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INFLUENCE OF THE GROUND ENVIRONMENT ON THE DIAGNOSTIC WILD PLANT SPECIES DIVERSITY

Abstract. The role of soil cover in the biosphere and human economic activity is well-known, but an established and substantiated assessment of its qualitative state becomes important. Preliminary soil diagnostics and establishment of its physical and chemical properties are carried out using vegetation cover, in particular, diagnostic plant species as indicators of the studied components of the environment state. The nature of the soil, its structure, density, oxygen content, salts, nutrients, and habitat can be determined using plant indicators.

The species diversity of wild diagnostic plants in the trial areas of Drohobych was determined. *Equisetum arvense* L., *Hepatica nobilis, Ranunculus repens, Plantago major* L., *Urtica dioica*, and *Arctium lappa* were among the most common diagnostic species.

It was found that the diagnostic plant species growing in the trial areas corresponded to those ecological groups, which vital functions correlate with certain soil environmental factors. Their dominance is related to the chemical composition of the soil. Diagnostic species can serve as indicators for the conditions of humidification, acidity, salinity, and excess salt content, as well as the nitrogen, calcium, magnesium, potassium, and other nutrients available in the soil.

As a result of the studies, it was found that, in general, the soils of the sample areas are acidic and slightly acidic (pH from 5.1 to 6.4), weakly and medium humus (2.6–3.7% of humus), with a relatively average content of gross nitrogen (0.12–0.27%) and phosphorus (0.05–0.14%), relatively poor on K_2O and P_2O_5 in the upper horizon. In general, vegetation in the trial plots was heterogeneous in terms of floristic features, and biological and cenotic properties. Some species of plants were at different stages of their development.

Indicator plants should be used to estimate both the soil cover state and the general state of the environment.

Key words: soil, indicator plants, soil cover, physical and chemical properties.

INTRODUCTION

Soil cover study, the study of an important natural resource of the country, possesses a special place among many problems of today. Soil occupies a leading place in human life and performs global socio-economic functions along with plants, animals, microorganisms, groundwater, and atmospheric air. Life on the planet is impossible without soil. It provides a constant interaction of large geological and small biological circuits of substances on the earth's surface, regulates the chemical composition of the atmosphere and hydrosphere, and accumulates active organic matter and associated chemical energy. The life of plants, their growth and development, and the life of all living organisms are closely related to the environment, particularly soil cover. The soil provides plants with nutrients necessary for their life, plants serve as soil indicators. Diagnostic species react quite sensitively to the nutrient content in the soil, and the availability of the nutrients in the soil [2, 15].

The role of soil cover in the biosphere and human economic activity is well-known, but an established and substantiated assessment of its qualitative state becomes important. Preliminary soil diagnostics and establishment of its physical and chemical properties are carried out using vegetation cover, in particular, diagnostic plant species as indicators of the studied components of the environment state. Based on the ecological characteristics of plant organisms and their reactions to the influence of environmental factors, eurebiont species are distinguished, in which there is a wide adaptive capacity for growth conditions, and stenobiont species, which have a limited narrow range of changes of a certain factor with a low adaptive capacity. It is the wallbionts (plant organisms or their populations), in which vital functions are quite closely correlated with certain environmental factors, that are used for soil bioindication [1, 5].

Plants are affected by three groups of edaphic factors: the physical properties of the soil, and its chemical and biotic composition. Edaphic conditions are of exceptional importance for plants since the soil is the habitat of plants, the substrate for their consolidation. The relationship between plants and the soil environment is determined by the physical and chemical properties of soils and the totality of all living organisms that inhabit them. Ecological groups of plants have several common adaptive features to a particular habitat factor. The distribution of plants into environmental groups in relation to external factors is quite conditional since in nature environmental factors are always combined into complexes. The adaptation of certain plant species to a certain set of environmental conditions is a kind of sensor with which the presence of certain elements in the soil can be detected. Plants having the ability to accumulate in their tissues substances formed as a result of the plant's interaction with external factors can act as indicators [5, 17].

The use of indicator plants is advisable both for assessing the general state of the environment and for identifying specific pollutants. Monitoring is carried out both at the level of phytocenoses (plant groups) and the level of individual species. Indicator properties are detected both in the presence and absence of a certain species. Indicator plants are used in the assessment of soil fertility, their mechanical and acid composition, moisture content and salinity, etc. Both the presence and absence of the species are of indicative importance [19].

