, but also for animal feed (Boruga et al., 2016). In Table 1, it can be observed that regarding the influence of the variety on the wheat production, both for A4-10 line and A44-13 line, the differences are distinctly significantly positive compared to the Trivale control.
Sowing in colder soils delays wheat emergence, so seed treatment is really necessary (Mureșan et al., 2020). Our experimental results highlighted that the treatment of the seed had a very significant positive influence on wheat production compared to the untreated variant (Table 2).
The most widely used fertilizers, globally, are those with nitrogen, this nutrient being essential for the growth and development of plants (Datcu et al., 2019). In Table 3, it can be seen that additional fertilization brings an increase in wheat production in the pedoclimatic conditions of ARDS Pitesti. Thus, the production difference compared to the control is very significantly positive.

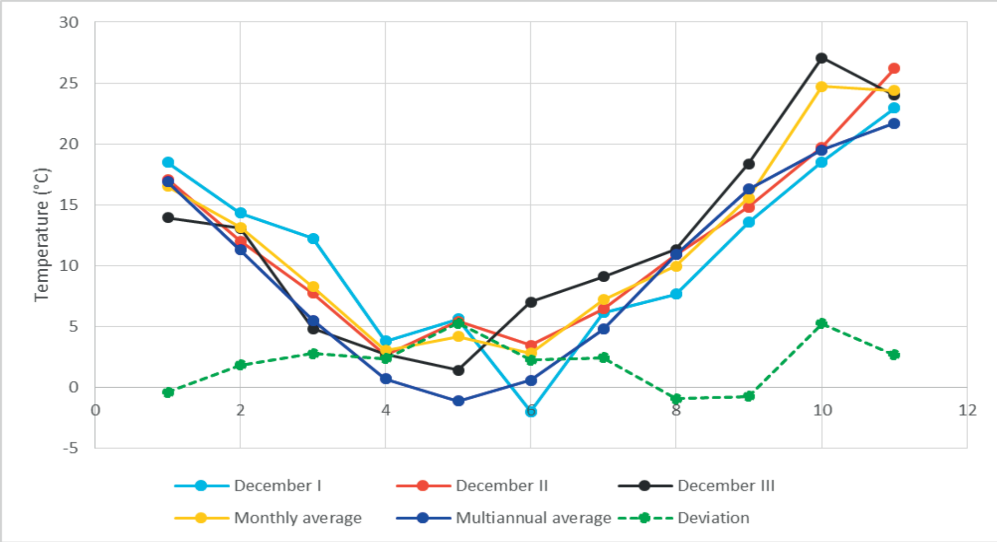

Figure 1. Average monthly temperatures recorded during September 2022-June 2023 at ARDS Pitesti

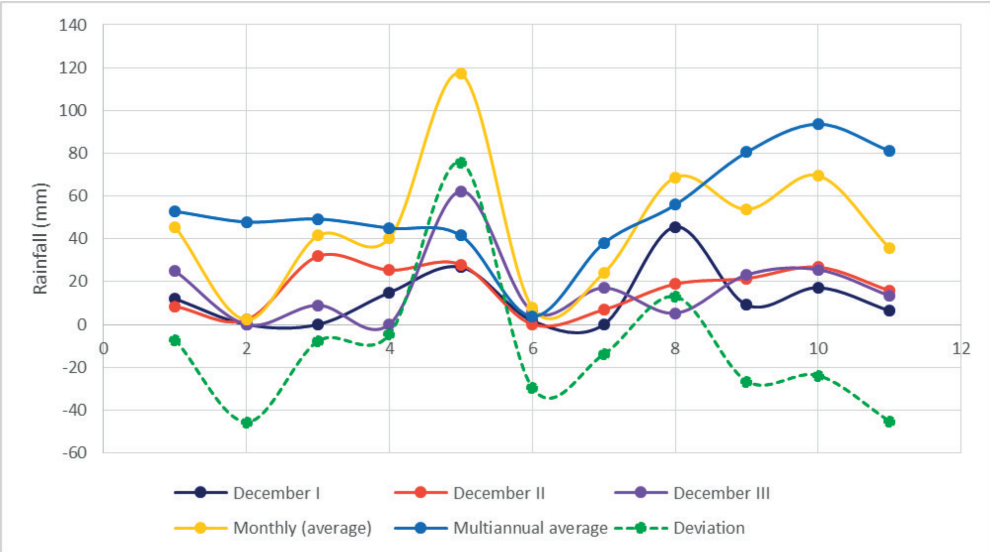

Figure 2. Average monthly rainfall recorded during September 2022-June 2023 at ARDS Pitesti

