SOIL AND FOREST CHARACTERISTICS OF THE SAMPLE PLOTS IN THE CONDITIONS OF SOD-PODZOLIC SOILS OF THE FOREST EXPERIMENTAL GARDEN, RUSSIAN STATE AGRARIAN UNIVERSITY — MOSCOW TIMIRYAZEV AGRICULTURAL ACADEMY

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In this paper, the influence of sod-podzolic soils with different expression of sod and podzolic processes of soil formation the formation of pure coniferous and deciduous, and mixed forest stands in terms of educational scientific consulting center "the Forest experimental cottage". Identified the relationship of physico-chemical properties of soil from silvicultural and forest inventory indices of the studied stands. In this regard, was a complex of forests and soil studies, which include the laying of soil profiles with detailed description of the soil horizons, the holding of descriptions of woody vegetation with the establishment of the age, vertical and horizontal structure of forest stands growing.

Key words: silvicultural-taxation characteristics of forest sod-podzolic soil; humus; physico-chemical properties of soils; forest litter; soil moisture

Stance forest experiment RSAU-MAA named after Timiryazev is a unique natural research laboratory in which, beginning in 1862, regular monitoring of the condition, growth, structure, structure and productivity of forest vegetation. A great contribution to the conduct of silvicultural and forest research this area was made by A.R. Vargas de Bedemar (1863), M.K. Toursky (1893), N. With. Nesterov (1917, 1935), V.P. Timofeev (1965, 1966), A.N. Poles (1993, 2003).

On permanent sample plots, along with the taxonomic studies of forest stands are carried out and soil studies. The first assessment of soil was made A.R. Vargas de Padamara using as a basis data on the growth of pine plantations, it was proposed to establish three classes of quality of soils [9]. In the future soil of the Forest experimental garden has been the object of scientific research carried out under the leadership of such scientists as S.K. Soloviev (1889), I.P. Grechin (1954, 1955, 1957), B.D. Zaitsev (1964), V.D. Naumov (2005, 2009, 2015).

Influence of forest ecosystems on structure, composition and properties of sod-podzolic soils to date remains largely debatable. Karpachevsky (1977, 1996, 1997) in their works, constantly raised the question: what comes first. The change of soil under the influence of vegetation, or, on the contrary, differentiation of vegetation depending on soil properties. Numerous studies [2; 4; 7; 8] it was found that private forest plantations have different impacts on the emerging properties of soils. Gavrilov [4], and later Demin [6], confirmed that under other equal conditions (climate, position in the relief, Genesis and granulometric composition of soil-forming rocks) there is a significant difference in morphology and chemical properties of soil under different forest crops.

Largely unclear is the question of the role of sod and podzolic processes in the formation of sod-podzolic soils. According to Lebedeva, Tonkonogov [8], organogenic horizons are mostly carriers of a near memory associated with the capacity of modern external environment; and eluvial median horizon, keep, especially, information about the properties of Litomerice and transformed in the process of soil formation substrate and are native mostly a distant memory, associated with the peculiarities of soil formation in terms of climate and biota in past stages. The upper horizons of the soils to the greatest extent affected by changes in heat and moisture corresponding to the fluctuation of these parameters for seasons and years. Their formation is dependent on the receipt of litter and mortality, their number, nature and speed of decomposition of organic matter, the characteristics of the process of humification. Soil-forming processes affect primarily the upper strata of soils that are experiencing the most vivid reflection of the intensity and specifics of their manifestations, dynamics and orientation, also in the literature there is a reverse opinion. In studies of T.N. Minina (1992), conducted on sod-podzolic soils not confirmed the statement about high dynamic labile forms of humus. For received data, significant differences in the content of organic substances that go into the pyrophosphate extract during 3 months (May-July), was absent, this was observed in soils with different humus content.

Thus, the analysis of literature data showed that there are different points of view on the question of the role of the arboreal plantations of different composition on the properties of forest sod-podzolic soils. Insufficiently studied question on seasonal dynamics of organic matter in soils under different tree plantations. Of great interest is the question of changing productivity of forest stands in dependence on properties of soils in the urban environment. All this served as the basis for our research.

