BIOSCIENCES BIOTECHNOLOGY RESEARCH ASIA, September 2015. Vol. **12**(Spl. Edn. 2), p. 395-403

Dispersive, Cluster and Correlative Analysis of Some Alfalfa Accessions under the Conditions of North Kazakhstan

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doi: http://dx.doi.org/10.13005/bbra/2216

(Received: 20 June 2015; accepted: 21 August 2015)

Field experiments to study the quality of different alfalfa accessions in dependence on weather conditions and stand age were carried out during the period from 2011 to 2013 at the experimental field of LLP "North Kazakhstan scientific research Institute of Agriculture" (v. Chaglinka) located in the northern part of the hilly-flat zone of Akmola region of Kazakhstan. The content of crude protein, crude fiber, crude fat, crude ash, carotin, nitrogen-free extractive substance (NFES) and sugar in the studied alfalfa accessions was reported. All research results were processed with the software packages SPSS. The correlation coefficients among some quality characteristics (dry matter weight ratio, crude protein, crude fiber, crude fat, crude ash, carotin, nitrogen-free extractive substance (NFES), and sugar) and the hydrothermic coefficient (HTC) and the leaf fractions were defined. The results of the multifactorial analysis of the SPSS statistical methods showed that many of the observed parameters in varying degrees are linked with the HTC, leaf fraction and among each other. Six of the nine parameters were statistically significant with the HTC. The correlation between the HTC and the protein content, leaf fractions is positively high; crude fat, crude ash - positively average; crude fiber - negatively high; and carotin - negatively average. The accessions with promising characteristics could be used for future breeding programs in Kazakhstan.

Key words: Alfalfa, Accessions, Crude protein, Crude fiber, Crude fat, Crude ash, Carotin, Nitrogen-free extractive substance (NFES), Sugar, Cluster analysis, Hydrothermic coefficient (HTC), Leaf fractions, correlation.

One of the most important factors for increasing the livestock production and reducing its cost is the introduction of high-yielding crops and varieties, as well as high quality ones suitable for soil and climatic conditions of the cultivation area. Due to its flat terrain, North Kazakhstan territory is exposed to three main air flows causing a strongly continental climate: in summer - droughts, dry winds and air cooling; in winter - warming; in summer and winter, day and night - temperature contrasts. Frosty period lasts up to six months, with two or more weeks of deviations from the average rate. January is the coldest month. Spring is short with frequent returns of frost in May and even in June. Last spring frosts are usually between 12 and 25 of May. The climate negative characteristic is the frequent strong

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winds[1]. Therefore, the changing weather conditions of North Kazakhstan need varieties with stable nutritive value, adaptive not only to the season changes, but also to temperature changes in different years.

Alfalfa is one of the main sources of high quality herbage in Northern Kazakhstan. It is also recognized as forage plant widely used in many countries (Zhang *et al*., 2008[2]; Turan *et al*., 2009[3]; Meyirman G.T., 2013[4]). Alfalfa is characterized with high productivity, longevity, ability to grow in a different environmental conditions, multiple use: green feed, pasture forage (grass mixture) (Kravtsov V.V., 2002[5]; Lazarev D.A., 2001[6]), hay, haylage, grass chop, combined silage, forage bales, protein concentrates (Malets I.F., 1990[7]; Bondarev V.A., 2003 [8]), pulp and green juice (Prodak N.I., 2000[9]). lfalfa is the crop with nitrogen fixing ability that increases soil fertility (Gavrilov A.M., 2000 [10]; P.D. Popov, 2002[11]). Alfalfa could be a source of essential amino acids (Vitkus A., 1993[12]; Lotti G., Paradossi C., Marchini F., 1991[13]). To develop more productive and improved alfalfa varieties is a way with theoretical and practical importance for increasing forage production.

Objectives: The main objectives of this study were to select some alfalfa variety accessions with the improved herbage production from the competitive variety nursery and to determine the effect of the hydrothermic coefficient on the leaf fraction and some quality characteristics of the plant.

