CORELATION BETWEEN THE SUNN PEST ATTACK AND THE BLACK POINT AND THEIR EFFECT ON THE BREAD MAKING QUALITY OF WHEAT

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Abstract

The main problem with the 2016's harvest relates to the high proteolytic activity as a consequence of the sunn pest attack and the presence of the Black Point. The scientific name of the sunn pest is *Eurygaster integriceps*. The sunn pest is an oligophagous insect thriving on wheat cultures and attacking both the cultivated grains as well as the spontaneous grasses. The damage produced by this pest is both in terms of quality and quantity. According to other scientific research, the Black Point is a disease affecting the wheat and is a result of the attack caused by some pathogenic agents. It can be easily observed since it manifests itself by giving the grain a darker colour especially around the embryo. Few studies were conducted regarding this disease and the existing ones underline the fact that the Black Point could not affect the grain's quality. The research carried out on the harvested wheat in 2016 shows a strong presence of the Black Point corresponding with a colour change to a greyish tint in the resulting flour. Studies have shown that the stronger the attack on the wheat is, the stronger the tint in the resulting flour. As a follow-up of these studies, a strong connection between the sunn pest's attack and the presence of the Black Point was found. If the sunn pest damage is of high percentage then the black point is more likely to appear, determining a decrease in the bread making quality of the resulting milled flour. To improve the bread-making quality solutions were found, but the grey tint of the attacked flour could not be corrected, this tint being present in the bread's core as well.

Key words: Black Point, sunn pest of the wheat, pests

Among grain crops, wheat represents the largest proportion of cultivated plant area, with a short period of vegetation and high production on a surface unit. Initially, wheat grains were consumed raw and later on roasted or boiled in water, in the form of flatbreads made by rough flour by grinding the grains between the stones (Banu I., 2008).

The cereal production and their technological methods were subjected to a continuous growth and adaptation, according to human needs and evolution, serving to improve the quality of lives all around the globe. By milling the wheat grains the flour is obtained, the main ingredient from which bread products are made, occupying a significant role in the food industry. (Banu I., 2007).

The common wheat (Triticum estivum SSP vulgare) is the most widespread cereal in the world representing 90% of the cultivated grains.

Its seeds are used especially in making various types of flour, the raw material used in bread making.

Wheat has autumn and spring forms and it covers a wide range of types. Also, this plant is highly susceptible to diseases and pests.

The most common type of pest that especially attacked the 2016 harvest is the sunn pest. This bug can cause significant damage to the wheat production, damaging both its quantity and quality.

Both the larvae and the adult sunn pest attack the plant damaging it by reducing the standard mass per storage volume, reducing energy and germination faculty and decreasing the bread making quality by degrading the gluten.

The scientific name of the sunn pest is *Eurygaster integriceps*.

The adult sunn pest has an oval shaped brown body and it measures between 11 and 13 millimetres in length. Its head has a triangular shape and its antennas consist of 5 joints. The pronotum is almost hexagonal and the scutellum is well developed and equal in length with the bug's abdomen, with a protuberance in the medial area. It also has two yellow dots on its base.

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When laid, the egg is sphere-shaped and greenish coloured, darker shades gradually appearing during the embryo's development. The larva resembles the adult insect but is smaller in size and it does not have wings.

In photo 1 the adult sunn pest found in one of the analysed wheat batches is presented.

Figure 1 **Adult sunn pest from the analysed batch no.1**

One generation lasts up to a year and during winter it hides under forest leaves, near trees close to the crops and under the grass. During spring, when temperatures increase beyond 10 degrees Celsius they make their appearance. Initially, they appear on the spontaneous grasses and later fly on the cereal crops. The largest number of insects is recorded during the middle of May.

After a period of feeding and sexual maturity, the mating process begins and the laying of the eggs begins. Larvae take up to 8-10 days to appear. They shed up to 4-5 times before reaching adulthood, their entire development process coinciding with the wheat's (30-40 days). The adults from the new generation emerge at the end of July, their feeding process continuing until August when they retreat for the cold season.

The sunn pest is of the oligophagous type and it develops mainly on wheat crops but is able to attack other cereals too, be it cultivated or spontaneous. The sunn pest adults attacks the young stems, the leaves, the ears rachis, the flowers and the seeds. Around the place in which the plant has been stung a swelling appears called a "salivary cone" surrounded by a yellow area.

Sometimes when the leaf is attacked it starts to curl, becoming yellow and eventually dries up hanging like a string from the stem. Frequently the ear remains within the spikelet, and when it emerges it has a wavy awn and it can become partially or fully sterile, whitened, with traits commonly found on the top of the ears. The attacked grains are undeveloped, shriveled or, if not completely deformed, they present black spots surrounded by a discoloured area.

The quality of the whole production is way diminished.

When the sunn pest stings, together with its saliva it introduces a protease that dissolves the gluten bonds.

Gluten is the protein with the biggest role in the bread making industry and is composed of gliadin and glutenin.

The presence of water in the dough confers the gluten the ability to form a three-dimensional structure that gives the dough elasticity and extensibility. In the baking process of the dough, the gluten coagulates. The gluten surrounding the starch particles which are partially gelled forms the outside crust surrounding the pores of the bread's core. The quality and quantity of the gluten determine the main bread-making properties.

