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A DYNAMIC MODEL OF THE WATER RELATIONSHIPS OF SOME BUSH CULTIVARS GROWING IN LOWER LAYER UNDER CONDITIONS OF PARK PHYTOCLIMATE ON SOUTH COAST OF THE CRIMEA

PLUGATAR YU.V., ILNITSKY O.A., KOVALYOV M.S., KORSAKOVA S.P.

Nikita Botanical Gardens – National Scientific Centre, the city of Yalta

Introduction

In the course of landscape architecture, aesthetic features of trees and bushes have a great significance for choosing of necessary plant species. They are characterized by changing size, form, colour, foliage capacity, that depends on their growth, development, seasonal cycles of their vital functions [1, 2, 10]. Each plant especially detached one is unique with its own characteristics of height, habitus and crown form. At the same time in group plantations trees and bushes are capable to adapt to each other, creating not just a set of separate plants, but a single correlated group capable of self-regulating and forming balanced plant mass.

While forming size-space park composition the prior significance goes to plant habitus, their height, macrobiosis and dynamics of their interrelations development.

Sharp fluctuations of meteorological factors, changing every year, often become a reason of stress situation for plants. One of such stress effect, emerging on different ontogenesis stages of any plant organism, is water stress. Considerable part of the Crimean territory is subhumid with irregularity of precipitation and frequent dry periods. Furthermore plants often have a lack of moisture deficit due to high temperature in summer, sharp fluctuations of weather conditions, environmental pollution, irrational utilization of water resources and incorrect agrotechnical measures [8]. Plant resistance to agroecological factors is one of the difficult questions in introduction of plants, especially concerning ornamental cultivars. Therefore response of lower layer plants to changes of environmental factors, assessment of these factors impact on moisture regimen are of great interest researching plant drought- and shadow-resistance, quite necessary parameters for further development of recommendations at growing under specific conditions [3,6].

In accordance to stated above, the research objective was defined: to investigate parameters variations of plant water exchange applying phytomonitoring methods and develop general biological assessment criterion of genotypic drought-resistance of an introduced cultivars that allows define plant tolerance degree to stress susceptibility [3, 7, 9].

Objects and methods of the research

This investigation was carried out using methodology and phytomonitoring instrument base. Following rapid methods were used:

- Determination of xylem (timber) moisture deficit;
- Measurement of xylem stream linear velocity in trunks of arboreal plants.

To define xylem moisture deficit, method of heat pulses was used. It is a matter of xylem, xylem stream makes 98-99% of the total stream (xylem and phloem stream), heat point moves up by xylem stream. In this technical decision results of heat-pulse measurements gained the principal significance to define xylem moisture level. It is generally known, this method is applied to determine linear velocity of xylem stream, though only this pulse time component was used. The amplitude component isn`t of great importance for scientists. A new method of this parameter determination was developed and patented [5].

Sensor for measurement of this parameter was installed at altitude of 0,6 – 1,1 m above ground.

This sensor determined the linear velocity of xylem stream as well [12, 14, 15]. This parameter lets determine correlation coefficient of water stress and drought-resistance of investigated plant cultivars. Water stress coefficient is calculated by formula:

$$C\ w.s. = Vm./Va.,\ sep.unit$$

Where: Vm. – xylem stream linear velocity in the morning;

Va. - xylem stream linear velocity in the afternoon.

Applied rapid-methods having simultaneous measurement of environmental parameters under microclimate conditions (illumination, air temperature, air humidity, temperature and moisture level of soil, air humidity deficit) allowed study some ecophysiological characteristics of investigated bush cultivars in the lower layer. Environmental parameters were measured by standard methods, applied in meteorology [11].

As pattern objects 8 plant species have been selected, various in their water relationships, drought- and shadow-tolerance level (table 1): *Pittosporum heterophyllum* Franch., *Buxus sempervirens* L., *Euonymus japonica* Thunb., *Chimonanthus praecox* (L.) Link, *Viburnum tinus* L., *Cornus mas* L., *Laurocerasus officinalis* M. Roem., *Aucuba japonica* Thunb.

