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# EVALUATION OF THE RELATIONSHIP BETWEEN AGRICULTURAL TECHNOLOGY AND PRODUCTIVITY AND QUALITY INDICATORS OF WHEAT (TRITICUM AESTIVUM L.

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***Abstract:*** *Increasing wheat production, despite climate change and the limitation of available resources, is a necessity in the context of increasing world consumption. The wheat breeding programs in Romania have continuously aimed to launch superior varieties, which meet the farmers' requirements. The research carried out between 2023 and 2024 led to important results both theoretically and practically regarding this crop. The two-year study, marked by significant climatic deviations, aimed to evaluate the behavior of five wheat varieties under various conditions, in order to identify the most productive and stable options for growers. The results obtained highlight a clear variability in the behavior of the tested varieties, emphasizing the importance of agricultural research for substantiating choices in practice. The SOLINDO, SOFRU and FLAVOR varieties offer promising prospects for producers, while SORRIAL and IZALKO require re-evaluations or adaptations in order to be able to effectively face the current climate challenges. Analyzing the protein content, the IZALKO variety stands out for its high values, being suitable for high-quality uses, along with SORRIAL, which exceeds the field average. Varieties with high starch content values (SOLINDO and FLAVOR) suggest better performing genetics or a higher capacity to capitalize on available resources, including climatic and soil factors. The analysis of the sedimentation index for the varieties taken in the study shows that IZALKO has the greatest potential for bakery applications, while the SOFRU and SOLINDO varieties may be less favorable for uses requiring a higher quality gluten.*

***Key words:*** *Varieties, yields, protein, starch, sedimentation index*

## INTRODUCTION

In the context of modern agriculture, wheat is predominantly cultivated through intensive systems, especially in developed countries where conventional practices prevail. These are characterized by extensive use of mineral fertilizers and chemical plant protection products. Although this type of agricultural management contributes to high yields, it is often associated with significant negative environmental effects (DURHAM, T.C.; MIZIK, T. 2021; GŁODOWSKA, M.; GAŁAZKA, A., 2018).

Increasing wheat production, despite climate change and limited available resources, is a necessity due to the growing global consumption. Wheat breeding programs in Romania have consistently aimed at releasing superior varieties that meet farmers' demands (SĂULESCU ET AL., 2007; MOLDOVAN ET AL., 2012; MARINCIU ET AL., 2021). Estimates show that production must increase by 1 billion tons to meet the food needs of the growing population. One method to meet future demand is to increase wheat yields by reducing the gap between actual and potential yields. In this regard, some researchers (HATFIELD & BERES, 2019; IMBREA F., 2014) have shown that technological advances in genetics and agronomic practices have made it possible to increase attainable yield, with the main limiting factor being unfavorable weather conditions during the growing season. Improving the structure of wheat varieties by developing and introducing high-yielding and more stable cultivars is an important way to achieve this goal (SHIMODA ET AL., 2022; LACHUTTA, K. & JANKOWSKI, K.J., 2024).

Since the early stages of wheat cultivation, grain shape and size have been important selection factors, as they influence both yield and wheat quality (MANDEA ET AL., 2023). One possible method to increase the yield potential of wheat is by increasing the individual grain weight. Ideally, the formation of grains at the top of the spikelets should be avoided, as grains located farther from the rachis receive fewer nutrients and remain smaller. In Romania, improving grain size has been a constant concern, with many of the varieties released over time being characterized by large grains.

Wheat, due to the valuable chemical composition of its grains and its exceptional technological properties, is a staple cereal for food processing, often referred to in many countries as the "bread cereal" (BIEL, W.; KAZIMIERSKA, K.; BASHUTSKA, U., 2020; CACAK-PIETRZAK, G., 2008, CITED BY KATARZYNA MITURA ET AL., 2023). Wheat grains are a source of carbohydrates, proteins, dietary fiber, and fats, as well as minerals (including P, K, Ca, and Mg), B vitamins, and other bioactive substances (SHEWRY, P.R.; HEY, S.J., 2015).

