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NUTRITION VALUE OF TWO GRAIN COMMON WHEAT

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Abstract

The research was conducted during 2011 - 2014 in the experimental field of the Department of Plant Production in Agriculture Faculty at Trakia University, Stara Zagora, Bulgaria. In this study has examined the nutritional value of two common wheat: Diamond (by the varietal list of Bulgaria) and Bologna (Syngenta). Comparative analysis of grain varieties and options of treatment of crops with some herbicides and herbicidal compositions and was made. The results of these variants were analyzed: 1. Control - no treatment; 2. Axial one - 1000 ml/ha; 3. Lintur +Traksos 150 g/ha+1200 ml/ha - a tank mix; 4. Logran+Traksos 37.5 g/ha +1200 ml/ha - a tank mix; 5. Lintur +Axial 150 g/ha+900 ml/ha - tank mixture and 6. Logran +Axial 37.5 g/ha+900 ml/ha - tank mixture. At the varieties Diamond and Bologna has been found that after treatment with the herbicides content of the crude protein for the period of the field study is moving in the range of 153.5 - 169.4 g/kg DM variety Diamant and from 156.9 to 158.7 g/kg DM for variety Bologna. Products for weed control does not significantly affect the content of FUG and FUM in two varieties of grain wheat. Analysis of regressions showed high positive correlation between PDI and CP in two varieties (r = 0.94-0.99) for the entire study period. Significantly higher the correlation between FUG and DEE. Data analysis for the content of intestinal digestible protein (PDI) show that the herbicide does not affect the levels of PDI in the grain.

Key words*: common wheat, herbicides, protein digestible in (small) intestine (PDI), feed unit for growth (FUG), correlation coefficient of Pearson (r).*

INTRODUCTION

Productivity of the varieties and grain quality indicators are important in zoning the most suitable varieties for different regions. On one hand, the stability of yields and high quality parameters indicate the stability of the variety, but on the other hand, they are an indicator for the level of environmental plasticity.

Atanasova et al. (2010) found that the proportion of the genetic potential is 25% at 22 varieties of common wheat, and 35% is the phenotypic expression of each indicator.

The stability of varieties is important, but in practice plasticity is the result of interaction with growing conditions. In the case of wheat, it is decisive, because it has a long vegetation period, with different voltage climatic elements (Sharma et al., 2010).

The main criteria in the selection of varieties are resistance to abiotic and biotic stress, combined with high productive potential and grain quality. (Panayotov et al., 2004; Yanchev et al., 2012).

Technology of cultivation has influence on the quality parameters at varieties. Along with a high level of agro equipment, including optimal terms for sowing, balanced fertilization, proper tillage and others, significant influence has the weed control (Ivanova et al., 2009; Ilieva, 2011).

The biological characteristics of the variety, such as height, cold tolerance, viability, significantly affect the competitive ability against weeds.

The productivity of varieties of wheat and grain quality depends at a great extent on the efficiency of applied resources to combat weed infestation (Chhokar et al., 2007; Dixit et al., 2011; Khan et al., 2011; Delchev, 2012; Delchev et al., 2014; Stoyanova et al., 2015).

The study aims, by using correlation analysis, to evaluate the relationship between the chemical composition of the wheat grain, energy and protein nutritional value of wheat for ruminants, typical of the two varieties of common wheat, which are changed under the influence of the applied herbicide combinations (Zijlstra et al., 1999).

MATERIALS AND METHODS

This study investigated the nutritional value of two varieties of common wheat - Diamond and introduced variety Bologna. Experience was set by the method of fractional land in educational-experimental field of the Plant-growing Department at the Agricultural Faculty of Trakia University. The soil of the experimental field was characterized as meadow cinnamon. Experiment was conducted during the period of 2011-2014. With the result of the harvested grain from the three agricultural seasons, it was made an analysis of the chemical composition of the grain for both common wheat varieties.

