Study of chemical (macroelement) composition of plants growing in Kostanay Region

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Abstract. The article presents the results of research conducted on the content of some nutrients (Ca, Mg, C, P, K) in plants of different families on the territory of Amangeldinsky district of Kostanay region. As an object of research, the leading families were chosen: *Poaceae, Chenopodiaceae, Asteraceae* and *Brassicaceae, Caryophyllaceae, Liliaceae, Apiaceae, Ranunculaceae.* From 102 species of higher vascular plants growing on the surveyed territory, 80 species of economically useful ones were studied: medicinal (34), fodder (34), essential oil (6), food (7), 30 ornamental (30) and technical value (6). When studying the composition of chemical elements (macronutrients) of rangeland plants of the study area, it is shown that the maximum value of chemical element was 0.98%. It is indicated that nutrient elements mainly enter the plant through the root system from the soil. Data on the content of Ca, Mg, C, P, K in the root system and above-ground part of the studied plants showing different composition are given. According to the results of the analysis, the average value of the pastures showed that the percentage of calcium 0.98%, potassium 3.28%, carbon 46.27%, magnesium 0.17% and phosphorus 0.15% in the plots.

1 Introduction

Chemical elements in every living organism play some important role and are in close contact with each other. Even in plants, deficiency of any nutrient element causes numerous fluctuations in the metabolic process.

Depending on their physiological role in living organisms can be divided into three groups. The first group includes structural elements (macronutrients), which form the bulk of all organs and tissues of the plant organism. The second group includes essential elements (trace elements), which are physiologically necessary for the vital activity of living organisms and perform many functions in cells. The third group includes toxic elements, which even at very low levels can have a toxic effect and lead to intoxication (aluminum, lead, cadmium, cadmium, chromium, silver, beryllium, etc.) [1, 2]. Mostly nutrient elements enter the plant

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through the root system from the soil. Calcium and magnesium are found in soil and plants in the form of divalent cation Ca^{2+} and Mg^{2+} [3]. Alteration in ionic balance disrupts photosynthesis, which is the main function of the plant [4]. The uptake of many essential nutrients is affected by the interaction of sodium (Na+) and ions in the soil solution and the selectivity of membranes towards ions. Extracellular Na+ reduces the intracellular influx of potassium (K+) and impairs the production of this important nutrient by leaves, shoots and roots [5]. All organic bonds in plants include: protein, hydrocarbons, organic acid, vitamins, and fat. Carbon comes from the air through the leaf stomata in the form of carbon dioxide CO_2. In the process of photosynthesis in green leaves, hydrocarbons are formed from carbonic acid and water and other organic matter, proteins, organic acids, depending on the conditions of photosynthesis. Organic matter in soil is a huge store of nutrients for plants and an effective defense against pollution. It can also bind atmospheric CO_2 [6]. The amount of carbon dioxide can be increased by using organic fertilizers [7]. In this regard, the purpose of the study is to analyze the content of some macronutrients in plants of different families growing in Stepnyak settlement, Amangelda district, Kostanay region.

2 Materials and Methods

The field study was firstly conducted in an area 10 m wide and 10 m long in each study area, identifying the plants in the area based on the reference trait to determine which family they belong to and what percentage they occupy in the area [8]. We recorded them in a diary, indicating their numerical values. The plant sample was taken from the 4 corners and the center of the square. In determining which family the plant belonged to, the focus was on the flower, leaf shape and roots of the plant. The average percentage of distribution of each family in each region was calculated for inclusion in the graph [8]. Determination of the amount of trace elements in the samples.

This analysis process was detected using a special program called Unity Spectro Star. The elements identified in the samples were: Ca; Mg; C; P; K [9]. The systematics of plants is given according to the POWO [10].

3 Results and Discussion

The use of radiocarbon showed that the amount of carbon delivered through the roots from soil carbonate is 1-5% of the total carbon assimilated by the low carbon plant. The carbon dioxide content in the air of the ripped layer reaches 0.3% and increases to 1.5% with deepening.

Table 1. Percentage content of macronutrients in harvested plants.

№	Sample name	Ca,%	K,%	C,%	Mg,%	P,%
1	2	3	4	5	6	7
1	R – 44	0.84	2.90	44.93	0.12	0.18
2	R – 15	1.14	3.51	46.24	0.19	0.14
3	R – 33	0.81	3.08	46.35	0.13	0.17
4	R – 65	0.94	3.14	46.64	0.19	0.11
5	R – 16	0.64	2.39	46.63	0.11	0.10
6	R – 20	1.26	3.33	46.74	0.26	0.12
7	R – 17	0.88	3.17	46.19	0.15	0.18
8	R – 42	0.86	3.36	46.36	0.14	0.14
9	R – 09	0.72	3.17	45.02	0.06	0.20
10	R – 47	0.77	3.00	46.63	0.14	0.16
11	R – 23	0.61	2.88	46.74	0.11	0.12

