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Research of some Corn from the EU and the Region in the Agroecological Conditions of Peja Region, Kosovo

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Abstract: The research of six hybrids corn F1 from the EU (France, Croatia) and the region (Serbia) were investigated during the 2015 season, comparing hybrids with their characteristics belonging to FAO groups on one side and conditions agro-climate of Kosovo on the other side. The research was conducted in the most important production area in Kosovo. In the research campaign of IBK (Peja Agricultural Institute) where they passed and controlled the hybrids during the vegetation until the harvest production, then the yield obtained from the hybrids plots we analyse the parameters in investigation: moisture content, protein content, fat content etc. The obtained result showed that statistically significant differences existed between corn hybrids compared to standard control. Statistically significant differences were observed between hybrids.

Keywords: *Corn, fat content, moisture content, plant, protein content,*

Introduction

Zea mays L.*,* is one of the most important crop cultivated in the Kosovo. In Kosovo, the areas planted with this crop reach about 80,000 ha each year, accounting for about 32.27% of the agricultural land (Fetahu, 2009). Over the centuries there has been a plant known as the main base of bread cereals. Production and sub-productions are used as feed for livestock and industrial needs. Corn yields give high yields for a relatively short time (3-4 months and a half). It is a crop that is very suitable for crop rotation. The high yield achieved for the surface unit spilled the work and the investments. Corn contains some unsubstituted amino acids such as lysine, tryptophan, methionine, etc, which increase the value of corn grain. It is used as a concentrate, silage on the eve of baking roasting, as it is in the milk stage. One kilogram of grain corn produces 3864 calories and is equivalent to 1.34 food units. It is estimated that 100 kg of silage prepared from corn along with the ears, in the dairy stage contains 21 food units, harvested in the wax stage with 30-35% moisture in the grain has 26 food units, while harvested on the eve of bloom has 18 food units (Darko et al., 2010).

Materials and Methods

Field experiments was carried out in a Kosovo agro-ecological region (Dukagjin plain) in Arbnesh, on the farm of the Kosovo Agricultural Institute in Peja, during 2010. For research was used a hybrid grain of corn F1 generation with variety of maturity groups according to FAO classification. The planting is carried out in three replications according to the system of randomized blocks. The grain origin is from some hybrid grain production companies from France, Croatia and Serbia. The number of researched hybrids was 5 and 1 standard hybrid as control (Andris et al., 2006).

The basic work of the soil was carried out in the autumn of 2009, whereby the basic fertilization was done with NPK fertilizer (15:15: 15) in a quantity of 300 kg / h. The preparation of sowing areas was done in Spring 2010. Pre-culture has been wheat.

Planting was carried out on April 15 th, thinning was done by hand on June 17, 2010, fertilization with nitrogen fertilization was done at the pre-flouring stage with NAG (27% N) in a quantity of 200 kg / ha. Harvest was completed by hand on October 17, 2010. From each plot, the two middle rows are picked, and the samples are labelled from which the researched parameters for each hybrid are determined.

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Table 1. The origin and characteristics of researched genotypes

Nr.	GenotypeHybrid[a] F1	Origin of genotypes[b]	Classification by FAO	The distance of planting and the number of plants per ha
1.	DKC 6574	France	delayed	30 x 70 – 51.300
2.	DKC 5143	France	delayed	30 x 70 – 51.300
3.	DKC 6677	France	delayed	30 x 70 – 51.300
4.	OS 515	Croatia	delayed	30 x 70 – 61.300
5.	OS 430	Croatia	medium	25 x 70 - 57.100
6.	Standard NS 444	Serbia	medium	25 x 70 - 57.100

[a] Genotype hybrids; DKC 6574, DKC 5143, DKC 6677, OS 515, OS 430 and Standard NS 444. [b]Origin of genotypes hybrids; France, Croatia and Serbia.

The geographic position of the locality

Peja is located at 42° 56 'of the geographic latitude and 20° 30' of the longitude at an altitude of 490 m. In the plain of Dukagjini (Peja) dominates the continental climate which is influenced by the mediterranean climate, which penetrates through the Drini i Bardhë valley. The coldest month is January and is the only month with monthly air negative average temperature. The hottest months of the year are July and August, meanwhile the average temperature for the period is 13.5°C.Rainfall in the Peja region during 2010 was 657.7 mm, respectively during vegetation fell to 247.90mm (37.7%) of the total amount. Rainfall in the Peja region during 2010 was 657.7 mm, respectively during vegetation fell to 247.90mm (37.7%) of the total amount.

