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STUDY OF PLANT ROOT SYSTEM IN NATURAL GRASSLANDS OF Mt. ARAGATS

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The work is devoted to the investigation of plant underground biomass changes along the vertical belts of south-west slope of Mt. Aragats. It is well-known, that the production rate and stability of mountain pastures and hayfields are mainly determined by the capacity of plant root system. It was revealed that according to vertical belts the coarse fraction of roots (diameter more than 1 mm) varied within 1023-2357 g, volume and absorbing surface – 4.3-9.8 dm³ and 34-89 m² per unit area of pasture, correspondingly. Meanwhile, the maximum values of all studied parameters were found in the subalpine and minimum ones in dry steppe zones except of root fine fraction (diameter 0.25-1 mm). In addition, a close relationship between all studied root biometrical parameters was revealed.

Grasslands – plant root biomass – root volume – root absorbing surface

Աշխատանքը նվիրված է Արագած լեռան հարավ-արևմտյան լանջի ուղղաձիգ գոտիականության երկայնքով բույսերի ստորգետնյա զանգվածի փոփոխման ուսումնասիրմանը: Հայտնի է, որ լեռնային արոտների և խոտհարքների արդյունավետության մակարդակը ու կայունությունը հիմնականում պայմանավորված է բույսերի արմատային համակարգի հզորությամբ: Պարզվել է, որ արմատների կոպիտ զանգվածն (տրամագիծը ավելի քան 1 մմ) ըստ ուղղաձիգ գոտիականության տատանվել է 1023-2357 գ, ծավալը և կլանող մակերևույթը՝ համապատասխանաբար 4.3-9.8 դմ³ և 34-89 մ² արոտի միավոր մակերեսի հաշվով: Միևնույն ժամանակ, ուսումնասիրված բոլոր ցուցանիշների բարձր արժեք դիտվել է ենթալպյան, իսկ նվազագույնը՝ չոր տափաստանային գոտում, բացառությամբ արմատների նուրբ ֆրակցիայի (տրամագիծը 0.25-1 մմ): Հայտնաբերվել է նաև սերտ փոխկապվածություն՝ արմատների բոլոր ուսումնասիրված կենսաչափական ցուցանիշների միջև:

*Կերահանդակներ-բույսերի արմատային զանգված-արմատների ծավալ-
արմատների կլանող մակերևույթ*

Работа посвящена исследованию изменений подземной биомассы растений вдоль вертикальных поясов юго-западного склона горы Арагац. Известно, что уровень продуктивности и устойчивость горных пастбищ и сенокосов в основном определяются мощностью корневой системы растений. Обнаружено, что по вертикальной поясности грубая фракция корней (с диаметром более чем 1 мм) варьировала в пределах 1023-2357 г, объем и поглощающая поверхность – 4.3-9.8 дм³ и 34-89 м² в расчете на единицу площади пастбищ, соответственно. Между тем, максимальные значения всех изученных параметров были обнаружены в субальпийском, а минимальные – в сухостепном поясе, за исключением тонкой фракции корней (диаметр 0.25-1 мм). Установлена также тесная взаимосвязь между всеми исследуемыми биометрическими параметрами корней.

*Кормовые угодья – биомасса корней растений – объём корней – поглощающая
поверхность корней*

Natural grasslands of Armenia serve as a principal fodder resource for animal husbandry. The proportion of pastures and hayfields makes about 60% of the country's agricultural lands. Many studies have shown [4, 9, 10] that production level of local grasslands is rather low mainly due to insufficient amount of precipitation and uncontrolled grazing. It is well-known that in mountain ecosystems the productivity of plant associations and their functional stability are closely related to the level of root capacity. In root biomass there are two fractions, including coarse or conductive (diameter > 1 mm) and fine-absorbing (0.25-1 mm), which provide plants with water and mineral elements. Besides, thanks to root system soils are enriched with humus, moreover root nodule bacteria of legumes also fix and accumulate atmospheric nitrogen [1,7]. Therefore, investigation of the structure of herbage plant roots and their distribution by soil layers has an important practical significance for increasing production rate of natural grasslands.

Many studies have shown that underground biomass makes of a significant proportion in total yield of mountain ecosystems, although this phenomenon mainly depends on the peculiarities of plant species and their location along vertical zones [2,8,12,13]. This work addresses the study on biometric parameters of fodder plants underground biomass sampled from different vertical zones.

Materials and methods. The study was carried out in 2013-2015 at natural grasslands of Nerqin Sasnashen community of Aragatsotnmarz (Armenia). The experimental sites were located in the dry steppe (1000-1400 m), meadow-steppe (1700-2200 m) and sub-alpine zones (2400-2670 m a.s.l.) on southwest slope of Mt. Aragats. At the experimental sites there are 3 types of soils (bright chestnut, chernozem and mountain meadows) the content of humus varied within 3-15%, pH – 7-5.5, nitrogen – 0.13-1.0, phosphorus – 0.15-0.5, potassium – 2.6-1.0%. Mean annual precipitation along studied vertical belts fluctuated from 300 to 800 mm and air temperature within 7.5-2.5°C. The following genera of grass, legume and forb meadow groups dominated in studied experimental sites: *Bromus* L., *Poa* L., *Agropyrum* Garm., *Festuca* L., *Phleum* L., *Stipa* L., *Koeleria* Pers., *Onobrychis* Mill., *Trifolium* L., *Vicia* L., *Artemisia* L., *Euphorbia* L., *Achillea* L., *Prangos* Lindl., *Scabiosa* L., *Betonica* L. [3, 11].