The aim of the study is to determine the mobility of various forms of humus under coniferous and pure deciduous, and mixed forest, establish the relationship between the capacity of the forest litter, field moisture content and qualitative composition of humus horizon. In this regard, was a complex of forests and soil studies, which include the laying of soil profiles with detailed description of the soil horizons, the holding of descriptions of woody vegetation with the establishment of the age, vertical and horizontal structure of forest stands growing.

As object of research was chosen permanent Stance forest experiment RSAU-MAA named after Timiryazev, 11M, 11E, 8H, 8O, 4O, 4N, 4M, 4L.

These data indicate the heterogeneity of the soil cover of the Forest experimental garden, which is due not only to heterogeneity in topography, but also different history and composition of woody vegetation.

The manifestation of such important properties as field soil moisture, in the present examples were specific. Identified a definite pattern under pure plantations (both under broad-leaved and coniferous), humidity was slightly higher than under mixed. Thus, it is possible to notice that such indicator as field soil moisture depends on the composition of wood plantations. This is because the woody vegetation creates a special microzone. Therefore, it is possible to notice that the climate, from the point of view of soil moisture, is specific under pure plantation in comparison with mixed plantations. Humidity is closely tied to microbiological processes in the soil, its value depends on their intensity. This indicator reflects the status of all modes. So we needed to watch this indicator in dynamics.

Table 1

Soil characteristics of the forest inventory sample plots

Room quarter	Plot	Age, years	Tier	The composition of the stand	Diametr, cm	Height, m	Class productivity	Completeness	Stockm3/he	Soil	Capacity Ao, cm	Capacity A1, cm	Capacity A1A2, cm	Capacity A2, cm
11	M	265	I	4Oak5Linden 1Birch single Elm, Maple	65,3 39,0 39,2	29,4 27,5	II	0,76	408,1	$П^{Дог-2}_{3/5}$ лс Мс	3	11	15	16
11	E	90	I	9Oak1Linden single Pine, Elm	32,1 39,6 26,1	25,3	II	0,79	314,0	$П^{Дог-1}_{1/3}$ сп Мп	2	8	13	18
8	H	110	1	8Oak2Linden single Pine	35,9 41,3 29,6	24,0 26,4	III	1,04	378,2	$П^{Дог-1}_{4/4}$ лс Мсп	5	13	13	17
8	O	120	I	6Oak4Linden	35,2 11,6	27,4	II	0,94 0,10	439,4	$П^{Дог-3}_{3/5}$ лс Мп	4	14	19	15
4	O	120	I	10Pine single Birch, Elm	30,9	25,3	II	1,07	465,8	$П^{Д}_{3/5}$ лс Млс	1	6	22	14
4	N	120	I	10Pine single Elm, Linden	28,4	25,0	II	0,91	340,4	$П^{Д}_{1/2}$ лс Млс	1	5	14	19
8	M	138	I	9Pine1Linden ед. Birch, Elm,Oak	27,6	24,4	II	1,09	432,9	$П^{Д}_{1/4}$ лс Мп	1	4	20	11
4	L	120	I	9Pine1Linden single Oak, Birch, Maple	25,6	25,2	II	1,01	414,3	$П^{Д}_{1/5}$ лс Млс	1	5	16	11

Was drawn up a diagram of distribution of values of field moisture of each month in the pilot areas and graphs of the distribution of this value separately for each area for 7 months (June—October, April—may).

It is noticed that the character of moisture distribution in the pilot areas in April, may, June and September were similar — large values of the field moisture was observed under pure oak and pine plantations for 5—10% less moisture was soil under mixed oak and pine forest. In July there was a slightly different picture — the difference in moisture in all areas was only 5% lower than the value observed under mixed pine and oak pure stands. In August, the driest month, the lowest moisture was in the soil samples under mixed and pure oak, but in mixed and pure pine plantations humidity was higher not by much. In October, a smaller value of field moisture was observed under the pure pine and mixed oaks.