Results and Discussion

Plant height

The height of the plant is a very important parameter and is the direct determinant of the production of biomass used for animal feed (Salillari et al., 2000).

From the data in Table 1, the height differences between hybrids were different, but these differences are not large because among the six hybrids that were the subject of research, five of them belonged to the 500-600 maturity group. The maximum value for the plant's height was reached by the hybrid of Croatia OS 515 with an average plant height of 263.3 cm, while the minimum plant height had hybrids from France DKC 6574 with a height of 226.6 cm.

When comparing the maximum and minimum hybrid values with the standard hybrid plant height, it appears that the maximum hybrid value is only 5 cm in comparison to the standard hybrid, whereas the hybrid with the minimum value is apparently smaller than the standard hybrid with a difference of 31.7 cm. It is generally noticed that hybrids from France showed a lower plant height of an average of 238.7 cm compared to the average height of hybrid plants from Croatia with a value of 256.6 cm. Meanwhile, the total plant height average was 247.9 cm.

Table 2. Plant height, corn ear height and number of earper plant in researched corn hybrids

No	Hybrid	Plants height, cm	The height of the first corn ear, cm	The number of corn ears in plants	Vegetative period according to FAO
1	DKC 6574	226.6	96.6	1.15	Delayed
2	DKC 5143	246.6	110.0	1.10	Delayed
3	DKC 6677	243.0	103.3	1.15	Delayed
4	OS 515[a]	263.3	113.3	1.25	Delayed
5	OS 430[b]	250.0	103.3	1.15	Medium
6	NS 444	258.3	110.0	1.15	Medium

Hybrids from Croatia OS 515[a], OS 430[b] are significantly more suitable by achieving a biomass value than hybrids from France DKC 6574, DKC 5143, and DKC 6677.By table 2 it can be ascertained as to the value of biomass, hybrids from Croatia are significantly more suitable by achieving a biomass value than hybrids from France. While among the hybrids from Croatia, the hybrid OS 515 should be distinguished, which was also shown superior to the standard hybrid. Therefore, this hybrid can be preferred to farmers of this region to cultivate it to ensure the maximum amount of biomass per unit of surface.

The height of placement of the first corn ear on the stalk

The height of the placement of the first corn ear on the stalk is a genetic feature of each hybrid and has a particular importance in adapting the mechanized harvest (Watson, 1964). The lowest value of the placement of the first corn ear on the stalk was in the French hybrid DKC 6574 with a height of 96.6 cm, while at the Croatian hybrid OS 515 the height of the placement of the first corn ear was 113.5 cm. The difference between hybrids at lower altitude than the first row and the one with the highest altitude of the plaice is 16.9 cm. The difference between hybrids with the lower height of corn ear placement and the one with the highest height of corn ear placement is 16.9 cm. Compared to the minimum and maximum value of the placement of the first corn ear with the standard hybrid value it emerges that the hybrid from Croatia OS 155 had a height of 3.3 cm higher than the standard hybrid NS 444 and the hybrid from France DKC 6574 had a height of 13, 4 cm lower than the standard hybrid. Also the number of corn ears for plants has been different. The number of corn ears for plants was the highest at the cultivar from Croatia OS 515 with the value of 1.25 and the smallest was hybrid from France DKC 5143 with a value of 1.10 while at the standard cultivar the value of the number of corn ears per plant was 1.15.

Corn ear features

From Table 2 it can be seen that the greatest length of the corn ear was in the OS 430 and DKC 6574 hybrids by 22 cm, while the smallest length of the corn ear was at the hybrid DKC 5143 with a length of 18cm. While the number of good traffic was good, there was a hybrid from Croatia OS515 and one from France with a number of 45 and 42 respectively. The number of circles in traffic was the largest at two French hybrids DKC 5234 and DKC 6677 with a value of 16, respectively 15.

Table 3. Some parameters of the corn ear as well as the moisture at harvest time of the researched hybrids

Hybrid	The height of the ear corn (cm)	Number of circles in corn ear	Number of rows in the corn ear	Moisture at harvest time
DKC 6574	22	38	14	17.9
DKC 5143	18	34	16	18.6
DKC 6677[a]	20	42	16	19.5
OS 515	20	45	14	18.2
OS 430	22	41	14	17.9
NS 444	20	38	14	18.4

The best harvest index was hybrid from Croatia OS 430 and hybrid from France DKC 6677[a].