A rather effective characteristic of plant conditions is the appearance and size of growing plants. Thus, the low productivity of plants, and unattractive appearance, indicate the inconsistency of plant conditions with environmental needs and their presence in this place. Accordingly, the improvement in the condition of the populations suggests an increase in soil nutrients and the provision of humidity [9, 16].

The nature of the soil, its structure, density, oxygen content, salts, nutrients, and habitat can be determined using plant indicators. Living conditions can stimulate or interfere with species in their struggle for living space with other plants. Indicator properties are particularly pronounced in wild herbaceous plants. Particularly pronounced indicator properties in wild herbaceous plants, according to which the physical and chemical properties of the soil can be predetermined, in particular the content of moisture, nutrients, salts, acidity, etc. In turn, the physical and chemical properties of soils affect the growth and development of plants and their spread [1, 2, 18].

The purpose of our study is to establish the dependence of the species composition of wild plants in the Precarpathian on the physical and chemical properties of the soil environment.

MATERIALS AND METHODS

Determining the physical and chemical properties of soils were carried out on the territory of Drohobych district in May–August 2021–2022. The studies included three main stages. In the first stage, the survey of the research area was carried out, a general route familiarization with the state of the vegetation cover was carried out, trial areas in phytocenoses with wild vegetation (the predominant growth of diagnostic species) were selected and the species diversity of diagnostic species was determined there. Trial areas were laid taking into account the growth of plant populations-indicators of natural biocenoses.

Plot No.1 – the site is located on abandoned farmlands, where meadows have been formed, and the soil is typical turf-podzolic surface-glazed.

Plot No.2 – fir-oak forest nodule with complete soaking of the root-containing soil layer with precipitation and melt water, gray forest soil with a flushing regime.

Plot No.3 – the site is located along the forest road, on the galley, the forest soil is gray with a partial flushing regime.

Plot No.4 – the site is located on the glades of mixed forest, the age structure of wood stands is uneven, and the soil is brown and podzolic with an incomplete flushing regime.

Plot No.5 – an area of abandoned farmland, vegetation is represented by a significant variety of groups, the soil is sod and slightly podzolic.

The species diversity of diagnostic species was determined using plant determinants. In the second stage, soil samples were taken for research on the selected sample areas. Soil samples were taken by Nekrasov's drill, mixing them from several points. At the third stage of research, the physicochemical properties of the selected soil samples were determined according to the tested methods (humus – according to the Tyurin method; pH of the aqueous and salt extract – potentiometrically; mobile potassium and phosphorus – according to the Kirsanov methods) [3, 10].

DISCUSSION

The territory of the Pre-Carpathian is located in a transitional strip between the northeastern slopes of the Ukrainian Carpathians and the northwestern landscape of the Podolia highlands. The region is characterized by differences in the relief, climatic and biological factors of soil formation, and the groundwater occurrence level, which contributed to the formation of different morphologies, genesis, and spectrums of soil formation [7].

Landscapes of the Drohobych region belong to the Drohobych foothills of the Dniester Pre-Carpathian. The territory houses different types and subtypes of soils; thus, the region is characterized by a significant complexity and diversity of soil formation conditions. Profile-differentiated soil strongly varies in terms of morphological indicators and properties, which affects the specificity, direction, and intensity of relic and modern soil-forming processes.

The sod-podzolic surface-odle soils occupy the largest areas of the territory of the Precarpathian and are the background soils of the Drohobych district. They were formed under conditions of excess moistening, flushing, and stagnant-flushing water regimes under broad-leaved forests with grass cover in the conditions of two opposite processes – turf, which causes the accumulation of organic substances and podzolic, in which organic and mineral compounds of rocks are destroyed [11, 12].

The nutrient content is extremely variable, due to the genetic nature of the soils and climatic conditions. The average depth of the root-containing soil layer is 50–60 cm. The soils are poorly humidified, acidic, and slightly acidic, with a relatively low content of gross nitrogen and phosphorus, relatively poor at P_2O_5 andK_2O. The content of mobile phosphorus is low, which is typical for sod-podzolic soils and brown soils. The amount of mobile potassium depends on the granulometric composition, especially on the fraction content of less than 0.001 mm, and varies within a wide range – from 2 to 12 mg/100 g of soil [11].

