IMPACT OF FERTILISATION ON BREAD-MAKING QUALITY IN SOME NATIVE WINTER WHEAT VARIETIES IN THE SOIL AND CLIMATE CONDITIONS OF THE DEVA – ORĂŞTIE AREA (THE MUREŞULUI RIVER FLOODING PLAIN)

Nadina Fugaciu, Valeriu Tabară
Banat's University of Agricultural Sciences and Veterinary Medicine, Faculty of Agricultural Sciences, Timisoara, Aradului Street, no. 119, RO-300645, Romania,
Corresponding author: nadinfugaci@yahoo.com

Abstract: *The agriculture of the future must be durable and competitive, which can be achieved through the correct application of the technological processes specific to agricultural crops. The paper presents the outcomes of the research carried out between 2008 – 2009 in the Orastie – Deva area (The Mures Valley), focusing on the influence of fertilization upon the wheat's bread manufacture quality. The experiment emphasized the influence of fertilization in different doses of azoth, phosphorus and potassium upon the physical and chemical factors: HM, the protein content, the moist gluten content and starch. Wheat is one of the agricultural plants which positively react to the application of fertilizers in all climatic changes in Romania. The experiments carried out until now have emphasized this plant's capacity to capitalize the organic and mineral fertilizers economically. The paper refers to the physical and chemical indicators that depend on the soil's fertility and on the soil and climatic factors. Wheat is the main cereal in people's nourishment, the bread manufacture quality being its most important feature. The bread manufacture characteristics depend on the protein and gluten content of the wheat berry, which is influenced by the doses of azoth, phosphorus and potassium. The method we used was related to four agri-funds:*

b1 – N_0 P_0 K_0
b2 – N_{60} P_{60} K_{60}
b3 – N_{90} P_{90} K_{90}
b4 – N_{120} P_{120} K_{120}

The research proved the increase of the protein and gluten content in the case of the wheat fertilized with bigger azoth, phosphorus and potassium doses. For soils in Romania the azoth remains the main mineral element which influences the wheat's bread manufacture capacity. Moreover, the increase in quantity and quality of the gluten in the fertilization with significant does of azoth, phosphorus and potassium has been emphasized. For bread manufacture, the content in gluten and the quality of the proteins determine the hydrating capacity of flour and the quality of the bakery products. The balanced fertilization of the wheat crop ensures the development of the plants. The ratio between the azoth, phosphorus and potassium is generally in favour of the azoth, which has a greater solubility in the soil and thus can be applied in several stages. The azoth, phosphorus and potassium fertilizers derived from NPK complex fertilizers. Used in the right proportion, the azoth ensures the good rooting of the plants increases the resistance to low temperatures and improves the content of the wheat berries in protean substances. The phosphorus influences positively the rooting, the resistance to the cold of the winter, the resistance to falling and increases the efficiency of the azoth. The potassium favours the synthesis of the carbon hydrates and contributes to the resistance of the plants. The hectolitric mass has been correlated positively with the protein content. The bread manufacture features and the hectolitric mass (HM) are influenced by the cultivated soil, the climatic conditions and technology applied.

Key words: *wheat, protein content,gluten content, variety,fertilization*

INTRODUCTION

With a production of over 7 million tonnes of wheat and a total consumption of almost 3 million tonnes of wheat, Romania could turn its position of importer into a position fo exporter.

On the ground of a larger production in 2008 than in 2007, includign at EU level, the price of wheat on inetrnational markets decreased from about 300 Euros/tonne below 170 Euros/tonne (panification wheat), almost raeching the average price of 2007 (150 Euros/tonne), when world wheat production was about 70 million tonnes smaller. In Romania too, the purchase price of wheat decreased from 0.80-1.00 lei/kg to 0,50 lei/kg, ane ever lower (Rabă 2008).

If we put aside the way prices were made up and the speculative interventions, the wheat production of the year 2008 is assessed with reservations. Specialists estimate that about 70% of the wheat is foder wheat, which means that quality parameters were not reached in 2008. this can be explained by the fact that, despite the low production of 2007, they did nto purchase certified seeds processed exclusively upon order: this means that they have cultivated *"wheat from the granary"* and, from a production of 3 million tonnes, Romania exported several hundreds of thousands of tonnes of wheat, almost exclusively as fodder wheat (Rabă 2008).