Table 4. The values of some parameters in the corn ear and harvest index of the researched hybrids

Hybrid	$\overline{X}$ of corn ear weight (gram)	$\overline{X}$ Of grain weight in corn ear (gram)	$\overline{X}$ Weight of the corn cob (gram)	Corn ear index
DKC 6574	268.76	211.08	57.68	0.78
DKC 5143	201.92	166.57	35.35	0.82
DKC 6677	301.17	257.80	43.96	0.85
OS 515	272.00	220.70	51.30	0.81
OS 430	250.10	213.90	36.20	0.85
NS 444	208.30	166.75	41.55	0.80

Table 4 shows the averages of 3 repetitions for all hybrids. Analysis of variance (ANOVA) were performed to analyse yield results. The grain harvest index represents the ratio between the weight of the grain and the total weight of the corn ear which varies from hybrid to hybrid (Borojevic, 1998).
In this case, the best harvest index was hybrid from Croatia OS 430 and hybrid from France DKC 6677 (Table 3). It should be noted that these two hybrids, although having the same harvest index, differ significantly between themselves, in terms of the weight of the grain in corn ear with a with a difference of 43.9 grams in favour of the hybrid from France. Also, if we compare the grain weight of this hybrid with the standard NS 444 of the hybrid, it is clear that the hybrid value of France DKC 6677 is significantly greater than the standard with a difference of 91.5 gram per corn ear. Therefore,

it can be concluded that this hybrid may be preferred for cultivation in the explored region if farmers are interested in achieving high yields of yeast grain per hectare.

Grain yield per unit area

Table 5 shows the averages of 3 repetitions for all hybrids. Analysis of variance (ANOVA) were performed to analyse yield results, where there were significant differences between the hybrids analysed (Table 5).

Table 5. Grain yield of researchedcorn hybrids in kg / plot

Hybrid	Yield (kg/researched plot) kg/ha			
	Repetition			Average
	I	II	III	
DKC 6574	19.50	18.20	19.20	18.97
DKC 5143	18.80	19.80	19.20	19.27
DKC 6677	19.40	18.80	18.30	18.83
OS 515	19.80	19.80	18.60	19.40
OS 430	18.90	18.20	18.90	18.67
NS 444	17.90	16.50	17.40	17.27

DMV 0.05 = 1.0692; 0.01 = 1.4990

Table 6. Analysis of variance for yield in researched hybrids

Source of variation	The degree of freedom	Quadratic amount	The quadratic average	F-Table
Treatment	5	8.8472	1.7694	4.899786*
Wrong	12	4.3335	0.3611	……..
Total	17	……..	……	……
Between treatments DMV 0.05=1.0692 0.01=1.4990		Overall average:18.7333 Standard plot error: 0.3470		

However, the Analysis of variance does not show that there are significant differences between the hybrid averages, and therefore the yield averages have been analysed by the Tukey HSD test to find that there is significant difference between the average hybrids for yields. (Brkiset al., 2006)

This is shown in Table 4, where there are significant differences only in the months of the NS 444 hybrid standard and the 3 researched hybrids (one from Croatia OS 515 and two hybrids from France DKC 5143 and DKC 6574), while between researched hybrids no significant difference has been observed. The highest yield was hybrid from Croatia OS 515, followed by hybrids from France DKC 5143 and DKC 6574. The lowest yield was therefore NS 444 hybrid standard (Figure 1). From this it can be concluded that all cultivated hybrids showed the highest performance value compared to the hybrid standard, while among the researched hybrids although there were no apparent differences and, the best performance was the hybrid from Croatia OS 515 and two hybrids from France DKC 5143 and DKC 6574.

Table 7. Tukey HSD test to find significant hybrid differences for yield

Hybrid	N	Subset	
	1	B	A
NS 444	3	17.2667	
OS 430	3	18.6667	18,6667
DKC 6677	3		18,8333
DKC 6574	3		18,9667
DKC 5143	3		19,2667
OS 515	3		19,4000
Significant		,066	,674

Means for groups in homogeneous subsets are displayed.