Table 1

Bioecological characteristic of some bush cultivars growing in the lower layer of parks on South Coast of the Crimea

Cultivar	Frequency of occurrence	Shade tolerance	Drought-resistance	Blossoming, fruitage	Ornametality	Function
Pittosporum heterophyllum	S	++	++	Fr.	1	2
Buxus sempervirens	M	+++	++	Fr.	1	1, 2
Euonymus japonica	O	++	++	Fr.	1	2
Chimonanthus praecox	S	++	++	Fr.	3	2
Viburnum tinus	S	+++	++	Bl.	1	2
Cornus mas	O	++	+++	Fr.	3	2
Laurocerasus officinalis	O	++	++	Fr.	1	1, 2
Aucuba japonica	S	+++	+	Bl.	1	2

Frequency of occurrence: S –single instance (from 1-5 specimens); O – often (from 20-100 specimens.); M – mass (over 100 specimens.)

Shade tolerance: +++ – very shade enduring, ++ – less shade enduring

Drought-resistance +++ endure drought conditions without discernible damage, in summer period capable to grow using just natural moisture; ++ are in need of artificial irrigation in dry season (these cultivars are resistant to air drought but require soil moisture); + necessary regular watering during the whole summer season; - plants suffering of air drought and having soil moisture deficit even being regularly watered

Ornamentality degree: 1 – a plant is ornamental all year round, 3 – ornamental only in blossoming and fruiting season

Function: 1 – medicinal and preventive properties, 2 – aesthetic and ornamental effect, 7 – vertical gardening

Results and discussion

These plant cultivars of the lower layer, besides *Chimonanthus praecox* (the lower park, altitude above the sea level – 115m), grow in the upper park of Arboretum in Nikitsky Botanical Gardens (altitude above the sea level ranges from 145 to 165m) in various microclimate conditions [10]. They can be divided into three main groups: 1. Growing under conditions of shade during the whole ontogenesis; 2. Being in the shade during the active vegetation period in frost-free season; 3. Growing on the comparatively open ar *Viburnum tinus* ea.

1. Growing under conditions of shade during the whole ontogenesis:
   - *Pittosporum heterophyllous* – evergreen ornamental bush with simple leathery nitid leaves, grows under cedarwood atlas crown, distantly 1 m from the tree stem.
   - *Buxus sempervirens* - evergreen ornamental bush, grows in area of combine projective cover of cedarwood atlas and laurel, equidistant from their stems - 2,5m.
   - *Chimonanthus praecox* - ornamental bush, blossoming in winter with deciduous oblong and elliptic leaves for this period. It is located under Monterey cypress crown (3,5m from the tree stem).
   - *Aucuba japonica* - ornamental evergreen bush, grows under crowns of evergreen trees: holm oak, wellingtonia and thuja orientalis (4m, 5m and 2,5m from the tree stems).
2. Plants, being in the shade during the active vegetation period in frost-free season, grow under deciduous tree crown:
   - *Euonymus japonica* – valuable ornamental evergreen plant, grows under golden shower crown (1m from the tree stem);
   - *Viburnum tinus* – evergreen bush with small nitid leaves and corymbs of white flowers, grows under English walnut (Juglans regia) and black locust (Gleditschia triacanthos) crown, 1m and 2,5m from the tree stem
   - *Laurocerasus officinalis* is a bush with simple leathery evergreen leaves; in South, West and north-west this plant is surrounded by three tillet (Tilia cordata) trees, 3,5 – 4,5 m from tree stem; in the North *Laurocerasus officinalis* is shaded by peripheral part of horse chestnut (Aesculus hippocastanum) crown.
3. *Cornus mas* is a deciduous bush growing on the comparatively open area.

Table 2 presents a brief biometrical characteristic of studied bush cultivars growing in the lower layer and trees-edificators which make under-crown space for these brushes, their location relative to edificators is given as well.

