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CONTENTS

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PECULIARITIES OF LIGHT CONDITIONS IN UNDERCROWN SPACE WITH WOODY PLANTS IN TERMS OF ARBORETUM OF NIKITA BOTANICAL GARDENS

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

Nikita Botanical Garden – National Scientific Centre
298648, Republic of the Crimea, Yalta, urban vil.Nikita
plugatar@ukr.net

Introduction

Arboreal plants of the overwood layer extremely effect on above-soil vegetative cover, forming and changing habitat for lower layers plants. Crown architectonics of woody plants conditions light structure of a plantation. Light structure tends to be a determining factor for forest phytoclimate, regime of soil processes, moisture penetration through the forest canopy and for decomposition and mineralization of that canopy as well [10].

Combination of arboreal plant crowns with different density causes four types of light structures: 1) lighten with mainly ornamental crown cultivars; 2) half-lighten with mainly half-ornamentally crowned trees; 3) half-shady with mainly half-dense crowned cultivars; 4) shady with mainly dense-crowned cultivars [2]. Soil condition of herbaceous and shrub flora in the forest cenoces depends upon light penetration. Crown density effects on some characteristics of arboreal vegetation: shade tolerance, growth intensity, efficiency. As photosynthesis plays an important part for metabolism and vital functions of plants in general, light conditions could be a ground for optimal structure and density of plantations in parks and gardens. Development of technology of high-intensive park phytocenoses attaches a great importance to increasing the coefficient of solar radiation used by plants as well as to complex of agro technical events. It is possible to solve the matter due to correct matching of plant cultivars and setting the optimal growing space for them.

As arboreal plantations transform the environment, in their phytogenous fields specific conditions are created which effect on formation of specific light regime. Quantitative assessment of illumination change within area of plants influence, links of this ecological factor with crown architectonics, determined by genetic cultivar characteristics, its importance in morphogenetic and physiological processes are quite actual issues [5].

Research objective is to investigate peculiarities of the light conditions under the canopy of arboreal plants with different architectonics and density of crown.

Objects and methods of the research

Objects of our research were arboreal introducents of overwood layer from the I group: *Cedrus atlantica* (Endl.) G. Manetti ex Carrière, *Cupressus macrocarpa* Hartw. & Gordon, *Abies numidica* de Lannoy ex Carrière, *Sequoiadendron giganteum* (Lindl.) J. Buchholz, *Sequoia sempervirens* Endl., *Pinus pinea* L., and bushes of the I and II groups: *Pittosporum heterophyllum* Franch., *Buxus sempervirens* L., *Euonymus japonica* Thunb., *Mahonia aquifolium* (Pursh) Nutt., *Chimonanthus praecox* (L.) Link, *Viburnum tinus* L., *Cornus mas* L., *Laurocerasus officinalis* M. Roem., *Aucuba japonica* Thunb.

Pattern objects were trees of the overwood layer, aged by 130-160 years. Due to shadowing, tree waste, changes of moisture conditions in their undercrown space phytogenous fields were formed, that function as specific microsites for many overtopped plant cultivars and soil fauna [12]. Bushes selected as the lower layer are 30-60 years. At the moment of research these bushes had a crown typical for their age period, didn`t have any signs of damage or disease, ecological conditions completely supplied their normal growth and development.

Control values of parameters were fixed out of zone with study and other large plants influence. Light stream was measured by luxmeter U-166 according to recommendations by V.A. Alekseyev [1] under conditions of the full natural lighting, at noon, having minimal wind velocity. Analyzing light conditions, parameter of illumination under crown was taken, that was evaluated by % from the solar radiation reached the open area. The observations were carried out in May-September during active vegetation and in December after growing process and tree waste were finished.

Results and discussion

Illumination as a parameter of energy supplying is widespread in different calculations of energy characteristics and while discussing the ecological issues concerning forest phytocenoces [3, 15]. It is one of the ecological factors, its level of influence is mostly changed by vegetative cover. Each of zones from phytogenous field (stem-by rise, undercrown space, zone of crown edge, intercrown space) is characterized by a definite illumination level that effects on vegetation of the lower layer depending on species composition, structure, ornamentality and degree of crown density [6,18]. Intensity of solar radiation decreases as far as penetrating into the crown mass. In May-June on fine days illumination on the open areas not-shaded by tree crowns reached 65000-70000 lx. In case of intensive shadowing much less solar radiation could penetrate under the tree canopy. The highest average illumination point (13196 lx) and coefficient of penetration (26,9%) in undercrown space was registered for *Cedrus atlantica* with wide cone-shaped and half-illuminated crown. The lowest values of these parameters (852 lx and 1,7%) were typical for *Sequoia sempervirens* with narrow cone-shaped and dense shady crown (table 1).

The investigations permitted to make a line of relative illumination in the phytogenous field of the undercrown space for study cultivars according to decreasing value of solar radiation penetration coefficient:

Cedrus atlantica → Sequoiadendron giganteum → Cupressus macrocarpa → Pinus pinea → Abies numidica → Sequoia sempervirens

Table 1

Archytechtonics, light structure and characteristics of arboreal introducents crowns

Cultivar	Crown shape	Ecological structure	Light structure	Light penetration into the undercrown space in summer (sunny day)			
				Illumination, lx	$K_{v1, \%}$	$K_{pen, \%}$	$K_{v2, \%}$
Cedrus atlantica	Wide cone-shaped	Half-ornamentally crowned	Half-lighted	13196±7583	71,2	26,9±13,3	59,7
Sequoiadendron giganteum	Loose, cone-shaped, rounded to the top	Half-dense crowned	Half-shady	8243±3902	60,8	16,9±6,4	46,8
Cupressus	Flat-	Half-dense	Half-shady	4635±3976	85,8	9,4±7,8	82,5

macrocarpa	umbrellate with bias growing up branches	crowned					
Pinus pinea	Umbrella-shaped with branches growing horizontally	Half-dense crowned	Half-shady	4297±1818	58,6	8,6±2,7	45,0
Abies numidica	Cone-shaped, densely branched	Dense-crowned	shady	2772±1171	55,7	5,7±2,0	44,5
Sequoia sempervirens	Narrow cone-shaped	Dense-crowned	shady	852±313	46,5	1,7±0,4	32,3
Notes: K_{pen} – coefficient of penetration, K_{v1} and K_{v2} – coefficients of illumination and penetration variations relatively							

Illumination in undercrown space is the most variable among parameters of plantations microclimate. Regime of so-called "patches of sunlight" is of great importance to determine the illumination conditions [3, 15, 19]. In case of "patch of sunlight" regime light fluctuation grounds often illumination change. Periods of contrast illumination are rated by changes in every point from 1 to 10 000 lx per every 10 minutes [17]. On a sunny day at about noon o`clock variation of solar radiation penetration coefficient, allowing for minimal wind velocity, under the *Cupressus macrocarpa* crown layer made 82,5, while coefficient of variation less than 33%, typical for homogeneous population, was registered only under dense shady crown of *Sequoia sempervirens* (see table 1).

Figure 1 gives some ideas about illumination in tree undercrown space. We supposed that illumination degree depends upon crown length and density along vertically above different points in undercrown space. Due to cone-shaped crown of *Abies numidica* its length from a stem to the edge evenly decreases what causes gradual gain of illumination (fig.1, curve 3). In spite of illumination going up from a stem to branch, transmission of light through crowns of *Cupressus macrocarpa* and *Sequoiadendron giganteum* differs a bit. Than further from a stem, from 2 to 3 m, in undercrown space of *Cupressus macrocarpa,* than illumination level is almost double higher, it rises from 7 to 14% (fig.1, curve 2). Such a regime of illumination is easily explained by flat-umbrallate shape of crown with huge directed up branches. Approximately at the same distance from a stem in undercrown space of *Sequoiadendron giganteum*, as opposite to *Cupressus macrocarpa,* a slight reduction of illumination level is registered (0,6-0,8% less, see fig.1, curve 4). Most probably it`s caused by growth of crown density, evenly branched tree structure with thin shoots. Considerable differences in illumination regime are fixed for *Cedrus atlantica* and *Pinus pinea,* in comparison with previous cultivars (fig.1, curves 1, 6). Depending upon crown architectonics, the most illuminated area for *Cedrus atlantica* is undercrown space, distant from a stem for 2-3 m (32%), *Pinus pinea* – 1-2 m 10-12%). The least illuminated zones of *Cedrus atlantica* were areas under crown edge and periphery, distance from a stem is 4-5m, while for *Pinus pinea* the lowest point of illumination level was near-by a stem and under crown edge (6-7%). Extremely low illumination in undercrown space of *Sequoia sempervirens*, that doesn`t exceed 2-3% from its parameter on an open area (fig.1, curve 5) is caused by dense narrow cone-shaped crown and considerable absorption ability of dark conifer, mainly located in top and external crown parts, by its low growing from the ground, what reduces side illumination level in undercrown horizon.

Therefore, shady crown effect creates special illumination regime in undercrown space of top layer, what becomes apparent in zone of permanent and variable shade in phytogenous field of *Cedrus atlantica, Sequoiadendron giganteum, Cupressus macrocarpa, Pinus pinea, Abies numidica* and zone of permanent shade only for *Sequoia sempervirens*. In this case higher absorption ability of dark conifer should be considered. Among study conifer cultivars the highest penetration ability is fixed for *Cedrus atlantica* (26,9%), the lowest - *Sequoia sempervirens* (1,7%). Unfavourable conditions for the second layer plants are created just in undercrown space of *Sequoia sempervirens.*

Weather conditions are of great importance for illumination parameters in undercrown space. In a cloudy day illumination in forest undercrown space 3-5 times less and better unchangeable in comparison with illumination on an open place [8, 15, 16]. Some balancing of extreme illumination values take place. All these facts indicate the complication and variety of radiation conditions for all layers of plantations. That`s why, according to opinions of some authors, illumination conditions are not correlated with such parameters as density of canopy, absolute forest stand, thickness [4, 6]. Determined, according to these or those origins, correlations of illumination under forest canopy with canopy structure are considered just in particular cases [4, 7, 15].

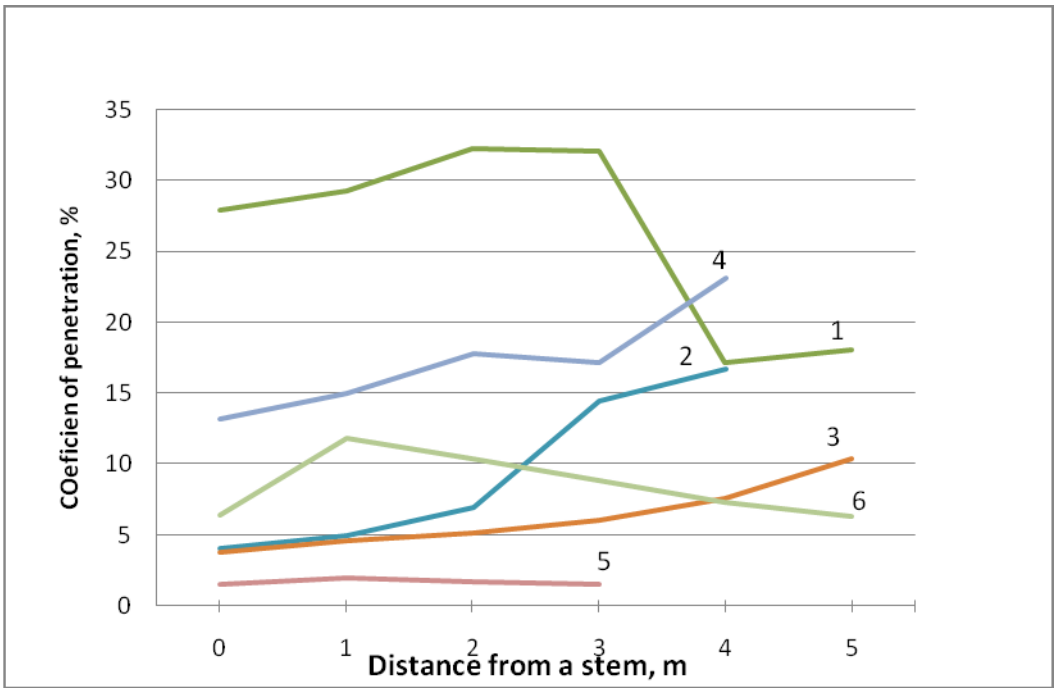

Fig.1 Illumination changes in phytogenous field of arboreal plants within Arboretum of Nikita Botanical Gardens

Tree cultivars: 1 - *Cedrus atlantica*; 2 - *Cupressus macrocarpa*; 3 - *Abies numidica*; 4 - *Sequoiadendron giganteum*; 5 - *Sequoia sempervirens*; 6 - *Pinus pinea*

Method of three-factor dispersed analysis was applied to reveal common tendencies of illumination changes in undercrown space of study trees of top layers level within Arboretum of Nikita Botanical Garden, which are grounded by cultivar effect, cardinal points, distance from a stem and possible combination of their interaction. Under crown of every of six conifer exots 768 measurements of illumination were carried out. Measurements were conducted close to a stem and on distance 1, 2 and 3 m far in northern, eastern, southern and

western directions (N, E, S, W). Figure 2 presents dynamics of average values of illumination coefficient according to cardinal points and distance from a stem. It`s possible to follow consecutive increasing of illumination level as removing from a stem and sharp increasing from southern side near-by a stem and gradual effect smoothing of cardinal points as far as remove from a stem. At the same time within a radius of 3 m tendency of maximum illumination under crown from southern side and minimal from western side is keeping on.

To create a complete factor model we applied a method that makes crossed decomposition of squares sum, marks out principal factors, all effects of their couple interaction and effect of joint action of all three factors:

$$Y = m + A + B + C + A*B + A*C + B*C + A*B*C + e,$$

where,

Y – coefficient of illumination penetration, %

A – plant cultivar, B – direction according to cardinal points, C – distance from a stem, m; e – effect of random factors; m – general average value; symbol "*" connects factors, for which effect of interaction is calculated.

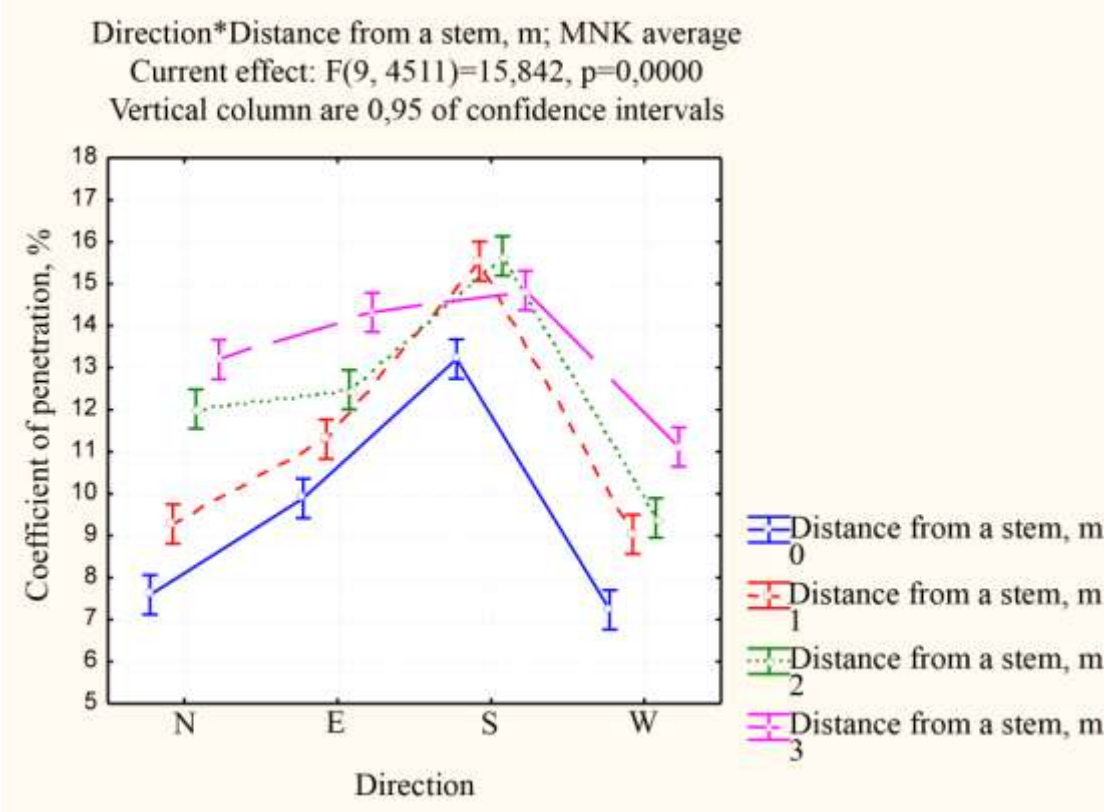

Fig.2 Correlation of illumination condition in the phytogenous field of arboreal plants within Arboretum of Nikita Botanical Gardens with cardinal points and distance from a stem (there are average values and their usual mistakes)

Calculation were carried out due to program STATISTICA, version 6.1, package Analysis (Factorial Yes). Results of dispersal analysis are presented in table 2. Coefficient of multiple correlation of the model R=0,95, while coefficient of determination R^2=0,90, dispersal ration of Fisher Fcommon=429 having 4511 degrees of freedom; statistic

importance of factorial model in general p=0,00. Presented in table 2 results certify that all these effects gained in out research, are of great importance for statistics.

Table 2

Result of effects dispersal analysis of combined impact of plant cultivar, direction according to cardinal points and distance from a stem on illumination in undercrown space

Source of changeability	SS	Degrees of freedom	MS	F	p
1	2	3	4	5	6
Free member	623350,4	1	623350,4	37877,97	0,00
Cultivar	410070,8	5	82014,2	4983,60	0,00
Direction	20038,1	3	6679,4	405,87	0,00
Distance from a stem, m	9612,4	3	3204,1	194,70	0,00
Cultivar*Direction	176773,7	15	11784,9	716,11	0,00
Cultivar*Distance from a stem, m	12166,6	15	811,1	49,29	0,00
Direction*Direction from a stem, m	2346,4	9	260,7	15,84	0,00
Cultivar*Direction*Distance from a stem, m	40084,7	45	890,8	54,13	0,00
The rest	74236,7	4511	16,5		

Effect of the model separate components on illumination level in undercrown space could be characterized due to results, presented in table 3. Dispersal analysis proves that dominant impact in creating the illumination regime in undercrown space is caused by genotypical peculiarities of a cultivar. At the same time it shows considerable mutual influence of cultivar and direction (according to cardinal points) on illumination level. Impact of the rest model components is insignificant.

Table 3

Matrix of dispersions/covariations of intergroup effects of a plant cultivar, direction according to cardinal points and distance from a stem on illumination level in undercrown space.

Source of changeability	Coefficient of penetration, %
Cultivar	89,02970
Direction	4,35044
Distance from a stem, m	2,08694
Cultivar*Direction	38,37901
Cultivar*Distance from a stem, m	2,64147
Direction*Distance from a stem, m	0,50943
Cultivar*Direction*Distance from a stem, m	8,70271

Illumination condition and luminosity of penetrated light under the plantation canopy depends to a large extent on season [11,15]. One of the key factors of climate is a stream of solar radiation that depends upon plantation structure, soil composition, age, density, age structure of the top layer. Illumination conditions, created by dominant cultivars, determine special diversity of cenoses. Cultivars-edificators plays a principal role in creating special environment around some specimens and totally, their influence mainly defines their views [14]. That`s why changes of illumination conditions in seasonal rhythm emphasizes role of arboreal plants for phytoclimate creation in undercrown space. Phytoclimate of plantations is mainly determined by character of energy reaching the canopy profile. Seasonal regularities of transmission capacity of top layer conifer cultivars are presented at figure 3.

Reflection and absorption of the main part of photosynthetic active solar radiation (PAR) by plants of top layers having a large crown density provide minimum light stream for plants of lower layers, and light-requiring cultivars are not available to grow in spite of other favorable conditions. Researches revealed that undercrown space of *Sequoia sempervirens* gets on average 2-3% of solar radiation reaching the open place, that is almost all PAR is absorbed, season doesn`t matter. Considerable differences at illumination penetration in winter and summer period weren`t found out for *Pinus pinea* undercrown space: 8-9% (fig.3). Undercrown space of other cultivars *(Cedrus atlantica, Sequoiadendron giganteum, Cupressus macrocarpa, Abies numidica*) got 5-11% much in summer than in winter (fig.3). Perhaps in case of conifer plants it`s caused by canopy structure and height of solstice.

Therefore arboreal canopy of study conifer introducents during a year has the following average data of solar radiation penetration: *Cedrus atlantica* – 16-27%, *Sequoiadendron giganteum* – 11-17%, *Cupressus macrocarpa* – 3-14%, *Pinus pinea* – 8-9%, *Abies numidica* – 4-8%, *Sequoia sempervirens* – 2-3%.

