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Chemical Composition of Sudan Mass Herbage Depending on Sowing Dates If Cultivated in Droughty Conditions of Akmolinsk Region of Kazakhstan Republic

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Abstract: Sudan grass is the most potentially productive crop for cultivation in droughty conditions, as it is notable for high drought-resistance and nutrition value. Wide spread occurrence of Sudan grass in arable fodder cropping of North Kazakhstan requires more advanced study of its biological peculiarities and agricultural engineering methods in soil-climatic conditions, specific for this region. At the present time, the impact of sowing dates on chemical composition of Sudan grass plants is understudied. The article deals with the analysis of chemical composition of Sudan grass plants in the stage of cut-sample ripeness, its dependency on sowing dates and its impact on herbage feeding qualities.

Key words: Sudan grass · Herbage · Sowing dates · Chemical composition · Chemical analysis · NMR-analysis (spectroscopy)

INTRODUCTION

Sudan grass herbage (Sorghum sudanense) has high feeding qualitative indicators. Sudan grass, as a feed crop, stands alone in main feeding element-protein. Real nutrition value is preserved both in herbage and in produced feed-stuff-hay, silage, haylage and grass meal, regardless of preparation or conservation methods [1].

At the present time, to determine chemical composition of various cultivated plants, the analytical methods with different degree of sensitiveness are used (gas chromatography, high pressure liquid chromatography, mass spectroscopy, infrared spectroscopy and nuclear magnetic resonance spectroscopy (NMR)). These methods are frequently used in combination with each other to obtain maximum analytical information about the object under study [2-4].

NMR-spectroscopy becomes one of the main analytical means in chemistry. High resolution, one-and multidimensional survey are the highly-precise characteristics of this method for determination the chemical structures and dynamics of the object under study [5].

Conditions for Establishment and Carrying out the Experiment: The analysis was carried out during the season of 2012 in conditions of dry-steppe zone of Kazakhstan Republic Akmolinsk Region on the basis of large agricultural plant LLP "Baymyrza-Agro". The content of humus and nutrition elements in soil layer of 0-20 sm is the following: N-38,1, P_2O_5-7,1, K_2O-480 mg/kg of soil, humus-5,2 %, pH-6, 95.

Mean annual precipitation is 302 mm, including 210 mm during the vegetation period. Frost-free period is 123 days, mean date of first autumn frost is September 16, the sum of positive temperatures above +10°C is 2295°C. In 2012 mean daily air temperatures were higher as compared to 2011 (Figure 1).

Pass of mean daily air temperature through 0 °C was recorded in the first decade of April. Air temperature heating up to + 6-8°C started in the end of the first decade of April; pass of mean daily temperature through +10°C was in the second decade of April. Degree days per periods of plants vegetation was the following: «seedlings-cut-sample ripeness »-1352°C, «seedlings-full seeds ripeness» - 2121°C. In 2011 the maximum quantity of precipitation for the warm period was in June-July, 1,5-2,0 times more than the long-time average annual data and in

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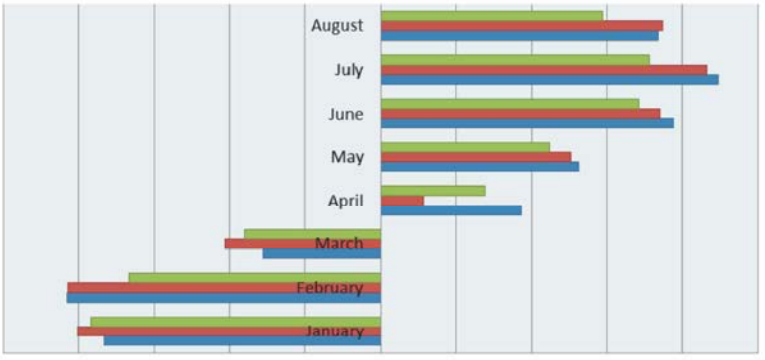


	January	February	March	April	May	June	July	August
2011	-19,2	-16,7	-9	6,9	11,2	17,1	17,8	14,7
LTA	-20,1	-20,7	-10,3	2,8	12,6	18,5	21,6	18,7
2012	-18,3	-20,8	-7,8	9,3	13,1	19,4	22,4	18,4

Fig. 1: Mean monthly air temperature in 2011-2012 as compared to long-time average annual indicators, °C