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Table 2
Biometrical characteristics of plants growing in the lower layer and their location relative to the stem in the under-crown space

Cultivar	Biometrical characteristic of plants				Plant location relative to the stem in the under-crown space		Biometrical characteristics of trees growing in the upper layer			
	Age, years	Height, m	Crown structure	Crown shape	Distance from the stem, m	Direction	Cultivar	Age, years	Height, m	Crown radius. m
Pittosporum heterophyllum	30	4	friable	inversely egg-shaped	1	N	Cedrus atlantica	80	20	4
Buxus sempervirens	60	4	dense	inversely egg-shaped	2,5	E	Cedrus atlantica	150	27	5
					2,5	N	Laurus nobilis	60	11	3
Euonymus japonica	30	3,5	friable	inversely egg-shapede	1	N	Laburnum anagyroides	40	12	3
Chimonanthus praecox	40	4,5	friable	Branchy	3,5	E	Cupressus macrocarpa	160	34	8
Viburnum tinus	30	3,5	friable	inversely egg-shaped	1	N	Juglans regia	30	10	3
					2,5	NE	Gleditschia triacanthos	60	22	3,5
Cornus mas	40	5	friable	inversely egg-shaped	0	0	*Cornus mas*	40	5	2
Laurocerasus officinalis	30	5	friable	Branchy	4,5-3,5-3,5	NE-SE	Tilia cordata	60	17	5
					5	S	Aésculus	60	15	5,5
Aucuba japonica	30	3	friable	inversely egg-shaped	5-5-4-4	SE-S-SE-SW	Holm oak	80	20	6-7
					5	E	Sequoiadendron	50	20	3
					2,5	W	Platycladus	30	10	3

Under plantation crown spatial variations of the most meteoparametres, first of all solar radiation and precipitation, are quite big and depend upon architectonics of crowns. Temperature condition of air and soil as the determining factor of plant activity depends upon solar radiation that gets the plants and ground surface. Plants, bedded under high trees of various breeds, occur in different insolation conditions. Change of illumination, temperature and moisture level is the most obvious evidence of plant effect on the environment. Having simultaneous observations, illumination power, measured on the open areas non-shaded by tree crowns, in the fair weather on August the 28th reached 47000-50000 lx. Under tree crown under intensive shadowing conditions, illumination power value getting under crown space of lower layer bushes ranges from 200 till 550 lx. Under crown space of Cornel has much more illumination - 1450lx. In the end of August in 2014, because of long period with lack of precipitation, plants of Arboretum in Nikitsky Botanical Gardens growing on non-watering areas and suffering of high air temperature were under water deficit conditions. Parallel measurements of illumination, air temperature and humidity, soil temperature and moisture level were made to compare the phytoclimatic characteristics under canopy of lower layer study plants (table 3).

Table 3

Phytoclimatic characteristics under canopy of lower layer plants (28.08.2014, 10:30 MSK)

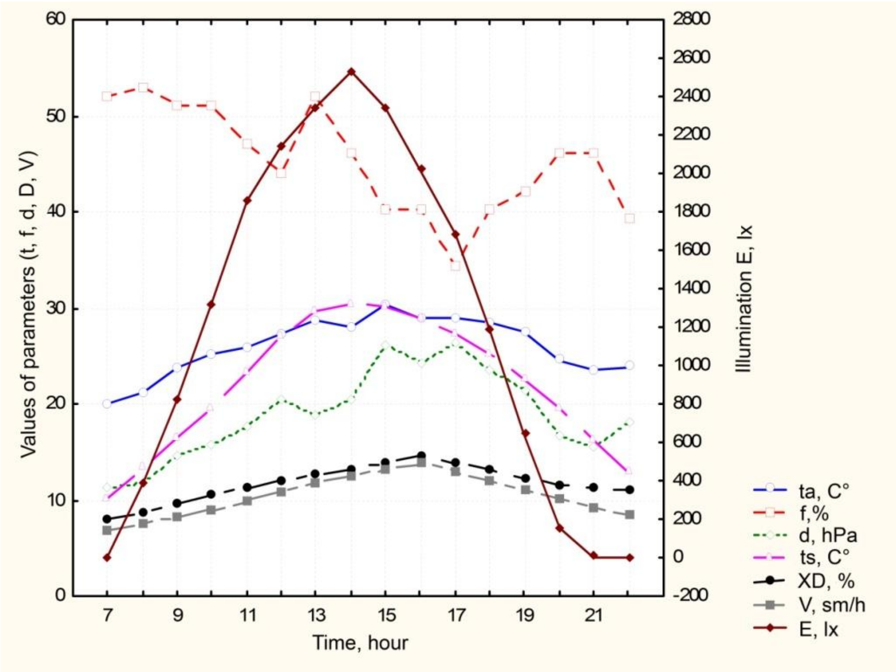
Cultivar	Environmental parameters					
	Air temperature, °C	Relative air humidity, %	Soil temperature, °C	Soil moisture at depth point of 20sm, %	Illumination, lx	Transmittance, %
Pittosporum heterophyllum	25,0	49	20,0	7,2	500	1,94
Buxus sempervirens	24,5	57	20,0	13,7	200	0,68
Euonymus japonica	25,0	54	20,0	7,2	200	0,58
Chimonanthus praecox	25,7	48	20,1	14,8	370	0,64
Viburnum tinus	27,1	49	21,0	12,4	550	1,11
Cornus mas	25,5	50	20,5	11,4	1450	3,18
Laurocerasus officinalis	25,2	52	20,0	10,2	300	0,69
Aucuba japonica	25,2	57	20,5	14,9	450	1,14

