THE QUALITY OF WHEAT FLOUR UNDER THE INFLUENCE OF NITROGEN AND PHOSPHORUS DOSES

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ABSTRACT

Analysis of flour quality indicators, ie wet gluten, falling number, Zeleny sedimentation test, gluten deformation index, the glutenic index, farinograph test and alveograph test, are currently used in the baking industry in the EU and highlights the favorable effect of different fertilization systems on them.

Following the application of nitrogen fertilizers together with the phosphorus it is obtain a good quality flour.

INTRODUCTION

The quality of raw material in the milling industry presents particular attention because of its implications in the quality of the finished product. Owing to the uneven harvests wheat in recent years both in terms of quality and in terms of quantity, a particularly important aspect for this food sector is the correct analysis of quality of raw materials in order to orient it towards bakery and pastry products and for determining appropriate corrective methods for improving the quality of wheat flour obtained by grinding in order to obtain constant quality finished products.

It is well known that wheat quality can not be determined only from gluten content and its deformation index, requiring a more thorough qualitative assessment designed to provide information about the flour quality obtained by grinding.

Following the percentage distribution of flour quality, it is estimated that 75% is attributed to wheat quality parameters and 25% to milling process (Vizitiu 2012).

By administration of fertilizers, it can be managed the metabolism to the desired direction and can promote the accumulation of proteins, starch, sugar, fats, and other substances in plants (Babeanu 2008).

Wheat responds well to nitrogen fertilizers by increasing the protein content (Boldoni 1988).

In terms of quality, should not be omitted in the case of wheat, the baking qualities. Nitrogen fertilizers in doses up to 200 kg/ha increase gluten content, which has positive effect of increasing loaf volume (Moule 1991).

Doses of nitrogen fertilizers may be accompanied by harmful effects for plants and may be removed if a fraction of the dose of nitrogen was applied in the late stage of plant development, while vegetative growth is terminated, and nitrogen is used in the formation of the reproductive organs, and for synthesis of protein in the grain as reserve substance thus improving quality traits of flour (Mocanu 2013, Dodocioiu 2013).

MATERIAL AND METHOD

The experience was placed in 2014 on cambic chernozem, baticalcaric and the cultivated variety was Crina. In the framework of experience was followed the influence of nitrogen - phosphate interaction on the quality indicators of flour.

To better highlight how chemical fertilizers affect wheat quality, especially the flour obtained, there were made the following determinations:

- wet gluten content (%);
- falling number;

- sedimentation test (Zeleny: ml);
- gluten deformation index (mm);
- glutenic index (mm);
-farinograph test: development time (min.), stability (min.);
-alveograph test: w-energy absorbed by stretching dough (Joules), P/L raport indicates the extent to which the dough is more extensible and more resistant.

RESULTS AND DISCUSSIONS

The interaction between nitrogen and phosphorus has had a more accentuated effect than unilateral applying of nitrogen or phosphorus fertilizers (Mocanu et al, 2012).

Interaction of nitrogen-phosphorus has a good influence on the falling time and respectively on the quality of wheat flour. Thus for $P_0N_{50}…N_{100}$ falling time is between 127-152, the flour falling in satisfactory bakery category.

Applying nitrogen fertilizer on P_{40}, P_{80} or P_{120} background has the effect of increasing sedimentation time and the quality of flour. So, for $P_{40}N_{200}$ dose is 211 seconds and for $P_{80}N_{100}…N_{200}$ is 224-244 seconds, $P_{120}N_{50}…N_{200}$ is 184-251 seconds, being for these variants between 180-260 seconds and the flour is suitable for bakery products.

Hence, from this point of view, moderate doses of nitrogen and phosphorus $P_{80}N_{100}$, N_{150} give the same sedimentation time, 234-244 seconds, quality of the flour obtained being conveniently, as in accordance with Table 1.

Nitrogen-phosphorus interaction influences best the wet gluten content. Thus while due to the use of phosphorus fertilizer in P_{40}-P_{120} doses give a wet gluten content from 21.5 to 22.8% range, and from the use of different doses of nitrogen fertilizers is achieved a wet gluten content from 21.7 to 23.4%, from the use of fertilizers with phosphorus together with the nitrogen, wet gluten content values reach 22.3 to 25.8%, and the wheat flour passes from satisfactory quality to good quality.