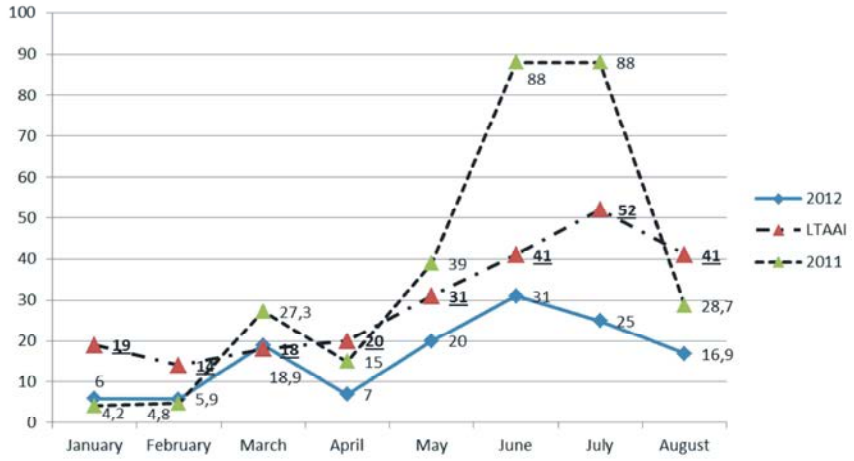
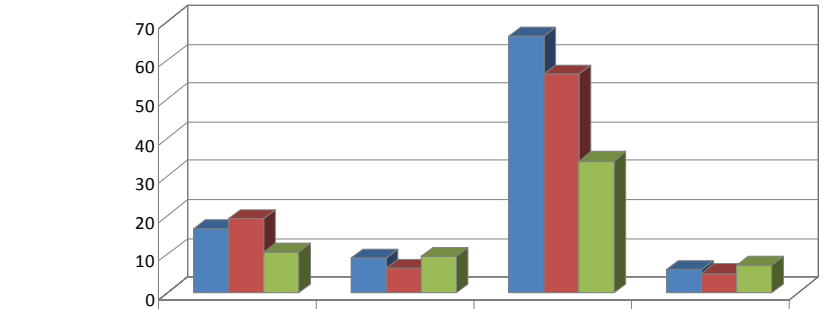


Fig. 2: Precipitation depth in 2011-2012 as compared to long-time average annual indices (LTAAI), mm

other months it was slightly below or at the level of the long-time average annual indices. In 2012 the precipitation depth per months of vegetation period was below the long-time average annual indices in 1,5-2,0 times (Figure 2). Thus, the conditions of 2011 are characterized as favorable ones, with hydrothermic index equal to 1,1; in 2012 a very strong draught was recorded, when the hydrothermic index was equal to 0,4.

The experiment dealt with the impact of such factor, as sowing date (second and third decades of May, first decade of June) on formation of Sudan grass herbage yield. Sort-Brodskaya 2, the record plot was 100 m^2, threefold replicate. Observations and recordings were carried out as per existing procedures of field studies [6, 7]. A process of annual grass cultivation, generally accepted for the area, was used in the experiment. All process steps in experimentation, apart from sowing dates, were equal. The seeding was done with the rate of 16-20 kg/ha (2-2,5 mln. fertile seeds/ha), at depth of 4-5 sm. The herbage was cut in the stage of cut-sample ripeness by method of straight cutting. Herbage yield was recorded in the field by weighting of the cut mass from each plot.

Conditions for Chemical Analysis: The indicators of food-value of herbage samples were determined during chemical analysis, carried out in the laboratory of Akmolinsk Branch of "Republican Veterinary Laboratory" of Kokshetau. For chemical analysis, a standard practice was used as per GOST: crude protein determination as per GOST 13496.4-93, humidity determiantion as per GOST 13496.3-92, crude cellulose determination as per GOST 13496.2-91, carotin determination as per GOST 13496.17-95 [8].



	Moisture,%	Crude protein, %	Crude cellulose, %	Carotin, mg
1st sowing date	16.4	8.87	66.39	6
2st sowing date	19.2	6.28	56.44	5
3st sowing date	10.4	9.27	34.02	7

Fig. 3: Chemical composition of Sudan grass herbage, % (mg)