## MATERIAL AND METHODS

The objective of the research carried out on the territory of the city of Pecica is to follow the behavior of the autumn wheat varieties under the influence of the biological and technological factor. The studied area is part of the Arad Plain and is characterized by very good vegetation conditions for wheat cultivation, being included in the area very favorable to cultivation in our country (PANAITESCU L ET AL., 2014; NIȚĂ L. ET AL., 2014; NIȚĂ S. ET AL., 2014).

The type of soil on which the experiment was placed is a chernozemic gleic soil.

The varieties of wheat taken into cultivation are the following: SORRIAL; SUFFER; SOLINDO; IZALKO and FLAVOR. The precursor plants were corn and sunflower crops. The preparation of the seedbed was done by ploughing at a depth of 25 cm, two passes with a disc harrow. After sowing, the rolling was carried out. We fertilized with DAP 190 kg/ha, in the spring we fertilized with ammonium sulfate 100 kg/ha, urea -120 kg/ha.

The data obtained showed significant differences between varieties in terms of grain production, these variations being correlated both with the genetic potential of each variety and with the way they responded to the applied agricultural technology. In general, it was found that varieties with a high capacity to adapt to local pedoclimatic conditions (specific to the cambic chernozem) generated superior yields.

## RESULS AND DISCUSSIONS

The present paper aimed to highlight the relationship between the applied agricultural technology and the productive and qualitative performance of five common wheat varieties (Triticum aestivum L.), cultivated on a cambic chernozem soil. The evaluation was carried out based on relevant indicators for the quality of bread and crop yield, namely: mass of 1000 grains (MMB), protein, starch, gluten content and Zeleny sedimentation index.

During the 2023-2024 experimental cycle, in which significant climatic deviations were recorded, the performance of five wheat varieties was evaluated, and the data recorded allow a detailed analysis of their behavior under various conditions. The average production of the field was 6331 kg/ha, and compared to this, the varieties showed a diversity in terms of performance (Table 1 and Figure 1).

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The SOLINDO variety, with a production increase of 452 kg/ha compared to the field average, this result significantly exceeds all DL values (69.6 kg/ha, 98.9 kg/ha and 143.2 kg/ha), confirming that the difference is very significant at all levels of significance.

For the SOFRU variety, the production increase of 271 kg/ha is also statistically significant, exceeding the LD value 5% (69.6 kg/ha), but does not reach the DL level of 0.1% (143.2 kg/ha). It indicates statistical significance at the level of 5%, but with less significance at higher levels of confidence. The FLAVOR variety registered a production increase of 3%, with a difference of 187 kg/ha compared to the field average. This increase in production is also statistically significant, confirming that the variety performs well and can be taken into account by growers. The varieties SORRIAL AND IZALKO, recorded production differences below the field average and do not exceed the DL value 5% (69.6 kg/ha), which suggests that the production differences are not statistically significant and are therefore not considered relevant to influence the choices for their cultivation.

*Table 1*

Summary of the harvest results obtained in the 2023-2024 experimental cycle

| Variant | Harvest kg/ha | Production Relative % | The difference of production kg/ha | Significance |
|---|---|---|---|---|
| **FIELD AVERAGE** | 6331 | 100 | Mt. | |
| **SORRIAL** | 5876 | 93 | -455 | 000 |
| **SUFFERED** | 6602 | 104 | 271 | xxx |
| **BEAUTIFUL** | 6783 | 107 | 452 | xxx |
| **IZALKO** | 5874 | 93 | -457 | 000 |
| **FLAVOR** | 6518 | 103 | 187 | xxx |

