ISSN 0513-1634

THE STATE NIKITA BOTANICAL GARDENS

BULLETIN SNBG

NUMBER 114

Yalta 2015

12+

THE STATE NIKITSKY BOTANICAL GARDENS

BULLETIN SNBG

Number 114

Yalta 2015

Editorial Board:

Plugatar Yu.V. – chief editor, Bagrikova N.A., Balykina E.B., Ilnitsky O.A., Isikov V.P., Klymenko Z.K., Koba V.P., Korzhenevsky V.V., Maslov I.I., Mitrofanova I.V., Mitrofanova O.V., Opanasenko N.E., Rabotyagov V.D., Smykov A.V., Shevchenko S.V., Shyshkin V.A. – responsible secretary, Yarosh A.M. – deputy chief editor

© The State Nikitsky Botanical Gardens, 2015

CONTENTS

ECOLOGY

UDC 504.064.3:574

ECOLOGICAL PHYTOMONITORING: HISTORICAL REVIEW, CURRENT STATE AND PROSPECTS

Yury Vladimirovich Plugatar, Oleg Antonovich Ilnitsky, Svetlana Pavlovna Korsakova, Andrey Vladimirovich Pashtetsky

Nikitsky Botanical Gardens – National Scientific Centre
298648, Nikita, the city of Yalta, Republic of the Crimea
ilnitsky.oleg@rambler.ru

Due to climatic changes and strengthening of human influence on biosphere there is a question about these factors consequences for the Earth vegetation cover. Strategies and adaptation ways of arboreal plants to the environmental changes underlie the research and prognostication of these variations. Last century, in 50th, a new biological direction emerged, "phytomonitoring". This term was found out in 1987 by research assistants of plant biocybernetics laboratory, Leningradsky AFI [9, 10]. In the beginning this direction was called "physiological monitoring" [10]. Due to different engineered microsized sensors, which permitted to get information about plant physiological state not damaged them, the cycle of investigations in study of possibility to registrate automatically different physiological processes in intact plant was carried out. The research objective was to develop automatical control systems concerning plant vital functions [14].

"Physiological state" means applying of non-damaging methods set in phytofisiological and ecological researches which reserve continuity of plant organism, and special data measuring systems which enable to get continuous and synchronic information about diverse processes in plant vital functions. This term also implies getting information about degree and direction of controlled plant parameters, such as: intensity of photosynthesis, different plant organs growth, CO_2 gas exchange, water regime, mineral nutrition, productivity and etc. Physiological state reflects optimal environmental conditions for plant necessities.

Monitoring cannot cover all plant physiological processes. Construction of data technology demands a minimal set of the most informative parameters, capable to characterize plant functional state to the full, and become markers of their functional state. A set of such basic physiological parameters, registered continuously, was suggested in 1987 [10].

Later it was found out absolute values of measured parameters were not the most informative and representative (though they are considered in data interpretation), but forms of curves, made due to their diurnal recording, multidiurnal trends of parameters changes.

Nowadays phytomonitoring as a new methodology has been totally recognized. Phytomonitoring courses are given in many well-known universities (Lvov, Sain-Petersburg, Ural Universities and others.). This term became generally accepted not only in scientific area of CIS, but in Australia, Holland, Israel, the USA, Chile and etc. At the same time, being accepted this term lost its original tenor. As any plant observation (even contemplation) applying different methods of its state assessment are called phytomonitoring as well.

Though "phytomonitoring" should be connected to its original occurrence in the scientific terminology.

Further development of methodology, and especially instrument base for phytomonitoring, increased a number of tasks actual for different scientific directions. Largely computer engineering promoted this concept [13].

Methodology and instrumental base of phytomonitoring became useful for specialist from other scientific areas, such as: ecology, selection, crop variety testing, introduction and for cultivation in protected and open ground [3, 5, 11, 12, 15, 16].

Ecophysiological researches haven`t got developed theoretical and resource base yet, necessary for collection and analyses of plant physiological state. Regular plant inspections are carried out on definite territories with the purpose to assess evolution of plants state and prognosticate its develop allowing for environmental changes in this region. Applying of phytomonitoring and instrumental base can make it possible to reveal peculiarities of parameters response, which characterize different processes of plant vital functions. radial trunk augmentation (integral parameter) and methods intended for study of different processes of plant vital functions.

Principal methods:

- Measurement of linear and relative velocities of xylem streams in different plant organs (body, trunk, root, branches, shoots and etc.);
- Study of the turgor changes in these organs effected by environment (linear dimension);
- Study of different organs growth and biomass increasing
- Study of water potential in plant organs
- Study of xylem moisture deficit concerning arboreal plants;
- Study of the main mineral nutrition elements concentration (P, N, K) in xylem exudates;
- Study of CO_2 – gas exchange (photosinthesis and respiration);
- Measurement of leaves optical properties from different angles to study characteristics of their water regime and drought-resistance;
- Indirect research methods of plant reproductive sphere (obtain the valuable and vigorous seeds and etc.).

Multivariate approach, based on collection and analysis of unique ecological and physiological characteristics of arboreal trees, growing in areas with different level of human influence, underlies these researches.

Ecological phytomonitoring makes it possible to assess anthropogenic effects on natural vegetable complexes, revealing probable consequences and in the long term accumulation of systematized database of plant functions.

Practical applying of such a database of plant functions consists of further prognostication of ecological situation in a specific region.

Function of phytomonitoring instrumental base lies in continuous monitoring of plant characteristics and environmental parameters, systematical analysis of data and their temporal variation.

Technical base of informative and measuring phytomonitoring complex should include the following:

- Sensors collecting information about plants and environment;
- Electronic module for sensor signal processing to display it on a computer;
- Special software.

Ecological researches permit to find out specific features of variations in different processes of arboreal plant vital functions connected with environmental changes, and

determine the most sensitive ones to either external effects, which can be useful for indication and monitoring.

In these researches special attention is given to the Crimea and its South Coast particularly (SCC), the city of Yalta and Nikitsky Botanical Gardens.

Water regime and drought-resistance of bushes, growing in Arboretum of Nikitsky Botanical Gardens under conditions of the lower belt microclimate, have been analyzed. Rapid methods, permitting to obtain ecophysiological characteristics of the studied species, have been applied. As a result of the studies well-known by scientific sources peculiarities of their water regime and drought-resistance have been clarified. According to these parameters a line of the studied species drought-resistance has been differentiated.

Dynamic models of correlation between studied species ecophysiological characteristics and main environmental factors have been constructed in the course of the research.

Difference between experimental and calculated values isn`t over 10-15%, what is quite acceptable for prognostication purposes in Biology.

Results of these researches are of biological significance and can be applied as a source of additional information while make a comparative assessment of plant drought-resistance, develop evaluation criterion of genotypic species drought-resistance, which enables to differentiate plants in passport system.

Such a differentiation makes it possible to recommend these plant species for cultivation in a specific region of SCC allowing for its microclimatic specific features. Comparative sensitivity of applied methods was studied as well.

It was conducted an investigation in selection of forest and ornamental cultures for dry climate of South Ukraine, Khersonskaya region, Novaya Kahovka area.

Selection of plants resistant to dry conditions is of a large importance for agriculture. Plants used in landscaping of forest belts should possess such a characteristic. Methods of phytomonitoring made it possible to study water regime and drought-resistance of 14 ornamental culture species, construct a line of their relative drought-resistant, calculate dynamic models of correlation between ecophysiological characteristics of the studied plant varieties and the main environmental factors. As a result of this work, it`s possible to make recommendations in growing of the most drought-resistant species in the definite region [4].

Methodology and instrumental base of phytomonitoring were also applied to investigate the growth dynamics of arboreal plants being under conditions of Karadag natural reserve [4]. Study cases were *Quercus pubescens* Willd. and *Pistacia atlantica* subsp. Mutica.

Growth dynamics through the whole vegetation period was under control, dependence of the trunk diameter from main environmental factors (integral plant growth parameter) was investigated as well.

Equalizations of linear regression, characterizing these dependences, were constructed in the course of the research. Two variants were used for construction of these models: the first variant was based on values of air and soil temperature, temporary, the second one used hourly accumulation of the temperature values from the beginning of vegetation period. In the first case models accuracy included error 30-40%, but the second case error made 15-20%, what was of prognostication significance.

Conducted researches enabled to assess trunk growth dynamics of the studied species and prognosticate it in further years depending on climatic conditions of the region.

Development of the instrumental base advanced methodological component of phytomonitoring. A certain contribution was made in development of the methodological base. Applying of the modern exploratory equipment made it possible to obtain and process a lot of data, presented in monographs [4, 6, 7]. A number of different methods in

determination of different parameters of plant vital functions has been developed and patented [8].

Pioneer incompleted phytometrical systems [8] were replaced by innovative systems, applying modern achievements of electronics.

In late 90th of XX century and in the beginning of XXI, based on the modern computer engineering the following foreign companies created small-sized phytomonitoring systems, which made it possible to measure different parameters of environment and plants: Phytech Ltd., Phyto-Sensor Group, Dynamax Inc., Skye Instruments Ltd., Decagon Devices Inc., Spectrum Technologies Inc., PP Systems, Li-Cor Inc., Daletown Company Ltd., Regent Instruments Inc., Hoogendoorn and etc. This development still has been carried out.

We don`t dispose systematized data about unfavorable ecology effect on plant life, physiological changes of plants being under long-term influence of this factor, otherwise we don`t dispose information about evolution of plant functions. Lacking of such systematized data for now doesn`t give an opportunity to assess their changes in future. Therefore our investigations result is to make a list of parameters for this databank, that is plant functions for study, what standard means to use it further. It is a compromise task of desire to use modern methodologies in full measure and costs for data collection procedure. Results of these investigations make it possible to:

- research correspondence of plant metabolism to environment, permitting determine natural or anthropogenic stresses or their absence;
- compare characteristics of "urban" and "unpolluted" plants, which will reveal differences of favorable and unfavorable environmental conditions, if they are important for plant living;
- formulate principal concepts of ecological monitoring databank and to start filling data base:
- assess if it is reasonable to use plants as an indicator of their growth area concerning ecological point.

Therefore in the course of ecological phytomonitoring analysis from the historical point it was revealed, emergence of this direction in the scientific area was going on as far as instrumental base (especially computer engineering) was improving. It permitted to set and solute complicated tasks and apply methodology and instrumental base of phytomonitoring in other fields of knowledge.

Lately due to GIS technologies there is an opportunity to create a common urban natural and informative space, which includes natural and ecological issues. The main functions of this issue are monitoring consequences of entrepreneurial activity on local and regional levels. Results of ground mapping or remote viewing from air transport or space can be sources of updated information. Applying of GIS technologies is useful for monitoring vital functions of local and introduced plant species, revealing cause-effect chains and correlations, assessment of favorable and unfavorable nature conservation measures within ecosystem and its separate elements, response and correction of these measures according to changeable environmental conditions [1, 2].

Developed GIS programs: ESRI ArcViev 3.2a, Arc Gis 9.2 and etc. Program City Green 5, which permits to solve a number of ecological problems using updated information, has been integrated into ESRI ArcViev 3.2a as a separate bloc:

1. Informational system "Catalogue of water objects"
2. Informational system "Green plantations"
3. Informational system "Atmosphere air"
4. Informational system "Land resources, relief"
5. Informational system "Engineering constructive works, roads"

Informational system "Green plantations" to be available for City Green 5, should possess ecological and physiological plant characteristics (plant species, age, crown size and others) to estimate ecological situation of a certain area (park, public garden, nature reserve, ward and some others). It makes possible to solve the following problems:

- Assess state of adjusted seaside water area, nature reserves and parks, and prognosticate their development being under anthropogenic effect;
- Develop and implement modernization programs of real productions and change the specialty and liquidate ecologically dangerous enterprises according to their parameters of influence on ecological resources;

Coordinate programs of activities of all state services and monitoring systems, which are specialized on observation and situation value of SCC territory.

The research was granted by the Russian Scientific Foundation (№ 14-50-00079)

References

1. GIS i ohrana okruzhayushchey sredy [Elektronny resurs] / Rezhym dostupa: http://dataplus.ru/Industries/13Ecolog/gis_ecol.htm.

2. *Glebova N.* GIS dlya ypravleniya gorodami i territoriyami // ArcReview. – 2006. – № 3 (38) [Elektronny resurs] / Rezhym dostupa: http://dataplus.ru/Arcrev/Number_38/1_Vved.html.

3. *Yermakov Ye.I., Meleshchenko S.N., Radchenko S.S.* Phytomonitoring. Sovremenniye problemi I perspektivi // C-h biologiya. – 2002. - № 3. – S. 25-35.

4. *Ilnitsky O.A. Boiko M.F., Fedorchuk M.I. i dr.*. Osnovy phytomonitoringa. – Kherson, 2005. – 345 s.

5. *Ilnitsky O.A., Lyshchuk A.I.* Dynamicheskaya model vodnogo rezhyma sazhentsev plodovyh kultur // Tez.dokl.sovetov botan.sadov Ukraini. – 1993. – S.22 – 24.

6. *Ilnitsky O.A., Shchedryn A.N., Gramotenko A.P.* Ecologichesky phytomonitoring. – Donetsk, 2010. – 294 s.

7. *Ilnitsky O.A., Lyshchuk A.I., Ushkarenko V.A. i dr.* Phytomonitoring v rasteniyevodstve. – Kherson, 1997 – 236 s.

8. *Ilnitsky O.A., Ushkarenko V.A., Fedorchuk M.I., Radchenko S.S., Bondarchuk S.V.* Methodologiya i pribornaya basa phytomonitoringa. Uchebnoye posobiye. – Kherson, 2012. – 124 s.

9. *Karmanov V.G.* Primeneniye avtomatiki i kibernetiki k rasteniyevodstvu. // Dokl. AN SSSR. – 1959. – T. 125, № 1. – S. 207-209.

10. *Lyalyn O.O., Radchenko S.S., Karmanov V.G.* Problemi phytomonitoringa na sovremennom etape. Physicheskiye methodi i sredstva polucheniya informatsii v agromonitoringe. – L., 1987. – S. 30-35.

11. *Nylov N.G.* Opyt primeneniya metodologii phytomonitoringa v vinogradarstve. // Biophysika rastenij i phytomonitoring. – L., 1990. – S. 140-150.

12. *Novak V., Osmolovskaya N.* Phytomonitoring v physiologii rastenij: organizatsiya, ustroistvo i vozmozhnosti // Physiologiya rastenij. – 1997. – T. 44, №1. – S. 138 – 145.

13. *Ton Yu.D., Kleiman E.I.* Algoritmicheskiye metody v phytomonitoringe // Biophysika rastenij i phytomonitoring. – L.: AFI, 1990. – S. 27 – 33.

14. *Chudnovsky A.F., Karmanov V.G., Savyn V.N., Ryabova Ye.P.* Kibernetika v selskom khozyaistve. – Leningrad: "Kolos", 1965. – 152 s.

15. *Nilov N., Ton Y.* 1996. Phytomonitoring and irrigation of vineyards // Phytomonitoring International Bulletin. – 1996. – № 2. – P. 3-7.

16. *TonYu., Kopyt M.* Phytomonitoring information and decision-support system for crop growing // Proc. 2-nd ISIITA. – Ed. Zhao Chunjian. – Beijing, 2003. – P. 39-43.

The article was received at editors 09.02.205

Plugatar Yu.V., Ilnitsky O.A., Korsakova S.P. Ecological phytomonitoring: historical review, current state and prospects // Bull. of the State Nikit. Botan. Gard. – 2015. – № 114. – P. 4-10

The article focuses on historical review of the new direction in Biology, phytomonitoring, its emergence and development. Applying of phytomonitoring methods gives an opportunity to get continuous and synchronic data about various processes of plant vital functions. Research of the natural and anthropogenic effects on vegetation cover is of great importance. Phytomonitoring methods permitted to determine plant-resistance and adaptation level to diverse stress factors and competitive ability being under conditions of climatic changes and environmental pollution. The research ultimate goal is to prognosticate ecological situation of the certain region and make recommendations for ecological problems solution.

Key words: *phytomonitoring, express-method, prognostication of the ecological situation.*

FLORA AND VEGETATION

UDC 581.524(477.75)

POPULATION *MEDICAGO MARINA* L. ON SPLIT OF THE DONUZLAV LAKE. PHYTOINDICATION OF ITS ECOLOGICAL AMPLITUDE.

Yuliya Sergeyevna Shkaranda, Vladyslav Vyacheslavovych Korzhenevsky

Nikitsky Botanical Gardens – National Scientific Centre
298648, Republic of the Crimea, Yalta, urban village Nikita
herbarium.47@mail.rul

Introduction

Vegetation is a formative element of environment, in complex with other elements it informs about ecological landscape conditions being a part of them. Out of desert area in the coastal zones of the oceans, seas, rivers and lakes sandy landscapes are developed. Within such landscapes there are dunes, unstable accumulative and deflationary sandy relief forms, emerged out of desert area [6].

Plants of coastal dunes become indicators of accumulation and erosion [12]. Projective cover and a height of the plant stand caused sand deposition around plants, reduction of erosion [9, 11]. As well as sand delivery and favorable wind direction, vegetation is the most important factor in dune development, being an indicator of formative processes [9, 10].

One of the mediterranian species, growing on foredunes, *Medicago marina* L., on the place of ecotone of cenosis with classes *Ammophiletea Br.-Bl. et R. Tx 1943u Festucetea vaginatae* Soo 1968 em Vicherek 1972 (occasionally this species was found on the front of foredunes). This species is quite rare for the Crimea (only 2 populations are known), their size decreases due to loads on littoral ecosystem [8]. This variety was noted as a rare species and included into the Red list of rare plants in the Crimea (1999), Red Data Book of Ukraine (2009). IUCN granted this species a status – lack of data, and this fact emphasizes urgent necessity to study *Medicago marina* L. population in the Crimea more thoroughly, its ecological and coenotic characteristics.

The research objective is to conduct phytoindication of ecological amplitude of *Medicago marina* L within split of the Donuzlav lake.

Research tasks: 1) determine floristic composition of the split in the locality of *Medicago marina* L.; find out minimum, optimum and maximum points for the studied

species within ecological amplitude; 3) analysis ecological range of *Medicago marina* L. allowing for a number of quite important factors.

Objects and methods of the research

Research object is *Medicago marina* L. population, located on the split of the Donuzlav lake (Fig.1). The lake split by length 9 km and width 8,5 km limits the water level size – 48,2 km². Donuzlav bay banks are pretty high and steep, twisting by outline and resemble meandering river [5]. Phytoindication of factors gradients and assessment of optimal gradations for the studied species was based on floristic composition of vegetation in the area of split foredunes of the Donuzlav lake.

Combination of vectors modulus of gradients makes a complex multivariable species characteristics or its real ecological niche, a certain hypervolume, tracing the edge values of vectors within detached factors. It permits to determine location of species coenopopulations within vegetation cover and its geographical natural habitat, as well as to reveal ecological optimum and response to the anthropogenic influence [2].

Scales of ecological factors by Tsyganov D.N. were applied for a comparative analysis of ecology [7]: thermo-climatic scale (Tm), scale of climate continentality (Kn), ombroclimatic scale of aridity and humidity (Om), cryoclimatic scale (Cr), scale of soil moisture (Hd), scale of soil saline regime (Tr), scale of soil acidity (Rc), scale of soil nitrogen satiration (Nt), scale of soil moisture variability (fH), scale of illumination-shadiness (Lc), scale of soil aeration (Ae), scale of carbonate concentration in soils (Ca), scale of soil humus content (Gr), ranged from 0 till 100. Correction of the origin scale allowing for regional specific was carried out according to methodical instructions by Korzhenevsky V.V. [3].

Fig.1 A fragment of foredune on the Donuzlav lake split with *Medicago marina L.* population. On the left hand there is fruiting *Medicago marina L.;* on the right hand it is in phenophases of flowering.

Results and discussion

The researches made it possible to determine a complete floristic composition of species being in cenosis of *Medicago marina L.* (17 species and 9 families) on the Donuzlav lake split (table 1). It underlies the ecological range of the study case.

Locality of the studied species within the Donuzlav lake split, is under influence of the following ecological factors. Type of ombroregime is close to subarid, cryoregime of the habitat corresponds to a warm winter type. Species are found on neutral and alkaline soils (pH 6,5-9,4), according to a trophic scale soils are not enriched, by nitrogen content are poor soils. Moisture level is characterized by variable type of moistening. This locality can be considered as an open area according to a scale by illumination-shading.

Analysis of abiotical factors made it possible to find out the most tolerant zone to all ecological factors, limited by maximum and minimum factors values: the main calculated indicators are the following: minimal and maximum range lines by scale, as well as optimum of the studied species (Fig.2).

At the same time a difference between ecological optimum and ecological conditions was analyzed within the researching locality (table 2). Coefficient of favorable environment (D) was calculated for each factor due to formula: ***D=(max-min)-opt*** (with D – value difference between ecological factor in the studied locality and optimal value of this factor) [1].

Table 1

Floristic composition of *Medicago marina L.* on the Donuzlav lake split.

Species	Family
Medicago marina L.	Fabaceae
Astragalus varius ssp. eupatoricus Sytin	Fabaceae
Artemisia arenaria DC.	Asteraceae
Lactuca tatarica (L.) C.A. Mey.	Asteraceae
Scorzonera parviflora Jacq.	Asteraceae
Halocnemum strobilaceum (Pall.) M. Bieb.	Chenopodiaceae
Suaeda salsa (L.) Pall.	Chenopodiaceae
Salicornia perennans Willd.	Chenopodiaceae
Salsola soda L.	Chenopodiaceae
Halimione verrucifera (M.B.) Aellen.	Chenopodiaceae
Elaeagnus angustifolia L.	Elaeagnaceae
Cakile euxina Pobed.	Brassicaceae
Limonium caspium (Willd.) Gams.	Plumbaginaceae
Eryngium maritimum L.	Apiaceae
Juncus maritimus Lam.	Juncaceae
Elytrigia elongata (Host) Nevski	Poaceae
Agropyron pectinatum (M.B.) P.Beauv.	Poaceae

Note: taxons names are presented according to Vascular Plants of Ukraine: A Nomenclatural checklist.- Kiev, 1999.- P. 345.

Table 2

Analysis of difference between ecological optimum (studied species) and ecological conditions (studied locality)

Abiotical factor	min	opt	max	max-min	D
Lc	74	90	99	25	-65
Tm	39	60	76	37	-23
Om	44	50	69	25	-25
Cr	42	64	81	39	-25
Kn	28	56	81	53	-3

Hd	15	48	64	49	1
fH	78	88	98	20	-68
Rc	59	85	96	37	-48
Tr	27	45	63	36	-9
Ca	41	59	77	36	-23
Nt	17	33	51	34	1
Gr	39	57	76	37	-20
Ae	25	38	51	26	-12

Coefficient of environmental contentment (D) estimates degree of favorable conditions for either species and it`s a measure of population ecological discomfort as well: than more its value, than less correspondence of habitat conditions to the studied species ecology [11].

Let`s analyze response of the studied species to each of these factors.

Illumination-shadiness scale (Lc). Due to analysis of this ecological factor, species *Medicago marina L.* can be classified as euheliophyte-plant, its optimum values reaches the maximum amplitude rate 90 units, coefficient D = 65 units.

Thermoclimatic scale (*Tm*). According to total of effective temperature values, it`s possible to determine this species group as xerophytes, optimum 60 units. The difference between accuracy of this ecological factor in the given locality and optimal conditions for *Medicago marina L.* population makes 23 units.

Ombroclimatic scale of aridity and humidity (Om). The studied case is a species inhabited in conditions of arid type, optimum zone is 50 units.

Cryoclimatic scale (Cr) makes it possible to analyze growing of *Medicago marina L.* population under conditions of warm winters with optimum zone 64 units.

Scale of soil moisture (Hd). Moistening of soil in the studied locality corresponds ecological demands of the researched population, D=1 unit.

Scale of climate continentality (Kn). Coefficient D=3 units is in range of optimal conditions for the given population growing on the Donuzlav lake split.

Scale of soil saline regime (Tr). Analysis of HCO_3, CI, SO_4 ions content (soil 100g/level 50 sm) permits to reveal favorable values of the saline regime for *Medicago marina L.* within investigated locality, D=9units.

Scale of soil acidity (Rc). Amplitude pH 6,5-9,4 characterized substrate of the studied area as neutral and alkalescent. Coefficient D=48 units indicates unfavorable conditions for the studied species.

Scale of soil nitrogen satiration (Nt). Occurrence of free nitrogen in soil causes favorable conditions for *Medicago marina L.*

Scale of soil moisture variability (fH). One of unfavorable factors for *Medicago marina L.* population in the given area is a soil moisture variability. Its coefficient occurred the highest in comparison with other factors mentioned above D=68 units.

Scale of soil aeration (Ae). Coefficient D=12 units, acceptable rate for surviving of the studied case within the Donuzlav lake split.

Scale of carbonate concentration in soils (Ca). Range of soil carbonate concentration in the studied area is 41-77 units, D=23 units, that is quite congenial for the species environment.

Scale of soil humus content (Gr). Analysis of this ecological factor rate indicates humus concentration from 375 till 575 ton/ha in one-meter-depth layer, that is enough to satisfy biological needs of nutrients on the average.

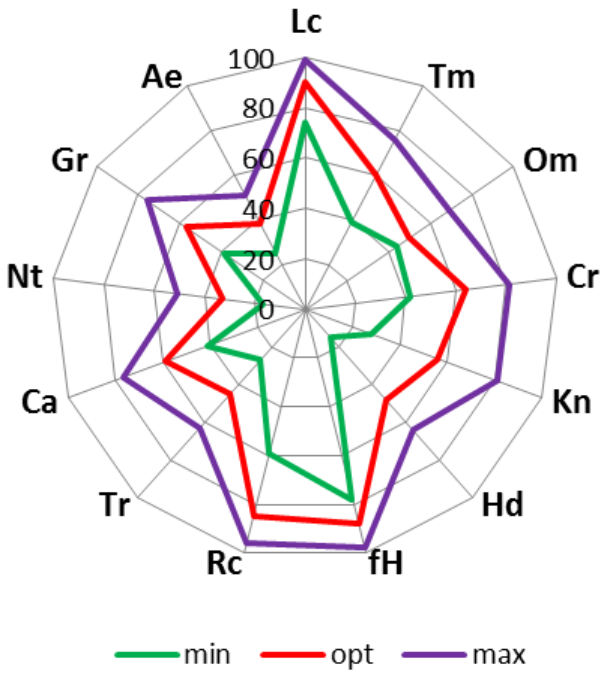


Fig.2 Amplitude ecological scale, its environmental range

Conventional signs of axes: temperature Tm, continental climate values (Kn), aridity and humidity (Om), cryoclimatic values(Cr), soil moisture (Hd), soil saline regime (Tr), soil acidity (Rc), soil nitrogen content (Nt), soil moisture variability (fH), illumination-shadiness (Lc), soil aeration (Ae), carbonate concentration in soils (Ca), soil humus content (Gr).

According to scales of abiotical factors with ranged from 0 till 100 units *Medicago marina L.* has a wide amplitude on soil moisture, continental climate and cryoclimatic values, the narrowest ecological amplitude was registered on illumination, soil aridity and humidity regimes.

Conclusions

Phytoindication of ecological scales makes it possible to characterize habitat of *Medicago marina L.* on the Donuzlav lake split in terms of ecology.

Maximum appropriate to favorable conditions factors within the given locality of studied population are free nitrogen content in the soil, moistening and aeration of soil, continentality of climate.

Due to method of ecological scales it was sorted out abiotical factors with unfavorable values in the population range: illumination, soil moisture regime, soil acidity. Probably just these very factors or combination of them make unfavorable conditions for *Medicago marina L.* population within this locality.

Gratitudes

Authors thank sincerely Svyrin S. for his assistance in a search of *Medicago marina L.* location.

The research was granted by the Russian Scientific Foundation (№ 14-50-00079)

References

1. *Zlobyn Yu.A., Sklyar V.G., Klymenko A.A.* Populyatsii redkih vidov rastenij: teoreticheskiye ocnovy i metodika izucheniya: monographiya. – Sumi: Universitetskaya kniga, 2013. – 439 s.

