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# EFFECTS OF HYBRID ON MAIZE GRAIN AND PLANT CARBOHYDRATES

Milica RADOSAVLJEVIĆ, Marija MILAŠINOVIĆ-ŠEREMEŠIĆ, Dušanka TERZIĆ, Goran TODOROVIĆ, Zorica PAJIĆ, Milomir FILIPOVIĆ, Željko KAITOVIĆ, Snežana MLADENOVIĆ DRINIĆ

Maize Research Institute, Zemun Polje, Belgrade, Serbia

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Maize is one of the most important naturally renewable carbohydrate raw materials. The basic chemical composition (content of starch, protein, oil, crude fibre and ash) and the content of lignocellulose fibres (content of NDF, ADF, ADL, hemicelullose and cellulose) were determined for grain and the whole maize plant of the seven ZP maize hybrids. The negative very significant correlation between protein and starch content (r=-0.78) and significant correlation between oil and starch content (r=-0.65) was obtained in grain. The hybrid ZP 666 had the highest starch, crude fibre, ADF and cellulose content, high NDF content, the

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*Corresponding author:* Milica Radosavljević, Maize Research Institute, Zemun Polje, Slobodana Bajića 1, Belgrade, phone: +381 11 37 56 704,
e-mail address: rmilica@mrizp.rs

lowest ADL and low protein content in grain. The lowest starch, crude fibre, ADF, cellulose content and the highest protein and oil content in grain was determined in hybrid ZP 158. The hybrid ZP 730 had the highest and hybrid ZP158 the lowest dry matter yield of whole plant, whole plant without ear, ear and yield of digestible dry matter of whole plant. The differences in the contents of NDF, ADF, ADL, hemicelluloses, cellulose and digestibility of the whole maize plant among observed ZP hybrids were 6.21%, 4.01%, 0.79%, 5.65%, 3.88% and 6.79%, respectively. Obtained values for the content of lignocellulose fibres differed significantly among hybrids and were closely related to digestibility.

*Key words:* ADF, ADL, hemicelullose and crude fibres NDF, maize, starch

## INTRODUCTION

Maize is one of the most important crops, and as such, one of the most significant naturally renewable carbohydrate raw materials of energy and numerous very different products. As a high-yielding carbohydrate plant, maize is very competitive in relation to other cereals (RADOSAVLJEVIĆ *et al.*, 2010).

Maize, as we usually think of it, is primarily feed and food grain. However, there are many uses and applications of maize. The fastest growing are industrial uses. Maize is processed by three major industries: wet millers that produce starch, sweeteners and maize oil; dry millers that produce maize flour and grits; and distillers that produce beverage and bioethanol. The increasing interest by processing industry in maize as the important source of carbohydrate has resulted in broadening of breeding programmes on hybrids with specific traits and for special purposes (PAJIĆ *et al.*, 2010). Traditionally, the main goals of maize breeding are production of high yielding hybrids tolerant to drought and pests. Little attention has been paid to the nutritional value of maize for food and feed. However, advances have been made by breeders within this area as well, resulting in maize kernels with a wide range of structures and compositions. By exploiting genetic variation, the composition of the kernel has been altered for both the quantity and quality of starch, proteins and oil throughout the kernel development.

Maize grain consists of approximately 70% of starch on the average (MILAŠINOVIĆ *et al.*, 2007). Starch is a carbohydrate component that has the greatest influence on maize grain yields. Moreover, starch is a very important raw material in making numerous diverse products and bioethanol as a renewable alternative energy source. In order to more fully define the carbohydrate content of maize, as well as, its nutritive value, it is also necessary to study the structure of cell walls of the whole plant. All carbohydrates in plant nutrients are grouped into: 1) structural carbohydrates (carbohydrates of cell walls), which include NDF (neutral detergent fibres – hemicelluloses + cellulose + lignin), ADF (acid detergent fibres – cellulose + lignin), ADL (lignin) and 2) non-structural carbohydrates - NFC (carbohydrates present in the plant cell content) that are made of starch, sugars and pectin. Many authors have reported that differences in the genetic background of maize genotypes affected the chemical composition, especially the ADF, NDF, starch and protein content (THOMSON *et al*., 2001, JOHNSON *et al*., 2002, SCHWAB *et al*., 2003, KRAKOWSKI, 2006) and the dry matter content (SZYSKOWSKA *et al*., 2007).