Table 1. The influence of genotype on wheat production

Genotype	Production (kg/ha)	%	Difference	Significance
Trivale	7440.13	100.0	0.00	Control
Line A4-10	8309.75	111.7	869.63	**
Line A44-13	8274.00	111.2	833.88	**
	DL (5%)		480.58	
	DL (1%)		727.73	
	DL (0.1%)		1169.08	

Table 2. The influence of seed chemical treatment on wheat production

Treatment	Production (kg/ha)	%	Difference	Significance
Untreated seed	7626.29	100.0	0.00	Control
Treated seed	8389.63	110.0	763.33	***
	DL (5%)	138.20		
	DL (1%)	198.74		
	DL (0.1%)	292.30		

Table 3. Influence of nitrogen doses on wheat production

Fertilizer rates	Production (kg/ha)	%	Difference	Significance
120 kg N/ha	7855.92	100.0	0.00	Control
160 kg N/ha	8160.00	103.9	304.08	***
	DL (p 5%)	159.24		
	DL (p 1%)	218.38		
	DL (p 0.1%)	297.24		

Regarding the influence of the genotype on the protein content, the A4-10 line recorded a significantly negative difference compared to the control (Trivale variety), while the A44-13 line recorded a highly significant positive difference (Table 4).

Table 4. Influence of variety on protein content

Genotype	Protein (%)	%	Difference	Significance
Trivale	14.15	100.0	0.00	Mt.
A4-10	14.18	98.1	-0.27	0
A44-13	15.11	104.5	0.66	***
	DL (5%)	0.25		
	DL (1%)	0.37		
	DL (0.1%)	0.60		

In the variants in which the seed was treated, an increase in protein was achieved in the grains, with a distinctly significant difference compared to the variants in which the seed was not treated (Table 5).

Table 5. Influence of seed treatment on protein content of wheat grains

Treatment	Protein (%)	%	Difference	Significance
Untreated	14.48	100.0	0.00	Mt.
Treatated	14.68	101.3	0.19	**
	DL (5%)	0.13		
	DL (1%)	0.19		
	DL (0.1%)	0.27		

Improving wheat productivity and grain quality remains a major concern because, in general, these traits are negatively correlated (Dobre et al., 2016). The protein content of wheat grains is influenced by the nitrogen content of the soil. Corresponding to the data presented in Table 6, due to the negative correlation between production and protein content, an insignificant difference is observed.

Powdery mildew is one of the main diseases of wheat, being present in all cultivated areas and producing quantitative and qualitative production losses by shrinking the grains (Cotuna et. al., 2015). In the case of additional fertilization, a higher frequency of the attack produced by the fungus is observed, the variants registering a very distinctly significant difference compared to the control (Table 7).

Table 6. Influence of nitrogen doses on wheat grain protein content

Fertilizer rates	Production (kg/ha)	%	Difference	Significance
120 kg N/ha	7855.92	100.0	0.00	Control
160 kg N/ha	8160.00	103.9	304.08	***
	DL (p 5%)	159.24		
	DL (p 1%)	218.38		
	DL (p 0.1%)	297.24		

Table 7. Interactions between fertilization rates and seed treatment on tillering

Fertilizers doses/Treatment	F (%)	%	Difference	Significance
120 kg N/ha / Untreated	124.67	100.0	0.00	Mt.
160 kg N/ha / Untreated	143.67	115.2	19.00	***
120 kg N/ha / Treated	83.67	100.0	0.00	Mt.
160 kg N/ha / Tratated	100.00	119.5	16.33	***
	DL (p 5%)	4.93		
	DL (p 1%)	6.77		
	DL (p 0.1%)	9.21		

CONCLUSIONS

Additional nitrogen fertilization and chemical seed treatment ensure superior expression of the production and quality potential of wheat genotypes. The production losses determined by the occurrence of powdery mildew vary from one year to another depending on the climatic conditions, as well as the nitrogen supply, the variant registering very significantly positive differences compared to the control dose.

The combined influence of genetic and technological factors, highlights a distinctly significant positive difference in yield for lines A4-10 and A44-13 and a highly significant positive difference in protein content of wheat grains in line A44-13.

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