2. *Korzhenevsky V.V., Kvytnytska O.A.* Do pitannya pro otsinku yemnosti mistsj zrostannya // Naukovi pratsi Lisivnichoyi akademii nauk Ukraini: zbyrnik naukovyh pratsj. – Lviv: RVV NLTU Ukrayini. – 2012. – Vyp.10. – S. 73-75.

3. *Korzhenevsky V.V.,Klyukin A.A.* Metodicheskiye rekomendatsii po phytoindikatsii sovremennyh ekzogennyh protsessov. – Yalta: Izd-vo Nikitskogo botanicheskogo sada, 1987. – 41 s.

4. *Seledets V.P., Probatova N.S.* Ekologichesky areal vida u rastenij. Vladivistok: Dalnauka, 2007. – 98 s.

5. Sovremenniye landshafty Kryma i sopredelnyh akvatorij: Monographiya / Nauchny redactor E.A. Pozachenyuk. – Simferopol: Biznes-Inform, 2009. – 611 s.

6. *Fedorovych B.A.* Dynamika i zakonomernosti reljefoobrazovaniya pustyn. – M.: Nauka, 1983. – 157 s.

7. *Tsyganov D.N.* Ekomorphy i ekologicheskiye svity // Bul. MOIP. Otd.biolog. – 1974. – T. 79. Vyp.2. – S. 128-141.

8. Chervona knyga Ukrayini. Roslynny svyt / Za red. Ya.P. Dydukha. – K.: Globalkonsalting, 2009. – 900 s.

9. *Arens S.M.* Aeolian processes in the Dutch foredunes. Landscape and Enviromental Research Group, University of Amsterdam, 1994. – 125 p.

10. *Carter R.W.G., Wilson P.* The geomorphological, ecological and pedological development of coastal foredunes at Magilligan Point, Northern Ireland. In: K.F. Carter (eds), Coastal dunes. Form and processes. John Wiley & Sons, Chichester, 1990.− P. 177-200.

11. *Hesp P.A.* Foredune formation of southeast Australia. In: Thom, B.G. (ed), Coastal Geomorphology in Australia. Accademic Press, Sydney. −1984.− P. 69-97.

12. *Piotrowska H., Celiński F.* Zespoły psammofilne wysp Wolina i Południowo-wschodniego Uznamu. Badania Fizjograficzne nad Polską Zachodnią, T. XVI, 1965.− P. 123-170.

The article was received at editors 18.11.2014

Shkaranda Yu.S., Korzhenevsky V.V., Population Medicago Marina L. on split of Donuzlav lake. Phytoindication of its ecological amplitude// Bull. of the State Nikit. Botan. Gard. – 2015. – № 114. – P. 10-15

For the first time phytoindication of *Meicago marina L.* ecological amplitude was carried out. It was based on analysis of floristic composition within split of the Donuzlav lake. Ecological range of the studied species allowing for principal abiotical factors was determined due to scale by Tsyganov D.N., methodology by Korzhenevsky V.V. In the course of the research it was found out a location of ecological optimum for *Meicago marina L.* population in syntaxonomic region space according to the main ecological factors.

Key words: *phytoindication, ecological scales, coastal vegetation of dunes; Meicago marina L.*

UDC 576.89:597 (261.2)

FLORISTIC DIVERSITY OF MACROPHYTES IN KAZACHYA BAY (THE CRIMEA, THE BLACK SEA)

Nataliya Afanasiyevna Mylchakova, Valentina Gennadiyevna Ryabogina
SBE "Institute of the South Marine Biology named after Kovalevsky A.O.",
2, Nakhymova av., the city of Sevastopol, RF, 299011
milchakova@gmail.ru

Introduction

Study of macrophyte flora in Kazachya Bay has taken almost forty years, though species composition of macroalgae and higher plants inhabited its territory, including water area, adjacent to the state wildlife preserve, has been published in recent years [1 – 4, 8 – 10]. This work presents an annotated list of macrophyte flora in Kazachya bay, based on inspection of published information and hydrobotanic surveys (1997 – 2007), allowing for nomenclatural changes. A comparative ecological and floristic analysis of the long-term changes in macrophyte flora has been made within the whole bay water area [1]. The research objective is to reveal cozoological importance of macrophyte flora in Kaachya bay and to ground increasing the wildlife preserve territory.

Results and discussion

105 species present macrophyte flora of Kazachya bay: Chara– 1, Ulva latissima – 28, Porphyra gen. – 50, Phaeophyceae – 20, flowering plants – 6 (Table).

Ulva latissima group is marked out by *Bryopsis hypnoides*, *B. plumosa*, *Chaetomorpha crassa*, *Cladophora liniformis*, *Cladophoropsis membranacea*, *Ulva intestinalis*, developed everywhere and not found out before.

Table

Macrophyte species composition of Kazachya bay (1967-2007)

Taxon	Type of vegetation	Period	
		1967-1987	1997-2007
1	2	3	4
Charophyta			
Chara aculeolata F.T. Kütz. in H. Reichenbach	A*	+	+
Chlorophyta			
Acrochaete viridis (Reinke) R. Nielsen (= *Entocladia viridis* Reinke)	A	+	+
Acrosiphonia arcta (Dillw.) Gain (= *A. centralis* (Lyngb.) Kjellm.)	Sw	-	+
Bolbocoleon piliferum Pringsh.	A	+	-
Bryopsis corymbosa J. Ag.	Ss	-	+
B. hypnoides Lamour.	A	-	+
B. plumosa (Huds.) C. Ag.	Sw	-	+
Chaetomorpha aerea (Dillw.) Kütz.	A	+	+
Ch. crassa (C. Ag.) Kütz.	A	-	+
Ch. linum (O.F. Müller) Kütz. (= *Ch. chlorotica* (Mont.) Kütz.)	A	+	+
Chlorochytrium cohnii E.P. Wright (= *Chlorocystis cohnii* (E.P. Wright) L. Reinhard)	?	+	-
Cladophora albida (Nees) Kütz.	A	+	+

Cl. dalmatica Kütz.	A	+	-
Cl. laetevirens (Dillw.) Kütz.	A	+	+
Cl. liniformis Kьtz.	A	-	+
Cl. sericea (Huds.) Kütz.	A	+	+
Cl. siwaschensis C. Meyer	A	-	+
Cl. vadorum (Aresch.) Kütz.	A	+	+
Cladophoropsis membranacea (Hofm. Bang ex C. Ag.) Børg.	Ss	-	+
Codium vermilara (Olivi) Delle Chiaje	P	-	+
Pedobesia simplex (Menegh. ex Kütz.) M.J. Wynne & Leliaert (= *Derbesia lamourouxii* (J. Ag.) Soland.)	Ss	+	-
Phaeophila dendroides (P.L. Crouan & H.M. Crouan) Batt.	A	+	-
Pringsheimiella scutata (Reinke) Marschew.	A	+	+
Rhizoclonium riparium (Roth) Harv. (= Rh. implexum (Dillw.) Kütz.)	A	-	+
Ulothrix implexa (Kütz.) Kütz.	A	-	+
Ulva clathrata (Roth) C. Ag. (= *Enteromorpha clathrata* (Roth) Grev.)	A	+	+
U. intestinalis L. (= *Enteromorpha intestinalis* (L.) Link.)	A	-	+
U. rigida C. Ag.	P	+	+
Ulvella lens P.L. Crouan & H.M. Crouan	A	-	+
Rhodophyta			
Acrochaetium secundatum (Lyngb.) Näg. (= *Kylinia virgatula* (Harv.) Papenf.)	A	+	+
Antithamnion cruciatum (C. Ag.) Näg.	A	+	+
Apoglossum ruscifolium (Turn.) J. Ag.	P	+	+
Callithamnion corymbosum (J.E. Smith.) Lyngb.	A	+	+
Ceramium arborescens J. Ag.	A	-	+
C. ciliatum (Ell.) Ducl.	Ss	+	+
C. deslongchampsii Chauvin ex Duby (= Ceramium strictum (Kütz.) Rabenh.)	A	+	+
C. diaphanum (Lightf.) Roth	A	-	+
var. *elegans* (Roth) Roth (= *Ceramium elegans* (Roth) Ducl.)	Ss	-	+
var. *tenuissimum* Roth (= *Ceramium tenuissimum* (Roth) Aresch.)	A	-	+
C. virgatum Roth (= *C. rubrum* (Huds.) Ag.)	A	+	+
C. pedicellatum C. Ag.	A	-	+
Chondria capillaris (Huds.) M.J. Wynne (= *Ch. tenuissima* C. Ag.)	A	+	+
Ch. dasyphylla (Wood.) C. Ag.	A	-	+
Chroodactylon ornatum (C. Ag.) Basson (= *Asterocytis ramosa* (Thwaites) Gobi ex F. Schmitz)	Ss	-	+
Colaconema daviesii (Dillw.) Stegenga (= *Acrochaetium davesii* (Dillw.) Näg.)	A	-	+
Corallina elongata J. Ellis & Soland. (= *C. mediterranea* Aresch.)	A	+	+
C. *officinalis* L.	P	-	+
Dasya baillouviana (Gmel.) Mont. (= *D. elegans* (G. Martens) C. Ag.)	Ss	+	-
D. hutchinsiae Harv. (= *D. arbuscula* Harv.)	Ss	-	+
D. pedicellata (C. Ag.) C. Ag.	Ss	-	+
Erythrodermis traillii (Holmes ex Batters) Guiry & Garbary (= *Phyllophora traillii* Holmes ex Batters)	P	+	+
Erythrotrichia carnea (Dillw.) J. Ag.	Ss	+	+
Eupogodon apiculatus (C. Ag.) P.C. Silva (= *Dasyopsis apiculata* (C. Ag.) A. Zin.)	P	+	+
Gelidium crinale (Hare ex Turner) Gaillon	P	+	+
G. spinosum (S.G. Gmel.) P.C. Silva, Basson & Moe	P	+	+

(= *G. latifolium* Bornet ex Hauck)			
Gracilaria dura (C. Ag.) J. Ag.	P	-	+
G. gracilis (Stackh.) M. Steentoft, L.M. Irvine & W.F. Farnham (= *G. verrucosa* (Huds.) Papenf.)	P	+	+
Haliptilon virgatum (Zanard.) Garbary & H.W. Johansen (= *Corallina granifera* Ell. et Soland.)	P	-	+
Hydrolithon farinosum (J.V. Lamour.) D. Penrose & Y.M. Chamberlain (= *Fosliella farinosa* (J.V. Lamour.) M.A. Howe; *Melobesia farinosa* J.V. Lamour.)	A	+	+
Jania rubens (L.) Lamour.	P	+	+
Laurencia coronopus J. Ag.	P	+	+
L. obtusa (Huds.) Lamour.	P	+	+
Lomentaria clavellosa (Turn.) Gail.	A	+	+
Nitophyllum punctatum (Stackh.) Grev.	P	+	+
Osmundea hybrida (A.P. de Candolle) K.W. Nam (= *Laurencia hybrida* (A.P. de Candolle) T. Lestiboudois)	P	+	-
O. pinnatifida (Huds.) Stackh. (= *Laurencia pinnatifida* (Huds.) Lamour.)	P	+	+
Palisada perforata (Bory de Saint-Vincent) K.W. Nam (= *Laurencia papillosa* (Forsk.) Grev.; *Chondrophycus papillosus* (C. Ag.) Garbary et Harper)	P	+	+
Phyllophora crispa (Huds.) P.S. Dixon (= *Ph. nervosa* (DC.) Grev.)	P	+	+
Phymatolithon lenormandii (J.E. Aresch.) W.H. Adey (= *Lithothamnion lenormandii* (J.E. Aresch.) Foslie)	P	+	+
Pneophyllum confervicola (Kütz.) Y.M. Chamberlain (= *Melobesia minutula* Foslie)	A	-	+
Pneophyllum fragile Kьtz. (= *Melobesia lejolisii* Rosan.)	A	-	+
Polysiphonia breviarticulata (C. Ag.) Zanard.	Ss	-	+**
P. denudata (Dillw.) Grev. ex Harv.	A	+	-
P. elongata (Huds.) Spreng.	P	+	+
P. fucoides (Huds.) Grev. (= *P. nigrescens* (Huds.) Grev., *P. violacea* (Roth) Spreng.)	A	-	+
P. opaca (C. Ag.) Moris et De Not.	P	-	+**
P. pulvinata (Roth) Spreng.	Ss	-	+**
P. subulifera (C. Ag.) Harv.	A	+	+
Rubrointrusa membranacea (Magnus) S.L. Clayden & G.W. Saunders (= *Audouinella membranacea* (Magn.) Papenf.)	P	+	-
Spermothamnion strictum (C. Ag.) Ardiss.	P	+	+
Stylonema alsidii (Zanard.) K.M. Drew (= *Goniotrichum elegans* (Chauv.) Zanard.)	P	-	+
Ochrophyta			
Cladostephus spongiosus (Huds.) C. Ag.	P	+	+
Corynophlaea umbellata (C. Ag.) Kütz.	Ss	+	+
Cystoseira barbata (Stackh.) C. Ag.			
var. *barbata*	P	+	+
f. *repens* A.D. Zinova & Kalugina	P	+	+
C. *crinita* Duby	P	+	+
Dictyota dichotoma (Huds.) Lamour.	Ss	-	+
D. linearis (C. Ag.) Grev.	Ss	+	-
D. fasciola (Roth) J.V. Lamour. (= *Dilophus fasciola* (Roth) Howe)	Ss	+	+
D. spiralis Mont. (= *Dilophus spiralis* (Mont.) Hamel)	Ss	+	+
Ectocarpus siliculosus (Dillw.) Lyngb. (= *E. confervoides* Le Jolis)	Sw	+	+

E. fasciculatus Harv.	Sw	+	-
Eudesme virescens (Carm. ex Berkeley) J. Ag.	A	+	+
Feldmannia irregularis (Kütz.) G. Hamel	Ss	-	+**
Giraudia sphacelaroides Derb. et Sol.	A	+	-
Myriactula rivulariae (Suhr) Feldm.	Ss	+	+
Myriotrichia repens Hauck	A	-	+
Nereia filiformis (J. Ag.) Zanard.	P	+	+
Padina pavonica (L.) Thivy in W.R. Taylor	Ss	+	+
Scytosiphon lomentaria (Lyngb.) Link (= *S. simplicissimus* (Clemente) Cremades)	Sw	+**	+
Sphacelaria cirrosa (Roth) C. Ag.	P	+	+
Stilophora tenella (Esper) P.C.Silva in P.C. Silva, Basson & Moe (= *S. rhizodes* (Ehrh.) J. Ag.)	Ss	+	+
Zanardinia typus (Nardo) P.C. Silva in W. Greuter (= *Z. prototypus* Nardo)	P	+	+
Angiospermae			
Ruppia maritima L.	P	+	+
Ruppia cirrosa (Petagna) Grande (= *R. spiralis* L.)	P	+	+
Stuckenia pectinata (L.) Börner (= *Potamogeton pectinatus* L.)	P	+	+
Zannichellia palustris L. (= *Z. major* (Hartman) Boenn. ex Reichenb.)	P	+	+
Zostera marina L.	P	+	+
Zostera noltii Hornem.	P	+	+
Всего: 105		73	97
Notes: * – P – perennial, A – annual, Sw – seasonal winter, Ss – seasonal summer; ** – data of other scientists [2 – 4]			

Species diversity of *Ceramium* and *Polysiphonia genus* and some coralline red algae has been increased in comparison with last century 60-70th [5, 6]. Besides floristic changes, a number of species with short vegetation cycle has increased (Fig.) especially it concerns seasonal summer and annual macroalgae (from 16,9 up to 20,2% and from 40 up to 42,7%). At the same time perennial species decreased their contribution in the ecosystem (from 38,5 down to 32,6%) causing deterioration of ecological conditions.

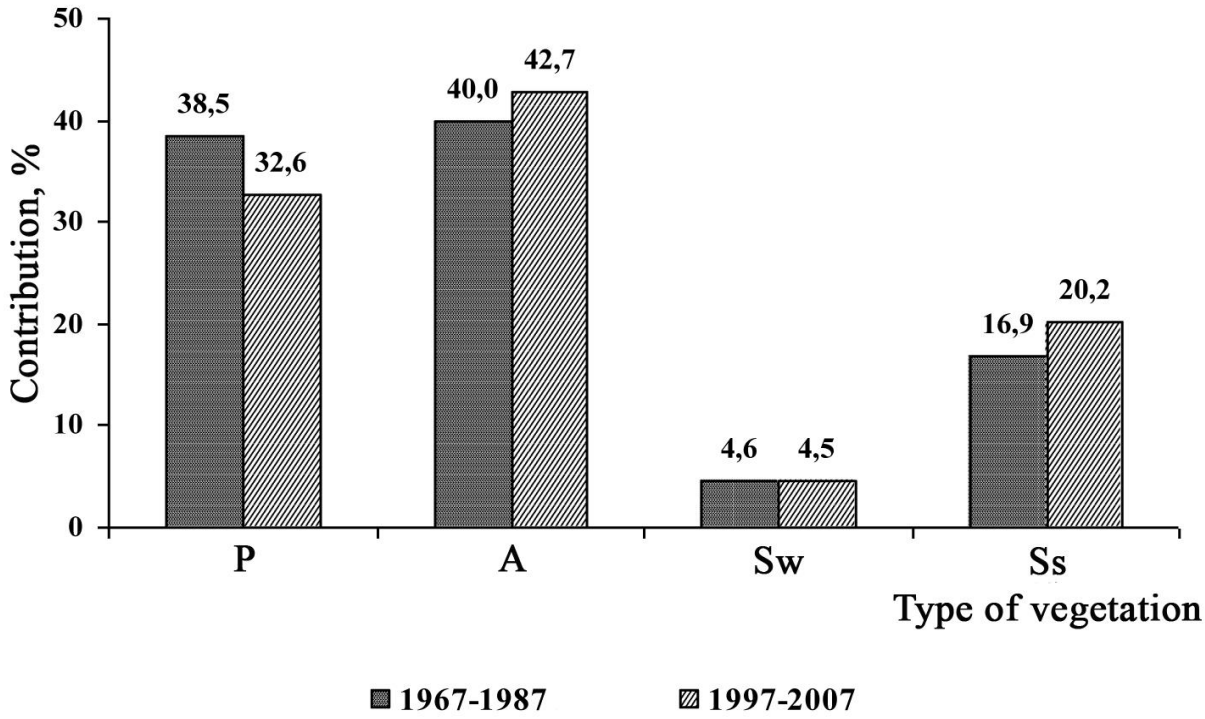


Fig. Long-term changes in contribution ratio of species with different vegetation type within algal flora, Kazachya bay (1967 – 2007)

Algal flora contains 16 rare and protected in the Black Sea species [7, 11, 12] as follows: 4 species of Ulva latissima (*Cladophora dalmatica, Cl. vadorum, Cladophoropsis membranacea, Codium vermilara),* 7 Porphyra gen. (*Chroodactylon ornatum*, *Eupogodon apiculatus, Laurencia coronopus*, *Osmundea hybrida, O. pinnatifida, Phyllophora crispa, Stylonema alsidii*) and 5 Phaeophyceae (*Cladostephus spongiosus*, *Cystoseira barbata, C. crinita, Dictyota dichotoma*, *Stilophora tenella*). Moreover *Zostera marina* and *Z. Noltii* are protected and included into the Black Sea Red Data Book [12].

Therefore 17,1% of macrophytes in Kazachya bay are protected species that emphasises originality of this water body and its nature conservation significance. Results of ecological and floristic analysis have been included into scientific basis concerning wildlife preservation territory increasing due to bay water area and its status change into general biological [1]. Actual task is to develop effective natural conservation measures aimed at maintenance of the unique flora within the wildlife preserve, a centre of biological organization "Gerakleisky" belonged to the Crimean maritime ecological system [9].

Conclusions

1. 105 species present macrophyte flora of Kazachya bay: Chara– 1, Ulva latissima – 28, Porphyra gen. – 50, Phaeophyceae – 20, higher plants – 6.
2. 18 macrophyte species of the Black Sea basin are protected (17,1%), one of them, *Zostera marina* was included into Berne Convention (1979).
3. In recent decades in algaflora of Kazachya bay a number of species with short vegetation cycle has increased especially it concerns seasonal summer and annual macroalgae (from 16,9 up to 20,2% and from 40 up to 42,7%). At the same time perennial species decreased their percentage in the ecosystem (from 38,5 down to 32,6%) causing deterioration of ecological conditions.

4. Taking into consideration importance of Kazachya bay flora, it was recommended to change wildlife preserve status and make it general biological, increase its territory due to water area and work out a management-plan for development of the protected object.

Gratitude

Researches have been funded due to financial support within the 7th Framework Programme of the European Union (FP7/2007 - 2013), project COCONET «Towards COast to COast NETworks of marine protected areas (from the shore to the high and deep sea), coupled with sea-based wind energy potential» (No. 287844).

References

1. *Bondaryova L.V., Mylchakova N.A.* Flora obshchezoologicheskogo zakaznika "Bukhta Kazachya" (Krym, Chyornoye more) // Zapovidna sprava v Ukraini. – 2002. – T. 8, vyp.2. – S. 36 – 47.

2. *Yevstigneyeva I.K.* Struktura tsytozirovo- i zosterovo-laurentsiyevyh phytotsenozov v nekotoryh rayonah krymskogo poberezhya Chyornogo morya // Ekologiya morya. – 1983. – Vyp.12. – S. 35 – 41.

3. *Yevstigneyeva I.K., Tankovskaya I,N.* Zelyoniye vodorosli probrezhya zakaznika "Bukhta Kazachya" (Chyornoye morye) // Ryb. Hoz-vo Ukraini. – 2005. – Spetc.vypusk. – S. 85 – 89.

4. *Yevstigneyeva I.K., Tankovskaya I,N.* Ekologo-taksonomichesky sostav i biomassa Rhodophyta i Phaeophyta zakaznika "Bukhta Kazachya" // Ekologiya morya. – 2006. – vyp. 72. – S. 21 – 29.

5. *Kalugyna-Gutnyk A.A.* Izmeneniya v donnoi rastitelnosti Sevastopolskoi bukhty za period s 1967 po 1977g. // Ekologiya morya. – 1982. – Vyp.9. – S. 48 – 62.

6. *Kalugyna-Gutnyk A.A., Kuftarkova Ye.A., Myronova N.V.* Usloviya proizrastaniya *Gracilaria verrucosa* (Huds.) Papenf. i zapasy makrophytov v Bukhte Kazachya (Chyornoye morye) // Rastitelniye resursy. 1987. – T. 23, vyp.4. – S. 520 – 531.

7. Krasnaya kniga Rossiskoj Federatsii (rasteniya i grybi) / Gl. Redkol.: Yu.P. Trutnyev i dr.; Otv.red. R.V. Kamelyn, V.S. Novykov; Sost. T.V. Abramova i dr. – M.: Tovaryshchestvo nauchnyh izdanij KMK, 2008. – 885 s.

8. *Mylchakova* N.A. Makrophytobentos // sovremennoye sostoyaniye bioraznoobraziya pribrezhnyh vod Kryma (chernomorsky sector) / pod red. V.N. Yeremeyeva, A.V. Gayevskoj, NAN Ukraini, Institut biologii yuzhnyh morei. – Sevastopol: EKOSI-Gydrophysika, 2003. – S. 152 – 208.

9. *Mylchakova N.A., Maslov I.I., Boltachova N.A.* Morskiye ohranyayemiye akvatorii v strukture ekoseti Kryma // Zapovedniki Kryma. Teoriya, praktika i perspektivi zapovednogo dela v Chernomorskom regione: materialy V mezhdunar. nauchn-prakt.konf. (Simferopol, 22-23 oktyabrya 2009). – Simferopol, 2009. – S. 98 – 102.

10. *Mylchakova N.A., Ryabogina V.G.* Floristicheskaya kharakteristika morskih akvatorij objektov pryrodno-zapovednogo fonda regiona Sevastopola (Chyornoye morye) // Ekologiya morya. – 2002. – Vyp. 60. – S. 5 – 11.

11. Chervona knyga Ukraini. Roslynnij svit / za red. Ya.P. Dydukha. – K.: Vydavnytstvo "Globalkonsalting", 2009. – 900 s.

12. Black Sea Red Data Book / Ed. by H. J. Dumont. – New York: United Nations Office for Project Services, 1999. – 413 pp.

The article was received at editors 17.11.2014

Milchakova N.A., Ryabogina V.G. Floristic diversity of macrophytes in Kazachya bay (the Crimea, the Black Sea) // Bull. of the State Nikit. Botan. Gard. – 2015. – № 114. – P. 16-22

The article presents an annotated list of macrophytes in Kazachya bay water area, which is going to be included into the state general zoological wildlife reserve "Buhta Kazacha". Species composition of macroalgae and higher plants corresponds to archives (1967 – 1980), published information and results of hydrobotanical surveys (1997-2007), according to actual taxonomic inspection and nomenclatural changes. It was pointed a cozoological importance of macrophyte flora in Kazacha bay. This work contains a checklist of rare macroalgae and discussion relative to increasing the reserve territory due to adjacent water area.

Key words: *macrophytes, species composition, long-term dynamics, rare species, wildlife preserve, Kazachya bay, the Black Sea.*

PLANT BIOCHEMISTRY

UDC 582.477:577.19

BIOLOGICALLY ACTIVE SUBSTANCES OF CUPRESSUS TORULOSA D. DON

Nadezhda Yurjevna Marchuk, Anfisa Yevgenjevna Paliy

Nikitsky Botanical Gardens – National Scientific Centre
298648, Republic of the Crimea, Yalta, urban village Nikita
marchuk_n@i.ua

Introduction

Essential oil is a complicated mixture of terpenoids and other components, isolated out of different parts of a plant; essential oils are used extensively in food, aromatic and pharmaceutical industries. As synthetic chemical substances are quite dangerous for health, usage of natural oils is getting popular that causes further flora investigation [10].

Bhutan Cypress (*Cupressus torulosa* D. Don, sin. *Cupressus tonkinensis* Silba, Himalayan Cypress) is an evergreen tree by height 40 m [8]. Preferable soil is limestone. It is a frost-resistant plant. For the Crimea this species was introduced by seeds from Hamburg in Nikitsky Botanical Gardens (NBG) in 1842. In the end of the XX century it was introduced on the Black sea Coast of the Caucasus. It belongs to category of park trees that`s why it`s mostly spread in the regions with sufficient amount of precipitation: south of France, Portuguese, Spain, north of Italy [3].

The objective of our researches was to study biologically active substances being contained in *Cupressus torulosa* D. Don for further usage in medicine. With this purpose a dynamic of total content of essential oils, phenol compounds and ascorbic acid in needles and cones during annual vegetation cycle was investigated, as well as component composition of essential oil having a maximum content of substances mentioned-above.

Objects and methods of the research

The researche was carried out at the laboratory of Biochemistry, biotechnology and virology of plants in NBG-NSC in 2013. Needles and cones of *Cupressus torulosa* D. Don were chosen as an analyzing material, collected within Arboretum of NBG-NSC.

Determination of an essential oil mass concentration was conducted by its distillation with water vapor out of a row material and further measurement of volume. Content of oil was expressed in volume weight percentage in terms of absolutely dry material [2]. The essential oil composition was determined by chromatograph Agilent Technology 6890 with mass spectrometric sensor 5973. Water heater HP-1 by length 30 m, inside diameter is 0,25 mm. Thermostat temperature was coded in range of 50°C - 250 °C with velocity 4°C /min. Injector

temperature was 250°C. Gas-carrier was helium, its stream velocity was 1 sm³/min Transfer from gas chromatograph to mass spectrometric sensor was conducted at a temperature of 230°C. Source temperature was being kept at 200°C. Electronic ionization was carried out at 70 eV in mass range m/z of 29-450.

Identification was based on comparison analysis of mass-spectra and librarian data NIST05-WILEY (about 500000).