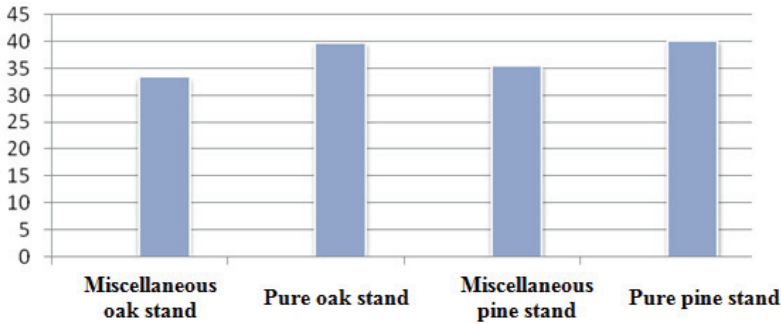Figure 1 presents the average values of field moisture.

Figure 1. Average values of field moisture depending
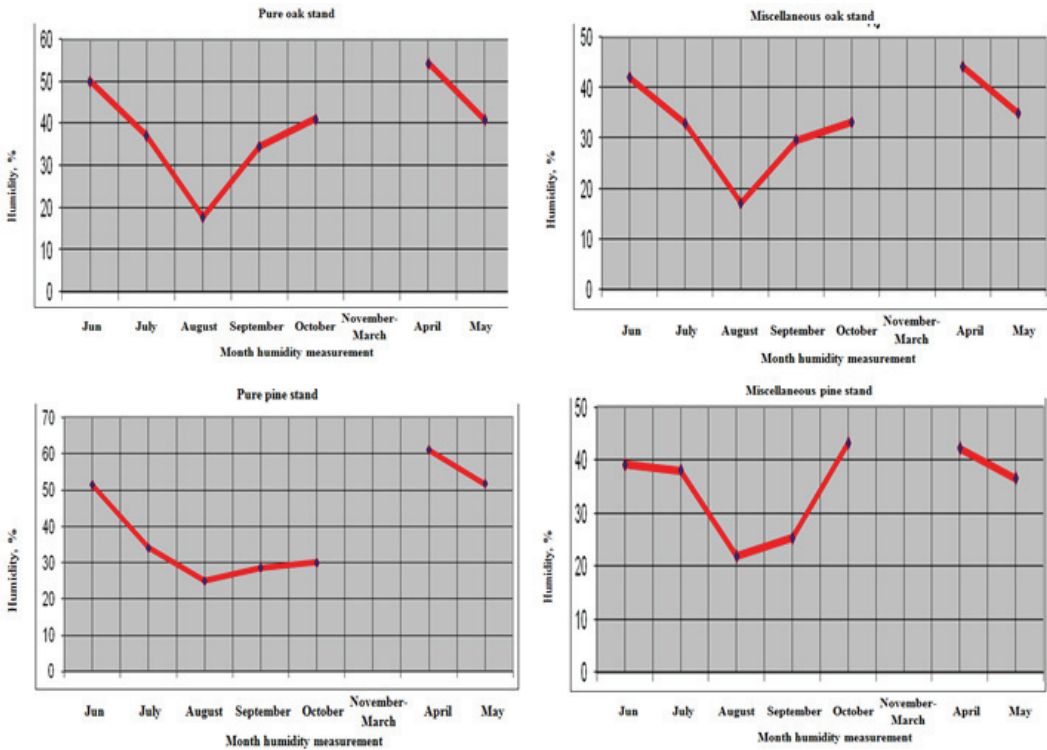on the composition of wood plantations