The main tasks were to observe the alfalfa accessions, belonging to variegated hybrid variety group, grown in comparative trial and to determine the chemical composition (the content of crude protein, crude fiber, crude fat, crude ash, carotin, nitrogen-free extractive substance (NFES), sugar in dry matter); to select alfalfa accessions with good nutritive characteristics; to define a correlation between hydrothermic coefficient (HTC) and some studied characteristics - content of crude protein, crude fiber, crude fat, crude ash, carotin, nitrogen-free extractive substance (NFES), sugar in dry matter and leaf fraction.

MATERIALS AND METHODS

Experimental studies were carried out at the LLP "North-Kazakhstan Scientific Research Institute of Agriculture" (v. Chaglinka) located in the northern part of the hilly-flat zone in Zerenda district of Akmola region, Kazakhstan, in 2011-2013. The Research Institute has breeding programme for perennial legumes, including alfalfa - "the queen of the forages". The soil is medium deep ordinary chernozem, medium-humic with humus horizon of 25-27 cm deep and the average humus content of 4.21%. The soil layer 0-40 cm contains nitrate nitrogen - 17.0 mg, labile phosphorus - 7.1 mg, and exchange potassium - 35.0 mg per 1 kg of soil. Hence, the nitrogen content is high, that of phosphorus – low, and potassium content is high. The texture of the soil is heavy clay loam, bulk density in plough layer is 1.19 g/cm^3, in a meter layer on average is 1.30 g/cm^3. Permanent wilting percentage is 13%.

Four promising alfalfa accessions were studied at the final stage of the research. The nursery for the alfalfa competitive variety trials was set up on a complete fallow. 4 alfalfa accessions were grown in the nursery: these were complex hybrid populations produced in local conditions in 2008-2011. The seeds were sown in the second decade of May with a hand-held sower SR-1. The alfalfa plants were planted in 15 cm rows. All numbers have been set thrice. The plots area was 25 m^2. The side border check irrigation was 0.7 m, and the end border - 10 m. The harvesting for herbage was carried out in the flowering stage. The local variety "Kokshe" was used as a standard 14].

Meteorological conditions during the experiments were characterized by HTC = 1.11 (slightly dry) in 2011 (the year of sowing); in the second and third years of life at the first cut (the interphase period "regrowth- bud stage" - "bud stage - blooming") in May-June 2012 and 2013, HTC was 0.88 and 0.85, respectively (dry)[15]. In the second year of life (2012) during the period "regrowth - blooming" from May 1 till June 24 the rainfall was 62.4 mm, and in the third year of life (2013) in the same period of growth and development from April 27 till June 24 the rainfall was 45.8 mm, which is 73% less. Temperature conditions during the years of research was as follows: in the second year of life at the first cut it was 878.5°C, and in the third year of life at the first cut - 617°C. In the third year of life at the first cut

the plants were developed in unfavorable water and temperature conditions.

The sampling for chemical analysis was carried out according to the procedure used in the breeding of perennial grass in the V. R. Williams All-Russia Research Institute of Forages[16]. The chemical analyses of the alfalfa accessions was conducted in the laboratory of biochemistry and breeding of LLC "A.I. Barayev SPC GF (Scientific and Production Centró of grain farming)" by the conventional techniques. Chemical analysis of plant samples in dry matter was conducted by the following techniques: dry matter, air-dry matter content was determined by the two-stage determination of the dry matter[17], the crude protein content was determined by the Kjeldahl method (using a device UDC - 142)[18]; crude fat - by weighing the extracted crude fat[19]; crude ash - by weighing the residue after burning and subsequent calcination of the sample[20]; crude fiber by the method based on the removal of acid soluble material from the product and weighing the remains conventionally taken as fiber[21]; carotin content was determined by dissolving it in petroleum ether[22]; NFES - by the calculation method[23].

The analysis of the experimental data were processed by IBM PC Genuineintel using statistical information processing program - SPSS version 13[24, 25].