Beside for grain production, maize is an important crop for forage production due to consistent quality and higher yield and energy contents than other forages, as well as because less labor and machinery time are needed for harvest and because costs per ton of dry matter are lower than of other harvested forages. The silage maize hybrids are generally characterized with high yield potential, valuable chemical components and good digestibility (HEGYI *et al.* 2009). The highest yielding grain hybrids were not necessarily the highest yielding silage hybrids. Silage quality of dent maize has reported in the literature to range from 54 to 86% dry matter digestibility, 7-11.5% protein content, 23-43% ADF and 40-68% NDF (LAUER *et al*., 2001). According to the study carried out by the same author in 2011 the range for NDF and digestibility among commercial maize hybrids is relatively narrow. Furthermore, the yield and quality differences among hybrids have increased and these trends are continuing.

The objective of the present study was to observe the effect of different genetic backgrounds of ZP maize hybrids on the carbohydrate content of grain and the whole plant and to determine the relationship of between and among these parameters, as well as, their effects on the digestibility maize biomass dry matter.

## MATERIALS AND METHODS

The hybrids of the FAO maturity groups 100-700 (ZP 158, ZP 377, ZP 444, ZP 555, ZP 606, ZP 666 and ZP 730) were analysed. The two-replicate trail was set up according to the randomised complete-block design in the experimental field of the Maize Research Institute. The experimental plot size amounted to $21m^2$, while sowing density was 60,000 plants $ha^{-1}$. Plants of each replicate were harvested in the full waxy maturity stage from the area of $7m^2$ (two inner rows), and yields of fresh biomass of the whole plants, plants without ears and ears were estimated. Five average plants per replicate were selected for further tests. Samples of the whole plants were cut and dried at $60^oC$ for 48h. In order to determine the content of dry matter, the whole plant samples were ground in the 1-mm mesh mill. Then, the analysis of the absolute dry matter was done on the oven dry basis ($105^oC$ for 12 h) in order to estimate the total dry matter. Moreover, the analysis of the content of forage fibres (NDF-Neutral Detergent Fibres, ADF-Acid Detergent Fibres, ADL-Acid Detergent Lignin, hemicelluloses, cellulose) was performed by the Van Soest detergent method modified by MERTENS (1992). *In vitro* digestibility of the whole maize plant was done by the Aufréré method (AUFRÉRÉ, 2006), which is based on the hydrolysis of proteins of the whole plant in the pepsin acid solution (Merck 2000 FIP u/g Art 7190) at $40^oC$ for 24 h, and then on the hydrolysis of carbohydrates in the cellulase solution (cellulase Onozuka R10) in duration of 24 h. Methods applied in order to determine basic chemical contents of the maize grain samples (contents of starch, protein, oil, crude fibre and ash) were described in the previously published paper (RADOSAVLJEVIĆ *et al*., 2000).

The experimental data were statistically processed by the analysis of variance (ANOVA) and the LSD multiple test was used for any significant differences at the P<0.05 level between the means. All the analyses were conducted using statistical software package STATISTICA 8.1. (StatSoft Inc. USA).

