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HARVEST TIME EFFECT ON YIELD AND QUALITY OF MAIZE (*ZEA MAYS* L.) GROWN FOR SILAGE

NOVĀKŠANAS LAIKA IETEKME UZ KUKURŪZAS (*ZEA MAYS* L.) RAŽU UN TĀS KVALITĀTI

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Kopsavilkums

2005. un 2006. gados LLU MPS „Vecauce" iekārtoja 3-faktoru izmēģinājumu ar mērķi novērtēt kukurūzas novākšanas laika ietekmi uz iegūstamās ražas apjomu un kvalitāti. Izmēģinājumā izmantoja četrus dažāda agrīnuma hibrīdus: divus agrīnus - Earlystar (Francija, FAO skaitlis 160) un RM-20 (FrancijaFAO skaitlis 180), vienu vidēji agrīnu Tango (Vācija, FAO skaitlis 210) un speciāli izmēģinājumam izvēlētu ļoti vēlīnu hibrīdu Cefran (Čehija, FAO skaitlis

340). Kukurūzu sēja četros dažādos termiņos (25. aprīlis, 5.maijs, 15. maijs, 25.maijs), bet sējas laika ietekme uz rezultātu šajā rakstā nav analizēta. Ražu novāca septembrī četros termiņos ar 10 dienu intervālu starp tiem, lai varētu konstatēt, kad kukurūza sasniedz vēlamo novākšanas gatavību: 1.septembrī, 10.septembrī, 20.septembrī, 30.septembrī. Iepriekšējos gados veiktie izmēģinājumi liecināja, ka vairumā sezonu tieši laiks ap 20.septembri (3.termiņš) varētu izrādīties optimālais kukurūzas novākšanai. Izmēģinājuma gados agreometeoroloģiskie apstākļi bija atšķirīgi; 2006.gadu raksturoja ekstremāls sausums, kas iespaidoja rezultātu (1.tabula).

Izmēģinājuma rezultāti nepārprotami pierādīja, ka pēc 1.septembra sausnas raža turpina pieaugt ($p<0.05$). Ražas pieaugums (vidēji par 3.38 t ha^{-1} 2005.g., 3.40 t ha^{-1} 2006.g.) abos izmēģinājuma gados konstatēts līdz 20.septembrim (2.tabula). Ražas pieaugums no 20. līdz 30.septembrim atzīmēts 2006.gadā (vidēji par 1.47 t ha^{-1}), bet nav novērots 2005.gadā, jo kukurūza nosala 17., 18.septembra salnās. Ražas pieaugums septembrī atzīmēts neatkarīgi no sējas laika (1.attēls)

Pats pirmais kukurūzas kvalitātes rādītājs Latvijā ir sausnas saturs zaļmasā. 2005.gadā vidēji izmēģinājumā sausnas saturs 250 g kg^{-1} atzīmēts tikai ap 20.septembri, bet 2006.gadā – jau ap 10.septembri. Novākšanas laiks ietekmēja sausnas saturu zaļmasā par 47% ($p<0.05$). Vidējie divu gadu rezultāti liecina, ka novākšanai atbilstošu sausnas saturu (≥250 g kg^{-1}) kukurūza sasniedz ap 20. septembri (3.tabula). Jāņem vērā, ka 250 g kg^{-1} ir minimālā sausnas satura robeža, lai skābbarības gatavošanas laikā izvairītos no lieliem barības vielu zudumiem sulas aiztecēšanas rezultātā; labāk, ja sausnas saturs kukurūzas zaļmasā ir 280 g kg^{-1}.