It is a well-known fact, that a cultivar drought-resistance is determined by plant response to changing of environmental conditions. Under effect of extreme factors, plants, adapted to certain environment, during evolutional process, are able to response in different way. Having low moisture potential of the root zone, plants of diverse ecological groups decrease their water exchange parameters (xylem stream velocity), whereby main physical and biochemical processes in plants are under control. Plants with different ecological and physiological characteristics possess diverse intolerance degree to soil moisture potential, what effects on plant metabolic rate as a response to water stress condition. Character of response to negative impact, its velocity and depth, displays the plant tolerance to an actual stress. Having water deficit more resistant cultivars are characterized by reduction of their metabolic rate (xylem stream velocity), that protects from excessive dehydration, and long-term turgor preservation [3]. Such a type of response is inherent for plants from dry areas and for xerophytes in general (fig.1 a, b). Nonresistant plant cultivars activate their mass exchange and power interchange to support water relationships on necessary high level;

(fig.2b) as a result we have an active water discharge in the system soil – plant – atmosphere, and incapacity to support level of water retentivity of tissue on maximum point. These differences can be useful for development the criterion of relative physiological drought-resistance degree of various plant cultivars based on investigation of water transport mechanism.

Applying the phytomonitoring methodological base makes it possible to determine general regularities of water exchange variations, that characterizes qualitative and quantitative correlations between physiological characteristics of plant water regime (xylem moisture deficit and linear velocity of xylem stream) and environmental parameters (air temperature and humidity, air humidity deficit, soil temperature and illumination). Pictures 1 and 2 present a dynamics of these parameters during the daylight for 4 studied plant cultivars with different degrees of drought-resistance. They occupy extreme (*Cornus mas* and *Viburnum tinus* – xerophytes, *A. japonica* – mesophyte) and intermediate (*E. japonica* – xero-mesophyte) places in our relative drought-resistance lines.

a)