Figure 2. Change the field of humidity under pure
and mixed oak and pine forest

The nature of the change of soil moisture under pure and mixed plantations is similar, maxima in spring months, and the lows in August, which is associated with the composition of plantations object of study. Under mixed and pure oak plantations change in the field of humidity occurred similarly, and under mixed pine plantations was observed, a slightly different picture in June and July humidity had a rather larger values and modified slightly in August, its value has decreased dramatically, little changed by September, and in October there was another high, and not very different in magnitude from the results taken in April of the following year. Under the pure pine plantations, the maximum value of humidity was observed in June and April, and the changes from July to October was pretty smooth.
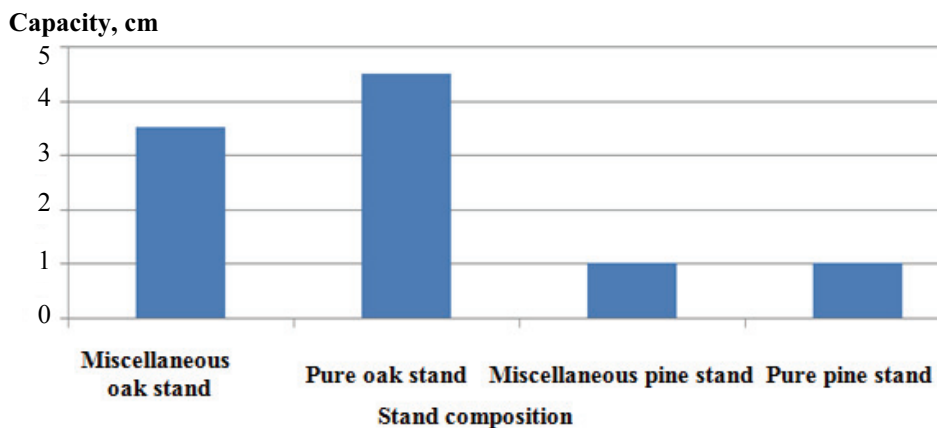
Capacity, cm

Figure 3. The capacity of the forest litter

According to Morozov (1912), litter plays a dominant role in the issue of forest impact on soil. Mats serve as the first battery and natural substances, the most important source of rolling organic substances, which migrate in the soil profile and within the profile of the litter is a sequential transformation of organic matter of the litter. The composition and structure of litter varies depending on the structure of forest stands, development of undergrowth, age, completeness, and sanitary condition. Properties of forest litter are in close genetic connection with the composition of plant residues, which formed a litter, and from the context in which the formation. A study of the forest litter showed that its capacity is closely linked with the composition of wood plantations (figure 3).

This diagram clearly shows that the capacity of the forest litter depends on the wood plantings presented on this space. The maximum value of power observed on the area of VIII H and VIII square O involved in pure oak plantations. Slightly less power is the A_0 horizon on the test areas M and E XI quarter, due to the fact that here in addition to oak, there are plantations and other tree species. The same power of the forest litter are plot O, N, M, L, IV block, located under the Mixed and pure pine plantations. The capacity of the A_0 horizon in these areas are minimal and make 1 cm, and are almost decayed and very thick. Hence it can be concluded that the litter of broad-leaved trees are more abundant and easier to transform.

Forest litter was collected in dynamics by months (June—October, April—may). Table 16 clearly describes the changes its power depending on the time of selection and composition of the woody planting plots.

The capacity of the forest floor, as can be seen from table 3, it is highly dynamic, which changes not only depending on the composition of plantations, but depending on the time of sampling.

As noted above, the largest capacity of the horizon A_0 was observed under deciduous stands, and lowest under conifers. However, this figure varies depending on the time of year. The maximum capacity of the litter observed in October, because at this time there is a leaf fall, and in the composition of litter is not only a waste of the past, but the litter of the current year. Under pure coniferous plantations changes the capacity of the forest litter was not observed, and under mixed coniferous — a slight increase in October, which is due to the litter of deciduous trees and underbrush.