Content of ascorbic acid was determined by iodometric titration [2].

Total phenol compounds was estimated by colorimetric method applying reagent Folin—Ciocalteu (cuvette depth was 10 mm, light filter (560 nm)). Concentration was calculated using graph according to rutin [4].

Results and discussion

It was found out that in spring content of essential oil in needles and cones of *Cupressus torulosa* D. Don is minimal: in June it reaches 0,37% (of dry mass) with further decreasing in July (0,22%). Secondly minimal oil content occurs in autumn: November (0,4%). As to cones, there is only one peak of essential oil content during vegetation, in January (0,1%), while minimum is typical for summer period (0,02%) (Fig.1).

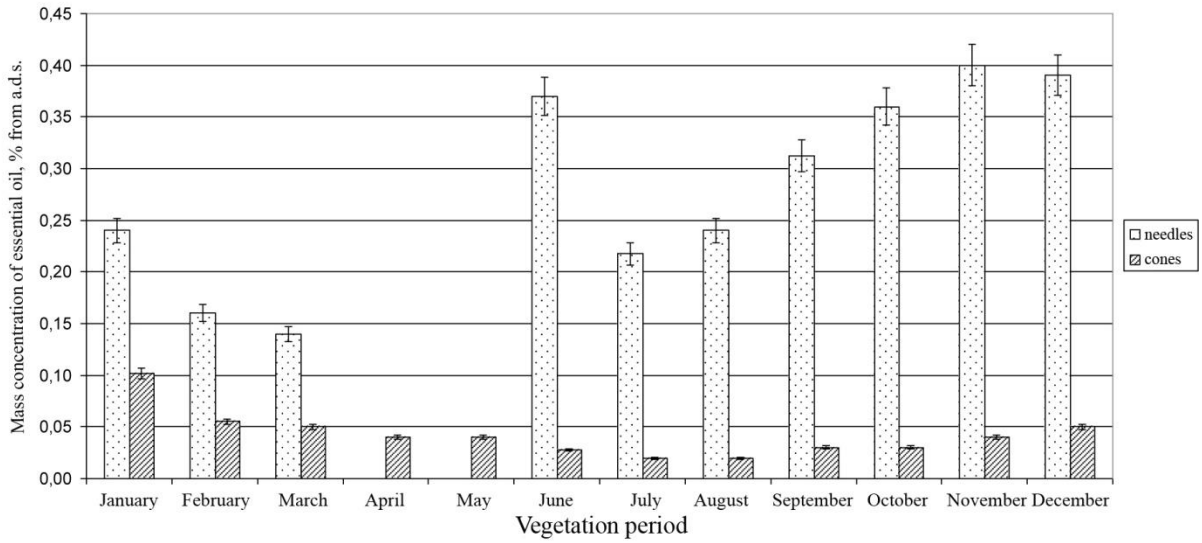


Fig.1 Mass concentration of essential oil in *Cupressus torulosa* D. Don needles needles and cones

Maximum mass concentration of essential oil was obtained out of needles in India – 1,3% [9]. In Vietnam output of essential oil out of air-dry leaves reached 0,13% [14].

During the research composition of individual components in essential oils of *Cupressus torulosa* D. Don needles and cones was studied (fig.2 and 3, table 1). The principal components of essential oil out of needles was sabinene (23,39%), terpinene-4-ol (14,96%), α-pinene (7,99%), γ-terpinene (5,90%).

As to researches in India, the principal components of essential oil out of *Cupressus torulosa* D. Don needles were α-pinene (30,30-34,25%), Δ^3carene (6,52-18,67%), limonene (8,54-23,79%) and sabinene (4,60-19,23%)[9]; in Vietnam: sabinene (29,34%), α-pinene (25,4%), 4-terpineol (13,91%) and γ-terpinene (5,5%) [14]. Essential oil, obtained in Argentina has the most similar quality composition with our results: α-pinene (25,8%), sabinene (22,3%), terpinene-4-ol (9,3%) [11]. Therefore, data obtained in our laboratories coincide with other studies, conducted in different countries, but occurrence of distinctions concerns geographical, population and seasonal variation.

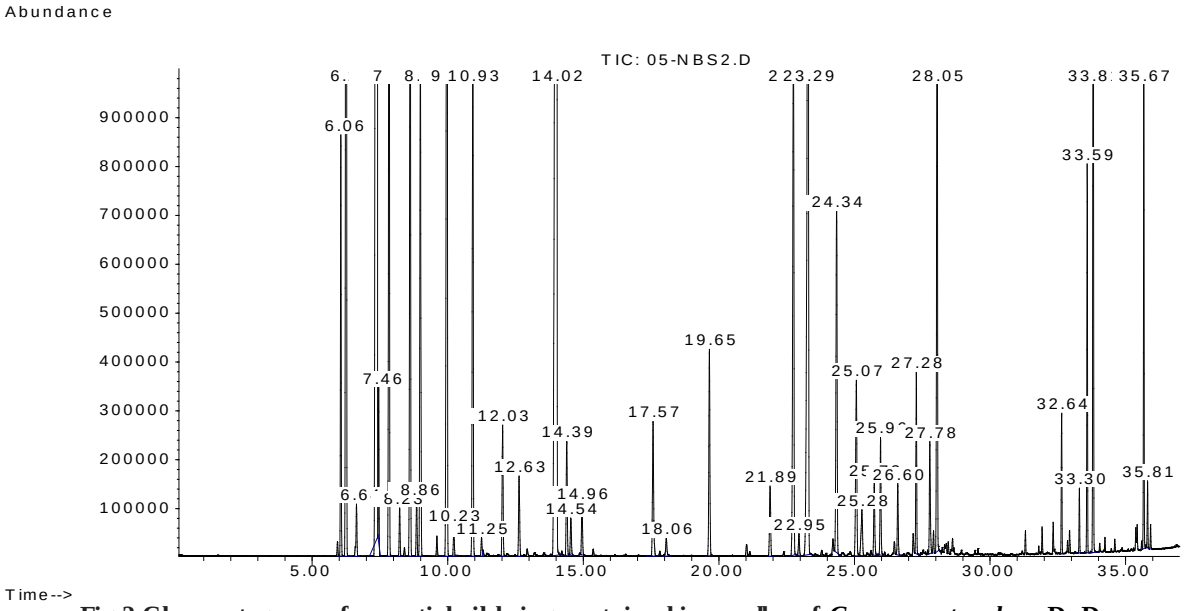


Fig.2 Chromatogram of essential oil being contained in needles of *Cupressus torulosa* D. Don

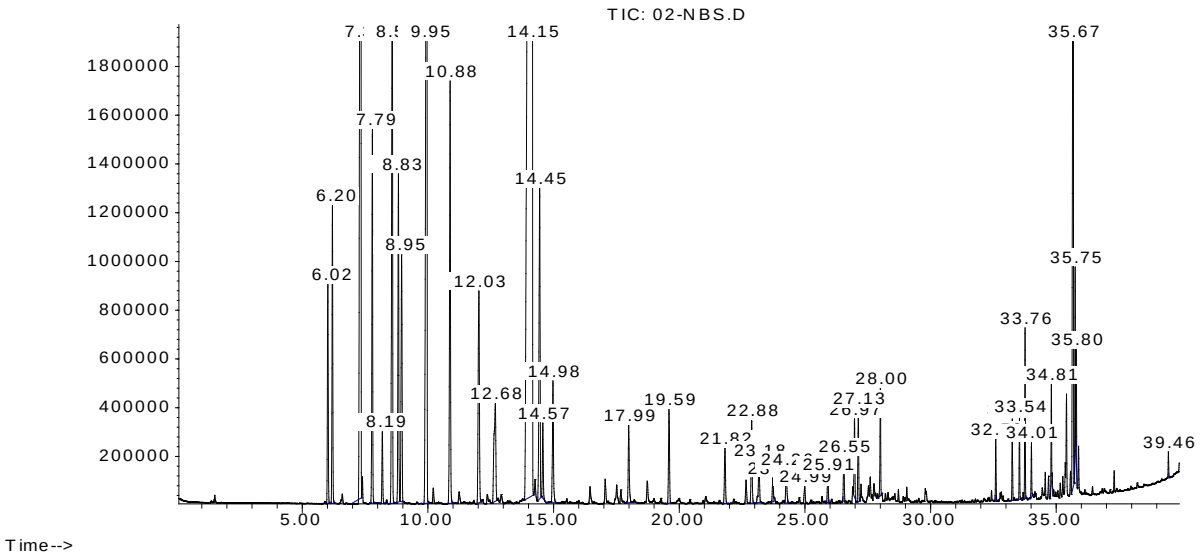


Fig.3 Chromatogram of essential oil being contained in Bhutan cypress cones

Composition of essential oil extracted out of cones mostly contains terpenine-4-ol (41,95%), sabinene (11,08%) and γ-terpenine (8,12%). In spite of the low mass concentration, cone essential oil is valuable by high content of terpenine-4-ol. Considered it is a component that gives antiseptic action to essential oil of a tea tree [6]. Terpenine-4-ol possesses antivirus, antibacterial, antifungal, insecticidal, antioxidant, antineoplastic and anti-inflammatory action [7]. That`s why essential oil of *Cupressus torulosa* D. Don cones is perspective material in the field of medicine, in a case of minimal tree damage.

Our data are corroborated by scientists from India [12, 13], where the main component of the cone essential oil was terpenine-4-ol as well (till 26%). In Indian tests against Gram-positive microorganisms (*Bacillus subtilis*, *Staphylococcus aureus*, *Bacillus megaterium*, *Bacillus coagulans*), Gram-negative microorganisms (*Escherichia coli*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, *Salmonella typhii*), in antifungal investigations (*Candida albicans*, *Aspergillus flavus*, *Trichoderma lignorum*, *Cryptococcus neoformans*) there was noted a higher antifungal activity than antibacterial one. Therefore crème contained some essential oil

of *Cupressus torulosa* D. Don cones was suggested as an antimicrobial agent for skin diseases treatment [13].

Table 1

Component composition of *Cupressus torulosa* D. Don essential oil

№	Holding time	Component	Mass concentration in needles essential oil, %	Mass concentration in cone essential oil, %
1	2	3	4	5
1	6.06	α-thujene	1,71	1,29
2	6.26	α-pinene	7,99	1,75
3	6.64	camphene	0,25	
4	7.39	sabinene	23,39	11,08
5	7.45	β-pinene	0,48	
6	7.84	myrcene	3,90	2,25
7	8.22	α-phellandrene	0,21	0,45
8	8.62	α-terpinene	3,58	4,50
9	8.85	*n*-cymene	0,27	2,14
10	8.99	limonene	2,69	1,79
11	9.97	γ-terpinene	5,90	8,12
12	10.22	*Trans*-sabinenehydrat	0,15	
13	10.92	terpinolene	2,76	3,03
14	11.24	*cis*- sabinenehydrat	0,09	
15	12.02	*trans*-p-ment-2-en-1-ol	0,68	1,88
16	12.63	*cis*-*n*-ment-2-en-1-ol	0,44	1,34
17	14.01	terpinene-4-ol	14,96	41,95
18	14.39	α- terpineol	0,60	2,48
19	14.54	*cis*- piperitol	0,21	0,50
20	14.95	*trans*-piperitol	0,27	0,97
21	17.57	bornyl acetate	0,82	
22	18.06	terpinene-4-ol acetate	0,13	0,61
23	19.65	α- terpinyl acetate	1,14	0,69
24	21.88	caryophyllene	0,41	0,43
25	22.95	humulene	0,13	0,64
26	23.29	epi-bicyclosesquiphellandrene	6,76	0,38
27	23.72	hermakren D		0,18
28	24.25	isoledene		0,29
29	24.34	episonarene	1,99	
30	24.99	δ-cadinene		0,13
31	25.06	*cis*-calamene	1,11	
32	26.59	caryophyllene oxide	0,35	0,29
33	26.97	α-cedrol		0,46
34	27.12	humulene oxide		0,56
35	27.28	Epi-cubenol	0,79	
36	27.77	γ-cadinole	0,58	
37	28.05	α- cadinole	3,16	0,59
38	32.59	Manoil oxide		0,29
39	32.64	Epi-manoil oxide	0,48	
40	33.25	Abieta-8(14),9(11),12-trien		0,37
41	33.29	abietan	0,23	
42	33.58	phyllocladene	1,27	
43	33.81	13(16),14-labdien-8-ol	3,45	0,75
44	34.01	8-β-oxi-sandaracopimarene (nesukol)		0,24
45	35.67	totarol	1,80	0,39
46	35.67	Totarol acetate		5,44

47	35.81	Ferrugenol	0,22	0,36
Total indentified components			**95,31**	**98,58**

Concentration of ascorbic acid in *Cupressus torulosa* D. Don needles made 66-95mg/100g, in cones – 40-48 mg/100g. The highest vitamin C content in needles was marked in winter (January), in summer it was lower (July), but in autumn it got increased. Production of material with ascorbic acid contain out of *Cupressus torulosa* D. Don needles and cones is not efficient, as needles of Scotch pine (Pinus *sylvestris*) contains much more vitamin C (374-506 mg%) [1].

Concentration of phenol substances in *Cupressus torulosa* D. Don needles ranged 3000-3600 mg/100 g of dry material, less in cones 2800-3400 mg/100 g. Its maximum concentration was marked in winter (January) and summer (July), minimum – spring (May).

In comparison with other coniferous plants (Scotch pine – 1800 mg/100 g of dry substance, Siberian cedar– 2000 mg/100 g [5]) content of phenol substances in needles of *Cupressus torulosa* D. Don exceeds 1,5-2 times. That`s why needles of *Cupressus torulosa* D. Don can be considered a real source of phenol compounds. But for a lack of details about their qualitative composition there is a necessity to carry out additional investigations in this direction.

Conclusions

During research a composition of essential oil extracted out of needles and cones of *Cupressus torulosa* D. Don has been studied. The main components of needles essential oil were sabinene (23%), terpinene-4-ol (15%), α-pinene (8%). Cone essential oil mostly contained terpinene-4-ol (42%), sabinene (11%) and γ-terpinene (8%). In spite of a low mass concentration (max 0,1%) cone essential oil is more promising in the field of medicine.

Extracts out of *Cupressus torulosa* D. Don needles and cones are perspective sources of phenol compounds, but there is a necessity to investigate their qualitative composition more thoroughly.

References

1. Boitsekovskaya S.A., Yumagulova E.R., Surnina E.N., Astafurova T.P. Issledovaniye physiologo-biokhimicheskih pokazatelej hvoi sosni obyknovennoj (Pinus sivestris L.) bolotnyh i lesnyh populyatsij // Vestnik Tomskogo gosudarstvennogo universiteta. Biologiya. – 2013. – T. 23, № 3. – S. 111 – 119.

2. Gosudarstvennaya farmakopeya SSSR. – M.: Medicina, 1987. – Vyp.1. – 334 s.

3. Zakharenko G.S. Biologicheskiye osnovy introduktsii i kultury vidov roda kyparis (*Cupressus* L.). – K.: Agrarna nauka, 2006. – 256 s.

4. Metody tekhnohymicheskogo kontrolya v vinodelii / Pod red. V.G. Gerzhykovoj – Simferopol: Tavrida, 2002. – 259 s.

5. Plaksyna I.V., Sudachkova N.E., Romanova L.I., Mylyutina I.L. Sezonnaya dynamika fenolnyh soedinenij v lube I hvoye sosni obyknovennoj i kedra sibirskogo v posadkah razlichnoj gustoty // Khimiya rastitelnogo syrja. – 2009. – T. 13, № 1. – S. 103 – 108.

6. *Carson C.F., Hammer K.A., Riley T.V. Melaleuca alternifolia* (Tea Tree) Oil: a Review of Antimicrobial and Other Medicinal Properties // Clinical microbiology reviews. – 2006. – Vol. 19, № 1. – P. 50 – 62.

7. *Chieh-Shan Wu, Yun-Ju Chen, Jeremy J. W. Chen, Jeng-Jer Shieh, Chia-Hsin Huang, Pei-Shan Lin, Gee-Chen Chang, JingHua-Tsai Chang, Chi-Chen Lin*. Terpinen-4-ol Induces Apoptosis in Human Nonsmall Cell Lung Cancer In Vitro and In Vivo // Evidence-Based Complementary and Alternative Medicine. – 2012. – Vol. 2012. –

http://www.hindawi.com/journals/ecam/2012/818261/ – Received 18 February 2011; Accepted 18 April 2011.

8. *Farjon A.A.* Handbook of the World's Conifers. Vol.2. – Leiden: BRILL, 2010. – 1111 p.

9. *Lohani H., Gwari G., Andola H.Ch., Bhandari U., Chauhan N.* α-Pinene Rich Volatile Constituents of *Cupressus torulosa* D. Don from Uttarakhand Himalaya // Indian Journal of Pharmaceutical Sciences. – 2012. – Vol. 74, № 3. – P. 278 – 280.

10. Lohani H., Nirpendra Kumar C., Andola H.Ch. Is a *Cupressus torulosa* is a Good Substitute of Two Selected *Juniperus* Species for Aroma Potentials? // Medicinal & Aromatic Plants. – 2013. – Vol. 2, № 2. – P. 122.

11. *Malizia R.A., Cardell D.A., Molli J.S., González S., Guerra P.E., Grau R.J.* Volatile constituents of leaf oils from the Cupressaceae family: part I. *Cupressus macrocarpa* Hartw., *C. arizonica* Greene and *C. torulosa* Don species growing in Argentina // Journal of Essential Oil Research. – 2000. – Vol. 12, № 1. – P. 59 – 63.

12. *Padalia R.C., Verma R.S., Chauhan A., Chanotiya Ch.S.* Essential oil compositions of branchlets and cones of *Cupressus torulosa* D. Don // Journal of Essential Oil Research. – 2013. – Vol. 25, № 4. – P. 251 – 256.

13. *Sellappan M., Palanisamy Dh., Joghee N., Bhojraj S.* Chemical Composition and Antimicrobial Activity of the Volatile Oil of the Cones of *Cupressus torulosa* D. DON from Nilgiris, India // Asian Journal of Traditional Medicines. – 2007. – Vol. 2, № 6. – P. 206 – 211.

14. *Tran Huy Thai, Nguyen Thi Hien, Do Thi Minh, Pham Van The*. Chemical composition of leaf oil of *Cupressus tonkinensis* Silba in Huu Lien, Lang Son province // Journal of Biology. – 2009. – Vol. 31, № 1. – P. 74 – 76. (Vietnamese)

The article was received at editors 13.11.2014

Marchuk N.Yu., Paliy A.E. The biological active substances of *Cupressus torulosa* D. Don // Bull. of the State Nikit. Botan. Gard. – 2015. – № 114. – P. 22-27

The article presents study results of biologically active substances being contained in needles and cones of Cupressus torulosa D. Don under conditions of South Cimea. Prevailed substances in an essential oil of needles were sabinene (33%), terpinene-4-ol (15%), α- pinene (8%). Essential oil composition of cones for the most part contained terpinene-4-ol (42%), sabinene (11%) and γ-terpenine (8%).

Key words: *Cupressus torulosa D. Don*, *essential oil, terpenine-4-ol, sabinene.*

HUMAN PHYTOREHABILITATION

UDC 616-001.26/.27-085:547.913

PROTECTIVE ACTION OF ESSENTIAL OILS IN CASE OF ANIMAL IRRADIATION AND POSSIBLE APPLIANCE FOR HUMAN

Tikhomirov Aleksandr Aleksandrovich, Govoroon Mariya Ivanovna

Nikitsky Botanical Gardens – National Scientific Centre, Yalta
298648, Republic of the Crimea, the city of Yalta, urban village Nikita
(patents@ukr.net)

KRU NII of physical methods in treatment and medicine climatology named after I.M. Sechenov, the city of Yalta, 8, Mukhina str.
(mehere@mail.ru)

Introduction

Protection of human body from ionizing radiation and preventive measures in radiation safety gain a great importance because of anthropogenic disasters and more active appliance of ionizing radiation source in medical practice. That`s why it`s urgent to search harmless means, which are capable to enhance body resistance to ionizing radiation.

Essential oils (EO) present a wide range of biological activity, which was described in this study: antioxidant properties [14, 15], ability to stimulate immune system [2, 3, 8], healing of wound and burn surface, processes of somatic cell division [1, 10], that is properties, extremely important in case of treatment the radiation injury

Study objective is to investigate if it`s possible to decrease injurious action of γ-irridation due to inhalation with essential oils.

Objects and research methods

Investigations of EO radioprotective properties were carried out according to standard scheme.

Total irradiation of animals was made by X-ray machine RUM-17, KFR 62 sm, combined filter (0,25mm Cu +1,0mm Al + 0,4mm Sn), dosage rate 0,32-0,42 Gy/min, irradiation dose 7Gy.

The main parameter of radiation injury was mortality percentage of animals for 30 days (%30) after X-ray irradiation. Total characteristic of death dynamics consisted of three stages: death rate of animals from 1-7 days (%7), from 8-14 (%14) and from 15 -30 (%21). On first stage (from the 1^{st} to 7^{th} day) animals die of gastrointestinal tract injury, on the second stage - irreversible damage of blood-making system is a reason of death. Average life of animals (AL), intensity of radiation sickness and rate of death are integral indices of body resistance.

Radiomodifying effect of EO was determined due to value FDV (factor of dosage variation), which reflects decreasing of effective irradiation dosage for animals after preventive procedures and defines their radioprotective action.

Course term (5-10 days or 30 days) and EO dosage were considered while investigating radiopreventive action of EO.

Test animals were placed into closed cells, where content of EO evaporation reached 20 or 100 mg/m^3 of air. Practical EO concentrations didn`t provoke toxic injury of internals.

Mice breathed air with EO content for 40 minutes every day. Procedure was finished 1 day before irradiation. Control animals were irradiated without EO procedure. In experiments 750 mice (line *CBA/lac*, hybrids (*CBAxC57Bl) F2* and outbred white mice weighted 20-25g) were used, 26-30 animals per each group.

Immunogenesis was studied on the model of primary immunal response to T-dependent antigen (erythrocytes of a sheep were injected v/v $5x10^8$ cell/ml); type of reaction was assessed by number of antibody-forming cells (AFC) in spleen [13].

Results and discussion

Protective action of inhalation with eucalyptus EO, dose 20 mg/m^3.

It was found out that 10 days preventive course of eucalyptus EO caused survival rate of 53,8% against 7,7% of control patterns (average life 47,3 and 14,0 days respectively). FDV was 1,59±0,33. Prolongation of EO preventive course up to 30 procedures didn`t cause any considerable changes of radio-resistance.

5-days eucalyptus EO course resulted less radioprotective effect: survival rate was 32% of mice while all control specimens died. Average life of "protected" mice made 25,7 days, in control group - 8,5 days.

In this experiment 10-days preventive course of EO gave maximum protective effect.

Marked protective effect of EO became apparent in decreasing of animal death rate, (gastrointestinal type): in 7 days all test animals were alive, while death rate in control groups made 22-44% (depending upon mice lot).

By 14th day survival animals, which were protected by EO, were 1,2, 2,2 and 2,3 times more (EO course terms – 5,10, 30 days) than in control groups. Prolongation of preventive course from 5 up to 30 days was accompanied by decreased death rate (marrowy type) 2,2% per day more [5, 6, 7].

Preventive inhalation with monarda and lavender EO favored survival rate of test mice: lavender EO of 20 mg/m^3 content (10-days course) – 34,6% (control group – 7,7%); 30-days lavender EO – 38,4% (3,7% - control groups); monarda EO of 100mg/m^3 (30-days course) effected considerably on survival rate – 51,5%.

Method of fractional irradiation permits to reveal influence of radioprotector on postradiotional rehabilitation.

Influence of eucalyptus EO for 11 days before irradiation (dosage 0,5Gy/fraction (total dosage 4 Gy) raised acute irradiation-resistance: in 30 days after acute irradiation 33,3% of animals survived (5% in control group), in 60 days – 25,9% (9,7% in control group).

Mechanisms of EO radioprotection might be the followings:

- injury reduction of blood-making system cells and epithelial cover, that is protective effect of essential oils relatively to quickly divided cells;
- activization of regenerative and reparative processes;
- stimulation of all parts in immunal system: cell-bound, humoral immunities and factors of non-specific resistance;
- activation of antyoxydant body systems;
- reduction of postradiation bacterial complications and etc.

Results of EO influence on animals and human permit to consider them as modulators-adaptogens, which raise body resistance and prepare biological object for further impact of extreme factors, that is irradiation.

That`s why we checked EO effect on immune and blood-making systems of healthy animals in order to determine resistance level before irradiation.

Animals inhaled eucalyptus EO for 5,10 or 20 days and last day they were immunized by erythrocytes of a sheep. Animals of control groups were immunized only.

Therefore eucalyptus EO favoured increasing of relative and absolute amount of AFC

in spleen. The most marked effect was after 10 and 20 days course, didn`t depend upon EO content. Relative and absolute amount of AFC in spleen increased as follows:

Eucalyptus EO content 20mg/m^3:

10-days course – 1,7/2,0 times more (relative/absolute amount of cells).

20-days course – 1,9/2,4 times more.

Eucalyptus EO content 100mg/m^3:

10-days course – 1,8-2,1 time more

20-days course – 2,0-2,4 times more.

During 5-days course stimulation was not so considerable: relative amount of AFC increased up to 1,3 times (20 mg/m^3) and 2 time with more content of EO.

In this experimental scheme eucalyptus essential oil effected on precursors of lymphosytes, which took part in immune response, and on primary stage of inductive phase of immunogenesis. Stable increasing of lysozyme, titre heterophile antybodies and compliment was marked out.

Influence of essential oils on value of radiation injury of blood-making system and character of its renewal in postradiation period

Opportunity to get over radiation sickness mainly depends upon state of blood-making organs – marrow and spleen [11].

10-days course of inhalations with eucalyptus EO (20 mg/m^3) caused increasing of myelocariocytes 1,2 time more ($P<0,01$). Reduction of spleen weight wasn`t accompanied by changes of splenocyte amount.

In this experiment influence of essential oil improved blood-making organs function of healthy animals.

Influence of monarda, eucalyptus and lemon tarragon EO (20 mg/m^3) on value of radiation damage of blood-making system and character of its renewal in postradiation period was investigated during the course of 10 sessions.

Irradiation of animals by sublethal and lethal dosages (6Gy) provoked dose-dependent reduction of myelocariocytes number. Inhalations with EO favored either keeping of a large number of viable myelocariocytes or activated their proliferation up to amount which was typical for smaller dosage effect. By 30^{th} day after irradiation amount of myelocariocytes of protected animals (inhaled eucalyptus and monarda EO) corresponded to healthy mice parameter; irradiated animals had the same value 1,6 time less. Preventive action of lemon tarragon was not so expressed: amount of myelocariocytes became 1,4 time more in comparison with parameters of irradiated animals, but didn`t reach the level of healthy mice. Effect of EO wasn`t registered applying higher doses (6 Gy).

Therefore in a definite dose range EO favors strengthening of reparative processes in blood-forming organs.

Effect of 20-days course of eucalyptus EO exposure (4 Gy) on the cellular composition of marrow and spleen was investigated in dynamics, in 10, 20, 30 and 60 days after irradiation. In 10 days marrow cellularity parameters of "protected" by EO and "unprotected" animals was similar. By 20^{th} day an amount of myelocariocytes was 1,4 time more and by 30^{th} day – 1,5 time more than it was registered in control group. Dynamics of spleen cellularity renewal had the same tendency: by 20-30^{th} days an amount of cells of EO "protected" animals was rather less than "unprotected" had, though by 60^{th} day the difference vanished.

Value of radiation injury of blood-making system wasn`t effected by EO in this experimental scheme. Though renewal of marrow cell pool of "protected" animals occurred more actively.

In case of higher irradiation dose EO effect became apparent by 10^{th} day: level of

myelocariocytes of "protected" animals was 2,7 and 3,6 times higher (accordingly to 5 and 6,25 Gy). FDV of marrow cellularity reached 1,225 – quite considerable value for natural radioprotectors.