RESULTS AND DISCUSSION

Alfalfa is not used during the first year in North Kazakhstan. The content of dry matter in the studied accessions ranged from 89.90% to 90.18% under the soil conditions of the experiment - ordinary chernozem with 25-27 cm humus layer and the average humus content of 4.21%. The accession 1040 and 1050 had the highest dry matter yield (at average 90.18%). The content of crude protein (counting on absolutely dry matter) ranged within 14.17-19.06% and averaged about 16.62 %. According to the content of protein all accessions belongs to Class II quality. It is necessary to conduct breeding in this direction, as the protein content is one of the important quality indicators in the forage crops. According to other researcher protein content in the second or third years of use vary depending on varieties - from 20.37 to 22.81% in Bulgarian variety Mnogolistna (Yancheva H.G., 2011[26]); from 22.4 to 22.7% in American cultivars Tough-459-New Stand, Fast and Baralfa 321 (Meshetovich V.N., Nokusheva J.A., 2012[27]).

On the basis of the statistical analysis (Table 1) it has been determined that the accessions 1042, 1045 and 1050 showed a smaller standard error of many studied characteristics than the standard variety "Kokshe".

The lowest standard error was observed in accession 1042. It showed high stability of many indicators: the dry matter weight ratio (90.10 ± 0.14), crude protein (15.41 ± 0.29), crude fiber (20.91 ± 0.11), crude fat (2.16 ± 0.02), crude ash (9.94 ± 0.07), carotin (18.10 ± 0.36). The accession 1050 is also stable, as according to the statistical analysis a lower standard error of several studied chemical parameters was observed: the dry matter weight ratio (90.18 ± 0.09), crude protein (16.65 ± 0.93), crude fat (2.34 ± 0.04), crude ash (10.31 ± 0.06). We can say that the accession 1045 also showed a smaller standard error and it had high stability in the following indicators: crude protein (16.95 ± 0.93), crude fat (2.35 ± 0.04), NFES (45.76 ± 0.02). With the same indications standard variety

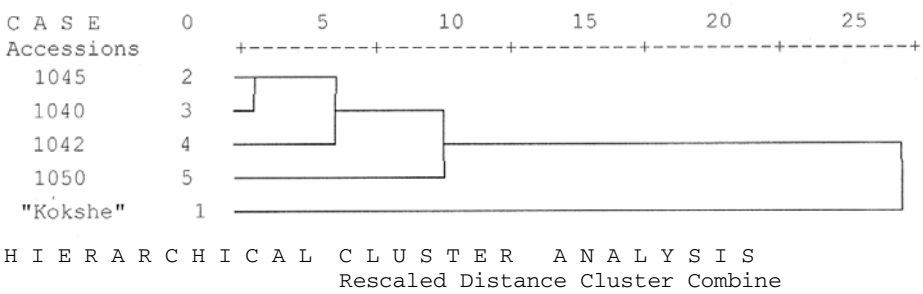

Fig. 1. Hierarchical cluster analysis of dry matter weight ratio and some chemical parameters of alfalfa accessions. Dendrogram of locating mean intergroup distances/ Dendrogram using Average Linkage (Between Groups)

Table 1. Some statistical characteristics for the investigated data / Descriptives

