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CLASSIFICATION OF THE SOURCE MATERIAL OF TOBACCO VARIETIES CULTIVATED IN THE CENTRAL PART OF THE FOREST-STEPPE OF UKRAINE BY THE MULTIVARIATE STATISTICS METHOD Leonova Katerina, Morgun Andriy	83
SEED PRODUCTIVITY OF ALFALFA DEPENDING ON THE METHODS OF CROP TENDING Maksymenko Artem, Tsigelnik Kristina	86
CHARACTERISTICS AND ASSESSMENT OF BIOLOGICALLY UNSTABLE FOREST PLANTATIONS OF VINNYTSIA USING INTERNATIONAL METHODOLOGY OF ICP-FORESTS Matusiak Mikhailo	89
OPTIMIZATION OF DOSES AND TIME OF MINERAL NITROGEN APPLICATION ON WINTER WHEAT PLANTINGS Onychko Viktor, Onychko Tetiana	92
INCREASING THE PRODUCTIVITY OF HUNGARIAN SAINFOIN BY OPTIMIZING THE BASIC TILLAGE METHODS AND DEPTH Petrovets Vladyslav, Myroshnychenko Vladyslav	95
ADAPTATION OF COWS OF SCHWYZ BREED IN ENGINEERING AND BIOLOGICAL SYSTEM “MAN – MACHINE – ANIMAL” Pishchan Ilona, Honchar Alona	98
REALIZATION OF MILK PRODUCTIVITY OF HOLSTEIN COWS OF DIFFERENT AGE ON THE INDUSTRIAL COMPLEX OF MILK PRODUCTION Pishchan Ilona, Lytvyschenko Liudmyla	101
REALIZATION THE GENETIC POTENTIAL OF MILK PRODUCTIVITY OF HOLSTEIN COWS AT INTENSIVE TECHNOLOGY OF EXPLOITATION Pishchan Stanislav	104
METHODS OF IMPROVEMENT OF THE MEAT PRODUCTIVITY OF SHEEP Pokhyl Volodymyr, Mykolaychuk Lyudmila	107
SELECTION AND BIOTECHNOLOGY IN MILK COLLECTION IN UKRAINE AND THE WORLD Pryshed’ko Vladimir	111
PRODUCTIVE CAPACITY OF CORN HYBRIDS FOR SILAGE Radchenko Mykola, Zhyrnova Anna	114
ADAPTABILITY AND CROP CAPACITY OF POTATO VARIETIES IN CLIMATE TERMS IN UKRAINE Sonets Tatiana, Kyienko Zinaida	117
TO THE PROBLEM OF ENVIRONMENTAL EVALUATION OF THE CONDITIONS FOR THE GROWTH OF AGRICULTURAL CULTURES Kharchenko Oleg, Petrenko Sergey	121
WEED CONTROL TECHNOLOGY ON SOYBEAN CROPS IN THE CONDITIOIN OF “AGRIFAS” COMPANY LTD BILOPILLIA DISTRICT SUMY REGION Shokun Oleksandr, Ishchenko Oksana	124
ENGINEERING SCIENCES	
MODELLING OF STRESS-STRAIN STATE OF CONCRETE REINFORCEMENT WELDED JOINTS Bolotov Maksym, Nahorna Iryna	126

CHARACTERISTICS AND ASSESSMENT OF BIOLOGICALLY UNSTABLE FOREST PLANTATIONS OF VINNYTSIA USING INTERNATIONAL METHODOLOGY OF ICP-FORESTS

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Monitoring of forest plantations having damaged stability is a system for monitoring, estimating and forecasting changes in the forest ecosystems caused by the influence of negative factors. Negative factors affecting forests can be classified by the nature and origin, period and duration, nature of effect, scale and scope of influence, as well as by their rate and consequences [1, p. 15].