Immune response correction effecting by eucalyptus and tarragon EO on irradiated mice with sublethal dosage

Under influence of ionized radiation immune system of human and animals is one of critical systems [4].

It was found out that preventive course with eucalyptus EO by 10^{th} day favored increasing of spleen AFC 1,7 time more, in 60 days this value was equal to parameter of healthy mice. Concerning group of radiation control in 60 days an amount of AFC made only 65% of standard.

Dynamics of spleen weight changes, its cellularity and an amount of AFC after preventive course with tarragon EO corresponded to the radiation control.

In the event inhalations with eucalyptus and tarragon were carried out after irradiation, in 30 days reduction of absolute number of AFC and a number of splenocytes occurred that renewed up to radiation control by 60^{th} day.

Prevention of endogenous infection applying essential oils

Postradiation period of animals and human is characterized by clinical syndrome with infectious complications.

Antibacterial activity of EO *in vitro* is described in a lot of works of native and foreign authors. *In vitro* essential oils effect in complicated combination with protective body structures, strengthening each other mutually. As a result of this interaction even mycro dose of essential oils displays antibacterial and anti-inflammatory action.

10-days course of inhalations with eucalyptus EO (20 mg/m^3) was used to prevent endogenous infections in irradiated body. In a day after that course was finished rats *Vistar* were exposed to radiation of lethal dose 8,5 Gy, that can cause animal death of bulks for the first 7 days.

The most of unprotected rats died because of intestinal disorders: in 7 days only 12,5% of rats survived. Inoculations out of histic homogenate of liver and spleen resulted development of microorganisms (100% of animals), multiple growth was registered in a half of cases, that is animals had heavy sepsis.

After eucalyptus EO effect 60% of irradiated animals survived by 7^{th} day; rate and intensity of bacterial contamination of internals reduced considerably – 33% of positive cases with no multiple growth. Bacterial contamination of internals of rats, irradiated by dose 8,5 Gy and animals protected by eucalyptus EO was decreasing till the level of animals that were exposed to radiation of 6 Gy.

Otherwise applying of EO eased endogenous infections of animals equally as if irradiation dose became 2,5 Gy less [8].

In conclusion of this serious of experiments it`s worth to note that it was found out a class of compounds which possesses radioprotective properties, though it hasn`t been applied with this purpose before.

By present there is information that EO can be considered as universal preventive remedy, which possesses a wide range of therapeutic effect: EO is already used to prevent SARS (Acute respiratory syndrome) [9], correction of secondary immunodeficiency [2, 3], also to treat chronic diseases [11, 12, 14, 15], to relief xenobiotic action on human body [10] and etc.

In Yalta KRU "NII named after I.M. Sechenov" essential oils were successfully used for rehabilitation treatment of emergency wreckers at Chernobyl power station with long-term

effect of radiation: as a result considerable improvement of characteristics during laboratory investigations and clinical state of patients were fixed. Schemes of cure included as separate essential oils as mixtures of 3-5 essential oils, duration and concentrations of preparations were worked out.

Children from zone of radionuclide pollutions had pathologic disorders characterized by systemic nature. It became apparent by early progressing disorders of main functional systems: as a rule injuries were poliorganic, chronic nidus of infection and disorders of immune and neuroendocrinal systems were registered as well. Applying of essential oils favored renewal of cell and humoral immunities, minimized imbalance of cytokine cascade and hemoblastoses, reduced rate of attaching respiratory virus infection [5].

Development of nuclear power engineering exposes more and more people to radiation: workers who deals with radiation sources, people exposed to radiation during anthropogenic disasters and sick people who got radio- and X-ray therapy. In these categories of people annual increasing of sickness rate by all main disease classes is actual for people from categories mentioned above.

This data permits to apply EO in treatment of people exposed to radiation.

Conclusions

In terms of this investigation radioprotective properties of compounds, which haven`t been used with this purpose before, were revealed. The animal experiment displayed a considerable effect of essential oils relative to blood-making and immune systems, possibility to reduce intensity of septic processes and as a result to prolong animal life after irradiation by lethal dose of γ-ray.

Working as adaptogens, EO favor improvement of critical systems when organism of animals meet radiation being in a state of increased functional activity and protection of blood-making and immune organs.

Including of EO procedures into scheme of rehabilitation treatment of emergency wreckers at Chernobyl power station with long-term effect of radiation improved characteristics of laboratory investigations and clinical state of patients.

This data is a ground for further development in applying of essential oils as preventive meanings for workers who deal with radiation sources and as a remedy for people who was exposed to radiation by case or with therapeutic purpose.

References

1. *Vavirovsky L.A., Tikhomirov A.A.* Kultivirovaniye kletok v prisutstvii biologicheski aktivnyh veshchestv // Efirniye masla i ih ispolzovaniye v zdravoohranenii i narodnom khozyaistve. Materialy konf., Nauchno-koordinats, Sovet yuzhnogo nauchnogo tsentra AN USSR, NII im. Sechenova (Yalta, dekabr 1988 g.). – Yalta. – S. 29-30.

2. *Govoroon M.I.* Radiomodifitsiruyushcheye i immunomodifitsiruyushcheye deistviye efirnyh masel // Aktualniye voprosy kurortologii, phyzioterapii i meditsinskoy reabilitatsii; materialy konf. – Yalta, 2003. – S. 127-135.

3. *Govoroon M.I., Tikhomirov A.A., Yeryomenko A.Ye.* Efirniye masla kak immunostimulyatory i adaptogeny // Aromakorrektsiya psykhophyzicheskogo sostoyaniya cheloveka: materialy 4-j mezhdunarodnoy nauchno-prakt. konf. (Yalta 3-6 iyunya 2014 g.). – Yalta, 2014. – S. 34-43.

4. *Ivanov A.A., Maltsev V.N., Ulanova A.M., Shalnova G.A.* Rol sistemy immuniteta v radiatsionnom porazhenii organizma. Razvitiye gipotezy // Meditsinskaya radiologiya i radiatsionnaya bezopasnost. – 2001. – Tom 46, №3. – S. 64-78.

5. *Karmazina I.V., Kaladze N.N., Semyonova L.I., Meltseva Ye.M., Dilmes K.L.* Immunotropniye effekty aromaterapii na sanatornom etape reabilitatsii detey, postradavshyh

ot posledstvy avarii na ChAES // Aromakorektsiya psykhophyzicheskogo sostoyaniya cheloveka: materialy 4-j mezhdunarodnoy nauchn.-prakt.konferentsii (Yalta 11-13 aprelya 2012 g.) – Yalta, 2012. – S. 32-34.

6. *Nikolayevsky V.V., Tikhomirov A.A., Yeryomenko A.Ye., Govoroon M.I.* Radioprotektornoye sredstvo / Avt. svidetelstvo № 856077. – 14.04.81 g., SSSR.

7. *Nikolayevsky V.V., Tikhomirov A.A., Shynkarchuk I.F.* Radiozashchitnoye sredstvo / Avt. svidetelstvo № 178591 ot 8 sentyabrya 1992 g., SSSR.

8. *Soldatchenko S.S., Govoroon M.I., Nikolayevsky V.V., Shynkarchuk I.F.* SPosob lecheniya postluchevyh bakterialnyh oslozhneniy / Patent 10691A ot 25.12.96 g. RF.

9. *Tikhomirov A.A.* Efirniye masla kak effektivniye sredstva profilaktiki ORVI // aromakorrektsiya psikhophyzicheskogo sostoyaniya cheloveka: materialy 4-j mezhdunarodnoy nauchno-prakticheskoy konferentsii (Yalta 3-6 iyunya 2014 g.). – Yalta, 2014. – S. 27-34.

10. *Tikhomirov A.A.* Perspektivniye napravleniya ispolzovaniya efirnyh masel v meditsine i veterenarii / tam zhe. – S. 30-31.

11. *Yarmonenko S.P.* Radiobiologiya cheloveka i zhyvotnyh / M.: Vysshaya shkola, 1988. – 424 s.

12. *Edris A.E.* Pharmaceutical and Therapeutic Potentials of Essential Oils and Their Individual Volatile Constituents // Phytother. Research 2007. – 21(4). – C. 308-323.

13. *Jerne N.K., Nordin A.A., Henry C.* Cell-bound antibodies. – Wistar Institute Press. – 1963. – 109 p.

14. *Pisseri F, Bertoli A, Pistelli L.* Essential oils in medicine: principles of therapy // Parassitologia. –2008 Jun; 50(1-2). – P. 89-91.

15. Shaaban H.A.E., El-Ghorab A. Shibamoto T. Bioactivity of essential oils and their volatile aroma components: Review // Journal of Essential Oil Research 2012. – Volume 24, Issue 2, P. 203-212.

The article was received at editors 09.09.2014

Tikhomirov A.A., Govoroon M.I. Protective action of essential oils in case of animal irradiation and possible appliance for human// Bull. of the State Nikit. Botan. Gard. – 2015. – № 114. – P. 28-33

Animal experiment showed radioprotective effect of essential oils on hematopoietic, immune systems and possible decreasing of septic process rate. Appliance of essential oils in rehabilitation treatment of emergence wreckers at NPS in Chernobyl favored considerable improvement of clinical state of patients and parameters of laboratory investigations.

A class of compounds, which haven`t been used specially with that purpose before, possesses radioprotective properties.

Key words: *essential oils, dosages, γ-irradiation, anti-radiation action*

UDC 616.1:616.891:615.322

PHYTOTHERAPY OF PSYCHOGENIC CARDIOVASCULAR DISEASES

Farkhad Maisovych Melykov

Nikitsky Botanical Gardens – National Scientific Centre
298648, Republic of the Crimea, Yalta, urban village Nikita
f.melikov@mail.ru

Introduction

Disorders of cardiovascular system are one of the main causes of death, reduction of human life expectancy and disability. In recent years a number of cardiovascular diseases caused by psychosomatic pathology has considerably increased. Psychosomatic disorders are particularly widespread among people in highly developed countries. Its frequency ranges from 15 till 60% among population, while 30 – 57% is for patient primary care. According to statistics 1/3 of patients received medical treatment initially have emotional disorders [2]. Classical psychosomatic diseases are: hypertension, bronchial asthma, thyrotocsicosis, duodenum ulcer, nonspecific ulcerative colitis, neurodermatitis, rheumatoid arthritis and a number of other diseases [1, 2, 4, 8, 10].

Therapeutic resistance of the most “difficult” cardio patients at hospitals causes further investigation of disease adaptation or psychosomatic disorders and their treatment methods. Cardiologic disorders are more often accompanied by functional disturbance of psychosomatic state, otherwise the most popular somatic pathology with 40-60% from the total number of visits to cardiologists, [3]. Treatment of psychosomatic disorders of cardiovascular system is of urgent importance for medicine today.

Experience in phytotherapy of cardiovascular system diseases caused by psychogenic nature

Medicinal plants with sedative action play a significant role in therapy of neurosis. Herb infusions or decoctions of single plants as well as mixtures are used to treat neuroticism. Taking into an account patient specifics, degree of his disease, treatment can include individual adjustment of decoction composition, dosage and regime mode. Allowing for a low possibility of side effects, prolonged course cure is actual, that can bring a patient into remission and total patient recovery. This treatment method is applied in medicine very seldom, which is unreasonably. Even preparations from scientific medicine, legalized in pharmacopoeia are ignored [6]. By present domestic and foreign pharmacopoeias have recognized the following medicinal plants with mainly sedative action as completely safe: *Valeriana officinalis* L., *Leonurus cardiaca* L., *Paeonia anomala* L., *Passiflora incarnata* L.; adaptogens with mainly tonic action: *Panax ginseng* L., *Eleutherococcus senticosus* Maxim., *Rhodiola rosea* L, (*Leusea carthamoides* L.), (*Echinopanax elatum* L., *Sterculia platanifolia* L., *Schizandra chinensis* Turcz., *Aralia mandshurica* Rupr. et Maxim.*;* with mainly vegetotropic action: L *Grataegus communis* L., *Passiflora*; with mainly antidepressant action: *Hypericum perforatum* L.

Phytopreparations are practically non-habit-forming, don`t have side effects if to adjust dosage correctly. It is worth to say herbal remedies and preparations of different type are possible to combine.

Having mild symptoms of neuroticism it`s possible to apply the following separate plants by short courses (15-20 days):

1. *Valeriana officinalis* L. Drug rhizomes with roots of *Valeriana officinalis* L. impact on an organism multilaterally; it calms CNS, reduces its excitability level; reliefs spasm of smooth muscle organs, regulates heart activity, impacting mediately through CNS and directly on a muscle and conducting system of heart, stimulates coronary circulation [12, 14, 15, 18, 19]. Preparation of *Valeriana officinalis* L. are applied to treat functional chronic disorders of CNS, neurosis, insomnia, psychosomatic neurotic states [9, 12, 17].

Preparations of *Valeriana officinalis* L. are used as ready tinctures or extract as water infusions.

Valerian tincture: 30-40 drops 3 times a day.

Valerian extract pills: 2 pills 3 times a day.

Infusion recipes:

a) 3 spoons (25g) of crushed root are poured with 0,5 l of boiling water, to leave in a warm place for 5 hours, take warm ½ glass twice a day;

b) 2,5 spoons (20g) of crushed root are poured with 200 ml of boiling water, the infusion is made by a common way; dosage is 2 to 3 spoons 3-4 times a day.

2. Lemon balm (*Melissa officinalis*) herb or leaf. It contains an essential terpenic oil, tannin, bitter substances. It possesses spasmolytic, sedative and analgetic action. Peroral intake of lemon balm infusion improves digestion. It is recommended for those who suffer from migraine, insomnia, undue fatiguability [11]. 10 g of row material (2,5 tablespoons) and 0,5 l boiling water are necessary for lemon balm (*Melissa officinalis*) infusion; dosage is 1 glass 3 times a days.

3. Brandy mint *(Mentha piperita*) leaf. This herb contains an essential oil, mainly monoterpenes and their ethers combined with isovaleric and acetic acids. Leaves of brandy mint also include organic acids, tanning agents, flavonoids, carotene, betaine, hesperidin, microelements (copper, manganese, strontium and etc.) [9,12]. They are widely adopted as sedative, spasmolytic medicine in treatment of stomach and bowels smasms purely or in herb infusions. The way of cooking and intaking is the same as for lemon balm herb.

4. Gnaphalium uliginosum herb. This herb contains essential oils, flavanoids and it`s enriched with carotinoids [9]. It is used in case of hypertension, gastric ulcer. 15 g of row material (2,5 to 3 tablespoons) are poured with 0,5 l of boiling water, dosage is 1 glass 3 times a days before meals.

5. Origanum vulgare herb. It includes an essential oil contained phenol compounds: thymol, carvacrol as well as sesquiterpenes and their oxygen intermediates and geranyl acetate. *Origanum vulgare* is mostly taken to improve peristalsis of gastrointestinal tract, as expectorant, anticonvulsive and sedative remedy. *Origanum vulgare* is included into composition of breast and sudorific tea [5,9,11]. 6 tablespoons of raw material are poured with 0,5 l of boiling water. Dosage is 1 glass 3 times a days, it`s recommended to intake with some honey instead of tea.

6. Rhizome and roots of *Polemonium caeruleum*. It contains triterpene saponins, organic acids, resinous substance and lipids. Firstly it was adapted as expectorant because of a high content of triterpene saponins in rhizomes. Later sedative properties of *Polemonium caeruleum* were revealed. Decoctions and infusions with its roots reduce motion activity, reflectory excitability. As to sedative properties of this herb, they are much more effective than *Valeriana officinalis* L. 8 to 10 times [9, 10]. Standard infusion: 6g of row material (app. 2 tablespoons) and 1 glass of boiling water; dosage is 1 tablespoon 3 to 5 times a days after meals.

7. Hop cones. Neurotropic action of galenicals made from hop cones is caused by lupulin in them, which possesses sedative action on CNS. Flavonoids, bitter tastes, hormones and vitamins being in this plant composition make for anti-inflammatory, spasmolytic, antiulcer, hyposensitizing analgetic action of hop cones [9,11,12]. 1 tablespoon of crushed

cones is poured with 1 glass of boiling water, should be infused for 10-15 minutes; dosage is 1 tablespoon twice a day and 2 tablespoons for the night.

8. *Leonurus* herb. It is emphasized with sedative action of CNS, which is much more effective than *Valeriana officinalis*. At the same time it has hypotension and cardiotonic action [11]. Herbal potion or water infusion of *Leonurus* herb are the most adapted form in medicine. Dosage for herb potion makes 30 to 40 drops three times a days.

15 g (app.4 tablespoon) of the row material should be poured with 200 ml of boiling water and infused for 20 minutes; ¼-1/3 of a glass twice a day one hour before meal.

9. Adonis herb. It contains cardiac glycosides of strophanthus group, possesses accumulative, stimulant cardiac function, sedative and diuretic property. It is used in mild cases of cardiac insufficiency and as a sedative remedy [9, 11]. The most wide-spread forms of Adonis preparation are drops (20 to 40 drops) and tableted (1 tablet three times a day). Infusion: 6g of row material and 1 glass of water. Recommended dosage: 1 tablespoon 3 to 5 times a day.

10. Flowers or fruits of *Crataegus sanguine*. Fruits of this plant contain flavonoids (quercetin, hyperin, hyperosides, vitexin), organic acids (citric, oleanolic, ursolic, crataegus, caffeic, chlorogenic), cartinoids, tanning agent, fixed oil, pectines, triterpene and flavonoid glycosides, sitosterol, choline, vitamins [9]. Practical use is in a form of *Crataegus sanguine* infusion, 30 to 40 drops 3 times a day.

Recommended dosage of flower infusion (1 tablespoon of the row material is poured with a glass of boiling water): 1 tablespoon 3 to 4 times a day before meals.

11. Roots of *Paeonia anomala*. Such an infusion is prescribed in case of neurasthenic state, insomnia, vegetative-vascular disorders with various etiology. As a result patients note better sleep, the frequency and intensity of headaches reduces, efficiency increases [7,11]. The practical form is a tincture, 30 to 40 drops 3 times a day.

12. *Hypericum* herb. It contains various biologically active compounds and possesses versatile pharmacologic properties. The most active compounds are the followings: flavonoids effecting spasmolitically on unstriated muscles of vessels, ureters, bile ducts and bowels. Medicines extract containing shoot vasospasm, especially it concerns capillaries, strengthen capillaries, as vitamin P effects, they stimulate dieresis as a result of ureter walls relief and enhancement of filtration in malpighian tufts [7, 9]. This herb contains hypericin, acting as a catalyst of some intracellular reactions and a factor which controls separate metabolic processes in an organism [5,11,12]. In recent years *Hypericum* herb. has gained its importance as an antidepressant, therefore pharmaceutical industry works out new high-efficiency and standardized medicines contained *Hypericum* herb. By current assessment in Germany percentage of preparation based on *Hypericum* herb made 25% to the total number of prescribed antidepressant. Clinical efficiency of preparations based on *Hypericum* herb has been proved by a great number of controlled investigations, though mechanism and nature of antidepressant action have been still unknown [13,16].

Preparations based on *Hypericum* herb have various action depending on its dosage [11], in our case infusion proportions are 10,0:100,0 (1 tablespoon 4 times a day).

Mediator between central nervous system and viscera is vegetative nervous system. Perceptibility of vegetative nervous system exhibits as under extreme influence as in response to weak emotional stimulators, during adaptation period. Crucial importance mostly consists of durably acting small “bites”, so-called “stress-plankton”, but less of serious shocks. They exhaust human strength causing chronic pathologic processes.

Emotions of alarm, fear and feeling of defenselessness and waiting for the pain are results of heightened blood adrenalin contain, at the same time affects of anger and fury emerge due to heightened noradrenalin. Emotional stress should be considered in terms of

psychosomatic diseases and as a factor causing "masks" of diseases. Emotional stress is getting more significant in case of ischemic heart and hypertension diseases.

If disorder of cardiovascular system gets aggressive form of disease, caused by psychosomatic factors, treatment course should include herb mixtures mostly.

In case of disorder in cardiac performance accompanied by insomnia, the following herb mixture is recommended: flowers of German chamomile – 10,0 g; flowers of Convallaria majalis – 10,0 g; fruits of Foeniculum – 20,0 g; Mentha piperita leaves – 30,0 g; Valerian root – 40,0 g. The herb mixture is taken as an infusion several times a day. Course of treatment makes 12-14 days.

Relief of internal emotion tension and better sleep can be achieved due to the herb mixture: Valerian root – 15,0 g; hop cones – 15,0g; Mentha piperita leaves – 30,0 g; Leonurus herb – 30,0 g. Recommended dosage of the infusion is 2 glasses twice a day in the morning and in the evening. Cure makes 12-14 days.

For treatment of psychosomatic disorders of cardiovascular system there are other recommended mixtures of medicinal plants:

1. Mentha piperita leaves – 20,0 g; Valerian root – 10,0 g; Menyanthes trifoliata leaves – 20,0 g; hop cones – 10,0 g. A glass of this infusion is recommended to take during a day. A course of treatment makes 2-3 weeks.

2. Mentha piperita leaves – 30,0 g, Valerian root – 40,0 g, flowers of lily of the valley – 10,0 g; fruits of Foeniculum - 20,0 g. Dosage: ½ glass 1to 2 times a days. A course of treatment makes 2-4 weeks.

3. Mentha piperita (leaves) – 30,0 g; Leonurus quinquelobatus (herb) – 30,0 g; Valerian (root) – 20,0 g; hop (cones) – 20,0 g. Dosage: 1 to 2 glasses 3 times a day having nerve excitation, irritability, insomnia. Cure makes 3 weeks.

4. Valerian (root) – 25,0 g; Leonurus quinquelobatus (herb) – 25,0 g; Carum carvi (fruits) – 25,0 g; Foeniculum (fruits) – 25,0 g. Dosage: ½ glass three times a day in a case of nerve excitation and tachycardia.

5. Valerian (root) – 30,0 g; Mentha piperita (leaves) – 30,0 g, Menyanthes trifoliate (leaves) – 40,0 g. Dosage: ½ glass a day in a case of nerve excitation and irritability for 1-3 weeks.

6. Equisetum arvense (herb) - 20,0 g; Polygonum aviculare – 30 g; Crataegus sanguine (flowers) – 50 g. Dosage: 1/3–1/4 glass of the infusion 3 to 4 times a day in a case of tachycardia, irritability and insomnia. Course of treatment makes 10 to 15 days.

7. Valerian (root) – 30,0 g; Leonurus quinquelobatus (leaves) – 30 g; Achillea millefolium (herb) – 20,0 g; Achillea millefolium (fruits) – 20,0 g. Dosage: 1/3-1/4 glass 2-3 times a day in a case of heart pain.

Conclusion

In the course of research it was carried out a data review about medicinal plants and medicinal herbal teas, used in treatment of cardiovascular diseases, caused by psychosomatic disorders. Modern information about phytochemical plant composition and medicinal effect of their main substances were summarized in this work. There are rational courses to treat various disorders of nervous and cardiovascular systems and a number of unjustly forgotten plants, which can be recommended as components for medicinal herb mixtures. In conclusion it is clear that modern phytotherapy possesses sufficient potential consisting of less-used or unjustly forgotten plants, means and methods for efficient treatment of psychosomatic disorders, underlaid of the most cardiovascular system diseases.

References

1. *Abramova G.S., Yudchyts Yu.A.* Psykhologiya v meditsine. Ucheb. posobiye. –

M.: LPA "Kafedra – M", 1998. – 272 s.

2. *Berezantsev A.Yu.* Psykhosomaticheskiye i somaticheskiye rasstrojstva (analitichesky obzor, chastj I)) // Rossijsky psykhiatrichesky journal. – 2001. - № 3. – S. 61 – 69.

3. *Bryazgunov I.P.* Mezhdu zdorovjem i boleznju. – M., 1995. – 224 s.

4. *Gavrylova Ye.A.* Rolj povedencheskogo typa A i psykhycheskogo stressa v razvitii ishemicheskoj bolezny serdtsa, vozmozhnosty psykhoprofilaktiki i psykhoterapii zabolevaniya // Kardiologiya. – 1999. - № 9. – S. 72 – 78.

5. *Gammerman A.F., Grom I.I,* Dikorastushchiye lekarstvenniye rasteniya SSSR. – M.: Meditsina, 1976. – 286 s.

6. Gosudarstvennaya pharmakopeya SSSR. XI izdaniye, vyp.2 – M.: Meditsina, 1989. – 398 s.

7. *Iordanov D., Nikolov P., Boichikov A.* Phytoterapiya. – Sophiya: "Meditsina i fizkultura", 1972. – 346 s.

8. *Korystov Yu.*N. Emotsii, stress, kureniye, potrebleniye alkogolya i rak – korrelyatsionniye i prichinniye svyazi // Journal VND im.Pavlova, 1997. - № 4. – S. 627 – 657.

9. *Muravjova D.A.* Pharmakognoziya. – M.: "Meditsina", 1978. – 657 s.

10. *Selje G.* Kogda stress ne prinosit gorya. – M., 1992. – S. 104 – 109.

11. *Sokolov S.Ya., Zamotayev I.P.* Spravochnyk po lekarstevennym rasteniyam (phytoterapiya). – M.: Meditsina, 1984. – 463 s.

12. *Turova A.D., Sapozhnykov E.N.* Lekarstvenniye rasteniya SSSR i ih primeneniye. – M.: Meditsina, 1982. – 288 s.

13. *Bruneton J.* Pharmacology, phytochemistry, medicinal plants. – Paris: Lavoisier, 1995. – C. 267-270.

14. *Feytag WE.* Bestimmung von Valerensauren und Valer-enal neben Valepotriaten in Valeriana officinalis durch HPLC. Pharmazeutische Zeitung, 1983, Vol. 269. – P. 2869-2871.

15. *Houghton P.* Herbal products: valerian. Pharmacy journal, 1994. Vol. 253. – P. 95-96

16. *Leathwood PD, Chauffard F.* Quantifying the effects of mild sedatives. Journal of psychological research, 1982. Vol. 17. – P. 115.

17. *Morazzoni P, Bombardelli E.* Valeriana officinalis: traditional use and recent evaluation of activity. Fitoterapia, 1995. Vol. 66. – P. 99-112.

18. *Wagner H, Jurcic K.* On the spasmolytic activity of Valeriana extracts. Planta medica, 1997. Vol. 37. – P. 84-89.

19. *Wagner H, Jurcic K, Schaette R.* Comparative studies on the sedative action of Valeriana extracts, valepotriates and their degradation products. Planta medica, 1980. Vol. 37. – P. 358-362.

The article was received at editors 09.12.2014

Melikov F.M. Phytotherapy of psychogenic cardiovascular diseases // Bull. of the State Nikit. Botan. Gard. – 2015. – № 114. – P. 34-38

The article presents a data review about medicinal plants and medicinal herbal teas, used in treatment of cardiovascular diseases, caused by psychosomatic disorders. Modern information about phytochemical plant composition and medicinal effect of their substances were summarized in this research as well. There are rational courses to treat various disorders of nervous and cardiovascular systems.

Key words: *cardiovascular diseases, hypertension, psychosomatic disorders, medicinal plants, phytotherapy, biologically active substances.*

UDC 547.913:634.334: 331.103.2:599.89

ESSENTIAL OIL OF JUNIPERUS VIRGINIANA IN DIFFERENT CONCENTRATION, ITS EFFECT ON PSYCHOEMOTIONAL STATE, MENTAL CAPACITY AND HUMAN MEMORY

Tatiana Vladymirovna Boroda[2], Valentyna Valerievna Tonkovtseva[1], Lyudmyla Andreyevna Serobaba[2], Oksana Sergeyevna Seredina[2], Elena Vladymirovna Borysova[2], Inna Nikolayevna Maksymova[2], Yuliya Petrovna Ovcharenko[2], Lyudmyla Gavriilovna Sushchenko[2], Natalja Igorevna Derzhavytskaya[2], Iryna Yurjevna Strashko[2], Olga Ivanovna Gtytskevich[2], Natalja Ivanovna Kulyk[2], Tatjana Anatoljevna Samotkovskaya[2], Aleksandr Mikhailovych Yarosh[1]

Nikitsky Botanical Garden – National Scientific Centre
298648, Republic of the Crimea, Yalta, Urban village Nikita
valyalta@rambler.ru
[2]Locomative sheds of Pridneprovskaya railway
bmtv@ukr.net

Introduction

Essential oil of Juniperus Virginiana L. (EOJV), by commercial name cedar oil, is used extensively in perfumery, though its pharmaceutical properties need further inverstigation. It`s considered cedar oil possesses common sedative, relaing and light hypnotic action [2]. EO of Juniperus Virginiana L. mostly consists of α- and β-cedrene, cedrol, tuyopsene.

