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EVALUATION OF ENERGY AND PROTEIN NUTRITION OF COMMON WHEAT VARIETIES TREATED WITH LEAF FERTILIZERS

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Abstract

The research was conducted during 2015 - 2016 in the experimental field of the Department of Plant Production in Agriculture Faculty at Trakia University, Stara Zagora, Bulgaria. The aim of this study is to investigate the effect of leaf fertilizer on the productivity of common wheat. In this study has examined the nutritional value of two common wheat: Diamond (by the varietal list of Bulgaria) and Ingenio (Syngenta). A comparative analysis of the results obtained from the treatment of varieties of common wheat with leaf fertilizers was made. Energetic and protein nutrition of ruminant wheat was evaluated in 1 kg of dry matter. Protein value of feed is extremely important for their nutritional value. The protein value of the feed is related to the bioavailability of the protein contained therein. The boundaries in which the protein values of the various feeding variants with different leaf fertilizers. The crude protein content ranges from 160.3 to 167.0 g/kg of dry matter (DM) for the Diamond variety and from 144.4 to 151.8 g/kg of dry matter Ingenio variety. On average, the content of raw protein in Diamond variety is higher by 10.7% of the found content of Ingenio variety.
Keywords: Common wheat, fertilization, intestinal digestible protein (PDI), correlation coefficient of Pearson (r), protein nutrition.

1. Introduction

Numerous studies have demonstrated the impact of agro-technical measures on the productivity and quality of wheat grain. The nutrient content, albeit genetically, varies depending on the level of agro-technology. Therefore still continue studies on the various components of the technology for growing common wheat.

Fertilization is one of the most powerful agro-technical measures to increase the yield and grain quality of wheat. The different regimen of diet created leads to specific varietal characteristics in terms of the ability to digest nutrients throughout the vegetation (Ivanova et al., 2006; Kindred et al., 2008). Mihailova et al., (2012) investigate the impact of soil treatment and fertilization on the nutritional value of grain in cereals.

The productive potential of wheat and grain quality are associated with increased tolerance to abiotic stress. In this respect, many countries are organizing environmental trials to gather information on the suitability of a given variety for a given region for years. Variety in wheat is a guarantee of success in stress conditions (Dimitrova et al., 2006; Demirevska et al., 2008; Hurkman et al., 2009; Tayyar, 2010).

Protein concentration and composition are key components of the end-use value for wheat (Triticum aestivum L.) grain. Although the qualitative composition of the grain is genetically determined, the quantitative composition is significantly modified by growing conditions, and there are important management × genotype × environment interactions (Maintaining grain quality of wheat under climate change is critical for human nutrition and for the feeding of animals (Martreet al. 2006; Nuttall et al. 2017). Simulation models explain a mechanical framework that explains the impact of the environment on the concentration and quality of the grain.

Agriculture is a sector of particular importance for the economy of the country, for the environment, for society, for the development of individual regions and has to solve a number of problems related to its stable and balanced development. The main objective is to analyze the factors that influence its development and to create models for studying and forecasting the productivity and economic efficiency of Bulgarian agriculture. (TodorovT., Tsanova S., Hristova M. 2011; Uzunova, R.& Atanasov D. 2017; Beluhova-Uzunova R., Atanasov D., Hristov K. 2017).

The aim of the study is to assess the influence of leaf fertilizers on the quality grain composition of two varieties of common wheat and to determine by correlation analysis the nature of the dependence between grain quality and the nutritional value of feed for ruminants and not ruminants.

2. Materials and Methods

For the purpose of the survey are used a data from a field experiment, drawn from the field of Trakia University, Agricultural Faculty, Stara Zagora, Bulgaria. The trials are staked on three fractions. In the period 2015-2016, in two varieties of common wheat, leaf fertilizers, imported alone and in combinations, were tested in the field.

Objects of the scientific experiment are Lactifrost, Lactofol baze and Wuxal Grano. Table 1 presents the content of micro and macroelements in the test liquid fertilizers. The variants on which the study was conducted are the following:1. Without fertilization, 2. Ammonium nitrate (N_{14}); 3. Lactifrost - l l/da; 4. Lactifros + Lactofol base - 1.0 l/da + 0.5 l/da; 5. Lactofol base - 0.5 l/da; 6. Wuxal Grano - 0,400 l/da; 7. Wuxal Grano - 0.400 l/da + 0.200 l/da. Except for the factors tested, the remaining agro-technological practices were carried out according to the common wheat technology adopted for the region.