It was made a comparative analysis of grain varieties and options of treatment of crops with some herbicides and herbicide mixtures. The results of the following variants were analyzed: 1. Control - no treatment; 2. Axial one - 1000 ml/ha; 3. Lintur +Traksos 150 g/ha + 1200 ml/ha - a tank mix; 4. Logran + Traksos 37.5 g/ha + 1200 ml/ha - a tank mix; 5. Lintur + Axial + 150 g/ha + 900 ml/ha - tank mixture and 6. Logran + Axial 37.5 g/ha + 900 ml/ha - tank mixture.

Besides the mentioned herbicides for weed control in the cultivation of the crop, it was applied a technology, which is standard for the area.

Chemical analysis of grain was done by the method Weende. Is definitely the content of the crude protein, crude fibre, crude fat, minerals, nitrogen free extract. By the formulas of Todorov and others (2004, 2007) it was calculated the content of FUG, FUM and PDI in ruminants.

$$GE = 0{,}0242\ CP + 0{,}0366\ EE + 0{,}0209\ CF + 0{,}017\ NFE$$

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

$$q = \frac{ME}{GE}$$

$$FUM = ME\ (0{,}075 + 0{,}039q)$$

$$FUG = ME\ (0{,}04 + 0{,}1q)$$

$$PDI = 1{,}11CP\ (1 - Deg)\ Dsi + 0{,}093\ FOM$$

$$FOM = DOM - DEE - FP - CP\ (1 - P\Pi)$$

$$FP = 250 - 0{,}5\ DM$$

Statistical analysis: Using correlation analysis, it was identified and evaluated the correlation between survey indicators expressed by the coefficient of linear correlation of Pearson (r). Correlations are the product of mathematical and statistical processing of the output data on Genchev et al. (1975).

Mathematical data processing was carried out with the statistical program SPSS 13.

RESULTS AND DISCUSSIONS

Energy and protein nutritional value of forage is determined by their ability to meet animals' needs for energy and protein. Energy content in forage is crucial for the productivity of livestock. In ruminants, because of the different energy recovery from forage for lactation and growth, two indicators are used - feed unit for milk (FUM) and feed unit for growth (FUG).

Analysis of the results showed higher crude protein content in grain in the first experimental year. The content of crude protein moved within 153.5 - 169.4 g/kg DM for Diamond variety; from 156.9 to 158.7 g/kg DM for Bologna variety (Table 1). The average crude protein content in Diamond was 158.95 g/kg DM, while for Bologna it was 157.7 g/kg DM. Average for the varieties of crude protein content, in Diamond it was higher only 0.8% of the content recorded for variety Bologna. With respect of treatment options, in both wheat varieties were measured higher values of crude protein in the untreated form. Differences in options vary in a narrow range. In the second year, compared to the first year, results in Bologna variety were significantly lower for all options (Table. 2).

The chemical composition of grain is genetically determined, but is also influenced by the level of applied agricultural equipment.

GE – gross energy
ME – metabolizable energy, MJ/kg
CP – crude protein
DP – digestible protein
EE – Ether extract
DEE – digestible ether extract
CF – crude fibre
DCF – digestible crude fibre
NFE – nitrogen free extract
DNFE – digestible nitrogen free extract
Deg– degradability of dietary protein in the rumen
FOM – fermentable organic matter
DOM – digestible organic matter
FP – silage fermentable products

Table 1. Chemical composition of the grain of common wheat, g/kg DM, 2012

Variety	Variant	CP	EE	CF	NFE
Diamant	1	153.50	11.10	12.60	803.50
	2	158.00	11.90	13.90	797.30
	3	169.40	11.60	15.30	782.90
	4	157.00	10.60	14.20	799.00
	5	160.30	9.70	15.50	794.50
	6	155.50	10.90	16.30	798.20
Bologna	1	156.90	11.60	11.20	802.00
	2	157.60	12.30	10.80	801.30
	3	157.10	14.30	12.00	797.70
	4	158.20	13.20	10.80	798.50
	5	157.70	13.60	12.50	796.50
	6	158.70	12.98	11.10	797.80