The most common disease that affected the 2016 harvest was the Black Point.

THE BLACK POINT, according to recent studies, is a disease that affects mainly wheat cultures and is assumed to be a result of the sunn pests attack produced by a number of pathogens. It is an easily noticeable disease because it causes the grain to darken in colour generally around the embryo. The darkening of the plant is not always very strong, and it is not defined in shape. In a recent analysis of the 2016 harvest, a high presence of this disease is underlined. The presence of the disease is proportional to the grey tint of the resulting flour by milling the grains in standard conditions. The core of the bread was darker in samples that had a higher percentage of Black Point.

MATERIAL AND METHOD

The main tracked elements were wet gluten, from a quantitative and qualitative point of view, and the presence of the Black Point disease. These tests have been correlated with baking tests with the effects they have on bakery products.

For all the measurements calibrated laboratory equipment was used, according to standards in force. Up to date methods were also applied.

The sampling process was performed in accordance with the SR EN ISO 24333:2010 standard with a mechanical extraction device that applies suction.

The wet gluten was determined according to the SR EN ISO 21425-2:2008 standard, using mechanical methods.

Determining the gluten is an important part of the whole process, both in terms of quantity and quality. Its quantitative determination was made according to the above-mentioned standard with the help of glutamate. The quality determination is made by analysing the rheological properties. These rheological properties are determined with the help of the alveograph, as stated in the SR EN ISO 27971:2008 standard.

The determination of the Black Point percentage was made according to the SR EN 15587:2008 standard for determining the content of wheat impurities and according to STAS 1069-77 standard for determining the content of foreign bodies and defective seeds.

The influence of the Black Point attack on the colour of the flour obtained was underlined by Pekar test. This is a quick analysis to verify the colour of a certain type of flour by comparing the sample with a determined ash standard.

RESULTS AND DISCUSSIONS

For this analysis two batches of wheat have been taken into consideration.

Batch number 1 was without signs of sunn pest attack or Black Point disease.

The average quality for this batch is recorded in table 1.

Table 1

Wheat quality parameters of the batch no.1

Parameter	Value
Hectolitre weight	81.2
Humidity	14.2
Protein	13
Wet gluten	25.4
Index gluten	78.5
F.N.	375
P	87
L	81
G	20
W	226
P/L	1.07
Ie	50.5

Figure 2 shows the rheological tests and parameters from the alveograph analysis.

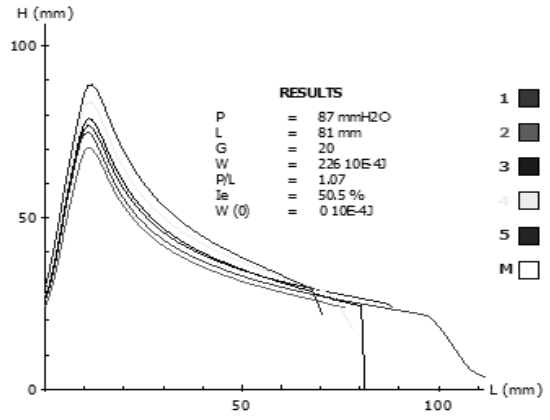

Figure 2 **Alveograph test of the first batch of wheat**

As shown in the graph both the wet gluten and the W value from this batch show very good characteristics.

The second batch analysed is affected by both sunn pests and Black Point with a percentage of more than 30%.

The average quality of the batch number 2 is shown in table 2.

Table 2

Quality parameters of wheat batch no 2

Parameter	Value
Hectolitre weight	78
Humidity	14.4
Protein	11.3
Wet gluten	22.8
Index gluten	79.2
F.N.	389
P	42
L	64
G	17.8
W	67
P/L	0,66
Ie	26.9

The sunn pest attack was the main problem relating to the 2016 harvested wheat, this attack is highlighted by the low W values. The sunn pest attacks the grain during its various stages of development. Upon stinging the plant, this bug introduces a proteolytic enzyme together with its saliva. Gluten is composed of gliadin and glutenin. The two components contribute to the formation of bread product's core. The protease introduced with the sunn pest's saliva decreases the bread making properties of the gluten by breaking the bonds of the gluten particles and excessively increasing its elasticity.

Multiple ways to correct the damage done by the sunn pest have been studied and the best results were given by adding oxidant substances such as ascorbic acid or different enzymes such as glucose oxidases and lipases.

In Figure 3 the alveograph test obtained by rheological analysis with the alveograph offer important information regarding the way flour behaves in the bread making process.

