Ecology of a nitrate exchange of plants of the Kaliningrad region

Olga Victorovna Yastreb

The Immanuel Kant Baltic Federal University, Nevskogo str., 14, Kaliningrad, 236000, Russian Federation

Abstract. The article shows the problem of dependence of a nitrate exchange of plants (Festuca pratensis, Dactylis glomerata, Cirsium arvense) from ecological factors in the considered coastal region of Russia. It is revealed that regardless of the latitudinal distribution of common nitrogen concentration in the soil of the Kaliningrad region variations in accumulation of nitrates by different types of plants are observed at different remoteness from the sea.
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Introduction

In the modern world there is a sharp problem of shortage of food resources. One of methods of its elimination is the intensive agriculture. In the Kaliningrad region as priority branch of agriculture the animal husbandry as about 50% of the territory occupy pastures and the haymakings, allowing to receive a good and cheapest nutrition for cattle – grassy forages [1] is chosen. The lack of grassy forages and their low nutritional value, imbalance of fodder diets, first of all on protein and amino acids, considerably constrain animal husbandry development. A number of factors affects on the content of nutrients in grassy sterns: specific feature of a plant to accumulate separate substances, conditions of growth of plants (the soil, its acidity and stock existence in it available nitrogen, phosphorus, a potassium and etc. elements), botanical composition of herbage, a phase of vegetation in which there is a scouring or sloping of plants on a forage, climate and weather conditions, supply of plants with moisture during the various vegetation periods. Phytocenose, an exposition of a slope on which plants grow, thickness of herbage and degree of opacity can also affect on chemical composition of separate herbs [2].This research is considered for clarification of regional features of nitrogenous metabolism of meadow plants depending on ecological factors.

Materials and methods

As a result, of the reconnaissance researches the selection of sites with endemic indexes of fertility was made with the subsequent laying of constant trial platforms on meadows of representative sites. The special attention was paid to convergence of granulometric composition, reaction of soil solution, to organic content, and also the relative frame forms of phosphorus and potassium. Trial platforms covered all territory of the Kaliningrad region to the east from coastal part of the Baltic Sea in interval of 30-40 kilometers. Plants were analyzed in a flowering phase. The whole plant together with root system was used for the analysis. In total 11 trial platforms were studied which presented in figure 1.

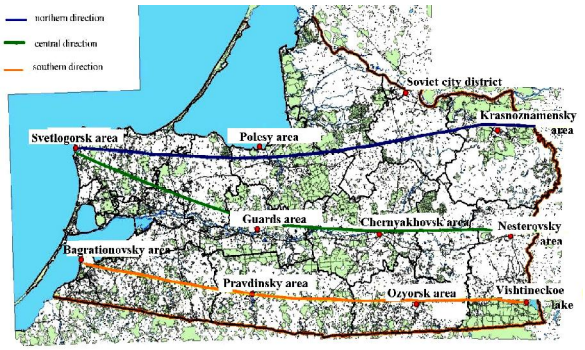

Fig. 1. Arrangement of trial platforms on the territory of the Kaliningrad region

For comparison of the received results were chosen 3 directions depending on geographical coordinates: northern (Svetlogorsk, Polesye areas, Soviet city district, Krasnoznamensky area), central (Svetlogorsk, Guards, Chernyakhovsk, Nesterovsky areas) and southern (Bagrationovsky, Pravdinsky, Ozyorsk areas and southeast of the Nesterovsky area).

Also in research dominant types in meadow phytocenoses were studied: Festuca pratensis, Dactylis glomerata differing big agropower effectiveness and efficiency in accumulation of a protein [3], and also widespread Cirsium arvense. Besides plants was made a selection of soil samples for the subsequent analysis of the content of common nitrogen [4]. For an assessment of common nitrogen in the soil GOST 26107-84 “Soils. Methods of definition of common nitrogen” was used [5]. The content of nitrogen in plants was carried out by a method Kyeldalya [6, 7, 8] on the device

"SPEKL10". The experimental data are processed statistically with Microsoft Office Excel program.