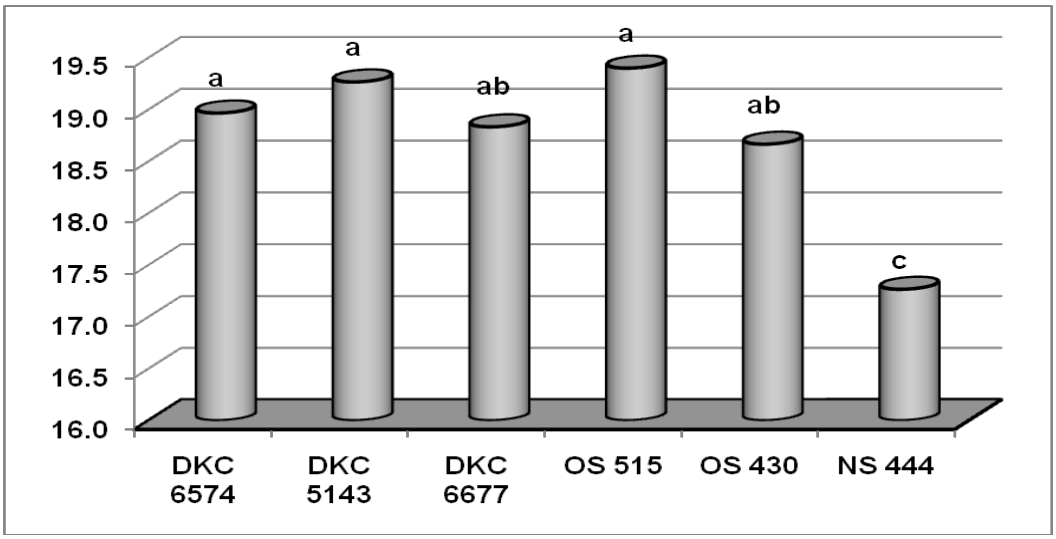

Figure 1. Graphic representation of hybrid averages for yields (the averages with the same letters do not have significant diff8Based on Type III Sum of Squares; The error term is Mean Square(Error) = ,361; a Uses Harmonic Mean Sample Size = 3,000; b Alpha = ,05.)

Protein content

The average protein content values are shown in Table 8. The results from ANOVA show that there are significant differences between errors in protein perception (Ottaviano & Camussi, 2008) (Table 10). The standard error of the experiment was 0, 265, while the standard error of the plot was 0.297. The overall protein content was 12.4%. According to the HSD Tukey test, there were significant differences between the hybrids of Croatia OS 515 and the Standard NS 444 hybrid, DKC 6574 and DKC 5143 hybrid. Thus, the highest protein content was to achieved by the hybrid of Croatia OS 515 with a protein content of 13.8%, followed by French hybrid DKC 6677 with a protein of 13.2%, while the hybrid standard had an average performance with a protein content of 12.3%. The lowest protein content has hybrids from France DKC 5143 with a percentage of 10.7 (Table 8).

Table 8. The content of proteins in the researched corn hybrids

Hybrid	Protein in %			
	I	II	III	Average
DKC 6574	11.1	12.0	11.2	11.43
DKC 5143	10.3	10.4	11.5	10.73
DKC 6677	13.4	12.5	13.8	13.23
OS 515	14.0	13.5	13.9	13.80
OS 430	13.0	12.5	13.4	12.97
NS 444	12.1	12.0	12.8	12.30

DMV 0.05 = 0.9168; = 1.2954

Table 9. The Analysis of variance for the protein content in researched hybrids

Source of variation	The degree of freedom	Quadratic amount	The quadratic average	F- table
Treatment	5	20.0911	4.0182	15.13203*
Wrong	12	3.1865	0.2655	……
Total	17	……..	…….	……
Between treatments		Overall average: 12.4111		
DMV 0.05=0.9168		Standard plot error: 0.2975		
0.01= 1.2954				

It is worth mentioning that the hybrid OS 515 from Croatia has shown a good enough performance both in yield and protein content, cultivated under the conditions of this region.

Table 10. Tukey HSD test to find significant differences in hybrids for protein content

Hybrid	N	Subset			
	1	D	C	B	A
DKC 5143	3	10,7333			
DKC 6574	3	11,4333	11,4333		
NS 444	3		12,3000	12,3000	
OS 430	3			12,9667	12,9667
DKC 6677	3			13,2333	13,2333
OS 515	3				13,8000
Significant		,577	,367	,297	,405

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = ,266.
a Uses Harmonic Mean Sample Size = 3,000.
b Alpha = ,05.