DL5%=69,6 kg/ha; DL1%=98,9 kg/ha; Dl0,1%=143,2 kg/ha

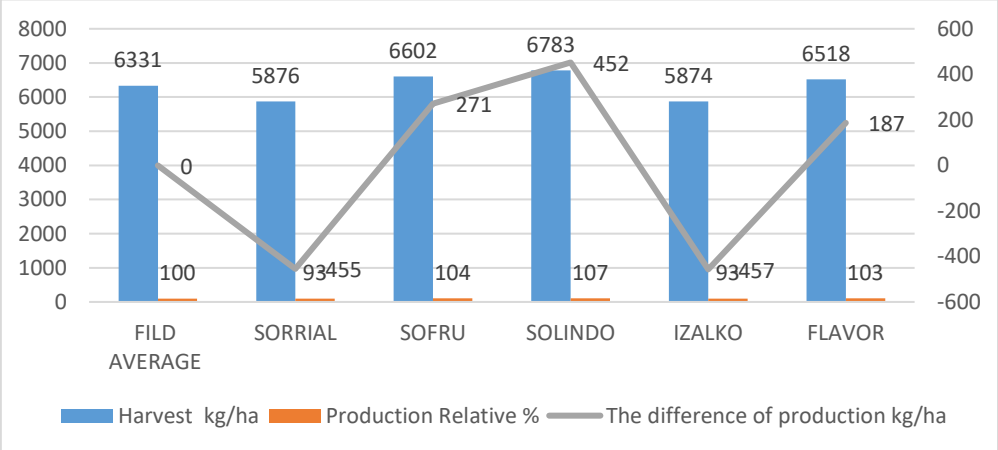


Figure 1. Summary of the harvest results obtained in the 2023-2024 experimental cycle

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**Results of quality indices for experimented wheat varieties**

**Mass of a thousand beans (MMB)**

Graph in Figure 2. shows the values of the mass of one thousand grains (MMB) for five varieties (SORRIAL, SOFRU, SOLINDO, IZALKO, FLAVOR) compared to the average of the field.

These values, expressed in grams, vary significantly between varieties, highlighting genetic differences and their adaptability to local conditions.

The average field is 41.56 g, representing a benchmark for evaluating the performance of varieties. The SOLINDO variety recorded the highest MMB value (45,65 g), indicating a higher accumulation capacity of reserve substances and good adaptability to experimental conditions. On the other hand, the IZALKO variety had the lowest value (36.51 g), suggesting a lower performance in terms of seed size and quality.

SOFRU recorded a high value of MMB (44.62 g), being the second best performing variety in the experiment, indicating a favorable production potential.

SORRIAL and FLAVOR had values close to the field mean of 39.91 g and 41.16 g, respectively, suggesting a moderate adaptation to the test conditions.

The differences observed in the MMB values reflect the genetic potential of each variety and the influence of pedoclimatic conditions on the accumulation of reserve substances.

Varieties with higher MMB values, such as SOLINDO and SOFRU, can offer significant advantages in terms of germination and uniform emergence, being recommended for exploitation under similar conditions.

In contrast, varieties with lower values, such as IZALKO, require increased attention in the selection of growing conditions to optimize their performance.