The landscape structure of the Drohobych foothills, in addition to the sod-podzolic soils, is also characterized by wide low terraces with meadows and rainy-marshy soils, which occupy almost 35% of the area of the entire district. Meadow soils were formed under the radiant vegetation in conditions of high groundwater level, on alluvial sediments, and have a well-developed profile. Humus horizon of dark gray color, fine-grained structure, compacted, 20–40 cm. Such soils are quite fertile Alluvial marsh soils are also quite common, which were formed in pristine reductions with the joint action of the marsh and alluvial processes of soil formation. Alluvial-ray soils were formed on alluvial sediments of river beds, under the radiant vegetation, and have a well-developed soil profile [11, 12].

The climate of Drohobych is moderate continental, which corresponds to a small difference in summer and winter temperatures, and high relative humidity. The climate of the area is characterized by frequent thaws in winter, high cloudiness, intense rains, and the summer and autumn floods caused by them. The amount of precipitation exceeds the amount of evaporation.

The modern vegetation cover of the area is sufficiently diverse. Oak, fir-oak, oak-beech, and fir-oak forests predominate among forest vegetation. Type of forest – wet fir sub-oak forest. Common species are *Fagus sylvatica*, *Quercus robur, Fraxinus excelsior*, *Acer pseudoplatanus*, *Tilia platyphyllos*, *Betula pendula*, *Carpinus betulus*, *Acer platanoides*, and conifers – *Pinus sylvestris*.

In the undergrowth *grows Euonumus verrucosa* Scop*., Daphne* mezereum L*., Crataegus monogyna* Jacq., *Sorbus aucuparia* L., *Frangula alnus* Mill., *Corylus avellana* L., *Swida sanguinea* (L.) Opiz, *Prunus padus* L., *Rosa canina* L.

Grass cover is quite varied, among plants common: *Athyrium filix-femina* (L.) Roth., *Leucojum vernum* L., *Pulmonaria obscura* Dumort., *Lysimachia vulgaris* L., *Majanthemum bifolium* (L.) F. W. Schmidt, *Ajuga reptans* L., *Galeobdolon luteum* Huds., *Stellaria holostea* L., *Oxalis acetosella* L., *Convallaria majalis* L., *Molinia coerulea* (L.) Moench, *Luzula pilosa* (L.) Willd., *Pteridium aquilinum* (L.) Kuhn, *Carex pilosa* Scop., C. *brizoides* L., *Allium ursinum* L., *Lathyrus vernus* (L.) Bernh., *Dryopteris filix-mas* L., *Aegopodium podagraria* L.

Thus, in general, the landscape of the Precarpathian and Drohobych foothills, which is uniform in nature, in particular, is complex in structure. Significant height differences, the dense mesh of dismemberment, and gradual-stage elevation from the Dniester to the Carpathians contributed to the formation of genetic horizons of soil cover and species diversity of the plant world.

An important indicator of plant organisms is the species or floristic composition, which serves as an indicator of growing conditions. Its composition includes species that reflect the cenotic and ecological properties of a particular biocenosis. These species induce vegetation conditions under which the diversity of soil cover can be determined [9].

On pre-selected trial areas in phytocenoses with wild vegetation, we determined the diagnostic species of plants.

Plot No.1 is the predominant growth of *Equisetum arvense* L. on abandoned farmlands, where bows were formed, the soil is typical sod-podzolic surface-glazed. *Equisetum arvense* L. is a typical representative of acidophiles of plants that are spread on acidic (pH 4.5–5.5) typical sod-podzolic and brown forest soils.

Plot No.2 – growth of the population of *Hepatica nobilis* on the nodule of fir-oak forest with full soaking of the root-containing soil layer with precipitation and meltwater, the age structure of tree plants is uneven, the soil is the gray forest with a flushing regime. *Hepatica nobilisis* a typical mesophyte that grows on fresh forest biocenoses with complete soaking of the root-containing soil horizon and a mesotron that is widespread on salt-rich soils where no SO2-, Cl- and HCO- ions are present.

Plot No.3 – Rapid growth of Ranunculus *repens* along the forest road, on the lawn, forest grey soil with a partial flushing regime. *Ranunculus repens* – typical nitrophilus (plants grow on sufficiently mineral nitrogen soils (0.3–0.4%). The species grows on slightly acidic soils.