## RESULTS AND DISCUSSION

The growing importance of the maize processing industries and maize-based products has imposed a need for more intensive research within a field of the grain quality and utilisation. The chemical composition is one of the most easily recognisable intrinsic properties of grain. Starch is the most important carbohydrate and a constitutional part of maize grain, which is the major source of the commercial starch production. Chemical compositions widely differed among seven selected maize hybrids. The starch, protein, oil, crude fibre and ash content ranged from 71.75 (ZP 158) to 74.32 (ZP 666), 9.31 (ZP 555) to 10.40% (ZP 158), 5.06 (ZP 606) to 6.9% (ZP 158), 2.07 (ZP 158) to 2.42% (ZP 666) and 1.35 (ZP 555) to 1.58% (ZP 158), respectively (Table 1). The range of obtained values correspondents with ones previously reported for ZP maize hybrids by RADOSAVLJEVIĆ *et al.* (2000) and MILAŠINOVIĆ *et al.*, (2007). RADOSAVLJEVIĆ *et al.* (2010) studied grain quality of 18 maize hybrids of different FAO maturity groups and different types of endosperm and found that starch content varied from 67,50 to 74,3%, oil from 4,1 to 8,0% (oil hybrids) and protein from 8,3 to 13,7%. Obtained results showing that genotype parentage affects chemical properties of hybrids are in agreement with results of HARRELSON *et al.* (2008), IDIKUT *et al.* (2009), RANĐELOVIĆ *et al.* (2011). The highest starch content was recorded in the following three maize hybrids with the genetically similar background: ZP 666, ZP 606 and ZP 555. The hybrid ZP 666 had significantly higher starch content than remaining hybrids. The hybrid ZP 158 with a different genetic background than remaining hybrids has the lowest starch and crude fibre content as well as the highest protein and oil content. The starch content was negatively correlated with protein (r=-0.78) and oil content (r=-0.65). This finding is in an agreement with findings of FABIJANAC *et al.*, (2006) and IDIKUT *et al.*, (2009). The range of grain quality parameters offers a new possibility in matching quality and desired properties to end user's needs and requirements.

Table 1. Grain Chemical Composition of ZP Maize Hybrids

| Hybrid | Starch (%) | Protein (%) | Oil (%) | Crude fibre (%) | Ash (%) |
|---|---|---|---|---|---|
| ZP 158 | $71.75^{d}$ | $10.40^{a}$ | $6.90^{a}$ | $2.07^{e}$ | $1.58^{a}$ |
| ZP 377 | $72.04^{d}$ | $10.07^{b}$ | $6.26^{b}$ | $2.14^{de}$ | $1.47^{bc}$ |
| ZP 444 | $72.67^{c}$ | $10.37^{a}$ | $6.19^{bc}$ | $2.20^{cd}$ | $1.55^{ab}$ |
| ZP 555 | $73.89^{ab}$ | $9.31^{e}$ | $5.09^{e}$ | $2.29^{b}$ | $1.35^{d}$ |
| ZP 606 | $73.48^{b}$ | $9.84^{c}$ | $5.06^{e}$ | $2.23^{bc}$ | $1.43^{c}$ |
| ZP 666 | $74.32^{a}$ | $9.61^{d}$ | $6.10^{cd}$ | $2.42^{a}$ | $1.44^{c}$ |
| ZP 730 | $72.10^{cd}$ | $9.94^{bc}$ | $6.06^{d}$ | $2.14^{de}$ | $1.53^{ab}$ |
| $LSD_{0.05}$ | 0.62 | 0.13 | 0.11 | 0.08 | 0.08 |

Means in the same column with different superscripts differ ($p<0.05$)

In addition to starch, which is one of the most important carbohydrates, lignocellulose fibers are important nutritional components of maize grain. The NDF, ADF, ADL, hemicelluloses and cellulose contents in maize grain of the ZP hybrids varied from 17.59 (ZP 730) to 28.84% (ZP 444), 3.89 (ZP 158) to 4.88% (ZP 666), 0.34 (ZP 666) to 1.08% (ZP 377), 13.23 (ZP 730) to 24.64% (ZP 444) and 2.79 (ZP 158) to 4.54% (ZP 666), respectively (Table 2). The hybrid ZP 444 had the highest NDF and hemicelluloses content whereas the hybrid ZP 730 had the lowest. Two hybrids with one common parent had the highest (ZP 444) and the low NDF content (ZP 377). Differences in the content of NDF in maize grain were not statistically significant between the hybrids ZP 606 and ZP 666 and between the hybrids ZP 158 and ZP 555. However, differences among all remaining hybrids were statistically significant. Two hybrids, ZP 666 and ZP 555, with a similar genetic background, had the highest ADF content. There were not significant differences in the ADF contents except between the hybrid ZP 158 and hybrids ZP 377, ZP 444, ZP 555 and ZP 666. Obtained values of the NDF and ADF content overlapped the range of values for maize hybrids originating from Germany, Italy and France (REYNOLDS *et al.,* 2005). Differences in the ADL contents in the maize grain were statistically significant among the ZP hybrids except between ZP 444 and ZP 555 and between ZP 158 and ZP 606. The hybrids ZP 377 and ZP 444, with one common parent, had the highest ADL content. On the other hand, the hybrid ZP 666 had a significantly lower ADL content compared with hybrids ZP 555 and ZP 606 with a similar genetic background.