Descriptives			Accessions	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
							Lower Bound	Upper Bound		
Dry matter % weight ratio,			"Kokshe" (standard)	89.90	1.34	0.77	86.58	93.21	88.56	91.23
			1045	90.08	1.14	0.66	87.25	92.91	88.94	91.22
			1040	90.18	0.88	0.51	87.99	92.37	89.30	91.06
			1042	90.10	0.24	0.14	89.49	90.70	89.85	90.34
			1050	90.18	0.16	0.09	89.79	90.56	90.02	90.33
Carotin content mg/kg			"Kokshe" (standard)	23.09	8.12	4.69	2.93	43.24	14.97	31.20
			1045	17.89	7.49	4.32	-0.71	36.48	10.40	25.37
			1040	19.55	3.75	2.16	10.24	28.85	15.80	23.29
			1042	18.10	0.62	0.36	16.56	19.64	17.48	18.72
			1050	14.77	1.88	1.08	10.11	19.42	12.89	16.64
Weight ratio in dry matter	crude protein	%	"Kokshe" (standard)	16.62	2.45	1.41	10.54	22.69	14.17	19.06
			1045	16.95	1.61	0.93	12.96	20.93	15.34	18.55
			1040	16.91	2.16	1.24	11.55	22.26	14.75	19.06
			1042	15.41	0.51	0.29	14.14	16.68	14.90	15.92
			1050	16.65	1.61	0.93	12.66	20.63	15.04	18.25
	crude fiber	%	"Kokshe" (standard)	18.32	3.03	1.75	10.80	25.83	15.29	21.34
			1045	18.48	1.93	1.11	13.69	23.27	16.55	20.41
			1040	18.21	2.59	1.50	11.77	24.64	15.56	20.74
			1042	20.91	0.19	0.11	20.44	21.38	20.72	21.10
			1050	19.07	2.59	1.50	12.64	25.50	16.48	21.66
	crude fat	%	"Kokshe" (standard)	2.35	0.13	0.08	2.03	2.67	2.22	2.48
			1045	2.35	0.07	0.04	2.18	2.51	2.28	2.41
			1040	2.30	0.13	0.08	1.98	2.62	2.17	2.43
			1042	2.16	0.04	0.02	2.06	2.26	2.12	2.20
			1050	2.34	0.06	0.04	2.17	2.50	2.27	2.40
	crude ash	%	"Kokshe" (standard)	10.02	0.61	0.35	8.50	11.54	9.41	10.63
			1045	10.48	0.30	0.17	9.74	11.21	10.18	10.77
			1040	10.28	0.51	0.29	9.02	11.53	9.77	10.78
			1042	9.94	0.12	0.07	9.65	10.22	9.82	10.05
			1050	10.31	0.10	0.06	10.06	10.56	10.21	10.41
	NFES	%	"Kokshe" (standard)	46.70	0.16	0.09	46.30	47.10	46.54	46.86
			1045	45.76	0.04	0.02	45.67	45.84	45.72	45.79
			1040	46.37	0.20	0.12	45.87	46.87	46.17	46.57
			1042	45.54	0.68	0.39	43.86	47.21	44.86	46.21
			1050	45.59	0.77	0.44	43.68	47.50	44.82	46.36
	sugar	%	"Kokshe" (standard)	3.15	0.15	0.09	2.78	3.52	3.00	3.30
			1045	4.90	1.90	1.10	0.18	9.62	3.00	6.80
			1040	2.45	0.55	0.32	1.08	3.82	1.90	3.00
			1042	3.65	0.95	0.55	1.29	6.01	2.70	4.60
			1050	4.10	1.30	0.75	0.87	7.33	2.80	5.40

"Kokshe" had a higher standard error than other accessions: the dry matter weight ratio (89.90 ± 0.77), crude protein (16.62 ± 1.41), crude fiber (18.32 ± 1.75), crude fat (2.35 ± 0.08), crude ash (10.02 ± 0.35), NFES (46.70 ± 0.09), carotin (23.09 ± 4.69).

The analysis of variance for the investigated indicators showed that the individual accessions had an essential difference between the mean for NFES because significance of the analysis of variance was 0.046 (lapse rate ád"0.05) (Table 2).

There was no significant difference in investigated parameters among the accessions because the statistical analyses showed that

Table 2. Results of the module SPSS – ANOVA

Alfalfa accessions			F	Sig.
Dry matter weight ratio		%	0.051	0.994
Carotin content in dry matter		mg/kg	0.978	0.462
Dry matter weight ratio of	crude protein	%	0.371	0.824
	crude fiber	%	0.715	0.600
	crude fat	%	2.166	0.147
	crude ash	%	0.996	0.453
	NFES	%	3.600	0.046
	sugar	%	1.985	0.173

Table 3. Comparative analysis between the studied accessions done by the LSD method

Accessions	Dry matter	Carotin content in dry matter	Dry matter weight ratio of					
			crude protein	crude fiber	crude fat	crude ash	NFES	sugar
	%	mg/kg	%	%	%	%	%	%
"Kokshe"	89.90	23.09	16.62	16.50	2.35	10.02	46.70	3.15
1045	90.08$^{n.s.}$	17.89$^{n.s.}$	16.95$^{n.s.}$	18.32$^{n.s.}$	2.35$^{n.s.}$	10.48$^{n.s.}$	45.76*	4.90$^{n.s.}$
1040	90.18$^{n.s.}$	19.55$^{n.s.}$	16.91$^{n.s.}$	18.48$^{n.s.}$	2.30$^{n.s.}$	10.28$^{n.s.}$	46.37$^{n.s.}$	2.45$^{n.s.}$
1042	90.10$^{n.s.}$	18.10$^{n.s.}$	15.41$^{n.s.}$	18.21$^{n.s.}$	2.16$^{n.s.}$	9.94$^{n.s.}$	45.54*	3.65$^{n.s.}$
1050	90.18$^{n.s.}$	14.77$^{n.s.}$	16.65$^{n.s.}$	20.91$^{n.s.}$	2.34$^{n.s.}$	10.31$^{n.s.}$	45.59*	4.10$^{n.s.}$