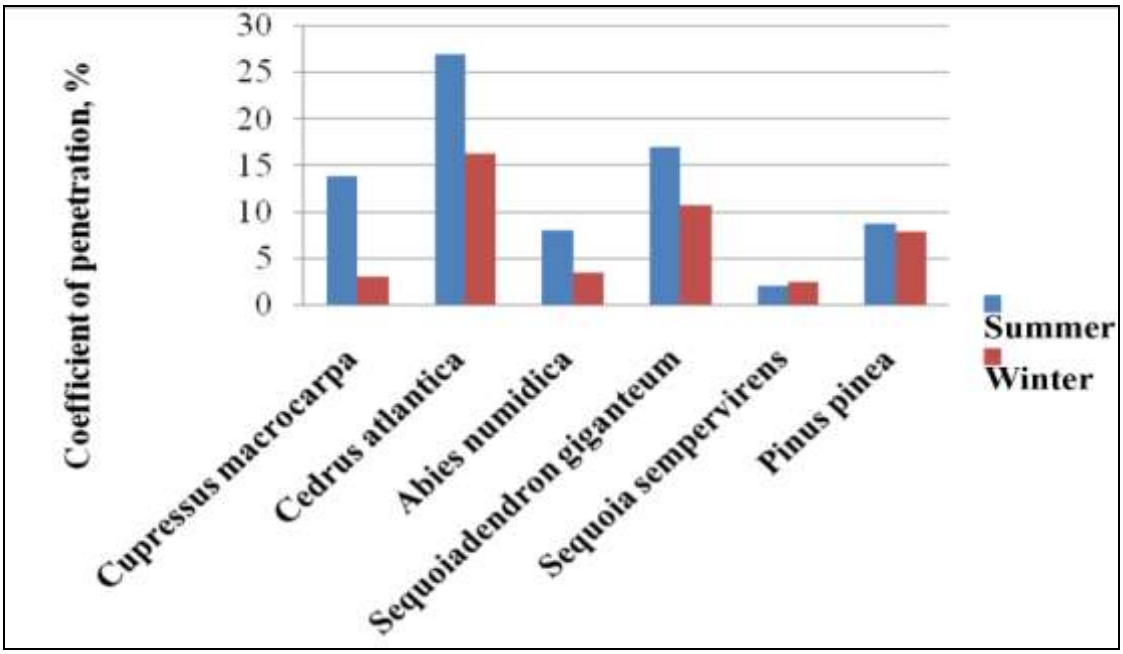

Fig.3 Seasonal variations of solar radiation penetration within canopy of top layer conifer cultivars

Investigation of breeds shade tolerance, peculiarities of their illumination regime are of great importance for cultivars and breeds matched for plantation to create landscape compositions. Shade tolerant plants possess wide ecological amplitude as to light conditions, as they are more comfortable in conditions of good illumination, but at the same time can adapt to low-light; such plants could be divided into more and less shade tolerant plants. Less shade tolerant arboreal plants (light-requiring) are considered trees and bushes growing on the open areas without tolerance to prolonged shading. Photosynthesis of study breeds gets the highest level under conditions of high illumination. This group includes: *Betula, Salix, Larix, Populus tremula, Juglans regia, Robinia, Pinus, Fraxinus.* Trees and bushes tolerant to slight shadowing, but well growing under conditions of high illumination as well are shadow tolerant arboreal plants. The highest rate of photosynthesis is typical for cultivars with 0,1-0,01 of complete solar illumination. The most shade-tolerant cultivars are: *Taxus, Abies, Buxus, Fagus, Carpinus, Siberian cedar, Tilia, Pices, Acer, elm tree, Viburnum, Euonymus, Prunus laurocerasus, Aucuba japonica, Corylus* [9,13]. Minimum illumination, that gets leaves makes the following portions from the total solar illumination: *Larix* – 1/5, *Fraxinus* –

1/6, *Betula verrucosa*– 1/7-1/9, *Populus tremula* – 1/8, *Pinus*– 1/10, *Quercus* – 1 /20, *Pices* – from 1/9 till 1/32, *Acer* – 1/55, *Fagus* – 1/60, *Buxus* – 1/100 [13].

Due to character of shoot location, degree of bush compactness, peculiarity of place and optical leaves properties, illumination within inside part of phytogenous field of study lower layer plants in August-September fluctuated from 0,6-0,7% (*Chimonanthus praecox, Buxus sempervirens)* till 2,6% *(Cornus mas)* of the total illumination (table 4).

Table 4

Physiological characteristics and illumination condtions of lower layer shrubs

Cultivar	Life form	Crown structure	Crown shape	Light penetration, % into undercrown space (sunny day)	
				summer	winter
Pittosporum heterophyllum	Evergreen	Friable	Inversely egg-shaped	1,4±0,6	1,6±0,6
Buxus sempervirens	Evergreen	Dense	Inversely egg-shaped	0,7±0,1	2,5±1,0
Euonymus japonica	Evergreen	Friable	Inversely egg-shaped	1,7±0,7	3,5±1,7
Mahonia aquifolium	Evergreen	Friable	Globular	1,5±0,2	4,4±1,7
Chimonanthus praecox	Deciduous	Close	Branchy	0,6±0,1	1,1±0,4
Viburnum tinus	Evergreen	Friable	Inversely egg-shaped	1,5±0,3	5,7±2,3
Cornus mas	Deciduous	Friable	Branchy	2,6±0,4	36,2±9,9
Laurocerasus officinalis	Evergreen	Friable	Branchy	1,1±0,5	6,9±2,6
Aucuba japonica	Evergreen	Friable	Inversely egg-shaped	1,0±0,2	2,0±0,5

In comparison with arboreal conifer cultivars, light penetration into undercrown space of lower layer shrubs in winter period (December) was higher, than in August – September either under evergreen plants or deciduous tree cultivars of top layer (fig.4).

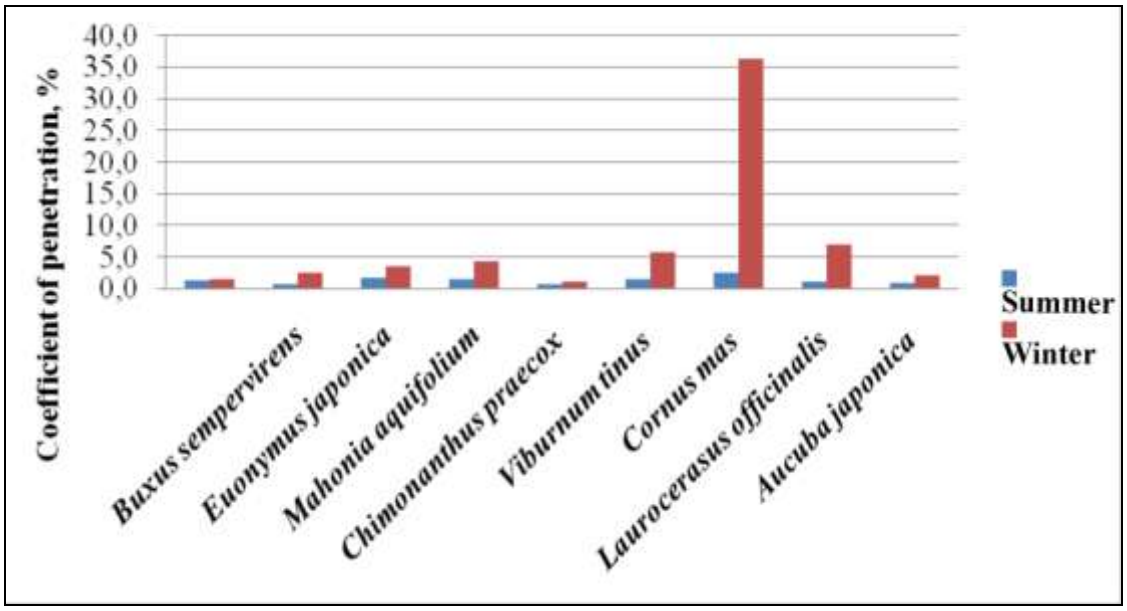

Fig.4 Seasonal variations of solar radiation penetration under canopy of lower layer plants

At the same time absolute values had some differences. *Pittosporum heterophyllum, Buxus sempervirens, Euonymus japonica, Mahonia aquifolium, Chimonanthus praecox and Aucuba japonica* which grow under crowns of evergreen trees penetrated into the undercrown space solar radiation only 0,2-2,8% as much, while *Viburnum tinus* and *Laurocerasus officinalis* growing under deciduous trees - 4,2-5,8% as much. The most considerable changes of illumination conditions within inside part of phytogenous field was registered for *Cornus mas*, a deciduous shrub, growing on an open area. The average penetration of its crown made 2,6% on a sunny day during the period of a total foliage, but after leaf fall it reached 36,2% (see table 4).

Research results indicate the complexity and variety of radiation conditions for all layers and depend upon species composition, age and density of stands of trees. Percentage of solar radiation capable to reach the soil surface within plantation, mainly depends upon plantation structure, its distribution across the canopy profile. Analyzing these data, it makes possible to conclude that transformation character of the light stream by lower layer plants depends on development of photosynthesizing apparatus within both layers (either top or lower layers).

Conclusions

1. Arboreal plants of the top layer with a high crown provide rather better conditions for lower layers due to side illumination.
2. In summer light stream of the study conifer exots besides *Sequoia sempervirens,* ranges from 8 till 27% from the total illumination what causes quite favorable conditions for soil cover plants.
3. More severe conditions according to this parameter are fixed for shrubs, which illumination of soil horizon makes from 1 till 3 % from the total light stream.
4. Degree of the light penetration that characterizes regime of light climate in undercrown space, is mainly determined not only by environmental parameters but genotypical peculiarities of a cultivar with its special crown architectonics.
5. Due to shady crown effect a special light regime occurs that is zones of permanent and changeable shadow within phytogenous field of plantations. The way of light stream transformation in the top layer undercrown space could be considered as a criterion of plant matching for the second layer according to cultivar shade tolerance.
6. Conducted researches essentially added information about phytogenous field of some plant cultivars. They are possible to use for theoretical base development in plant ecology and ecology of forest phytocenoses.
7. Results of the given research can be applied during planning and creation of single and group tree plantations in landscape and other compositions under conditions of introduction on South Coast of the Crimea.

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Light conditions of undercrown space where woody plants grow (15 cultivars) were analyzed in terms of Arboretum of Nikita Botanical Gardens. As a result of crown shady effect created by overwood plants, specific light conditions are formed in undercrown space, that causes formation of zones with permanent and variable shadow in phytogenous field of *Cedrus atlantica, Sequoiadendron giganteum, Cupressus macrocarpa, Pinus pinea, Abies numidica, Sequoia sempervirens.* In frost-free season light stream of study alien plants, besides *Sequoia sempervirens,* ranges from 8 up to 27% from total illumination supply, what is favorable for growth of shrubby plants. Light pellucidity which characterizes light climate in undercrown space, is mainly determined by environmental factors, genotypical features of the cultivar with its typical architectonics of crown. Transformation character of the light stream in undercrown space is a possible criterion for selection of the second layer plants according to cultivar shadow tolerance.

Key words: *light conditions; phytogenous field; undercrown space; overwood trees*.

ECOLOGY

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ECOLOGICAL PROBLEMS OF LANDSCAPES IN NEARBY SIVASH REGION

Fyodor Fyodorovich Adamen[1], Yury Plugatar[2], Alyona Fyodorovna Stashkina[1]

Department RAS in cooperation with scientific organizations of the Crimean federal district
295000, RF, Republic of the Crimea, the city of Simferopol, 5, Oktyabrskaya str.
vitainviva@ukr.net

Nikita Botanical Gardens – National Scientific Centre, the city of Yalta
298648, Republic of the Crimea, Yalta, urban vil.Nikita
plugatar@ukr.net

Introduction

Basic of stable and efficient agricultural production is rational soil and water use having constant control of evolutional environmental changes.

Control of soil fertility dynamics is necessary to accomplish guided not only by culture productivity but dynamics of humus concentration and soil saline regime. Therefore principal task with further positive effect on soil fertility is science-based reclamation work, keeping and storage of organic substances what is caused by culture introduction into agrocenosis that contributes to soil fertility. These requirements are satisfied due to plant root systems what has been so far impossible to replace by other measurements.

Salinization and desalinization prevention of grounds with higher standing mineralized waters remains extremely urgent problem especially these soils and ground water contain natural storage of readily soluble salts, that due to ground water rising could be a source of their deposit in root layer. The problem becomes more complicated as different regions of melioration have differences at climatic conditions, soil cover, hydrological conditions and vegetation.

Besides soil fertility reduction as a result of resaliniation, increasing the alkalinity, sodium formation, alkalinization are hard-reversible phenomena, demand huge expenses and applying the chemical irrigation as well.

That`s why strict control after qualitative and quantitative composition of getting out and keeping in soil salts and nutrients, reliable methods of their prognostication based on analysis of peculiarities of engineering irrigation systems and total diversity of natural conditions where irrigation occurs.

Near-by Sivash region is the most subjected to anthropogenic load area within Republic of the Crimea.

Reduced complex alkaline steppe or actually near-by Sivash region takes a beginning off-shore Sivash and Karkinitsky bay and runs out on the territory with points 30-40 m above the sea level. On the area of this soil and climatic zone there are farms of Krasnoperekopsky (besides its southern part), near-by Sivash part of Dzhankoisky, Nizhnegorsky, Sovetsky and Kirovsky regions.

Transition of low alkaline steppe into high steppe is gradual and almost un-noticeable. Soil cover of this zone is presented by dark-chestnut poorly- and medium alkaline soils. In the lower relief there are meadow and chestnut soils. Type of salinization is chloride-sulfate and sulfate-sodium. Soils of this zone are characterized by high level of water permeability and water-retaining capacity. In 1 meter layer they are able to deposit 324-365 mm of

moisture, though about half of this deposit is unavailable for plants. Dark-chestnut poorly alkaline soils possess the most favorable agrophysical properties [3].

Relief of a low complex alkaline steppe was more plain and even, than high area, in places gullies with steep waved slopes here and there can be found. Waved nature is grounded by system of ancient nowadays matted wide but not deep gullies, their slopes gradually transform into watersheds. River valleys (river Salgir, Bulganak, Indol and etc.) are not so marked on relief map, near-by the river mouth they form floodplain terraces. Coast line is a complicated combination of many bays, regularly flooded, previously mouth parts of peninsular gullies, deeply jutted out into Sivash, and alluvial islands and spits. Surface of the plain is slightly inclined to north and north-east. On the background of a common even macrorelief, in the low steppe a microrelief is quite well-marked, especially in the coastal zone.

Hydrographic system in Steppe Crimea is presented by a few of small rivers with graded plains, that getting full of current water in spring and dry up in summer. The most major by length is the Salgir river and river-gully Chatyrlyk vanishing nowadays. In western near-by Sivash region there is a large group of saline lakes (Staroye, Krasnoye, Aigulskoye and etc.), lengthened along the meridional direction and isolated from the sea. Lakes have abrupt banks from 3 to 10 m. Lake depth ranges during a year from 0,2 till 0,5 m. Salt replenishment happens due to surface flow and underground waters, that have outlets all over the whole lakes square within coastal cliffs [2].

In Steppe Crimea underground waters are united into one water-bearing horizon that increases its level as far as close to Sivash, everywhere spread, generally inclined from south to north and north-east. At the joint with coastal zone of near-by Sivash region there is back up of underground waters by Sivash water, where there level rises reaching 1,5-0,5 m deep near Sivash and Karkinitsky bay coasts, - occurrence of neutral hydro-isohypse not far from the coast is a certain proof (table 1).

Table 1

Balance of underground waters on different elements of relief (Krasnoperekopsky region RC)

Datum	Average depth of underground waters	Balance elements m^3/day.		±
		inflow	outflow	
More than 7 m	1,50	0,0089	0,0148	-0,0059
4,3	1,20	0,0148	0,0151	-0,0003
2,3	1,0	0,00013	0	+0,00013

The main points of underground water flow rate are evaporation, human use and partly – outflow. Water regime of near-by Sivash region is closely connected with a number of environmental parameters that can intensify or reduce its rate. These factors are atmospheric precipitation, irrigation, underground water, river waters, canals filtering; they replenish moisture reserve in soil. Its consumption is accounted for other factors: evaporation, transpiration, underground outflow, drainage. The problem is complicated by considerable differences in relief, soil cover, hydrologic conditions, vegetation within different irrigation regions

As far as underground waters reach ground surface level of their mineralization increases from 3-5 g/l till 20-60 g/l or more. At the same time chloride concentration of underground waters goes up.

As a result of natural rising of underground waters level the importance of ground flow in soil formation is various. Within territory with high hypsographical levels (high steppe, raised areas of a low steppe), where underground waters are deposited deeper than 10 m from ground surface, they are not so considerable in process of soil formation, but they

transfer salts, leached out of soil and rocks, and get away from that region to Sivash coast. Therefore underground waters contribute to salts outflow from uplands soils favoring their desalinization. And vice versa in places with low hypsographical level, where underground waters possess high concentration of mineral substances and reach the ground surface, they cause soil salinization. [1] As far as underground waters get critical level (critical depth of deposit 0,5-1,5m) it makes possible to use them intensively for evaporation and transpiration. As soon as water balance gets point when water consumption is more than income (precipitation, irrigation water and underground inflow), the process of resalinization begins. Water regime of soils is closely connected with a number of environmental parameters, capable to intensify or reduce its fluctuations. They are natural climatic conditions.

Climate of lower complex alkaline steppe is extremely dry. Hydrothermal coefficient, rate of precipitation to evaporation, is 0,47-0,50. Average temperature of the coldest month January is 2,20° below zero, frost -19-21°C are registered in 50% of winters, absolute minimum 29-31°C below zero is possible in 5% of winter periods. Depth of frost penetration gets 30-70 sm. Cold season (period with daily average air temperature below zero) lasts 75-80 days. Vegetative thaws ("winter windows") occur in 15-20% of winter periods. Annual temperature sum above +10°C makes 3360°C.

Autumn frosts happen in the third decade of April. Free frost period includes 186 days. Annual average temperature is about + temperature 10°C. The warmest month is July (annual average temperature +23). In some years day temperature gets +40-42°C.

Annual precipitation sum in western zone makes 340, in eastern – 445mm. During period with air temperature above +10°C (time of intensive crop vegetation) it falls 195 and 205mm. June is a month with maximum amount of precipitation – 45mm, in March this number gets minimum point – 22mm.

Continentality and aridity of climate in this region gain strength due to wind regime. Dry winds of north-east direction - 47% and wet winds of west direction – 39% prevail in this zone. Winds with velocity of 15m/sec occur often here, what dry soil extremely. In summer there are 13-17 days with hot dry winds. Drought frequency in western part of the zone is 50-60%, in eastern – 40-50%. During vegetative period water balance with area of dry steppes is negative. In July-August deficit gets the highest point.

Soil and climatic conditions of Lower complex alkaline steppe are considered rather severe. The principal reason of ecological problems is climatic and anthropogenic impact on environment by the way of geological space alienation, changing the properties of geological environment, changing the surface shape and drastic changing the hydrodynamical and hydrogeochemical situation caused by water cut by North Crimean canal.

Among soil forming rocks of near-by Sivash region yellow-red loess-like loam soils and light clays prevail. Distinctive feature of loess-like loams is their porosity (40-45%), comparatively small weight – 1,2-1,45 sm^2, occurance of carbonates (10-22% CaCO – salinity). Granulometric composition of forests is variable. In near-by Sivash region light clayey, silty-pulverescent variations that contain 60-70% of clay fractions, that`s why soils of this region are subjected to wind erosion, cracking, silting. Discharges of chemical plants, located in the region, increase concentration of heavy metals and polluting substances in the upper soil layer. Process of soil fertility loss is worsened by anthropogenic impact. The first anthropogenic load on landscapes of near-by Sivash region occurred in period of construction and exploitation start of North Crimean canal accompanied by system of water intake and drainage in 70-90s last century, the second one happened in 2014 when Ukraine cut water supply by canal.

Area of North Crimean irrigation system of the near-by Sivash region is located on Pliocene terrace, irrigation and underground waters of its north part deposit rather close to ground surface, what is favored by general drainlessness of the area. Besides active practice

of paddy sowing caused underflooding and raising the water level in the Sivash lake. Horizontal drainage constructed on a big area improves reclamative situation, but irrigation and underground waters deposit here quite close about 3-5 m deep. Before irrigation system was set up underground waters in the Crimean near-by Sivash region were saline by neutral salts, sodium wasn`t fixed. As far as irrigation process develops sodium occurred in irrigation and underground waters, though it wasn`t found out everywhere, but sporadically. Therefore conclusion comes to mind: though sodium in irrigation and underground waters didn`t occur within every irrigated area, but sporadically, in general it`s typical for the whole Black sea coast, what wasn`t registered before irrigation system started up. That`s why based on study processes going on in soils of Ingulets irrigation system after irrigation had stopped on some crop rotations and within Spanish areas requiring irrigation, especially on Castillo plateau, in Andalucía and Aragón, where saline ground is developed as well as mineralized underground waters in range, a supposition takes place that in soils of near-by Sivash region process of sodium occurrence in underground waters, transfer into soils and their resalinization are quite possible.

It`s necessary to determine correlation between dynamics of salts and moisture as salt migration and accumulations mainly occur in aquatic environment therefore if not to consider characteristics of this environment regime it`s impossible to explain process of salt accumulation and work out measurements to prevent it. In soils of near-by Sivash region circulation of soil solutions in the main part of soil profile doesn`t stop in winter. There is a frequent change of soil frost penetration and defrosting, falling precipitation in winter-spring period (about 150-160 mm) are absorbed by soil and moisten it till 100 sm deep or more what rises underground waters level.

According to our observations maximum rising of underground waters level happens in spring time. As far as air temperature goes up intensity of evaporation from the soil surface increases. Evaporation process depends upon temperature and humidity of air and soil, wind strength, vegetation density, area relief, degree of soil structural properties and level of underground waters deposit.

Therefore moistening is principally seasonal process. In autumn-winter-spring time landscapes are subjected to washing out that is salts gravitational transfer. In spring-summer period having active evaporation process rising capillary currents of moisture and salt accumulation in the upper profile layer prevail.

Within landscapes with close surface underground water deposit evaporation value gets critical parameters in late spring and early summer, what increases salt concentration in soil strata. When North Crimean canal functioned, poorly mineralized waters on irrigated areas reduced salt concentration in soil under washing out regime. But now for lack of irrigation in this region productive desalinization of soils isn`t possible due to summer precipitations only. As the aqueous and salt balances present difference between total income and consumption of water and salts, equal to variations of their deposits within a certain soil difference during particular period of time it can be expected that annual concentration of salts in the upper horizon of soil will increase and soon resalinization will make impossible to cultivate majority of field crops in this soils.

North Crimean canal stretches along the whole near-by Sivash region, along its border on hypsometrical points of 30-40 m above the sea level with the total length on this territory about 300 km.

Such natural and practical organization predetermines way of certain processes, particularly development of regional current of filtering water loss from the main canal (up to 450 mil m^3 per year) that causes natural load (Sivash lake). Besides according to project irrigation water discharge into these receivings waters was provided (emergency discharge,

water discharges from puddlings and etc.) what was flagrant violation of nowadays ecological demands.

But along with shallow discharges there is regional underground flow, its velocity and consumption are determined by inclination and granulometric rock composition. particularly power of quaternary rocks makes 25-40 v, they are poorly pervious and saline (till 2% of salts). Than closer to Sivash than velocity of side stream becomes lower, while underground waters level goes up since 8-10 m till 0,5 m from the soil surface (flow rate is 0,1 l/sec/km^2).