Plot No.4 – growth of *Plantago major* L. and *Trifolium pretense* L. on the node of the mixed forest, the soil for which is bored and podzolic with an incomplete flushing regime. *Plantago major* L. is a typical acidophile and likes acidic (pH 4.5–5.5) sod-podzolic soils. The species (subanitrophil) is widespread on oligotrophic soils with low mineral nitrogen content (0.05–0.2%).

Plot No.5 – abrupt growth of *Urtica dioica* and Arctium *lappa* on abandoned farmland, the soil is sod and slightly podzolic. *Urtica dioica* and *Arctium lappa* are eunitrophil plants that grow on soils well supplied with mineral nitrogen (0.4–0.5%).

In general, vegetation in the trial plots was heterogeneous in terms of floristic features, and biological and cenotic properties. Some species of plants were at different stages of their development.

As a result of the research, it was found that the trial areas of wild plants chosen by us are the growth sites of diagnostic species that identify (induce) the physical and chemical properties of soils. The physical and chemical properties of soils belong to the main properties and have a determining influence on the growth and development of plants. Soil samples were taken on separate sample areas were studied according to the following physical and chemical indicators: determination of field soil moisture, pH of aqueous and salt extract, humus content, macroelements (nitrogen (N), phosphorus (P_2O_5), potassium (K_2O)).

Background sod-podzolic surface-glazed soils of Precarpathian were formed in conditions of excess moisture and flushing type of the water regime on ancient alluvial and diluvial carbonate-free loams. Their genetic nature is complex. Soils have a sharply differentiated by type eluvial-illuvial profile and signs of dullness, a shallow humus horizon (30–40 cm). They are unsaturated with bases, acidic, and contain little nitrogen and phosphorus available to plants. As a result of weak water permeability, the upper horizons are overwetted.

It is generally known that according to the species diversity of plants of a certain ecological group, which are widespread in the territory characteristic of their optimal growth and development, it is possible to pre-determine the water regime of the soil, the degree of salinity, the content of nutrients, acidity.

As a result of the studies, it was found that the total moisture reserve in the soils in the sample areas was sufficient, and its content did not differ significantly between the study areas and was within 18.0–30.0% (see Table 1).

Table 1. Indicators of physical and chemical properties of soils

Indicators	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Characteristics of the territory	Abandoned farmland, meadows	The territory of fir and oak forest	Along the forest road, on the lawn	Mixed Forest Nodule	Abandoned farmland, meadows
Humidity, %	26.0	30.0	22.0	18.0	20.0
Humus, %	2.6	3.1	3.5	2.9	3.8
pH (aqueous solution)	5.2	6.3	5.8	5.4	6.4
pH – Saline	3.5	4.0	3.7	3.3	3.9
Gross N content, %	0.15	0.18	0.24	0.13	0.28
Gross P content, %	0.13	0.05	0.09	0.14	0.11
P_2O_5, mg/100 g according to Kirsanov	78.0	45.4	50.2	63.6	52.5
K_2O, mg/100g according to Kirsanov	39.1	51.3	54.2	33.6	57.4
Widespread Diagnostic Plant Species	*Equisetum arvense* L.	*Hepatica nobilis*	*Ranunculus repens*	*Plantago major* L. *Trifolium pretense* L.	*Urtica dioica Arctium lappa*

The highest moisture content (30.0%) was recorded in trial plot No.2 (fir-oak forest area), where there was an increase in the population of *Hepatica nobilis*. It is known that *Hepatica nobilisis a* typical mesophyte that grows on fresh forest biocenoses with complete wetting of the root layer [1]. The results of physicochemical studies confirmed that the plant is a diagnostic species of the soil water regime of this biocenosis.

An important indicator of the soil is its acidity. Closely related to the reaction of the soil solution is the life of the soil microflora, the processes of transformation of mineral and organic substances in the soil, their solubility, sediment formation, and accumulation of substances in the soil profile [14]. Each soil has a specific reaction of soil solution, on which the development of plants and the direction of soil formation depend. Most plants grow best in a weakly acidic or neutral reaction of the soil environment, so knowledge of the acidity and alkalinity of soils, and the sources of their formation are extremely necessary for studying the process of plant development [14].