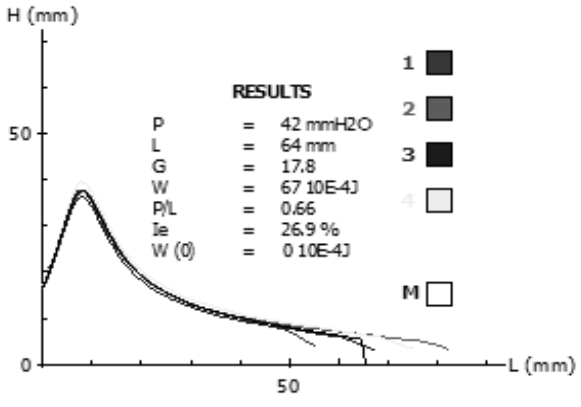

Figure 3 **Alveograph test of lot nr.2 of wheat**

During the milling, the processed wheat has been classified in multiple categories by means of quality. The analysis performed can be separated into quality analysis and quantity analysis.

The ones regarding quantity are: hectolitre weight, humidity, foreign bodies' content and impurities' content.

The ones relating to quality, define the bread making properties and are as follows: determination of wet gluten and index gluten, determination of rheological properties and determination of the Falling Number. Taking these into account together with the processing needs, in order to obtain various flour types, a set of minimum values for quality have been established which define the bread making process.

Thus, in order to obtain common 650 type flour (this number represents the ash content after which the types of flour are classified) the minimum values have been set to 22 for gluten and 120 for W. The wheat from batch no. 2 was analysed from the gluten's quantity standpoint and can be classified as suitable for bread making. Although from a quality standpoint defined by the alveograph and represented by the W value, the wheat falls within the fodder category.

Taking into consideration the quantity of the wet gluten this wheat could be processed at the small percentage of 10% together with a high-quality wheat.

The sunn pest can cause damage both to quality and quantity by reducing the hectolitre weight, reducing energy and the germination faculty, diminishing the bread making quality by degrading the gluten.

As a result of the analysis, a high percentage of Black Point disease was detected too. The proportion of Black Point identified was over 30% in the batch analysed. The Black Point is a disease that affects wheat and supposedly does not affect the quality of the flour obtained from this wheat, but during the milling process, the high presence of this defect greatly influence the bread making process by changes in the flour colour obtained under standard ash conditions. Also, semolina flours and the rough flours obtained from milling wheat with Black Point attack show black dots, determining the non-conforming quality of the flour.

Four samples were analysed: witness sample and three other samples with different attack percentages.

The witness sample is good quality wheat without black point attack as shown in Figure 4.

Figure 4 **Healthy wheat seeds batch 1**

Batch number two is a batch with a black point attack of over 30 %. Figure 5 shows Black Point attacked grains.

Figure 5 **Black Point attacked wheat grains batch 2**

Figure 6 shows comparative healthy grains (marked with B) while grains of Black Point attack (marked with A).

Figure 6 **Comparison between healthy grains (B) and attacked grains (A)**

To track the influence of the black point on the colour of the flour, in the sample of the wheat batch number 1 was added 5% grains of Black Point attack and then 10% grains of Black Point attack.

The colour of the three samples was compared, after which the colour was compared with the wheat sample in batch number 2 with Black Point attack of over 30% attacked grains.

CONCLUSIONS

The colour of the flour obtained from healthy wheat, without sunn pest attack or Black Point attack, determined by Pekar method and then by determining the ash content is within the imposed extraction limits.

In the performed tests, the degree of extraction was 0.76%, the flour obtained was that of 0.65 ash content. Type 650 flour is commonly used with a percentage of 95% in almost all bakeries in order to obtain bread.

The corresponding flour has a white-yellowish colour determined by the colour of their endosperm and carotenic pigments. Based on colour the minimum quality properties are classified and established for all the types of flour existent in our country. Usually, there is a direct connection between the core's colour of the bread and the flour's colour.

The Pekar method used to determine the colour of the flour is a quick method of comparing the colour, using a standard sample with the determined ashes and the analysed sample.

The measurable colour of the flour is given to it by the ash content which is standardised for each flour type.

In Figure 7 the colour of the flour is presented for both the witness sample and the sample resulted from the wheat attacked by Black Point.

Figure 7 **Pekar comparison**

The grey variation of the flour sample made from sunn pest attacked wheat is noticeable.

Figure 7 clearly shows the colour deviation given by the high percentage of Black Point, a colour that will be retained further in the colour of the dough obtained (Figure 8) and then further in the colour of the bread core (Figure 9).

Figure 8 **Colour comparison between doughs**

Figure 9 C**olour comparison between finished products**

The dark colour of the core of the bread is emphasized by the low quality of the W value, caused by the sunn pests attack.

From the analysed samples a correlation can be spotted between the low quality the product reveals and the attack of the sunn pest and of the Black Point disease.

The lower the W value, the higher the Black Point percentage.

In the healthy wheat sample in which 5% of Black Point attacked grains were added after milling the grains and obtaining the flour, no major influences were observed in Pekar method versus the witness sample method.

In the sample that was mixed with 10% attacked wheat a slight greyish deviation in colour is worth noting, although the ash contents did not show signs of change as shown in Figure 10.

This greyish deviation in the flour's tint perpetuates itself to the baking process causing a change in colour of the core of the final product.

The grey background given by both the sunn pest attack and the Black Point attack can easily be confused with the high degree of flour extraction, so that a standard ash flour is visually confused with a higher degree of extraction flour.

Figure 10 **Comparative colours of the core of bread made with healthy wheat and mixed wheat (10%)**

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