Otrs pirmējo kvalitāti raksturojošais rādītājs, kas ietekmē enerģētisko vērtību, – vālīšu īpatsvars kopējā sausnas ražā, liecina par to, ka abos izmēģinājuma gados kukurūzas novākšanu vajadzēja novilcināt līdz septembra trešajai dekādei vai salnām – 2005.gadā 20. septembrī šis rādītājs vidēji izmēģinājumā atzīmēts 446 g kg^{-1}, bet 2006.gadā 20.septembrī tas bija 547 g kg^{-1}, kas ir tuvu vēlamā intervāla augšējai robežai. Vālīšu īpatsvaru kopējā sausnas ražā novākšanas termiņš ietekmēja par 45% ($p<0.05$; 3.tabula)

Kopproteīna samazināšanās abos gados novērota līdz pat septembra beigām; tas ir neizbēgami, ja vēlamies novākt lielāku masu, kurai citi kvalitatīvie rādītāji septembra laikā uzlabojas (2.attēls, pa labi). NDF (neitrāli skalotā kokšķiedra) un ADF (skābi skalotā kokšķiedra) saturs abos izmēģinājuma gados samazinājās līdz 20.septembrim; 2005.gadā pēc 20.septembra tas atkal pieauga, bet 2006.gadā turpināja samazināties (4.tabula un 2.attēls, pa kreisi). Vislielākā ietekme uz NDF un ADF saturu bija izmēģinājuma gada apstākļiem (53% un 73% atbilstoši, $p<0.05$), taču konstatēta arī būtiska ($p<0.05$) novākšanas laika ietekme. Ja rudens salnās kukurūza nosalst, kā notika 2005.gadā, un pēc tam ilgāku laiku netiek novākta (kā to prasīja 4 termiņu novākšanas metodika), tad gan rasas, gan lietus ietekmē vērtīgās barības vielas viegli izskalojas un kukurūzas lapas sāk atgādināt nevērtīgas papīra lapas. Arvien vēl pieaugošais gatavo graudu frakcijas iznākums šādos apstākļos vairs nespēj izlīdzināt košķiedras līmeni visā masā, tāpēc NDF un ADF saturs atkal pieaug. Jāatceras arī mikotoksīni, kurus izdala mikroskopiskās sēnes, kas attīstās uz nosalušajām kukurūzas lapām. Kukurūzas kvalitātes izmaiņas pēc salnām būtu jāpēta turpmāk.

Pētījuma rezultāti liecina, ka kukurūzas sausnas raža pieaug līdz septembra beigām, ja vien nenovēro nāvējošas salnas. Ražas vākšanas novilcināšana septembrī galvenokārt nodrošina arī kvalitātes uzlabošanos: sausnas saturs zaļmasā un vālīšu sausnas ražas īpatsvars kopējā sausnas ražā pieaug, bet NDF un ADF saturs – samazinās. Nāvējošas rudens salnas var pārtraukt kukurūzas ražas un kvalitātes pieaugumu; ja kukurūzas novākšanu pēc salnām ilgi novilcina, kvalitāte pat ievērojami samazinās. Kukurūzas kvalitātes izmaiņas pēc salnām, īpaši iespējamais piesārņojums ar mikotoksīniem, būtu jāpēta turpmāk.

Abstract

Growing manner of maize (*Zea mays* L.) for silage production is widely investigated in the USA and more Southern countries of Europe. Due to changes in attitude toward this crop over the last 10 to 15 years, Latvia lacks expertise in this field. The aim of our research arranged in the Research and Study farm "Vecauce" of Latvia University of Agriculture (2005 to 2006), was to define more accurately the harvest time of maize grown for silage production. Four maize hybrids with different maturity rating defined by FAO number (Earlystar (FAO 160), RM-20 (FAO 180), Tango (standard, FAO 210), Cefran (FAO 340)) were harvested at four different times beginning on 1 September at ten day intervals. Strong harvest time effect on maize yield was observed ($p<0.05$); harvest time affected obtained maize yield by 32 to 48% depending on year. Our results have shown yield increase until the end of September. However, in some years (2005) maize yield increase could be stopped by fall frosts. Quality of maize yield, measured by dry matter content, corn-cob yield percentage within the total dry matter yield and net energy in lactation, increased in the similar manner. Such parameters as neutral detergent fiber, acid detergent fiber and crude protein content decreased with the maturity of maize during September. Harvest of maize late after the fall frosts deteriorated quality. The main criterion for selection of proper maize harvest time should be dry matter content of maize (min 25%, optimum 28-30%). We concluded that in central and western part of Latvia harvest of maize for silage mainly should be delayed up to the third ten-day period of September thus improving both, yield and its quality.