As a result of the studies, it was found that the soils in the sample areas were acidic and slightly acidic. The highest indicator of the soil solution (pH 5.2) was recorded in plot No.1 (abandoned farmlands), where there was a predominant growth of *Equisetum arvense* L. From the scientific information, it is known that *Equisetum arvense* L. is a typical representative of the ecological group of acidophile plants, which are widespread on acidic (pH 4.5–5.5) sod-podzolic soils [9]. *Plantago major* L., Trifolium pretense L. Growth was observed in trial area No.4 (mixed forest nodule). As a result of research, it was found that soils in this trial area also had a rather high acidity index (pH 5.4). According to the results obtained, it can be stated that *Plantago major* is a typical acidophile that grows on acidic (pH 4.5–5.5) sod-podzolic soils [9]. A medium acidic acidity index (pH 5.8) was noted in trial plot No.3 (area along the forest road), where a rapid increase in *Ranunculus repens* was recorded. It is known from literature sources that this species is a typical representative of the group of subacidophiles plants, which are widespread on weakly acidic (pH 5.5–6.5) soil [9]. In general, the results of the studies confirmed that the soils of natural biocenoses on which the diagnostic plant species were growing were acidic and medium acidic.

Determination of the humus content serves as one of the main parameters for assessing the physical and chemical properties of soils. Determination of the humus content shows the nature of the natural phytocenoses influence on the soil formation process. Depurative substances affect the development of soil properties, which determine its fertility, namely: improve water-physical properties, and thermal properties, increase the buffering capacity of the soil solution, and microbiological activity of the soil enriched with nitrogen and other elements of root nutrition of plant organisms [13].

The results of the studies showed that the humus content in the trial areas fluctuated within the limits (2.6–3.8%), which is generally typical for most soils of Drohobych. It is interesting to note that the highest humus index of 3.8% was in trial plot No.5 (abandoned farmland), where there was a rapid increase in *Urtica dioica* and *Arctium lappa.* The hummus and nitrogen reserves in the soils of natural biocenoses are most concentrated in the upper 10 cm layer of soil, and are not constant, but change throughout the growing season. On trial plot No.5 (abandoned farmland), we established the highest nitrogen content (0.28%), which characterizes the degree of expression of the nitrification process and the provision of soil with mineral nitrogen. *Urtica dioica and Arctium* lappa are eunitrophil plants that grow on soils well supplied with mineral nitrogen [9].

A fairly high nitrogen content (0.24%) was noted in trial plot No.3, where a rapid increase in Ranunculus repens *was recorded.* It is known from literature sources that *Ranunculus repens* is a representative of the ecological group of nitrophilic plants that grow on soils sufficiently supplied with mineral nitrogen. Relatively low nitrogen content (0.13%) was found in trial plot No.4, where *Plantago major* L. The results of the research confirm the scientific information that *Plantago major* L. is a subanitrophil species, which is widespread on oligotrophic mineral nitrogen-poor (0.05–0.2%) soils [9].

In the course of the research, we established quantitative indicators of the organo-mineral elements contained in the soil, which come from the soil to plants in the form of organic and inorganic compounds. Their number primarily varies depending on the presence of the hummus. The presence of phosphorus and potassium in the soil is especially important. In particular, mobile forms of phosphorus are important indicators of soil fertility. Closely related to it are the development of the root system, its absorption capacity for moisture and nutrients, and the intensity of photosynthesis. It is believed that the phosphorus content in parent rocks is one of the reasons for its different content in soils. The amount of gross phosphorus is lower in sod-podzolic soils, but increases in black soils [7]. As a result of the studies, it was found that the gross phosphorus content in the sample areas ranged from 0.05 to 0.14%. The phosphorus content (according to Kirsanov) was 45.4–63.6 mg/100 g of soil, in particular, phosphorus compounds were more in low-humus soils. The potassium content (according to Kirsanov) in the study areas was within 33.6–57.4 mg/100 g of soil.

As a result of the studies, it was found that, in general, the soils of the sample areas are acidic and slightly acidic (pH from 5.1 to 6.4), weakly and medium humus (2.6–3.7% of humus), with a relatively average content of gross nitrogen (0.12–0.27%) and phosphorus (0.05–0.14%), relatively poor on K_2O and P_2O_5 in the upper horizon.