In this paper, we analyse certain quality indicators of some native wheat varieties – Ciprian, Alex and Arieşan – in the conditions of the Mureşului River flooding plain.

MATERIAL AND METHOD

To test winter wheat varieties in the field, we set, in the Mureşului River flooding area (Orăştie – Deva) a bifactorial experiment in which the experimental factors were factor A - fertilizer: a_1 - $N_{60}P_{60}K_{60}$, a_2 - $N_{90}P_{90}K_{90}$, a_3 - $N_{120}P_{120}K_{120}$, a_4 - $N_0P_0K_0$ and factor B – variety, with 3 graduations: b_1 – the variety Arieşan, b_2 – the variety Alex, b_3 – the variety Ciprian.

These varieties aer native. They cover important areas in the Hunedoara County. Harvesting was done upon full maturity, using a combine for experimental fields. We sampled each experiemntal variant to determine certain quality indicators in the panification industry.

Research and agricultural practice show without ant doubt that technological factors also can contribute largely to the changing of the chemical composition of the wheat and of wheat yield quality (Borlan *et al*. 1994).

The experimental field in the Mureşului River flooding plain has the following soil features: clayish to clay-sandy texture, medium to good productivity, moderate phosphorus and potassium content, alkaline reaction, 20-30% physical argyle content, humus content 2.4%, useful water holding caapcity 8.2%, wilting coefficient 13.5%, pH in the water 7.5.

In order to ake up the raw matter for the milling industry and for the panification industry, wheat technological features are determined through exact laboratory analyses.

Physical and chemical tests of the present study were done in the "Seed and vegetal material quality testing laboratory" using last-generation milling and panification equipment. The laboratory is within the Agricultural Technologies Department of the Faculty fo Agriculture of the Banat University of Agricultural Science and Veterinary Medicine in Timişoara.

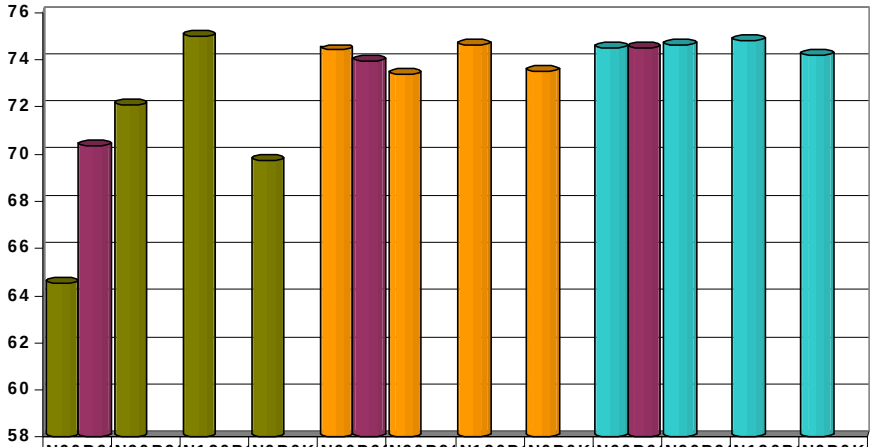
In the laboratoty, we determined, among physical features, only hectolitric mass (kg/hl), and among chemical features, only moisture content (%), protein content (%) and gluten content (%).

Quality indicators analysis in some native wheat varieties in the conditions of the Mureşului River flooding plain on a certain agri-fund points out the bread-making value of the varieties studied: Ciprian, Alex, and Arieşan. Grouping indicators per quality criteria is orientative, since research duration was only 2 years (2010-2011).

Hectolitric mass is considered a quality element to be assessed, since high hectolitric mass points out a high-quality seed. Hectolitric mass is an indicator influenced by the setting of the grains and by the inter-grain space, by the nature and amount of empty, broken, or

undergrown grains, etc. Panification wheat hectolitric mass should be, according to requirements, over 75 kg/hl and it is considered very good when above 78 kg/hl.