Capacity of the forest litter in the investigated test areas

Plot	A month sampling						
	Jun	July	August	September	October	April	May
	The capacity of the forest litter, cm						
11 M	2	2	2	3	6	3	3
11 E	3	2	2	4	6	4	3
8 N	5	4	5	5	6	5	5
8 O	4	3	4	4	5	5	5
4 O	1	1	1	1	2	1	1
4 N	1	1	1	1	1	1	1
4 M	1	1	1	1	1	1	1
4 L	1	1	1	1	1	1	1

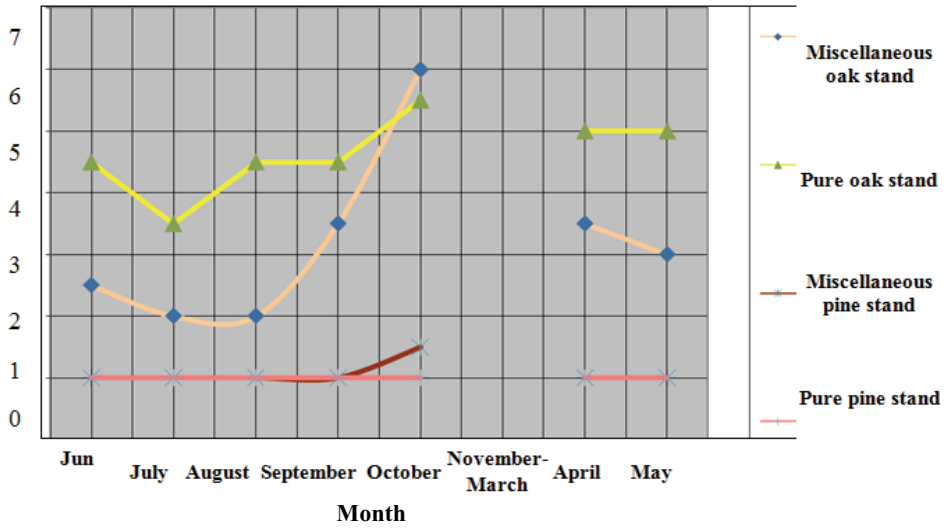**The capacity of the forest litter, cm**

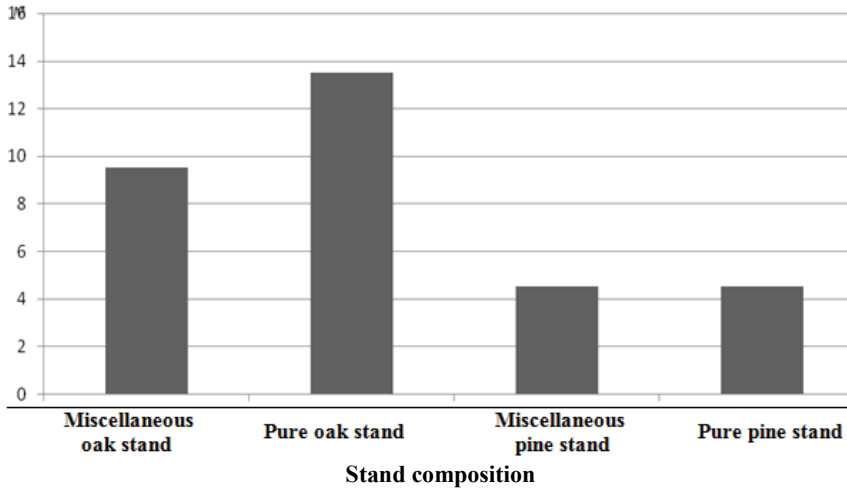**Figure 4.** The capacity of the forest floor

Capacity, cm

Figure 5. The capacity of humus horizon

The minimum capacity of the litter observed in the summer months (June—August), at this time, the conditions for microbial growth are optimal, manifested their active life, expressed increased rate of biological decomposition of the organic substrate (figure 4).

The humus-eluvial horizon in different experimental areas is presented in chart form in figure 5.

On the picture you can see that the humus-eluvial horizon depends on the composition of plants on sample plots. The greatest capacity of the A_1 horizon surface areas with a predominance of deciduous vegetation, which is faster transformered and contributes to the accumulation of soil organic matter. In Piazza VIII grow On pure oak stands, the humus-eluvial horizon there was the highest.