Key words
Maize, hybrid, harvest time, yield, quality

Introduction

Maize (*Zea mays* L.) is moving further into the Northern latitudes due to improvements in plant breeding and in agronomic practices (Gaile, 2004, Keady, 2005). Latvia is located between the Northern latitudes 55° and 58° that means – out of traditional corn growing areas, but during last years sown area with maize for silage is again increasing. As maize, in addition, nowadays is one of the common substrates for biogas production it is almost certain that sown area will increase also further. Accurate selection of hybrid, as well as precise consideration of every step in growing practice is the key for harvesting high dry matter (DM) yield with good quality. Optimum harvest date for silage is crucial for exploiting the yield and forage quality potential of the crop, and for minimizing losses during silage storing and feed-out phases. Growing manner of maize for silage production is widely investigated in the USA and more Southern countries of Europe. Previous studies have indicated that maximum DM yield occurred at 300 – 350 g kg^{-1} average DM content (Darby and Lauer, 2002, Lauer, 2003). Previous studies in Latvia indicated that it is not possible to obtain maize yield with DM content above 250 g kg^{-1} every year as well as that during September DM content, proportion of corn-cobs in the whole DM yield and net energy for lactation are increasing, but content of neutral detergent fiber (NDF), acid detergent fiber (ADF) and crude protein (CP) is decreasing (Gaile, 2004). A change of DM yield during September is not documented in Latvia using modern hybrids before. Researchers as well as producers in Latvia have changed attitude toward this crop over the last 10 to 15 years, but we still lack expertise in several substantial points connected with growing manner of maize, including optimum harvest date.

The aim of our research was to define more accurately the harvest time of maize grown for silage production. The hypothesis was presumed that harvesting maize later in September (approximately around 20 September or even later) higher yield with better quality will be obtained.

Materials and Methods

Three factor field trials were carried out during 2005-2006 in Research and Study farm "Vecauce" (latitude: N 56° 28′, longitude: E 22° 53′) of LLU. Trials were arranged in four replication randomised blocks with plot size 16.8 m^2. Row width was 0.7 m. Planted population density was 82000 plants per ha. Original seed of four maize hybrids (Factor A) with different maturity rating defined by FAO number (Earlystar (FAO 160), RM-20 (FAO 180), Tango (standard, FAO 210), Cefran (FAO 340)) was used. Soil at the site was sod podzolic sand loam with pH_{KCl} - 7.0-7.1, available for plants content of P – 198-263 mg kg^{-1}; K – 191-196 mg kg^{-1}, humus content – 21-25 g kg^{-1}. Maize was sown at four different sowing times (factor B; results of sowing time effect is not analysed in current paper) starting with April 25 at ten day intervals till May 25 in both years. Traditional soil tillage was used: mould-board ploughing in previous fall, cultivation and rototilling before sowing in spring. Given fertilisers: 34 kg ha^{-1} P, 75 kg ha^{-1} K and 148 kg ha^{-1} N (18+70+60). Planting was carried out with by hand handled planter at 3 – 4 cm depth. Weeds were controlled spraying herbicides (nicosulfuron 1.0 L ha^{-1} + dicamba 0.3 L ha^{-1}) and mechanically. Harvesting was done at four different times (factor C) beginning with 1 September at ten day intervals. Yield was accounted from 0.7 m^2 on 1, 10 and 30 September and from 8.4 m^2 during the main harvest time on 20 September. Following observations were carried out: field germination, flowering (tasseling and silking), plant density before harvest, plants per ha, plant height before harvesting, m, (data are not presented), green and dry matter (DM) yield, t ha^{-1}, DM yield of corn-cobs, t ha^{-1}, and proportion of corn-cob DM yield in the whole plant DM yield, g kg^{-1}. For detecting the corn-cob yield, covering leaves of corn-cobs were peeled. Following quality analyses for every hybrid and in every harvest time were carried out using standard methods: content of DM of whole plant and corn-cobs, g kg^{-1} (Forage analyses met 2.2.1.1.); crude protein (CP), g kg^{-1} of DM (ISO 5983); neutral detergent fibre (NDF), g kg^{-1} of DM (Forage analyses met 2.2.1.1.) and acid detergent fibre (ADF), g kg^{-1} of DM, (Forage analyses met 4.1.); ash (ISO 5984), Ca (ISO 5490/2) and P (ISO 6491), in g kg^{-1} of DM (data are not presented). Some parameters were calculated in addition: digestible dry matter DDM g kg^{-1} = 889 – (0.779 x ADF); net energy for lactation NEL MJ kg^{-1} of DM = (0.00245 x DDM - 0.12) x 4.184; dry matter intake DMI g kg^{-1} of cow body weight = 12000/NDF. As they are derived from NDF and ADF data are not presented. Meteorological conditions were variable in the research years, and the main indices, average daily temperature and precipitation, are characterized in Table 1.