* Evidence at the error level α=0,05
n.s. Difference is not significant

Table 4. Comparative analysis of any possible differences between the examined accessions by Duncan method

Accessions	Dry matter	Carotin content in dry matter	Dry matter weight ratio of					
			crude protein	crude fiber	crude fat	crude ash	NFES	sugar
	%	mg/kg	%	%	%	%	%	%
"Kokshe"	89.90^{a}	23.09^{a}	16.62^{a}	16.50^{a}	2.35^{a}	10.02^{a}	46.70^{a}	3.15^{ab}
1045	90.08^{a}	17.89^{a}	16.95^{a}	18.32^{a}	2.35^{a}	10.48^{a}	45.76 ^{b}	4.90^{a}
1040	90.18^{a}	19.55^{a}	16.91^{a}	18.48^{a}	2.30^{ab}	10.28^{a}	46.37^{ab}	2.45 ^{b}
1042	90.10^{a}	18.10^{a}	15.41^{a}	18.21^{a}	2.16 ^{b}	9.94^{a}	45.54 ^{b}	3.65^{ab}
1050	90.18^{a}	14.77^{a}	16.65^{a}	20.91^{a}	2.34a^{b}	10.31^{a}	45.59 ^{b}	4.10^{ab}

a, b, cThe degree of evidence at the error level ?=0,05

Table 5. Correlation coefficients between HTC, alfalfa leaf fraction and chemical indicators

Parameters			HTC	Leaf fraction weight ratio	Dry matter in the substance	Carotin content protein	Dry matter weight ratio crude fiber	crude fat	crude ash	crude	NFES	sugar
				%	%	mg/kg	%	%	%	%	%	%
HTC			1	0.703**	-0.220	-0.700**	0.867**	-0.764**	0.672**	0.614*	-0.081	0.137
Leaf fraction		%		1	-0.191	-0.458	0.524*	-0.453	0.515*	0.251	-0.067	0.426
Dry matter weight ratio		%			1	0.146	-0.399	0.402	-0.394	-0.440	-0.043	-0.408
Carotin content in dry matter		mg/kg				1	-0.709**	0.572*	-0.497	-0.777**	0.413	-0.023
Weight ratio	crude protein	%					1	-0.969**	0.898**	0.874**	0.122	0.081
in dry	crude fiber	%						1	-0.901**	-0.824**	-0.354	-0.019
matter	crude fat	%							1	0.800**	0.182	0.164
of	crude ash	%								1	-0.111	0.121
	NFES	%									1	-0.290
	sugar	%										1

** Evidence at the error level á=0,01
* Evidence at the error level á=0,05

significance was more á = 0.05. Meanwhile, the LSD method showed that variety "Kokshe" taken as the standard differed from the accession 1042, but the ANOVA has shown that significance with the crude fat was over á = 0.05 (á = 0.147). In this case, the results of LSD could be considered like incidental and this results do not have to be counted as a difference.

The results of the comparative analysis of alfalfa accessions were presented in table 3. As mentioned above, results of ANOVA showed that accessions differ by NFES (á = 0.046). With the LSD method we have specified the difference between the standard and the other investigated alfalfa accessions. With this indicator the standard differed in accessions 1045, 1042, 1050 with a certainty deviation at the error level á = 0.05. The rest of the studied indications do not demonstrate any significant difference between the standard "Kokshe" and the other analyzed alfalfa accessions.

The comparative analysis for determining any possible differences between the investigated accessions by the Duncan method is shown in Table 4. The accessions 1045, 1042, 1050 significantly differ in nitrogen-free extractives content from the standard.