At points 4-5 above the sea level velocity of side stream and rising flows becomes equal and water discharges into atmosphere. Allowing for mineralization of underground waters ranges from 7 to 21 g/l, irrigation extinction and disability of soil washing out regime will cause immediate salinization of arable layer if watering (approximate area is 108 thousand hectars) and as a result reduction of crop capacity in the near future (2-3 years). In 5-6 years this area will occupy 30-40 % as much [3].

Possibility for areas previously being irrigated to get saline is extremely urgent problem, especially these soils, grounds and underground waters contain natural deposit of freely soluble salts, which in case of underground waters level rising up could become a source of their accumulation in root-inhabited layer. Moreover decreasing of soil fertility caused by resalinization, alkalinity, sodium formation are hard reversible phenomena, demand a lot of time and funds and applying the chemical amelioration as well.

Based on methodic of V.A. Kovda (1954), that suggests to carry out assessment of seasonal salinization allowing for coefficient of salt seasonal accumulation, which presents correlation of autumn concentration to spring one. If this coefficient is “one”, seasonal salinization doesn`t occur. In case it is more than “one” seasonal salinization takes place, but if it`s less than “one” we are talking about desalinization. Analyzing results of stationary observations for aqueous-salt regime in near-by Sivash region it`s possible to conclude that for 2014 this coefficient is more than “one” and seasonal salt accumulation was registerd. Unfortunately, in 2015 researchers of the Crimean agrotechological University, department of agriculture, didn`t have any admission to most stationary objects.

At the same time importance of these investigations is undoubted and carrying out of stationary researches needs to solve the following problems:

- to conduct qualitative and quantitative assessment of soil salt composition and point out borders of geographical distribution of possible resalinization;
- to find out character of soil aqueous-salt regimes, caused by irrigation extinction;
- based on direction of salinization processes to determine volume and measurements in chemical and agrotechnical soil melioration;
- to define drainage system efficiency, its impact on outflow of strongly mineralized underground waters.

CHARACTERISTICS OF SOIL ECOLOGICAL EVOLUTION IN CASE OF RICE CULTIVATION IN NEAR-BY SIVASH REGION

Rice irrigation systems with total area of 30 thousand hectares are located in the most unfavorable conditions at points of 12,0-1 m above the sea level and only about 10% are in high-water bed of the Salgir river with relatively free-salined soils.

As rice is cultivated by means of submersion, the field should be thoroughly flatted (±5 sm). While constructing the field was divided into maps, each map was divided by cross shafts into puddlings of 2,5 ha. According to hydrotechnical system, water supply is provided to puddlings and drainage system directs it from the field by canals. Majority of rice canals was built in earthen channel and just a few of them in concrete slabs or in trays. Drainage system is totally organized in earthen channel.

Through the whole area of irrigated rice systems the main soil top horizon was shifted, fertile soil layer is used for road construction as well, puddling, walls of canals. Therefore building of rice map-basins caused anthropogenic load and brought to the total vanishing of natural landscape characteristics.

Before paddy culture areas, allotted for rice growing, belonged to continental type of annual variation of precipitations with arid climate (humidity factor – 0,38-0,42), drought, hot-dry winds, duststorms and automorphic regime of soil formation. Along coasts of sea bays alone salted and extremely salted chloride-sodium underground waters were involved into process of soil formation, loess-like loams on the rest territory were waterless [4].

While rise irrigation systems were in use level of underground waters mineralization was decreasing. In early years of irrigation salt concentration rose in underground waters of meadow saline soils only, but there were no any changes in ground waters under the rest types of soils. It should be noted that in 2010 concentration of sodium cations increased in underground waters for all soil types, rate of underground water desalinization reduced as well. According to Titkov`s opinion (2011), it`s caused by mineralization reduction 3-4 times less in comparison with initial level.

Qualitative parameters were closely connected with genetic soil type, what was keeping up during the whole period of rice growing, though ion composition has some variations. On the background of general reduction of underground water mineralization under all soil types their composition is various according to content of Na_2S0_4 and $MgS0_4$. All soil types are characterized by stabilization of the general alkalinity, calcium sulphate and sodium chloride almost vanished out of solution, but content of Na_2S0_4 increased especially on meadow saline soils. Before irrigation process was launched this salt wasn`t presented at all in saline soils, but 20 years after it became a basic component (90% of total). Besides concentration of salts, washed out of principal soils of near-by Sivash region under rice culture, has considerable variations (table 2).

Rice cultivation was desalinating soils during 50 years just in upper soil layers (dark-chestnut soils), the rest territory didn`t have any considerable changes in soil salt concentration, but qualitative composition became different (at present 90% is toxic salt Na_2S0_4), content of calcium sulphate and sodium chloride dropped out at all.

Nowadays within area of paddy fields it`s possible to grow any cultures, but as far as water regime changes, from descending to ascending, process of resalinization will begin almost all over the whole territory of rice irrigated systems, but with different rate. It means that on soils of saline type (there about 200 thousand of hectars in near-by Sivash region) soil degradation can be launched up to removal out of agricultural industry, that is transition from cultivated soils to their previous natural condition.

Table 2

Total concentration of salts (mg-equivalent per 100 g of soil), washing out of principal soils within near-by Sivash region under rice culture

Terms of sampling	Depth of sampling				
	0-20	20-50	50-100	100-150	0-150
Dark-chestnut soils					
1964	0,09	1,65	4,41	10,46	17,51
2010	0,20	0,18	0,190	0,26	0,83
± to initial	-0,79	-1,47	-4,22	-10,2	-16,68
% to initial	79,8	89,1	95,6	97,5	96,3
Meadow-chestnut soils					
1964	2,32	3,27	5,12	9,59	20,3
2010	2,95	3,65	3,53	11,79	21,92
± to initial	+0,63	+0,33	-1,59	+2,50	+1,62

% to initial	127,1	111,6	67,7	122,9	107,9
Meadow saline soils					
1964	2,72	3,81	5,18	7,19	18,9
2010	3,73	4,70	4,99	8,68	22,1
± to initial	+1,01	+0,89	-0,19	+1,49	+3,2
% to initial	137,1	123,3	96,3	120,7	116,9

Therefore it can be concluded that irrigation by landflood, to grow rice culture, changed soil salt composition in dark-chestnut and very saline soils dramatically for quite long period since rice irrigated systems on these soils started to work. In spite of long washing out period on paddy fields the problem of soil and ground resalinization is still urgent even after 40 years because of close to surface deposit of high-toxic underground waters. Extinction of water supply to paddies, having close to surface deposit of mineralized waters, anyway causes soil resaliniation.

It should be considered that Lower complex saline steppe, according to data of

E.A. Ryshes (1967), V.A. Kovda (1967), Ye.V. Lvov (1982), A.A. Titkov (2011), is an object of salts accumulation and simultaneously zone of mineralized solutions discharge, which deposit in the ground strata and underground waters. These properties made construction of irrigated-drainage systems in nearby Sivash region necessary.

Though in recent years there are some disorders in natural process of water and salt exchange, especially on soils with lack of underground natural flow-out that cause changes in mineralization of underground waters, rehead, strengthening of salt accumulation, development of area resalinization and intensification of salt inflow into Sivash due to high level of mineralized underground waters.

At the same time worsening of reclamation condition within area of near-by Sivash region occurs as a result of administration breach at drainage systems operation and disability to maintain working state of this complicated complex, that`s why efficiency of irrigated-drainage systems reduced itself, especially it concerns inhouse systems. Unreasonable technique and economical decisions at melioration speeded up ecological disbalance in this region.

No matter that renewal of irrigation of areas in near-by Sivash region from North Crimean canal is the only way to keep ecological balance here, it`s necessary to launch a number of large-scale melioration events on saline areas as soon as possible:

1. To create system of experimental-industrial areas all over the irrigated territory of near-by Sivash region, where it could be possible to conduct fieled observations of ecological-reclamative processes and manage them.
2. To carry out reclamation works of irrigated-drainage systems, that control water-saline regime of soils.
3. Annually gypsuming of soils to keep and improve their fertility.
4. To grow plants with fibrous root system and relative resistance to saline soil (wheat, flax oil, safflower and etc.) and permanent grasses (alfalfa, esparcet, tall-fescue, payza and etc.) on areas with high level of underground waters deposit.
5. At government level to manage the point of water supply resumption in North Crimean canal.

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This article deals with ecological problems of landscapes in nearby Sivash region, reduction of soil fertility as a result of resalinization, increasing of alkalinity level, alkalinization. Peculiarities of soil ecological evolution while rice growing in nearby Sivash region is also studied here. A number of large-scale measurements was suggested for melioration of saline soils.

Key words: *landscapes; ecological problems; nearby Sivash region; melioration; ground water.*

FLORA AND VEGETATION

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NEW DATA ABOUT POPULATION OF A RARE PROTECTED CULTIVAR *CRATAEGUS TOURNEFORTII* GRISEB. GROWING IN SOUTH-EAST CRIMEA

Viktoriya Yuryevna Letukhova, Iryna Leonidovna Potapenko

SBE SNP RC Karadag wildlife preservation,
298188, Republic of the Crimea, the city of Feodosiya
ira_potapenko@mail.ru

Introduction

Crataegus tournefortii Griseb. (= *C. schraderiana* Ledeb.) is an east-mediterranean cultivar, being entered into the "Red Data Book of Ukraine" (category "vulnerable") [11]. It is a hybrid origin cultivar, bred of *Crataegus* of two different sections: *C. orientalis* Pall. ex Bieb. (section *Azaroli* Loud.) and *C. pentagyna* Waldst. et Kit. (section *Pentagynae* C.K. Schneid.). Recently most authors have considered this cultivar as subspecies of *C. Orientalis* [3, 15]. Other authors in opposite believe it is a separate species [9, 12, 16]. We hold the second opinion. According to K.M. Zavadsky [4], subspecies spatially exclude each other, that is an area occupied by one definite taxon cannot be inhabited by another, they just mix on the narrow border lines. In all study populations *C. Tournefortii* grows in combination with *C. Orientalis*. Besides in nature being in generative condition they have visual distinctions (table 1).

Fig. Habit view and fruits of *Crataegus orientalis* (on the left) and *Crataegus tournefortii* (on the right)

Table 1

Morphological characteristics of *Crataegus orientalis* and *Crataegus tournefortii* [2, 6]

Characteristics	*Crataegus orientalis*	*Crataegus tournefortii*
Annual shoots	Dark-brown, downy-felted	Cherry, densely piliferous-downy
Barbs	5–10 sm long	4–5 sm long

leaves	Light-green, mild downiness	Dark-green, appresed bristly downiness
Inflorescences	compact, 5–8-flowers	Loose, 6–18-flowers
Flowers	Till 20 mm across diameter	Till 15 mm across diameter
fruits	Color ranges from orange-yellow to orange-red	Dark cherry colored

Data about general distribution of *C. tournefortii* are rather conflicting. V.M. Kosyh notes that its areal is limited by the Crimea and South Transcaucasia [6]. "The Red Data Book of USSR" includes Greece as well, besides the Crimea and South Transcaucasia (Zangezur, Gorissky district, outskirts of Goris mountain) [7]. In "Flora of Eastern Europe" areal of this cultivar is presented within the Crimea, the Caucasus (Transcaucasia) and Minor Asia [12].

In the Crimea its population is registered within: Monastyrskaya mountain (close to village Rodniky, Belogorsky district), Agarmysh range (close to Stary Krym city), in hole Karagach (outskirts of Sudak). Single specimens of this cultivar are presented there, few places with small groups of plants [11]. There is information *C. Tournefortii* also grows within Karadag, Echkidag and on Tepe-Oba range [5, 13, 14].

Therefore research objective is to determine its population, geographical and coenotic belongings and reveal biological characteristics of this cultivar.

Objects and methods of the research

Study object became plants of *C. tournefortii*. Well-known populations of this cultivar were investigated and area of South East Crimea with similar phytocenoses were studied as well to find out new populations: Karadag, Echki-Dag, partly Armatlukskaya valley (nearby mountain Belaya and Tatar-Khaburga), Tepe-Oba range, outskirts of Stary Krym city and village Rodniki, hawthorn growth along highways Stary Krym-Russkoye and Sudak-Grushevka.

Quantitative composition of population was defined due to calculation of reproductive trees. The following parameters of each plant were measured: height, crown diameter, a number of stems, diameter of the largest stem.

Seed propagation of *C. Tournefortii* was researched due to methodic of I.V. Vainagy [1]. Particularly he suggested to split "seed productivity" into two notions: 1) potential seed productivity (PSP), that is a number of seedbuds per a specimen or a reproductive shoot; 2) actual seed productivity (ASP), that is a number of seeds. In this way productivity coefficient (PC) is calculated by formula: $PC=\frac{ASP}{PSP}*100$.

As a number of seedbuds in gynoecium and a number of seeds in a fruit for *C. tournefortii* are determined statistically and range from 3 to 5, seed productivity (potential and actual) was measured by elementary units, that is a flower and a fruit.

Results and discussion

As a result of our field researches occurance of populations in outskirts of Rodniki village and on Agarmysh range was proved, at the same time a new population was found out close to spring of St. Panteleimon in the valley of Churuk Su valley to south from Stary Krym city (fig.1). Population size approximately made: on agarmysh range (population 1) – 6 ha; close to spring of St. Panteleimon (population 2) – 60 ha; in outskirts of Rodniki village (population 3) – 25 ha. In spite of the largest area belongs to population 2 (its length made about 2 km, width 300 m), the biggest size of *C. tournefortii* was registered in population 3 – 38 plants (table 2). Investigations within other study areas weren`t successful.

In all three populations the cultivar is a part of shrub cenoses, located on the slope of range (population 1), along the forest edge (populations 2, 3), on clearing in the wood

(population 3). Only once *C. tournefortii* was found out in the forest. The subtend shrubs and arboreal cultivars: in population 1 – *Acer campestre* L., *Crataegus orientalis* Pall. ex Bieb., *Fraxinus excelsior* L., *Ligustrum vulgare* L., *Padellus mahaleb* (L.) Vass., *Prunus divaricata* Ledeb., *P. spinosa* L., *Rhamnus cathartica* L., *Rosa corymbifera* Borkh., *R. turcica* Rouy, *Ulmus carpinifolia* Rupp. ex Suckow; in population 2 – *Carpinus orientalis* Mill., *Cornus mas* L., *Crataegus atrofusca* Stev. ex Fisch. et Mey., *C. curvisepala* Lindm., *C. orientalis* Pall. ex Bieb., *Ligustrum vulgare* L., *Malus sylvestris* Mill., *Pyrus communis* L., *P. elaeagnifolia* Pall., *Rosa corymbifera* Borkh., *Swida australis* (C.A. Mey.) Pojark ex Grossh., *Quercus pubescens* Willd.; in population 3 – *Crataegus dipyrena* Pojark., *C. orientalis* Pall. ex Bieb., *Ligustrum vulgare* L., *Malus sylvestris* Mill., *Pyrus elaeagnifolia* Pall., *Rosa corymbifera* Borkh. Crown density of a shrub layer is rather high in all three cases – 0,5-0,6. Though, if in two cases shrubs are distributed evenly across the whole locality, in population 1 *C. tournefortii* is a part of dense growth, available in clusters on open dry slopes.

Fig.1 Locality of *C. Tournefortii* populations in South-East Crimea; 1 –population on Agarmysh range; 2 – population close to spring of St Panteleimon; 3 – population in outskirts of Rodniki village

Morphologic peculiarities of *C. tournefortii* are described by many authors [6, 12, 15]. In study populations we marked out two types of plant crown: loose and dense globular. On more moistened areas nearby gullies and dells plants reach 4-5 m high and possess loose crown; on dry stony-rubble highlands plants are no more than 1,5 m and have close location of skeletal axes and branches, shoot tops create more or less even surface, as a result crown is globular. The largest number of plants with globular crown was registered in population 1 - 5 (26,3%) of 19 specimens. Population 2 included 4 (11,8%) of 34 plants, population 3 – 2 (5,3%) of 38 plants. Besides population 3 consisted of plants with larger diameter of a stem (12,1 sm) and a height (3,3 m) than in rest both populations. As an opposite, population 1 was characterized by the smallest average stem diameter (9,9 sm) and the lowest average plant height (2,3 m) (table 2).

Table 2

Characteristic of *C. Tournefortii* population in South-East Crimea

Population	Locality	A number of plants	Morphological characteristics of plants			
			Height, m	Crown diameter	A number of stems	Stem diameter, sm

			aver.	max/ min	aver.	max/ min	aver.	max/ min	aver.	max / min
Population 1	Agarmysh range	19	2,3	5/1,5	3,4	5/2	7	14/2	9,9	15/5
Population 2	Nearby spring of St Panteleimon	34	2,7	5/1,2	3,3	6/1,5	4	20/1	11,5	24/3
Population 3	Outskirts of rodniki vilage	38	3,3	5/2	–	–	5	15/1	12,1	20/8

Therefore allowing for this fact it can be suggested that population 3 (outskirts of Rodniki village is the oldest one), the youngest – population 1 (Agarmysh range).

If population on Agarmysh range includes only deliquescent plants (from 2 to 14 stems), it means the rest two populations have monocormic trees as well. The largest number of such trees was registered in population 2 – 8 (23,5%) of 34 plants (within Rodniki village there are only 3 such specimens). We consider grazing sheep and goats impacts on formation of the monocormic trees; this factor became determining in population 2, but it wasn`t fixed in others. Goats and sheep, browsing shrubs, destroy brushwood of hawthorn, sometimes it causes changes of habitus of the whole plant (crown becomes umbrallate-shaped). Though grazing isn`t the only factor, that influences on crown formation. *C. Tournefortii* growing in outskirts of Stary Krym city on the border line with its natural areal in the Crimea, adapts to growth under extreme natural conditions (arid climate, big range of temperature variations in summer and winter periods)

In populations of *C. tournefortii* we marked out plants with small fruits. In comparison with standard fruit average size – 13,5 – 17,1 mm with flattened-globular shape of dark-cherry color, they were 10,1-10,2 mm on average with almost regular globular shape, brick-red-colored (table 3). As a rule small fruits are typical for plants with dense globular-shaped crown, but they were fixed on plants with loose crown as well. In this way almost all population 1 consists of small-fruited trees, in population 2 they seldom occur, population 3 doesn`t include such plants at all.

Therefore, populations of *C. tournefortii* included plants with different shapes of crown and fruits. Further investigations will reveal if these morphological distinctions are intraspecific diversity of ecological forms. Though on this stage it`s obviously they occur on the borderline of hawthorn natural areal only. Allowing for these factors it can be concluded that growing within Piedmont Crimea in the belt of piedmont forest-steppe, *C. Tournefortii* doesn`t spread to east from Stary Krym city and other populations could be found to west from here, that is Belogorsky and Simferopolsky districts. Besides data about *C. Tournefortii* occurrence in outskirts of Sudak, on Echki-Dag, Karadag and Tepe-Oba range seems mistaken.

Table 3

Characteristics of different fruit forms of *Crataegus tournefortii* (dated by 2012)

Form	Fruit size						Weight of 100 fruits, g
	Length			Diameter			
	M+m, mm	max/min, mm	Cv, %	M+m, mm	max/min, mm	Cv, %	
Tree with standard fruits	13,5±0,3	14,8/12,3	4,9	17,1±0,3	18,7/14,9	5,2	202,4

Tree with small fruits	10,1±0,2	10,8/9,0	4,6	10,2±0,2	11,4/8,6	5,8	59,0

Study of *C. Tournefortii* seed productivity revealed it is heterogeneous: together with high efficient trees there are trees with low productivity as well (table 4). In general, seed productivity of *C. Tournefortii* on territory of South-East Crimea is rather low: only in single cases coefficient of productivity exceeded 10% (tree № 1 on Agarmysh range – 17,95% and tree № 21 in outskirts of Rodniki village – 12,36%). Coefficient of productivity of *C. tournefortii* plants mainly made 1%. The lowest productivity level was registered in population № 2. As such a poor fruitification happens not the first year running [8], we suppose it is connected with hybrid origin of a cultivar what causes its low population in the Crimea.

Table 4

Seed productivity of *Crataegus tournefortii* of pattern trees, expressed by accounting units (dated by 2013)

Tree №	Age condition	Locality	A number of inflorescences on a branch	A number of flowers on a branch (PSP)	A number of ripen fruits on a branch (ASP)	Productivity coefficient (PC)
№1	G_3	Agarmysh	16	156	28	17,95
№ 6	G_3	Agarmysh	15	201	6	2,98
№11	G_2	Agarmysh	39	250	2	0,80
№22	G_3	Spring of St Panteleimon	165	1392	4	0,29
№29	G_3	Spring of St Panteleimon	25	234	1	0,43
№28	G_2	Spring of St Panteleimon	54	333	3	0,90
№25	G_2	Spring of St Panteleimon	49	233	0	0
№1	G_3	Rodniki village	50	203	1	0,49
№21	G_3	Rodniki village	89	809	100	12,36
№25	G_3	Rodniki village	177	1129	95	8,42

Conclusions

1. *Crataegus tournefortii* grows in three population within South-East Crimea: in outskirts of Rodniki village (38 plants) and Stary Krym city; on Agarmysh range there are 19 plants and nearby spring of St Panteleimon – 34 plants. Population nearby spring of St. Panteleimon was found out for the first time.
2. *C. Tournefortii* plants on study areas within: shrub cenoses (population 1), on the forest edge (population 2, 3) and rare occurrence was fixed on clearings of wood (population 3).
3. Populations have got two crown forms (loose and dense globular), and fruit forms as well (large dark-red and small brick-red colored). All study plants present low seed productivity.
4. This cultivar needs extra protection, that`s why it would be a reasonable step to include it into Red Data books of the Crimea and RF.

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Population of a rare protected cultivar *Crataegus tournefortii* growing in south-east Crimea was investigated in terms of this research. Its size, geographical distribution, coenotic belonging and some biological characteristics were determined as well.

Key words: *Crataegus tournefortii; south-east Crimea; population.*

SOUTHERN HORTICULTURE

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HORTICULTURE NURSERY OF THE CRIMEA – INTENSIVE BASES

Valentina Viktorovna Tankevich, Aleksandr Ivanovish Sotnik, Anatoly Ivanovich Popov, Timur Serverovich Chakalov

Nikita Botanical Gardens – National Scientific Centre, branch "Crimean experimental station of orcharding"
297517, Republic of the Crimea, Simferopol region, Malenkoye vil.
sadovodstvo@ukr.net

Introduction

All over the world they pay great attention to development of agriculture including horticulture. The main task is to provide population by ftuits, berries and by-products of their processing, that take quite important role in a human life.