It was revealed essential oil with content of 1,0 mg/m^3 influences on human mental cpacity: velocity of information processing increases, a number of mistakes in simple and complex sensomotor reaction goes down [1].

Objective of this research is to study influence of Juniperus Virginiana L. EO in various content on human mental activity.

Objects and methods of the research

60 workers of locomotive shed in the 20-60 age range, divided into three groups of 20 people took place in this investigation. Control group was similar by number and membership group. Test people of the control group were being at rest listening to psychorelaxational record for 20 minutes. Test people of experimental groups were being at the same room during the same time listening to the same psychorelaxational record, but under influence of evaporating Juniperus Virginiana L. essential oil in various contents.

Content of EO volatile components in the air for the 1st group made: 0,5 mg/m^3; 2nd group – 1,0 mg/m$^{3;}$ 3rd group – 2,0 mg/m^3. Test was conducted before and after this procedure.

In assessment of EO influence on the nervous system it was used proofreading trial: “Landolt rings”, WAM test (well-being, activity, mood), Spilberg test, memory test using 10 words, simple complex sensomotor reactions [4, 5]. The data were processed using Student`s t test for conjugate and independent sorting [3].

Results and discussion

According to dynamics of WAM test, EO of Juniperus Virginiana L. has a positive effect on psychoemotional state of test people in spite of its content (table 1).

General condition becomes better if the EO content makes 0,5 and 1,0 mg/m^3, 2,0 mg/m^3 keeps this tendency. Well-being improves under EO effect of all contents, mood level - 0,5 and 2,0 mg/m^3. Psychological tension considerably relieves under EO influence of all contents.

Table 1

Influence of Juniperus Virginiana L. essential oil on psychoemotional human state. Contents 0,5-1,0-2,0 mg/m^3 (parameters of WAM test, standard unit).

Parameter		Before procedure	After procedure	P b/a<
General condition	0,5 mg/m^3	133,50±6,14	149,20±4,18	0,001
	1,0 mg/m^3	140,54±5,06	151,27±4,73	0,02
	2,0 mg/m^3	133,10±6,82	147,30±6,56	0,06
	Control	137,50±3,68	137,85±4,37	>0,1
Well-being	0,5 mg/m^3	147,47±5,79	157,23±4,03	0,0006
	1,0 mg/m^3	142,29±6,40	156,56±5,13	0,008
	2,0 mg/m^3	147,95±8,04	163,04±7,12	0,05
	control	146,80±6,38	150,45±6,15	0,01
Mood	0,5 mg/m^3	150,96±5,34	157,34±3,78	0,02
	1,0 mg/m^3	147,18±4,95	151,01±5,03	>0,1
	2,0 mg/m^3	149,05±7,04	161,70±6,10	0,02
	control	148,40±7,14	154,95±7,55	0,01
Tension–relief	0,5 mg/m^3	131,85±10,99	155,90±9,84	0,03
	1,0 mg/m^3	129,25±8,47	151,05±11,26	0,02
	2,0 mg/m^3	133,10±8,95	155,48±7,40	0,007
	Control	135,15±5,84	142,75±3,76	>0,1

Juniperus Virginiana L. essential oil of 1,0 and 2,0 mg/m^3 contents decreased situational anxiety, though it didn`t effect on personal anxiety (table 2).

Table 2

Influence of Juniperus Virginiana L. essential oil on general situational and personal anxiety (Spilberg test) Contents 0,5-1,0-2,0 mg/m^3

Parameter		Before test	After test	P b/a<
Situational anxiety, standard unit	0,5 mg/m^3	32,10±2,24	31,05±2,27	>0,1
	1,0 mg/m^3	33,30±1,86	29,50±1,97	0,05
	2,0 mg/m^3	34,10±2,83	29,95±1,83	0,02
	control	34,60±0,72	33,30±0,91	>0,1
Personal anxiety, standard unit	0,5 mg/m^3	34,85±1,51	34,05±1,70	>0,1
	1,0 mg/m^3	35,95±1,33	35,40±1,80	>0,1
	2,0 mg/m^3	38,95±2,42	36,80±2,56	>0,1
	Control	34,00±0,59	31,40±1,36	>0,1

Influence of Juniperus Virginiana L. essential oil on workability self-rating was insignificant (table 3). But attentiveness level became higher (EO content – 1,0 mg/m^3).

Table 3

Influence of Juniperus Virginiana L. essential oil on human workability self-rating (parameters of WAM test, standard unit). EO content – 0,5-1,0-2,0 mg/m^3.

Parameter		Before procedure	After procedure	P b/a<
Weakness-capacity to work	0,5 mg/m^3	140,04±9,05	134,68±9,27	>0,1
	1,0 mg/m^3	143,06±5,51	146,84±6,33	>0,1
	2,0 mg/m^3	139,95±9,38	146,50±8,31	>0,1
	Control	140,15±5,68	146,85±5,72	>0,1
Weakness-vivacity	0,5 mg/m^3	138,64±7,70	138,78±9,81	>0,1
	1,0 mg/m^3	144,25±9,20	157,35±8,53	>0,1
	2,0 mg/m^3	139,80±10,66	150,12± 9,49	>0,1
	control	142,30±7,62	149,60±7,24	>0,1
Abcent-mindedness-attantiveness	0,5 mg/m^3	143,42±6,48	139,41±9,17	>0,1
	1,0 mg/m^3	146,80±5,53	165,35±6,66	0,0007
	2,0 mg/m^3	139,11±9,92	154,29±7,32	>0,1
	control	139,00±4,83	143,00±6,92	>0,1

Influence of Juniperus Virginiana L. essential oil on sensomotor reactions reveals under effect of minimal content (table 4)

As a result time of simple sesomotor reaction increases and a number of mistakes in complex sensomotor reaction decreases for tendency.

Under influence of essential oil with content 1,0 mg/m^3, a number of mistakes in the simple sensomotor reaction goes down for certain.

Juniperus Virginiana L. essential oil with content 2,0 mg/m^3 didn`t result in changes sensomotor reactions.

Table 4

Influence of Juniperus Virginiana L. essential oil on time of simple (Tsimp) and complex (Tcomp.) sensomotor reactions and their number of mistakes (Msimp and Mcomp accordingly). EO content – 0,5-1,0-2,0 mg/m^3.

Parameter		Before procedure	After procedure	P
Tsimp, msec	0,5 mg/m^3	286,65±6,89	300,79±6,65	0,03
	1,0 mg/m^3	279,92±7,03	291,28±8,13	>0,
	2,0 mg/m^3	287,52±9,92	300,01±9,60	>0,
	control	297,28±2,89	296,35±5,80	>0,
Msimp, units/test	0,5 mg/m^3	0,50±0,24	0,65±0,25	>0,
	1,0 mg/m^3	0,54±0,10	0,14± 0,05	0,00
	2,0 mg/m^3	0,56±0,18	0,32±0,10	>0,
	Control	0,55±0,15	0,70±0,23	>0,
Tcomp, msec	0,5 mg/m^3	363,34±10,80	375,14±10,27	>0,
	1,0 mg/m^3	349,88±12,66	350,96±9,57	>0,
	2,0 mg/m^3	357,74±14,12	365,38 ±10,54	>0,
	Control	362,83±1,87	363,80±9,67	>0,
Mcomp, units/test	0,5 mg/m^3	0,85±0,20	0,45±0,18	0,07
	1,0 mg/m^3	1,20±0,25	0,95±0,26	>0,
	2,0 mg/m^3	1,15±0,37	0,65±0,21	>0,
	Control	0,80± 0,14	0,85±0,18	>0,

Influence of Juniperus Virginiana L. essential oil on volume of processed information and velocity of information processing change under minimal EO content: there is a tendency for increasing of processed information volume and velocity of information processing (table 5).

Authentic increasing of information processing velocity keeps under content 1,0 mg/m^3. But EO content of 2,0 mg/m^3 removes this effect.

Table 5

Influence of Juniperus Virginiana L. essential oil on general volume of processed information (GVPI) and processing information velocity (PIV) in correction (Landolt`s rings) EO content – 0,5-1,0-2,0 mg/m^3.

Parameter		Before procedure	After procedure	P b/a<
GVPI, bit	0,5 mg/m^3	137,46±8,17	149,50±3,29	0,08
	1,0 mg/m^3	143,30±4,17	149,15±3,06	>0,1
	2,0 mg/m^3	142,20±2,79	140,40±4,53	>0,1
	control	141,15±0,99	143,65±2,00	>0,1
PIV, bit/sec	0,5 mg/m^3	1,32±0,11	1,53±0,13	0,02
	1,0 mg/m^3	1,43±0,10	1,59±0,11	0,003
	2,0 mg/m^3	1,49±0,14	1,58±0,12	>0,1
	control	1,50±0,05	1,49±0,07	>0,1

Influence of Juniperus Virginiana L. essential oil on short-term visual memory was marked under low content: authentic decreasing of memorized words with EO 0,5 mg/m^3 and tendency for its decreasing – 1,0 mg/m^3 (table 6).

Table 6

Influence of Juniperus Virginiana L. essential oil on short-term visual and aural memories (test 10 words, average number of memorized words). EO content – 0,5-1,0-2,0 mg/m^3.

Parameter		Before procedure	After procedure	P b/a<
Short-term visual memory	0,5 mg/m^3	5,65±0,26	4,55±0,27	0,004
	1,0 mg/m^3	5,95±0,34	5,35±0,23	0,08
	2,0 mg/m^3	6,60±0,28	6,55±0,39	>0,1
	Control	5,95±0,09	5,60±0,35	>0,1
Short-term aural memory	0,5 mg/m^3	4,95±0,28	5,00±0,29	>0,1
	1,0 mg/m^3	5,25±0,42	4,75±0,29	>0,1
	2,0 mg/m^3	5,30±0,33	5,55±0,31	>0,1
	control	4,95±0,14	5,10±0,32	>0,1

Conclusions

1. Essential oil of Juniperus Virginiana L. in spite of its content, has an euphoric effect on human subjects and didn`t influenced on their workability self-rating.
2. Under effect of this essential oil with 1,0 and 2,0 mg/m^3 content situational anxiety decreased and didn`t change its parameters under minimal EO content.
3. Acceleration of simple sensomotor reaction, less number of mistakes in simple and complex sensomotor reactions, increasing of volume and velocity of processing information revealed under EO effect of 0,5 and 1,0 mg/m^3 content and weren`t marked under EO content of 2,0 mg/m^3.

4. Short-term visual memory impairment also became apparent under EO contents of 0,5 and 1,0 mg/m^3 and it wasn`t marked under EO content of 2,0 mg/m^3.

The article was received at editors 09.12.2014

References

1. *Boroda T.V., Tonkovtseva V.V., Serobaba L.A., Seredina O.S., Borysova E.V., Maksymova I.N., Ovcharenko Yu.P., Sushchenko L.G., Derzhavytskaya N.I., Strashko I.Yu., Gtytskevich O.I., Kulyk N.I., Samotkovskaya T.A., Yarosh A.M.* Vliyaniye efirnyh masel lavandy uzkolistnoj i mozhzhevelnika virginskogo na nervnuyu i serdechno-sosudistuyu sistemu cheloveka // Aromakorrectsiya psykhophyzicheskogo sostoyaniya: materialy III mezhdunarodnoj nauchno-prakticheskoj konferentsii (Yalta, 4-7 iyunya 2013 g.). – Yalta, 2013. – S. 22-30.

2. Voitkevych S.A. Efirniye masla dlya parfumerii i aromaterapii. – M.: Pishchevaya promishlennostj, 1999. – 284 s.

3. Lakyn G.F. Biometriya. – M.: "Vysshaya shkola", 1989. – 291s.

4. Osnovy psykhologii: Praktikum / Red.-sost. Stolyarenko L.D. – Rostov-na-Donu: Feniks, 2002. – 704 s.

5. Praktikum po psykhologii / Pod red. Leontjeva A.N., Gippenreiter Yu.B. – Izd. Mosk. un-ta, 1972. – 248 s.

The article was received at editors 09.12.2014

Boroda T.V., Tonkovtseva V.V., Serobaba L.A., Seredina O.S., Borisova Ye.V., Maksimova I.N., Ovcharenko Yu.P., Sushchenko L.G., Derzhavitskaya N.I., Strashko I.Yu., Gritskevich O.I., Kulik N.I., Samotkovskaya T.A., Yarosh A.M. Essential oil of Juniperus Virginiana in different concentration, its effect on psychoemotional state, mental activity and human memory // Bull. of the State Nikit. Botan. Gard. – 2015. – № 114. – P. 39-43.

The article concerns influence of Juniperus Virginiana essential oil on psychoemotional state, mental activity and human memory depending on its content: 0,5; 1,0; 2,0 mg/m^3. Juniperus Virginiana essential oil in all studied contents had an euphoric effect on people being tested, but it didn`t influence on their workability self-rating; contents 1,0 и 2,0 mg/m^3 decreased situational anxiety. Objective tests showed improvement of mental activity and short-term memory impairment with essential oil content 0,5 and 1,0 mg/m^3, and a lack of effect with content 2,0 mg/m^3.

Key words*: essential oil, Juniperus Virginiana L., psychoemotional state; mental activity, memory.*

SOUTHERN HORTICULTURE

UDC 634.11: 631.52

VARIABILITY OF APPLE FRUIT CHEMICAL COMPOSITION DURING STORAGE

Valerij Dmitriyevych Shcherbatko[1], Nina Ivanovna Sharova[2]

[1]Nikitsky Botanical Gardens - National Scientific centre
Republic of the Crimea, Yalta, urban village Nikita
sevastopol.filolog@mail.ru

Introduction

Vital functions of fruits during ripening after harvest is directly connected with biological peculiarities of sort, storing conditions. Biochemical variations in apple fruits during storage determine level of their storeability [1, 2]. Long-term storage success depends upon correct sort, meant for this purpose. Investigation of domestic and abroad sorts identifies their specifity during strorage. Revealing of biochemical characteristics of diverse sots and the most capable varieties for long-term storage will inspire economical efficiency of horticulture and proof actuality of researches mentioned-above.

Objects and methods of the research

During investigation variability of apple fruit chemical composition (10 perspective apple sorts belonged to the collection of Crimean pomological station in Sevastopol) was studied while storage in the fridge. The main research objective was to reveal sorts with the highest level of storeability and highest parameters of fruit chemical composition. The fruits were storing on the shelves in a fridge with regulated temperature. While storing air temperature made 2,0 – 3,0 °C, relative air humidity – 90-95%.

Fruit analysis was carried out before storing and after it. Content of dry substances, free acids (in terms of malic acid), ascorbic acid, phenol compounds (catechines, anthocyanins, leukoanthocyanins, flavonols). Chemical analysis was conducted at laboratory of Biochemistry of the Crimean pomological station using common methods [3], and revealing of flavonoids – by method of L.I. Vigorov [4].

Results and discussion

Study of dry substances in fruits while storing gives an idea about biochemical processes in fruits and their trend. According to studied sorts, in most cases content of these components in fruits reduced by the end of storage, in comparison with data before it. Only in fruits of the following sorts content of dry substances increased a bit (0,7 to 0,9%) : Waine Spur Delicious, Golden Delicious, Spigold (table 1). In fruits of Electra sort this increasing was more considerable (3,9%). Decreasing of moisture level caused rise of dry substances content in these fruits, what was probably connected with peel structure. Sugars level in apple fruits got the highest point of variation (table 1). On average in fruits of all sorts sugar content (both total sugar and sucrose) went down in the end of storing. Though Electra, Spigold, Galia Beauty were marked as sorts with increasing total sugar content. Carola and Waine Spur Delicious didn`t change the concentration of this components. Variation of all sorts was quite different. Considerable changes in sucrose and monosaccharide content were noted. Proportion of sucrose to monosaccharide reduces inversely (sucrose content decreases, monosaccharide content increases mainly) in the end of storage. This proportion is extremely different for sorts. As to the following sorts the proportion sucrose:monosaccharide was more considerable (0,19 to 0,5): Golden Delicious, Summerland, Waine Spur Delicious; in fruits of Carola, Spigold, Goljohn, Electra this proportion decreased not much.

Content of free acids changed greatly. On average all sorts had a tendency to decreasing of these substances by the end of storage. Only in fruits of Electra sort their content kept unchanged. There is an assumption this sort is capable to be stored more, as by the end of storing content of dry substances and sugars in fruits was the same in comparison with initial data.

Concentration of ascorbic acid in fruits of two sorts (Goljohn and Ducat) reduced by the end of storing in comparison with input parameters, and it had a tendency to considerable growth for a number of apple sorts: Spigold, Spilove, Summerland).

Table 1

Variation of chemical composition in apple fruits while storing (average over 3 years)

Sort	Terms of analysis	Dry substances , %	Saccharides %		Proportion of sucrose to monosaccharides	Acidity (in terms of melic)	Ascorbic acid, mg/100g	Storing period, days
			Sum	Including sucrose				
Waine Spur Delicious	Before storage	15,3	13,2	3,0	0,29	0,35	5,2	209
	By the end of storage	16,0	13,5	1,2	0,10	0,21	7,3	
Galia Beauty	Before storage	14,5	9,6	0,7	0,08	0,41	5,3	220
	By the end of storage	13,9	11,3	2,0	0,22	0,35	6,8	
Golden Delicious	Before storage	17,9	15,6	7,0	0,81	0,28	4,2	196
	By the end of storage	18,7	15,4	3,6	0,31	0,21	4,9	
Goljohn	Before storage	15,0	12,1	2,7	0,29	0,48	5,6	220
	By the end of storage	14,7	11,5	2,4	0,26	0,21	3,9	
Ducat	Before storage	21,2	16,5	5,7	0,53	0,41	7,9	159
	By the end of storage	19,0	14,2	2,8	0,25	0,35	5,6	
Carola	Before storage	18,0	12,6	3,5	0,39	0,62	5,3	158
	By the end of storage	16,4	12,7	2,3	0,22	0,41	7,3	
Summerl and	Before storage	16,3	12,0	3,8	0,46	0,55	2,3	217
	By the end of storage	13,6	10,7	0,9	0,09	0,28	7,1	
Spigold	Before storage	13,2	10,5	2,5	0,31	0,35	4,2	166
	By the end of storage	14,1	11,3	2,3	0,26	0,14	7,2	
Spilove	Before storage	19,7	12,5	2,7	0,28	0,35	2,6	208
	By the end of storage	15,8	12,9	1,4	0,12	0,14	7,0	
Electra	Before storage	18,0	13,7	2,4	0,21	0,35	3,8	196
	By the end of storage	21,9	14,7	1,6	0,12	0,35	4,4	

The main polyphenols in apple fruits chemical compositions are catechines and leukoanthocyanins. Stored sorts differed a lot by content of these components in fruits (table 2). In fruits of Goljohn, Spigold and Summerland sorts a total content of catechines and leukoanthocyanins didn`t exceed 126,0 mg/100g, but the same parameters for sorts Golden Delicious, Carola and Electra are much higher – more than 200mg/100g.

Average content of phenol compounds for all sorts was heightened.

Variations of catechines contents in fruits of all sorts is different. In fruits of 5 sorts (Waine Spur Delicious, Goljohn, Ducat, Summerland, Spigold) their concentration was higher in the end of storing, though other sorts (Galia Beauty, Golden Delicious, Spilove, Electra) had this number decreased, and only sort Carola kept the initial data of catechines content.

Leukoanthocyanins content in fruits of 5 sorts was reduced during the storage (Carola, Electra and etc.), Ducat, Summerland and Spigold raised this number. As to sorts Galia Beauty and Goljohn, there weren`t reported any considerable changes in the end of storage.

Concerning anthocyanins concentration, it tended to increasing for majority of sorts by the end of storage. This concentration was considerably reduced in fruits of Ducat and Carola.

Table 2

Variation of phenol compounds content (mg/100 g) in apple fruits while storing (average over 3 years)

Sort	Terms of analysis	Catechines	Anthocyanins	Leukoanthocyanins	Flavonols	Total flavonoids	Storing period, days
Waine Spur Delicious	Before storage	100,1	0,57	95,1	9,8	205,6	209
	By the end of storage	105,7	0,80	92,0	18,2	216,7	
Galia Beauty	Before storage	65,8	0,22	66,8	9,8	142,6	220
	By the end of storage	49,7	0,34	66,8	11,9	128,7	
Golden Delicious	Before storage	100,1	0,43	107,7	18,2	226,3	196
	By the end of storage	84,0	0,57	79,4	6,3	170,3	
Goljohn	Before storage	56,7	0,34	63,0	13,3	133,3	220
	By the end of storage	79,8	0,73	66,8	23,8	171,1	
Ducat	Before storage	79,8	0,43	69,9	11,2	161,3	159
	By the end of storage	97,3	0,38	109,6	14,7	222,0	
Carola	Before storage	105,7	0,38	107,7	23,8	237,6	158
	By the end of storage	105,7	0,22	69,6	15,4	190,9	
Summerland	Before storage	51,8	0,38	73,7	19,6	145,5	217
	By the end of storage	78,4	0,70	89,5	13,3	181,9	
Spigold	Before storage	54,6	0,27	64,9	9,8	129,6	166
	By the end of storage	69,3	0,22	82,5	9,8	161,8	
Spilove	Before storage,	81,9	0,38	92,0	23,8	198,1	208
	By the end of storage	75,6	0,57	86,3	19,6	182,1	
Electra	Before storage	158,2	0,55	139,2	11,2	309,2	196
	By the end of storage	139,3	0,84	102,1	47,6	289,8	

Flavonol concentration didn`t have any regular variations.

Conclusions

As a result of the research sorts characterized by high parameters of chemical composition by the end of storage and a good storeability were marked out: Waine Spur Delicious, Spilove, Summerland. As to key parameters of fruit chemical composition, the sorts mentioned-above surpassed the control sort Golden Delicious. Their storability was much higher as well.

Ducat, Electra and Carola were marked out as sorts with a bit lower level of storability in comparison with control sort Golden Delicious, but much better by most of chemical parameters.

References

1. *Vygorov L.I.* Opredeleniye polyphenolov // Biologicheski aktivniye veshchestva. – Sverdlovsk, 1968. – Vyp.3. – S. 492-506.

2. *Yermakov A.I., Arasimovich V.V., Smirnova-Ikonnikova M.I.* and etc. Metodi biokhimicheskogo issledovaniya rastenij. – L., 1972. – 456 s.

3. *Lukjan L.S.* Sravnitelnaya kharakteristika biokhimicheskih i phiziologicheskih izmenenij v plodah slaboroslih i silnoroslih derevjev pri sozrevanii i hranenii // Hraneniye

plodov, ovoshchej i vinograda v usloviyah integratsii i intensifikatsii sel. h-va MSSR. – Kishinyov. 1982. – S. 14-24.

4. *Sedova Z.A.* Sovremenniye sposobi hraneniya plodov i yagod (obzornaya informatsiya). – M., 1979. – 47 s.

The article was received at editors 09.02.2014

Shcherbatko V.D., Sharova N.I. Variability of apple fruit chemical composition during storage// Bull. of the State Nikit. Botan. Gard. – 2015. – № 114. – P. 43-47.

The article presents three-year investigation of 10 introduced apple sorts their chemical composition before storing and in the end of it. The following sorts were marked as varieties combined high parameters of fruit chemical composition by the end of storing and good storability: Waine Spur Delicious, Spilove, Summerland.

Key words*: apple tree, sorts, biochemical variations, chemical composition, dry substances, sugars, free acids, ascorbic acid, catechines, anthocyanins, leukoanthocyanins, flavonols, storability.*

UDC 634.86.07:632.4/.952(477.75)

POSSIBILITY TO INCREASE HARVEST OF EARLY TABLE GRAPE CULTIVAR UNDER CONDITIONS OF SOUTHWEST ZONE OF THE CRIMEAN VITICULTURE

Natalja Vasilievna Aleinikova, Yevgeniya Spiridonovna Galkina, Ilkham Burkhanovich Mirzayev

GBU RK "National research institute of vine and wine "Magarach", 298600, Republic of the Crimea, the city of Yalta, 31, Kirova str.
e-mail: plantprotection-magarach@mail.ru

Introduction

Viniculture as a branch of plant cultivation is of great economic importance, connected with primary processing of vine, one of the most valuable dietary and food staff. Historically viniculture having quite a small share of agricultural territories (up to 4,4% in the Crimea) significantly affects on regional socio-economic development, filling the state and local budgets. One of the principle task for this sector is expansion of table vine production to keep its quantity consumed – no less than 5,2 kg/person/year in the Crimea – and considerably to increase its consumption in other regions [1, 6]. Thereby researches aimed at solving of these tasks are quite current.

High and stable vine crops are possible if to carry out complex of agrotechnical measures, which could provide regular growth and development of vine bushes and protect crop from pests and diseases [1, 2].

At present the principle method of vine plants protection from diseases is a chemical method, which assumes applying of various fungicides – contact and systematic. As to modern preparations, certified for vine plants, there are strobilurines which possess quite important physiological properties besides fungicidal action: phytohormonnal effect on plant growth which results increasing of photosynthesis intensity and its productivity, lowing of plant breath intensity, reduction of water evaporation by leaves. Investigations conducted on annual cultures revealed antioxidant property of strobilurines, which favored rise plant resistance to drought, temperature variation, over illumination and etc. [11, 7, 8, 10].

The research objective was to investigate combined fungicide and growth regulating action of strobilurine class preparations to apply them in optimal way. That method is aimed at effective protection against diseases and raising the crop of early table grape cultivars under conditions of southwest zone of viniculture in the Crimea ("Estate of Zakharjinyh" Ltd., Bakhchisaray region).

Objects and methods of the research

Field investigations were carried out on the territory of vineyards with extra early table grape cultivar – Elegant extra early – in 2013-2014 in accordance with conventional methodics in viticulture and plant protection [3, 4, 5].

Fungicide property of these preparations was studied under the field conditions on 30 experimental bushes by three repeatabilities (10 plants per each repeatability). Leaf damage was registered after disease declared itself, further records were made as far as disease develpped (no less than three times per vegetation). Investigations in diagnostics of visual symptoms of disease were conducted during phonologic phases of vine development according to VVSN scale : "the end of blooming", " pea-sized berries, "berries growth", "beginning of ripening", "full berry ripening" [9]. Quantity and quality of crop were registered in the first decade of August during the main harvesting.

Results and discussion

Experimental scheme included the following variants: control (non-protected against mildew); standard; experimental (table 1).

Table 1

Experimental scheme

Variant	Objects	Applied fungicides	Rate of application (g, kg, j/ha)
Control	Non-protected		
Standard	Oidium	Topaz KE	0,2
	Mildew Oidium	Antrokol SP Topaz KE	1,5 0,2
	Mildew Oidium	Tanos WG Falcone KE.	0,4 0,3
	Mildew Oidium	Cocide2000 WG Cumuluse WG	2,5 5,0
Experimental	Mildew, oidium	Cabrio Top WG	2,0
	mildew, oidium, gray rot, blackspot	Quadrice KS	0,8
	oidium, mildew	Collis KS	0,4
	Gray rot	Switch WG	1,0

Treatment by fungicides was carried out during the following development phases: "shoots 15-20 sm", "before and after blooming", pea-sized berries".

Weather conditions in 2013-2014 in the first half of grape vegetation favored the primary infection by mildew. The first symptoms of diseases appeared like an "oily" spots on leaves in the first decade of June. In the second decade of July a lack of precipitations deterred development of pathogen, though insignificant rainfalls with day and night temperature difference in the end of July caused development of mildew (table 2).