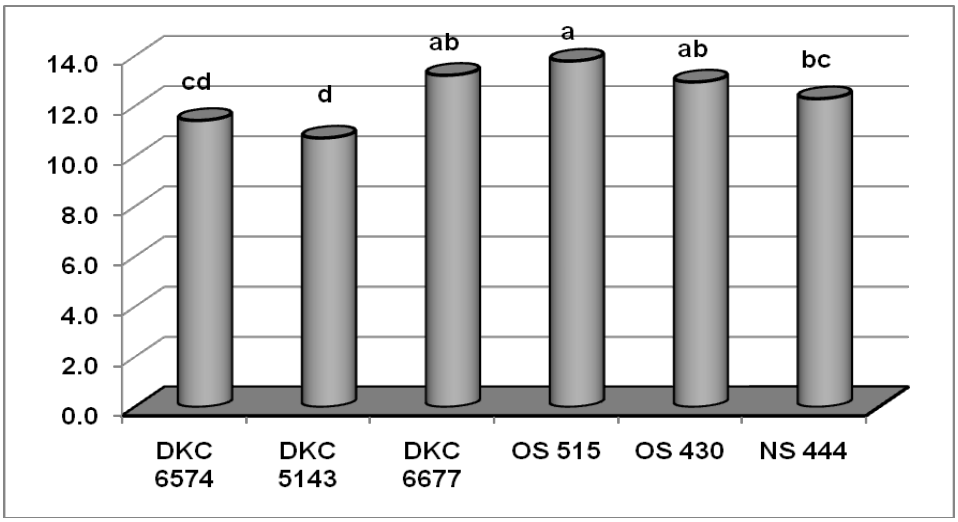

Figure 2. Graphical representation of hybrids averages for protein content (the averages with the same letters do not have significant differences)

Fat content

The arithmetic percentages of the fats content for all hybrids are given in table 12. As far as the fats content is concerned with ANOVA, it has been found that there are very significant differences between the researched hybrids (Brkis et al., 2006). The HSD Tukey test clearly demonstrates the significant differences between the two hybrids from France DKC 6677 and DKC 5143 with the standard hybrid and hybrid of Croatia OS 430 (Table 11). Thus a higher percentage of fat contains hybrid DKC 6677 with 5.07%, while the hybrid with lower fats content is the standard NS 444 hybrid with 3.5%. Low-fats percentage has had also the hybrid from Croatia OS 430 with 3.63% (Figure 3). It should be noted that even the hybrid OS 515 had a relatively high content of fats and differs only by 0, 4% from the higher content hybrid, whereas compared to standard hybrid, the difference is significant with a value of 1% in favour of the Croatian hybrid. (Abou Deif, 2007)

Table 11. Fat content in % of corn hybrids

Hybrid	Fat			
	I	II	III	Average
DKC 6574	4.5	4.2	4.6	4.43
DKC 5143	5.0	4.9	5.1	5.00
DKC 6677	5.1	5.2	4.9	5.07
OS 515	4.7	4.6	4.6	4.63
OS 430	3.8	3.2	3.9	3.63
NS 444	3.7	3.4	3.5	3.53

DMV 0.05 = 0.3607; 0.01 = 0.5058

Table 12. The Analysis of variance for the fatscontent inresearchedhybrids

Source of variation	The degree of freedom	Quadratic amount	The quadratic average	F- Tabelar
Treatment	5	6.5917	1.3183	32.06884*
Wrong	12	0.4933	0.0411	.....
Total	17	.....	.....	.....
Between treatments DMV 0.05=0.3607 0.01=0.5058		Overall average: 4.06884* standard plot error: 0.1171		

Table 13. Tukey HSD test to find significant differences in hybrids for fatscontent

hybrid	N	Subset		
	1	2	3	1
NS 444	3	3,5333		
OS 430	3	3,6333		
DKC 6574	3		4,4333	
OS 515	3		4,6333	4,6333
DKC 5143	3			5,0000
DKC 6677	3			5,0667
Significant		,989	,825	,166

Means for groups in homogeneous subsets are displayed; Based on Type III Sum of Squares; The error term is Mean Square(Error) = ,041; a Uses Harmonic Mean Sample Size = 3,000; b Alpha = ,05.