Good quality wheat flour (22-24% wet gluten), is obtained due to the use of subsequent doses of fertilizer: $P_{40}N_{150}…N_{200}$ - 24,3%; $P_{80}N_{100}…N_{200}$ 24,8 - 25,6%; $P_{120}N_{100}…N_{200}$ - 25,1 - 25,8%.

And from this point of view, of wet gluten content, stands out those moderate doses of phosphorus P_{80} with moderate and large doses of nitrate N_{100}, N_{150}, leads to a high content of wet gluten and good wheat flour in terms of quality.

At values between 20-60 ml flour is middle satisfactory, at values above 60 ml flour is good for bakery.

Table 1

The influence of nitrogen-phosphorus interaction on few quality indicators of flour

Studied factors kg s.a /ha		Wet Gluten %	Falling-Number (seconds)	Zeleny Test (ml)	Gluten Deformation Index (mm)	Glutenic Index (%)	Farinograph Test		Alveograph Test	
							Development time (min)	Stabi-lity (min.)	Joule W	P/L
P_0	N_0	21.2	118	18	24.2	19.5	1.8	0.6	81	0.3
	N_{50}	21.5	127	20	22.3	22.8	1.8	0.8	110	0.4
	N_{100}	22.8	138	26	18.6	26.4	2.2	1.4	128	0.5
	N_{150}	23.0	146	34	18.0	28.9	2.5	2.1	136	0.5
	N_{200}	23.6	152	42	17.5	31.3	3.1	2.3	145	0.5
P_{40}	N_0	21.9	131	23	21.2	24.6	2.0	1.1	92	0.3
	N_{50}	22.3	150	26	18.7	31.3	2.3	1.7	125	0.4
	N_{100}	23.5	152	44	17.6	36.5	2.6	1.9	141	0.4
	N_{150}	24.2	167	56	15.4	41.2	3.2	2.5	156	0.6
	N_{200}	24.3	211	58	15.5	39.0	3.2	2.5	160	0.5
	N_0	22.1	137	28	20.3	25.8	2.3	2.6	113	0.3

P_{80}	N_{50}	23.6	176	42	15.8	34.2	2.5	3.0	134	0.4
	N_{100}	24.8	224	61	15.0	42.8	3.5	3.2	155	0.4
	N_{150}	25.3	238	63	14.4	48.6	4.6	4.4	180	0.5
	N_{200}	25.6	244	60	14.1	46.3	4.8	4.5	182	0.5
P_{120}	N_0	22.9	149	29	19.4	36.1	3.0	3.0	121	0.2
	N_{50}	24.0	184	48	15.8	38.5	4.0	3.6	146	0,5
	N_{100}	25.1	229	59	14.0	51.3	5.4	4.5	174	0.5
	N_{150}	25.3	242	64	13.6	54.8	5.2	4.5	184	0.6
	N_{200}	25.4	251	66	14.2	56.7	5.8	4.3	181	0,6

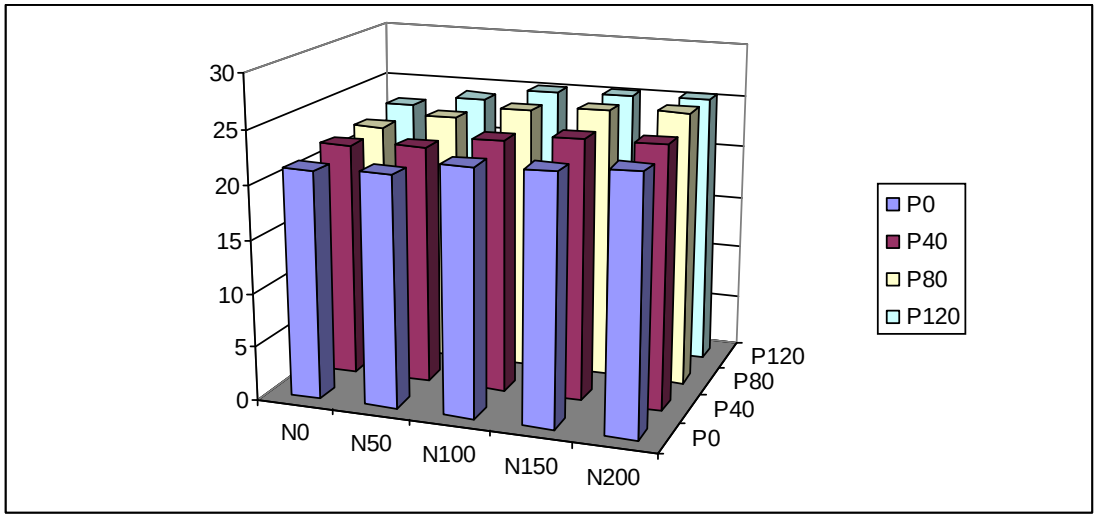

Fig.1.The influence of nitrogen-phosphorus interaction on wet gluten content (%).