During the research, we examined pine, oak, hornbeam and beech forest associations. The sites for monitoring were located in these forest plantations. The sites intended for monitoring had about 100 wood species, for which indicators were determined according to the international methodology of ICP-Forests. For certain trees, the diameter, crown length in%, Craft class (position of the tree in the forest stand according to its development), defoliation, dechromation, crown density in % on the trial sites were determined (Table 1).

Table 1

Generalized data obtained on the monitored sites in the forest plantations of Vinnitsa region

Species	Diameter, cm	Length of the crown, %	Craft class	Defoliation, %	Dechromation, %	Crown density, %
Common pine	24.0	27.3	2.2	23.1	8.0	62.7
Common oak		35.0	2.0	15.0	10.0	70.0
Beech	17.9	48.3	2.6	13.6	2.5	73.2
Common spruce	17.3	26.1	2.3	21.3	0.0	73.6

Assessment of the state of forest plantations was carried out based on the established indicators of defoliation and dechromation of the monitoring methodology that are given in Table 2.

According to the table, forest plantations with the rate of defoliation and dechromation of up to 10 % are considered to be undamaged, 11-25% – conditionally damaged, 26-60 % – moderately damaged, 61-99 % – heavily damaged. According to the given grouping, pine plantations should be classified as moderately damaged (rate

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of defoliation and dechromation exceeds 25 %), spruce, common oak, common beech, common hornbeam can be treated as conditionally damaged. The state of pine and spruce can be characterized as the worst. Since these forest plantations are adjacent to the city of Vinnytsia and motor transport is the main source of pollution, probable deterioration of their state is caused by the effect of aero-anthropogenic emissions. Coniferous breeds are less resistant to the effects of pollutants, so we analysed the content of heavy metals in the components of forest ecosystems. For the first time, the research on the content of heavy metals in the needles of common pine and common spruce was carried out [2, p. 27].

Table 2

**Characteristics of plantations according to the methodology
of the international monitoring program**

Damage rate	Characteristics of the forest status	Rate of defoliation and dechromation, %
1	undamaged	0-10
2	conditionally damaged	11-25
3	moderately damaged	26-60
4	heavily damaged	61-99

In order to evaluate the content of heavy metals in the components of forest ecosystems, during the research we have selected the samples of needles of common pine and common spruce to estimate the content of heavy metals. Samples were selected in summer, analysis was carried out in the laboratory. Data on the content of heavy metals are given in Table 3.

Table 3

The content of heavy metals in the needles of common spruce and common pine

No	Name of the indicator	Unit of measurement	Method of testing	Maximum allowable concentration	Actual value in spruce	Actual value in pine
1	lead	mg/kg	State standard 30178-96	5.0	0.338	0.329
2	cadmium	mg/kg	State standard 30178-96	0.3	0.112	0.111
3	copper	mg/kg	State standard 30178-96	30.0	1.605	0.963

According to the table, lead, cadmium and copper are accumulated in pine needles in the following concentrations: 0.338, 0.112, 1.605 mg/kg. The content of these elements in spruce is as follows: lead – 0.338, cadmium – 0.112, copper – 1.605 mg/g. Evaluation of the content of heavy elements at maximum allowable concentrations (MAC) indicates the absence of significant accumulation of these elements in the tree needles. However, the indicated values of concentrations are given in general for plants. Thus, currently, MAC for the content of heavy metals in the needles of pine and common spruce, which could significantly affect the state of forest ecosystems, have not been determined. Therefore, even these concentrations may, to some extent, worsen the state of forest plantations.

According to the results of the estimation of forest plantations (Table 2), pine forests are characterized by the worst condition (defoliation and dechromation rates are 31.1 %), while spruce forests are slightly better (the rate is 21.3 %). However, the content of heavy metals in the pine needles is higher compared to that one in spruce. This indicates that, along with the impact of aero-anthropogenic emissions, other factors, including abiotic (primarily climatic) and biotic factors, have a significant influence on the state of the forest ecosystems [3, p. 12].

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