

VARIATION OF SOME PRODUCTION PARAMETERS IN WHEAT IN RELATION TO FOLIAR BIOSTIMULATOR, CULTIVARS AND CROPS SITE IN ROMANIA

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Abstract

The study evaluated the variation of some wheat production parameters, in relation to the Super Fifty foliar biostimulator, different cultivars and crop locations. Testing experiments were performed in the area of Bazos (Baz), 'Altigo' wheat cultivar, Gataia (Gat), 'Glosa' wheat cultivar, and Lovrin (Lov), 'Alex' wheat cultivar, Timis County; in the area of Caracal (Car), 'Izvor' wheat cultivar, Caracal County; and in the area of Secuieni (Sec), 'Glosa' wheat cultivar, Neamt County. The Super Fifty (SF) product, based on algae extract, was used according to the manufacturer's recommendations (BioAtlansis). Under the influence of the Super Fifty biostimulator, the production (Y) had values between 5,280.00 kg ha⁻¹ in the conditions from Lovrin, 'Alex' cultivar, and 8,565.75 kg ha⁻¹ in the conditions of cultivation from Bazos, 'Altigo' cultivar. The protein content (Pro) varied between 10.30% in the conditions from Secuieni, 'Glosa' cultivar, and 15.90% in the conditions from Caracal, 'Izvor' cultivar. The gluten content (Glt) varied between 20.80% in the conditions from Secuieni, 'Glosa' cultivar, and 36.50% in the conditions from Lovrin, 'Alex' cultivar. In the PCA - Correlation Matrix, PC1 explained 53.704% of variance, and PC2 explained 32.806% variance, on the values of the recorded quantitative and qualitative production parameters. Regarding the production increase (ΔY), the protein increase (ΔPro) and the gluten increase (ΔGlt), in the PCA - Correlation Matrix, PC1 explained 69.848% of variance, and PC2 explained 27.316% variance.

Key words: crops site, foliar biostimulator, PCA-Correlation Matrix, wheat cultivars, yield parameters

INTRODUCTION

In classical-conventional agricultural systems, soil is the main source of nutrients for crop plants [19], [25], [37].

The application of fertilizers to the soil, with incorporation, by different methods and techniques, is the main way of supplementing nutrients for plants of crops with nutrients [10], [43], [8].

Nutrient management has an important role in agricultural technologies due to the influence of mineral elements to the metabolic processes and substantial contribution to the formation of agricultural production and its quality [15], [9], [33], [21], [36].

Foliar fertilization is a fast and efficient way of supplementing nutrients, with favorable effects in directing plant nutrition [18], [12], [32], [1], [28]. Foliar fertilization can be associated with phytosanitary treatments (various pesticides), which represent

advantages regarding the application costs, the volume of agricultural works and the effectiveness of the treatments [13], [5].

Products based on natural extracts, with a role in plant nutrition and as activators of metabolic processes are of high interest for plant production systems in terms of production quality, environmental protection, and capitalization of natural resources in agricultural production processes [42], [3], [4], [35], [39].

Such products, such as natural extracts, have a high importance especially in ecological, biological, organic, biodynamic agriculture systems, but also for conventional agricultural systems [30], [44], [11].

In the category of natural extracts with use in foliar treatments for crops, different categories of products are used, with specific active principles, in relation to crop plants and for the purpose pursued [6], [16], [27], [14].

Products based on algae extracts are of

particular interest in agriculture, due to the content of minerals, but especially of specific bioactive compounds, which makes it possible to prepare biofertilizers and biopesticides, with use for conventional agriculture but also for organic agriculture [26], [7], [4], [31], [40].

The present study evaluated the variation of production, protein and gluten in several wheat cultivars in five different locations, under the influence of the Super Fifty foliar biostimulator based on algae extract.

MATERIALS AND METHODS

The study evaluated the variation of production and quality elements in different wheat cultivars under the influence of the foliar biostimulator Super Fifty (SF) and cultivation sites.

Testing experiments were performed in the area of Bazos (Baz), Gataia (Gat) and Lovrin (Lov), Timis County, in Caracal (Car), Caracal County, and in Secuieni (Sec), Neamt County.