A little less power had the A1 horizon in Piazza VIII N, here the wood vegetation is presented by oak trees. The space occupied mixed oak plantations were even less sensitive to the power of the humus-eluvial horizon, but the lowest it was in the squares IV N I M engaged in mixed and pure pine plantations slightly more power horizon A_1 in the squares of the fourth quarter and L are also employed in mixed and pure pine plantations.

The dependence between the humus-alluviales the horizon and capacity of the forest floor. The highest values are observed under broad-leaved forest and lowest under conifers.

The research conducted in the soil on permanent sample plots Forest experiment station RGAU-MAA showed that between the capacity of the forest litter, humus-alluviales horizon, the value of humus content, its qualitative composition, as well as field moisture content revealed the General nature of the distribution, which indicates their close relationship. As can be seen from the graphs, between the considered indicators of the close relationship, which is determined by the composition of wood plantations. The capacity of the forest litter, field soil moisture depends primarily on the composition of the plantings and, as our research has shown, dynamically change according to months and seasons. It is the composition of the forest affects sod soil-forming process and, as a consequence, it is displayed in the capacity humus-alluviales horizon and humus content in sod-podzolic soils. The dependence between the parameters determined by the composition of woody plants, humus content and its qualitative composition.

Soil reflects both genetic and biogeocenosis properties, the resulting functioning of the forest ecosystem. Changes in the soil caused by the effects of various forest crops, ultimately lead to changes in forest properties, which in turn affects the nature of the plantations and their productivity.

Insights

1. Conducted inventory survey of pilot areas 11, 8, and 4 blocks. Studied composition and age of trees. Tree planting area M (4Д5Лп1Б units In a, CL, I) and E (9Д1Лп units. With, In) the 11th quarter are mixed, with a predominance of oaks; N (8Д2Лп units C) and (10Д4Лп) 8th quarter is represented by pure stands of oaks; ON(10S unit B, E, V) and N (10C per, PL, B) 4th quarter are mixed stands dominated by pine trees, and M (9C1Лп units B, C, D) and L (9C1Лп units D, B, C) is the pure pine plantations.

2. Morpho-genetic study of sod-podzolic soils showed that the sample area differ according to the capacity and composition of litter and the power of humus and eluvial

horizons. Most power horizons A_0 and A_1 was observed under the pure and mixed oak plantations. The capacity of the forest litter on the areas with mixed pine and pure pine plantations differed only slightly. The humus layer was higher in the soil under mixed pine, compared to pure pine plantations.

3. The Capacity of the forest litter and humus layer have similar patterns. With the increase in the share of broad-leaved trees in mixed plantings increases the humus layer.

4. The Capacity of the forest litter was changed only slightly under pure and mixed coniferous stands, the reverse situation was observed on the sample areas with deciduous vegetation. Least power A_0 is marked in summer, when the rate of decomposition of organic matter maximum, due to the high activity of microorganisms. Maximum amount of litter observed in October after leaf under deciduous trees, and the minimum in summer under coniferous vegetation. The capacity of the forest floor varies depending on the season of the year.

5. Found that a positive effect on the soil have a broad-leaved tree species, which contribute to the formation of a more powerful humus horizon in comparison with soils under pine plantations. Reducing the capacity of the humus horizon is noted in the series: pure oak plantations — mixed plantations of oak — pine mixed stands and pure pine stands.

6. The Amount of hygroscopic moisture varies slightly by month and not depend on the composition of wood plantations.

7. The value of the field humidity varies by month and depending on the composition of wood plantations. This preserves the General pattern: field moisture content is higher in soils of the sample plots in almost all months occupied by pine plantations and lower in soils of plots with oak plantings.

8. In the soils under deciduous vegetation, the humus content is higher than under the mixed and pure coniferous stands.

9. The dependences between indicators: the capacity of forest litter, field moisture content, humus content and qualitative composition of humus horizon.