Continuation of Table 1

12	R – 01	1.12	3.84	46.14	0.20	0.17
13	R – 46	1.29	1.46	45.96	0.38	0.12
14	R – 62	1.09	3.51	46.62	0.20	0.12
15	R – 48	0.90	3.62	46.09	0.12	0.15
16	R – 14	0.93	3.62	46.05	0.10	0.15
17	R – 02	1.04	3.57	46.21	0.18	0.17
18	R – 22	1.15	3.59	46.56	0.22	0.11
19	R – 27	1.05	3.42	46.34	0.17	0.14
20	R – 63	1.04	3.28	46.60	0.21	0.14
21	R – 10	0.82	3.15	45.37	0.09	0.19
22	R – 19	1.13	3.70	46.43	0.18	0.15
23	R – 59	1.00	3.21	46.74	0.24	0.13
24	R – 29	1.00	3.34	46.91	0.18	0.12
25	R – 49	0.90	3.29	46.92	0.19	0.13
26	R – 58	0.99	2.81	44.83	0.12	0.21
27	R – 37	1.18	3.54	47.05	0.28	0.15
28	R – 26	1.10	3.50	46.52	0.22	0.15
29	R – 57	0.75	2.58	46.56	0.13	0.15
30	R – 54	0.96	3.31	46.48	0.18	0.15
31	R – 64	1.02	3.69	47.11	0.22	0.16
32	R – 34	1.13	3.88	45.09	0.19	0.23
33	R – 32	1.14	4.30	45.47	0.18	0.21
34	R – 07	1.10	3.38	46.70	0.24	0.14

Note: R – rangelands

The study in the area as shown in the table, the percentage of macronutrients in plant composition was determined. The average of the pasture showed that the percentage of calcium-0.98%, potassium-3.28%, carbon-46.27%, magnesium-0.17% and phosphorus-0.15% in the sites.

From the total number of 102 species of higher vascular plants growing on the surveyed territory we studied 80 species of economically useful: - 34 medicinal, 34 fodder for animals, 6 essential oil plants, 7 food plants, 30 ornamental and 6 species of technical importance. (Table 2).

Table 2. Classification of studied plants according to their economic importance.

No.	Plant families, species	How to use					
		Medicinal	Animal feed	Essenal-oil	Food	Beauty	Technical
	Type						
1	2	3	4	5	6	7	8
Poaceae Barnhart							
1	*Agropyron pectinatum* (M.Bieb.) P.Beauv.		+			+	
2	*Alopecurus pratensis* Bourg. ex Lange	+	+				
3	*Bromopsis inermis* Leyss.		+				
4	*Elytrigia repens* (L.) Gould		+				
5	*Eremopyrum orientale* (L.) Jaub. & Spach		+				
6	*Eremopyrum triticeum* (Gaertn.) Nevski		+				

Continuation of Table 2

7	*Festuca valesiaca* Schleich. ex Gaudin		+				
8	*Koeleria cristata* Pers.					+	
9	*Koeleria macrantha* (Ledeb.) Schult.					+	
10	*Leymus ramosus* (K. Richt.) Tzvelev		+				
11	*Poa bulbosa* L.		+				
12	*Stipa capillata* L.					+	
13	*Stipa lessingiana* Trin. & Rupr.		+				
Chenopodiaceae Vent.							
1	*Anabasis salsa* (Ledeb.) Benth. ex Volkens		+				
2	*Atriplex cana* Ledeb.		+				+
3	*Atriplex sagittata* Ledeb.		+		+		
4	*Bassia sedoides* (Pall.) Asch.		+				
5	*Camphorosma monspeliaca* L.	+		+			
6	*Ceratocarpus arenarius* L.		+				
7	*Chenopodium acuminatum* Willd.	+					
8	*Climacoptera brachiata* (Pall.) Botsch.		+				
9	*Kochia prostrata* (L.) Schrad.		+				+
10	*Salsola orientalis* S.G.Gmel.		+				
Asteraceae Bercht. & J.Presl							
1	*Achillea nobilis* L.	+	+	+		+	
2	*Artemisia austriaca* Jacq.	+	+	+			
3	*Artemisia lerchiana* Weber ex Stechm.		+	+			
4	*Artemisia nitrosa* Weber ex Stechm.	+		+			
5	*Artemisia pauciflora* Weber ex Stechmann		+				
6	*Filago arvensis* L.	+				+	
7	*Galatella villosa* (L.) Rchb.f.	+					
8	*Jurinea multiflora* (L.) B.Fedtsch.					+	
9	*Senecio dubitabilis* C.Jeffrey & Y.L.Chen	+					
10	*Serratula cardunculus* (Pall.) Schischk.	+					
11	*Serratula dissecta* Ledeb.	+					
12	*Tanacetum achilleifolium (*M.Bieb.) Sch.Bip.	+	+		+		
Brassicaceae Burnett							
1	*Alyssum desertorum* Stapf		+				
2	*Descurainia sophia* (Lange) Sauvage & Vindt	+					
3	*Euclidium syriacum* (L.) W.T.Aiton	+					
4	*Lepidium perfoliatum* L.	+					
5	*Lepidium ruderale* L.	+					+
6	*Lepidium songaricum* Schrenk ex Fisch. & C.A.Mey.	+					
Caryophyllaceae Juss.							