The cluster analysis of the examined parameters: dry matter weight ratio, carotin content in the dry matter, weight ratio of crude protein, crude fiber, crude fat, crude ash, NFES, sugar in dry matter - has shown that the studied accessions samples form 5 clusters: accessions 1045 and 1040 form a single cluster, the Euclidean distance between them is the smallest (Figure 1). The rest of the accessions form separate clusters, which join the clusters of accessions 1045 and 1040 but their Euclidean distance is longer, the longest has cluster standard "Kokshe". The accessions 1045, 1040 are similar in their chemical composition and differ from others (1042, 1050, variety "Kokshe") in the above mentioned parameters. Thus, the investigated chemical composition of the standard "Kokshe" and other accessions was not similar (Figure 1).

The results of the used multifactorial SPSS statistical methods showed both positive and negative correlations. The strength of the correlations among the studied accessions was determined. The correlation dependence on a response of the quantitative indicator (HTC ...) with 9 other quantitative indicators (table 5) were analyzed. The correlation coefficient characterizes the strength of the correlations (e.g. HTC) with a set of indicators. Only those correlations, whose coefficient is positive or negative, have been taken into account: the mean (r = 0.5-0.7), high (r = 0.7-0.9) and very high (r > 0.9), and if the correlation is regular at 1 ! and 5 ! significance level. The results from this analyses was more reliable.

It was determined that HTC positively correlates with the following parameters: crude protein (r = 0.867 **), leaf fraction (r = 0.703 **) - high; crude fat (r = 0.672 **), crude ash (r = 0.614 *) - mean. However, crude fiber (r = -0.764 **), carotin (r = -0.700 **) had inverse correlation with HTC. The indicator protein shows significant positive correlations with crude fat (r = 0.898 **), crude ash (r = 0.874 **), (HTC (r = 0.867 **)), foliage (r = 0.524 *) and negative with crude fiber (r = -969 **), carotin (r = -0.709 **). Out of all the studied indicators, crude fiber positively correlates only with carotin (r = 0.572 *) and also has a significantly negative correlation with crude fat (r = -0.901 **), crude ash (r = -0.824 **) and HTC. Besides the ones listed above, crude fat shows a direct correlation with crude ash (r = 0.800 **) and leaf fraction (0.515 *). Carotin negatively correlates with crude ash (r = -0.777 **).

The effects of climate and other factors on the herbage chemical composition were determined by Shumakov A.V. (2000)[28]. Other authors Krasota V.F., Potokin V.P., Lebedev Y.V. (2011) also noted the variability of herbage chemical composition and its dependence on the climate factors: plants grown at lower temperatures contain more fiber, less fat and protein than plants growing in hot weather; protein content increases from north to south[29]. According to our data, the protein is directly dependent on the temperature (r = 0.867 **) and rainfall (r = 0.867 **). A positive correlation of hydrothermic coefficient with leaf fraction (r = 0.703 **) is probably due to the fact that the leaf is main organ of the photosynthesis. The rate of photosynthesis is a factor affecting crop yields. Temperature is one of the limiting factors for photosynthesis. The water is the starting substance for the photosynthesis: its deficiency in plants results in yield decreasing[30]. According to our data, the leaf fraction dependence on rainfall

and temperature was 0.703 **, though many authors noted that alfalfa through deeply penetrating root system is able to use the water from lower soil layers which other herbaceous plants cannot reach. Hydro stressful conditions contribute to the biosynthesis of photosynthetic pigments (chlorophyll, carotin ...) (Polevaya I.P., Metallov A.B., Illy I.E., 2005)[31]. The author regards a sharp increase in the biosynthesis of leaf pigments under such circumstances as the response of homeostatic reaction of the plants needing additional assimilates. The negative correlation of carotin with HTC (r = -0.700 **) confirms the data obtained by Kirsanov V.A. showing that plants both of the second and third years of life contain maximum carotin in cooler time and reduce its content during the periods of warm weather. The carotin content has negative dependence on precipitation and temperature (r = -0.700 **).