The initial descriptions of gardens can be found in manuscripts that belong to 3000 BC (Assyria, Babel, India, China). Crimean horticulture, which appeared in IX-X centuries being a scion-rooted Tatarian gardens were in consumer`s demand. On peninsula with its moderately tropical climate and about 2,5 thousand of plant species, to grow majority of fruit-bearing and some subtropical culture is possible, as this area is situated between latitudes $46^0$21' and $44^0$23' North and longitude $32^0$30' and $36^0$30' East according to Greenwich. In the beginning of XIX century in the Crimea, close to Yalta, Nikita Botanical garden was founded, and in 1913 – Crimean experimental station of gardening, what became a start of South horticulture. Successful development of this branch was fixed in 50-70s last centure. Later due to a number of objective and subjective causes decreasing of gross harvest of fruits, crop capacity took place, and as a result - reduction of agricultural lands.

In the end of XX century total orchard area made 60 thousand ha. Nowadays in structure of agricultural lands perennial plantations occupy 72,5 thousand ha, including 39 thousand of fruit-bearing plants. Allowing for their present condition there is a necessity to replace unproductive plants and plant new modern plantations tending to 50 thousand ha by 2024. Realization of this tasks requires annual growing of 1,5 mln of fruit-bearing seedlings, free of principal virus. Production of so much planting stock needs new certified mother plants of tree stocks and grafts. Today this area makes 63 ha including 28 ha with free of virus plants. In the Crimea there are 11 nurseries with permits, most of which cultivates ordinary production. "Crimean fruit company" CO Ltd. of Krasnogvardeisky district and "Fruit Nursery" of Nizhnegorsky district are engaged in growing the virus-free and sanative seedlings. Other nurseries are small-scale and mostly provides population demands. About a half of million of fruit seedlings were cultivated in 2014, including 40% of virus-free plants.

Intensive base in the Crimean horticulture nursery is necessary to realize mentioned plans, that is to introduce modern adopted to local agroecological conditions species, seedling stocks, advanced technologies for seedling growing, cultivation of virus-free planting stock.

Research objective is to create and match promising seedling stock, cultivar and seedling stock combinations, free of virus, practice and improve elements of standard planting stock cultivation.

Objects and methods of the research

Investigations were carried out within experimental areas of the Crimean experimental station of horticulture in Piedmont zone of the Crimea. Soils are southern carbonate chernozem with medium concentration of nitrogen slip forms (relatively 1,5-1,9 and 2,8-6,5 per 100 g of dry soil) and high content of exchange potassium (44-58 mg).

Study objects: seedling stock, cultivar and seedling-stock combinations, technologies applying in mother plants, nursery and garden. The way of work corresponds to methodics of field investigations with fruit-bearing cultures [2, 4, 6].

Results and discussions

Foundation of the Crimean experimental station of horticulture in 1913 on peninsula, according to references and archival data, caused development of agrotechnical component in horticulture of the region. The project that included urgent then and considerable now tasks was developed. Selection of local seedling stocks and development of cultivation technologies of planting stock were of great importance like species selection.

Grigorovich N.A. underlines in his article, published in 1917, necessity to research natural, historical and economical conditions of the station area, including reasons of chlorosis, tree infecundity and effect of seedling stocks and combinations of species and seedling stocks on growh and plant fruiting in gardens.

In the nursery Crimean OSS (today branch Horticulture “Krymstantsiya” SBE “NBG-NSC”) most points of planting stock cultivation were investigated. Various banding materials (paper, fibre, film) were tried. Banding by chlorvinyl film prevent moisture loss and oxidation of tanning agents, what is important for nurseries in south with arid hot climate. In recent decades films destroying by light are in great use, this material considerably saves outlays on its removal.

Due to researches that had taken place since 60s it`s possible to accelerate seedlings cultivation using winter inoculation, otherwise it makes possible to get standard seedlings on slow-growing seedling stocks, omitting the first field and cutting them on a low stem [6]. But in the Crimea it needs 2 years. During one vegetation period it`s possible to cultivate seedlings, that meet OST standard, out of winter inoculations in non-heated film rooms [5]. According to study research having optimal plantation scheme 40x10 sm it`s possible to get 2000 of standard seedlings.

Tatarinov A.N., Merehko I.M., Kolesnik V.M. [1, 3, 7] were involved in development of technological methods [1, 3, 7]. Tankevich V.V., Sotnik A.I., Popov A.I. and Lyapugin I.V. followed this work. As a results of long-term researches there is a list of cultivars biologically capable to branching of seedlings: apple tree (*Malus domestica* Borkh.) – “Avrora”, “Dhonagold”, “Salgirskoye”. “Predgornoye”, Tavriya”; pear tree (*Pyrus communis* L.) – “Dream”, “Maria”, “Tavricheskaya”. These cultivars mainly belong to station selection, according to many parameters they exceed foreign analogs.

The best height of inoculation was determined as 28-40 sm. Optimal period for seedlings top removal was found out as well. By our data, top removal should be planned since the second decade of June every two weeks. Yield of standard seedlings makes 85% in this way.

Kolesnik V.M. developed resource-saving technology of fruit seedlings cultivation in film containers. Yield of standard seedlings reaches 400 thousand per hectare. This technology makes it possible to use worthless for agriculture areas, what is of great importance for mountainous and piedmont cultivation districts.

In different period station scientists as follows were engaged in selecting the most productive seedling stocks of apple, pear and other fruit cultures: Tatarinov A.N., Merezhko

I.M., Borisenko I.G. Nowadays these points are a field of activity for Tankevich V.V., Sotnik A.I., Lyapugin I.V., Popov A.I., Chakalov T.S. Researches of many years proved prospectivity among seeds as a seedling stock for apple trees – "Sara Sinap". According to opinion of Doctor of Agricultural Science (PhD), Tatarinkov A.N., till 60s of XX century all nurseries in the Crimea, Moldova, Bukovina, Uzbekistan, Kazakhstan started working with seedlings of the very cultivar.

Later, as far as clonal seedling stocks were transported into the Crimea (under control of Berezovsky G.A. and Tatarinov A.N.), horticulture took M.2, M.3, M.4, M.9, M.M. 102 and MM. 106. Agronomists-operatives Popov I.T., Tankevich B.N. and Tikhohod K.T. made huge contribution into development of horticulture nursery at the station and in the Crimea.

At present in collection stool of the gardening branch "Krymsadstantsiya" a large fulnd (more than 60 forms) of seedling stocks with vegetative propagation for apple and pear trees. This fund includes seedling stocks of either foreign or domestic (own selection as well) breeding (fig.1). The most productive, early-maturing, adapted to soil and climatic Crimean conditions plants are in process of selection now.

Fig.1 Collection stool of clonal seedling stock of apple and pear trees

According to results of long-term work seedling stock for apple trees K 104 (breeding of horticulture nursery laboratory) was put into Register Book of Ukraine plant cultivars, in 2015 all necessary documents for its putting in zoning in Russia were prepared. By growth intensity it occurred between M. 9 and MM. 106 (fig.2). Trees grafted on K. 104, gained good anchor base, high crop capacity and great fruit tastes. Average yielding for 14 years, allowing for different damages of fruit buds by frost, makes 14-16 t/ha (table 1). Cultivation efficiency of "Golden Delicious", Dzhonagold" and "Krymsky" on seedling stock K. 104 is 113-123%.

Table 1

Crop capacity of cultivar and seedling stock combinations within 14-years old garden

Layout	Seedling stock	Average crop capacity for 2000-2014, t/ha				
		Golden Delisious	Dzhonagold	Kimmeriya	Krymskoye	Reinette Simirenko
4 x 2 m	M.9	16,5	13,2	17,6	16,8	14,3

	К 104	15,9	14,3	16,1	15,1	13,9
	Д 1071	13,6	11,4	14,8	13,7	12,8
	62-396	26,2	19,8	21,2	22,7	21,5
4 x 3 m	ММ.106	13,9	15,4	13,9	14,5	13,1
	М.26	12,3	12,8	14,7	16,4	10,7
	D1161	15,7	17,8	16,9	12,1	-
$НСР_{05}$: By cultivars – 6,4 By seedling stock – 5,8						

As a result of long-term scientific activity station nurserymen bred poorly growing seedling stock for pear trees КА 53, КА 61, КА 86, Ка 92, tolerant to a high concentration of $CaCO_3$ in soil (up to 40%). Productivity of these seedling stocks in the stool is 20-30% as much than ВА 29 has (table 2).

Table 2

Efficiency of clonal seedling stocks in stool for pear tree, 2003-2014

Seedling stock	Offset yeilding per 1 ha, thousand of units			
	Totally		Including standard	
	Average for 2003-2014	2014	Thousand, units	%
ВА-29 (к)	324,8	332,6	272,7	82
КА 53	341,0	339,1	239,3	80
КА 86	363,2	370,3	296,2	80
КА 92	351,0	380,0	365,5	85
IS 2-10	332,0	332,7	276,1	83
$НСР_{05}$	16,8	30,6	29,9	

Yielding of standard seedlings within nursery is no less than 85%. Study of seedling stocks makes it possible to reveal prospectivity of cultivar and seedling stock combinations: “Izyuminka Kryma”, “Dream”, “Tavricheskaya”, on Ka 53, Ka 92 (fig.3). Efficiency degree is 20-25% as much than on ВА 29 and makes 140%.

In recent years prospective seedling stocks for peach (*Persica vulgaris* Mill.) are thoroughly investigated. Among seed plants GF-305 was emphasized, among clonal – Kuban 86. Crop capacity of peach “Veteran” on Kuban 86 made 29-32 t/ha (table 3).

Fig.2 Eight-years old apple tree "Dzhonagold" on seedling stock K 104

Fig. 3 Seven-years pear-tree "Maria" on seedling stock Ka 92

Table 3

Garden yield of peach cultivar and seedling stock combinations

Seedling stock	Veteran		Collins		Sochny	
	yielding, ton/ha					
	2009	Average for 2003-2009	2009	Average for 2003-2009	2009	Average for 2003-2009
Almonde (к)	27,0	23,3	24,5	22,2	22,6	24,0
Brompton	26,0	20,8	23,8	19,8	20,4	21,7
Kuban 2	27,0	25,1	24,1	24,3	23,4	24,1
Kuban 86	32,0	29,0	26,3	25,8	24,6	27,2

BBA-1, Evrika 99 and seedling stocks for cherry (*Cerasus avium (L.)* Moench) in plantations with small crowns are studying as well.

Highly developed world gardening is based on virus-free horticulture nursery. France, the USA, Italy, Belgium, Holland and Germany use the state systems to produce healthy planting material and control its quality level. Ordinary, non-tested, material is cultivated restrictedly, and considerable difference at price stimulates virus-free production.

In recent decades mass distribution of virosis, bacterial infections and quarantine pests within our region became a result of a lack of control system after quality and phytosanity condition of plantation, spontaneous way of seedling production and realization. Branch intensification suppose obligatory transfer of the Crimean horticulture to virus-free base,

what makes it possible to reduce pesticide load on environment within sanitary resort zone and increase garden efficiency to a large degree.

Table 4

Impact of virus injuriousness on apple yielding

Variants	Yielding, ton/ha			
	Golden Delicious		Aurora Krymskaya	
	1990	Average per 7 years	1990	Average per 7 years
1. ChBL + pit of apple timber	21,2	104,5	16,3	80,7
2. Striation of apple timber	16,7	100,6	18,1	89,1
3. ChBL + pit + striation of apple timber	20,9	107,3	19,2	83,3
4. ChBL + pit+ being gutta-percha	19,7	89,0	15,0	69,8
5. Control	30,6	132,8	24,4	96,1
HCP_{05}		9,1		5,1

Protective package against virus includes early and strict diagnostics, which makes it possible to find out plant state, reveal and put away damaged material in time, select good parent plants and propagate them. In the Crimea this process isn`t developed due to lack of virus-free planting material. Cultivars and stocks of seed cultures are mainly infected by latent viruses. The following damages of plants are especially spread: timber pit, striation and chlorosis blotch of leaves. Virus ChBL is the most spread. According to scientists from department horticulture nursery KOSS Tatarinov A.N., Tankevich V.V., Popov A.I. yielding reduction of Reinette, Simirenko and Aurora makes 25-39%, 30-40 ton/ha, what brings down service life of gardens to a large degree.

In recent years Krymsadstantsiya has carried out serious measures testing cultivars and stocks (including its own selection) to find out the principal harmful viruses and define main points of their further propagation. Parent and seedling gardens, stool areas of clonal stocks for apple and pear are projected.

Conclusions

Setting up of modern and progressive fruit plantations is based on new promising stocks and cultivar-stock combinations - adapted to locality agroecological conditions - combined with highly productive cultivars and rational methods of cultivation using virus-free potential.

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Tankevich V.V., Sotnik A.I., Popov A.I., Chakalov T.S. Horticulture nursery of the Crimea – Intensive bases // Bull. of the State Nikit. Botan. Gard. – 2015. – № 116. – P. 29-35.

The article presents summery and results of long-term investigations in the field of stocks, cultivar-stock combinations and methods for cultivation of competitive pruned plant material of fruit-bearing cultures. This research covers work of scientists of the Crimean experimental horticulture station for last 50 years. It brings up necessity to transform Crimean horticulture to virus-free work way and the main aspects of the Crimean horticulture nursery as well.

Key words: *horticulture nursery; stock; provine; maternal plant; the Crimea.*

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ASSESSMENT OF ECONOMICAL AND BIOLOGICAL CHARACTERISTICS OF WINTER APPLE CULTIVARS

Nadezhda Alekseyevna Litchenko, Nadezhda Nikonorovna Gorb

Nikita Botanical Gardens – National Scientific Centre,
branch "Crimean experimental station of horticulture"
297517, Republic Crimea, Simferopol district, Malenkoye vil.
sadovodstvo@ukr.net

Introduction

Crimean peninsula has got quite favorable soil and climatic conditions for horticulture development. Fruits, cultivated in the region, are characterized by high taste and dietic properties. They are in great demand and could be an important item for export and economy stabilization of the Republic. Reduction of sanitary standard for fruit consumption has a negative effect on human body and causes oncolytic diseases. That`s why foundation of new intensive perennial fruit plantations takes a big role in development of the Crimean agriculture. Planting of new gardens in the region is realized allowing for scientifically grounded zonality of fruit cultures, as natural and climatic conditions has a big range.

Apple is the key fruit culture being in a structure of the Crimean plantations. Soon its part in the gardens will make 65-70%. The Peninsula attracts tourists all year round, and during this period guests and inhabitants of the region must be supplied by fresh fruit production completely. Apple trees, in particular winter cultivars which provide consumers in winter-spring, are of great importance to solve this task. Hereafter this cultivar group will make 80-85% from the total value cultivated in the Crimea. It should be noted these climatic conditions are favorable for growing winter apple cultivars.

Objects and methods of the research

Branch "Crimean experimental station of horticulture" was involved in studying the economical and biological peculiarities of apple cultivars with winter ripening, its own breeding: Aurora Krymskaya, Kimmeriya, Krymskoye, Krymskoye Zimneye, Predgornoye,

Tavriya, 1-8th, 3-2-11-79, 10-99-78, 2-1-18-79, 75-74; and foreign selection: Aidared, Brebern, Golden Delicious, Champion, Florina.

An experimental area was founded in 2000. Plantation consisted of seedlings grafted on stock MM-106 with insertion-9 using scheme 3,5 x 1,75 m. Area soils are heavy loamy, alluvium meadow-chernozyom-like. Humic horizon is massive, humic content isn`t considerable.

Area climate is semiarid and warm with changeable winter weather with significant range of snow cover. Average annual air temperature makes 10°C, in the warmest month it`s 20°C, the coldest month – January – 1,4°C below zero. Average annual temperature minimum is -20°C, absolute minimum - 31°C below zero. Spring is the most arid and windy season with frequent recurrent frosts. The latest frosts occur in early May, in the end of April this phenomena is possible ones per 4 years only. Precipitations are not even along the year. Maximum point is reached in June-July, considerable amount falls in autumn. Autumn frosts come on 16th of October on average. Ones per 20 years they happen in middle of September.

Investigations were based on program and methodic of fruit, baccate and nut-bearing cultures [11], using methodic of field studies with fruit cultures. Fruit chemical composition was assessed using methodic of fruit-baccate production merit-rating [7]. Fruits were stored under conditions of standard gaseous medium at 0-2°C and relative air humidity 86-90%. Statistical processing of data was carried out by methodic of field experiment [4].

Results and discussion

Crop capacity is the major economic and biological characteristic of apple cultivars, as it provides cost-efficiency of cultivation. Principal tasks of culture species study is to mark out cultivars with high yielding [9]. Crop capacity of 17 apple cultivars belonging to domestic breeding were investigated in comparison with intensive cultivar from foreign breeding – Golden Delicious, taken as a control. In this way maximum values of parameters were registered for the following cultivars from own selection: Aurora Krymskaya (31,2), Kimmeriya (32,1), Tavriya (34,1), 10-99-78 (30,3), 2-1-18-79 (38,6), 75-74 (33,8) and foreign cultivar Champion (30,7 ton/ha. The following station cultivars presented approximately the same crop capacity as control variant: Krymskoye (28,3), 1-8th, (28,1), 3-2-11-79 (28,5); minimal value of this parameter was registered for cultivar Florina (18,1 ton/ha), foreign breeding.

Apple fruits with high commercial qualities, that is large size, attractive appearance, high tasty properties, are in great demand. As researchers suppose, average weight of an apple fruit, cultivated in southern zone, should be 160-170g [12]. Most cultivars and forms had a fruit weight reaching 130-150 g: Golden Delicious, Aurora Krymskaya, Aidared, Brebern, Krymskoye, Krymskoye Zimneye, Reinette Simirenko, Tavriya, Champion, Florina, 2-1-18-79, 10-99-78; 155-170 g was typical for Kimmeriya, Predgornoye and 1-8th, 3-2-11-79. The largest fruits (210 g) characterized form of the station own breeding 75-74 (table 1).

Nowadays apple cultivars with rounded, oval and rounded-conic fruit shape, smooth surface, bright red color all over the whole fruit, without rusty spots gain the great demand. Demad for fruits without induviate color goes up considerably [8].

Table 1

Economical and biological parameters of apple winter cultivars

Cultivar	Average crop capacity 2011-2014, ton/ha	Fruit rating			Storage capacity, days
		Appearance, points	Weight, g	Taste, points	
Golden Delicious	26,4	4,3	140	4,7	150

(Control)					
Aurora Krymskaya	31,2	4,6	150	4,6	120
Aidared	22,8	4,5	150	4,2	200
Brebern	22,6	4,3	140	4,4	210
Kimmeriya	32,1	4,4	155	4,1	190
Krymskoye	28,3	4,5	140	4,6	200
Krymskoye Zimneye	23,2	4,4	135	4,6	240
Predgornoye	21,4	4,7	165	4,7	110
Reinette Simirenko	26,8	4,3	130	4,6	120
Tavriya	34,1	4,6	145	4,6	240
Champion	30,7	4,5	140	4,6	170
Florina	18,1	4,6	140	4,6	190
$1\text{-}8^{th}$	28,1	4,5	150	4,5	160
2-1-18-79	38,6	4,6	150	4,5	190
3-2-11-79	28,5	4,7	160	4,6	170
10-99-78	30,3	4,4	130	4,5	160
75-74	33,8	4,7	210	4,4	100
HCP_{05}	2,7				

High parameters of fruit appearance (4,6-4,7 points) were registered for the following cultivars and forms: Aurora Krymskaya, Predgornoye, Tavriya, Florina, 2-1-18-79, 3-2-11-79, 75-74. Attractiveness of these fruits appearance is mainly based on their regular shape and bright induviate color with stripes or diffused color over the most part of surface. There is an exclusion, form 2-1-18-79, its fruits have got flat-rounded and regular shape with smooth surface and delicate pink erubescence spread over less fruit surface; they are attractive as well. Fruits of Kimmeriya cultivar and form 10-99-78 possess induviate color spread over less surface or absent at all, what makes it possible to include them into clinical nutrition and baby food.

According to taste properties of apple fruites, cultivars are classified into dessert (4,5-5,0), table (3,0-4,4) and industrial (3,8 points and lower) [8]. Taking into account organoleptic rating of fruit taste majority of study cases belongs to dessert (4,5-4,7 points).

Storage period of fruits depends upon concentration of solid, what is a positive correlation, but the principal influence is made by genotype [2]. Winter ripening apple cultivars are characterized by long-term preservation of fruits, late winter cultivars are possible to store fruits till the next yield. Maximum storage period (240 days) is typical for late-winter cultivars such as Krymskoye Zimneye and Tavriya. 170-210 days is the preservation period for cultivars of station own breeding, Kimmeriya, Krymskoye, 2-1-18-79, 3-2-11-79, 10-99-78, and foreign one – Aidared, Brebern, Champion, Florina.

Biosynthesis of ascorbic acid is determined by many factors. Vitamin “C” concentration depends to a large degree upon cultivar biological characteristics [8]. Apples, cultivated in the Crimea, don`t have a high content of ascorbic acid, what is typical for fruits grown in regions with colder climate. Maximum content of vitamin “C” was fixed in fuits of Reinette Simirenko (12,1) and Krymskoye Zimneye (12,8 mg%) (table 2). According to other studies, vitamin “C” content in Reinette Simirenko made 11,4 mg% [9].

Table 2

Biochemical composition of apple fruits (average factor for long-term study)

Cultivar	Vitamin “C” mg %	Titratable acidity, %	Sugars, %		Solid, %	Sugar-acid coefficient
			mono	Total sugar		
Golden Delicious	4,2	0,33	11,7	15,1	16,4	45,8

Reinette Simirenko	12,1	0,76	12,4	14,9	17,7	19,6
Aurora Krymskaya	9,8	0,94	9,8	14,2	18,5	15,1
Brebern	6,0	0,99	9,0	12,7	16,6	12,8
Kimmeriya	8,9	0,96	7,5	10,4	14,3	10,8
Krymskoye	7,2	0,52	12,1	17,0	19,6	32,7
Krymskoye Zimneye	12,8	0,55	10,0	16,1	18,4	29,3
Predgorrnoye	8,8	0,46	12,8	14,9	16,8	32,4
Tavriya	5,8	0,29	8,9	11,0	17,0	28,2
Champion	6,7	0,50	10,5	12,9	15,8	25,8
Florina	6,2	0,42	12,2	15,5	17,2	36,9
1-8th	6,0	0,28	11,1	14,6	16,1	52,1
2-1-18-79	5,0	0,47	11,5	13,7	15,8	29,2
3-2-11-79	4,9	0,65	10,4	12,5	15,1	19,2
10-99-78	6,8	0,49	12,1	14,5	16,5	25,6
75-74	6,7	0,44	12,3	14,5	16,8	32,9

Availability of organic acids in apple fruits is determined by soil-climatic conditions and cultivar biological characteristics. There is an opinion that maximum acidity is typical for winter cultivars [3]. In terms of our researches we could mark out the following apple cultivars and form according to organic acids in fruits (0,76-0,99%): Reinette Simirenko, Aurora Krymskaya, Brebern, Kimmeriya and 3-2-11-79.