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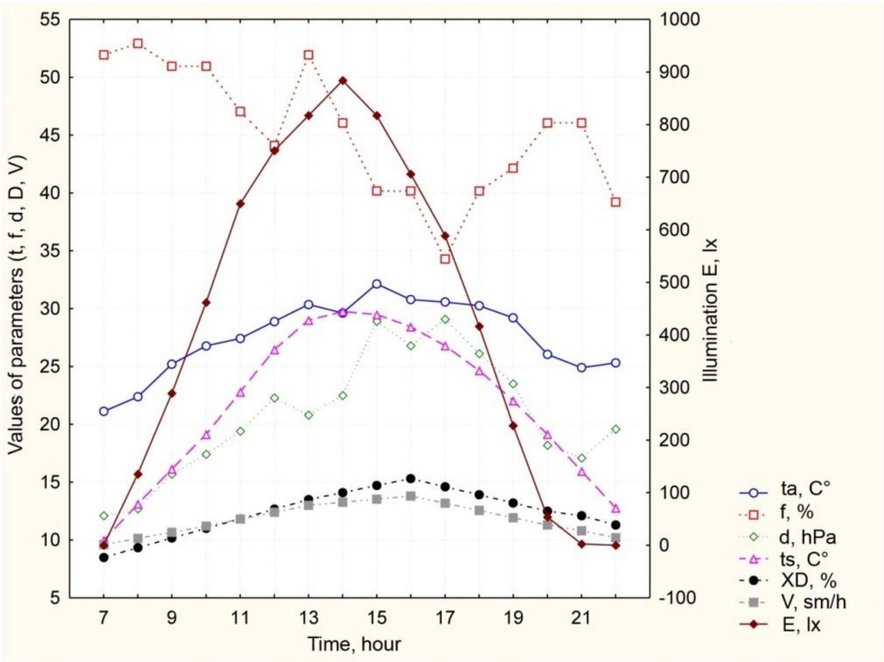
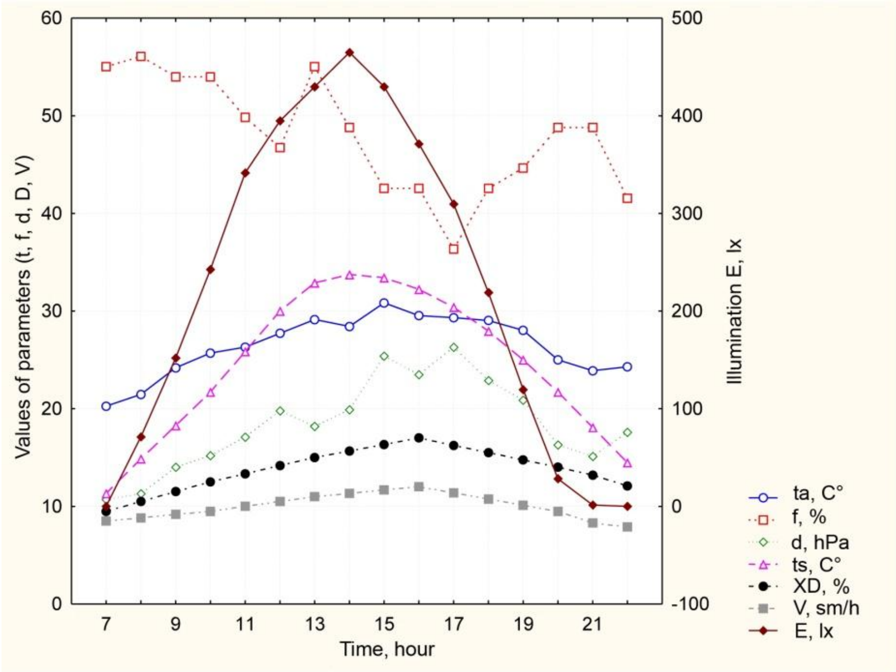


Fig. 1 Diurnal variation of environment and water regime parameters
а) *Cornus mas*
б) *Viburnum tinus*

at – air temperature, °C; f – relative air humidity, %; d – air humidity deficit, hPa; st – soil temperature, °C; E – illumination, lx; XD – xylem deficit, %; V – Linear velocity of xylem stream, sm/h)

a)