The biological material was represented by the 'Altigo' wheat cultivar (Bazos test field), the 'Glosa' wheat cultivar (Gataia test field), the 'Alex' wheat cultivar (Lovrin test field), the 'Izvor' wheat cultivar (Caracal test field) and the 'Glosa' wheat cultivar (Secuieni test field).

The product Super Fifty (SF), based on algae extract, was used, according to the recommendations given by the manufacturer (*BioAtlansis*) [2]. The experiments were organized under appropriate conditions of production technology.

Production (Y, kg ha⁻¹), protein content (Pro, %) and gluten content (Glt, %) were evaluated. Production increase (ΔY , kg ha⁻¹), protein increase (ΔPro , %) and gluten increase (ΔGlt , %) were calculated, under the influence of Super Fifty treatment.

In order to evaluate the increase generated by the Super Fifty (SF) product, the analysis and interpretation of the results was made in relation to the untreated variant, within each wheat cultivar and study location.

PCA was used to discriminate the source of variance, versus treatment (SF), location and

wheat cultivar and correlation of production parameters.

The analysis and processing of the obtained results, for the three production parameters taken into study (Y, Pro, and Glt) was done with the statistics module from the EXCEL application, and with the PAST software [17].

RESULTS AND DISCUSSIONS

The application of the Super Fifty foliar biostimulator (SF) to wheat, in the five cultivation locations, led to yields (Y) between 5,280.00 kg ha⁻¹ in the conditions of Lovrin, 'Alex' cultivar, and 8565.75 kg ha⁻¹ in the conditions of culture from Bazos, 'Altigo' cultivar. The protein content (Pro) varied between 10.30% in the conditions from Secuieni, 'Glosa' cultivar, and 15.90% in the conditions from Caracal, 'Izvor' cultivar.

The gluten (Glt) content varied between 20.80% in the conditions from Secuieni, 'Glosa' cultivar, and 36.50% in the conditions from Lovrin, 'Alex' cultivar. The values of production (Y) and of the studied quality indices (Pro, Glt) are presented in Table 1.

Table 1. The values of the production parameters in relation to the wheat cultivar and crops location, under the influence of the foliar biostimulator Super Fifty

Location Cultivar Parameter	Control (Ct)	Fertilized variant Super Fifty (SF)	Differences (%)
Y (kg ha ⁻¹)			
Baz-Altigo-Y	7,763.16	8,565.75	110.34
Gat-Glosa-Y	6,624.00	6,980.00	105.37
Lov-Alex-Y	4,960.00	5,280.00	106.45
Car-Izvor-Y	5,594.00	6,537.00	116.86
Sec-Glosa-Y	5,539.00	6,430.00	116.09
Pro (%)			
Baz-Altigo-Pro	12.70	13.00	102.36
Gat-Glosa-Pro	15.00	15.40	102.67
Lov-Alex-Pro	13.80	14.20	102.90
Car-Izvor-Pro	15.90	15.90	100.00
Sec-Glosa-Pro	10.00	10.30	103.00
Glt (%)			
Baz-Altigo-Glt	24.60	26.00	105.69
Gat-Glosa-Glt	34.40	35.50	103.20
Lov-Alex-Glt	33.50	36.50	108.96
Car-Izvor-Glt	24.30	24.40	100.41
Sec-Glosa-Glt	19.10	20.80	108.90

Source: Original data from test fields.

The ANOVA test highlighted the presence of the variance in the data set regarding the studied production parameters (Y, Pro, Glt), and the statistical safety of the results ($F > F_{crit}$, $p < 0.01$, for $\text{Alpha} = 0.001$).

The production increase registered, in statistical safety conditions ($p = 0.0078$, t-test), between the variants treated with the SF biostimulator and the control variants, in the five test locations is shown in Figure 1.

The Super Fifty (SF) biostimulator generated production increases (ΔY) of 802.59 kg ha⁻¹ under the cultivation conditions of Bazos

(Baz), 'Altigo' wheat cultivar; 356.00 kg ha⁻¹ under the conditions of cultivation from Gataia (Gat), 'Glosa' wheat cultivar; 320.00 kg ha⁻¹ under the conditions of cultivation from Lovrin, 'Alex' cultivar; 943.00 kg ha⁻¹ under the conditions of cultivation from Caracal, 'Izvor' cultivar; 891.00 kg ha⁻¹ in the conditions of culture from Secuieni, 'Glosa' cultivar.