Consequently, a laboratory study of the physical and chemical indicators of soils showed that the diagnostic species of plants growing on the trial plots correspond to those environmental groups whose vital functions are closely correlated with certain factors of the soil environment. The dominance of certain species is associated with the chemical composition of the soil, because plants are sensitive to the content of macro- and microelements in the soil, and can serve as indicators in relation to the conditions of humidification, acidity, salinity, excess salt content, as well as the availability of nitrogen, calcium, magnesium, potassium and other nutrients in the soil. Diagnostic plant species confirmed the physicochemical characteristics of the soils on which they grew.

RESULTS

As a result of the studies, it was found that in selected trial areas where such diagnostic species as *Equisetum arvense* L., *Hepatica nobilis, Ranunculus repens, Plantago major* L., *Urtica dioica*, *Arctium lappa* grew, it is possible to pre-predict the physical and chemical properties of soils. In general, the vegetation was heterogeneous in terms of floristic features, the species were at different stages of their development. Diagnostic plant species confirmed the physicochemical characteristics of the soils on which they grew.

As a result of the studies, it was found that, in general, the soils of the sample areas are acidic and slightly acidic (pH from 5.1 to 6.4), weakly and medium humus (2.6–3.7% of humus), with a relatively average content of gross nitrogen (0.12–0.27%) and phosphorus (0.05–0.14%), relatively poor on K2O and P2O5 in the upper horizon.

Indicator plants should be used to estimate both the soil cover state and the general state of the environment.

BIBLIOGRAPHY

1. Balashov L.S. Plants-indicators of excessive new flooding. *Ukrainian Botanical Journal.* 1989. 26. No. 6. P. 70–75.
2. Baliuk S.A, Kucher A.V. Spatial features of soil cover as a basis for sustainable development. *Ukrainian Geographical Journal*. 2019. No. 3. P. 3–14.
3. Sampling and soil samples preparation for agrochemical analysis: Methods of sampling and samples preparation for chemical, bacteriological, and helminthological analysis: DSTU17.4.4.02-84. Moscow : Standartinform, 2008. 8 p.
4. Hlukhov O.Z., Prokhorova S.I. Indication of the state of the technogenic environment by the morphological variability of plants. *Industrial botany.* 2008. Issue 8. P. 3–9.
5. Honcharenko I.V. Phytoindication of anthropogenic load: monograph. Dnipro: Seredniak T.K., 2017. 127 p.
6. Hryhorchuk I.D. Use of plant bioindicators to estimate the soil toxicity in the territory of Kamianets-Podilskyi. *Biological systems*. Vol. 8 Iss. 2. 2016. P. 212–217.

7. Yeterevska L.V., Khrystynko A.O., Momot H.F., Kimova R.V. Evaluation of phosphate and potassium states of the whole, arable, and recultivated soils. *Bulletin of Agricultural Science.* 2019. Iss. No.5 (794). P. 62–68.
8. Ivaniuk T.M. Physical and chemical parameters of fresh sougrudes of the Polissia of Ukraine. *Scientific Bulletin of NFU of Ukraine*. 2013. Iss. 23.4. P. 40-44.
9. Krasnov V.P., Orlov O.O., Vedmid M.M. Atlas of plants-indicators and types of forest conditions of the Ukrainian Polissya Monograph. Novograd-Volynskyi, 2009. 488 p.
10. Moroz A.O. Physical and chemical methods of soil analysis. *Student Bulletin of the NUVGP.* Iss. 2(4). 2015. P. 54-57.
11. Pankiv Z.P. Problems of the genesis of sod-podzolic surface-glazed soils of Precarpathia. *Visnyk of Lviv University*. Geographical series. Issue 29. 2003. P. 210–213.
12. Pankiv Z.P., Malyk S.Z., Yamelynets T.S. Diagnostic criteria for elementary soil-forming processes in profile-differentiated soils of Precarpathia. *Agrochemistry and Soil Science*. Iss. 89. Kharkiv: National Research Center "IGA named after O.N. Sokolovsky". 2020. P. 34–40.
13. Popovych V.V. Study of the physical and chemical properties of soils and burnt rocks on the territories of the Novovolynskyi Mining and Industrial District. *Scientific Bulletin of NFU of Ukraine.* 2008. Iss. 18.12. P. 258–264.
14. Yaroshko M. Acidity of soils and its effect on plant nutrition. *Agronomist.* 2013. No. 1. P. 30-33.
15. Tao Y.e., Wu G.-L., Zhang Y.-M. Dune-scale distribution pattern of herbaceous plants and their relationship with environmental factors in a saline–alkali desert in Central Asia. *Sci Total Environ.* 2017. P. 473–480.
16. Cannon H.L. The use of plant indicators in ground water surveys, geologic mapping, and mineral prospecting. *Taxon.* 1971. Vol. 20(2-3) P.227–256.
17. Khan S.M., et al. Phyto-climatic gradient of vegetation and habitat specificity in the high elevation Western Himalayas. *Pak J Bot.* 2013. Vol. 45. P. 223–230.
18. Rasheed S., Khan S.M., Ahmad Z., Mustafa G., Haq Z.U., Shah H., et al. Ecological assessment and indicator species analyses of the Cholistan desert using multivariate statistical tools. *Pak J Bot/* 2022. Vol. 54. P.28-30.
19. Hussain M., Khan S.M., Abd_Allah E.F., Ul Haq Z., Alshahrani T.S., Alqarawi A.A., et al. Assessment of Plant communities and identification of indicator species of an ecotnal forest zone at durand line, district Kurram, Pakistan. *Appl Ecol Environ Res.* 2019. Vol.17(3). P. 6375–6396.