In general, share of mildew on leaves and bunches of control variant (non-protected), extra early grape cultivar Elegant, made 1,2 – 1,4% and 1,1 – 1,5% relatively (table 2).

As to experimental and standard variants decrease of mildew development was statistically reliable in comparison with control variant, all deflections were registered in terms of experimental mistake. Appliance of the fungicides Kabrio Top WG., Quadris KS. and Collis KS (experimental variant) regulated disease progression (0,3 – 0,6% on leaves and 0,1 – 0,8% on bunches) as effectively as fungicides Antrakol SP Tanos WG. and Kocide 2000 WG. (0,4 – 0,7% on leaves, 0,2 – 0,9% on bunches, table 2).

Table 2

Dynamics of mildew spread and development in case of strobilurines appliance ("Estate of Zakharjinyh" Ltd; Elegant ,extra early grape cultivar, 2013-2014)

Variant	Spread (P), %				Disease development (R), %			
	"berry growth"		"beginning of berry ripening"		"berry growth"		"beginning of berry ripening"	
	leaves	bunches	leaves	bunches	leaves	bunches	leaves	bunches
Control	4,6	3,5	7,5	3,7	1,2	1,1	1,4	1,5
Standrd	1,5	1,9	1,7	2,1	0,4	0,2	0,7	0,9
Experimental	0,7	1,3	1	1,9	0,3	0,1	0,6	0,8
$HCP_{05\ (2013)}$	1,2	0,7	1,8	0,7	0,7	0,8	0,8	0,6
$HCP_{05\ (2014)}$	0,2	0,2	0,7	0,4	0,1	0,1	0,4	0,5

Biologically effective strobilurine protection of grape plants against mildew on average for two years of investigations was constantly on a high level during vegetation period: 95-97,4% and 90-96,6% on leaves and bunches. On standard pattern this parameter made 86,6 – 90% on leaves and 80-90% on bunches (table 3).

Table 3

Biological efficiency of strobilurine protection against mildew ("Estate of Zakharjinyh" Ltd, 2013-2014)

Variant	Biological efficiency, %			
	"the end of bunch development"		"full berry ripening"	
	leaves	Bunches	leaves	bunches
Standard	86,6	80,0	90,0	90,0
Experimental	95,0	90	97,4	96,6

Growth regulating properties of strobilurines demanded investigation of crop uvological characteristics, quantitative and qualitative parameters of extra early grape cultivar Elegant (table 4,5).

Table 4

Influence of strobilurines on uvological characteristics of table grape cultivar ("Estate of Zakharjinyh", Ltd; Elegant extra early 2013-2014)

Variant	Mechanical composition of a bunch							
	Bunch mass, g	A number of berries, units	Berry mass, g	Mass of grape bunch skeleton, g	Mass of 100 berries, g	% berries	% Grape bunch skeleton	Indictor of texture, %
Control	437,6	149,7	420,9	9,5	271,8	96,7	3,3	36,2
Standard	443,1	166,4	438,5	9,4	283,5	96,4	3,6	46,2
Experimental	470,4	163,1	481,4	9	295,1	97	3	51,4
$HCP_{05\ (2013\ r.)}$	3,5	3,3	3,3	1,3	3,1	0,5	0,5	0,9
$HCP_{05\ (2014\ r.)}$	3,3	2,6	2,7	1,1	3,3	0,5	0,5	1,5

According to data of table 4, mass of 100 berries of experimental variant made 295,1 g for two years on average, that exceeded parameters of standard and control variants - 11,6g and 23,3 g more relatively. Indicator of bunch texture was registered as 51,4% for experimental pattern, 46,2% - standard, control – 36,2%. It`s well-known than more indicator of texture (ratio of berry mass to bunch skeleton mass) than texture of this bunch is more profitable concerning grapes consumed. Grape cultivar with a high indicator of texture first of all is good for fresh usage. Therefore due to research results it was determined that strobilurines had a positive effect on mechanical composition of grape bunch, berry mass and indicator of texture of extra early grape cultivar Elegant.

Two-years research of quantitative and qualitative crop parameters (experimental variant) showed that having applied fungicides from strobilurine group, crop of extra early cultivar Etalon made 7,3 kg, what is 1,1 kg more than Standard variant and 2 kg more than Control (table 5). So, gain in crop made 16 and 34% relatively. According to data of table 5 the crop increase is caused by considerably large average mass of bunch on the experimental variant.

Table 5

Effect of strobilurines on quantitative and qualitative crop parameters of table grape cultivar ("Estate of Zakharjinyh", Elegant extra early 2013-2014)

Variant	Average bunch mass, g	A number of bunches, units/bush	Crop, kg/bush	Mass concentration	
				sugars, g/100 sm^3	titrating acids, г/$дм^3$
Control	418,5	13,8	5,9	17,3	5,5
Standard	432,5	14,6	6,8	17,6	5,2
Elegant	460,3	15,7	7,9	17,8	5
$НСР_{05\ (2013\ г.)}$	1,8	0,8	0,9	0,5	0,3
$НСР_{05\ (2014\ г.)}$	2,1	2,1	1,0	0,7	0,7

Findings indicate positive effect of strobilurines on qualitative crop characteristics of table grape cultivar: mass concentration of sugars (17,8 g/ 100sm^3) in berry juice of experimental variant was maximum in comparison with standard and control variants, while mass concentration of titrating acids (5 g/dm^3) was minimal (table 5).

Conclusions

Hereby during the research of combined fungicide and growth regulating action of preparations belonging to strobilurines class it was determined these preparations can be applied either for effective protection of table cultivar elegant against mildew or to increase its crop capacity and improve qualitative and uvological characteristics under conditions of southwest zone of the Crimean viticulture.

References

1. *Aleinikova N.A.* Osnovniye bolezni vinograda v usloviyah Kryma, prognoz ih razvitiya i sistema zashchiti: dis. dok. s.-h. nauk: 06.01.11 / NAAN Ukraini NIViV "Magarach" – Yalta 2010. – 303 s.

2. *Volkov A.A.* Fungitsidi na vinogradnikah Tamani i stepenj ih ekologo-toksikologicheskogo riska // Vinodeliye i vinogradarstvo. – 2012. - № 5. – S. 40-42.

3. *Dospekhov B.A.* Planirovaniye polevogo opyta i statisticheskaya obrabotka ego dannyh. – M.: Kolos, 1979. – 206 s.

4. Metodicheskiye rekomendatsii po primeneniyu phytosanitarnogo kontrolya v zashchite promyshlennyh vinogradnyh nasazhdenij Yuga Ukraini ot vreditelej i boleznej. – Yalta: NIViV “Magarach”, 2006. – 24 s.

5. Metodicheskiye ukazaniya po gosudarstvennym ispytaniyam fungitsidov, antibiotikov i protravitelej semyan selskokhozyaistvennyh kultur / Pod red. Novozhylova K.V. – M.: Kolos, 1985. – 89 s.

6. Programma razvitiya vinogradarstva i vonodeliya Respubliki Krym do 2020 goda (proekt). – Simferopol, 2014. – 22 s.

7. *Brendler Fritz* Strobilurine – Praxiserfahrungen aus dem Westen // Getreide Mag. - 1997. - 3, № 1. - P. 36-37.

8. *Gerhard Michael, Habermeyer Johann* Der Greening-Effekt // Getreide Mag. - 1998. - 4, № 2. - P. 86-88, 90.

9. *Grossmann Klaus, Retzlaff Günter* Bioregulatory effects *of* the fungicidal stroвi1urin kresoxim- methyl in wheat (Triticum aestivum) // Pestik. Sci. – 1997.- 50, № 1. – P. 11-20.

10. Growth stages of mono- and dicotyledonous plants / BBCH Monograph [2 edition]. – Edited by Uwe Meier / Federal Biological Research Centr for Agriculture and Forestry. – 2001. – 158 p. – P. 91-93.

11. *Tiedemann Andreas V., Wu Yuexyan* Physiologische Effekte von Azolen und Strobilurinen bei Weizen und Gerste // Getreide Mag. – 2001. – 7, № 2. – P. 78-82.

The article was received at editors 31.03.2015.

Aleinikova N.V., Galkina E.S., Mirzaev I. B. Possibility to increase harvest of early table grape cultivar under conditions of southwest zone of the Crimean viticulture // Bull of the State Nikit.Botan.Gard. – 2015. - № 114. – P. 47-51.

Efficiency level of strobilurines in protection of grapes against mildew was investigated in terms of this research. It was demonstrated that treatment of grape plants by these fungicides favors high protection against that disease, permits to increase table grape crop and improve quality of its fruits.

Key words: *vine, mildew, growth-regulating properties, strobilurines, texture of grapes bunch, biological efficiency.*

UDC 634.75:631.527.5

GARDEN STRAWBERRY (*FRAGARIA ANANASSA*): ASSESSMENT OF PROSPECTIVE HYBRIDS BASED ON ECONOMICALLY VALUABLE CHARACTERISTICS UNDER CONDITIONS OF THE CRIMEA

Aryfova Zera Ilmiyevna, Gorb Nadezhda Nikonorovna

Nikitsky Botanical Gardens – National Scientific Centre,
Branch “The Crimean Experimental station of horticulture”
297517, Republic of the Crimea, Simferopol region, vil.Malenkoye
sadovodstvo@ukr.net

Introduction

Strawberry is one of those fruit and berry products which are in a great demand among consumers. These berries are valuable for their food dietary and medicinal properties. They contain sugars, organic acids, microelements and vitamins – so important for human in spring period [3]. Though real strawberry assortment doesn`t cover all population requirements for berries and has a fundamental defects such as: a lack of high-yielding, high-quality and frost-

resistant all-purpose cultivars, low adaptive capacity to complicated soil and climatic conditions of the Crimea (returnable frosts, dry and hot climate).

Selection of new regional strawberry cultivars, adapted to specific climatic conditions is an effective method to improve present assortment [4]. Strawberry cultivars with the highest biological and economical characteristics and wide-spread locality are the most prospective [1]. Thereby task of present researches is to assess prospective hybrids of garden strawberry based on economically valuable characteristics.

Objects and research methods

Investigations were conducted on the experimental ground of branch "The Crimean experimental station of horticulture", 2012-2014. This plot is located on the border of two climatic regions: Low piedmont and Central steppe. Climate in the zone of experiment is semi-arid and warm with changeable winter weather, considerable variations of snow cover, frequent thaw and rainfalls. Average annual minimum of temperature is -20 ^{o}C, absolute minimum is -31 ^{o}C. Late frosts end later, but autumn frosts begin before change over 10 ^{o}C . Soil on experimental ground is meadow and alluvial carbonate middle loamy on river loams.

Objects of this investigation are prospective hybrid forms № 20-9, 4-10, 5-10, 6-10, 7-10, selected by crossing strawberry garden cultivars of national and foreign selection. Regional cultivar Red Gonglet was chosen as a control pattern.

Assessment of studied cultivars and hybrids was carried out according to "Program and methodic of cultivar investigation of fruit, baccate and nut-bearing cultures" [7, 8].

Assessment of biochemical composition of berries was conducted according to rating of fruit and berry products [5]. Statistical processing of study results was carried as described in methodic of field experiment [2].

Results and discussion

On the basis of requirements to cultivar and definite climatic and soil cultivation conditions, a complex of characteristics and properties were of great importance that is force of growth, blooming terms, annual stable crop capacity, size, taste and commercial qualities and biochemical composition of berries.

One of the factors limiting garden strawberry cultivation is low winter resistance. Assessment of hybrid seedlings revealed a high-leveled winter resistance. In spite of a sharp drop in temperature of 2012-2014 winters (from -16 till -24^{o}C), studied hybrid didn`t have any signs of subfreezing.

Cultivar peculiarities effect on vegetation terms of strawberry, they are mainly determined by meteorological conditions of the growing year (temperature and air humidity, conditions of wintering). According to observation results vegetation of the culture on average started in the second decade of March; beginning of blooming – in the second decade of April-the first decade of May; beginning of berry ripening – the second-third decades of May.

Investigators consider that characteristics which determine crop capacity and large-fruitedness of strawberry hybrid seedlings play the decisive role in their prospectivity [6]. Comprehensive study of economically valuable properties of strawberry permitted to define that biological and actual crop capacity is determined by combination of productivity components. Therefore a large number of berries on a bush is rather having increased a number of flower-bearing stems, than a number of berries per one flower-bearing stem. But control variant and hybrids have almost the same number of flower-bearing stems. The largest number of berries per flower-bearing stem (7,0) was registered for hybrid 6-10, the largest number of flower-bearing stems (3,8) was on hybrid 20-9 (control variant: 6,2 and 3,1 units).

Difference in crop capacity was determined by value of an average berry mass. Hybrids № 6-10, 20-9, 5-10 had the largest berries (12,8-13,0 g), that exceeded control variant by 18-20%. Crop capacity of studied hybrids ranged from 0,196 till 0,298 kg/bush. GF № 4-10, 6-10, 20-9 were characterized by maximum indicators, which exceeded control variant by 1,2 – 1,5 times (table 1).

Table 1

Comparative economically biological characteristics of garden strawberry cultivars and hybrids (2012-2014)

Cultivar form	A number of flower-bearing stems /1 bush, units	A number of berries /1 flower-bearing stem, units	Crop capacity, kg/bush	Berry assessment	
				Average mass, g	taste, point
Red Gontlet (Control)	3,1	6,2	0,207	10,8	4,4
GF № 20-9	3,8	6,4	0,298	12,9	4,8
GF № 4-10	3,5	6,6	0,277	12,0	4,5
GF № 5-10	3,0	6,0	0,234	13,0	4,5
GF № 6-10	3,5	7,0	0,278	12,8	4,8
GF № 7-10	3,0	5,5	0,196	12,0	4,6
HCP_{05}	0,2	0,4	0,03	1,1	

According to berry biochemical composition of studied hybrids leaders by contain of ascorbic acid was hybrid № 20-9 (85,4 mg%), which are followed by hybrids № 5-10 (65,0), 6-10 (63,4). Hybrids № 7-10 (50,2) and 4-10 (48,4 mg%) had the lowest concentration of vitamin "C".

Value of cultivar is mainly defined by its berry taste. High taste parameters (4,8 points) were registered for hybrids № 20-9 и 6-10. Sugars, organic acids and especially their ratio are quite important components which specify strawberry taste. Sugar-acid index, which reflects favorable ratio of sugar and acid, was registered for hybrids № 20-9 (7,99), 6-10 (7,19), that`s why their berries can be referred to dessert (table 2).

Table 2

Biochemical composition of strawberry, (on average for 2012-214)

Cultivar form	Ascorbic acid, mg %	Titrable acidity, %	Sugar, %			Dry matters, %	SAI (sugar-acid index)
			glucose	sucrose	total sugar		
Red Gontlet (control)	33,7	1,17	5,51	-	5,51	8,30	4,70
GF № 20-9	85,4	0,80	5,34	1,05	6,39	9,00	7,99
GF № 4-10	48,4	1,14	4,28	-	4,28	7,33	3,75
GF № 5-10	65,0	0,98	4,43	-	4,43	7,96	4,52
GF № 6-10	63,4	0,80	5,14	0,61	5,75	8,33	7,19
GF № 7-10	50,2	1,08	4,43	-	4,43	8,30	4,10

Conclusions

All studied hybrids have attractive large-sized berries (12,0-13,0 g). Hybrids GF № 20-9, 4-10, 6-10 were characterized by maximum crop capacity (17,3-18,6 t/ha). High taste quality (4,8 ponts) and sugar-acid index were registered for hybrids GF № 20-9, 6-10 (dessert berries). All studied hybrid plants weren`t damaged by typical strawberry diseases.

References

1. *Burmistrov A.D.* Yagodniye kultury. – L.: Kolos, 1972. – S. 49-137.
2. *Dospekhov B.A.* Metodika polevogo opyta (S osnovami statisticheskoy obrabotki rezultatov issledovaniy). – M.: Kolos, 1985. – 208 s.
3. *Kopylov V.I.* Zemlyanika. – Simferopol: Poli PRESS, 2007. – 368 s.
4. *Katinskaya Yu.K.* Zemlyanika. – L. Selkhozizdat, 1961. – 168 s.
5. *Kondratenko P.V., Shevchuk L.M., Levchuk L.M.* Metodyka otsinky yakosti plodovo-yagidnoyi produktsii. – K.: SPD "Zhytyelev S.I.", 2008. – 79 s.
6. *Kopan V.P., Kopan K.M., Yareshchenko O.M., Khodakivska Yu.B.* / Metody, rezultaty i perspektivy selektsii plodovyh ta yagidnyh kultur v Instituti sadivnytstva YAAN / V.P. Kopan K.M., Kopan O.M., Yareshchenko Yu.B., Khodakivska // Sadivnytstvo. – 2005. – Vyp. 57. – S. 47-65.
7. Programma i metodika sortoizucheniya plodovyh, yagodnyh i orekhoplodnyh kultur // VNIISPK; [pod red. Ye.N. Sedova i T.P. Ogoltsovoy]. – Orel: Izd-vo VNIISPK, 1999. – 608 s.
8. Programma I metodika sortoizucheniya plodovyh i orekhoplodnyh kultur // VNIISPK; [pod red. G.A. Lobanova]. – Michurinsk: BNIIS, 1973. – 492 s.

The article was received at editors 29.06.2015

Aryfova Z.I., Gorb N.N. Garden strawberry: assessment of prospective hybrids based on economically valuable characteristics under conditions of the Crimea // Bull. of the State Nikit.BOtan.Gard. – 2015. - № 114. – P. 51-54.

The article presents assessment results of prospective garden strawberry hybrids (Krymchanka, Aroza, Belrubi, Red Gontlet, Sunrise) based on the complex of economically valuable properties: crop capacity, average mass, biochemical composition of a berry, frost- and fungous diseases-resistance. These hybrids were bred by crossing of cultivars from national and foreign selections.

The most promising hybrids for high crop capacity, large fruitedness and high tastes were marked out in terms of the research: № 20-9, 4-10, 6-10.

Key words: *strawberry, cultivar, blooming, mass of a berry, crop capacity, large fruitedness, biochemical composition, the Crimea.*

PLANT PROTECTION

UDC 634.85.07:632.753.1 (477.75)

ASSESSMENT OF NEW PHYTOFAGE INJURIOUSNESS - *ARBORIDIA KAKOGAWANA* MATS. – ON AREA OF THE CRIMEAN VINEYARDS

Yana Eduardovna Radionovskaya, Liana Vladimirovna Didenko

GBU RK "National research institute of vine and wine "Magarach", 298600, Republic of the Crimea, the city of Yalta, 31, Kirova str.
e-mail: plantprotection-magarach@mail.ru

Introduction

Arboridia kakogawana Mats. (Hemiptera, Auchenorrhyncha, Cicadellidae, Typholocybinae) is an invasive (alien) species in the Crimea. Its natural habitat is Japanese islands (Matsumura, 1932), Korean peninsula (Dworakowska, 1970) and south of Far East of Russia (Anufriyev and Yemeljanov, 1988), where it was found on wild grape cultivars in mixed and broad-leaved forests [2, 3, 6, 8, 9, 10, 12, 13, 15].

In recent decades intensive economical activity resulted considerable increasing of *Arboridia kakogawana* Mats. areal and its damaging effect on cultivated grape species. In 2005 *A. kakogawana* was registered as a grapevine pest in Republic of Korea [8, 10]. In the European part of Russia this pest was found for the first time on the territory of private vineyards in Krasnodarskiy Kray, since 2004 that leafhopper (*Arboridia kakogawana* Mats.) became the main damaging species of leafhopper complex of industrial grape plantations within West Ciscaucasia [3, 9, 10, 12]. On territory of the Crimean peninsula the first site of this invader development was found in 2008 within industrial plantations of South Coast of the Crimea, since 2012 its colonization was registered on vineyards of Piedmont and Steppe Crimea [2, 8].

A. kakogawana belongs to suborder Auchenorrhyncha suctorial insects, which possess huge biotical potential. These insects are characterized by capability to develop several generations during one season, high fecundity, available winged forms in their development; high ecological plasticity which favors insects mass propagation [13].

Mouthparts of *A. kakogawana* are piercing-sucking. Maggots of all development stages and adult insects feed piercing a grape leaf epidermis from down side. During feeding saliva ferments of insects damages chlorophyll in leaves and a shrub becomes chlorotic. According to scientific literature and own investigations there is information that maximum density of *A. Kakogawana* population on grape leaves occurs in the second half of vegetation. Percentage of damaged and decolorized leaves in this period can reach 80-100% in places, some of them wither and fall off [2, 3, 6, 8, 9, 10, 12, 13, 15]. Naturally enough vine communities are concerned about this problem which stimulates development of necessary measures to protect vineyards from this species of leafhopper.

According to Tanskoj V.I. (1975), parameter of phytophage injuriousness is a ground to assess economical suitability of protection measures for plants [11]. Modern protection of vineyards isn`t aimed at damage of particular harmful species, but the common optimization of phytosanitary situation of plantations, what is also possible having objective information about grapevine state and degree of phytophage injuriousness [12, 13]. In scientific literature there is a lack of data about injuriousness of *A. kakogawana* at vineyards [13]. This problem wasn`t investigated before in the Crimea, but today it is quite actual.

Research objective is to assess effect of a new invasive leafhopper species on agrobiological parameters and parameters of biological productivity of vine plants on territory of the Crimean peninsula.

Objects and research methods

Researches were carried out in 2012-2014 on territory of industrial vineyard "Livadiya" GK NPAO "Massandra", the city of Yalta, South Coast of the Crimea (SCC), in a long-standing site of *A. kakogawana* development with industrial grape cultivars: Cabernet Sauvignon, Aligote and Muscat White. In terms of investigations standard methods in plant protection and viticulture were applied.

Entomological methods were applied to determine damage degree of grape leaves by invasive for the Crimea pest. In stationary experiment the improved for this test 9-point scale was successfully applied, it was grounded on conventional in plant protection scale [14]:

0 point – no marks of damage by leafhopper;
1 point – up to 2,5% of decolorized area on a leaf;
2 points – 2,6-5% of decolorized area on a leaf;
3 points – 6-10% of decolorized area on a leaf;
4 points – 11-15% of decolorized area on a leaf;
5 points – 16-25% of decolorized area on a leaf;
6 points – 26-50% of decolorized area on a leaf;

7 points – 51-75% of decolorized area on a leaf;
8 points – more than 75% of decolorized area on a leaf.

Findings about number of damaged leaves (P, %) and degree of their injury by pest (point) were used to calculate damage intensity (R, %) of leaf apparatus on pattern shrubs of three vine cultivars.

Agrotechnical methods were applied to study injuriousness of *A. kakogawana* according to potential productivity of grape plants including coefficient of fruiting (K_1) and fruitfulness (K_2), content of principal pigments (chlorophyll *a* and *b*), quantity and quality of crop and vine ripening [5, 7].

Design and statistical methods were necessary to process received results and determine the least marked difference between test variants for data verification [4].

Meteorological conditions on South Coast of the Crimea during years of observation differed from average data of many years by increased air temperatures and uneven distribution of rainfall during grape vegetation. In general, according to moisture and warmth supply the most favorable years for vine in south-coastal zone of viniculture were 2013 and 1014.

Results and discussion

On long-term habitat of *A. kakogawana* within the experimental ground the following was determined: development of no less than 3 pest generations with a high intensity of imago flight and occupancy of leaves by maggots during the second half of grape vegetation. For three years of investigations minimal population density of pests was registered in 2012, maximum value was in 2013, population size in 2014 took interposition.

Data about *A. kakogawana* damage rate on leaf apparatus of various grape cultivars was received under conditions of South Coast of the Crimea for three years of investigations (table 1).

Table 1

***A. kakogawana* damage rate on leaf apparatus of three grape cultivars**
(GP "Livadiya", experimental ground, on average for 2012-2014)

Cultivar	Leaf damage, P, %			Damage rate, R, %		
	June	July	August	June	July	August
Cabernet Sauvignon	55,3	88,3	**99,3**	25,0	41,8	**60,9**
Aligote	48,8	82,2	**96,9**	20,8	37,9	**54,5**
Muscat White	46,9	79,8	**96,4**	19,7	35,2	**51,0**

According to this information, the highest percentage of damaged leaves (P) was registered for cultivar Cabernet Sauvignon: from 55% in June up to 99% in August; while on shrubs of Aligote cultivar a part of damaged leaves made 49% in June and 97% in August; and Muscat White suffered from this pest as follows: 47 - 96% relatively in June-August.

Fast increasing of damage rate (R) of leaf apparatus on pattern grape shrubs was determined in summer period (June-August): Cabernet Sauvignon – from 25% up to 61%; Aligote – from 21% up to 55%; Muscat White – from 20% up to 51%.

Therefore out of three studied grape cultivars the most suffering from *A. kakogawana* was Cabernet Sauvignon. This cultivar is characterized by the most intensive indumentums of leaves [1], what is probably a direct reason of damage by studied phytophage.

In general received data about damage rate (discoloration) of leaves by *A. kakogawana* indicates considerable decreasing of photosynthesizing grape leaf surface in especially important phases of development (growing and berries ripening): 20-25% in June, 35-42%

in July and 51-61% in August. It`s well-known, that during phase of berry ripening occurrence of organic matters in a grape plant reaches maximum value due to photosynthesis. Perhaps registered considerable loss of photosynthesized leaf surface in July-August doesn`t favor a good quality crop.

Laboratory researches were carried out to determine value of green pigments content (chlorophyll *a* and *b*) which provide photosynthesis in plants. Grape leaves of Cabernet Sauvignon cultivar with different damage degree were used with that purpose.

Table 2 presents researches results.

Table 2

Content of pigments in grape leaves damaged to varying degree by *A. kakogawana*

(GP "Livadiya", cultivar Cabernet Sauvignon, 21.08.2014)

Damage of leaf, point (damaged leaf surface, %)	Chlorophyll *a*		Decrease %	Chlorophyll *b*		Decrease %	Chlorophyll *a+b*		Decrease%
	mg/g	%		mg/g	%		mg/g	%	
0 (0%)	1,19	100	-	2,36	100	-	3,55	100	-
1 (till 2,5%)	0,90	75,6	**24,4**	1,78	75,4	**24,6**	2,68	75,5	**24,5**
2 (till 5%)	0,81	68,1	**31,9**	1,61	68,0	**32,0**	2,41	68,0	**32,0**
3 (till 10%)	0,71	59,7	**40,3**	1,43	60,1	**39,9**	2,14	60,3	**39,7**
4 (till 15%)	0,71	59,7	**40,3**	1,41	59,7	**40,3**	2,13	60,0	**40,0**
5 (till 25%)	0,69	58,0	**42,0**	1,37	58,0	**42,0**	2,07	58,3	**41,7**
6 (till 50%)	0,68	57,0	**43,0**	1,35	57,0	**43,0**	2,03	57,2	**42,8**
7 (till 75%)	0,59	49,6	**50,4**	1,17	49,6	**50,4**	1,76	49,6	**50,4**
8 (over 75%)	0,58	48,7	**51,3**	1,16	49,1	**50,9**	1,74	49,0	**51,0**
HCP_{05}	0,40	-	-	0,80	-	-	1,20	-	-

According to study results it`s obviously that grape leaves which have 10% or more of decolorized surface due to leafhopper nutrition, contain much less of chlorophyll *a* and *b*, than uninjured leaves do. So, undamaged leaves with 1,19 mg/g of chlorophyll *a* increased this value in damaged leaves (3-8 points) 40,3 – 51,3% more, otherwise content of chlorophyll *a* in the latter made 0,71 – 0,58 mg/g. While content of chlorophyll *b* in undamaged leaves made 2,36 mg/g, decrease of this value in decolorized (3 or more points) leaves was corresponding – 39,9% - 50,9% less, that is 1,43 – 1,16 mg/g.

Thus considerable decrease (40-51%) of the total value of mentioned pigments in grape leaves proves a significant reduction of photosynthesize activity of leaf apparatus due to maggots and imagoes nutrition.