Differences in the hemicellulose content in maize grain were not statistically significant between hybrids ZP 158 and ZP 666 and between hybrids ZP 377 and ZP 555. In remaining ZP hybrids, differences in the hemicellulose content were statistically significant. Two hybrids with a similar genetic background had the highest (ZP 666) and high (ZP 555) cellulose content, but the difference is not statistically significant. The differences in the cellulose content in the maize grain were statistically significant among the hybrids ZP 158, ZP 666 and ZP 730.

*Table 2. Lignocellulose Fibres Content of the Grain of ZP Maize Hybrids*

| Hybrid | Content (%) | | | | |
|---|---|---|---|---|---|
| | NDF | ADF | ADL | Hemicellulose | Cellulose |
| ZP 158 | $21.63^{c}$ | $3.89^{c}$ | $0.75^{c}$ | $18.08^{c}$ | $2.79^{d}$ |
| ZP 377 | $19.78^{d}$ | $4.15^{b}$ | $1.08^{a}$ | $15.63^{d}$ | $3.07^{cd}$ |
| ZP 444 | $28.84^{a}$ | $4.20^{b}$ | $0.85^{b}$ | $24.64^{a}$ | $3.35b^{cd}$ |
| ZP 555 | $21.19^{c}$ | $4.42^{ab}$ | $0.84^{b}$ | $16.76^{d}$ | $3.59^{bc}$ |
| ZP 606 | $24.18^{b}$ | $4.08^{bc}$ | $0.73^{c}$ | $20.10^{b}$ | $3.35^{bcd}$ |
| ZP 666 | $23.29^{b}$ | $4.88^{a}$ | $0.34^{e}$ | $18.41^{c}$ | $4.54^{a}$ |
| ZP 730 | $17.59^{e}$ | $4.36^{ab}$ | $0.56^{d}$ | $13.23^{e}$ | $3.79^{b}$ |
| $LSD_{0.05}$ | 0.95 | 0.59 | 0.08 | 1.25 | 0.72 |

Means in the same column with different superscripts differ ($p$<0.05)

The effects of hybrid on dry matter digestibility are presented in Table 3. The dry matter yield of the whole plant, whole plant without ear and the ear, and yield of digestible dry matter of the whole plant varied from 14.0 (ZP 158) to 21.9 $tha^{-1}$ (ZP 730), 6.1 (ZP 158) to 11.0 $tha^{-1}$ (ZP 730), 7.9 (ZP 158) to 10.9 $tha^{-1}$ (ZP 666 and ZP 730), and 9.2 (ZP 158) to 13.4 $tha^{-1}$ (ZP 730), respectively. The hybrid ZP 158 had the lowest and the hybrid ZP 730 the highest dry matter yield of whole plant, whole plant without ear, ear and yield of digestible dry matter of the whole plant. Differences in the dry matter yield of the whole plant, whole plant without ear, ear and digestible dry matter of hybrids ZP 158 and ZP 377 were statistically significant compared to the remaining hybrids. As far as the dry matter yield of plants without ears is concerned, the differences between hybrids ZP 555 and ZP 666 as well as between ZP 444 and ZP 606 are not statistically significant**.**