Table 1. Temperature and precipitation compared with meteorological norm during 2002-2004

Month	Average daily air temperature, °C			Precipitation, mm		
	2005	2006	Norm	2005	2006	Norm
April	6.0	5.8	4.9	17.2	20.4	42
May	**11.2**	**11.6**	11.2	**43.0**	**27.6**	43
June	**14.3**	**16.2**	15.1	**48.6**	**24.2**	51
July	18.3	20.1	16.6	65.0	13.0	75
August	16.1	17.5	16.0	106.4	150.0	75
September	13.3	13.9	11.5	35.6	46.0	59

Spring frost after maize emergence in research field was observed in 1 June 2006; plants were stressed and due to this herbicide spray was delayed; mechanical weed control was used in addition thus favouring moisture losses from soil and drought stress for plants. Strong fall frosts during September were observed on 17, 18 September 2005 – maize was frost-bitten. Summarising meteorological description, one could say that better suitable for maize growing and more typical for Latvia was year 2005; 2006 was atypical due to critically dry conditions; in July 2006 yield was really endangered.

Results were statistically analysed using analysis of variance.

Results

On average per trial maize DM yield was 2.06 t ha^{-1} higher in 2005 (14.17 t ha^{-1}) if compared with yield in 2006 (12.11 tha^{-1}). Our results showed strong harvest time effect on obtained maize yield ($p<0.05$; Table 2).

Table 2. Maize DM yield of four hybrids harvested in four different dates in 2005-2006, t ha^{-1}

Harvest dates	Hybrid				
	Earlystar FAO-160	RM-20 FAO-180	Tango FAO-210	Cefran FAO-340	On average for harvest dates,
	2005 (LSD $_{\text{hybrid x harvest date}}$ = 1.00)				$LSD_{0.05}$ = 0.50
September 1	12.02	12.09	12.18	11.76	12.01
September 10	14.45	14.81	14.37	12.96	14.15
September 20	15.75	15.91	15.35	14.54	15.39
September 30	14.26	16.37	15.82	14.04	15.12
On average for hybrid, $LSD_{0.05}$ = 0.50	14.12	14.79	14.43	13.33	X
	2006 (LSD $_{\text{hybrid x harvest date}}$ = 1.15)				$LSD_{0.05}$ = 0.58
September 1	10.00	9.99	9.53	9.14	9.66
September 10	11.29	11.29	11.19	10.98	11.19
September 20	13.02	13.55	12.93	12.74	13.06
September 30	15.00	14.25	14.70	14.17	14.53
On average for hybrid, $LSD_{0.05}$ = 0.58	12.33	12.27	12.09	11.76	X

From September 1 to September 20 yield increased by 3.38 t ha^{-1} in 2005 and by 3.40 t ha^{-1} in 2006. Further yield increase till the end of September was not observed in 2005, but in 2006 yield increase continued and on average it was by 1.47 t ha^{-1} during last decade (Table 2). Harvest time affected maize DM yield by 32% in 2005 and even by 48% in 2006. Despite differences in maturity rating of selected hybrids, substantial hybrid effect ($p<0.05$) on DM yield was noticed only in 2005 (Table 2). Small hybrid x harvest time interaction effect (by 3%, $p<0.05$) on DM yield was also noticed only in 2005.