Results and discussion

During research it was established that concentration of common nitrogen in the soil varies from 0,095 to 0,180 mg/kg that corresponds to data on chemical composition of cespitose and podsolic soils of the Kaliningrad region. This type of the soil provides low natural fertility [9]. Depending on the width arrangement of a trial platform, it is noted that the central and southern directions have a common tendency of accumulation of common nitrogen whereas the northern differs an inverse relation, as shown in figure 2.

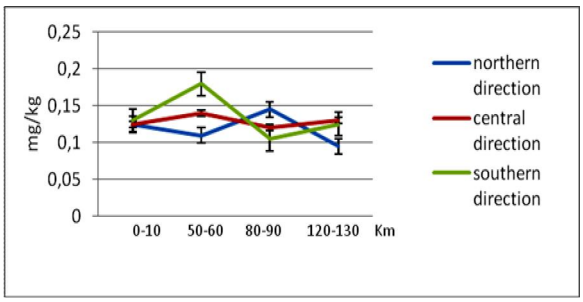

Fig. 2. Accumulation of common nitrogen in the soil of Kaliningrad region depending on geographic latitude

So, for example, near the coast of the Baltic Sea and Vistula Lagoon concentration of common nitrogen is not really different (0,125 and 0,130 mg/kg respectively), after 50-60 km on the southern and central directions gradual accumulation of nitrogen in the soil occurs whereas on northern its concentration decreases. Apart 80-90 km from a coastal zone on the southern direction the concentration of nitrogen in the soil decreases, on northern on the contrary increases. Every 40-50 km the concentration of nitrogen on the northern direction reaches a minimum for the Kaliningrad region whereas on the southern and central directions remains in mean values.

The concentration of nitrates of Dactylis glomerata (fig. 3) varied from 32,5 to 124,0 mg/kg that is the maximal value of accumulation of nitrates among the studied plants.

In literature it is noted that Dactylis glomerata is the most productive agricultural plant.

Except the maximal values in the central part of area, the considerable fluctuations in accumulation of Dactylis glomerata of nitrates is not very depended on width and remoteness from coastal part of area.

The concentration of nitrates in plants of the Kaliningrad region (mg/kg)

Region	Dactylis glomerata	Festuca pratensis	Cirsium arvense
Svetlogorsky region (54,897002;19,940947)	48,0±4,3	25,5±0,4	57,0±6,9
Bagrationovsky region (54,556473;19,973949)	32,5±7,4	18,5±0,4	38,5±1,3
Polessky region (54,90145; 21,057143)	48,5±7,4	19,5±0,4	13,5±1,3
Gvardeisky region (54,649881; 21,045197)	53,5±21,35	33,5±3,0	47,5±7,4
Soviet city region (55,064005; 21,94695)	42,0±5,2	65,0±32,27	54,5±24,0
Pravdinsky region (54,450898; 21,011513)	63,5±7,4	19,5±1,3	22,5±3,9
Chernyahovsky region (54,634834;21,785835)	38,0±2,6	41,0±3,5	37,5±13,51
Ozersky region (54,419742; 22,010593)	56,0±5,54	37,0±5,2	27,5±2,2
Krasnoznamensky region (54,950784;22,504506)	45,0±17,5	41,0±3,5	31,5±12,6
Nesterovsky region (54,628829; 22,583942)	124,0±64,62	42,5±12,6	53,5±1,3
Ozersky region (54,425846; 22,680631)	38,0±3,5	25,5±3,0	33,0±1,7
Middle values	53,5±15,4	33,5±8,57	38,0±8,6

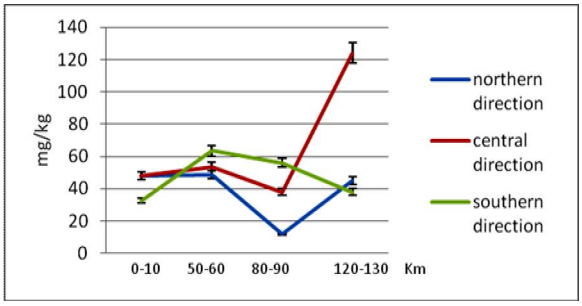

Fig. 3. Accumulation of nitrates of Dactylis glomerata depending on geographic latitude of the Kaliningrad region