*Table 3. Yield Structure of ZP Maize Hybrids*

| Hybrid | Dry matter yield ($tha^{-1}$) | | | Yield of digestible dry matter of whole plant (%) |
|---|---|---|---|---|
| | Whole plant | Whole plant without ear | Ear | |
| ZP 158 | $14.0^{b}$ | $6.1^{e}$ | $7.9^{b}$ | $9.2^{b}$ |
| ZP 377 | $15.7^{b}$ | $7.5^{d}$ | $8.2^{b}$ | $9.3^{b}$ |
| ZP 444 | $19.9^{a}$ | $9.7^{b}$ | $10.2^{a}$ | $12.3^{a}$ |
| ZP 555 | $19.7^{a}$ | $9.1^{c}$ | $10.6^{a}$ | $12.4^{a}$ |
| ZP 606 | $20.1^{a}$ | $10.0^{b}$ | $10.1^{a}$ | $12.5^{a}$ |
| ZP 666 | $20.0^{a}$ | $9.1^{c}$ | $10.9^{a}$ | $12.5^{a}$ |
| ZP 730 | $21.9^{a}$ | $11.0^{a}$ | $10.9^{a}$ | $13.4^{a}$ |
| $LSD_{0.05}$ | 2.4 | 0.5 | 1.9 | 1.5 |

Means in the same column with different superscripts differ ($p<0.05$)

The content of NDF, ADF, ADL, hemicelluloses, cellulose and digestibility of the whole maize plant are presented in Table 4. The NDF, ADF, ADL, hemicelluloses, cellulose contents and digestibility of dry matter in the whole maize plant varied from 43.92 (ZP 666) to 50.13% (ZP 444), 22.34 (ZP 158) to 26.35% (ZP 377), 2.82 (ZP 555) to 3.61% (ZP 444), 19.17 (ZP 666) to 24.82% (ZP 444), 18.94 (ZP 158) to 22.82% (ZP 377) and 59.20 (ZP 377) to 65.99% (ZP 158), respectively. The differences in the contents of NDF, ADF, ADL, hemicelluloses, cellulose and digestibility among observed ZP hybrids were 6.21%, 4.01%, 0.79%, 5.65%, 3.88% and 6.79%, respectively. The significant hybrid difference in fibre components in our study ($p<0.05$) is in agreement with reports of DIRIBA *et al.* (2011) who found significant varietal differences in NDF ADF and ADL contents in maize.

The differences in the NDF content in two hybrids, ZP 377 and ZP 444, with one common parent, were statistically significant in relation to the remaining hybrids. Nevertheless, the differences in the NDF content were not significant between the hybrids ZP 377 and ZP 444, ZP 158 and ZP 666, as well as, between the hybrids ZP 555 and ZP 606. The hybrid ZP 158 with the lowest ADF content had the highest dry matter digestibility and vice versa, the hybrid ZP 377 with the highest ADF content had the lowest digestibility. Mean NDF and ADF values were 46.52% and 24.65%, respectively, and comparable with the values of 46.7% and 25.2% reported by MEESKE *et al.* (2000) for 21 maize hybrids.

The differences in the ADL content were statistically significant among the hybrids ZP 444, ZP 555 and ZP 730, with a completely different genetic background. The hybrids ZP 444 and ZP 377, with one common parent, had the highest and second high hemicellulose content of whole plant. The difference in the hemicellulose content in those hybrids was statistically significant in relation to remaining hybrids. The hybrid ZP 377, i.e. ZP 158, has the highest i.e. the lowest cellulose content, respectively. The determined differences in the cellulose content were statistically significant between the hybrids ZP 158 and ZP 377, and also between these two hybrids and remaining hybrids. The mean content of ADL, cellulose and hemicellulose were 3.34%, 21.31% and 21.87%, respectively. XU (2012) has studied 32 inbred lines and 20 widely utilised hybrids in China and the obtained mean content of ADF, ADL, NDF, cellulose and hemicellulose in maize stalk amounted to 30.74%, 4.08%, 54.2, 27.1% and 22.8%, respectively.

The differences in digestibility of dry matter between the hybrid ZP 158 with the highest dry matter digestibility as well as the hybrids ZP 377, with the lowest one, and remaining hybrids were statistically significant. All three hybrids ZP 555, ZP 606, ZP 666, with the similar genetic background had high dry matter digestibility of whole plants. Differences in dry matter digestibility of the hybrid ZP 555 were statistically significant in comparison with hybrids ZP 606 and ZP 666. On the contrary, hybrids ZP 606 and ZP 666 had no statistically significant difference in dry matter digestibility, but this difference was statistically significant compared with remaining hybrids.