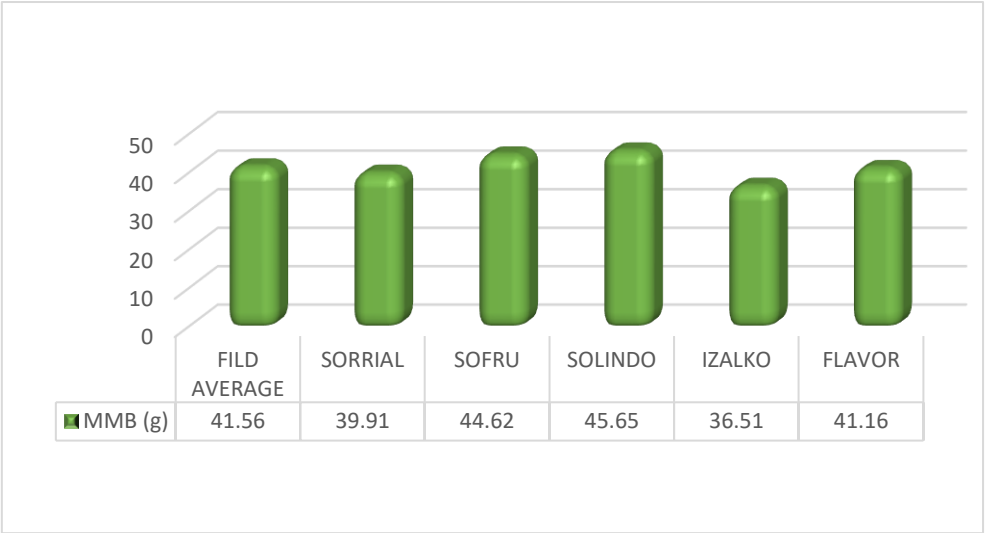


Figure 2. Mass of a thousand beans for the experimental cycle 2023-2024

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**Protein content in 2023-2024**

The analysis of the protein content (%), a key indicator of the nutritional and industrial value of wheat, reveals significant differences between varieties. Protein plays a crucial role in the formation of gluten, directly influencing the quality of bakery products. The average value of the field (11.65%) (figure 3.) on the protein content for the entire period (2023-2024), providing a reference point for comparing the studied varieties, suggesting a standard level of protein in the respective field.

The protein content of the SORRIAL variety (12.75%) is significantly higher than the field average, which indicates better nutritional quality. SOFRU (10.55%) and SOLINDO (10.2%), both varieties have lower protein values than the field average, which may indicate lower quality compared to other varieties, these varieties may be more suitable for other destinations such as feed production or processed foods. IZALKO (14%) stands out for its significantly higher protein content than all other varieties, indicating a superior nutritional value, being ideal for the production of high-quality bakery products.

The protein content of the FLAVOR variety (10.75%) is slightly higher than that of the SOFRU and SOLINDO varieties, but still below the field average, suggesting an average quality, which may be suitable for uses in various industries.

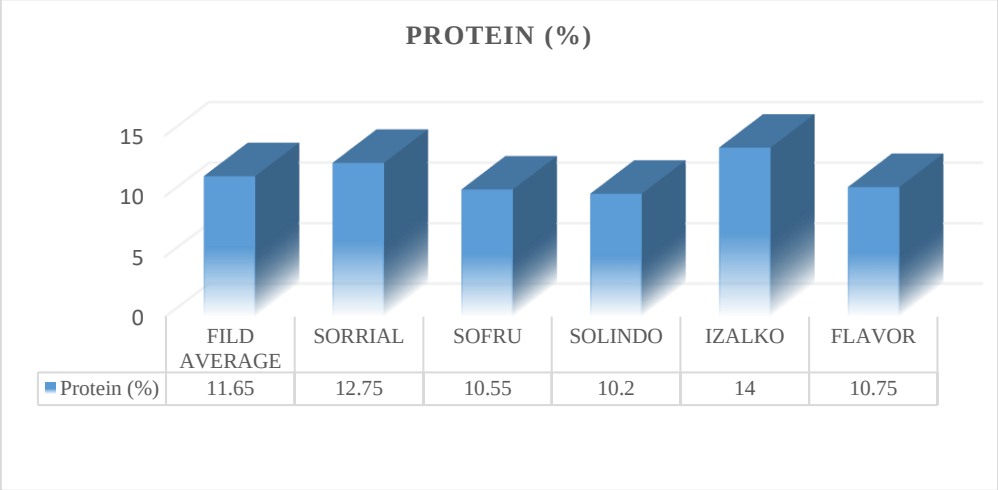


Figure 3. Protein content (%) 2023– 2024

**Starch content (%) in the experimental cycle 2023-2024**

In Figure 4. The synthesis of starch content (%) in the experimental cycle 2023-2024 is presented, compared to the field average. This parameter reflects the potential of varieties to accumulate starch, an important factor in determining crop quality for industrial or food uses. The average value of the starch content field is 54.9%, providing a benchmark for evaluating the performance of each variety.