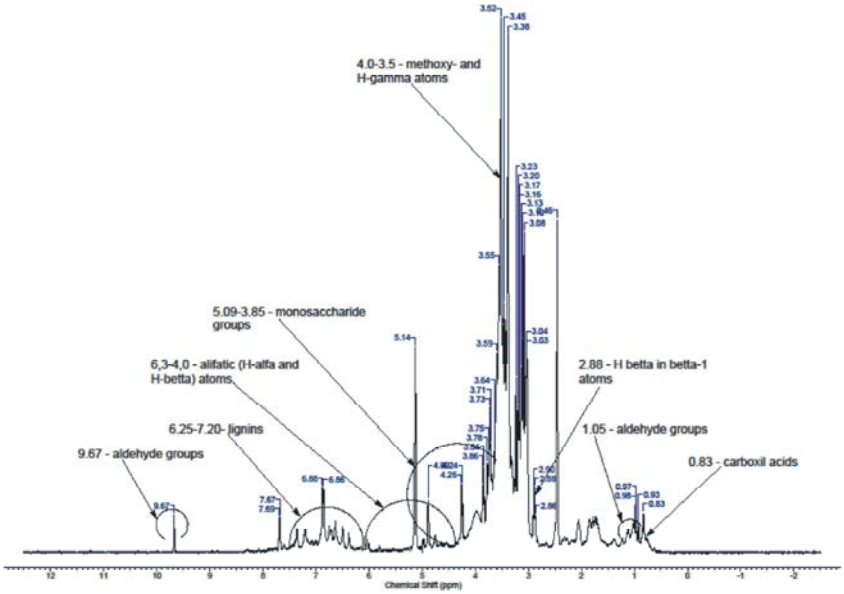


Fig. 4: [1]H NMR-spectrum of Sudan grass herbage extract with suppression of water protons

Alongside with that, the NMR (nuclear-magnetic resonance)-spectroscopy of ethanolic extracts of the selected samples of Sudan grass herbage (Sorghum sudanense) was carried out in the Engineering Laboratory of NMR-Spectroscopy of Sh. Ualikhanov Kokshetau State University in Kokshetau. Herbal samples were selected in 2012 during the investigation on the field station of Plant-Growing and Agricultural Department of S.Seifullin KAU based on production plant LLP "Baymyrza-Agro" of Enbekshildersky District of Akmolinsk Region. Samples were cut on August 2, then they were put to 70% ethyl alcohol on boiling water bath for 25-30 min and the concentrated extract was used for NMR-spectral study. Deuterated DMSO-d6 (dimethylsulfoxide) was selected as a solvent; sample extracts were fully dissolved in it. [1]N NMR-spectrums of the samples were taken at NMR-spectrometer JNM-ECA 400 of JEOL Company(Japan) with operating frequency equal to 400 MHz.

The Results of Laboratory Analyses and Their Discussion: Figure 3 shows some indices of chemical composition of Sudan grass herbage depending on sowing dates. The results of the laboratory investigations show that the maximum concentration of crude protein was observed in the third (June, 10) sowing date of Sudan grass. As per A.I. Tutunnikov, it is explained by the increased leafage of plants during the late sowing dates, as the leaves contain more protein than stalks; it results in increase of general nutrition value of green feed-stuff [9].

Table 1: Chemical shifts of putative components

No.	Components	Chemical shifts, ppm
1	Carboxil acids	0.83
2	Aldehydes	1.05, 9.67
3	H B ■ in ■ B position	2.9-2.8
4	Methoxy-and H γatoms	4.0-3.5
5	Monosaccharide groups	5.09-4.0
6	Aliphatic (HA * ■HB) atoms	6.3-4.0
7	Lignins	6.25-7.20
8	Chlorophylls*	0.68-7.69

** - chlorophyll signal overlapping all over the whole area*

The content of crude cellulose, on the contrary, decreases with the sowing dates, which also has a positive impact on the general nutrition value of green feed-stuff, as its exceeding content reduces the quantity of the consumed feed and its digestibility for animals [10, 11].

Carotin content at all sowing dates was low, what as mainly explained by the weather conditions of the season, which influenced significantly both on the dynamics of carotin accumulation per vegetation stages and on its absolute content in plants. The proof is the results of the three-year experiments of V.M. Troitsky, carried out near the city Semipalatinsk. The scientist revealed that carotin content drops at the event of hot weather, apart from the plant vegetation stage. Besides, it is also explained by the carotin (carotinoids) destruction, mentioned by M.S. Tsvet, occurred in plants at increased solar radiation and air temperature, which were typical for conditions of 2012 season.

The obtained ^{1}N NMR-spectrum is the overlapping of NMR-spectrum of the components of analysed mixture. Figure 4 and table 1 show the fragments of ^{1}N NMR-spectrum of ethanol extract of Sudan grass herbage. Spectral NMR-picture of the extract is a so-called "dactyloscopy" of the investigated object, which allows concluding about its originality. NMR-spectrum of our samples have the peaks, corresponding to signals of lignin, polysaccharides, chlorophyll and other alcohol-soluble ingredients [12-15].

CONCLUSION

Thus, as a result of our investigation it was determined that some indices of chemical composition of Sudan mass herbage are dependent on the sowing dates as of the date of gathering. To increase the nutrition value of the Sudan grass for herbage it is recommended to apply the later sowing date.

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