Sampling of root biomass was carried out at three experimental sites on a depth 20-30 cm of soil layer using folding meter (with 5.0 dm² surface). To separate the coarse and fine root fractions, the soil samples were washed using sieves with pores' diameter 1 and 0.25 mm, correspondingly. The volume of coarse fraction was determined using graduated cylinder and absorbing surface by I. Kolosov method [6]. Then, both root fractions were dried at 65-70°C and weighed. Statistical analysis of experimental data was done using IBM SPSS Software.

Results and Discussion. The data on root coarse fraction biometric parameters obtained for studied experimental plots are presented in the tab. 1. It is obvious that the mean value of root dry weight, volume and absorbing surface varied within 1023-2357 g, 4.3-9.8 dm³ and 34-89 m², correspondingly, per 1m² soil surface. The maximum value of studied parameters was observed in subalpine zone, which exceeded the same indices for dry steppe zone by 2.3-2.6 and meadow steppe 1.2-1.7 times. This phenomenon may be explained by lower level of root decomposition observed at higher zone than those located below [5].

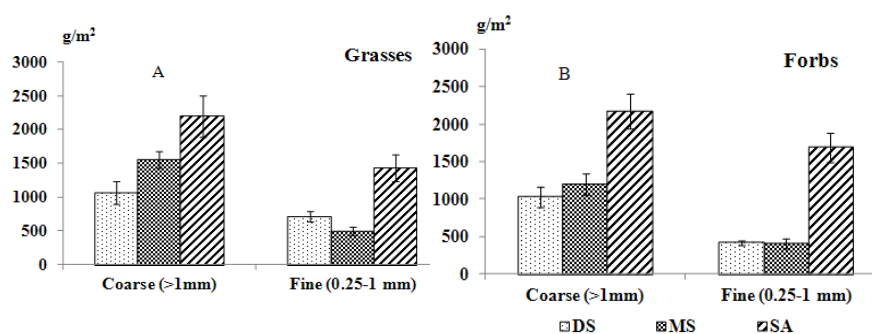
It was revealed that there is a wide range of variation and close correlation between studied parameters, i.e. the higher root biomass the larger its volume and absorbing surface indices. For example, the coefficient of variation (the ratio of maximum value to minimum) changed within 2.5-4.3; 2.0-4.4 and 1.8-10.6 correspondingly for root biomass, volume and absorbing surface, which probably was connected with the patchiness of vegetation cover. ANOVA t-test analysis revealed a significant difference (p<0.05) between all studied parameters except root absorbing surface obtained for meadow steppe and subalpine zones.

Table 1. Changes in some biometric parameters (per 1 m² area) of coarseroot fraction according to vertical belts

Vertical belt	Dry weight, g	Volume, dm ³	Absorbing surface, m ²
Dry steppe	<u>1023±105</u>	<u>4.3±0.5</u>	<u>34±2.9</u>
	657-1617	2.9-5.8	25-46
Meadow steppe	<u>1531±89</u>	<u>5.8±0.3</u>	<u>76±6.3</u>
	605-2620	2.5-11	15-158
Subalpine	<u>2357±254</u>	<u>9.8±0.8</u>	<u>89±7.8</u>
	1136-4078	6.2-14.2	45-145

The data on dry weight of root coarse and fine fractions (diameter more than 1 mm and 0.25-1 mm respectively) of studied plant groups for 3 experimental sites are presented in fig. 1.

The root coarse fraction of this plant group varied within 1026-2171 g/m² and similarly to grasses it increased bottom-up according to studied vertical belts.

**Fig. 1.** Impact of vertical zones on roots' coarse and fine fractions

Approximately equal values of fine fraction were found in the dry and meadow steppe zones (≈ 410 g/m²), as to subalpine zone this parameter was more than 4 times higher than in the lower zones. Moreover, a significant difference was observed between the dry weight of both fractions of the studied plant groups ($p < 0.05$). It is necessary to mark that the weight of coarse fraction always exceeds the fine one from 1.3 to 3 times depending on vertical belts, and as a rule, the maximum values were found in meadow steppe zone. Statistical analysis showed that the standard error of mean values varied within 7-15% and revealed a significant difference ($p < 0.05$) between the dry weight of coarse and fine root fractions of both plant groups except the data on forbs grown at subalpine zone. A wide range of variations of some biometrical parameters of grasslands' underground biomass located at three vertical zones of Mt. Aragats was revealed. The maximum values of all studied parameters were found in subalpine and minimum steppe zones. It was shown that roots coarse fraction of grass and forbs plants exceeded the fine one by 1.5-2.5; 3.1-2.9 and 1.5-1.3 for the dry steppe, meadow steppe and subalpine zones.

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