Variations of concentration of nitrates are noted in Festuca pratensis (fig. 4) - from 18,5 to 65,0 mg/kg. In the central and southern directions with general tendency of increasing the concentration of nitrates in Festuca pratensis is observed the peak with the maximal concentration of nitrates (65,0 mg/kg – northern and 37,0 mg/kg – southern the directions) apart 80-90 km from the sea.

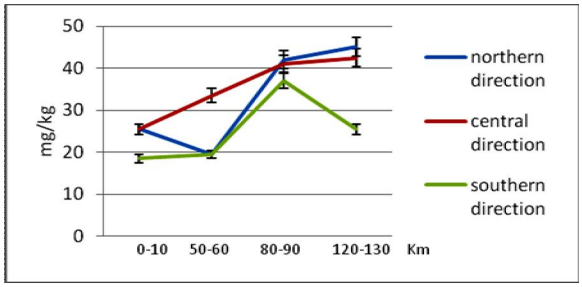

Fig. 4. Accumulation of nitrates in Festuca pratensis depending on geographic latitude of the Kaliningrad region

The concentration of nitrates in Cirsium arvense fluctuated from 13,5 mg/kg to 57,0 mg/kg (fig. 5). In the central width is the maximal concentration of the saved-up nitrates, in southern - minimum are noted, and in northern - two minima apart 50-60 km and 120-130 km from the sea are noted.

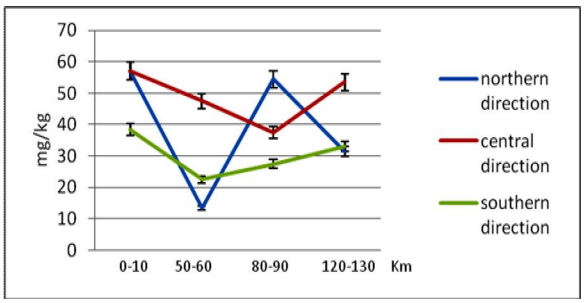

Fig. 5. Accumulation of nitrates in Cirsium arvense depending on geographic latitude of the Kaliningrad region

Comparing data on the content of common nitrogen in the soil and nitrates in plants it is possible to make the following conclusions. Regardless of the latitudinal distribution of concentration of common nitrogen in the soil of the Kaliningrad region are stable and a little variable but that it is impossible to tell about the concentration of nitrates in different types of plants.

The greatest stability in accumulation of nitrates among plants differs Dactylis glomerata, the maximal index of concentration on one trial platform (removal by the 120-130 km) is bound, apparently, to the previous importation to the soil of nitrogenous fertilizers. The coastal zone of the Baltic Sea differs lower air temperatures, high humidity and almost continuous wind influence. It is possible to say that plants of a coastal zone are in less favorable conditions [10]. In such conditions increases the reaction of the maintenance of antioxidants that raises plants resistance to stress [11]. Therefore, from three studied plants Dactylis glomerata keeps an endogenic pool of nitrates irrespective of remoteness degree from the sea.

For Festuca pratensis is typical the increase in concentration of nitrates with gradual removal from coastal areas, with peaks of the maximal concentration apart 80-90 km from the sea. Inverse tendencies are noted for Cirsium arvense: the maximal values of concentration of nitrates are found in coastal areas and they are decreasing during removal from the sea.

As recommendations Dactylis glomerata can be suggested to use as sowing culture for all regions of the Kaliningrad region since for it steadily high concentration of nitrates are typical. Festuca pratensis can approach as a sowing culture only in areas removed from the sea apart 80-90 km.

Corresponding Author:
Dr.Yastreb Olga Victorovna
The Immanuel Kant Baltic Federal University
Nevskogo str., 14, Kaliningrad, 236000, Russian Federation

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