Continuation of Table 2

1	*Eremogone longifolia* (M.Bieb.) Fenzl					+	
2	*Gypsophila paniculata* L.	+				+	
3	*Silene viscosa* (L.) Pers.	+				+	
4	*Spergularia segetalis* (L.) Vill.	+					
5	*Stellaria Graminea* L.	+					
Liliaceae Juss.							
1	*Gagea bulbifera* (Pall.) Salisb.						+
2	*Ornithogalum fischerianum* Krasch.						+
3	*Tulipa biflora* Pall.						+
4	*Tulipa patens* C.Agardh						+
5	*Tulipa schrenkii* Regel						+
Apiaceae Lindl.							
1	*Chaerophyllum prescottii* DC.					+	
2	*Falcaria vulgaris* Bernh.	+	+			+	
3	*Ferula caspica* M.Bieb.	+					
4	*Ferula tatarica* Fisch. ex Spreng.	+					
5	*Palimbia salsa* (L.f.) DC.						+
Ranunculaceae Juss.							
1	*Ranunculus platyspermus Fisch. ex DC.*	+					+
2	*Ranunculus polyrhizus Soleirol ex Nyman*	+					+
Lamiaceae Martinov							
1	*Phlomoides tuberosa (L.) Moench*	+				+	+
Cyperaceae Juss.							
1	*Carex praecox* Schreb.		+				
2	*Carex stenophylla* (L.H.Bailey) Hultén		+				
3	*Carex riparia* Curtis		+				
Polygonaceae Juss.							
1	*Atraphaxis frutescens* (L.) K.Koch	+	+				
2	*Polygonum patulum* M.Bieb.	+					
Plumbaginaceae Juss.							
1	*Limonium suffruticosum* (L.) Kuntze					+	+
Rosaceae Juss.							
1	*Potentilla humifusa* Willd. ex D.F.K.Schltdl.	+					+
2	*Spiraea hypericifolia* L.	+					+
Scrophulariaceae Juss.							
1	*Verbascum phoeniceum subsp. flavidum (Boiss.) Bornm.*					+	
2	*Veronica spicata*	+				+	
Boraginaceae Juss.							

Continuation of Table 2

1	*Lappula stricta (Ledeb.) Gürke*		+				
2	*Onosma tinctoria M.Bieb.*					+	
Crassulaceae J.St.-Hil.							
1	*Pseudosedum lievenii* (Ledeb.) A.Berger	+				+	
Ephedraceae							
1	*Ephedra distachya* L.	+			+		
Alliaceae Borkh.							
1	*Allium pallasii* Murray				+		
Fabaceae Lindl.							
1	*Astragalus cornutus* Pall.				+		
Geraniaceae Juss.							
1	*Geranium linearilobum* DC.				+		
Plantaginaceae Juss.							
1	*Plantago tenuiflora* Waldst. & Kit.		+				
Rubiaceae Juss.							
1	*Galium ruthenicum* Willd.		+		+	+	
Valerianaceae Batsch.							
1	*Valeriana eriophylla* (Ledeb.) Utkin	+	+	+			

According to the results of the study, Table 2 shows that fodder and medicinal plants such as *Alopecurus pratensis, Camphorosma monspeliaca, Chenopodium acuminatum, Achillea nobilis, Artemisia austriaca, Artemisia nitrosa* are dominant , *Artemisia pauciflora, Filago arvensis, Galatella villosa, Senecio dubitabilis, Serratula cardunculus, Serratula dissecta, Tanacetum achilleifolium,* which have a wide range of application and use for medicinal purposes and fodder for livestock. A special place in the study of vegetation cover of different regions has essential oil plants, here they are represented by the following species: *Camphorosma monspeliaca, Achillea nobilis, Artemisia austriaca, Artemisia lerchiana, Artemisia nitrosa*. Of the recorded plants, the families *Poaceae* and *Asteraceae* predominate.

4 Conclusion

Macronutrients (Ca, Mg, C, P, K) vital for plants, they are involved in the regulation of various physiological and biochemical processes in their organism.The analysis of life forms showed that perennial herbaceous plants are the main ones. The analysis of life forms showed that perennial herbaceous plants are the main ones. Their share is 83.3%. The plants were found to contain sufficient amounts (>0.1% of dry weight) of calcium, magnesium, carbon, phosphorus, potassium (Ca, Mg, C, P, K), which play an important role in the life cycle.

The use of radiocarbon has shown that the amount of carbon delivered through roots from soil carbonate is 1-5% of the total carbon assimilated by a low-carbon plant. The carbon dioxide content in the air of the ripped layer reaches 0.3% and increases to 1.5% when deepening. The high index of macronutrients in the composition of collected plants showed carbon - 46.27%.

According to the results of the study it is shown that fodder and medicinal plants dominate, which have a wide range of application and use in medicinal purposes and livestock feed.

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