In the case of protein content, the increase (ΔPro) generated by the Super Fifty (SF) product is represented in Figure 2.

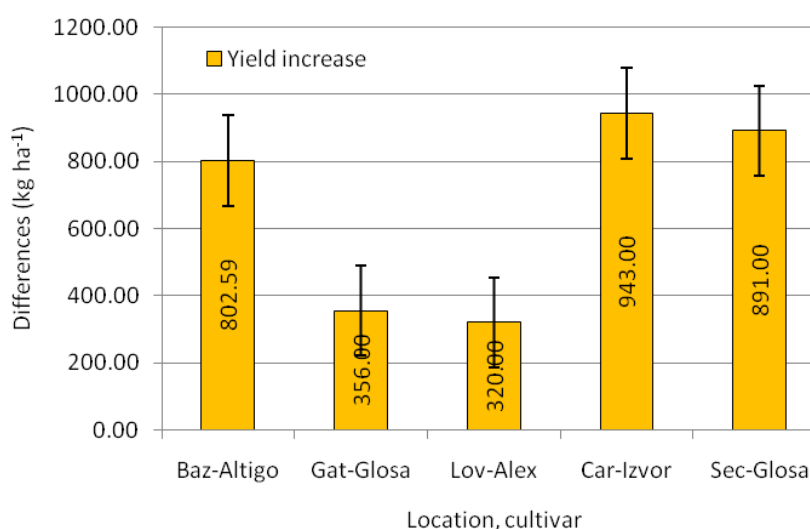


Fig. 1. Production increase (ΔY) generated by the biofertilizer Super Fifty in wheat testing locations, different cultivars

Source: Original data, resulted by calculation.

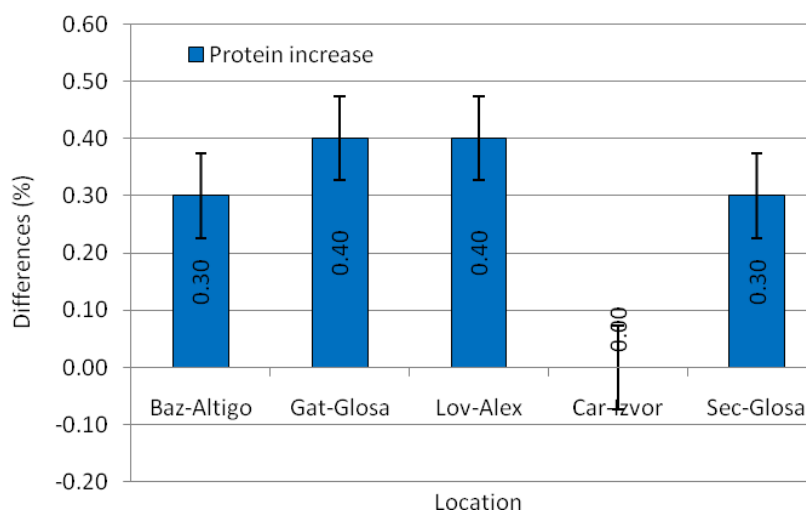


Fig. 2. Protein increase (ΔPro) generated by the biofertilizer Super Fifty in wheat testing locations, different cultivars

Source: Original data, resulted by calculation.

Although with low values, the increase of the registered protein content presented statistical safety ($p = 0.0189$, t-test).

The biofertilizer Super Fifty (SF) generated increases in protein content (ΔPro) of 0.30% in the cultivation conditions of Bazos (Baz), 'Altigo' wheat cultivar; 0.40% in the conditions of culture from Gataia (Gat), 'Glosa' wheat cultivar; 0.40% in the conditions of culture from Lovrin, 'Alex'

wheat cultivar; 0.30% in the culture conditions from Secuieni, 'Glosa' wheat cultivar. No increases in protein content were recorded under the Caracal culture conditions, 'Izvor' wheat cultivar.