Sedimentation test (Zeleny).

Both Zeleny sedimentation index and glutenic index properly express bread quality of wheat. These indices associated with farinograph note and bread volume constitutes the basic element in assessing wheat for bakery products.

Analysis of this indicator from data contained in the table 1 revealed that it was influenced by the fertilizer dosages used.

Interaction of nitrogen-phosphorus contributes largely on the basis of this indicator at increasing the quality of wheat flour.

At the unfertilized N_0P_0, as we have seen Zeleny sedimentation index has values below 20, flour being of low quality.

Applying nitrogen fertilizer on background P_{40}, caused an increase in sedimentation index at values 23-58, flour going into middleweight or satisfactory category.

Applying nitrogen fertilizer on background P_{80}, resulted in a dramatic increase of the sedimentation index value, in particular where were applied $P_{80}N_{100}$-61 ml, $P_{80}N_{150}$-63 ml doses wheat flour moving in a better bakery category.

Close values for this indicator 64 - 66 ml are obtained using $P_{120}N_{50}$…$P_{120}N_{200}$ doses, but we believe that it is not necessary to use such large and non-economical doses which are leading to the same results of good quality flour, as when $P_{80}N_{100}$…N_{150}. moderate doses were used.

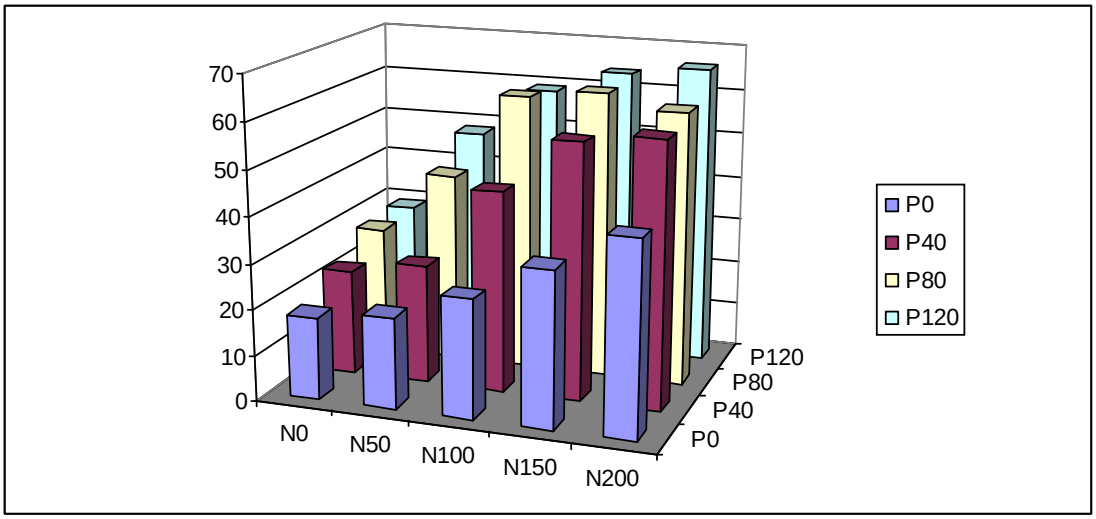

Fig.2 The influence of nitrogen-phosphorus interaction on Zeleny test (ml).

Gluten deformation index.

Gluten deformation is high if it is greater than 15 mm and this happens more often as bedbug attacks cereals introducing exogenous proteolytic enzymes in the grain.

If the deformation of the gluten index is less than 5 mm, the proteolytic activity is very low, gluten is very elastic and flour requires improvement with proteolytic enzymes or reducing agents. Instead of chemical reducing agents can be used yeast derivatives, which have endogenous proteases glutathione type, capable of causing a softening of gluten.

Deformation index of gluten was influenced by factors A, B, used in the experience presented.

Application of the different doses of nitrogen on P_{40} background has the effect of lowering gluten deformation index to the values of: 17.6; 15.4; 15.5 mm, the lowest value 15.4 mm is obtained for P_0N_{150} dose, flour passing in this situation at the satisfactory category.