REFERENCES

[1] Bogatyrev L.G., Sapozhnikova V.A., Voegele A.A. Transformation of organic matter in the pine ecosystem as one of the criteria of estimation of intensity of cycle. Bulletin of Moscow University, No. 3, 1999, pp. 13—24.

[2] Vargas de Bedemar A.R. Mensuration forest cottage Petrovskaya agricultural Academy. A handwritten report. M., 1863, p. 281.

[3] Gavrilov K.A. Impact of different forest plantations on the soil. Forestry, No. 3, 2000, pp. 30—37.

[4] Gerasimova M.I., Isachenkova L.B. "Short memory" of sod-podzolic soils in forest regeneration successions In the book "soil Memory". M.: Publishing house LKI, 2008. P. 638—649.

[5] Demin G.V. Influence of different forest types on the content and qualitative composition of humus in soddy-podzolic soils. // Forest Bashkortostan'. Modern heritage and prospects. Ufa, 2004.

[6] Dobrovolsky G.V. Diversity of the Genesis and functions of forest soils // Soil science. 1993.

[7] Karpachevsky L.O., Stroganova M.N. General regularities of soil formation in the forest zone // Soil formation in forest biogeocenoses, Nauka, 2006.

[8] Lebedeva I.I., Tonkonogov V.D. Memory of the genetic horizons of the soil profile and the Memory of soils. M.: Izd. LCI, 2008. P. 162—180.

[9] Morozov, G.F. The doctrine of the forest. 3 edition, state publishing house, Leningrad, 1928.

[10] Naumov V.D., Polyakov A.N. 145 years of the Forest experimental garden, Russian state agrarian University-MTAA named after K.A. Timiryazev. M.: Publishing house of Russian state agrarian University-MAA, 2009. 511 p.

[11] Naumov V.D., Rodionov B.S., Gomonov A.V. Estimation of forest growing conditions of tree plantations on the territory of LOD RGAU-MAA // Mat. International scientific-practical Conf. "Science in information space". Dnepropetrovsk, 2013. 77—83.

[12] Naumov V.D., Rodionov B.S., Gomonov A.V. Comparative assessment of soil and vegetation on sample plots of LOD under mixed and pure coniferous and deciduous trees // Izvestiya. 2014. No. 2.

[13] Naumov V.D., Smirnova M.A. Morphogenetic classification and evaluation of sod-podzolic soils of the Forest experimental garden, Russian state agrarian University-MAA named after K.A. Timiryazev // Izvestiya, 2009; № 2.

[14] Polyakov A.N., Khlyustov V.K. Foresters Peter's and the Timiryazev Academy. M.: Publishing house of Russian state agrarian University-MTAA, 2009. P. 149.

ПОЧВЕННО-ТАКСАЦИОННАЯ ХАРАКТЕРИСТИКА ПОСТОЯННЫХ ПРОБНЫХ ПЛОЩАДЕЙ ЛЕСНОЙ ОПЫТНОЙ ДАЧИ РГАУ-МСХА ИМЕНИ ТИМИРЯЗЕВА В УСЛОВИЯХ ДЕРНОВО-ПОДЗОЛИСТЫХ ПОЧВ

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В статье рассмотрено влияние дерново-подзолистых почв с разным проявлением дернового и подзолистого процессов почвообразования на формирование чистых хвойных и лиственных, а также смешанных древостоев в условиях учебно-научного консультационного центра «Лесная опытная дача». Выявлены взаимосвязи физико-химических свойств почв с лесоводственно-таксационными показателями исследуемых древостоев. В связи с этим был проведен комплекс лесотаксационных и почвенных исследований, которые включают в себя закладку почвенных разрезов с детальным описанием почвенных горизонтов, проведение описания древесной растительности с установлением возрастной, вертикальной и горизонтальной структуры произрастающих древостоев.

Ключевые слова: лесоводственно-таксационная характеристика, лесные дерново-подзолистые почвы, гумус, физико-химические свойства почв, лесная подстилка, влажность почвы