In the case of gluten content, the increase (ΔGlt) generated by the Super Fifty (SF) product, in statistical safety condition ($p = 0.0359$, t-test), is represented in Figure 3.

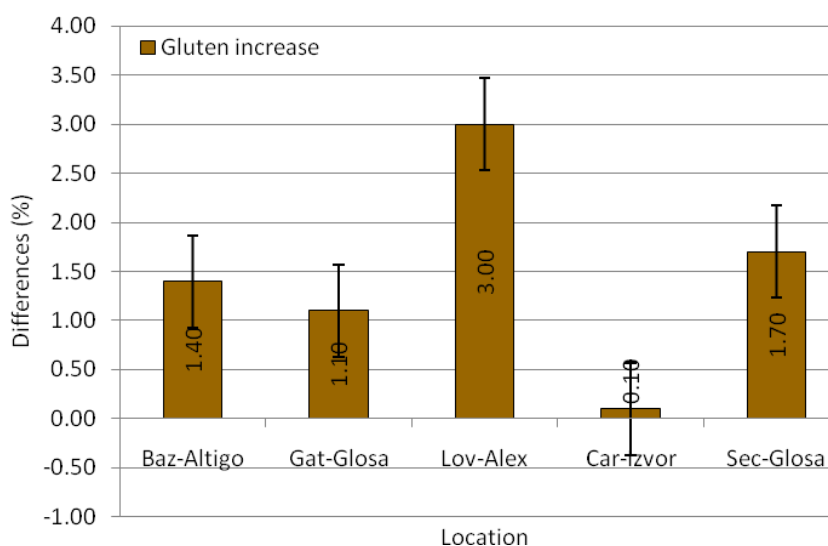


Fig. 3. Gluten increase (ΔGlt) generated by the biofertilizer Super Fifty in wheat testing locations, different wheat cultivars

Source: Original data, resulted by calculation.

The biofertilizer Super Fifty (SF) generated increases in gluten content (ΔGlt) of 1.40% in the cultivation conditions of Bazos (Baz), 'Altigo' wheat cultivar; 1.10% in the conditions of culture from Gataia (Gat), 'Glosa' wheat cultivar; 3.00% in the conditions of culture from Lovrin, 'Alex' wheat cultivar; 0.10% in the conditions of culture from Caracal, 'Izvor' wheat cultivar; 1.70% in the culture conditions from Secuieni, 'Glosa' wheat cultivar.

Considering the level of evaluated parameters (Y, Pro, Glt) on the background of SF treatment, in relation to wheat cultivars and crop locations, the Correlation matrix within PCA led to the diagram in Figure 4. PC1 explained 53.704% of variance, and PC2 explained 32.806% variance, on the absolute values recorded at quantitative and qualitative production parameters.

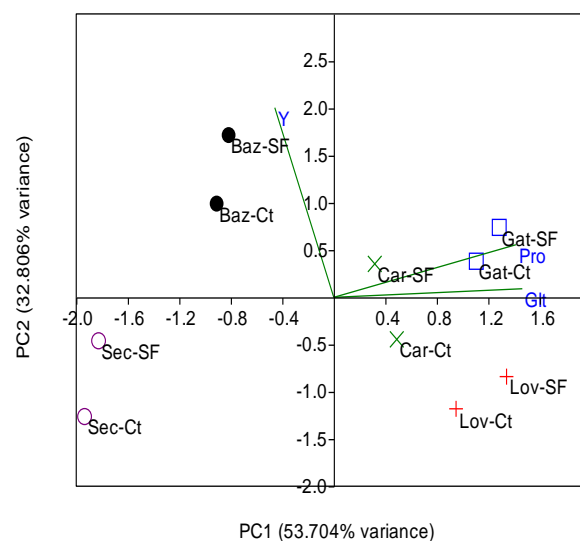


Fig. 4. PCA Correlation matrix diagram on the distribution of experimental cases studied in relation to production parameters analyzed, wheat cultivars, and crop location (Y, Pro, Glt, as bi-plot)

Source: Original graph, general based on experimental data.

In relation to the considered parameters (as bi-plot) in the case of the 'Altigo' cultivar, was found to be correlated with production (Y), as a result of the high values recorded for this analyzed parameter.