If nitrogen rates apply on P_{80} background, it is reached to a very low deformation index 14.4-14.1 mm ($P_{80}N_{150}$; $P_{80}N_{200}$), flour passing into the good bakery products category, which happens in case of using $P_{120}N_{100}$, N_{150}, N_{200}.

However, given the very close values of deformation index of gluten between $P_{80}N_{150}$ and $P_{120}N_{150}$ doses, it is recommended moderate doses $P_{80}N_{150}$ for a good quality of the flour.

Glutenic index.

Interaction of nitrogen-phosphorus had a rather favorable effect in increasing the quality of wheat flour, so the P_0 background only at N_{150} dose, flour has a satisfactory quality with glutenic index 31.3% (Babeanu, 2010).

Application of the different doses of nitrogen on P_{40} background has led to increased glutenic index at values between 31.3 to 41.2%. At doses $P_{40}N_{50}$…N_{200} flour quality is satisfactory, while for $P_{40}N_{150}$ flour is of good quality.

At N_{100}, N_{150}, N_{200} nitrogen application doses on P_{80} background, there was obtained a good quality flour, with glutenic index over 30% (34.2 to 48.6%).

In case of application of nitrogen doses on P_{120} background, at the same nitrogen doses abovementioned, is obtained a flour of good quality with glutenic index from 51.3 to 56.7%.

It follows from analysis of this indicator that using moderate doses of fertilizers $P_{80}N_{100}$ and N_{150} is obtained good quality flour.

Farinograph test.

Nitrogen-phosphorus interaction had a favorable effect on the growth and quality of wheat flour. Thus on all backgrounds P_{40}, P_{80}, P_{120}, even at small doses of nitrogen N_{50}, N_{100} is obtained average quality flour.

In the case of $P_{40}N_{150}$, $P_{80}N_{150}$, or $P_{120}N_{150}$ doses are obtained high development times and dough stability, so an average quality flour, being placed in the move towards strong quality flour.

Alveograph test.

Fertilizing with nitrogen and phosphorus further enhances flour quality indicators W and P/L, gaining values of 180-182 Joules at $P_{80}N_{150}$-N_{200} and P/L raport reaches 0.5-0.6 flour being classified under potentially bakery category. Likewise at higher doses $P_{120}N_{100}$-N_{200}.

CONCLUSIONS

Analysis of flour quality indicators, are wet gluten, falling number, Zeleny sedimentation test, gluten deformation index, the glutenic index, farinograph test and alveograph test, are currently used in the baking industry in the EU and highlights the favorable effect of different fertilization systems on them.

Wet gluten content has been changed favorably by moderate doses of nitrogen N_{100} - N_{150}, applied on a background of moderate doses of phosphorus, P_{80}, when it is obtained 24.8 to 25.3% wet gluten, flour being of good quality.

Falling number has values of a suitable quality flour (234-244 seconds) when moderate doses of nitrogen and phosphorus are used, N_{100}-N_{150} on P_{80} or P_{120} background.

Zeleny sedimentation test recorded, as a result of the interaction of nitrogen - phosphorus, N_{100}-N_{150} on P_{80}-P_{120} background, values of 61 - 63 and 59 - 64 ml (good quality flour).

Deformation index of gluten, as a result of the application of nitrogen fertilizer together with the phosphor, reaches values of 15.4 to 18.6 at $N_{50}P_{40}$ and $N_{150}P_{40}$ and therefore satisfactory flour, decreased to values below 15 (flour good for bakery products) when the following doses are used: N_{150} - N_{200}, P_{80}, N_{100}, N_{150}, N_{200} - P_{80}.

The use of moderate doses of nitrogen and phosphorus, N_{100}, N_{150} on P80 background contributed to obtaining good quality flour (glutenic index over 40%).

Farinograph test appreciated by two indicators of his: development time and stability, emphasized that without fertilizers, flour is of poor quality, at the use of fertilizers with phosphorus and nitrogen flour switches to medium quality, by the use of potassium and nitrogen fertilizers flour remains of poor quality and when using doses of $P_{40}N_{150}$, $P_{80}N_{150}$ or $P_{120}N_{150}$, flour is approaching a strong quality.

Alveograph test, by two indicators of its: value W (power dough) and the ratio between the power and extensibility (P/L) is positively influenced by phosphorus fertilizer (flour passing to quality flour good for biscuits) especially for the interaction with nitrogen and nitrogen - phosphorus, factors which make flour go from poor quality (at unfertilized or fertilized only with potassium) to a potential bakery flour.

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