Carbohydrates are an essential part of apple fruits. They suppose that winter cultivars contain more sugars in comparison with summer and autumn ones [1]. According to our researches a high concentration of monosaccharide (12,1-12,8%) was fixed for Reinette Simirenko, Krymskoye, Predgornoye, Florina and forms 10-99-78, 75-74. Level of total sugar ranged from 11,1 in fruits of Tavriya till 17,0% of Krymskoye.

A number of scientists suppose fruit taste is determined by sugar-acid coefficient. It is 15-27 for cultivars with dessert taste [5]. Allowing for this coefficient almost all study cultivars are classified as dessert (15,1-52,1), besides Brebern and Kimmeriya (12,8 and 10,8 relatively) that have lower taste properties of course. Golden Delicious and forms – 1-8th having sugar-acid coefficient 45,8 and 52,1 relatively are identified as the cultivars with the sweetest fruits.

Concentration of solids considerably effects on apple fruit storage, but cultivar genotype has the key influence [10]. In our researches cultivars with long-term fruit preservation had a high content of solids: Brebern (16,6), Krymskoye (19,6), Krymskoye Zimneye (18,4), Tavriya (17,00%).

Conclusions

Maximum value of average crop for 4-years research (more than 30 ton/ha) was received from station own breeding: Aurora Krymskaya, Kimmeriya, Tavriya, 2-1-18-79, 10-99-78, 75-74 and foreign cultivar Champion.

Cultivars Aurora Krymskaya, Predgornoye, Tavriya, Florina and forms 2-1-18-97, 3-2-11-79, 75-74 had attractive fruits (4,6-4,7 points).

The longest storage period (240 days) was fixed for late winter cultivars: Krymskoye Zimneye and Tavriya. Cultivars with prolonged storage capacity of fruits were characterized by high content of solid (16,6-19,6%).

As to ascorbic acid concentration the following cultivars were marked out: Reinette Simirenko (12,1) and Krymskoye Zimneye (12,8 mg%).

Concerning sugar-acid coefficient (15,1-52,1) majority of cultivars, besides Brebern and Kimmeriya, are rated as dessert.

Taking into consideration economical and biological parameters almost all study apple cultivars are applicable for cultivation in industrial gardens of the Crimea, though Florina needs further investigation.

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Litchenko N.A., Gorb N.N. Assessment of economical and biological characteristics of winter apple cultivars // Bull. of the State Nikit. Botan. Gard. – 2015. – № 116. – P. 35-39.

This article presents study results of economical and biological characteristics of 17 winter apple cultivars of native and foreign breedings. Maximum crop capacity was registered for “Aurora Krymskaya”, “Kimmeriya”, “Tavriya”, 2-1-18-79, 75-74 and cultivar of foreign selection “Champion”. Attractive fruits were marked for “Aurora Krymskaya”, “Predgornoye”, “Tavriya”, “Florina” and forms 2-1-18-79, 3-2-11-79, 75-74. Fruits of “Tavriya” and “Crymsky Zimny” cultivars had the longest period of storage. A high concentration of ascorbic acid was typical for fruits of “Reinette Simirenko” and “Krymskoye Zimneye”. Assessment of fruit taste properties was carried out according to sugar-acid coefficient.

Key words: *apple; winter cultivar; crop capacity; fruit keeping capacity; sugars; solids; ascorbic acid; sugar-acid coefficient; the Crimea.*

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NEW SELECTIVE SEED STOCKS OF DRUPACEOUS CULTURES FOR NECTARINE

Yevgeny Petrovich Shoferistov[1], Anatoliy Nikolayevich Kabar[2], Vladimir Fedotovich Opanasenko[2], Dmitry Alekseyevich Chelombit[3], Natalja Aleksandrovna Lutsay[3]

Nikita Botanikal Gardens – National Scientific Centre, the city of Yalta, 298648, Republic of the Crimea, the city of Yalta, urban vil. Nikita
fruit_culture@mail.ru
[2]Botanical Garden of Dnepropetrovsk National University named after O.Gonchar, Dnepropetrovsk
[3]Dzhankoy IKP, vil.Medvedevka, Republic of the Crimea

Introduction

Previous joint researches of Nikita Botanical Gardens – National Scientific Centre and Botanical Garden of Dnepropetrovsk National University named after O.Gonchar covered results in search of new origins and donors for valuable economical and biological properties, formation the new planting stock what makes it possible to improve selection of modern nectarine, peach cultivars and their seed stocks [5, 6, 24]. Breeding new or enriching real cultivars of nectarine, peach and their seed stocks are caused by climatic zone requirements to get effective cultivation of fruit production in the Crimea, Dnepropetrovsk and Kherson regions. Our joint researches gain great importance due to low frost-resistance of almond seed stocks, which are used to grow nectarine and peach seedlings in different regions of Russia and Ukraine [4, 16, 24]. Thereby it`s necessary to breed new stocks resistant to winter frost. Scientists of Nikita Botanical Gardens contributed a lot into study of seed stocks for nectarine and peach cultivars [3, 5, 7, 9, 11, 13 – 15, 17 – 22, 24, 25].

For efficient selection of better seed stocks of drupaceous cultures it would be more reasonable to use bred in Nikita Botanical Gardens genotypes of intraspecific hybrids with wild Chinese co-genuses of *Persica* Mill. – Peach of David (*P. davidiana* (Carr. Franch.), Peach of Gansu (*P. kansuensis* Rehd.), peach of the world *(P. mira* Koehne) and nectarine cultivar Kuldzhynsky (2x), as they possess cytoplasmic male sterility (CMS). Among hybrids mentioned above the following are recommended: F_1 40-99, $F_1$41-99, F_1 47-99, F_1 48-99, F_1 55-99, F_1 62-99, F_1 65-99 and etc. [23].

Horticulture nursery of the Crimea should follow experience in research of drupaceous seed stocks, gained by scientists of Central Republic Botanical Garden AS USSR (Kiev)

I.M. Shaitan, L.M. Chuprina and V.A. Anpilogova [12]. According to their study results valuable peach and almond hybrids 2151,4-0 and 3669 were identified as seed stocks for drupaceous cultures. These hybrids bring balanced seed generation in the second and further cohorts. Intraspecific hybrid Sputnik 1 (Stock 1), bred by I.M. Shaitan and L.M. Chuprina in CRBG of AS USSR applying crossing of Mao-tha-or and wild Chinese peach cultivar – *P. davidiana* Carr., is a successful seed stock for peach [12]. Seed stock Sputnik 1 is recommended for cultivated peach and nectarine species in regions with possible freezing of root system in winter [8].

Objective research is to sort out new best seed stocks of drupaceous cultures for nectarine

in terms of study genotypes in Kherson State University, Steppe branch of Nikita Botanical Gardens, Dzhankoy IKP for further use in horticulture nursery of the Crimea and Ukraine.

Objects and methods of the research

Research objects were seed stocks of drupaceous cultures, sowed in different years in horticulture nurseries in November-January where their germinating capacity was determined (%, points). Seed germinating capacity registered from 1-10% was equal to 1 point (too low); 11-25% - 2 points (low); 26-50% - 3 points (middle); 51-75% - 4 points (high); 75% or more – 5 points (very high).

In 2009 seed sowing of stock forms was realized in Kherson State University, in 2011 – in Steppe branch of Nikita Botanical Gardens, in 2014 – in Dzhankoy IKP, village Medvedevka. Seed sowing, soil and plants treatment and stock growing were carried out according to standard technology in horticulture nursery [2].

Results and discussions

Analyzing study results in seed germinating capacity of drupaceous cultures stock forms within three nurseries it was found out that not all study stock specimens possess high germinating capacity, close to control specimen, almond (table 1, table 2), and to intraspecific hybrid Sputnik 1 (table 3).

The best seed stock in the nursery of Kherson State University was registered form 1-1-35, as its seed germinating capacity made 79,1% (5 points). Almond seeds germinating capacity was 66,5% (4 points). Too low seed germinating capacity was fixed for stocks: 1-1-44 – 3,1% (1 point), 1-2-17 – 3,2% (1 point), alycha 61-88 st. – 5,0% (1 point). Stock forms with too low germinating capacity of seeds are out of interest for further research. In the nursery of Steppe branch of Nikita Botanical Gardens (table 2) the best seed germinating capacity was marked for 3 selective forms of stocks: 1-1-35 – 56,6% (4 points), 1-2-26 – 53,7% (4 points), 2-7-10 – 51,6% (4 points). It`s reasonable to exclude form 2-03-3 out of further experiments, as its seed germinating capacity made 5, 7% (1 point). In the nursery of Dzhankoy IKP (table 3) high seed germinating capacity was presented by three stock forms: 2-01-12 – 61,6% (4 points), 2-02-08 – 70,0% (4 points), 2-05-14 – 56,2% (4 points). The prime selective forms, by germinating capacity, close to control specimen – Sputnik 1, are forms 2-06-20, 2-07-9, 171-00 and 174-00. Forms with only 2 points germinating capacity needs to be studied in future.

Table 1

Seed germinating capacity of drupaceous cultures on an experimental area of Kherson State University (November the 17th 2009)

№	Stock, Selection form	A number of seed, units.		Seed germinating capacity	
		sowed	germinated	%	point, (5points-scale)
1	2	3	4	5	6
1	3-9-11*	75	28	37,3	3 (middle)
2	3-7-5a-16*	74	31	41,9	3 (middle)
3	Peach of the world 13-1-4-51*	200	85	42,5	3 (middle)
4	644-89*	170	74	43,5	3 (middle)
5	631-89*	300	134	44,7	3 (middle)
6	2-10-8*	85	35	44,6	3 (middle)
7	3-9-16*	200	86	43,0	3 (middle)
8	F_1 (peach x almond) 13 block.*	170	91	53,5	4 (high)
9	621-89*	200	120	60,0	4 (high)

10	1005-88*	165	98	59,4	4 (high)
11	3-9-33*	200	62	31,1	3 (middle)
12	1-1-37**	149	102	68,5	4 (high)
13	3-9-63*	200	112	56,0	4 (high)
14	2-6-9**	80	47	58,8	4 (в high)
15	1-2-14**	139	17	12,2	2 (low)
16	3-11-37*	200	20	10,0	1 (too low)
17	1-1-35**	139	110	79,1	5 (very high)
18	1-1-41**	270	87	32,2	3 (middle)
19	1-1-44**	96	62	64,6	4 (high)
20	1-2-5**	166	5	31,1	1 (too low)
21	1-2-11**	190	19	10,0	1 (too low)
22	1-1-1**	197	37	18,8	2 (low)
23	1-2-27**	260	123	47,3	3 (middle)
24	1-1-42**	138	51	36,9	3 (middle)
25	2-4-25**	200	118	59,0	4 (high)
26	1-2-26**	200	75	37,5	3 (middle)
27	1-2-17**	95	3	3,2	1 (too low)
28	Shalakha apricot*	49	11	22,4	2 (low)
29	Apricot from Kherson	880	196	22,3	2 (low)
30	Apricot (mix of cultivars)*	112	13	11,6	2 (low)
31	Peach*	200	39	19,5	2 (low)
32	Almond*	200	133	66,5	4 (high)
33	ALycha Stock yellow*	200	31	15,5	2 (low)
34	Alycha 61-88 st.*	200	10	5,0	1 (too low)
35	Alycha 7-1-4-38 st.*	200	64	32,0	3 (middle)
36	ALycha Pissardi Large-fruited*	200	44	22,0	2 (low)

*Seed stocks, bred in Nikita Botanical Gardens

**Seed stocks bred in Botanical Gardens of Dnepropetrovsk National University.

Table 2

Seed germinating capacity of drupaceous cultures in Steppe branch of Nikita Botanical Gardens (November the 9th 2011)

№	Stock, Selective form	A number of seeds, units		Seed germinating capacity	
		sowed	germinated	%	point, (5-points scale)
1	1-1-1**	269	125	46,5	3 (middle)
2	1-1-35**	189	107	56,6	4 (high)
3	1-1-42**	102	47	46,1	3 (middle)
4	1-2-26**	616	331	53,7	4 (high)
5	1-2-27**	112	12	10,7	2 (low)
6	1-2-33**	267	49	18,4	2 (low)
7	1-3-2**	57	7	12,3	2 (low)
8	2-01-13**	133	23	17,3	2 (low)
9	2-02-4**	373	62	16,6	2 (low)
10	2-02-30**	135	15	11,1	2 (low)
11	2-03-3**	1070	61	5,7	1 (too low)
12	2-05-4**	102	23	22,5	2 (low)
13	2-7-10**	64	33	51,6	4 (high)
14	Peach*	238	13	5,5	1 (too low)
15	Almond*	260	239	86,6	5 (very high)

*Seed stocks, bred in Nikita Botanical Gardens

**Seed stocks bred in Botanical Gardens of Dnepropetrovsk National University.

Table 3

Seed germinating capacity of drupaceous cultures in Dzhankoy IKP, village Medvedevka (January the 24th in 2014)

№	Stock, Selective form	A number of seeds, units		Seed germinating	
		sowed	germinated	%	point, (5-points scale)
1	2	3	4	5	6
1	1004-88*	260	74	28,5	3 (middle)
2	1-1-1**	327	108	33,3	3 (middle)
3	1-2-36**	40	13	32,5	3 (middle)
4	1-3-2**	42	21	50,0	3 (middle)
5	2-01-12**	73	45	61,6	4 (high)
6	2-01-13**	112	45	40,1	3 (middle)
7	2-01-15**	53	15	28,3	3 (middle)
8	2-01-16**	127	51	40,1	3 (middle)
9	2-02-2**	96	32	33,3	3 (middle)
10	2-02-8**	157	110	70,0	4 (high)
11	2-04-17**	13	5	38,4	3 (middle)
12	2-04-19**	214	92	42,9	3 (middle)
13	2-05-4**	150	60	40,4	3 (middle)
14	2-05-14**	16	9	56,2	4 (high)
15	2-06-13**	183	70	38,2	3 (middle)
16	2-06-15**	67	21	31,3	3 (middle)
17	2-06-20**	28	6	21,4	2 (low)
18	2-07-9**	94	23	24,4	2 (low)
19	10-02-27*	32	12	37,5	3 (middle)
20	171-00*	496	117	23,5	2 (low)
21	173-00*	387	116	29,9	3 (middle)
22	174-00*	200	32	16,0	2 (low)
23	Apricot*	122	42	34,4	3 (middle)
24	Sputnik 1(Stock 1) – control specimen*	28	16	57,1	4 (high)

*Seed stocks, bred in Nikita Botanical Gardens

**Seed stocks bred in Botanical Gardens of Dnepropetrovsk National University.

Analyzing eyelet (bud) establishment rate of nectarine cultivars, grafted on seed stocks of drupaceous crops in Dzhankoy IKP (table 4) it was found out that a number of selective forms (2-04-19, 2-05-14, 2-06-20 and 10-02-27) presented very high nectarine eyelet establishment, that meets control seed stock Sputnik 1. We recommend to give these stock forms widespread in nurseries of the Crimea and Dnepropetrovsk region. Currently used in nurseries of Russia and Ukraine in regions with severe ecological conditions almond seedlings as stocks are not so effective. Their root system is often subjected to freezing, what destroys nectarine and peach trees grafted on them. Absolute minimum of air temperature in different zones of the Crimea is too low – from 27-35°C below zero in the eastern piedmont zone till 31-37°C below zero in the central steppe zone of the Crimea [1].

Table 4

Eyelet establishment of the nectarine cultivars grafted on seed stocks of drupaceous crops in Dzhankoy IKP, village Medvedevka (2014)

№	Stock, Selective form	Graft, nectarine cultivar	Grafted eyelets, units	Established eyelets		
				units	%	points (5-point scale)
1	2	3	4	5	6	7

1	1004-88*	Nikitsky 85	36	16	44,4	3 (middle)
2	1004-88*	Super Creamson Gold	36	25	69,4	4 (high)
3	1-1-1**	Nikitsky 85	49	25	51,0	4 (high)
4	1-1-1**	Super Creamson Gold	49	34	69,4	4 (high)
5	1-2-36**	Nikitsky 85	5	3	60,0	4 (high)
6	1-2-36**	Super Creamson Gold	8	4	50,0	3 (middle)
7	1-3-2**	Nikitsky 85	11	5	45,5	3 (middle)
8	1-3-2**	Super Creamson Gold	8	5	62,5	4 (high)
9	2-01-12**	Nikitsky 85	26	17	65,4	4 (high)
10	2-01-12**	Super Creamson Gold	24	15	62,5	4 (high)
11	2-01-13**	Nikitsky 85	23	14	60,7	4 (high)
12	2-01-13**	Super Creamson Gold	20	13	65,0	4 (high)
13	2-01-15**	Nikitsky 85	5	2	40,0	3 (middle)
14	2-01-15**	Super Creamson Gold	10	2	20,0	2 (low)
15	2-01-16**	Nikitsky 85	23	9	39,1	3 (middle)
16	2-01-16**	Super Creamson Gold	22	14	63,6	4 (high)
17	2-02-2**	Nikitsky 85	16	9	56,3	4 (high)
18	2-02-2**	Super Creamson Gold	16	11	68,8	4 (high)
19	2-02-8**	Nikitsky 85	54	27	50,0	3 (middle)
20	2-02-8**	Super Creamson Gold	54	29	53,7	4 (high)
21	2-04-17**	Nikitsky 85	2	0	0	-
22	2-04-17**	Super Creamson Gold	3	2	66,7	4 (high)
23	2-04-19**	Nikitsky 85	49	24	49,0	3 (middle)
24	2-04-19**	Super Creamson Gold	49	39	79,6	5(very high)
25	2-05-4**	Nikitsky 85	29	17	58,6	4 (high)
26	2-05-4**	Super Creamson Gold	32	24	75,0	4 (high)
27	2-05-14**	Nikitsky 85	4	2	50,0	3 (middle)
28	2-05-14**	Super Creamson Gold	5	4	80,0	5(very high)
29	2-06-13**	Nikitsky 85	30	10	33,3	3 (middle)
30	2-06-13**	Super Creamson Gold	40	25	62,5	4 (high)
31	2-06-15**	Nikitsky 85	10	6	60,0	4 (high)
32	2-06-15**	Super Creamson Gold	11	7	63,6	4 (high)
33	2-06-20**	Nikitsky 85	2	2	100,0	5(very high)
34	2-06-20**	Super Creamson Gold	4	4	100,0	5(very high)
35	2-07-09**	Super Creamson Gold	14	10	71,4	4 (high)
36	10-02-27*	Nikitsky 85	6	4	66,7	5(very high)
37	10-02-27*	Super Creamson Gold	6	5	83,3	5(very high)
38	171-00*	Nikitsky 85	49	21	42,9	3 (middle)
39	173-00*	Super Creamson Gold	49	28	57,1	4 (high)
40	173-00*	Nikitsky 85	56	24	40,7	3 (middle)
41	173-00*	Super Creamson Gold	40	15	37,5	3 (middle)
42	174-00*	Nikitsky 85	12	7	58,3	4 (high)
43	174-00*	Super Creamson Gold	13	3	23,1	2 (low)
44	Apricot*	Nikitsky 85	22	7	31,8	3 (middle)
45	Apricot*	Super Creamson Gold	22	6	27,3	3 (middle)
46	Sputnik 1 (Stock 1) – control specimen*	Nikitsky 85	8	7	87,5	5(very high)
47	Sputnik 1 (Stock 1) – control specimen*	Super Creamson Gold	8	8	100,0	5(very high)

*Seed stocks, bred in Nikita Botanical Gardens

**Seed stocks bred in Botanical Gardens of Dnepropetrovsk National University.

Researching the nursery properties of drupaceous crops seeds it was found out that seed stocks shouldn`t be considered for further investigations. Like seed stocks with low

germinating capacity mentioned above, apricot, peach and alycha with 2-3 points seed germinating capacity are possible to exclude them out of experiments (Tables 1, 3).

Conclusions

1. Investigated seed stocks of drupaceous crops in three Crimean nurseries gain a great practical importance for Russia and Ukraine, where almond stock for nectarine and peach is of little use due to low frost resistance of its root system.
2. Seed stocks of selective forms - 1-1-1, 1-3-2, 2-01-12, 2-01-13, 2-02-2, 2-05-4, 2-06-15, 2-06-20, 10-02-2 - and seed stocks for nectarine and peach – Sputnic 1 of CRBG AS USSR selection, presented a high efficiency in the Crimean nurseries, are possible to recommend for experimental studies under different soil and climatic conditions of Russia and Ukraine.
3. Seed stocks of drupaceous crops with low indices of their nursery properties are to exclude out of further investigations.

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Shoferistov Ye.P., Kabar A.N., Opanasenko V.F., Chelombit D.A., Lutsay N.A. New selective seed stocks of drupaceous cultures for nectarine // Bull. of the State Nikit. Botan. Gard. – 2015. – № 116. – P. 40-46.

New selective seed stocks of drupaceous cultures of the joint breeding work (Nikita Botanical Garden and botanical garden of Denpropetrovsk National University named after O.Gonchar in Dnepropetrovsk region) used for nectarine cultivation were researched. The most promising Crimean seed stocks of the following genotypes were sorted out: 1-1-1, 1-3-2, 2-01-12, 2-01-13, 2-02-2, 2-05-4, 2-06-15, 2-06-20, 10-02-27.