*Table 4. Whole Plant Lignocellulose Fibres Content and Digestibility of ZP Maize Hybrids*

| Hybrid | Content (%) | | | | | Dry matter digestibility (%) |
|---|---|---|---|---|---|---|
| | NDF | ADF | ADL | Hemicellulose | Cellulose | |
| ZP 158 | $44.15^{d}$ | $22.34^{e}$ | 3.40b$^{cd}$ | $21.81^{bc}$ | $18.94^{e}$ | $65.99^{a}$ |
| ZP 377 | $50.12^{a}$ | $26.35^{a}$ | $3.53^{ab}$ | $23.77^{a}$ | $22.82^{a}$ | $59.20^{f}$ |
| ZP 444 | $50.13^{a}$ | $25.31^{b}$ | $3.61^{a}$ | $24.82^{a}$ | $21.70^{bc}$ | $61.62^{d}$ |
| ZP 555 | $46.24^{b}$ | $23.88^{d}$ | $2.82^{e}$ | $22.36^{b}$ | $21.06^{d}$ | $63.02^{b}$ |
| ZP 606 | $45.83^{bc}$ | $25.48^{b}$ | $3.46^{abc}$ | $20.35^{de}$ | $22.02^{b}$ | $62.37^{c}$ |
| ZP 666 | $43.92^{d}$ | $24.75^{bc}$ | $3.31^{cd}$ | $19.17^{e}$ | $21.44^{bcd}$ | $62.41^{c}$ |
| ZP 730 | $45.26^{c}$ | $24.44^{cd}$ | $3.24^{d}$ | $20.82^{cd}$ | $21.20^{cd}$ | $61.02^{e}$ |
| LSD 0.05 | 0.75 | 0.77 | 0.19 | 1.26 | 0.59 | 0.6 |

Means in the same column with different superscripts differ ($p<0.05$)

Considering the crucial effect of the lignocellulose fibres on the digestibility of the whole maize plant dry matter, the correlation dependence between the content of these components and the dry matter digestibility was observed (Table 5). A highly significant correlation between the contents of NDF and hemicelluloses (r=0.87) and between contents of ADF and cellulose (r=0.97) of whole maize hybrid plants and a significant correlation between the content of NDF and the content of ADF and cellulose (r=0.65, r=0.61) were established. A very significant negative correlation was determined between the digestibility and ADF and cellulose content (r=-0.88, r=-0.89), and a significant negative correlation between the NDF content and the dry matter digestibility (r=-0.65). Similar results were reported by TERZIC *et al.* (2012) and JANČIK *et al.* (2008). FIRDOUS and GILANI (2002) ascertained that NDF, ADF, cellulose and hemicelluloses were significantly negatively correlated with in vitro dry matter digestibility of whole plant in maize hybrids.

WERMKE (1986) has established a significant negative correlation (r=-0.67) between the digestibility and the ADF content, as well as, between the digestibility and lignin content (r=-0.95). The same author has reported that there were maize hybrids with a low digestibility and a high content of stover cell wall constituents, as well as, that there were hybrids with a high digestibility and a low content of cell wall constituents. These hybrids were defined as a dislocation type of hybrids. Hybrids with a high digestibility and a low NDF content of stover and a high NDF content of stover and a low ear digestibility are classified into types of hybrids with prolonged stover assimilation.

*Table 5. Correlation Dependence between Whole Plant Digestibility and Lignocellulose fibres of ZP Maize Hybrids*

| | NDF | ADF | ADL | Hemicellulose | Cellulose |
|---|---|---|---|---|---|
| Digestibility | -0.65* | -0.88** | -0.24 | -0.27 | -0.89** |
| NDF | | 0.65* | 0.43 | 0.87** | 0.61* |
| ADF | | | 0.42 | 0.19 | 0.97** |
| ADL | | | | 0.28 | 0.23 |
| Hemicellulose | | | | | 0.16 |

* and ** - significance at 0.05 and 0.01 probability levels, respectively.