The results related to the crops from Lovrin (Lov), 'Alex' cultivar, Gataia (Gat), 'Glosa' cultivar, and Caracal (Car), 'Izvor' cultivar, the correlation with the quality indices (Pro and Glt) was found, according to PCA diagram, Correlation matrix.

The case study on the 'Glosa' wheat cultivar, in the Secuieni location (Sec), was placed on an independent position from the considered elements (Y, Pro, Glt), as a result of the low values recorded for the studied production parameters.

The variation of the production parameters was analyzed in terms of the increase (%) recorded (Y-Increase - ΔY , Pro-Increase - ΔPro , Glt-Increase - ΔGlt) in relation to the cultivars and crop location, under the influence of the SF biostimulator. The PCA - Correlation matrix diagram, obtained is shown in Figure 5.

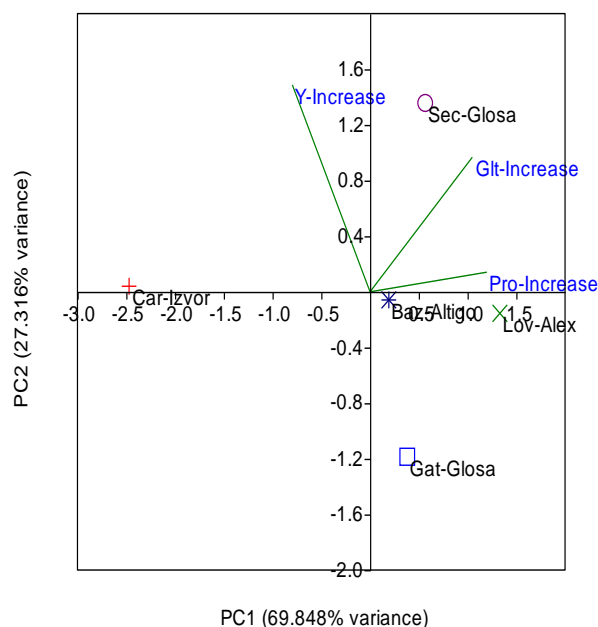


Fig. 5. PCA diagram, Correlation matrix, regarding the distribution of experimental variants in relation to the increase recorded at the analyzed production parameters, wheat cultivar and crop location (ΔY , ΔPro , ΔGlt , as bi-plot; Δ - Increase symbol)

Source: Original graph, general based on experimental data.

PC1 explained 69.848% of variance, and PC2 explained 27.316% variance, based on the values of the production increase (ΔY) and the increase of the quality indices (ΔPro and ΔGlt).

The highest production increase (ΔY) was registered for the 'Izvor' cultivar in the cultivation conditions from Caracal (116.86%), followed by the 'Glosa' wheat cultivar in the cultivation conditions from Secuieni (Sec), Neamt (116.09 %). Due to the wheat cultivation conditions in the two locations, Caracal and Secuieni, the Super Fifty product led to higher production increases compared to the other cultivars and crop locations.

Also, a high increase in production (ΔY) was registered in the case of the 'Altigo' wheat cultivar (110.34%) in the crop conditions from Bazos (Baz). The 'Glosa' wheat cultivar, in the crop condition from Gataia (Gat), Timis, ensured an increase in production (ΔY) of 105.37%, the lowest in the study, which shows the important role of the habitat in the formation of production (interaction genotype x site location).

In the case of protein content, the recorded increase (ΔPro) was generally reduced, by 2.36 - 3.00%. Higher values were recorded in the crop conditions of Lovrin (Lov), the 'Alex' wheat cultivar.

In the case of gluten, the highest increase (ΔGlt) was recorded in the crop conditions of Lovrin (Lov), the 'Alex' wheat cultivar, with a value of 8.96%.

The cluster analysis facilitated the grouping of the cases studied based on the degree of similarity in relation to the evaluated production parameters (Y, Pro, Glt), in statistical safety conditions (Coph.corr. = 0.766). The obtained dendrogram is presented in figure 6.