Table 1. Content of Macro and Micro Elements in Leaf Fertilizers

Foliar fertilizers	**gram liter^{-1}**					**mg liter^{-1}**				
	N*	**P_2O_5**	**K_2O**	**SO_3**	**MgO**	**B**	**Cu**	**Mn**	**Mo**	**Zn**
Lactofol base	101	29.4	50.9	1.36	-	305	203	226	23	452
Lactifrost	13.8	42.4	37.9	2.12	-	477	106	106	2120	64
Wuxal Grano	219	-	-	365	29	-	0.0043	0.0043	-	0.0146
* NO_3-N + NH_4-N + NH_2-N (g l^{-1}): 22.6 and 13.8 + 11.3 and 6.4 + 67.8 + 0,3										

The field experiment includes two varieties of common wheat - Diamond (by the varietal list of Bulgaria) and Ingenio (Syngenta). The chemical analysis of grain is done by the method Weende.Is definitelythe content of the crude protein (CP), crude fiber (CF), crude fat (CFAT), digestible ether extract (DEE), minerals. The chemical analysis of grain is done by the method Weende. After determination of the qualitative composition the contents of FUM, FUG and PDI in ruminants and CE and OE in non ruminants by formula formulas (Todorov et al., 2004, 2007) are calculated:

GE = 0,0242 CP + 0,0366 EE + 0,0209 CF + 0,017 NFE

ME = 0,0152 DP + 0,0342 DEE + 0,0128 DCF + 0,0159 DNFEq=$\frac{ME}{GE}$

FUM = ME (0,075 + 0,039q)

FUG = ME (0,04 + 0,1q)

PDI = 1,11CP (1 - Deg) Dsi + 0,093 FOM
FOM = DOM - DEE - FP –FP-CP (1 - DEG)
FP = 250 – 0,5 DM
BPR = CP(Deg – 0,1) – 0145 FOM

Where: GE – gross energy; EE – ether extract; ME – metabolizable energy; NFE – nitrogen free extract; DP – digestible protein; E – digestible ether extract; DNFE – digestible nitrogen free extract; Deg– degradability of dietary protein in the rumen; FOM – fermentable organic matter; DOM – digestible organic matter; PDI – protein digestible in (small) intestine; Dsi– digestibility in small intestine

Digestibleenergy (DE) and metabolizable energy (ME) values for pigs and poultry were calculated using the equations (Todorov et al., 2004):

DEpg = 0,0242 DP + 0,0394 DEE+0,0184 DCF + 0,0170 DNFE
MEpg = 0,0210 DP + 0,0374 DEE+0,0144 DCF + 0,0171 DNFE
DEp = 0,0239 DP + 0,0398 DEE+0,0177 DCF + 0,0177 DNFE
MEp = 0,0178 DP + 0,0397 DEE+0,0177 DCF + 0,0177 DNFE

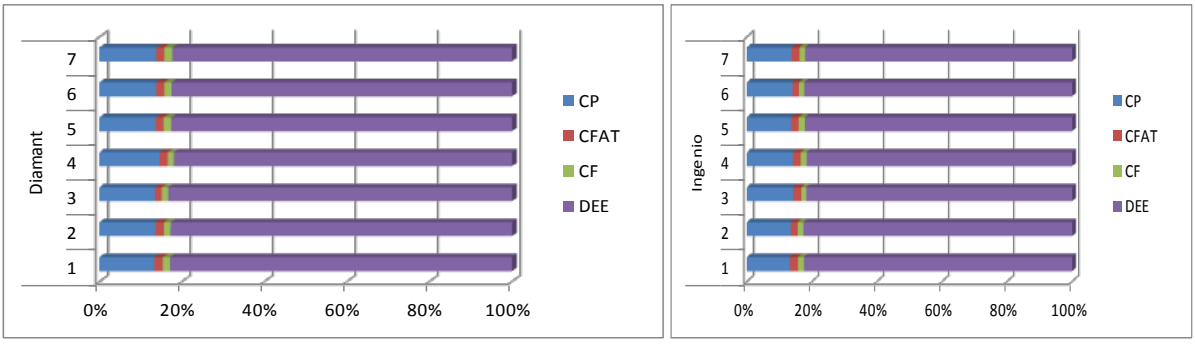
Experimental data were processed by a correlation analysis, which established and evaluated the relationship between the studied indicators. The same is expressed by the correlation coefficient r, determined through the statistical program SPSS 13.

The correlation dependencies are a product of the mathematical and statistical processing of Genchev's output data and others. (1975).