The highest starch content is presented at SOLINDO (57.85%), indicating excellent potential for industrial uses such as the production of bioethanol or food starch. FLAVOR follows

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closely, with a starch content of 56.3%, being a high-performance and adaptable variety. The values recorded by SORRIAL (51.8%) and IZALKO (53.45%) are significantly below the field average (54.9%), suggesting a lower capacity of these varieties to accumulate starch. This may be the result of lower efficiency of photosynthetic processes, less favorable pedoclimatic conditions, or greater sensitivity to abiotic stressors.

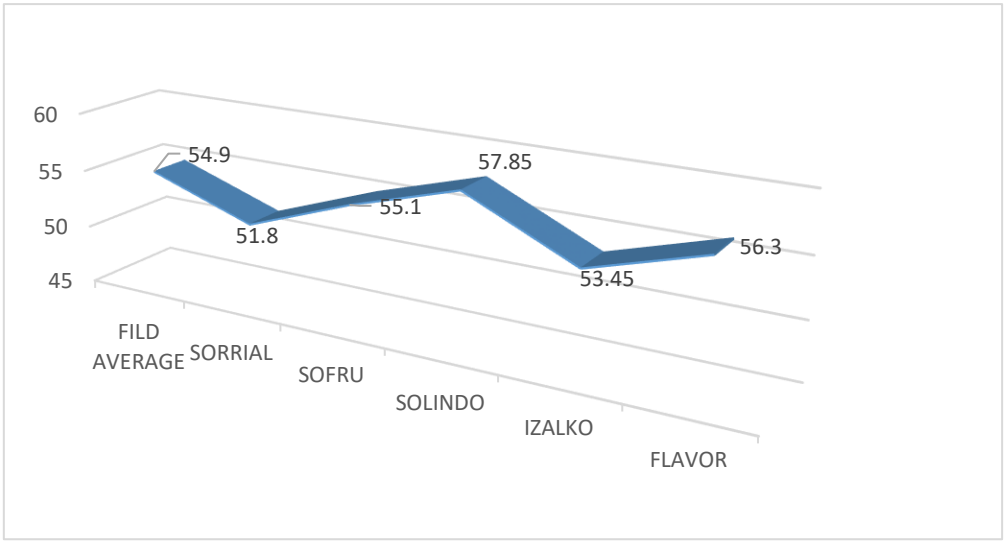


Figure 4. Starch content (%) in the experimental cycle 2023-2024

**Gluten content (%) of the five wheat varieties compared to the field average in 2023-2024**

Data in Figure 5. represents a synthesis of the gluten content (%) of the two experimental years, which allows a broader analysis of the behavior of each variety under variable environmental and agronomic management conditions.

The field average of 22.55% reflects an average value for gluten content within the field experienced, setting a benchmark for all other parameters.

This suggests that the agro-climatic conditions and technologies used were relatively constant, and the fluctuations in gluten content are probably due to the genetic characteristics of the varieties studied. SORRIAL (25.65%) is above the average of the field, indicating a variety with a superior performance in terms of gluten synthesis. This value suggests a high potential for the use of this variety in the bakery industry or other applications that require an increased gluten content. IZALKO, with a content of 30.3%, continues to be the best performing variety in terms of gluten content. This confirms its potential for the production of high-quality flour, while indicating excellent genetic adaptability under the analysed growing conditions. SOFRU (18.35%), SOLINDO (18.45%) and FLAVOR (19.95%) are below the field average, and these low gluten values suggest a more limited use in bakeries that require high gluten content. These varieties may be better suited for the production of low-gluten foods or for markets that require such characteristics.