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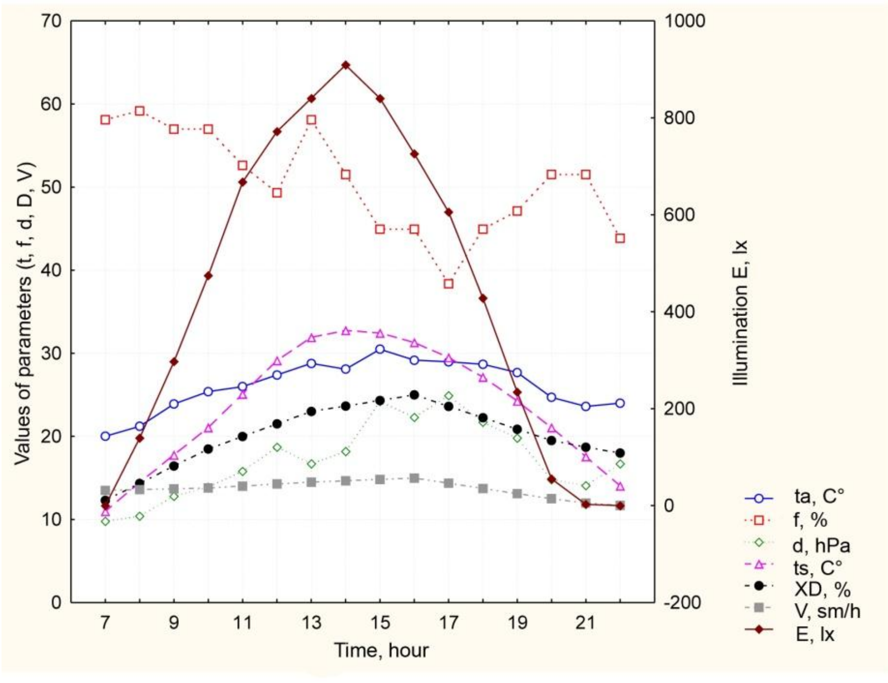


Fig. 2 Diurnal variation of environment and water regime parameters
a) *Euonymus japonica*
b) *Aucuba japonica*

at – air temperature, °C; f – relative air humidity, %; d – air humidity deficit, hPa; st – soil temperature, °C; E – illumination, lx; XD – xylem deficit, %; V – Linear velocity of xylem stream, sm/h)

A number of methods to define relative drought-resistance of plants was developed before. [3,4,5]. In regard to described investigations of 8 plant cultivars xylem moisture deficit is calculated by formula (1):

$$XD = (1 - \frac{A}{Amax})100\% \qquad (1)$$

XD – xylem moisture deficit, %;

A – Current value of heat pulse variation, rel.unit;

Amax – maximum value of heat pulse variation, rel.unit.

In our researches xylem moisture deficit value of study cultivars rates from 14,6% - 25,0% and it was reported as an equal value in decreasing order: *A. japonica*– 25 %, *P. heterophyllum*– 18,9 %, *L. officinalis*– 17,5 %, *E. japonica* - 17,3 %, *B. sempervirens*– 16,6 %, *Ch. praecox* – 16,2 %, *V. tinus* - 15,7 %, *C. mas* – 14,6 %.

To determine common mechanism of variation of water exchange parameters, characterizing quantitative correlations between physiological features of plant water relationships and environmental parameters, it was attempted to create a simulator that allows prognosticate studied correlations extremely accurately. To this purpose equalization of linear multiple regression was equated, where independent variable is environment X_1 – X_5 (see below), dependent variable is xylem moisture deficit in the plant stem – XD, %.

1 – air temperature, °C (X_1);

2 – Relative air humidity, % (X_2);

3 – air humidity deficit, hPa (X_3);

4 – temperature of soil surface, °C (X_4);

5 – illumination, lx (X_5).

The equalization:

$$XD, \% = a_0 + a1 \times X_1 + a2 \times X_2 + a3 \times X_3 + a4 \times X_4 + a5 \times X_5.$$

Having substituted environmental parameters (received on 28.08.2014) into equalization, following values for study plant cultivars were obtained:

P. heterophyllum:

$XD, \% = 2{,}8089 - 0{,}5040 \times X_1 + 0{,}1802 \times X_2 + 0{,}5464 \times X_3 + 0{,}2528 \times X_4 - 0{,}0001 \times X_5$,

$R^2 = 0{,}9895$ – coefficient of determination.

B. sempervirens:

$XD, \% = 11{,}69 + 0{,}1636 \times X_1 - 0{,}1478 \times X_2 - 0{,}1888 \times X_3 + 0{,}3488 \times X_4 - 0{,}0065 \times X_5$

$R^2 = 0{,}9479$.