Key words: *stock, nectarine, peach, breeding, starting material, genotype, qualities appreciated in nursery field.*

PLANT PROTECTION

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ANALYSIS OF THE MODERN EQUIPMENT APPLYING FOR SPRAYING OF VINEYARDS UNDER CONDITIONS OF THE CRIMEA

Natalia Vasiliyevna Aleinikova, Liana Vladimirovna Didenko

SBE RC "National research Institute of grape and wine "Magarach", 298600, Republic of the Crimea, the city of Yalta, 31, Kirova str.
plantprotection-magarach@mail.ru

Introduction

Nowadays cultivation technology and their elements need to be upgraded for reducing the expenditure of energy for grapes production. This point is the urgent for most researchers.

Spraying the cultures vegetans is the most popular and spread protection method that suppose to use pesticides. It`s obviously improvement of technologies applied to realize this method has a direct connection with reliability, ecological compatibility and safety of chemical protection against harmful organisms [2].

"Increasing the efficiency" of protection system includes the following parameters: expansion of biological efficiency intended for a certain object, accelerating and prolonging the protection effect of applied preparations, reducing the phytotoxic effect on a culture, following the antiresistant programs. "Reducing the expenditure" for manufacturing work includes such parameters as cost dropping of 1 hectare cultivation, decreasing a number of treatments [1, 9].

Effective applying the plant defenders is possible having reliable equipment and qualified skills of necessary settings. Established practice of "error process" causes preparation waste, extra expenditure of time for settings, environmental protection, sometimes it brings exceeding the limits of acceptable defender concentration. Correct settings of a sprayer are possible if there are all necessary component units, a specialist well knows points of effective pesticide preparation and strict adhearance to fixed mode of aggregate.

Actually more than 90% of used plant defenders are applied by different sprayers. The most important parameter of a sprayer technical level is stability of its supplies, which is determined by material endurance of jets and initial fabrication accuracy. It`s necessary to replace sprayers in time according to their service life. Statistics presents that majority of sprayer disrepairs, fixed during equipment check-up, goes to atomizers. Atomizers with more or less 10% error must be replaced by new ones [4].

Leading foreign industries package their machines by different automatic adjusting devices. It`s well-known, that minimal loss of preparation during spraying occurs applying aerosol with drops till 100 mkm. Monodisperse sprayers are considered as high expensive technologies, but equipment with such level will be able to make out agriculture competitive [5, 8].

Recently home-made sprayers are supplied by import equipment. Having such a package and affordable prize they meet all demands of production. In many enterprises sprayers don`t give necessary effect. In practice it`s a well-known fact that the most effective preparations being applied by modern sprayers in terms of the latest technologies won`t bring a high quality and efficiency of chemical treatment in case of a wrong atomizer. So further investigations to find out optimal regulations for modern equipment application are still urgent.

The objective of this research is to assess and analyze modern equipment, which is in use for chemical treatment of fruit grape plantations in the Crimea.

Objects and methods of the research

The field experiments were carried out in 2013-2014 on Rkatsiteli grape plantations in south-west zone of the Crimean vineyard (AO "Agrofirma"Chernomorets"). The following methods, agreed in viticulture and plant protection, were applied during these researches:

- Itinerary inspections to reveal disease development on industrial vineyards;
- Field research to investigate dynamics of diseases development, determine grape crop capacity;
- Laboratory researches to determine sugars and titrable acids content in grape berry juice;
- Rated-statistical researches to find out development of diseases and biological efficiency of fungicides [3, 6, 7].

Water-sensitive paper was used to define a number of drops and their size for spraying by pesticide solution. It`s a cartridge paper with a special yellow cover, which gets dark blue if to contact with water drops. It was provided by company "Syntega" to intensify result rating of spraying by water solution under field conditions.

Water-sensitive paper was steppled directly on grape leaves on their border and inside the bush on the top, middle and down part before spraying. After spraying water-sensitive paper got dark-blue in case of contact with pesticide water solution. Colored paper was put away from the leaves at ones after it`s drying. In laboratory conditions spraying quality was determined.

Results and discussion

Dispersion of solution is one of the most important parameters that determine spraying quality of plants vegetans. It effects not only on chemical preparation containment by plants but on its falling out, covering of vegetative and generative organs, preparation penetration into tissue (leaf absorption) and its toxic properties for pesticides as well.

It was found out that principal technological parameters of slot atomizers set on various sprayers didn`t have any differences and corresponded to agrotechnical requirements: middle diameter of solution drops was 193,7 – 203,3 mkm, concentration of covering– 61,7 – 62,7 drops/sm^2, total working surface – 1,9 – 2 mm^2 (table 1).

Table 1

Quality rating of process solution spraying, using tractor atomizers OPV – 2000 ad IDEAL (AO "Agrofirma "Chernomorets", grape cultivar Rkatsiteli, on average per 2013-2014)

Layers of grape bush	Drop diameter, mkm	A number of drops (n), n/sm^2	Total working surface. mm^2
Eperiment – atomizer IDEAL (centrifugal atomizers)			
Top layer	210	62	2,1
Middle layer	202	64	2,04
Lower layer	198	59	1,8
Average	203,3	61,7	2
Etalon– atomizer OPV (centrifugal atomizers)			
Top layer	203	67	2,2
Middle layer	186	61	1,7
Lower layer	192	60	1,7
Average	193,7	62,7	1,9

At the same time biological efficiency against mildew was rated allowing for different atomizers. Biological efficiency against mildew working with tractor atomizers was rated as high – 88,2% in all experimental variations. Applying the injector atomizers which were set on sprayer IDEAL gave the best efficiency – 90,1% on leaves and on bunches – 91,6% (the beginning of ripening). Experiments where centrifugal atomizers were used resulted at the same phase 86,6 – 88,2% on leaves and bunches relatively (table 2).

Due to lack of favorable days for spraying and higher biological efficiency of injector atomizers in this research area (table 2), their technological parameters were rated through experiments conducted on vineyards.

Table 2

Biological efficiency against mildew applying tractor atomizers OPV – 2000 and IDEAL (AO "Agrofirma "Chernomorets", grape cultivar Rkatsiteli, 2013-2014)

Cultivar	Biological efficiency, %					
	Phase "pea-sized"		Phase "development of berries and shoots"		Phase "beginning of ripening"	
	leaves	bunches	leaves	bunches	leaves	bunches
IDEAL (injector atomizers)	100	-	99,5	98,7	90,1	91,6
OPV – 2000 (centrifugal atomizers)	100	-	90,7	93,6	86,6	88,2

Injector atomizers were set on sprayer IDEAL. They have a unique design what makes it possible to inhaust air, mixing it with process solution of pesticides, as a result it increases drop weight and size, which in this case can stand the wind, resist to evaporation and even runoff having correct settings.

During tests in 2013-2014 scientists compared characteristics of spraying quality by ceramic slot injector (IDEAL) and centrifugal atomizers (OPV – 2000). Study results are presented in table 3.

Table 3

Quality rating of process solution spraying using tractor atomizers OPV – 2000 ad IDEAL (AO "Agrofirma "Chernomorets", grape cultivar Rkatsiteli, on average per 2013-2014)

Layers of grape bush	Drop diameter, mkm	A number of drops (n), n/sm^2	Working surface, mm^2
Experiment-sprayer IDEAL (injector atomizer)			
Top layer	311	42	3,2
Middle layer	347	55	5,2
Lower layer	323	38	3,1
Average	327	45	3,8
Etalon – sprayer OPV (centrifugal atomizer)			
Top layer	210	61	2,1
Middle layer	198	70	2,2
Lower layer	221	65	2,5
Average	209,7	65,3	2,3

As a result drops ranging from 311-347 mkm applying sprayers IDEAL with injector atomizers are capable to get better treatment cover under non-optimal environmental conditions and reduce development of harmful organisms (table 2). Therefore we have

considerable advantages of injector atomizers as follows: level of falling out tends to decrease significantly, more even distribution of process solution across the whole grape bush and a large total surface of projection – on average 3,8 mm^2 of working surface in comparison with etalon - 2,3mm^2.

Conclusions

As a result of researches occurred on vineyards of Rkatsiteli cultivar in south-west zone of the Crimean viniculture the following was found out:

1. At present modern equipment and injector atomizers are actual during chemical treatment of plants.
2. Principal technological parameters of centrifugal atomizers meet the agrotechnical requirements: middle drop diameter of the process solution made 193,7 – 203,3 mkm, covering concentration – 61,7 – 62,7 drops/sm^2 and total surface of projection is 1,9 0 2 mm^2.
3. Sprayer IDEAL with injector atomizers produce drops ranges from 311 till 347 mkm what made it possible get better covering of the working surface under non-optimal environmental conditions, reducing level of harmful organisms development.
4. Biological efficiency of treatments using injector atomizers was rather high and during "beginning of ripening" it made 90,1% across leaves and 91,6% across bunches, what was higher than during the same phase presented by centrifugal atomizers (86,6 – 88,2% across leaves and bunches relatively).

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Aleinikova N.V., Didenko L.V. Analysis of the modern equipment applying for spraying of vineyards under conditions of the Crimea // Bull. of the State Nikit. Botan. Gard. – 2015. – № 116. – P. 47-51.

Sprayers applying for chemical protection of vineyards in the Crimea were analyzed and assessed. It was revealed that modern spraying equipment provides accurate dosage of preparation, its uniform distribution

over the work surface, good penetration through the grape bush, high or rather good degree of drip precipitation using injector or centrifugal atomizers. In terms of this research it was determined that applying the large-drop injector sprayer reduces drift of chemical preparations, improves quality and efficiency of pesticidal treatments.

Key words: *grape; equipment; spraying; dispersibility; sprayers; biological efficiency.*

PLANT CULTIVATION

UDC 635.92:582.923.5:631.542(477.75)

REGENERATIVE PRUNING PECULIARITIES OF *NERIUM OLEANDER* CULTIVARS WITHIN SOUTH COAST OF THE CRIMEA

Yelena Nikolayevna Spotar

Nikita Botanical Gardens – National Scientific Centre
298648, Republic of the Crimea, the city of Yalta, urban vil. Nikita
E-mail: elen_persic@mail.ru

Introduction

Due to warm Mediterranean climate on South Coast of the Crimea there is a large collection of evergreen arboreal plants, which are successfully used in green building to create landscape compositions of sanatoria - resorts zones and embankments. A quite important role goes to summer ornamental plants, capable to make resort guests and inhabitants happy. Oleander with high ornamental characteristics takes a special place here as it presents prolong continuous flowering period in summer-autumn. Though damaged shoots in severe for SCC winters cause some difficulties for this culture to be used in green building. As a result of hard damages by frosts some plants are subjected to renewal pruning till the stub.

Objective of our research is to determine regeneration terms of above-ground parts of oleander after pruning till the stub and its capacity to blossom the same year.

Objects and methods of the research

Material for our research was oleander collection of Nikita Botanical Gardens (NBG) aged by 4-30 years. At the same time visual observation after oleander plants being pruned till stub took part. These plants grow within detached areas under conditions of sufficient illumination and irrigation that is territory of parks: Alupka, Paradise, park of sanatorium Miskhor, Krym, Frunzenskoye; and embankments of Yalta and urban village Gurzuf, as well as unirrigated illuminated areas of some street plantations.

Phenological and biometrical observations after shoots were carried out by methodics developed in department of Dendrology and Floriculture [1], and making visual observations as well. As model specimens following plants were sorted out: 24 plants of 4 years (21 cultivars). growing under similar conditions on area with regular irrigation, 10 plants (6 cultivars) of 15-30 years, growing on different exposition sites under different care conditions, 30 plants of 70 years growing in Alupka (Vorontsov) park being under similar conditions with area regularly irrigated.

Results and discussion

Representatives of the only cultivar of *Nerium* L. Genus are plants with a high drought-resistance due to their xeromorphy. Ornamental properties combined with prolong flowering period (up to 90 days or more) make this culture widespread on the coast. Gardeners pay much attention to this oleander due to its easy cultivation, evergreen leaves

and of course its abundant flowering that starts from the beginning of June (in good years – from the end of May) and continue till the middle of October. Terms and time of oleander flowering to a large degree depend upon genotype, meteorological conditions and locality. Double-flowering group gets to start blossoming period 7-10 days later than plants of single group. In shady places plants are depressed: shoots stretch, blossoming period comes 2-3 weeks later than usual and keeps on for a little. Open areas favor intensive growth and abundant flowering of these plants. Southern exposition sites near building walls are also favorable localities for oleander cultivation, as they accumulate warmth in summer-autumn causing continuous blossoming of plants. Though due to their origin – from the coast of the Mediterranean Sea till Central Asia and Morocco, oleander doesn`t possess frost-resistance that`s why it inhabits only within the most southern parts of the Crimea – from Laspi in west till eastern border of Alushta. In the most severe for the Crimea winters, on non-wind-blown and unprotected places perennial shoots get damage by frost at -12 C° and freezes to the root, juvenile soft-wood shoots are damaged even at -5-6 C°. As a result of such weather conditions oleander shoots are subjected to renewal pruning till stub. It`s a well-known fact that on the Black Sea Coast of Caucasus (BCC) complete regeneration of oleander crowns after pruning till stub occurs in 3-4 years [4, 5]. As authors consider it`s caused by high humidity on BCC this very factor keeps off process of shoot lignifications. That`s why inflorescences of oleander plants are formed on lignified shoots. On South Coast of the Crimea (SCC) after freezing oleander is capable to regenerate its shoots fast enough and even start flowering the same year [3]. But there is a lack of data about shoot regeneration in cultivar profile.

Since 2012 till 2014 we conducted observations after oleander plants growth and development (21 cultivars), which were subjected to renewal pruning till stub, growing in similar conditions in introduction-collection nursery of Nikita Botanical Gardens.

Winter 2012 was characterized by unfavorable weather conditions for majority of introduction cultivars. At night from 1-2 February air temperature dropped down till -11,9 C° and was keeping on up for 12 hours, while from 7-8 of February frosty weather (-9,4 C°) was accompanied by storm wind of 21-24 m/sec and reduction of relative humidity till 24-27% [2]. Such a decrease of temperature in subtropical zone is considered as natural phenomena. Severe damages were registered on 4-years oleander plants what forced renewal pruning till stub [6].

It is known that oleander is characterized by high capacity to form shoots. Development of shoot system of study plants occurred due to latent buds, located in close to crown plant part. Observations after study plants made it possible to rate efficiency of crown renewal process after pruning till stub.

In May 2012 even shoot growing was fixed. On 31.05.2012 average height made 12-14 sm (fig.1), on 9.08.2012 their growth intensity presented good results – on average 76 sm (fig.2).

Fig.1 Status of 4-years oleander plants growing on area of introduction and collection nursery after spring pruning forced by frost damages in February 2012. 31.05.2012

Fig. 2 Status of 4-years oleander plants on area of introduction and collection nursery. 9.08.2012

During vegetative period in 2012 a number of renewal shoots ranged from 3 till 7 with an average height of 80 sm. In 2013 this number increased till 5-11 with an average height of 120 sm. Next year average shoot height reached 150 sm while number of renewal shoots became 23 (table 1).

Table 1

Results of oleander crown recovery after forced renewal pruning till the stub, April 2012

Cultivar	2012				2013				2014			
	Pruning till the stub	Shoot height, sm	A number of shoots, units	Flowering	Partial pruning	Shoot height, sm	A number of shoots, units	Flowering	Partial pruning	Shoot height, sm	A number of shoots, units	Flowering
Prof. Granel	+	65	4	-	-	110	5	+	-	150	10	+
Max	+	90	4	-	-	155	6	+	-	160	14	+
Cousine Marie	+	130	7	-	-	200	9	+	-	220	13	+
Jean de Battalier	+	80	5	+	+	100	7	+	-	155	12	+
M-me Allen	+	85	6	-	+	115	7	+	-	200	9	+
Angele Durac	+	60	6	-	+	90	7	+	-	120	12	+
Savort	+	90	6	-	-	135	6	+	-	210	8	+
Aurantiacum	+	95	3	+	+	120	6	+	-	145	6	+
Claude Blanc	+	115	4	+	+	145	9	+	-	145	11	+

M-me Planchon	+	115	7	+	-	160	8	+	-	170	11	+
Album Maximum	+	70	6	+	+	140	6	+	-	155	6	+
Splendens Giganteum	+	110	6	-	+	145	6	-	-	210	9	+
N.ol. var. atropurpureum hort.	+	45	4	-	+	95	6	+	-	130	6	+
Amabile	+	80	4	+	+	135	7	-	+	145	7	+
Loddigessii	+	70	6	-	+	100	7	+	-	110	9	+
Richard de Dellaval	+	85	5	-	-	145	10	+	-	155	20	+
Prof. Martin	+	60	5	-	-	105	11	+	-	170	14	+
Eos	+	65	5	-	-	115	11	+	-	160	11	+
Gilbert Bravy	+	20	5	-	-	60	5	+	-	70	5	+
Splendens foliis variegatum	+	30	5	-	+	60	10	-	-	70	13	-
Inodorum Soulgelii	+	55	5	-	-	110	6	+	-	155	7	+

Urgent point of our observations is to determine regeneration degree of renewal shoots the same year after pruning. Minimal shoot height was fixed for cultivar with single crimson flowers Gilbert Bravy – 20 sm. A group of double cultivars with pink flowers were had maximum height (from 110-130 sm): Splendens Giganteum, Claude Blanc, M-me Planchon.

Formation of generative sphere of study cases (table 2) had the following picture: double cultivar with pink flowers Jean de Battalier (5.07) and single cultivar Aurantiacum (9.07) with fair salmon flowers were characterized by the earliest inflorescence development with budding start (hereinafter b.s.) 18.07 and flowering beginning (hereinafter b.fl.) 2.08.

Table 2

Generative sphere formation of oleander plants in 2012

Cultivar	Plant height, the end of	Formation of reproductive shoots	Budding start	Flowering start	The end of flowering	Flowering duration (a number of

		2012, sm					days)
Prof. Granel		65	29.08	-	-	-	
Max		90	31.08	-	-	-	
Cousine Marie		130	21.09	-	-	-	
Jean de Battalier		80	5.07	18.07	2.08	26.08	24
Aurantia cum	I fl.	95	9.07	18.07	2.08	18.08	16
	II fl.		12.09	25.09	8.10	21.10	13
M-me Allen		85	18.09	-	-	-	
Angele Durac		60	20-30.08	-	-	-	
Savort		90	8.08	-	-	-	
Claude Blanc		115	1.08	16.08	28.08	19.09	22
M-me Planchon		115	8.08	15.08	8.09	23.09	15
Album Maximum		70	4.08	20.08	6.09	26.09	20
Splendens Giganteum		110	30.08	-	-	-	
N.ol. var. atropurpureum hort.		45	23.08	-	-	-	
Amabile		80	20.08	5.09	22.09	20.10	28
Loddigessii		70	9.08	-	-	-	
Richar de Dellaval		85	29.08	-	-	-	
Prof. Martin		60	15.09	-	-	-	
Eos		65	-	-	-	-	
Gilbert Bravy		20	-	-	-	-	
Splendens foliis variegatum		30	-	-	-	-	
Inodorum Soulgelii		55	-	-	-	-	

In the first decade of December cultivars Album Maximum (4.08) (a group of single white flowered cultivars), Savort (8.08), Claude Blanc (1.08), M-me Planchon (8.08) (double pink-flowered cultivars) and Loddigessii (9.08) (single red-flowered cultivar) started formation of inflorescences. Though budding with further flowering takes place only for Claude Blanc (b.s. 16.08;b.fl. 28.08), M-me Planchon (b.s. 15.08; b.fl. 8.09) and Album Maximum (b.s. 20.08; b.fl. 6.09).

Single pink-flowered cultivars Max, Angele Durac as well as double pink-flowered cultivars Prof. Granel, Splendens Giganteum, Amabile, Richar de Dellaval and red-flowered N.ol. var. atropurpureum hort. presented shoot formation in the third decade of August. In this case only Amabile (b.s. 5.09; b.fl. 22.09) initiated phase of budding and flowering.

Double white-flowered cultivar Cousine Marie, double pink-flowered cultivar M-me Allen and le single red-flowered cultivar Prof. Martin initiated development of reproductive shoots rather late (from 15.09 – 21.09). Budding and flowering phases weren`t fixed for them. Though it`s worth to point out Aurantiacum which presented the second flush of flowering 8.10.

In terms of the research it was found out only 5 oleander cultivars of both either double or single groups initiated flowering the same year after pruning. Concerning flowering period cultivars were classified as follows: the longest flowering period was fixed for Amabile (28 days); Jean de Battalier was in blossom 24 days; Claude Blanc and Album Maximum were flowering 22 and 20 days relatively; blossoming period of M-me Planchon made 15 days; Aurantiacum had the minimum period of flowering - 13 and 16 days. Shoot development is presented at figures 3-6.

In 2013 flowering period was fixed for 18 cultivars (table 1) in spite of forced renewal partial pruning carried out with 11 cultivars. Drop of air temperature till -2,3°C below zero accompanied by high wind of 30 m/sec on March the 24th determined the result we have. By the end of March air temperature rose till +21,2 °C [3]. In 2014 all cultivars showed intensive flowering besides double pink-flowered cultivar Splendens foliis variegatum with golden and varicoloured leaves and weak development of shoots.

Besides study cases of IKP, there were 15-30 years plants of four oleander cultivars, growing in Arboretum of Nikita Botanical Gardens within different exposition sites (table 3); 3 of them - Album Maximum, Splendidissimum, Italia develop on open area, one cultivars - Emile Sehut grows in shady wind-blown place. Album Maximum and Splendidissimum initiated blossoming the same year after pruning having from 16-25 shoots with height of 60-90 sm. Cultivar Emile Sehut began to blossom next year after pruning. Italia was characterized by weak

growth and late beginning of flowering – in 2015.