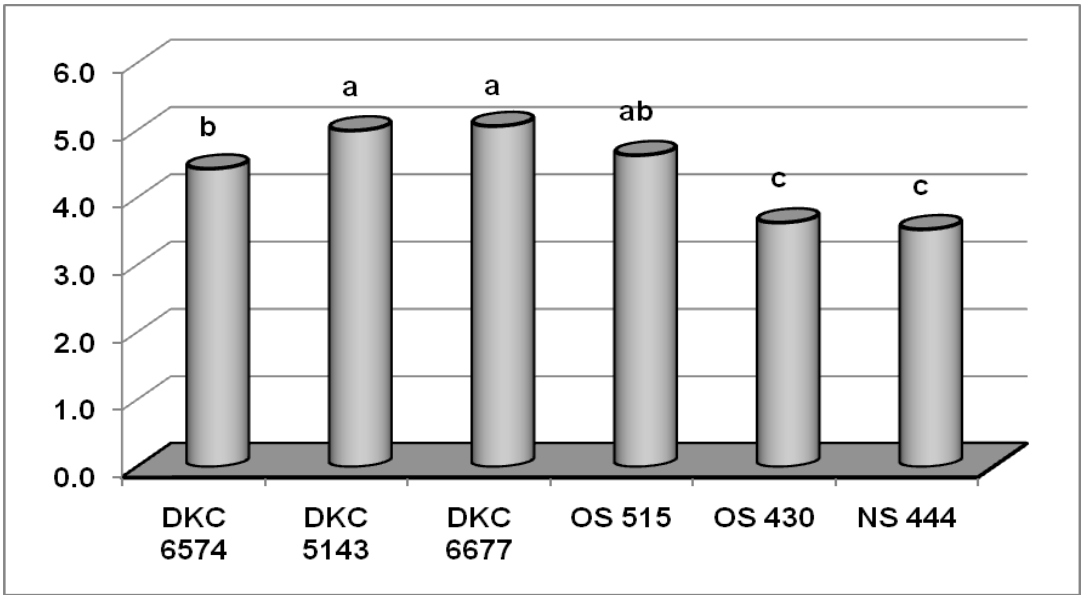

Figure 3. Graphical representation of hybrids averages for fat content (the averages with similar letters have no significant differences)

From Table 10 there is a significant dependence (r = 0.669 **) between yield and fat content and between the length of the plant and protein content with a correlation coefficient of r = 0, 518 *. Also there is a very significant dependence between the height of plants and the height of the placement of the first corn ear with correlation coefficients of r = 0.854 **, but this dependence is normal and visible.

Table 14 shows a significant dependence (r = 0.669 **) between yield and fats content and between the plan heightened protein content with a correlation coefficient of r = 0, 518 *. There is also a very significant dependence on the height of plants and the height of the placement of the first corn ear with a correlation coefficient of r = 0.854 **, but this dependence is normal and visible.

Table 14. Presentation of correlations between researched parameters

		Yield	Protein	Fats	Plant Length	Corn ear length
Yield	Pearson Correlation	1	-,027	,669(**)	-,171	-,006
	Sig.(2-tailed)		,916	,002	,498	,981
	N	18	18	18	18	18
Protein	Pearson Correlation	-,027	1	-,111	,518(*)	,254
	Sig. (2-tailed)	,916		,661	,028	,309
	N	18	18	18	18	18
Fats	Pearson Correlation	,669(**)	-,111	1	-,249	-,200
	Sig. (2-tailed)	,002	,661		,319	,426
	N	18	18	18	18	18
Plant length	Pearson Correlation	-,171	,518(*)	-,249	1	,854(**)
	Sig. (2-tailed)	,498	,028	,319		,000

*** Correlation is significant at the 0.01 level (2-tailed).* Correlation is significant at the 0.05 level (2-tailed).*

Conclusions

Based on the results achieved we can conclude as follows:

• Hybrid from Croatia OS 515 had a better performance compared to other hybrids and standard hybrid in terms of plant length, length of placement of the first corn ear in plant such as the number of corn ear in plant.

• The length of the corn ear was equal to the French hybrid DKC 6574 and the Croatian hybrid OS 515 but higher than other hybrids, while the number of rows and circles in the corn ear was significantly higher at the Croatian hybrid OS 515 than that of France DKC 6574.

• The weight of grain in the corn ear as well as the corn ear index was higher at DKC 6677 hybrid compared to other hybrids and especially compared to the standard hybrid.

• The surface unit yield was the highest in Croatian hybrid OS 515 and two French hybrids DKC 5143 and DKC 6574, while the standard hybrid had the lowest yield.

• Also, the protein content was higher in the Croatian hybrid OS 515, while the fat content was a little smaller than the two French hybrids DKC 6677 and DKC 5143.

• It has been observed that there is a significant dependence between yield and fat content and between the length of the plant and the protein content.

• As a result of this we can conclude that in general all the investigated hybrids showed a performance better than the standard hybrid, while the hybrid from Croatia OS 515 was superior to the hybrids investigated for almost all of the investigated parameters. This hybrid can be preferred for cultivation by the farmers of the region where the research was conducted, but always taking into consideration the application of appropriate agro-technical measures and care during cultivation.

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