Table 2. Chemical composition of the grain of common wheat, g/kg DM, 2014

Variety	Variant	CP	EE	CF	NFE
Diamant	1	136.30	12.40	12.90	822.50
	2	135.20	12.10	14.40	823.50
	3	142.10	14.20	15.60	809.70
	4	152.70	15.70	14.20	798.60
	5	159.30	13.40	12.50	798.20
	6	157.90	16.10	13.60	797.70
Bologna	1	115.40	13.70	13.00	841.90
	2	110.80	14.70	12.70	845.30
	3	118.30	14.60	12.20	839.70
	4	108.70	14.90	12.50	849.30
	5	111.30	12.60	12.90	848.80
	6	108.70	12.80	12.10	852.40

Table 3. Energy and protein value of wheat for ruminants in 1 кg DM

Variety	Variant	2011-2012			2013-2014		
		FUM	FUG	PDI	FUM	FUG	PDI
Diamant	1	1.45	1.61	106.21	1.47	1.64	103.84
	2	1.44	1.60	106.80	1.47	1.64	103.75
	3	1.43	1.58	108.31	1.46	1.62	104.25
	4	1.44	1.60	106.73	1.45	1.61	105.69
	5	1.44	1.59	107.19	1.45	1.61	107.10
	6	1.44	1.60	106.43	1.45	1.61	106.80
Bologna	1	1.45	1.61	106.80	1.49	1.67	100.62
	2	1.45	1.61	106.88	1.49	1.67	99.82
	3	1.45	1.61	106.52	1.49	1.67	101.06
	4	1.45	1.61	106.77	1.49	1.68	99.66
	5	1.45	1.60	106.58	1.49	1.68	10.25
	6	1.45	1.60	106.85	1.49	1.68	99.91

FUM – feed unit for milk (= 6 MJ net energy for lactation)
FUG – feed unit for growth (= 6 MJ net energy for growth)
PDI – protein digestible in (small) intestine

Agro-climatic characteristics of the region during the growing season have an important role in the formation of grain. It is scientifically proven that the influence of rainfall on the level of crude protein is significant (Delibaltova al. 2014). A reverse correlation was proven between these two factors, i.e. at a higher amount of precipitation, grain is formed with a lower crude protein content.

As a result of treatment with certain herbicides, it was reported a slight variation of the content of nutrition. In Diamond variety the content of FUM in 1kg DM in wheat grain was in the range of 1.43 to 1.45 1 kg DM in the first year FUM, and 1.45 to 1.47 1 kg DM FUM in the second year. The values of FUG moved in the range 1.58 - 1.61 1 kg DM in the first year, and 1.61 - 1.64 1 kg DM in the second year, respectively. In variety Bologna content of FUM and FUG in 1kg DM in wheat grain was 1.45 in the first year, and 1.49 1 kg DM in the second year, and was moving in the range 1.60 - 1.61 in the first year, and 1.67 - 1.68 1 kg DM in the second year. The results showed very weak influence of the applied herbicide during the crop vegetation.

The data for the content of PDI (Table. 3) showed that the applied methods of crop treatment did not affect the content. For Diamond variety it moved within 106.2-107.3, 1 kg DM for the agricultural period 2011-2012 and 103.8-107.1, 1 kg DM for the agricultural period 2013-2014. For variety Bologna again it was registered insignificant influence of the applied products for weed control.