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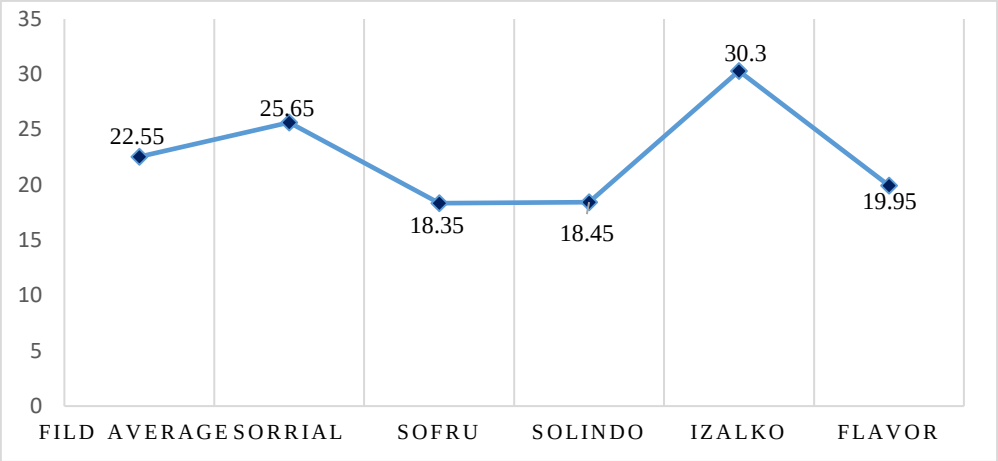


Figure 5. Gluten content (%) of the five wheat varieties compared to the field average in the period 2023-2024

**Variation in the Zeleny sedimentation index at the five wheat varieties compared to the field average**

The SORRIAL variety has a sedimentation index of 47.95 ml, which suggests a good gluten content, indicating an average seed quality in terms of bakery, above the field average (38.05 ml) (Figure 6.). The result suggests that this variety has potential for producing flour with good properties.

The SOFRU variety recorded a sedimentation index of 28.85 ml, below the average of the field, indicating a lower quality of gluten. This result suggests that the SOFRU variety may not be ideal for the production of higher-quality flour with a lower gluten content.

With a sedimentation index of 26.3 ml, the SOLINDO variety is below the field average, which suggests a lower seed quality in terms of bakery. It may have a lower gluten content, which can affect performance in the baking process.

The IZALKO variety, registers a sedimentation index of 55.95 ml, the highest of all the varieties tested, indicating a superior quality of gluten and a high potential for use in the production of high-quality flour. This variety stands out for its better adaptability to growing conditions, which can contribute to the production of high-quality bakery products.

With a sedimentation index of 31.25 ml, FLAVOR is in an intermediate position, having a better gluten content than SOFRU AND SOLINDO, but lower than IZALKO. This variety may be considered suitable for use in the bakery industry, but it does not rise to the level of the best performing varieties.

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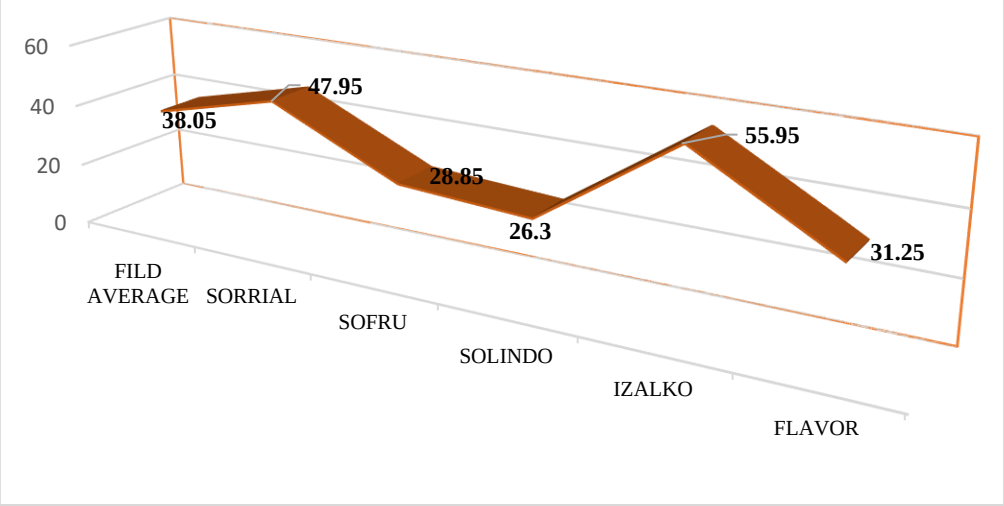