3. Results and Discussions

Protein value of feed is extremely important for their nutritional value. The protein value of the feed is related to the bioavailability of the protein contained there in. The analysis of the grain quality of the two varieties shows that the values crude protein crude fat, crude fiber and without nitrogenous extractsvary within narrow limits, under the influence of the applied liquid fertilizers. The boundaries in which the protein values of the various feeding variants with different leaf fertilizers are determined.

In the Diamond variety, the crude protein content ranges from 131.24 g/kg DMin the non-fertilizer control to 143.17 g/kg DMin the variant with the combined fertilization of Lactiftfost and Lactofol base. The increase of 9.1% shows the influence of fertilizers imported during tillering and ear formation in phenophase wheat. In Ingenio, an increase in crude protein levels was also observed, and the highest (139.76 g/kg DM) was recorded with Lactifrosts in the crop. Compared to non-fertilizer control, the increase was 7.8%.



a) Diamond b) Ingenio

Figure 1. Chemical Composition of the Grain in Two Variety Common Wheat, DM

Crude fiber content in the diamond varies, while the control values have been higher (16.0%) compared to embodiment 4. In Indzhenio crude fiber content varies in the range of 15.25 - 18.72 g/kg DM. Crude fiber lower digestibility of the feed and thus reduce the nutritional value. As seen from the attached diagram largest share is the content of DEE in both wheat varieties.

The energy and protein feed of ruminant wheat was evaluated in 1 kg of dry matter. The feed energy feed is a major indicator of the nutritional value of feed and is measured by gross energy, digestible energy, exchange energy and net energy.

In ruminants, there are two units of energy nutrition assessment: blood growth units (FUG), blood units for milk (FUM). Protein nutrition is determined by the amount of protein truly digestible in the intestine - digestible protein (PDI). This indicator takes into account the contribution of feed to meet the animal's protein needs. The crude protein shows the potential protein feed of the feed but does not take into account the quality of the protein.

After the treatment and analysis, the variance of the studied parameters was determined under the influence of the fertilizer introduced during the vegetation. The data shows a slight variation of FUM and FUG for both wheat varieties. At PDI again, the movement in the narrow range 102.38-104.14 g/kg DMfor Diamond and 101.49-103.3 g/kg DMat Ingenio was again reported. Slight variation indicates that fertilizing with liquid leaf fertilizer does not contribute to increasing the nutritional value of feed.

Table 2. Energy and Protein Value of Common Wheat for Ruminants, for Pigs and Poultry in 1 кgDM

		Ruminant Animals			**Non Ruminant Animals**			
		FUM	**FUG**	**PDI**	**DEp**	**MEp**	**DEpg**	**MEpg**
Diamant	1	1.48	1.65	102.38	15.91	15.27	16.50	16.20
	2	1.48	1.65	102.67	15.92	15.26	16.52	16.20
	3	1.47	1.64	102.81	15.87	15.22	16.45	16.15
	4	1.47	1.63	104.14	15.95	15.25	16.55	16.21
	5	1.47	1.64	102.66	15.87	15.21	16.47	16.15
	6	1.47	1.64	102.87	15.89	15.23	16.49	16.18
	7	1.47	1.64	102.92	15.86	15.20	16.46	16.15
Ingenio	1	1.48	1.65	101.49	15.89	15.26	16.50	16.19
	2	1.48	1.65	102.31	15.90	15.25	16.50	16.19
	3	1.48	1.64	103.27	15.98	15.29	16.59	16.26
	4	1.47	1.63	102.95	15.91	15.23	16.52	16.19
	5	1.48	1.64	102.59	15.91	15.26	16.53	16.21
	6	1.47	1.64	103.30	15.91	15.24	16.51	16.18
	7	1.48	1.65	102.58	15.94	15.28	16.55	16.23

A different approach has been adopted with pigs and poultry. For the pigs, the CE content is measured, which is measured in MJ/kg of feed. For the birds are assessed for OE content, the unit of measurement being the same as for pigs -MJ/kg. In the determination of digestible and exchange energy in non-ruminants again the slight variation of the values obtained is again impressed. Digestive energy values for pigs range from 15.87 to 15.95MJ/kg for diamond and 15.89 to 15.98MJ/kg for Ingenio.

The exchange energy for pigs is calculated and its values range from 15.24 to 15.29MJ/kg for both varieties. The digestible energy in birds has been found to be higher in pigs. The ranges of variation are narrow and are within 16.45-16.59MJ/kg for the two studied varieties. The trend for higher bird values is also maintained when determining the levels of exchange energy. The parameters for the exchange energy for birds 16.15-16.26MJ/kg have been established.