Within the two formed clusters, it was found the grouping of the variants from Timis County within the C1 cluster; Lovrin, 'Alex' wheat cultivar and Bazos 'Altigo' wheat cultivar with a higher level of similarity, to which was added Gataia, 'Glosa' wheat cultivar. Within the C2 cluster, the variants from Caracal 'Izvor' wheat cultivar and

Secuieni 'Glosa' wheat cultivar were grouped.

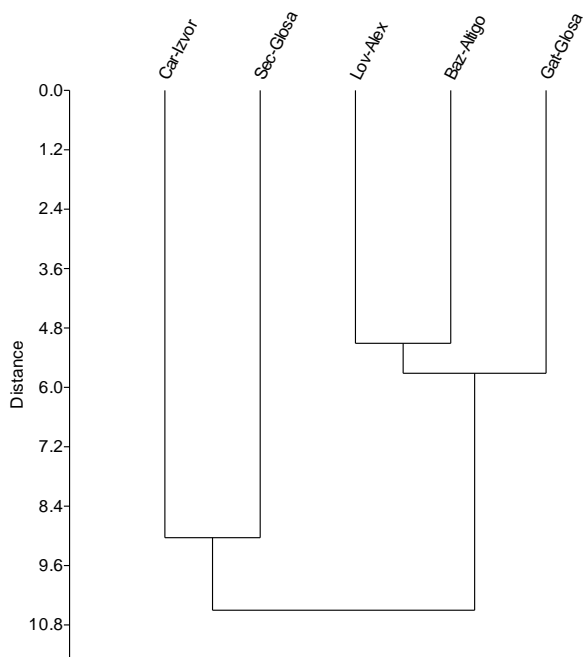


Fig. 6. Grouping of case studies based on similarity (Euclidean distances) in relation to the values of the evaluated production parameters (Y, Pro, Glt) for wheat, different cultivars and crop locations
Source: original diagram, based on the recorded data.

The SDI values also expressed the degree of similarity in the case of the studied cases (wheat cultivars/location) in relation to the values of the production parameters. The highest level of similarity was recorded for the cultivars 'Alex' (Lovrin) and 'Altigo' (Bazos), $SDI = 5.1104$, followed by 'Altigo' (Bazos) and 'Glosa' (Gataia), $SDI = 5.5675$.

The variation of the response of different wheat genotypes to foliar treatments has been studied in relation to foliar fertilizers [20], [32], [33], [23] or bioactive products [22], [29].

Complex interactions such as [foliar treatment x genotypes x habitat] in wheat were evaluated in relation to different foliar fertilizers and bioactive substances, in terms of productivity elements (spike, spikelets, grains/spike, etc.), production, grain and straw ionome and quality elements [34], [41], [38], [24].

From the overall analysis of the results, it could be found that the studied varieties had specific receptivity to the treatment and capitalized differently the treatment applied

with the foliar biofertilizer Super Fifty (SF), at the level of production (Y) and the quality indices (Pro, Glt) evaluated.

CONCLUSIONS

The Super Fifty foliar biofertilizer (SF) based on algae extract, generated differentiated variation of production (Y), protein (Pro) and gluten (Glt) in the studied wheat cultivars, in relation to the cultivar and the location of the crop.

The highest production, on the background of the treatment with the SF biofertilizer was registered in the culture conditions from Bazos (Baz), Timis County, the 'Altigo' cultivar, and the highest increase under the influence of SF (ΔY , related to the location and variety) was registered under the conditions of Caracal (Car), the 'Izvor' cultivar.

The highest protein (Pro) content was recorded under Caracal conditions, 'Izvor' wheat cultivar, while the highest increase under SF influence (ΔPro , relative to location and cultivar) was recorded under crop conditions from Lovrin, the 'Alex' wheat cultivar, and Secuieni, the 'Glosa' wheat cultivar.

The highest gluten content (Glt) was recorded in the conditions of Gataia, 'Glosa' wheat cultivar, and the highest increase under the influence of SF (ΔGlt , relative to location and variety) was recorded in Lovrin, 'Alex' wheat cultivar.

ACKNOWLEDGEMENTS

The authors thank the staff of the company SC ARMANDIS IMPEX SRL, and its collaborators, for facilitating this study.

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