Ash is an inorganic material: calcium, phosphorus, magnesium, sodium, potassium, sulfur, iron and other mineral elements, including silicon [32]. Plants get ash elements from soil and water that are necessary for normal growth and development, such as the formation of the middle lamella, the normal development of the cell wall (calcium); synthesis of nucleic acids, ATP, several proteins (phosphorus); it is a part of the chlorophyll, cofactor of many enzymes (magnesium); cofactor of the enzymes involved in photosynthesis and respiration (glycolysis), a component of enchylema (sodium, potassium), ...[30]. The ash content increases with the rise of the HTC, temperature and rainfall (r = 0.614 *).

According to Gryazeva T.V. the correlation of dry matter and protein was negative high (r = -0.72)[33]. The results in table 5 showed that the signs of the weight ratio of dry matter, nitrogen-free extractives, and sugar do not correlate with HTC, leaf fraction, the carotin content in the dry matter, the weight ratio of crude protein in dry matter, crude fiber, crude fat, and crude ash.

The content of crude fat, NFES differed insignificantly from the stand age, moisture and temperature conditions. Besides, the chemical substances content is defined by the crop genetic potential. The values of the correlation coefficients of alfalfa accessions characterizing the strength of the parameters intercorrelation could be including in further studies.

CONCLUSION

The level of moisture content (HTC lower than 1) is one of the limiting factors for the first cut of alfalfa growing under conditions of North Kazakhstan. The alfalfa accession 1045 was with the highest value of crude protein, crude fiber, crude fat, crude ash, carotin, nitrogen-free extractive substance, and sugar. The accession 1045 showed a smaller standard error and higher stability of crude protein (16.95 ± 0.93), crude fat (2.35 ± 0.04), NFES (45.76 ± 0.02), and also differed from the others (1042, 1050, variety "Kokshe") by the chemical composition, and had a larger Euclidean distance from cluster standard "Kokshe". A high positive correlation of the parameter HTC - protein (r = 0.867 **), protein - crude fat (r = 0.898 **), protein - crude ash (r = 0.874 **), and a high negative correlation protein - crude fiber (r = - 969 **), crude fiber - crude fat (r = -901 **) are of interest in breeding. The accession with high leaf fraction could be used as marker for the selection of forms with a high protein content (0.524 *). Breeding work with alfalfa will continue with observing different accessions for valuable characteristics that could be used as marker parameters for the selection of high quality forms.

REFERENCES

1. Schepetkov, N.G., Scientific basis for efficient productivity of vegetable crops. Textbook. Astana: S.Seifullin Kazakh Agro Technical University, 2013; pp: 130.
2. Zhang, T., X. Wang, J. Han, Y. Wang, P. Mao, and M. Majerus, Effects of between-row and within-row spacing on alfalfa seed yields. //*Crop science*, 2008; **48**: 794-803.
3. Turan, M., F. Kiziloglu and Q. Ketterings, Phosphorum management of luzerne grown on calcareous soil in Turkey. //*J. Plant Nutrition*, 2009; **32**: 16-535.
4. Meyirman, G.T. and R.S. Masonichich-Shotunova, Alfalfa. Almaty. "Asyl kitap" 2012; publ. house, pp: 416.
5. Kravtsov, V.V. and V.A. Kravtsov, Cultivars of perennial and legume grasses to restore the feeding potential of hayfields and pastures. *Grassland*, 2002; **4**: 10-11.
6. Lazarev, D.A. and N.N. Shorin, Botanical composition and yield of clover and alfalfa-grass mixture with two or three cuts mowing. 60 years

of experiments with fertilizers geographic network: Bull. ARSRIFSS (All-Russian Scientific Research Institute of Fertilizers and Soil Science), 2001; **115**: 42.