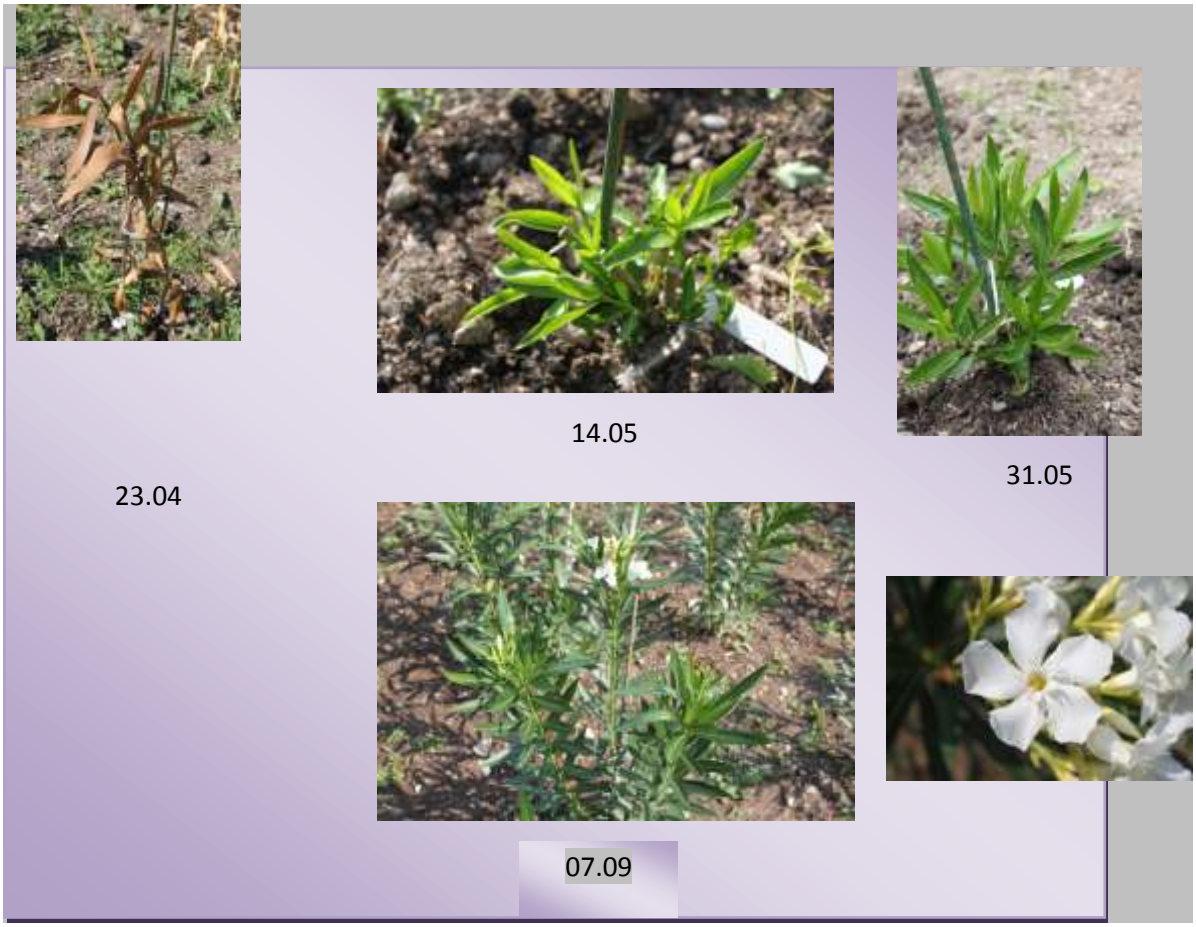

Fig. 3 Album Maximum. Development of shoots. 2012

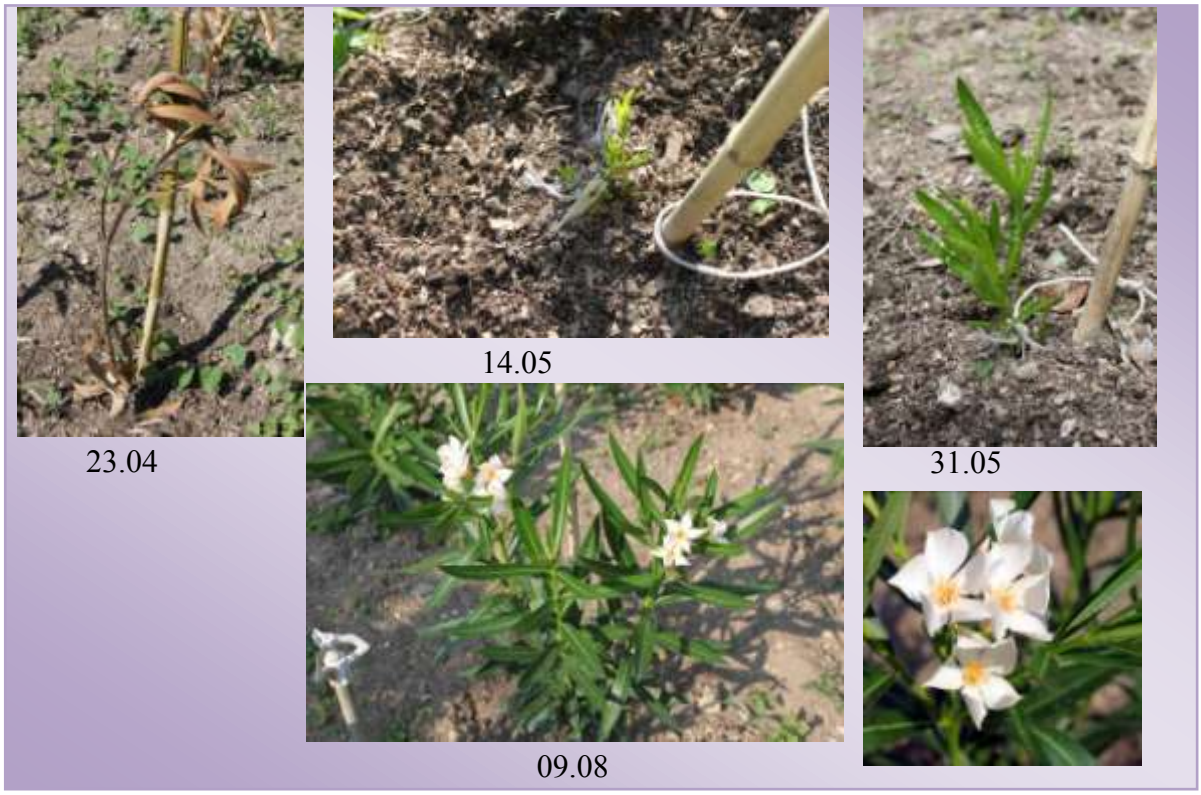

Fig. 4 Aurantiacum. Development of shoots. 2015

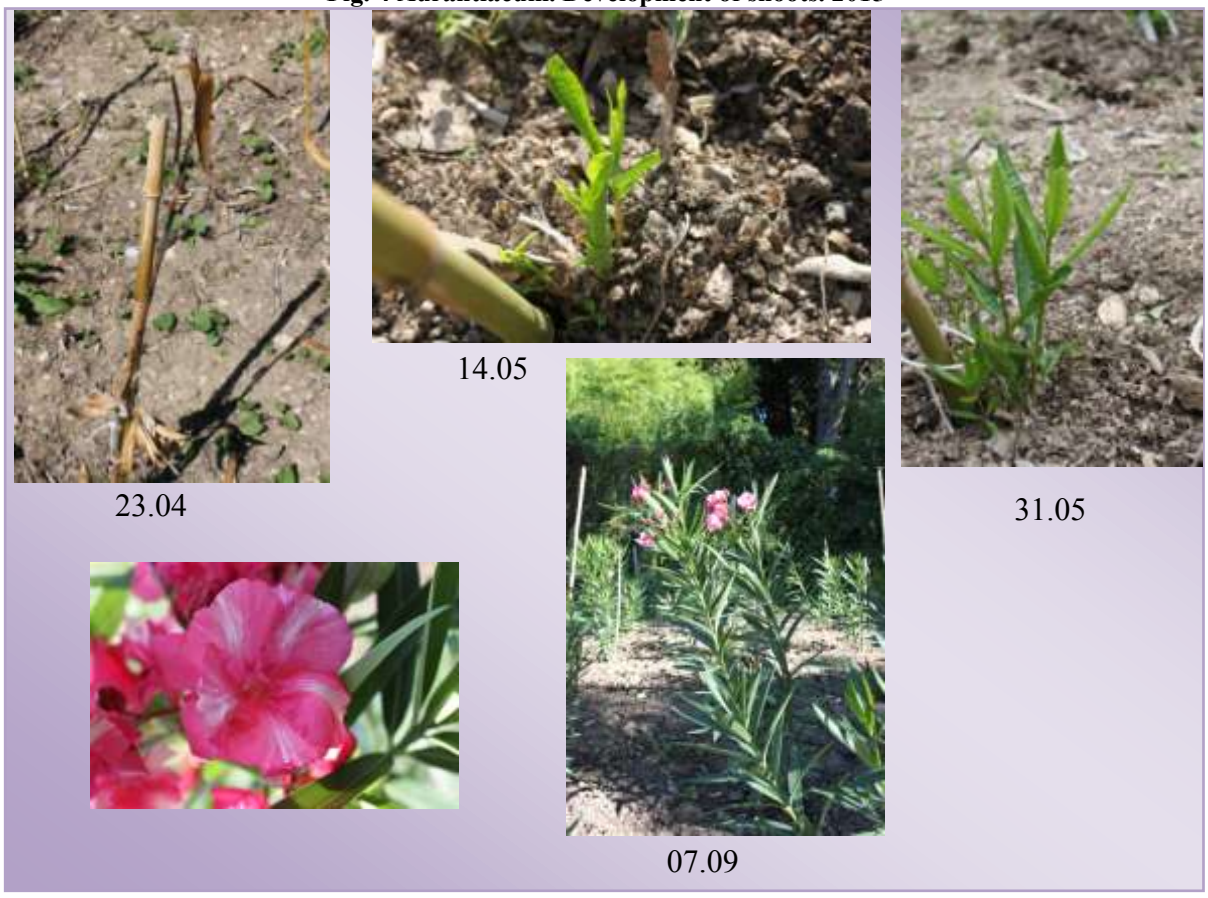

Fig. 5 Claude Blanc. Development of shoots. 2012

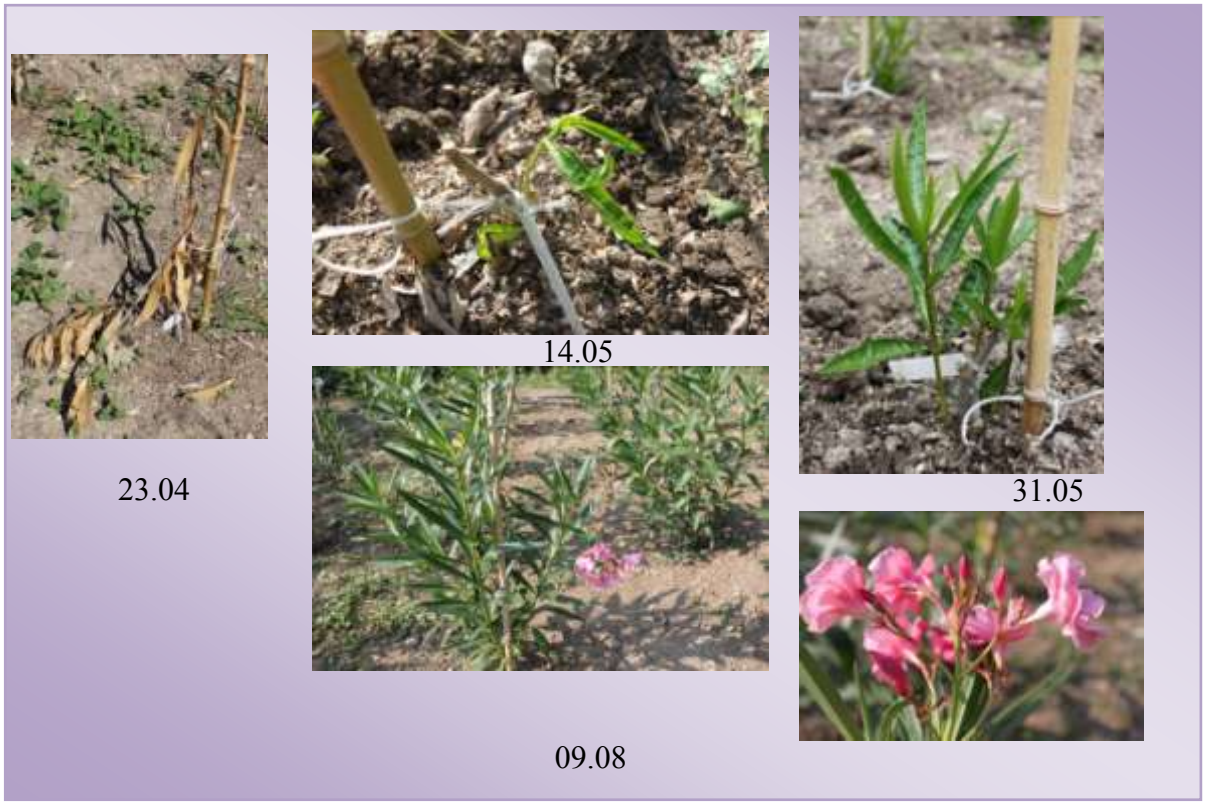

Fig. 6 Jean de Battalier. Development of shoots. 2012

Plants of double pink-flowered, growing in Alupka park of Vorontsov palace-museum (palm alley), were objects of our observations as well. In 2013 renewal pruning till stub of 70-years plants with diameter of stem branches till 15 sm resulted successful regeneration of all plants above-ground parts (30 specimens) during vegetative period of a current year; a number of renewal shoots reached 20 with height of 120 sm. Majority of these plants presented intensive blossoming in September.

Ten plants aged 15-20 years of Roseum cultivar, the most widespread on South Coast of the Crimea, were sorted out as control specimens. These plants grow in Arboretum under rather severe conditions being in need of regular irrigation. It was determined during the pruning year renewal shoots were 40-50 sm. Blossoming period happened a year later.

Table 3

15-30-years-old cultivars growing in Arboretum of Nikita Botanical Gardens

№	Cultivar	Plant status at year end 2012		Flowering		
		Height, sm	A number of renewal shoots, units	2012	2013	2014
1	Album Maximum	60	16	+	+	+
2	Splendidissimum	90	25	+	+	+
3	Emile Sehut'*	60	8	-	+	+
4	Italia	30	12	-	-	-

*- a plant grows on a shady wind-blown site of park

Conclusions

Observation with study plants made it possible to rate efficiency of crown regeneration as a result of rejuvenation pruning till stub.

It was found out that keeping all necessary measurements oleander plants subjected to forced rejuvenation pruning till stub are capable to renew lost crown easily during the pruning year.

Blossoming period comes during the pruning year depending upon cultivar and place of growth. If rejuvenation pruning till stub on South Coast of the Crimea is possible after strong frosting of stem branches, the same measurement isn`t appropriate under conditions of high humidity on the Black Sea of Caucasus because of continuous (3-4 years) expectation for renewal crown and further blossoming. Due to this criterion oleander is welcome as a coppice culture in landscape gardening and green building on South Coast of the Crimea.

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Spotar E.N. Regenerative pruning peculiarities of *Nerium oleander* cultivars within South Coast of the Crimea // Bull. of the State Nikit. Botan. Gard. – 2015. – № 116. – P. 51-59.

The article highlights the problem of Nerium oleander ornamentality if it`s used as a coppice culture on South Coast of the Crimea. It also presents results of crowns renewal after emergency regenerative pruning. Cultivars characterized by the most intensive growth and capacity to start blossoming the same year after pruning were marked out as well.

Key words: *plant condition; level of frosing up*; *Nerium oleander* L.*; regenerative pruning; renewal; renewal shoots.*

PLANT BIOTECHNOLOGY

UDC 602.4:635.21:631.52

TUBERIZATION AS A METHOD TO PRESERVE A VALUABLE GENE POOL OF *SOLANUM TUBEROSUM* L. FROM UKRAINIAN SELECTION BEING CULTIVATED *IN VITRO*

Oksana Leonidovna Klyachenko, Vera Vitaljevna Boroday

National University of Bioresources and Nature management
030041, Ukraine, the city of Kiev, 15, Geroyiv Oborony str.
veraboro@gmail.com

Introduction

Microtubers of *Solanum tuberosum* L. gained being cultivated in vitro, are widespread for mass intensified propogation of stronger test-tube material within system of elite seed farming, storage and propagation of stronger material, breading the new valuable forms due to tissue culture method, propagation of unique regenerants, as a result of distant somatic hybridization in terms of experiments at transformation and cell selection [1, 3, 6, 8, 10]. Microtubers are also used for safe carry during introduction, transport and exchange by gene pool between selection organizations, distribution taking quarantine steps of trial an examination.

Safekeeping of seed gene pool that belongs to cultures with vegetative propagation, including potatoes, isn`t possible as pubescence changes genetic composition of cultivars, presented by highly heterozygous genotypes. Among modern technology of gene pool safekeeping under controlled conditions there are introduction of different genotypes *in vitro*, plant rehabilitation after diseases, micropropogation, monitoring of phytosanity status of plants, genetic typing, middle-term safekeeping *in vitro*, cryopreservation and long-term cryokeeping [2].

Safekeeping of potato gene pool takes more than field collection, doublet specimens *in vitro* are necessary as well. One of the principal approaches in this case is keeping collection by way of slow-growing test-tube plants [4, 7, 11, 13]. Safekeeping *in vitro* collection under optimal growth conditions (+20-23°C) demands frequent transport of microplants into new nutrient medium what upvalues its storage and enhances chance of plants infection, especially it concerns untested specimens for pathogen. Various methods are applied to increase interval between passages. These methods are based on growth impairment of tested-tube plants. Getting and safekeeping under lower temperature of storage organ plants, including microtubers is one of the methods to slowdown culture growth. Characteristics of formed microtubers during the last growth phase are mainly determined by genotype and as a result demand differentiated conditions of initiation and tubers formation *in vitro*.

Research objective is to investigate tuberization peculiarities of different genotypes in Ukrainian selection, optimize regimes of their medium-term storage.

Objects and methods of the research

Researches had been carried out in laboratory of plant biotechnology at National University of Bioresources and Nature management of Ukraine for 2010-2013. Potato tubers of the following cultivars were chosen as research objects: early ripe cultivars – Serpanok and Povin; middle-early – Oberig and Zeleny Gay; mid-season – Kalynovskaya and Bylina; middle-late – Chervona Ruta and Dherelo Polesya.

Intermediate internodes of germinated tubers of 1-2 sm with one couple of leaves that contain meristematic tissue were used to get stools. Received aseptic shoots were separated from primary explantats and cultivated in modified nutrient medium Murasige-Skuga (MS) [1, 5, 9, 12].

The way of microtubers formation were investigated in nutrient mediums with different contents of sucrose (4-9%), phytohormones (indoleacetic acid – 0,1-0,4mg/l), kinetin (0,5-1,5 mg/l), mesoinosit (110-120 mg/l). Effect of daylight length and temperature were studied allowing for duration of photoperiod (14-16, 8-10 hours), illumination (lack of illumination, 3-4 klx, 6-8 klx), temperature regimes of middle-term storage of microtubers (+2-4, 6-8, 8-10°C).

Modified medium by D.P. Ostapenko was used to determine peculiarities of plant tuberization [6]. Mature tubers were kept in a coolroom for 4-6 months under various controlled temperatures.

Tables presented below contain arithmetical mean value from received values and standard deflection (SD). Application software Statistika 5.1 and Microsoft Office XP® for Microsoft Windows® were used for statistic processing of study results.

Results and discussion

Plant tuberization of *Solanum tuberosum* L. is a highly coordinated process, that includes morphologic, physiologic and biochemical variations of plants on different stages of ontogenesis. Stages of tuberization are stolon induction and initiation, stolon growth and its branching, the end of stolon growth, induction and initiation of tubers, growth and ripening of tubers [3, 13]. Carbohydrate and hormone factors are among principal conditions of these processes. These factors effect on photoperiodic reactions, complex of biochemical processes. Tuberization is preceded by increasing of photosynthetic activity, accumulation of assimilate fund in stems and intensive transport of carbohydrates towards tubers [1, 3, 9].

In terms of our researches induction of stolon formation took place in 5-6 days after laterals occurrence in case of stem explants cultivation under conditions of diffuse light 0,5-1 klx in medium MS, added by kinetin of 0,5 mg/l and 2-4% of sucrose. Cytokinins effect became apparent due to intensive formation of laterals and development of stolons. Later for 3-5 weeks after thickening of stolon subapical zone formation of microtubers occurred. Hereafter intensity of tuberization reduced due to their formation period finished and their size enlarged. Microtubers, as a rule, were formed on stolons and from nodes on stems (fig.1).

Fig.1 Peculiarities of *Solanum tuberosum* microtubers formation being cultivated *in vitro*

Sometimes having removed apical dominance had the following sequences: slowdown of axial growth, slowdown of shoot growth and microtubers formation in atriums of stem explantats within non-hormonic medium MS with 2% content of sucrose during 16 hours of photoperiod (fig.2).

Fig.2 Microtuber formation having removed apical dominance within non-hormonic medium MS

Differences in induction of tuberization had cultivar correlation (fig.3). A number of plants, that produced microtubers, ranged from 68,7 – 98,2%. Culyivars Oberig, Zeleny Gay, Chervona Ruta and Kalinovskaya were characterized by the highest capacity to form microtubers with rate 1,7-2,1 microtubers per 1 plant; cultivars Bylina and Dzherelo Polesya – 1,2 and 1,4 relatively; cultivars Serpanok and Povin – 1,1 and 1,0. At the same time microtubers were ovel and oblong with various colours (from dark-green to dark-purple depending upon genotype) and size (3-1 mm). During further clonal micropropagation of somaclones with insignificant morphological differences capacity to form tubers hardly differed from parent forms. Microtuberization of dwarfish and bushy forms with small leaves and weakened apical dominance wasn`t much pronounced (insignificant thickening of stolons).

Fig. 3 Microtubers of Solanum tuberosum, cultivars of Ukrainian breeding: Early ripe – Serpanok (1) and Povin (2), middle-early – Oberig (3), mid-season – Kalinovskaya (5) and Bylina (6), middle-late – Chervona Ruta

Belonging to this or that group of ripening didn`t effect much on formation of microtubers *in vitro*. Each group included cultivars with high, middle and low capacity to form microtubers. All study cases presented induction of microtuberization during the first month. According to statistic data reliable regularities didn`t take place between plants of different ripening groups (table).