DM yield increased similarly with harvest time delay in September regardless of sowing time of maize, i.e. yield increase with later harvest was observed for maize sown in May 25 as well as for that sown in April 25 or in other date (Fig. 1).

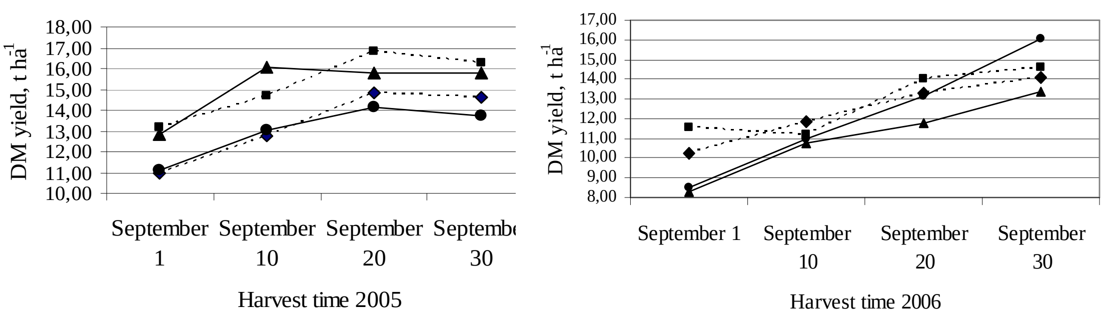


Figure 1. Maize yield increase depending on harvest time if sown in different sowing times (♦- April 25; ■ - May 5; ▲ - May 15; ● - May 25)

Quality of maize measured by DM content higher was in 2006, conditions of harvest year affected it by 20% ($p<0.05$). If average two year DM content is evaluated, again strong harvest time effect was noticed (by 47%, $p<0.05$). Two year average data shows that from September 1 till September 30 average DM content in the whole plant maize yield increased by 87 g kg^{-1} (Table 3). Hybrid effect was also substantial (by 17%, $p<0.05$) as different maturity hybrids were used. Other important initial quality indicator is a proportion of corn-cobs' DM yield in the whole plant DM yield, and later in September harvest time as well as used hybrid affected it strongly in every separate year ($p<0.05$). If average data of two trial years was used (Table 3) proportion of corn-cobs' DM yield in the whole plant DM yield was affected by conditions of year (23%), by used hybrid (18%) and by delayed harvest time (45%).

Table 3. DM content of maize and proportion of corn-cobs DM yield in the whole plant DM yield depending on hybrid and harvest date on average during 2005-2006, g kg^{-1}

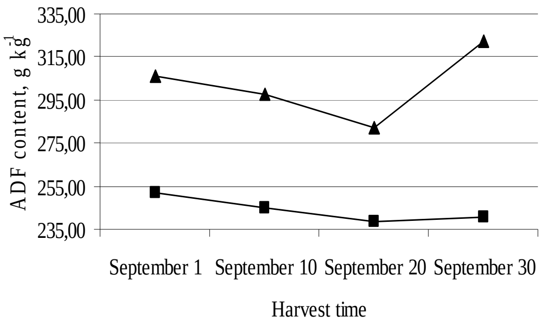
Harvest dates	Hybrid				
	Earlystar FAO-160	RM-20 FAO-180	Tango FAO-210	Cefran FAO-340	On average for harvest dates,
	DM content (LSD $_{hybrid\ x\ harvest\ date}$ = 18.10)				$LSD_{0.05}$ = 9.05
September 1	225.27	220.02	222.88	192.73	215.23
September 10	249.63	251.70	252.33	213.81	241.87
September 20	290.55	286.70	291.47	239.87	277.15
September 30	327.28	306.59	321.58	253.46	302.23
On average for hybrid, $LSD_{0.05}$ = 9.05	273.18	266.25	272.06	224.97	X
	Proportion of corn-cobs DM yield in the whole plant DM yield (LSD $_{hybrid\ x\ harvest\ date}$ = 52.58)				$LSD_{0.05}$ = 26.29
September 1	354.23	344.46	407.22	212.67	329.64
September 10	433.06	415.28	446.75	286.29	395.34
September 20	528.42	510.53	548.42	399.04	496.60
September 30	630,21	593.31	602.22	491.34	579.27
On average for hybrid, $LSD_{0.05}$ = 26.29	486.48	465.89	501.15	347.33	X