Following correlation analysis of the studied wheat varieties, a very high correlation (r = 0.979) between CP and PDI in the Diamond variety (Table 3) was found. We have a negative correlation between CP and FUG (r = -0.815), also between DEE and PDI (r = -0.755).

Mathematically unproven are the correlation relationships between CRAF, CF and the other indicators considered.

Table 3. Correlation Coefficients between the Chemical Composition of the Grain of Wheat, Energy and Protein Nutritional Value of Wheat Variety in Diamant for Ruminants, 2015-2016

	CP	CFAT	CF	DEE	FUM	FUG	PDI
CP	1						
CFAT	0.150	1					
CF	-0.387	0.180	1				
DEE	-0.866*	-0.459	-0.077	1			
FUM	-0.426	0.549	-0.181	0.378	1		
FUG	-0.815*	0.329	0.204	0.649	0.849*	1	
PDI	0.979**	-0.033	-0.497	-0.755*	-0.478	-0.858*	1

A negative correlation was observed between CF and DEp, MEp, DEpg and MEpg (r =- 0.600 ÷ 0.741). The relationship between CP, CFAT and exchange and digestible energy in non-ruminants is not mathematically proven.

Table 4. Correlation Coefficients between Wheat Grain Chemistry, Energy and Protein Nutrition of Wheat in Variety Diamant for non Ruminants - 2015-2016

	CP	CFAT	CF	DEE	DEp	MEp	DEpg	MEpg
CP	1							
CFAT	0.150	1						
CF	-0.387	0.180	1					
DEE	-0.866*	-0.459	-0.077	1				
DEp	0.592	0.500	-0.741	-0.392	1			
MEp	0.040	0.520	-0.635	0.109	0.820*	1		
DEpg	0.649	0.625	-0.600	-0.540	0.976**	0.744	1	
MEpg	0.406	0.641	-0.625	-0.288	0.953**	0.913**	0.935**	1

After the correlation analysis of the studied common wheat varieties, a high correlation correlation (r = 0.944) between CP and PDI in the Ingenio variety was found. A high positive value of r = 0.763 is reported between DEE and FUG. We have a negative correlation correlation between CP and DEE and FUG (r = -0.758, r = -0.760).

Table 5.Correlation Coefficients between the Chemical Composition of the Grain of Wheat, Energy and Protein Nutritional Value of Wheat Variety in Diamant for Ruminants, 2015-2016

	CP	CFAT	CF	DEE	FUM	FUG	PDI
CP	1						
CFAT	-0.121	1					
CF	-0.585	0.037	1				
DEE	-0.758*	-0.457	0.319	1			
FUM	-0.283	0.304	0.086	0.326	1		
FUG	-0.760*	0.082	0.137	0.763*	0.563	1	
PDI	0.944**	-0.403	-0.553	-0.507	-0.218	-0.651	1

Mathematically unproven are the correlation relationships between CFAT, CF and other indicators considered. (Table 5.)

Table 6. Correlation Coefficients between the Chemical Composition of the Grain of Wheat, Energy and Protein Nutritional Value of Wheat Variety in Diamant for non Ruminants, 2015-2016

	CP	CFAT	CF	DEE	DEp	MEp	DEpg	MEpg
CP	1							
CFAT	-0.121	1						
CF	-0.585	0.037	1					
DEE	-0.758*	-0.457	0.319	1				
DEp	0.660	0.313	-0.674	-0.501	1			
MEp	0.010	0.512	-0.316	-0.002	0.748	1		
DEpg	0.619	0.419	-0.532	-0.539	0.978**	0.775*	1	
MEpg	0.396	0.522	-0.442	-0.376	0.931**	0.898**	0.964**	1

The correlation analysis of the surveyed indicators indicates that dependencies are unproven in the Ingenio variety. There is a negative relationship between CF and DEp (r = -0.674). Positive correlation dependence (r = 0.660) between CP and DEp, as well as between CP and DEpg (r = 0.619) was found.

4. Conclusion

As a result of the present experiment, crude protein content ranged from 131.24-143.17 g/kg DM in the Diamond variety and 129.45 to 139.76 g/kg DM of the Ingenio variety.

Treatment of common wheat with liquid leaf fertilizers does not contribute to increasing the FUM, FUG and PDI content.

It is establish a very high positive correlation dependence with coefficient of correlation r = 0.979 between CP and PDI of the Diamond variety and r = 0.944 of the Ingenio variety was found.

The results of the present study show that the use of leaf fertilizers is not justified economically. The analysis of the nutritional value of the grain that the influence is insignificant. The cost of feeding wheat only increases its cost without contributing to an increase in protein nutrition, energy nutrition.

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