## CONCLUSION

Seven ZP maize hybrids of different genetic backgrounds differ in the chemical composition, dry matter yield and lignocelluloses fibres components. The highest starch content had hybrids of new generations belonging to FAO maturity groups 500-600. The hybrid ZP 158 had the lowest starch and crude fibre content as well as the highest protein and oil content. This range of grain quality parameters offers a wide possibility in hybrid selection for new specific uses of maize.

In comparison with remaining hybrids, the hybrid ZP 666 had the highest starch, crude fibre, ADF and cellulose content, high NDF content, the lowest ADL and low protein content in grain. The lowest starch, crude fibre, ADF, cellulose content and the highest protein and oil content in grain were determined in the hybrid ZP 158.

The difference in the digestibility of the dry matter of the whole plant among observed hybrids amounted to 6.79%. The hybrid ZP 158 had the lowest and the hybrid ZP 730 the highest dry matter yield of whole plant, whole plant without ear, ear and yield of digestible dry matter of the whole plant. The differences in the contents of lignocellulose fibres affected the differences in digestibility of dry matter. The hybrid ZP 158 with the lowest ADF content had the highest dry matter digestibility and vice versa, the hybrid ZP 377 with the highest ADF content had the lowest digestibility. A very significant negative correlation was determined between the digestibility and ADF and between digestibility and the cellulose content (r=-0.88 and r=-0.89, respectively). A significant negative correlation was established between the NDF content and the dry matter digestibility (r=-0.65).

Results gained in this study, as well as, results of previously performed long-term studies on maize quality show that the highest number of grain traits depends on the genetic background, that is on hybrids, growing conditions and environments. Furthermore, obtained results point out to the great importance and necessity of the characterisation of the released maize hybrids, as well as, of the determination of parameters affecting its utilisation value for the determination of both, purposes of certain hybrids and selection, that is the development of new high yield potential hybrids for various agroecological conditions and different uses.

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## UTICAJ HIBRIDA NA UGLJENE HIDRATE ZRNA I BILJKE KUKURUZA

Milica RADOSAVLJEVIĆ, Marija MILAŠINOVIĆ-ŠEREMEŠIĆ, Dušanka TERZIĆ, Goran TODOROVIĆ, Zorica PAJIĆ, Milomir FILIPOVIĆ, Željko KAITOVIĆ, Snežana MLADENOVIĆ DRINIĆ

Institut za kukuruz "Zemun Polje", Beograd, Srbija

Kukuruz je jedna od najznačajnijih prirodno obnovljivih ugljenohidratnih sirovina. Određivan je osnovni hemijski sastav (sadržaj skroba, proteina, ulja, sirovih vlakana i pepela) i sadržaj lignoceluloznih vlakana (sadržaj NDF, ADF, ADL, himiceluloze i celuloze) zrna i cele biljke sedam ZP hibrida. Dobijena je negativna značajna korelacija između sadržaja proteina i skroba (r=-0,78) i ulja i skroba (r=-0,65) u zrnu. Hibrid ZP 666 je imao naveći sadržaj skroba, sirovih vlakana i celuloze, visok sadržaj NDF, najniži sadržaj ADL i nizak saržaj protina u zrnu. Najniži sadržaj skroba, sirovih vlakana, ADF i celuloze i najviši sadržaj proteina i ulja u zrnu su određeni kod hibrida ZP 158. Hibrid ZP 730 je imao najviši a hibrid ZP158 najniži prinos suve materije cele biljke, cele biljke bez klipa, klipa i prinos svarljive suve materije cele biljke. Razlike u sadržaju NDF, ADF, ADL, hemiceluloze, celuloze i svarljivosti cele biljke kukuruza kod ispitivanih ZP hibrida iznosio je 6,21%, 4,01%, 0,79%, 5,65%, 3,88% i 6,79%. Vrednosti dobijene za sadržaj lignoceluloznih vlakana su se razlikovale od hibrida do hibrida i bile su tesno vezane za svarljivost.

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