Table 4. Correlation coefficients between the chemical composition of wheat grain, energy and protein nutritional value of wheat variety Diamond – 2012

	CP	EE	CF	NFE	FUG	PDI
CP	1					
EE	0.19	1				
CF	0.40	-0.31	1			
NFE	-0.99**	-0.20	-0.51	1		
FUG	-0.96**	-0.03	-0.62	0.97**	1	
PDI	0.99**	0.15	0.39	-0.98**	-0.96**	1
*,**- P<0.05, P< 0.01, respectively						

After the correlation analysis, the studied varieties of common wheat identified a high positive correlation PDI with the CP (r = 0.99, P<0.01) in Diamond variety for 2012. NFE was significantly correlated with FUG (r = 0.97, P<0.01). Fodder units for growth are negatively correlated (r = -0.62, P<0.01) with CF (Table 4).

Table 5. Correlation coefficients between the chemical composition of wheat grain, energy and protein nutritional value of wheat variety Bologna-2012

	CP	EE	CF	NFE	FUG	PDI
CP	1					
EE	0.15	1				
CF	-0.32	0.61	1			
NFE	-0.45	-0.87*	-0.64	1		
FUG	-0.58	-0.24	-0.45	0.64	1	
PDI	0.39	-0.79	-0.88*	0.64	0.09	1

The analysis of indicators in variety Bologna in 2012 established a lower degree of correlation PDI (r = 0.39, P <0.05) with CP and between FUG and NFE (r = 0.64 P <0.05).

The analysis of indicators set a degree of negative correlation of crude fibre (CF) (r = -0.88, P<0.05) with FUG (r = -0.45, P<0.05) (Table 5).

Table 6. Correlation coefficients between the chemical composition of wheat grain, energy and protein nutritional value of wheat variety Diamond-2014

	CP	EE	CF	NFE	FUG	PDI
CP	1					
EE	0.71	1				
CF	-0.37	0.18	1			
NFE	-0.97**	-0.83*	0.15	1		
FUG	0.95**	0.71	-0.42	0.92*	1	
PDI	0.99**	0.62	-0.47	-0.91*	0.94**	1

In the second year, in Diamond variety it was established again a high positive correlation of the PDI with the crude protein (CP) (r = 0.99, P<0.01), and in correlation with the FUG (r = 0.95, P<0.01), and significantly with NFE (r = 0.92, P<0.01).

Correlation coefficients, calculated in variety Bologna for 2014, showed quite different results from those of the same variety in 2012.

With high positive significant correlation is the PDI and CP (r = -0.94, P <0.01) and significant with the (r = 0.94, P <0.01), NFE was a significant positive correlation with a correlation forage unit for growth (FUG) (r = 0.89, P <0.05). Crude fibre are significant negative correlation with FUG (r = -0.20, P<0.05) (Table. 7).

Table 7. Correlation coefficients between the chemical composition of wheat grain, energy and protein nutritional value of wheat variety Bologna-2014

	CP	EE	CF	NFE	FUG	PDI
CP	1					
EE	0.21	1				
CF	0.08	-0.12	1			
NFE	-0.93**	-0.47	-0.21	1		
FUG	-0.75	-0.49	-0.20	0.89*	1	
PDI	0.94**	-0.03	-0.00	-0.81	-0.57	1

The analysis of correlations showed high positive correlation between PDI and CP for the two varieties (r=0.94-0.99) for the entire study period.

There was significantly high correlation dependence between NFE and FUG. For the whole period it was identified negative correlation between indicators FUG and CF.

CONCLUSIONS

The content of crude protein average for the period of the field study moved within 153.5 - 169.4 g/kg DM for variety Diamond and from 156.9 to 158.7 g/kg DM for variety Bologna.

Products for weed control did not significantly affect the content of FUM and FUG in the grain of the two wheat varieties.

Data analysis shows that the herbicides do not affect the levels of the PDI in the grain.

Correlation analysis shows a positive correlation between FUG and NFE (r = 0.64 - 0.97, P <0.01), PDI and CP in two varieties (r = 0.39 - 0.99, P <0.01) for the study period.

Crude fibre are significant negative correlation with FUG (r = -0.20 - 0.62, P<0.05).

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