E. japonica:

$XD, \% = 8{,}1090 + 0{,}1101 \times X_1 - 0{,}0806 \times X_2 - 0{,}0304 \times X_3 + 0{,}3594 \times X_4 - 0{,}0070 \times X_5$

$R^2 = 0{,}9793$

Ch. Praecox:

$XD, \% = 3{,}7516 - 0{,}0502 \times X_1 + 0{,}008 \times X_2 + 0{,}1714 \times X_3 + 0{,}4227 \times X_4 - 0{,}0057 \times X_5$

$R^2 = 0{,}9812$

V. tinus:

$XD, \% = 8{,}4648 + 0{,}0994 \times X_1 - 0{,}0986 \times X_2 - 0{,}0369 \times X_3 + 0{,}3651 \times X_4 - 0{,}0034 \times X_5$

$R^2 = 0{,}9717$

Cornus mas: XD, % = $9{,}0391 + 0{,}1964\times X_1 - 0{,}1268\times X_2 - 0{,}0837\times X_3 + 0{,}2667\times X_4 - 0{,}0008\times X_5$

$R^2 = 0{,}9626$

L. officinalis:

XD, % = $14{,}3608 + 0{,}4695\times X_1 - 0{,}2416\times X_2 - 0{,}3897\times X_3 + 0{,}3380\times X_4 - 0{,}0047\times X_5$

$R^2 = 0{,}9726$

A. japonica:

XD, % = $16{,}7119 + 0{,}8671\times X_1 - 0{,}3375\times X_2 - 0{,}6430 X_3 + 0{,}4076\times X_4 - 0{,}0019\times X_5$

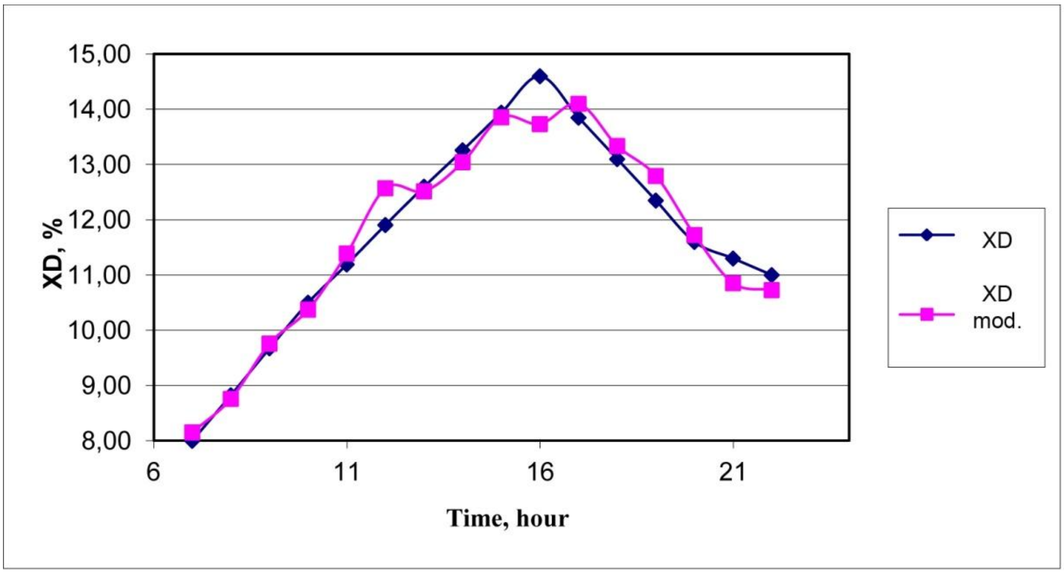
$R^2 = 0{,}9814$

Due to analysis of received results, it`s possible to approve a high accuracy of this simulator, range of coefficient of determinations is 0,9479 – 0,9895, what is permissible for biological objects.

Received correlations due to this way allow calculate xylem moisture deficit of the study cultivars in accordance to environmental parameters at any time with frequency of 1 hour.