In 2009, as shown in Figure 1 for the indicator "HECTOLITRIC MASS" that the variety Arieşan has, on the whole, a "good" harvest quality, with an average of 75 kg/hl, followed by the variety Alex with an average of 74 kg/hl, which means, as in the case of the variety Ciprian (an average of 71 kg/hl), a "satisfactory" wheat yield quality.



MH	64,5	72,1	75	69,7	74,4	73,4	74,6	73,5	74,5	74,6	74,8	74,2
Media MH	70,32				73,95				74,52			

Fig.1: Assessment of panification wheat quality depending on the variety and on the fertilisation system for the quality indicator "HECTOLITRIC MASS"

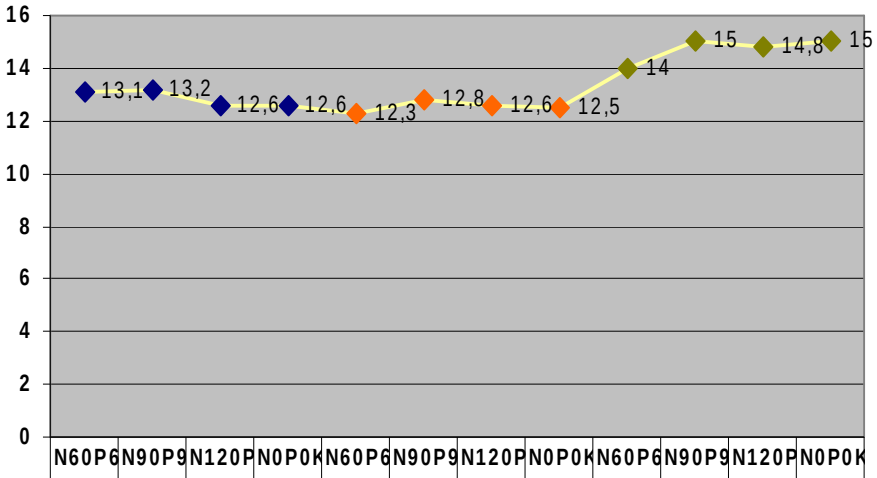
The impact of fertilisation on hectolitric mass shows that on the agri-fund $N_{120}P_{120}K_{120}$ we obtained the highest masses – values between 79.6 kg/hl and 75.0 kg/hl – in all three varieties.

Moisture is, from several points of view, an important indicator in assessing wheat quality. Optimal state upon harvesting is characterised by wheat water content – which should not be above 15% – while storing should be done at no more than 14%. High moisture and mainaining it for longer periods of time can result in important wheat quality and quantity losses; it also favours, together with temperature, disease and damage of wheat grains.

In 2009, water content of native wheat varieties was as follows: the best conditioning and storage water content in wheat grains was in the Arieşan variety for the agri-fund $N_{90}P_{90}K_{90}$ (Figure 2).

Protein is the main element of wheat quality. A high protein content is associated with good panification quality. Among technological factors, fertilisation ahs the most important imapct on protein (Hera et al. 1986). Among technological elements, nitrogen fertilisers have a rather considerable imapct on protein content.

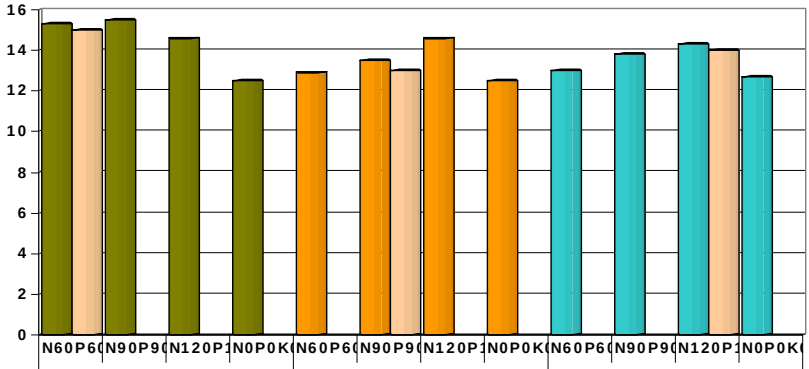
Wheat protein content largely depends on the geentic heritage of the wheat variety, on the seeding procedures, on the maturity state of the grains, as well as on soil and climate conditions, etc. Applying chemical fertilisers, the irrigation seeding system, as well as droughty periods during grain development favour the increase of protein content in the grains. A year with heavy rains results in a decrease of the protein content.