Table

Peculiarities of microtubers formaton depending upon genotype

Cultivars	Initiation of tuberization, day	Formation of microtubers, %	Average weight of microtubers, (mg)	Productivity of tuberization, units	Fraction classification of microtubers, %		
					large, 8-10	*middle, 5-7 mm*	*small ,*

					mm		*till 5 mm*
Early-ripe							
Serpanok	18,3	75,3	148±12	1,1±0,02	15,2	50,5	34,3
Povin	25,6	68,7	114±15	1,0±0,01	13,3	34,6	52,1
Middle-early							
Oberig	17,5	85,1	236±21	1,9±0,03	45,1	35,2	19,7
Zeleny Gay	19,9	92,8	363±20	1,7±0,01	25,4	43,7	30,9
Mid-season							
Kalinovskaya	21,3	81,6	270±12	2,1±0,02	38,7	39,2	22,1
Bylina	19,1	81,4	178±17	1,2±0,04	30,2	41,5	28,3
Middle-late							
Chervona Ruta	14,0	87,3	287±18	1,8±0,02	29,4	36,8	33,8
Dzherelo Polesya	16,7	77,4	218±14	1,4±0,03	20,0	36,1	43,9

Medium Ms, supplemented by kinetin – 0,5-0,8 mg/l indoleacetic acid – 0,1-0,2 mg/l, mesoinosit – 100-110 mg/l, sucrose – 4-9%, had stimulative effect on process of tuberization. For cultivars, inclined to tuberization *in vitro,* sucrose concentration made 4-6%, while for cultivars which have not so easy way of these processes sucrose content is 6-8% [2,4]. Maximum number of plants with tubers was registered in medium with kinetin 0,5-0,8 mg/l, reducing or increasing concentration of these hormones tended to decrease of microtubers.

Minimum number of microtubers formed under conditions of 16-hours of photoperiod, further cultivation during 1,5-2,0 months under controlled conditions (14-16 hours photoperiod, illumination 6000-8000 lx, temperature +20-22°C) induced germination of forming tubers. Abatement of illumination caused considerable growth of specimens with microtubers. 8-hours photoperiod and controlled temperature (+19-20°C) during first 8-10 days with further cultivation in the dark, favored formation of some small microtubers (fig.4). During dark period formation of microtubers practically didn`t occur.

High intensity of microtuber formation was actual during first 10-12 days under conditions of 8-hours photoperiod, but later - illumination 3-4 klx (diffusal light) and controlled temperature +19-21°C.

Fig.4 Peculiarities of *Solanum tuberosum* tuberization having different illumination regimes

The most favorable temperatute for keeping microtubers in coolroom during 4-6 months was +2-4°C. At the same time by the end of storage small shoots occurred, which didn`t reduce high vital capacity of tubers which were planted into sterile soil later (fig.4). Plants with mirotubers formed 1-2 stems with 5-10 internodes. Plant establishment ranged from 80-89%.

Fig.4 Sprouting of potato microtubers after long storage *ex vitro*

Taking into consideration natural physiological period of microtubers rest, which was artificially prolonged due to permanent specimen storage under low temperatures above zero (+2-4°), and then delayed sprouting of microtubers under these conditions, direct cycle of specimens storage is possible to extend much.

Conclusions

Effect of potato cultivar characteristics on process of microtuber formation was determined as a result of this research. In this way cultivars Oberig, Zeleny Gay, Chervona Ruta and Kalinovskaya presented the highest capacity to microtuber formation.

Optimal conditions of tuberization for Ukrainian breeding genotypes were determined as well allowing for cultivation in medium Ms, supplemented by kinetin 0,5-0,8 mg/l, indoleacetic acid – 0,1-0,2 mg/l, mesoinosit – 100-110 mg/l, sucrosw – 4-9 %. Initiation of tuberization for cultivars Oberig, Zeleny Gay, Chervona Ruta and Kalinovskaya were more intensive keeping plants under conditions of 8-hours photoperiod and controlled temperature +19-20°C during the first 8-10 days with further cultivation under condition of diffusal light (3-4 klx).

Collection *in vitro* is kept in gene bank with controlled temperature +2-4°C with a lack of illumination during 4-6 months.

Keeping in collection *in vitro* highly productive and adaptive to local climatic and soil conditions potato cultivars that have different vegetative period (early maturation) and purpose is an important stage in elite seed farming. Optimization of potato tuberization induction is practical and necessary part in researching the new valuable plant forms of this culture being cultivated *in vitro.*

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Klyachenko O.L., Boroday V.V. Tuberization as a method to preserve a valuable genotype of *Solanum Tuberosum* l. from Ukrainian selection being cultivated *in vitro* // Bull. of the State Nikit. Botan. Gard. – 2015. – № 116. – P. 60-65.

The most favorable conditions of tuberization for different *Solanum tuberosum* genotypes from Ukrainian selection were determined in terms of the research. Initiation of tuberization was more intensive if plants were kept under conditions of 8-hours photoperiod and controlled temperature +19-20°C during the first 8-10 days with further cultivation under conditions of diffused light (3-4klux). Within research it became possible to investigate tuberization peculiarities of gene pools with different ripening terms, get microtubers of 3-11mm and 114-287mg and optimize regimes of microtubers medium-term storage.

Key words: *Solanum tuberosum L; tuberization in vitro; microtubers; genotype*

HUMAN PHYTOREHABILITATION

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ESSENTIAL OIL OF *NEPETA CATARIA* AND ITS EFFECT ON PSYCHOPHYSIOLOGICAL STATE OF ELDERLY PEOPLE BREATHING IT IN LOW CONCENTRATION

Valentina Valerievna Tonkovtseva, Timur Rustemovich Bekmambetov, Nadezhda Nikolayevna Bakova, Aleksandr Mikhailovich Yarosh

Nikita Botanical Gardens – National Scientific Centre
298648, Republic of the Crimea, the city of Yalta, urban vil. Nikita
valyalta@rambler.ru

Introduction

Essential oil (EO) of *Nepeta cataria* L. is well-known as an aphrodisiac first of all [7]. It was revealed as a spasmolytic preparation as well [6]. Being concentrated in the air of 1 mg/m^3 it reduces personal anxiety, improves general condition, mood, work capacity, vivacity and attentiveness [5].

Important task is to minimize body burden during aromatherapy due to reduction of the EO concentration in the air. It particularly concerns elderly people. But at the same time aromatherapy effect is impossible to the full.

Research objective is to investigate *Nepeta cataria* L. EO effect breathing it in low concentration on some functions of human central nervous system and cardiovascular system to find out if it does for aromatherapy.

Objects and methods

Researches were carried out in a group of 20 people, mainly women aged at 50-80 years old. The same by composition and number group was used as a control variant. Tested people of a control group were in rest listening to psychorelaxing record for 20 minutes. Experimental group were placed in the same room during the same time listening the same psychorelaxing record but breathing evaporated EO of *Nepeta cataria* L. till the final concentration in the air of 0,1 mg/m^3. Tests were conducted before and after procedures.

To assess procedure effect on cardiovascular system we measured heart rate (HR), systolic (BPS) and diastolic (BPD) blood pressure (BP).

Correction task, WAM test (well-being, activity, mood) and scale of anxiety and depression were applied to rate EO effect on nervous system [1,3,4].

Results were processed statistically due to paired test t-criterion by Student [2].

Results and discussion

According to parameters of WAM test experimental and control groups didn`t have any reliable difference initially (table 1).

After psychorelaxation session (control) psychoemotional condition of tested people held on the same level.

After aromapsychorelaxation session (experiment) reliable differences weren`t registered as well. Otherwise, aroma session with *Nepeta cataria* L. EO didn`t influence on psychoemotional condition of tested people.

Table 1

Effect of *Nepeta cataria* L. EO on psychoemotional condition of tested people (Parameter of WAM-test, standard units)

Parameter	Experimental group initially	Control group initially	Experim.group after test	Control after test
General condition	157,40 ±3,85	155,90 ±7,69	156,70 ±6,14	163,30 ±5,55
Well-being	158,30 ±4,10	160,45 ±6,57	157,70 ±5,84	163,40 ±5,36
Mood	158,05 ±4,19	158,60 ±6,23	159,65 ±5,49	162,95 ±5,81
Weakness - capacity to work	155,60 ±4,33	151,90 ±8,03	155,75 ±6,18	158,25 ±5,69
Tension – relaxation	146,75 ±5,87	151,90 ±6,96	149,85 ±6,42	156,15 ±5,08
Inertness –vivacity	155,85 ±4,59	153,85 ±7,47	153,75 ±7,00	160,85 ±5,77
Absend-mindedness – attentiveness	140,25 ±8,56	142,25 ±8,71	139,75 ±8,05	149,05 ±7,38

Psychoemotional condition of tested people from both groups (experimental and control) according to scale of anxiety and depression didn`t present any reliable differences (table 2).

Session of psychorelaxation didn`t reveal any reliable variations of test parameters in control group.

At the same time session of aroma psychorelaxation also didn`t cause any reliable changes of test parameters in experimental group as well.

Table 2

Effect of *Nepeta cataria* L. EO on psychoemotional condition of tested people (by scale of anxiety and depression, standard units)

Scale	Experimental group initially	Control group initially	Experim.group after test	Control after test
Anxiety, standard units	7,30±0,92	7,20±1,01	7,30±0,84	6,50±1,14
Depression,standard units	7,75±0,79	7,70±1,02	7,50±0,58	7,64±0,98

Rating of procedure effect on mental capacity by correction task (literal variant) found initial difference between parameters of control and experimental groups unreliable (table 3).

After psychorelaxation control group didn`t show reliable changes of test parameters. While after aroma psychorelaxation in experimental group pace of work had reliable variations during the second minute of the test. At the same time a number of mistakes decreased reliably during both minutes of this test.

Table 3

Effect of *Nepeta cataria* L. EO on mental capacity (by parameters of correction task)

Parameter	Group	Initially	After test	P b/a<
Tempo 1,symbol/min	Control	228,50±16,41	230,95±16,47	
	Experiment	235,40±15,44	240,15±18,32	
Mistakes 1, symbols	control	1,15±0,41	0,95±0,32	
	experiment	1,70±0,37	0,76±0,19	0,01
Tempo 2, symbol/min	control	213,00±17,74	226,05±17,06	
	experiment	202,60±12,77	244,85±18,73	0,005
Mistakes 2,symbols	control	1,45±0,58	1,29±0,48	
	experiment	1,85±0,44	0,70±0,24	0,01

Initially (before test) reliable differences between values of BP and HR in both groups (control and experiment) weren`t registered (table 4). At the same time either experimental or control group presented normal average value of BPS, BPD – optimum by JNC6, HR were normal as well.

After session of psychorelaxation parameters of BP and HR in control group didn`t differ from initial data. But in experimental group session of aromarelaxation caused reliable reduction of BPS and HR.

Table 4

Relaxation effect on BP and HR using *Nepeta cataria* L. EO

Group	Experimental group initially	Control group initially	Experimental group after test	Po b/a<	Control group after test
BPS, mm of mercury	123,60 ±3,45	120,80 ±3,90	115,75 ±2,69	0,002	119,41 ±3,88
BPD, mm of mercury	78,05 ±1,88	77,75 ±1,86	76,80 ±1,73		76,70 ±2,09
HR, hearbeat/min	72,05 ±1,94	70,85 ±1,36	68,25 ±1,64	0,0008	70,40 ±1,38

Therefore *Nepeta cataria* L. EO breating it in low concentration didn`t have any effect on psychoemotional condition of tested people. Though it stimulated mental capacity (reliable increasing of work rate during the second minute of the test). Moreover its accuracy level went up.

Consequently the principal result of *Nepeta cataria* L. EO effect on human higher nervous activity is stimulation of mental capacity. Light hypotensive and bradicardial influence of *Nepeta cataria* L. EO is considered as a positive property for its practical appliance, especially in work with people suffered from hypertension.

Pointed positive changes were registered in case of very low *Nepeta cataria* L. EO concentration in the air, that is 0,1 mg/m^3.

Conclusions

1. *Nepeta cataria* L. EO didn`t effect on psychoemotional condition of tested people breathing it in concentration 0,1 mg/m^3.
2. During correctional task *Nepeta cataria* L. EO presented a light stimulative effect on mental capacity and increased its accuracy in the same concentration.
3. *Nepeta cataria* L. EO in concentration 0,1 mg/m^3 possesses light hypotensive and bradicardial effect.

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Tonkovtseva V.V., Bekmambetov T.R., Bakova N.N., Yarosh A.M. Essential oil of N*epeta Cataria* and its effect on psychophysiological state of elderly people breathing it in low concentration // Bull. of the State Nikit. Botan. Gard. – 2015. – № 116. – P. 66-69.

Essential oil (EO) of *Nepeta Cataria* didn`t make any effect on psychoemotional state of tested people. In a test proof the EO stimulated mental capacity and improved its accuracy a bit. EO of *Nepeta Cataria* possesses some hypotensive and bradycardial effect.

Key words: *essential oil; aroma session; aromatherapy; Nepeta Cataria; psychorelaxing record; mental capacity; psychoemotional state*

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ESSENTIAL OIL OF *SALVIA SCLAREA* AND ITS EFFECT ON PSYCHOPHYSIOLOGICAL STATE OF ELDERLY PEOPLE BREATHING IT IN LOW CONCENTRATION

Yelena Stanislavovna Koval, Valentina Valeriyevna Tonkovtseva, Timur Rustemovich Bekmambetov, Aleksandr Mykhailovich Yarosh

Nikita Botanical Gardens – National Scientific Centre
298648, Republic of the Crimea, the city of Yalta, urban village Nikita
valyalta@rambler.ru

Introduction

Essential oil of *Salvia sclarea L.* is quite popular in aromatherapy [6]. It was found as an antidepressant [8], stress-limiting [9] and hypotensive remedy [5]. *Salvia sclarea L.* composition is rather close to *Lavandula angustifolia*: its main components are linalil acetate, linalool, geranyl acetate and terpineol [7]. To minimize body burden in terms of aromatherapy is an important task. It`s possible due to reduction of EO content in the air. It

especially concerns elderly people. But at the same time this result can be achieved on account of aromatherapy effect.

Research objective is to investigate effect of *Salvia sclarea L.* EO of low content on some functions of human central nervous sytem and cardiovascular system to rate if it does for aromatherapy.

Objects and methods

Researches involved a group of 20 people, mainly women aged by 55-80 years old. There was a control group, the same by composition and number. Tested people of a control group were in rest listening to psychorelaxing record for 20 minutes. Experimental group were placed in the same room during the same time listening to the same psychorelaxing record but breathing evaporated EO of *Salvia sclarea L.* till the final concentration in the air of 0,1 mg/m^3. Tests were conducted before and after procedures.

To assess procedure effect on cardiovascular system we measured heart rate (HR), systolic (BPS) and diastolic (BPD) blood pressure (BP).

Correction task, WAM test (well-being, activity, mood) and mental speed test were applied to rate EO effect on nervous system [1,3,4].

Results were processed statistically due to paired test t-criterion by Student [2].

Results and discussion

According to parameters of WAM test experimental and control groups didn`t have any reliable difference (table 1).

After psychorelaxation session (control) well-being and mood of tested people improved reliably.

After aromapsychorelaxation session (experiment) well-being tended to improve. Otherwise, aroma session with *Salvia sclarea L.* EO didn`t influence on psychoemotional condition of tested people.

Table 1

Effect of *Salvia sclarea L.* EO on psychoemotional condition of tested people (Parameter of WAM-test, standard units)

Parameter	Experimental group initially	Control group initially	Experim.group after test	Po b/a<	Control after test	Pк b/a<
General condition	118,2±6,6	115,5±6,0	127,4±5,5		118,2±6,0	
Well-being	115,1±6,7	113,0±6,7	128,1±5,6	0,06	118,3±6,4	0,02
Mood	125,7±7,5	124,6±11,8	129,9±5,7		138,3±9,3	0,06
Weakness - capacity to work	111,4±8,5	113,5±7,9	123,6±6,4		116,4±8,0	
Tension – relaxation	115,2±7,0	108,2±6,4	125,5±6,1		113,1±7,3	
Inertness –vivacity	120,2±8,3	122,2±9,6	125,8±6,9		126,7±6,6	
Absend-mindedness – attentiveness	118,8±8,6	122,6±6,5	128,7±6,2		121,3±6,9	

Procedures effect on mental capacity of tested people from both groups (experimental and control) according to correction task (numeric variant) didn`t present any reliable differences (table 2).

Session of psychorelaxation didn`t reveal any reliable variations of test parameters in control group, while session of aroma psychorelaxation considerably increased work rate during the second minute of the test in experimental group. At the same time a number of mistakes rose reliably during both test minutes.

Table 2

Effect of *Salvia sclarea L.* EO on mental capacity of tested people (according to data of correction task)

Parameter	Group	Before procedure	After procedure	P b/a<
Tempo 1, symbol/min	control	285,20±16,98	305,30±17,05	
	experimental	284,70±20,36	306,80±20,63	
Mistakes 1, symbols	control	1,70±0,45	2,50±0,59	
	experimental	1,50±0,39	3,20±0,37	0,0002
Tempo 2, symbols/min	control	283,45±20,04	274,80±23,02	
	experimental	288,60±17,17	330,20±24,96	0,01
Mistakes 2, symbols	control	2,35±0,75	2,95±0,66	
	experimental	1,60±0,48	3,85±0,81	0,01

Test that included more complicated intellectual processes (restore of missed letters in words) initially didn`t present reliable differences between groups (table 3). A lack of reliable variations became a result of psychorelaxation procedures in a control group and aroma psychorelaxtion in experimental group.

Table 3

Effect of *Salvia sclarea L.* EO on mental speed (according to test of restoring the missed letters)

Parameter	Group	Initially	After procedures
A number of words, units	control	23,50±1,58	22,70±1,67
	experiment	24,30±1,20	25,00±1,91
A number of mistakes, units	control	1,20±0,29	1,85±0,44
	experiment	1,20±0,25	1,80±0,37

Initially (before test) reliable differences between values of BP and HR in both groups (control and experiment) weren`t registered (table 4). At the same time either experimental or control group presented normal average value of BPS, BPD – optimum by JNC6, HR were normal as well.

After session of psychorelaxation parameters of BP and HR in control group didn`t differ from initial data. But in experimental group session of aromarelaxation caused reliable reduction of BPS and HR.

Table 4

Relaxation effect on BP and HR using *Salvia sclarea L.* EO

Group	Experimental group initially	Control group initially	Experimental group after test	Po b/a<	Control group after test
BPS, mm of mercury	124,75 ±3,93	126,10 ±4,14	118,25 ±3,68	0,003	124,25 ±4,24
BPD, mm of mercury	78,35 ±2,11	78,85 ±1,96	76,50 ±1,76		77,45 ±2,29

HR, hearbeat/min	77,00 ±2,49	73,40 ±1,89	73,95 ±1,94	0,05	72,15 ±1,86

Therefore *Salvia sclarea L* EO breating it in low concentration didn`t have any effect on psychoemotional condition of tested people and complicated mental work. Though it stimulated mental capacity (reliable increasing of work rate during the second minute of the test), accuracy went down.

Consequently the principal result of *Salvia sclarea L* EO effect on human higher nervous activity is stimulation of quite simple processes. Light hypotensive and bradicardial influence of *Salvia sclarea L* EO is considered as a positive property for its practical appliance, especially in work with people suffered from hypertension.

Pointed positive changes were registered in case of very low *Salvia sclarea L* EO concentration in the air, that is 0,1 mg/m^3.

Conclusions

1. *Salvia sclarea L*. EO didn`t effect on psychoemotional condition of tested people.
2. *Salvia sclarea L.* EO presented a light stimulative effect on mental capacity making rather simple tasks.
3. *Salvia sclarea L.* EO possesses light hypotensive and bradicardial effect.

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Koval Ye.S., Tonkovtseva V.V., Bekmambetov T.R., Yarosh A.M. Essential oil of *Salvia Sclarea L.* and its effect on psychophysiological state of elderly people breathing it in low concentration // Bull. of the State Nikit. Botan. Gard. – 2015. – № 116. – P. 69-73.

Essential oil of *Salvia Sclarea* of 0,1 mg/m^3 didn`t effect on psychoemotional state of people being tested, it called forth some stimulant influence on mental capacity only in case of a quite simples tasks, some hypotensive and bradycardial effect was fixed as well.

Key words: *essential oil, aroma session, aromatherapy, Salvia sclarea L., psychorelaxing record, mental capacity, psychoemotional state.*

INFORMATION FOR AUTHORS

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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.).

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PATTERN OF ARTICLE EXECUTION

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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

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
3. Determiner of higher…Literary source…
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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.*

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2. Words shouldn`t be hand-carried.
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6. Decimal fractions are separated by commas: 0,1 or 0,5.
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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.
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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.

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FIGURE PATTERN

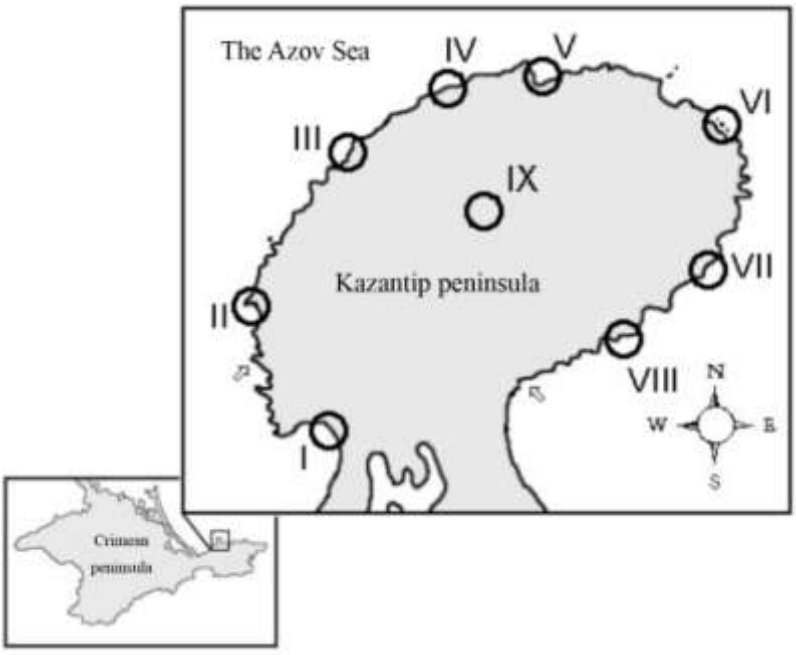

Fig. 1 Sketch map of inspected region (stations I-VIII)

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

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

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Books:

1. *Novosad V.V.* Flora Kerchensko-Tamanskogo regiona. – K.: Naukova dumka, 1992. – 275 s.
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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.

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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.

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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.

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