Annually against the background of leafhopper natural development (control variant) and investigation of biological efficiency of modern insecticides in protection against *A. Kakogawana* (experimental variants) potential productivity of grape plants were assessed in the end of May, and in September-October quantitative and qualitative parameters of three studied cultivars crop were estimated.

During the whole period there was not registered considerable difference between agrobiological indices of potential productivity of control and experimental shrubs of three grape cultivars (with probability of 95%). To our point, it is partly caused by not enough protection of grape shrubs (experimental variants) against the new pest species: biological efficiency of studied modern insecticides and biopreparations in June-July ranged from 42 up to 100%; another reason is perhaps peculiarities of the very pest, characterized by high flight activity and population peak in July-September.

Nevertheless analyzing long-term data of potential productivity of control plants (Cabernet Sauvignon and Aligote) annual reduction of fruiting (K_1) and fruitfulness (K_2) was registered: K_1 - from 1,7 down to 1,2 and from 1,8 down to 1,6 relatively; K_2 – from 1,8 down to 1,4, from 1,9 down to 1,7 relatively (table 3). This tendency wasn`t revealed for control plants of Muscat White (the least damaged of three cultivars).

Table 3

Influence of *A. Kakogawana* development on potential productivity of grape plants
(GP "Livadiya", experimental ground, control variant, 2012-2014)

Observation year	A number of eyelets, unit/shrub	A number of growing shoots		Fruiting cane		Inflorescence, unit/shrub	K_1*	K_2**
		unit/shrub	%	unit/shrub	%			
Cabernet Sauvignon								
2012	59,3	56,2	94,8	51,8	87,3	96,0	**1,7**	**1,8**
2013	62,0	59,7	96,3	52,9	85,3	89,4	**1,5**	**1,7**
2014	58,3	53,2	91,2	47,2	81,0	65,5	**1,2**	**1,4**
Aligote								
2013	53,2	48,5	91,2	45,6	85,7	86,6	**1,8**	**1,9**
2014	43,8	40,5	92,5	35,7	81,5	62,7	**1,6**	**1,7**
Muscat White								
2012	41,5	35,7	86,0	31,2	75,2	41,5	1,2	1,3
2013	49,2	45,8	93,1	39,5	80,3	49,0	1,0	1,2
2014	43,3	38,7	89,4	32,7	75,5	43,5	1,2	1,4

Notes:
K_1* - coefficient of fruiting;
K_2** - coefficient of fruitfulness.

According to table 4 after crop assessment of Cabernet Sauvignon, the most damaged grape cultivar by *A. kakogawana*, reliable difference between estimate crop indicators of control and experimental variants was registered: 10,2 and 12,2 kg/shrub.

Table 4

Influence of *A. Kakogawana* development on parameters of crop and its quality
(GP "Livadiya", cultivar Cabernet Sauvignon, 2012-2014)

Variant	Average weight of 1 bunch, g	A number of bunches, units/shrub	Crop, kg/shrub	Mass concentration	
				sugars, g/100 sm^3	titrating acids, g/dm^3
2012 г					
Control	111,3	94,0	10,5	23,3	7,4
Experimental	117,8	93,6	11,0	23,9	7,4
HCP_{05}	11,9	10,2	0,7	1,3	1,5
2013 г					

Control	117,8	86,4	**10,2**	23,1	7,2
Experimental	137,8	88,2	**12,2**	24,1	8,3
HCP_{05}	22,2	12,1	0,9	2,4	1,6
2014 r					
Control	**83,8**	65,5	**5,5**	**20,5**	**8,9**
Experimental	**112,7**	71,2	**8,0**	**23,5**	**7,5**
HCP_{05}	11,9	8,1	0,8	1,5	0,2

In 2014 considerable difference between experimental variants was registered, it concerns not only quantum indices (average mass of bunch – 83,8 and 112,7g, shrub crop – 5,5 and 8,0 kg/shrub in relative to control and experimental variants) but qualitative characteristics were also considered: mass concentration of sugars in control variant made 20,5g/100sm^3, experimental variant – 23,5g/100 sm^3, mass concentration of titrating acids – 8,9 and 7,5 g/dm^3 relatively.

Received in meteorological conditions data (2012-2014) about long-term dynamics of plant crops characteristics of Cabernet Sauvignon cultivar (control variant) indicate an abrupt decrease of the following indices in the third year of observation: average bunch mass (24,7 – 28,9%), a number of bunches (30,3 – 25,2%), bush crop (47,6 – 46,1%) and sugar mass concentration in berry juice (12,0 – 11,3%).

Therefore in terms of Cabernet Sauvignon cultivar, one of the main industrial vine cultivars on the peninsula, it`s worth to discuss a considerable negative effect of leafhopper *A. Kakogawana* development on biological productivity of this cultivar vine plants in the third year of our investigations allowing for a big population size of pests.

Vine ripening on pattern bushes of three studied cultivars was assessed within the experimental ground in 2013-2014 (table 5).

Table 5

Influence of leafhopper *A. Kakogawana* on ripening of annual shoots of three studied cultivars
(GP "Livadiya", experimental ground, on average for 2013-2014)

Experimental pattern	Shoot length, sm	Length of the ripened shoot part, sm	Ripened parts of a shoot, %
Cabernet Sauvignon			
Control*	159,0	111,2	69,9
Experimental**	166,4	120,6	72,5
Aligote			
Control	174,7	124,1	71,0
Experimental	163,8	124,3	75,9
Muscat White			
Control	161,7	106,0	65,6
Experimental	184,3	127,3	69,1

Notes:
Control* - unprotected grape plants
Experimental** - grape plants being protected by special measures.

It was registered that such parameters as shoot length and length of ripened shoot part of control and experimental variants were close. It was determined that percentage of ripened shoot part on control bushes of three cultivars is just 2,6 – 4,9% less, than on pattern plants; in spite of cultivar and protection measures, ripening of all variants is satisfied, because ripened part makes no less than 2/3 or 66,6% of the total shoot length. Vine ripening on the control variant of Muscat White (without protection measures against leafhopper) had a low level of ripening: 65,6%, that is lower than limiting value of acceptable.

Therefore on average for two years of investigations reduction of vine ripening degree of pattern plants (Cabernet Sauvignon and Aligote) wasn`t registered against the background

of long-term development of leafhopper; at the same time Muscat White, non-protected patterns, was characterized by certain decrease of shoot ripening.

Conclusion

For the first time in the Crimea injuriousness of *A. kakogawana* was investigated under conditions of its habitat within industrial vineyard.

1. Fast increasing of this phytophage damage rate (decoloration) of grape leaves was determined in summer period (June-August): Cabernet Sauvignon – from 25% up to 61%; Aligote – from 21% up to 55%; Muscat White – from 20% up to 51%.

2. It`s obviously that grape leaves which have 10% or more of decolorized surface (3 – 8 points according to rating scale) due to leafhopper nutrition, contain much less of chlorophyll *a* and *b*, than injurious leaves do: 1,41 – 1,81 mg/g or 39,7 – 51,0% less.

3. Against the background of leafhopper *A. kakogawana* natural development, fruiting (C_1) and fruitfulness (C_2) coefficients of Cabernet Sauvignon and Aligote were reduced annually: C_1 (Cabernet Sauvignon) - 1,7 - 1,2; C_1 (Aligote) - 1,8 - 1,6; C_2 (Cabernet Sauvignon) - 1,8 - 1,4; C_2 (Aligote) 1,9 - 1,7. This tendency wasn`t revealed for control plants of Muscat White. In the third year of observations an abrupt decrease of the following was registered for Cabernet Sauvignon cultivar: average bunch mass (24,7 – 28,9%), a number of bunches (30,3 – 24,2%), bush crop (47,6 – 46,1%) and sugar mass concentration in berry juice (12,0 – 11,3%).

4. Evident reduction of crop estimate indicator per 1 bush was registered for the most damaged by leafhopper *A. kakogawana* grape cultivar Cabernet Sauvignon having compared fruiting characteristics in natural conditions and being protected by special measures: in 2013 it became 2 kg/bush less, in 2014 - 2,5 kg/bush less, allowing for biological efficiency of preparations 42-100%. In the third year of investigations considerable deterioration of crop qualitative parameters was fixed: mass concentration of sugars decreased till 3,0 g/100 sm^3 while mass concentration of titrating acids became 1,4 g/dm^3 more.

5. Negative effect of *A. Kakogawana* development on annual shoot ripening of three industrial grape cultivars wasn`t revealed.

References

1. Ampelographiya SSSR, T. III / otv. red. A.M. Frolov-Bagreyev; zam.otv.red. A.M. Negrul, P.P. Blagonravov; red. kollegiya M.A. Gerasimov, V.I. Yegorov, P.K. Kartavchenko i dr. – M.: GNTIMPPT SSSR "Pishchepromizdat", 1954. – 396 s.

2. Atlas nasekomih, kleshchej i paukov, obitayushchih na vinogradnikah Yuzhnogo berega Cryma / Radionovskaya Ya.E., Volkova M.V. – Yalta: Vizavi, 2013. – S. 27.

3. *Balakhnina I.V., Sugonyayev Ye.S., Yakovuk V.A.* Yaponskaya vinogradnaya tsikadka – novij potentsialno opasnij vreditel vinogradnoj lozi na Severnom Kavkaze // Zashchita i karantin rastenij. – 2009. - № 12. – S. 33 – 34.

4. *Dospekhov B.A.* Planirovaniye polevogo opyta i statisticheskaya obrabotka dannyh. – M.: Kolos, 1979. – 206 s.

5. Metodicheskiye rekomendatsii po agrotekhnicheskim issledovaniyam v vinogradarstve Ukraini / pod red. Avidzba A.M. – Yalta: NIViV "Magarach". – 2004. – 264 s.

6. Opredelitel nasekomih Dalnego Vostoka SSSR, T. II. Ravnokryliye i poluzhestkryliye. – L.: Nauka, 1988. – 972 s.

7. *Pochinok Kh.N.* Metodi biokhimicheskogo analiza rastenij. – Kiev: Naukova dumka, 1976. – 334 s.

8. *Radionovskaya Ya.Ye., Didenko L.V.* Invaziya ta osoblivosti rozvitku tsikadki yaponskoyi vinogradnoyi *Arboridia kakogawana* Mats. na vinogradnih nasazhdeniyah Krymu // Karantin i zakhyst roslin. – 2014. - № 8 – S. 5 – 7.

9. *Sugonyayev Ye.S., Gnezdilov V.M., Yakovuk V.A.* Novij potentsialnij vreditel vinograda // Zashchita i karantin rastenij, 2004. - № 7. – S.35.

10. Sugonyayev Ye.S., Balakhnina I.V., Yakovuk V.A. Yaponskaya vinogradnaya tsikadka (*Arboridia kakogawana* Matsumura.) – novij potentsialno opasnij vreditel vinogradnoj lozi na Severnom Kavkaze // Biologicheskaya zashchita rastenij, perspektivi i rolj v phytosanitarnom ozdorovlenii agrotsenozov i poluchenii ekologicheski bezopasnoj selskokhozyaistvennoj produktsii: mezhdunarodnaya nauchno-prakticheskaya konferentsiya (Krasnodar, 23 – 25 sentyabrya 2008 g.). – Krasnodar, 2008. – S. 160 – 165.

11. *Tanskij V.I.* Vredonosnostj nasekomih i metodi ee izucheniya. – M.: VNIITEISH, 1975. – 68 s.

12. *Yurchenko Ye.G.* Biologicheskiye osobennosti rastitelnoyadnih tripsov i tsikadok v vinogradnih agrotsenozah Zapadnogo Predkavkazjya // Vinodeliye i vinogradarstvo. – 2011. - № 4. – S. 44 – 46.

13. *Yurchenko Ye.G.* Metodicheskiye rekomendatsii po phytosanitarnomu monitoringu tsikadok na vinograde. – Krasnodar: GNU SKZNIISiV, 2012. – 50 s.

14. *Yakushyna N.A., Stranishevskaya Ye.P., Radionovskaya Ya.E., Tsybulnyak Yu.A., Khyzhnyak Yu.Ye.* Metodicheskiye rekomendatsii po primeneniyu phytosanitarnogo kontrolya v zashchite promyshlennyh vinogradnyh nasazhdenij yuga Ukraini ot vreditelej i boleznej. – Simferopol: "Polypress", 2006. – 24 s.

15. *Gnezdilov V.M., Sugonyaev E.S., Artokhin R.S. Arboridia kakogawana* (Matsumura) (Hemiptera Cicadellidae Typhlocybinae) – a new pest of grapevine in Southern Russia. – REDIA, 2008. – P. 51 – 54.

The article was received at editors 31.03.2015

Radionovskaya Ya.Ye, Didenko L.V. Assessment of new phytopage injuriousness – Arboridia kakogawana Mats. – on the area of the Crimea vineyards // Bull. of the State Nikit.Botan.Gard. – 2015. - № 114. – P. 54-62.

Negative effect of *Arboridia kakogawana* mats. on growth and development of industrial grape cultivars (Kaberne-Sovinyon, Aligote, Muskat white) was investigated for the first time in the Crimea in 2012-2014. The rate of leaf damage caused by the phytophage activity reached 51 – 61%. As a result of insect nutrition the level of chlorophyll *a+b* in decolorized leaves reduced till 40 – 51%. The coefficients of fruiting and fruitfulness as well as the qualitative and quantitative crop parameters also went down.

Key words: *Arboridia kakogawana Mats., grape cultivars, injuriousness, damage rate, chlorophyll, biological productivity.*

AGROECOLOGY

UDC 631.445.9:631.442.6:631.48

RELIEF AND DENSE ROCK IN THE PROCESS OF WEATHERING AND SOIL FORMATION OF SKELETAL SOILS

Nikolay Yevdokimovich Opanasenko

Nikitsky Botanical Gardens – National Scientific Centre
298648, Republic of the Crimea, Yalta, urban village Nikita
E-mail: igorkostenko@ukr.net

Summarized monographic works on skeletal soils and soil-forming rocks are not presented in scientific studies within CIS, though diverse, partly fragmentary information about it, permitted to collect key investigations on genesis, weathering and redeposition of soil-forming rocks depending on geological materials and relief as it is.

Concerning factors of soil formation, geological materials and relief, denudation processes are of great importance for weathering and soil formation, earth moving and mixing, formation of skeletal soil composition, properties and fertility. The following authors researched this topic at different times: V.V. Dokuchayev [14], K.D. Glynka [12], S.S. Neustruyev [24], I.N. Antipov-Karatayev, L.I. Prasolov [1], S.A. Zakharov [16], V.R. Viljams [8], N.M. Sibirtsev [31], V.M. Fridland [36, 37], B.B. Polynov [28], M.A. Kochkin [22], N.N. Dzens-Litovskaya [13], E.M. Samoilova [30], A.I. Romashkevich [29]. They noticed processes of residual soils formation (fragmental, calcareous, sialite), which depend upon zonal and phased regularities, are not only a unit of geological cycle of matter, but they play a considerable role in soil formation, as well as rock transformation isn`t cyclic, but directed. Just this transformation of mineral compounds is basical in develppment of skeletal soils (stony, rubbly, pebble).

While researching primary soils on rocks of the Crimea, Caucasus, Tien Shan and Urals a huge geological, geochemical and soil forming role of microorganisms and lithophilous vegetation was emphasized; processes of mechanical disintegration and biochemical transformation of primary minerals and synthesis of secondary ones, including clay minerals and biolith were revealed as well; a special attention was paid to the level of mineral-resistance, their composition and proportion in fine earth of primary soils. Quite important achievement was determination of biological uptake lines and a leaching degree of ash constituents. Special enriching of colloidal and precolloidal soil layers by vadose minerals, organic and mineral compounds and products of humification and mineralization of lithophilous vegetation was also noted. Microorganisms and lithophilous vegetation were proved to be direct denudation agents, they process huge mass of rocks into a fertile fine earth and create favorable conditions for more highly-developed vegetative formations [2, 11, 17, 22, 26, 35].

In low-efficient residual and transit weathering crusts on surfaces which are in constant renewal process, soil profile of skeletal soils occupies horizons of unstable weathering crust completely or to a large degree. That`s why soil formation is closely connected with weathering in space and time. Thereupon it`s necessary to emphasize methodological works of S.A. Zakharov [16, 17], K.P. Bogatiryov [3], B.B. Polynov [28], V.O. Targuljan [35], M.A. Kochkin [22], V.M. Fridland [37], I.A. Sokolov, B.P. Gradusov [34], A.I. Romashkevich [29]. Weathering is scientifically considered as a process of parent rocks emergence (ortho- and paraeluvium), favoring soil formation and as a process of soil

profile formation. In the course of investigation the following points were noted: soil formation is an integral part of eluvium and non-eluvial weathering crust in its secondary occurrence as a result of alluvial, dealluvial, proluvial drift of eluvial rock strata, soil formation and exogenesis of former times prepared material for soils we have at present.

Soil scientists [9, 12, 14, 16, 22, 24, 28, 31, 36, 37] enunciated key points on the following items: leading role of dense rock chemical composition (its direction and rate of weathering and soil formation); connection of dense rocks and soils: substance composition and properties of dense rocks have the full activity on the initial stages of skeletal soil development, then as far as chemical composition of parent rocks changes, dense rock effect decreases, soils become zonal; at the same time rocks mainly containing calcium carbonate or silicic acid influence on generated soils as well, causing disorder of soil zoning; free carbonates, sulphates, chlorides slow down weathering of primary minerals according to the law of mass action; acid environment stimulates process of weathering, but neutral and alkaline conditions slow down it; the main processes of chemical weathering of carbonate soils are dissolution and carry-over of carbonates out of rocks and deposition of insoluble residue (SiO_2, R_2O_3); products of weathering of various rocks, which runs under the same conditions are much more resembling than initial rocks (the convergence rule as a result of zonal weathering peculiarity); having equal soil formers different rocks can create soils of the same type; different soil formers on the same rocks contributes to formation of various soils.

During rock weathering carry-over and activization of bases and sesquioxides slow down process of podzolization and regulate humid acids content, create infiltration geochemical barriers in the form of coherent layers or crusts under subvertical motion of carbonate and magnesium solutions, reduces to occurrence of magnesium malts, carbonate or solonetzic soils [3, 9, 19, 20, 25, 27, 34].

A certain effect of the dense rocks on weathering and soil formation depends upon climatic conditions. In humid zones weathering rate and as a result occurrence in the soil solution of R_2O и R_2O_3 is much higher, what grounds soil formation with undifferentiated profile on either calcareous or basic rocks. On acid rocks podzolic process is much more clearly marked. Concerning arid zones, where aridity slows down weathering, rock effect on soil formation is feebly marked therefore it`s not determinant. For instance, chernozem on carbonate skeletal sialite rocks is close to chernozem on carbonate loess-like loamy soils. In the former case mountain soil forming rocks are characterized by a high taxonomic value (type, subtype), as in geochemical terms processes of subsurface weathering conflict with processes in flushing soils. In the second case, on non-flushing soils where that conflict is not so substantial, dense soil forming rocks are considered as genus, type, variety or lithologic series [4, 9, 12, 16, 19, 33, 36].

Argillization is particularly important in subsurface weathering in skeletal soils which contain a great deal of primary minerals. It`s one of the key processes in formation of textural horizons of brown forest soils, chernozems, brown and other soils [3-5, 10, 13, 17, 19, 22, 23, 36, 37].

Weathering rate of rocks also depends upon proportion in rocks of different by weathering-resistance level principal soil forming minerals. Predominance of quite resistant minerals (quartz, rutile, tourmaline) favor accumulation of inert soil layer, which doesn`t take part in biological cycle of matters, moves without marked chemical changes in geological cycle as well. Therefore inert soil layer influences only on potential fertility of skeletal soils causing their hydro-physical properties. Predominance in rocks of unresistant to weathering olivine, augite, carbonate and alkaline plagioclases, hornblende plays much more considerable role in soil formation than predominance of more resistant biotites, potash feldspars. But in both cases components of active (soil solutions, absorbed cations) and surface-active part of soil (clay minerals, hydrogen oxides) occurred due to weathering,

participate in chemical, physicochemical and biochemical processes, conditioning efficient and potential fertility of skeletal soils.

Among geomorphological processes, which considerably effect on soil formation, scientists [7, 15, 16, 22, 29] emphasize denudation of watersheds, that leads to constant descending "rejuvenation" of skeletal soils having simultaneous soil formation processes in the weathering crust. Resultant of such syndenudation soil formation is determined by rate of weathering and soil formation processes and strength of denudation phenomena. If the latter factor intensifies, effect of debris on soil formation processes increases on eluvial depositions downward, but on dealluvial – from the surface, as in this case mainly fine earth moves, skeletal fractions gradually come to the surface and form rubbly armor which is capable to resist to weathering for a long time due to aridity and lack of plant roots.

To realize polygenetic holocene and pleistocene-pliocene skeletal soils and paleosoils on alluvial and alluvial-proluvium depositions of river valleys, synclines, on piedmont cones it`s necessary to registrate simultaneous processes of sedimentogenesis (subaqueous and subaerial), diagenesis and soil formation [6, 18, 32, 33]. Hydrogenetic (fluvial) and eolian accumulation of fine earth, skeletal fractions, true and colloidal solutions in river valleys, on piedmont plains, depressions causes ascending "rejuvenation" of ground profile; at the same time transit motions of moisture and metabolic by-product using side interflow are able not only to activate soil formation processes, but result overwetting and soil gleization, alkalinization and salinization in case of poor drainage [3, 16, 20, 22, 28].

Objective factors of chemical weathering of rocks are availability or lack of calcium carbonate, calcium sulfate, easily soluble soils, secondary minerals, degree of desilication or resilication (SiO_2/Al_2O_3), allitic (SiO_2/R_2O_3) in fine earth; factors of physical weathering are content of fine earth and skeletal fractions, physical clay and silt in fine earth [21, 28].

In conclusion it`s necessary to note, that leading factors of investigation might be the followings: history of area soil cover is a history of rock transformation into soils, that`s why total genetic characteristic of skeletal soil is impossible without its origin, parent rock properties and composition fine earth and skeletal layers of which tag rate and direction of soil formation process, morphological appearance, hydro-physical properties, granulometric and chemical mineralogical composition and fertility of skeletal soils in general, besides determine their systematic division on various taxonomical levels.

References

1. *Antipov-Karatayev I.N., Prasolov L.I.* Pochvi Krymskogo gosudarstvennogo lesnogo zapovednika i prilegayushchih mestnostej // Trudi Pochv. in-ta im. V.V. Dokuchayeva. – L.: Izd-vo AN SSSR, 1932. – T.7. – 280 s.

2. *Bobritskaya M.A.* Pogloshcheniye litophilnoj rastitelnostju mineralnih elementov iz massivno-kristallicheskih porod // Trudi Pochv. In-ta im. V.V. Dokuchayeva. – 1950. – T. 34. – S. 5 – 27.

3. *Bogatiryov K.P.* O nekotorih osobennostyah razvitiya pochv gornih stran // Pochvovedeniye. – 1946. - № 8. – S. 492 – 500.

4. *Bogatiryov K.P.* Fragmentarniye (gruboskeletniye) pochvi i ih mesto v obshchej klassifikatsii pochv // Pochvovedeniye. – 1959. - № 2. – S. 19 – 28.

5. *Valkov V.F., Kryshchenko V.S.* Oglinivaniye v chernozyomah i kashtanovyh pochvah Severnogo Kavkaza // Pochvovedeniye. – 1973. - № 7. – S. 5 – 11.

6. *Veklich M.F., Sirenko N.A.* Pliotsen i pleistotsen levoberezhja Nizhnego Dnepra i ravninnogo Kryma. – K.: Naukova Dumka, 1976. – 185 s.

7. *Vilenskij D.*G. O nekotorih zakonomernostyah razvitiya pochvoobrazovatelnogo protsessa // Pochvovedeniye. – 1937. - № 6. – S. 792 – 809.

8. *Viljams V.R.* Vivetrivaniye gornih porod i protsess obosobleniya svojstv

pochvoobrazuyushchih porod // Pochvovedeniye: zemledeliye s osnovami pochvovedeniya – M.: Selkhozgiz, 1946. – S. 36 – 52.

9. *Gagarina E.I.* Opit izucheniya vivetrivaniya oblomkov karbonatnih porod v pochve // Pochvovedeniye. – 1968. - № 9. – S. 117 – 126.

10. *Gerasimov I.P.* Korichneviye pochvi sukhih lesov i kustarnikov lugostepej / I.P. Gerasimov // Trudi pochv. in-ta im. V.V. Dokuchayeva. – 1949. – T. 30. – S. 213 – 233.

11. *Glazovskaya M.A.* Vivetrivaniye gornih porod v nivalnom poyase Tsentralnogo Tyanj-Shanya / Trudi Pochv. In-ta im. V.V. Dokuchayeva. – 1950. – T. 34. – S. 28 – 48.

12. *Glinka K.D.* Pochvovedeniye / 3-e izd., ispr. i pererab. – M.: Novaya derevnya, 1927. – 580 s.

13. *Dzens-Litovskaya N.N.* Pochvi i rastitelnostj stepnogo Kryma. – L.: Nauka, Leningr.otd., 1970. – 156 s.

14. *Dokuchayev V.V.* Rabor glavneishih pochvennih klassifikatsij / Izb.soch.v 3 t. – M.: Gosizdat selkhoz.literaturi, 1948 – 1949. – T. 3. Kartographiya, genesis i klassifikatsiya pochv. – 1949. – S. 163 – 239.

15. *Dolotov V.A.* Genezis gorno-stepnih fragmentarnih pochv Kopet-Daga // Pochvovedeniye. – 1958. - № 7. – S. 36 – 41.

16. *Zakharov S.A.* Pochvi gornih rajonov SSSR // Pochvovedeniye. – 1937. - № 6. – S.810 – 848.

17. *Zakharov S.A., Serebryakov A.K.* Perviye stadii pochvoobrazovaniya v visokogornoj zone Yugo-Osetii // Problemi sovetskogo pochvovedeniya. – M.-L.: Izd-vo AN SSSR, 1949. – Sb.15. – S. 31 – 54.

18. *Ivanov I.V.* Izmeneniye prirodnih uslovij stepnoj zoni v golotsene // Izv. AN SSSR: Ser.geogr. – 1983. – Vyp.2. – S. 26 – 41.

19. *Ivanova E.N.* Pochvi Urala // Pochvovedeniye. – 1947. - № 4. – S. 213 – 228.

20. *Kasimov N.S., Perelman A.I.* O geokhimii pochv // Pochvovedeniye. – 1992. - № 2. – S. 9 – 26.

21. *Kovda V.A.* Obshchnotj i razlichiya v istorii pochvennogo pokrova kontinentov (k sostavleniyu pochvennoj karti Mira) // Pochvedeniye. – 1965. - № 1. – S. 3 – 17.

22. Kochkin M.A. Pochvi, lesa i klimat gornogo Kryma i puti ih ratsionalnogo ispolzovaniya // Trudi Gos. Nikit.botan.sada. – M.: Kolos, 1967. – T. 38: . Pochvi, lesa i klimat gornogo Kryma i puti ih ratsionalnogo ispolzovaniya. – 368 s.

23. *Mamytov A.M.* pochvi gor Srednej Asii i Yuzhnogo Kazakhstana / 2-e izd., ispr. i pererab. – Frunze: Ilim, 1987. – 310 s.

24. *Neustruyev S.S.* Elementi geografii pochv / Pod red. L.I. Prasolova. – M. – L.: Gos. s-h.izd-vo, 1931. – 220 s.

25. *Nogina N.A.* Vliyaniye porod na podzoloobrazovaniye v gornoj chasti Srednego Yrala // Trudi Pochv.in-ta im. V.V. Dokuchayeva AN SSSR. – 1948. – T. 28. – S. 105 – 195.

26. *Parfenova E.A.* Issledovaniye primitivnih gorno-lugovih pochv na dioritah hrebta Magimo (Severnij Kavkaz) // Trudi Pochv. in-ta im. V.V. Dokuchayeva. – 1950. – T. 34. – S. 49 – 109.