UMIDITATE	13,1	13,2	12,6	12,6	12,3	12,8	12,6	12,5	14	15	14,8	15

Fig.2: Assessment of panification wheat quality depending on the variety and on the fertilisation system for the quality indicator "MOISTURE"

Mean values of protein content obtained in the Mureşului River flooding plain depending on the agri-fund and on variety allow us to draw the following conclusions: the variety Ciprian has a very good protein content, the best value being on the agri-fund $N_{90}P_{90}K_{90}$ (15.5%), followed by the agri-fund $N_{60}P_{60}K_{60}$ with a protein content of 15.3%. The next wheat variety is Arieşan, with a protein content of 14.3% on an agri-fund of $N_{120}P_{120}K_{120}$, and of 13.8% on an agri-fund of $N_{90}P_{90}K_{90}$. On an agri-fund of $N_{120}P_{120}K_{120}$, the variety Alex has a protein content of 14.6% considered as *"very good"* (Figure 3).



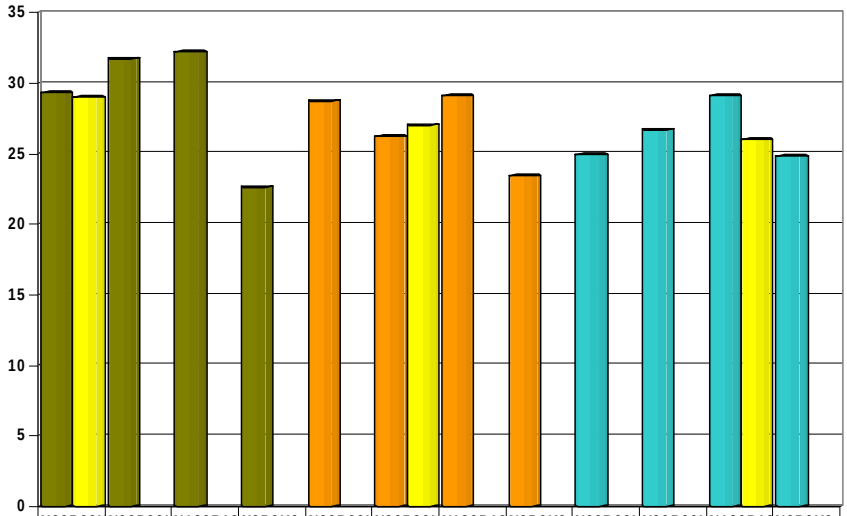
PROTEINA	15,3	15,5	14,6	12,5	12,9	13,5	14,6	12,5	13	13,8	14,3	12,7
Media Proteina	15					13					14	

Fig.3: Assessment of panification wheat quality depending on the variety and on the fertilisation system for the quality indicator "PROTEIN"

Gluten content is favourably influenced bu nitrogen efrtiliser application (Naidin 2004). Gluten conetnt – gluten quantity and quality are very important quality indicators in bread-making. Gluten si formed during the technological process from gluten-generating protein and it contribuets essentially to the fromation of the structure of the bread loaf crumb.

Gluten is capable of forming, together with starch, a visco-elastic network whose features of extensibility, elasticity, and tenacity have an impact on dough behaviour during the etchnological process and on finite produce quality (Figure 4).

Climate conditions halso have an impact on gluten content. Analysis persented in Figure 4 shows that it has an impact on gluten accumulation, a main element in panification wheat. Taking into account the interaction between soil and agri-fund, the highest gluten content was in the variety Ciprian (32.2%) on an agri-fund of $N_{120}P_{120}K_{120.}$



GLUTEN	29,3	31,7	32,2	22,6	28,7	26,2	29,1	23,4	24,9	26,7	29,1	24,8
Media Gluten	29					27					26	

Fig.4: Assessment of panification wheat quality depending on the variety and on the fertilisation system for the quality indicator "GLUTEN"

CONCLUSIONS

We need to note that, in the conditions of the Mureşului River flooding plain, most of the wheat varieties are very high panification indicator wheat varieties, which makes them extremely valuable for the panification industry and for the amrket, at the same time.

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