Figure 6. Sediment Index (ml) 2023-2024

## CONCLUSIONS

The results obtained confirm the existence of a close relationship between the applied agricultural technology and the agro-productive and qualitative performance of wheat. The analyzed varieties responded differently depending on the agro-pedoclimatic conditions and technological inputs, highlighting the importance of the correct choice of genotypes in relation to the agricultural management strategy. Quality indicators, in particular protein content, gluten and Zeleny index, can be improved through a rational fertilisation regimen, without significantly compromising productivity.

In conclusion, the differences in production between the varieties, correlated with the DL values, confirm that the SOLINDO, SOFRU AND FLAVOR varieties have a statistically significant significance at different confidence levels, while the SORRIAL AND IZALKO varieties are not statistically relevant. This analysis helps to understand the behavior of varieties under different conditions and can guide decisions to select varieties for future crops.

The differences observed in the MMB values reflect the genetic potential of each variety and the influence of pedoclimatic conditions on the accumulation of reserve substances.

Varieties with higher MMB values, such as SOLINDO and SOFRU, can offer significant advantages in terms of germination and uniform emergence, being recommended for exploitation under similar conditions.

In contrast, varieties with lower values, such as IZALKO, require increased attention in the selection of growing conditions to optimize their performance.

Choosing varieties with high MMB can help increase productivity and
crop quality, especially in intensive cropping systems.

Close monitoring of factors that can influence MMB (such as seeding density or availability of nutrient resources) is essential to improve crop performance.

IZALKO stands out for its high protein content, which makes it suitable for high-quality uses, while SORRIAL is also in a favorable position, being a variety with a protein content above the field average. In contrast, the SOFRU, SOLINDO and FLAVOR varieties have lower protein

values, which makes them more suitable for destinations that do not require a high protein content. These differences underline the importance of choosing varieties according to the specific needs of the agri-food industry.

From an agronomic point of view, climatic conditions have a direct impact on the availability and absorption of nutrients, especially nitrogen, an essential element for protein synthesis in plants.

An adequate level of nitrogen in the soil favors protein production in wheat, and climatic fluctuations, such as high temperatures or insufficient rainfall, can negatively affect the absorption of this nutrient, thus influencing the protein content of plants. Thus, the interaction between the genetics of the varieties and the environmental conditions largely determined the protein production capacity of wheat.

Varieties with high starch content values (SOLINDO and FLAVOR) suggest better performing genetics or a higher capacity to capitalize on available resources, including climatic and soil factors.

Lower values (SORRIAL and IZALKO) could be caused by a higher sensitivity to limiting factors (e.g. water stress, nutritional stress) or by genetic characteristics less adapted to local conditions. Continuous monitoring of this parameter is essential to optimize production quality and guide the selection of varieties according to the harvest destination.

Overall, varieties with a higher sedimentation index, such as IZALKO, stand out for a higher potential for the production of quality flour, while the SOFRU and SOLINDO varieties have a lower index, indicating a lower quality of gluten and a possible limited use in the bakery process.

In conclusion, the analysis of the sedimentation index for these varieties suggests that IZALKO has the greatest potential for bakery applications, while the SOFRU and SOLINDO varieties may be less favorable for uses requiring a higher quality gluten.

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