7. Malets, I.F., Alfalfa at intensive forage production. Kiev: Crop, 1990; pp: 117.
8. Bondarev, V.A. *et al.*, Technology of forage silage. Moscow: FSSI (Federal State Scientific Institution) Rosinformagrotekh, 2003; pp: 5.
9. Prodak, N.I. and G. Peydun, Unconventional processing of alfalfa into multi-purpose production. Introduction of nonconventional and rare agricultural plants, III International Scientific and Production Conference, *Penza*, 2000; **1**: 217-218.
10. Gavrilov, A.M., Improving the efficiency of irrigated forage production. Scientific support for sustainable development of agriculture in the unsaturated zones of Russia, Proceedings of the scientific session, Moscow, 2000; pp: 198.
11. Popov, P.D., A.V. Sokolov and S.P. Zaman, Outlook for improving the productivity of forage land. *Agriculture,* 2002; **1**: 22-23.
12. Vitkus, A., Genus Medicago L. species as valuable forage and their biological characteristics: Abilitation work of the natural sciences. Vilnius, 1993; pp: 50.
13. Lotti, G., C. Paradossi and F. Marchini, ^{22} metabolismo proteico durante il ciclo di sviluppo di Medicago sativa-L. Agrochimica, 1991; **33**, 3\4: 362-373.
14. Sagalbekov, U.M. *et al.*, Characteristics of zoned and promising varieties of forage crops in Kokshetau region. Guidance note. Kokshetau, 1994; pp: 47.
15. Losev, A.P. and L.L. Zhurina, Agrometeorology. Moscow: Kolos, 2001; pp: 304.
16. Guidelines for the perennial grass breeding, Moscow: V.R. Vil'yams All-Russian Scientific Research Institute of forages, 1985; pp: 188.
17. V.M. Kosolapov, I.F. Draganov, V.A. Chuikova, Kh.K. Khudyakov, L.M. Korovina, F.V. Voronkova, M.V. Mamayev. Methods of feed analysis. - Moscow, 2011. - 219 p.
18. GOST 13496.4 -93. "Feed, mixed feed and raw mixed feed. Methods for determination of nitrogen and crude protein content".
19. Standard 13496.15-97. "Feed, mixed feed and raw mixed feed. Methods for determination of crude fat".
20. GOST 26226-95. "Feed, mixed feed and raw mixed feed. Methods for determination of crude ash".
21. ST RK GOST R 50817-2008. "Feed, compound feed, feed raw materials. Method for determining the content of crude protein, crude fiber, crude fat and moisture using spectroscopy in the near infrared region".
22. GOST 13496.17-95. "Feed. Methods for determination of carotene".
23. Guidelines for assessing the quality of forage, 2002. Moscow, pp: 75.
24. Nasledov, A.N., SPSS 19: professional statistical data analysis. St. Petersburg: "Piter", 2011; pp: 400.
25. Onkov, K., T. Mokreva and D. Stoianova, Metodichno rykovodstvo za izpolzvane na Baza danni za stareene na naselenieto na Bylgariia. Agraren Universitet, 2009; pp: 65.
26. Iancheva, Kh., LIuTsERNA: monografiia. Plovdiv: Akademichno izdatel'stvo na Agrarniia universitet, 2011; pp: 152.
27. Meshetich, V.N. and J.A. Nokusheva, 2012. The energy value and chemical composition of American selection alfalfa under northern Kazakhstan forest-steppe conditions. Agriculture, Forestry and Water Management. Date Views: http://agro.snauka.ru/2012/05/396.
28. Shumakov, A.V., The chemical composition of forage crops. *Animal Science,* 2006; **5**: 15-17.
29. Krasota, V.F., V.P. Potokin and Y.V. Lebedev, Factors influencing the feed chemical composition. "Breeding" 2011; Date Views: http://fermer02.ru.
30. Taylor, D., N. Green, W. Stout, 2013. Biology in 3 volumes. Vol. 1. Soper, R., Eds. Moscow: BINOM. Knowledge Laboratory, pp: 454.
31. Polevaya, I.P., A.B. Metallov and I.E. Illy, Photosynthetic yield of alfalfa cultivars green mass under the conditions of the Angara region. International applied research conference "Rotations, resource-saving technologies and soil fertility reproduction in the adaptive landscape agriculture of Angara region". The collection of materials (Irkutsk, October 19-22, 2005). Irkutsk, 2005; pp: 244-245.
32. Ryadchikov, V.G., Basics of farm animals' nutrition and feeding. Krasnodar: KSAU, 2014; pp: 616.
33. Gryazeva, T.V., Selection of alfalfa and sainfoin under the Rostov region conditions. // Dissertation abstract of Candidate of Agriculture, Zernograd, 2005; pp: 24.