REFERENCES

1. Balashov L.S. (1989). Plants-indicators of excessive new flooding. *Ukrainian Botanical Journal*, 26, 6, 70–75 [in English].
2. Baliuk S.A, Kucher A.V. (2019). Spatial features of soil cover as a basis for sustainable development. *Ukrainian Geographical Journal*, 3, 3–14 [in English].
3. Sampling and soil samples preparation for agrochemical analysis: Methods of sampling and samples preparation for chemical, bacteriological, and helminthological analysis: DSTU17.4.4.02-84 (2008). Moscow : Standartinform [in English].
4. Hlukhov O.Z., Prokhorova S.I. (2008). Indication of the state of the technogenic environment by the morphological variability of plants. *Industrial botany,* 8, 3–9 [in English].
5. Honcharenko I.V. (2017). Phytoindication of anthropogenic load: monograph. Dnipro: Seredniak T.K., 2017. 127 [in English].
6. Hryhorchuk I.D. (2016). Use of plant bioindicators to estimate the soil toxicity in the territory of Kamianets-Podilskyi. *Biological systems*, Vol. 8, Iss. 2, 212–217 [in English].

7. Yeterevska L.V., Khrystynko A.O., Momot H.F., Kimova R.V. (2019). Evaluation of phosphate and potassium states of the whole, arable, and recultivated soils. *Bulletin of Agricultural Science,* 5 (794), 62–68 [in English].
8. Ivaniuk T.M. (2013). Physical and chemical parameters of fresh sougrudes of the Polissia of Ukraine. *Scientific Bulletin of NFU of Ukraine*, Iss. 23.4, 40-44 [in English].
9. Krasnov V.P., Orlov O.O., Vedmid M.M. (2009). Atlas of plants-indicators and types of forest conditions of the Ukrainian Polissya Monograph. Novograd-Volynskyi. 488 [in English].
10. Moroz A.O. (2015). Physical and chemical methods of soil analysis. *Student Bulletin of the NUVGP,* Iss. 2(4), 54-57 [in English].
11. Pankiv Z.P. (2003). Problems of the genesis of sod-podzolic surface-glazed soils of Precarpathia. *Visnyk of Lviv University*. Geographical series, Issue 29, 210–213 [in English].
12. Pankiv Z.P., Malyk S.Z., Yamelynets T.S. (2020). Diagnostic criteria for elementary soil-forming processes in profile-differentiated soils of Precarpathia. *Agrochemistry and Soil Science*. Iss. 89. Kharkiv: National Research Center "IGA named after O.N. Sokolovsky", 34–40 [in English].
13. Popovych V.V. (2008). Study of the physical and chemical properties of soils and burnt rocks on the territories of the Novovolynskyi Mining and Industrial District. *Scientific Bulletin of NFU of Ukraine,* Iss. 18.12, 258–264 [in English].
14. Yaroshko M. (2013). Acidity of soils and its effect on plant nutrition. *Agronomist,* No. 1, 30-33 [in English].
15. Tao Y.e., Wu G.-L., Zhang Y.-M. (2017). Dune-scale distribution pattern of herbaceous plants and their relationship with environmental factors in a saline–alkali desert in Central Asia. *Sci Total Environ,* 473–480 [in English].
16. Cannon H.L. (1971). The use of plant indicators in ground water surveys, geologic mapping, and mineral prospecting. *Taxon*, Vol. 20(2-3), 227–256 [in English].
17. Khan S.M., et al. (2013). Phyto-climatic gradient of vegetation and habitat specificity in the high elevation Western Himalayas. *Pak J Bot,* Vol. 45, 223–230 [in English].
18. Rasheed S., Khan S.M., Ahmad Z., Mustafa G., Haq Z.U., Shah H., et al. (2022). Ecological assessment and indicator species analyses of the Cholistan desert using multivariate statistical tools. *Pak J Bot*, Vol. 54, 28-30 [in English].
19. Hussain M., Khan S.M., Abd_Allah E.F., Ul Haq Z., Alshahrani T.S., Alqarawi A.A., et al. (2019). Assessment of Plant communities and identification of indicator species of an ecotnal forest zone at durand line, district Kurram, Pakistan. *Appl Ecol Environ Res,* Vol.17(3), 6375–6396 [in English].