27. *Petrov B.F.* Pochvi Altaisko-Sayanskoj oblasti // Trudi Pochv. in-ta im. V.V. Dokuchayeva. – 1952. – T. 35. – S. 1 - 247

28. *Polynov B.B.* Izbranniye trudi. – M.: Izd-vo AN SSSR, 1956. – 751 s.

29. *Romashkevich A.I.* Gornoye pochvoobrazovaniye s pozitsij geologo-geomorphologicheskih i istoricheskih ego osnov // Pochvovedeniye. – 1996. - № 1. – S. 64 – 76.

30. *Samoilova E.M.* Gornaya poroda v svete Dokuchayevskogo ucheniya o faktorah pochvoobrazovaniya // Vestnik Moskovskogo un-ta: Ser.17. Pochvovedeniye. – 1983. - № 1. – S. 20 – 26.

31. *Sibirtsev N.M.* Izbranniye sochineniya: v 2 t. – M.: Gosizdat s-h.lit-ri, 1951-1953. – T. 1. Pochvovedeniye. – M.: Gosizdat s.-h. lit-ri, 1951. – 472 s.

32. *Sirenko N.A., Turlo S.I.* Razvitiye pochv i rastitelnosti Ukraini v pliotsene i pleistotsene. – K.: Naukova dumka, 1986. – 188 s.

33. *Sokolov I.A.* Bazovaya substantivno-geneticheskaya klassifikatsiya pochv // Pochvovedeniye. – 1991. - № 3. – S. 107 – 121.

34. *Sokolov I.A., Gradusov B.P.* Pochvoobrazovaniye i vivetrivaniye na osnovnih porodah v usloviyah kholodnogo humidnogo klimata // Pochvovedeniye. – 1978. - № 2. – S. 5 – 17.

35. *Targuljan V.O.* O pervih stadiyah vivetrivaniya i pochvoobrazovaniya na izverzhennyh porodah v tundrovoj i tayozhnoj zonah // Pochvovedeniye. – 1959. - № 11. – S. 37 – 48.

36. *Fridland V.M.* O roli vivetrivaniya v sozdanii pochvennogo profilya i o razdelenii pochvennoj massi // Pochvovedeniye. – 1955. - № 12. – S. 6 – 17.

37. *Fridland V.M.* Vliyaniye stepeni vivetrelosti pochvoobrazuyushchih porod na protsessi formirovaniya pochv v razlichnih bioklimaticheskih zonah // Pochvovedeniye. – 1970. - № 6. – S. 5 – 15.

The article was received at editors 18.11.2014.

Opanasenko N.Ye. Relief and dense rock in the process of weathering and soil formation of skeletal soils // Bull. of the State Nikit. Botan. Gard. – 2015. – № 114. – P. 62-66.

The article presents summarized fundamental investigations of scientists in the field of genesis, weathering and redeposition of soil-forming rocks depending on rocks, relief, denudation phenomena. The work demonstrates that process of residual soils formation, depending on zonal and phased regularities, is not only a unit of geological cycle of matters, but it plays a considerable role in soil formation and development of skeletal soils.

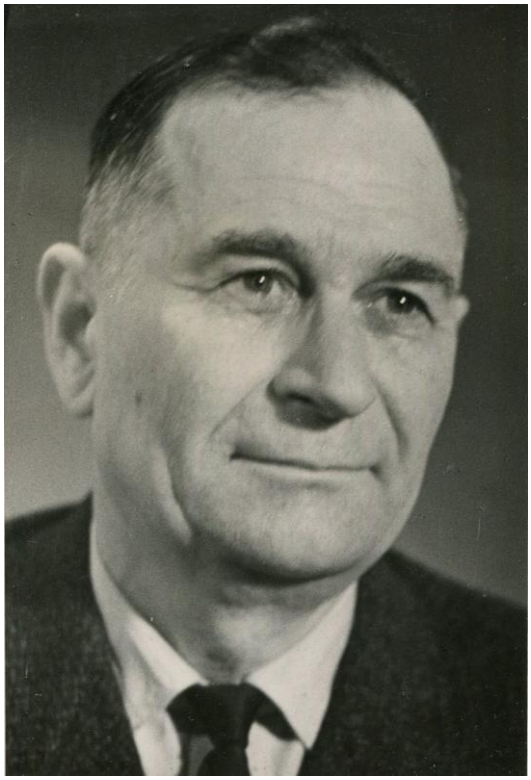
Key words: s*keletal soils, geological materials and soil-forming rocks, relief, soil formation.*

BIOGRAPHIES

UDK 635.9:582.572.8

SELECTIONIST K.T. KLYMENKO

(Devoted to the 110th anniversary)



Konstantin Trophymovich Klymenko was born on May the 21st in 1905, Rylske town of Kurska province in Russia.

Since 1921 he had been in Anti-gang Special Forces of the Red Army and due to his courage and bravery was awarded by personal weapon.

After Army Klymenko K.T. worked as a metalworker at Moskovsky factory, in the evenings he visited workers` courses. After courses he entered Timiryazevskaya Academy and became a student of urban greening department in a start-up group of selectionists-orchadists.

In spring being one of 12 best students he was sent for practice to Kozlov city (Michurinsk), nursery of I.V.Michurin. Purpose of this practice was to familiarized with I.V. Michurin achievements in selection of fruit and other cultures and master his efficient selective methods. At the nursery of Michurin I.V. students worked as trainees and studied breeding cycle, agrotechnology, plant care and science of nurseries. Konstantin Trofimovich was one of I.V. Michurin`s favourite pupils, who was trusted preparation and staging of the most complicated combinations of distant hybridization.

Students of Timiryazevskaya Academy were pioneers at the new Institute of fruit cultures named after I.V. Michurin.

In 1934 after graduation Konstantin Trofimovich with his wife Vera Nikolayevna having speciality “agronomist-orchadist-selectionist” were recommended by I.V. Michurin as talented interns for selection of citrus cultures to Georgia and Adzharia. In autumn 1934 couple Klymenko started their investigations at the department of citrus culture selection in Batumi botanical garden.

Besides selection of citrus cultures Klymenko K.T. was charged with breeding of tung tree, significant for the whole country culture in prewar period, as fruits of this plant were sources of valuable tung oil, necessary for airplanes and submarines.

In his selective researches on citrus and tung cultures Klymenko K.T. successfully applied diverse Michurin methods, but principal method of his work was distant hybridization with species from China and Japan. He was a researcher in development of biological fundamentals of efficient selection under conditions of Adzharia subtropical climate.

Hundreds of crossing combinations were carried out, was grown a whole selection fond.

Vavilov N.I. twice saw works on introduction and selection of K.T. Klymenko personally in Batumi botanical garden and he was quite satisfied by their results. Their first meeting happened in Michurinsk.

Vavilov N.I., concerned about floriculture state in the country, which was far from satisfactory, recommended Konstantin Trofimovich and Vera Nikolayevna to take up selection of flower-ornamental cultures in addition. To develop this direction Konstantin Trofimovich chose quite rare at Caucasian Coast at that date camellias and ornamental rhododendrons.

Results of his selective researches with citrus cultures became 6 frost-resistant sorts of orange, bred in collaboration with Vera Nikolayevna: "Adzharsky bessemyanny", "Gladkokozhy", "Gruzinsky", "Korolyok Gruzynsky", "Korolyok №15", "Korolyok № 25". These varieties were released in Georgia with author`s certificates. New high-yielding hybrid forms of tung were presented for industrial growing. Highly ornamental forms of camellia and rhododendrons, which still decorate expositions of Batumi Botanical Garden, were picked up out of rich selective fond.

Results of selective researches carried out in the Caucasus were described by Konstantin Trofimovich in his three monographs and Ph.D. thesis "Selection of tung tree in Adzharia", which was successfully defended in 1954 at All-Union Institute of Plant-growing.

In 1941 on June the 23rd Konstantin Trofimovich went to the front. He was badly wounded twice on Caucasian passes, near Sukhumi and in the Ukraine near Belaya Tserkov. He participated in organization of Tehran Conference. After the war he resumed his activity in Batumi.

In 1949 Konstantin Trofimovich together with his wife were invited and transferred to the Crimea, Nikitsky Botanical Gardens, where he continued his introduction and selective researches with citrus and floral cultures.

Later Kostantin Trofimovich started introduction and selective researches with herbaceous and tree-like peonies, primulas and bulbous cultures as well: snowdrops, crocuses, narcissi and tulips. Collections of these plants were replenished and recreated. Classical methods of selection were applied based on cultures mentioned above: individual selection, clonal selection, hybridization (intraspecific and distant), development and applying of new methods of experimental mutagenesis, thereby chemical mutagens, x-ray and gamma irradiation were applied, different ways to overcome combining disability and get polyploid forms were developed.

As a result of intervarietal and interspecific hybridization, highly ornamental forms of tree-like peonies were bred: "Solnechny Krym", "Geroyam Adzhymushkaya", "Yaltinskaya Vesna".

Valuable hybrid fond resulted from hybridization of early blooming Central Asian varieties of tulips with 20 best sorts of Holland selection. After the death of Konstantin Trofimovich (March the 22nd in 1977) 4 varieties out of this fond were marked and presented for State sort testing: "Zhemchuzhny", "Skif", "Krymsky", "Yaltinsky", which were released all over the Crimea with authorized certificates (in co-authorship).

A senior researcher, candidate of Agricultural Sciences K.T. Klymenko had worked in Nikitsky Botanical Gardens for more than 20 years.

Course of his life was determined by active stand in life. Patriot of his native country, inexhaustible toiler, creative personality, whose works and ideas were and still remain actual.

Results of his scientific studies were published in 82 works. Workers of Nikitsky Botanical Gardens remember him as a generous, sympathetic and extremely hard-working person. He was a good mentor for young workers, talented scientist-selectionist.

In memory of this great person a new special white and pink tulip variety selected in Nikitsky Botanical Gardens was named "Konstantin Klymenko".

L.M. Aleksandrova, Z.K. Klymenko

The article was received at editors 14.04.2015

Aleksandrova L.M., Klymenko Z.K. Selectionist K.T. Klymenko (devoted to the 110th anniversary) // Bull. of the State Nikit.Botan.Gard. – 2015. – №114. – P.67-69.

The article covers main life scientific stages in Nikitsky Botanical Gardens of K.T. Klymenko, candidate of Agricultural Sciences.

INFORMATION FOR AUTHORS

"GNBS Bulletin" is published by Nikitsky Botanical Gardens – National Sientific Centre (NBG-NSC).

RULES OF ARTICLE EXECUTION AND PRESENTATION

1. Articles should be in Russian or English, not published or registrated in other journals, collections of works before (exept thesis reports and material of conferences, symposiums, meetings and etc.).

2. Articles must contain brief and clear summery about current state of the subject, description of research methods, issue and discussion of findings. Article title should correspond its contain. An article must be divided into structural parts, cited in the pattern below. Part "Introduction" should include research currency (problem statement and its connection with important scientific and/or practical tasks), analysis of references, used while solving the problem, and research objective.

3. Article is typed in MS Word for Windows (*.doc or *.docx). The following page setup should be used: format – A4, page orientation is book, border size is 2,5sm, print – Times New Roman 12 pt (except summeries, key words, figures and tables, which are typed in 10pt – see patterns below), indent – 1,25 sm, line spacing of the main text is 1 (single spacing), text is typed without word division, justified alignment, text is not paged. During execution and formatting of the text or its structural elements, please follow patterns carefully!

4. Publication size shouldn`t be more than 8 pages. Relative volume of illustrations mustn`t surpass 1/3 of total. The list of references shouldn`t contain more than 30 sources in survey articles and only 15 sources in articles with author`s own research results. Initials are not spaced, but initials and surname are separated by spacing. It`s not allowed to carry over surname to another line (I.I. Ivanov,

Ivanov I.I.).

5. Summeries are presented in two languages (Russian and English). Summery and key words are placed before "Introduction" in language the article was written (type – 10pt, **"Key words"** are bolded, key words are italicized). Key words or word combinations are separated by semicolon. After references summery and key words in English are placed. Summery size is 500 characters; a number of key words is 5-7. Execution and formatting setup of these elements should correspond to the pattern (see below).

6. Printed version of manuscript (1 copy) is enclosed by electronic version of files in formats *.doc or *.docx (can be sent to e-mail of editorial office).

7. The manuscript is signed by all authors. One page is taken for authors` data: place of work, position, academic degree, address of establishment, contact details for feedback (telephone number and e-mail of all authors). An article is attached by assignment from establishment where the work was carried out. Articles of postgraduates and candidates are attached by review of research supervisor.

8. All articles are anonymously reviewed.

9. Editors of journal have a rule to abridge texts of manuscripts as agreed upon with authors.

If editors return an article as requiring improvements authors have one month for it.

10. Article heading should contain: surname, name, middle name of all authors in full (in Russian); full organization name – place of work of each author in nominative case, country, city (n Russian). If all authors of an article work at the same establishment, place of

work can be specified ones; e-mail for each author; correspondent postal address and telephone number for contact with article authors (one for all authors is allowed).

Manuscripts of articles are sent by address:

Redaction of academic publications
Of Nikitsky Botanical Gardens
Urban village Nikita, Yalta, Republic of the Crimea, 298648
Tel.: (0654) 33-56-16
E-mail: redaknbg@yandex.ru

PATTERN OF ARTICLE EXECUTION

UDC 635.055:504.753:712.253(477.75)

ANCIENT TREES OF ARBORETUM OF NIKITSKY BOTANICAL GARDENS

Lyudmila Ivanovna Uleiskaya[1], Anatolij Ivanovich Kushnir[2], Yekaterina Stepanovna Krainyuk[1], Vladimir Nikolayevich Gerasimchuk[1]

[1]Nikitsky Botanical Gardens – National Scientific Centre, Yalta 298648, Republic of the Crimea, Yalta, urban village Nikita
E-mail: mymail@mail.ru
National University of Bioresources and nature management, Kiev
Postal code, Kiev, 5, Sadovaya str.
E-mail: mymail@mail.ru

For the first time analysis of vital state and ecologic and ornamental characteristics … (summery)…

Key words: *key words, key words, key words, key words, key words, key words, key words, key words*

Introduction

Text text text text text text text text text text text text text text text text text text text text text text text text text text text text text text text text

Objects and research methods

Text.

Results and discussion

Text.

Conclusions

Text.

Gratitudes (optional)

Text

References

1. Hydrochemistry… Literary source…
2. *Ivanov I.I.* Literary source source source source source source source source source source source source source source source source source source source
3. Determiner of higher…Literary source…
4. *Petrov P.P.* Literary source…
5. *Sidorov S.S.* Literary source…

Uleiskaya L.I., Kushnir A.I., Krainyuk E.S., Gerasimchuk V.N., Kharchenko A.L. Centuries-old trees of Arboretum in Nikitsky Botanical Gardens // Works of the State Nikit. Botan. Gard. – 2012. – Vol. 134. – P. 168 – 174.

The analysis of vital state, ecological and ornamental characteristics of….

Key words: *key word; key words; key words; key words; key words; key words; key words; key words; key words.*

END OF PATTERN

Typing and correction of the text should be carried out in accordance with the following rules:

1. MS Word is used to create tables.
2. Words shouldn`t be hand-carried.
3. **Don`t put full stop after:** UDK, title of article, authors` surnames, organization name, heading, figure captions, names of tables, notes and references to tables, dimensions (h-hour, s-second, g-gram, min-minute, day, C - degree centigrade, m-meter) and in subscripts as well. Full stop should be put after contractions (mes. – mesyats (month), ned. – nedelya (week), g. – god (year), mln. – million).
4. Names of species and genera of plants and animals are presented in Latin in Italics according to actual international codes of biological nomenclature, together with author`s name and (if necessary) year of description (author and year of description are typed in usual print), for instance: *Quercus pubescens* Willd. But further mention of the same taxon, its generic name is contracted, author`s name isn`t typed (*Q. pubescens*). If the article contains taxonomic list with full names (including taxons` authors) it`s possible not to indicate author`s name. Authors` names are typed either fully or in standard contractions (Recommended!) in accordance to Authors of plant names (2001). References to authorities of either nomenclature combinations are necessary. Latin names of taxons which belong to higher class than genus are not italicized. Names of plant cultivars are single quoted (**'**…**'**), if there is no the word "cultivar" before them; all words in cultivar name begin with capital letters (for instance, peach 'Zolotoj Yubilej', but cultivar Zolotoj Yubilej).
5. **Requirements for quotation:**

- ellipsis in quotation is enclosed in curly brackets <…>. If there was a punctuation mark before or after omitted text, it is dropped;
- if an author uses a quotation and emphasizes some words in it, after explanatory text of these words there must be full stop, then dash and article author`s initials (first letters of his/her name and surname), warning text is taken in parentheses. For example: (italics added. – A.S.), (underlined symbols added. – A.S.), (spacing added. – A.S.).

6. Decimal fractions are separated by commas: 0,1 or 0,5.
7. Dash isn`t put in the beginning of line.
8. Double or multiple space isn`t allowed.
9. Such contractions as "i t.d., i t.p.", indices, subscripts and mathematical signs are not spaced.
10. Numerals and signs %, ° are not spaced.

11. Before measures and signs №, §, © there is a space.

12. Hiphen is used only in compound words such as „vsyo-taki" (anyway), „khimiko-pharmatsevticheskij" (chemical and pharmaceutical), which are not spaced. Dash is used in all other cases and two-sided spaced (18 – 30, 1999 – 2014).

13. Tables and illustrations are put into the text after their first mention. Optimal table size is one page.

14. Before figure, after it and its caption (before text) there are indents of 1 line. Figure caption is centering and typed in lower-case bold letters 10pt, single-space (**Fig. 1** – there is no full stop after numeral). Figures and captions should be placed into a table of 1 column and 2 lines, option "Remove table borders" should be activated to avoid their display when printing (see pattern below).

15. There is an indent of 1 line before table and after it. Word **"Table"** with its number is placed on the right side, table caption is centering below; lower-case bold letters of 10pt, single-space (**Table 1 –** there is no full stop after numeral). Table text is typed in lower-case non-emphasized letters of 10pt with single-space. The first words of table column headings are started with the capital letters, subheadings are started with lower-case letters if they are combined in one sentence with heading, with capital letters if subheadings are independent. Measures are pointed after commas. Execution and formatting parameters must correspond to the pattern – see below.

Repeated text in a table column may be replaced by quotation marks (« - »). Quotation marks instead of numerals, notes, signs, mathematical and chemical symbols are not recommended.

If a table size exceeds 1 page all its columns are numbered by Arabic figures, its continuation on the next pages is typed on the right side in 10pt print (for example, "Continuation of table 1").

FIGURE PATTERN

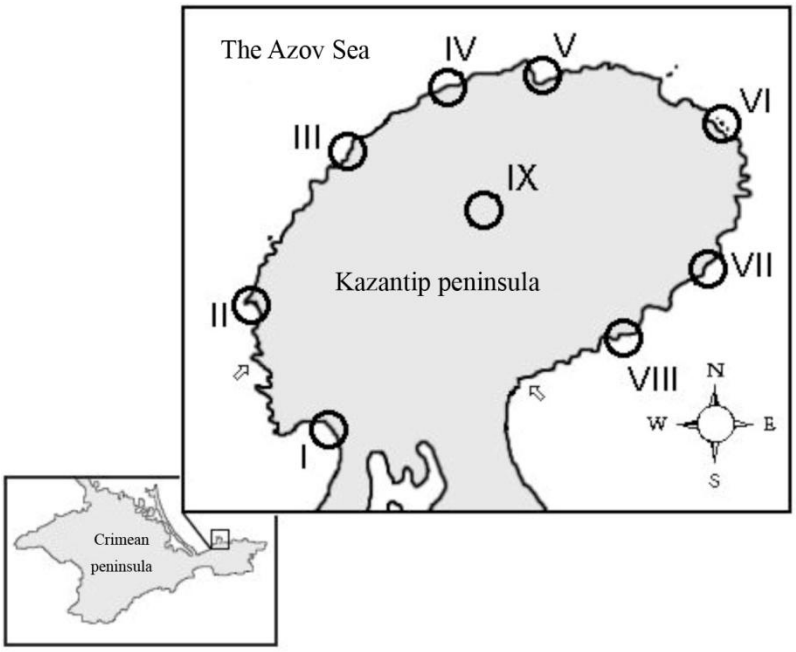


Fig. 1 Sketch map of inspected region (stations I-VIII)

TABLE PATTERN

Table 1

Cultivar composition and biomass of macrophytobenthos within offshore zone of Blessed Trinity Cape

Cultivar	Biomass, g/m^2 (stations I-IV)					
	PLR (±0,25 m)		SLR(–0,5-5 m)			
	I	II	III	IV	V	VI
Ulothrix flacca (Dillwyn) Thur.	F		F			
Chaetomorpha aërea (Dillwyn) Kütz.	F	F	15,00 ±3,92	1,67±0,72		F

Notes:
Hereinafter: PLR – pseudolittoral, SLT – sublittoral. F – few (less than 0,01 g in a sample).
Empty table cells mean absence of cultivar in samples.

16. Bibliographical references in article text are taken in square brackets, several sources are separated by commas in the order of number increasing.

List of references is formed according to State Standard R 7.0.5-2008. Bibliographical reference. General requirements and rules of formation (reference to State Standard http://protect.gost.ru/document.aspx?control=7&id=173511

List of references is made alphabetically, firstly works typed in Cyrillic symbols are enumerated and after it works in Latin. Bibliographical descriptions of works, published in other languages (for example Arabic, Chinese and etc.) should be presented in English and point origin language (in brackets after page number).

17. In the list of references names of cultivars and genera are italicized; numbers of volumes (issue, № or no) are typed by Arabic figures.

18. Line drawings, maps, graphics and photos are enumerated by Arabic figures as they are mentioned in the text. References to drawings and tables in a text are taken in parentheses and pointed in shorthand form with a small letter (tab. 1, fig. 1), if they are mentioned again, add the word "see" (see tab. 1, see fig. 1)

Examples of bibliographical descriptions in references:

Books:

1. *Novosad V.V.* Flora Kerchensko-Tamanskogo regiona. – K.: Naukova dumka, 1992. – 275 s.
2. *Ostapkp V.M., Boiko A.V., Mosyakin S.L.* Sosudistiye rasteniya yugo-vostoka Ukraini. – Donetsk: Noulidzh, 2010. – 247 s.
3. Ekologichesky atlas Azovskogo morya / Gl.red.akad. G.G. Matyshov. – Rostov-na-Donu: Izd-vo UNC RAN, 2011. – 328 s.
4. Authors of plant names: A list of authors of scientific names of plants, with recommended standard forms of their names, including abbreviations / Eds. R.K. Brummitt and C.E. Powell. – Kew: Royal Botanical Gardens, 1992, reprinted 2001. – 732 p.

Periodicals and serials:

5. *Bagrikova N.A.* Analiz adventivnoj fraktsii flori prirodnih zapovednikov Kerchenskogo poluostrova (Krym) // Ekosystemi, ih optimizatsiya i ohrana. – 2011. – Vyp. 4(23). – S. 3 – 9.

6. *Nikiforov A.R.* Elementarnij pobeg i sezonnoye razvitiye rastenij *Silene jailensis* N.I.Rubtzov (Caryophyllaceae) – reliktovogo endemika Gornogo Kryma // Ukr.botan.journ. – 2011. – T. 68, № 4. – S. 552 – 559.

7. *Sadogurskij S.E.* Makrophitobentos vodoyomov ostrova Tuzla i prilegayushchih morskih akvatorij (Kerchenskij proliv) // Algologiya. – 2006. – T. 16, № 3. – S. 337 – 354.

8. *Hayden H.S., Blomster J., Maggs C.A., Silva P.C., Stanhope M.J., Waaland J.R.* Linnaeus was right all along: *Ulva* and *Enteromorpha* are not distinct genera // European Journal of Phycology. – 2003. – Vol. 38. – P. 277 – 294.

Abstract of a thesis:

9. *Belich T.V.* Raspredeleniye makrophitov psevdolitoralnogo poyasa na Yuzhnom beregu Kryma: Avtoref. Diss…kand. biol. nauk: 03.00.05 / Gosudarstvennij Nikitskij Botanicheskij Sad. – Yalta, 1993. – 22 s.

10. *Yena An.V.* Phenomen Florystychnogo endemizmu ta yogo proyavi u Krymu: Avtoref.dys. … d-ra boil. nauk: 03.00.05 / Instytut botaniki im. M.G. Kholodnogo NANU. – K., 2009. – 32 s.

Abstract of a paper:

11. *Sadogurskaya S.A., Belich T.V.* Algoflora pribrezhnoj akvatorii u mysa Troitsi (Chornoye morye) // Aktualniye problemi sovremennoj algologii: materialy IV mezhdunarodnoj konferentsii (Kiev, 20-23 aprelya 2012 g.). – K., 2012. – S. 258-259.

12. *Bagrikova N.A.* Syntaxonomical checklist of weed communities of the Ukraine: class Stellarietea mediae // 19-th International Workshop of European Vegetation Survey Flora, vegetation, environment and land-use at large scale (Pécs, 19.04–2.05, 2010): Abstr. – Pécs, 2010. – P. 51.

Section in a collective monograph:

13. *Bagrikova N.A., Kolomijchuk V.P. Astragalus reduncus* Pall. // Krasnaya kniga Priazovskogo regiona. Sosudistiye rasteniya / Pod red. d.b.n., prof. V.M. Ostapko, k.b.n., dots. V.P. Kolomijchuka. – K.: ALterpres, 2012. – S. 198 – 199.

14. *Korzhenevskij V.V., Rudenko M.I., Sadogurskij S.Yu.* PZ Krymskij // Phytoriznomanittya zapovidnykiv i natsionalnyh pryrodnyh parkiv Ukrainy. Ch.1. Biospherni zapovidnyky. Pryrodni zapovidnyky / Pid red. V.A. Onyshchenko i T.L. Andriyenko. – K.: Phytosotsiotsentr, 2012. – S. 198 – 220.

Multivolume editions:

15. Hydrometeorologiya i hydrokhimiya morej SSSR, T. IV. Chornoye morye. Vyp.1.Hydrometeorologicheskiye usloviya / Pod red. A.I. Simonova, E.N. Altmana. – SPb: Hydrometeoizdat, 1991. – 426 s.

16. Algae of Ukraine: Diversity, Nomenclature, Taxonomy, Ecology and Geography. Vol. 1. Cyanoprocaryota – Rhodophyta / Eds. Petro M. Tsarenko, Solomon P. Wasser, Eviator Nevo. – Ruggell: A.R.A.Gantner Verlag K.G., 2006. – 713 p.

Internet resources:

17. *Guiry M.D., Guiry G.M.* 2013. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. – http://www.algaebase.org. – Searched on 05 August 2013.

If a literary source has four or more authors, **all names should be specified.**

As VAK requires electronic copies of published articles are placed into database of Scientific electronic library elibrary.ru (for numbering of Russian index of scientific citation). Therefore author`s consent for article publication extends to placement of its electronic copy at electronic library.

Bulletin SNBG is published according to resolution of Academic Board
Of Nikitsky Botanical Gardens –
National Scientific Centre
Dated 09.07.2015, record № 6

Number 114

Responsible for issue
Shyshkin V.A.
Desktop publishing
.Golovnyova Ye.Yu
Translation from Russian into English
Golovnyova Ye.Yu.
http://bult.nbgnsc.ru

Certificate of registry PI № FS77-61874 dated 25.05.2015
Signed for printing 09.07.2015. Format 210 x 297. Offset paper – 80 g/m^2
Rizograph printing, accounting printing sheets 10,0. Number of copies 500. Order № 9A/10.

Edition of scientific publications
Nikitsky Botanical Gardens –
National Scientific Centre
urb.vil.Nikita, Yalta, Republic of the Crimea, RF, 298648
Tel: (0654) 33-56-16
E-mail: redaknbg@yandex.ru

Original layout was used for printing at «ARIAL»press, Co Ltd.
295034, Republic of the Crimea, Simferopol, 31-a/2, Sevastopolskaya str.,
Tel. (0652) 70-63-31, +7 978 717 29 01.
E-mail: it.arial@yandex.ru