Other basic quality indicators are NDF (Table 4) and ADF (Fig. 2) content, from which DMI, DDM and NEL are derived. Strong harvest year effect was noticed on content of NDF (53%; p<0.05). On average per trial NDF content was by 55.9 g kg^{-1} higher in 2005 (547.8 g kg^{-1}) if compared with that in 2006 (491.9 g kg^{-1}) (Table 4). Substantial harvest time effect on NDF content was observed in separate years as well as on average values per two years (12%; p<0.05). Little or no changes of NDF content in both trial years were observed from 1 till 10 September, sharp decrease – from 10 till 20 September, and increase (in 2005) or further decrease (in 2006) from 20 till 30 September depending on year (Table 3). Few effect of used hybrid was noticed only on average values per two years.

Table 4. NDF content of maize depending on hybrid and harvest date, 2005-2006, g kg^{-1}

Harvest dates	Hybrid				
	Earlystar FAO-160	RM-20 FAO-180	Tango FAO-210	Cefran FAO-340	On average for harvest dates,
	2005				p < 0.05
September 1	527.35	551.25	565.75	560.55	527.35
September 10	528.18	561.13	568.65	555.80	528.18
September 20	507.20	512.25	545.35	538.35	507.20
September 30	546.48	564.63	562.65	569.25	546.48
On average for hybrid, p = 0.066	527.30	547.31	560.60	555.99	X
	2006				p < 0.001
September 1	495.18	512.58	521.40	519.78	512.23
September 10	504.65	518.05	516.80	506.58	511.52
September 20	472.70	473.18	481.63	481.25	477.19
September 30	448.18	459.33	470.18	488.95	466.66
On average for hybrid, p = 0.69	480.18	490.78	497.50	499.14	X

Similarly to NDF content, ADF content also was mostly affected by harvest year (by 73%, p<0.05), and on average per trial it was 302.3 g kg^{-1} in 2005, but by 58.4 g kg^{-1} less in 2006 (243.9 g kg^{-1}) (Fig. 2, on the left). On average two year data some hybrid (8%; p<0.05) and harvest time (6%; p < 0.05) effect was noticed. Interesting is results during separate trial years: hybrid effect (p=0.1) was not substantial in 95% confidence level on ADF content in 2005, but harvest time effect (p=0.42) - in 2006.



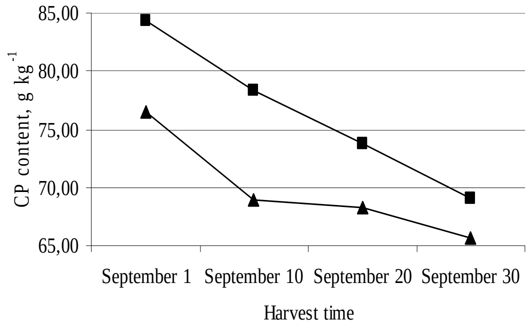


Figure 2. Changes in ADF (left) and CP (right) content in maize yield depending on harvest time (▲ - 2005; ■ 2006)

CP content less than 90 g kg^{-1} was observed in both trial years (Fig. 2, on the right). Strong harvest time effect ($p<0.05$) was noticed on CP content on average for two years (by 36%), and CP content decreases with delay of harvest during September.

Discussion

Our results approved the hypothesis that delayed harvest of maize till 20 September or in some years (2006) even later resulted with higher yield. This is fully in agreement with results of other researchers reported in different countries and years (Herbert, 1997, Darby and Lauer, 2002, Lewis et al., 2004, Little et al., 2005). Yield increase after 20 September was not observed in 2005 due to strong fall frosts when maize maturing was stopped. Cold weather accompanied with frosts is common phenomenon in September in Latvia and maize growers have to take it into consideration. If frosts are not noticed, mainly harvest time should be delayed at least till the third ten-day period of September or maize have to be harvested directly after frosts. Delay of harvest into October is highly risky because often October is rainy, and harvest and ensiling of forage due to rain and wet soil is inconvenient. In some rare years when all the season is hot and assurance of moisture is uneven, for instance, 2002, maize harvest could be done before 10 September (Gaile, 2004), and decision when to harvest has to be adopted judging by maize DM content analyses.