АНОТАЦІЯ

ВПЛИВ ГРУНТОВОГО СЕРЕДОВИЩА НА РІЗНОМАНІТНІСТЬ ДІАГНОСТИЧНИХ ДИКОРОСЛИХ ВИДІВ РОСЛИН

Серед важливих проблем сьогодення особливе місце належить дослідженням присвяченим грунтовому покриву. Грунт займає провідне місце в житті людини та виконує глобальні соціально-економічні функції. Життєдіяльність рослин тісно пов'язана з навколишнім середовищем, зокрема із ґрунтом, який забезпечує їх поживними речовинами, одночасно, рослини слугують індикаторами грунтів. За допомогою діагностичних видів рослин можна визначити характер грунту, спрогнозувати його фізико-хімічні властивості, зокрема вміст вологи, поживних речовин, солей, кислотність та ін. У свою чергу, фізико-хімічні властивості грунтів впливають на ріст і розвиток рослин, їх поширення. Особливо чітко виражені індикаторні властивості у дикорослих трав'янистих рослин.

Метою нашого дослідження було встановити залежність видового складу дикорослих рослин Передкарпаття від фізико-хімічних властивостей грунтового середовища.

Дослідження проводили на території Дрогобицького району в травні-серпні 2021–2022 рр. Проведення досліджень включало три основних етапи. На першому етапі було обрано пробні площі у фітоценозах з дикоростучою рослинністю (переважаючим зростанням діагностичних видів) та проведено визначення видової різноманітності. Пробні площі закладали з урахуванням зростання популяцій рослин-індикаторів природних біоценозів. На другому етапі на обраних пробних площах було відібрано зразки грунтів для досліджень. На третьому етапі досліджень було проведено визначення фізико-хімічних властивостей відібраних зразків грунту за апробованими методиками (гумус – за методом Тюріна; pH водної і сольової витяжки – потенціометрично; рухомий калій та фосфор – за методами Кірсанова).

У результаті досліджень встановлено, що загальний запас вологи в грунтах на пробних площах був достатнім і знаходився в межах 30,0–18,0%, в цілому грунти є кислі та слабокислі (pH від 5,1 до 6,4), слабо- та середньогумусовані (2,6–3,7% гумусу), з відносно середнім вмістом валового азоту (0,12–0,27%) та фосфору (0,05–0,14%), відносно бідні на K_2O та P_2O_5 у верхньому горизонті.

Лабораторне вивчення фізико-хімічних показників грунтів показало, що діагностичні види рослин, які зростали на пробних площах, відповідають тим екологічним групам, життєві функції яких тісно корелюють з певними чинниками ґрунтового середовища. Встановлені діагностичні види рослин, зокрема *Equisetum arvense* L., *Hepatica nobilis, Ranunculus repens, Plantago major* L., *Urtica dioica*, *Arctium lappa,* підтвердили фізико-хімічні показники грунтів, на яких вони зростали.

Отже, рослини-індикатори доцільно використовувати для оцінювання як загального стану навколишнього природного середовища, так і стану ґрунтового покриву.

Ключові слова: грунт, рослини-індикатори, грунтовий покрив, фізико-хімічні властивості.