Although, obtained DM yield level is highly important for production forage, quality of harvested yield is even more important indicator. Due to cool climatic conditions the first quality indicator in Latvia is DM content of maize at harvest and the second - proportion of corn-cobs in the whole plant DM yield. Harvesting of forages when they are too wet makes the silage susceptible to effluent losses, but corn-cob portion is closely associated with the grain that means starch and energy. Our results show that DM content and proportion of corn-cobs' DM yield in the whole plant DM yield increases with the harvest delay in September that is in connection with other findings (Little *et al.*, 2005). The minimum limit for DM content in maize yield at harvest in Latvia is stated 250 g kg^{-1} (Gaile, 2004). On the one hand making silage in such conditions some effluent losses is observed, but on the other hand - often it is hard to obtain even such DM content. Average data per two year shows that earlier hybrids (Earlystar, RM-20, Tango) ensure DM content around 250 g kg^{-1} on 10 September, but in 20 September DM content was noticed around 290 g kg^{-1}, that is considered good for high quality yield by researchers in traditional maize growing areas (Keady, 2005). Desirable corn-cob proportion in the whole plant DM yield is 400-600 g kg^{-1}, and similarly to DM content corn-cob proportion increases with the delayed harvest date, exceeding 400 g kg^{-1} around 20 September.

Major changes occur in the composition of the maize plant as it mature or when season progressed. NDF, ADF and CP content decrease, whilst (as mentioned above) starch and energy content increase (Darby and Lauer, 2002, Lewis *et al.*, 2004, Keady, 2005). Results of current study match with these and our previous results (Gaile, 2004), and have shown such change during September in Latvia. CP content was the highest at earliest harvest dates and show unambiguous decline with increasing maturities of maize, i.e. with delay of harvest date in September.

The same was noticed for NDF and ADF content in 2006. In addition, concentration of fibre fractions is obviously lower in 2006 if compared with that in 2005 that could be attributed to more mature maize in the same harvest dates in 2006. Similar regularity for NDF and ADF content decrease was observed in 2005 from 1 till 20 September, but in the third ten-day period again increase of these parameters were noticed. Before such phenomenon when NDF and ADF content increase at the end of season in Latvia was observed in 2002 (Gaile, 2004) when it was connected with maturity stage close to black layer. Darby and Lauer (2002) reported similar data. Situation was absolutely another in 2005. Strong fall frosts were observed on 17, 18 September 2005, and maize was frosted. Last ten-day period of September characterised with heavy dew every day, rainstorm in 28 September, and light rain in 30 September. Such wet conditions led to sugar leach from the frosted leaves and feed value of stover portion was reduced. NDF and ADF content in stover portion during 10-12 days after frosts increased in so high level that grain portion could not dilute it and the whole plant NDF and ADF level also increased. In addition, mould can grow on frozen leaves, and maize yield could be contaminated with mycotoxins. As fall frosts in different parts of Latvia in September are usually observed, research of quality changes of frosted maize is needed.

Conclusions

Delayed harvest of maize till 20 September or even later (in 2006) resulted with higher yield, but growers have to consider that in some years (2005) yield increase could be stopped by fall frost.

Delayed harvest of maize in September in Latvia resulted mainly in quality increase: DM content and corn-cob portion in the whole plant DM yield increased, but NDF and ADF content – decreased. CP content also decreased, but its decrease is unavoidable when we expect mentioned above improvement of other quality parameters.

Killing fall frosts can stop increase of yield and can cause quality decrease if maize is not harvested immediately after frosts. Further research of quality changes after frost are needed taking into account mould produced micotoxins.

Acknowledgement

The study was supported by the grant of Latvian Council of Sciences Num.05.1605.3.

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