Figures 3 and 4 present experimental and calculated values of xylem moisture deficit for *C. mas*, *V. tinus*, *E. japonica* and *A. japonica*.

a)



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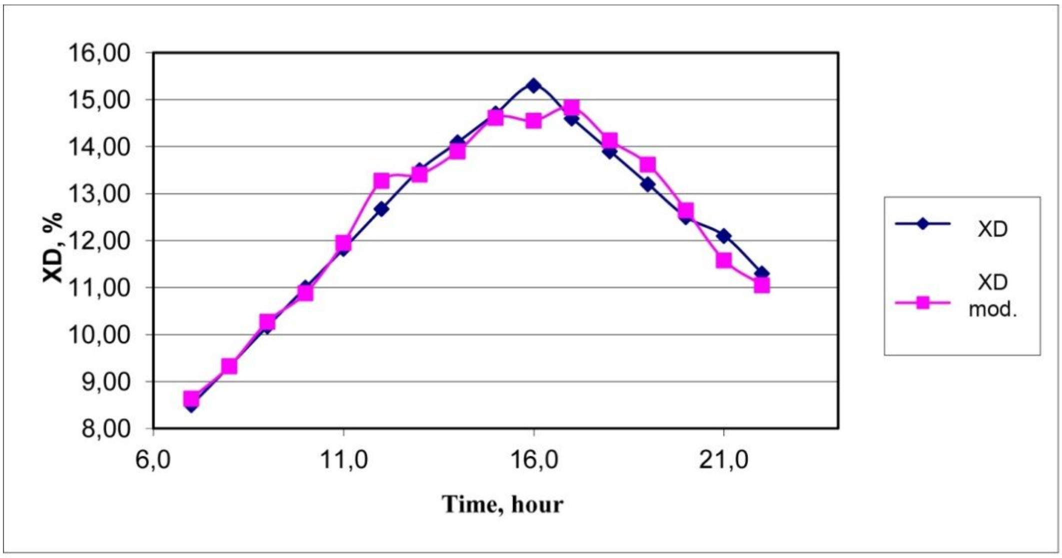
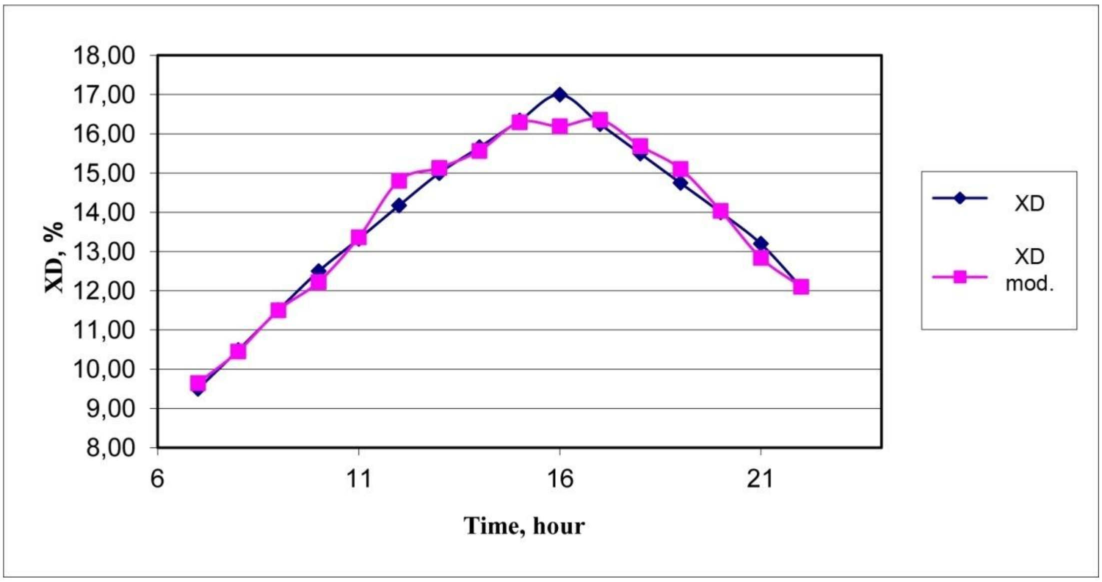


Fig. 3 Diurnal variation of xylem moisture deficit
a) *Cornus mas*
b) *Viburnum tinus*

XD – experimental curve
XD mod. – theoretical curve

a)



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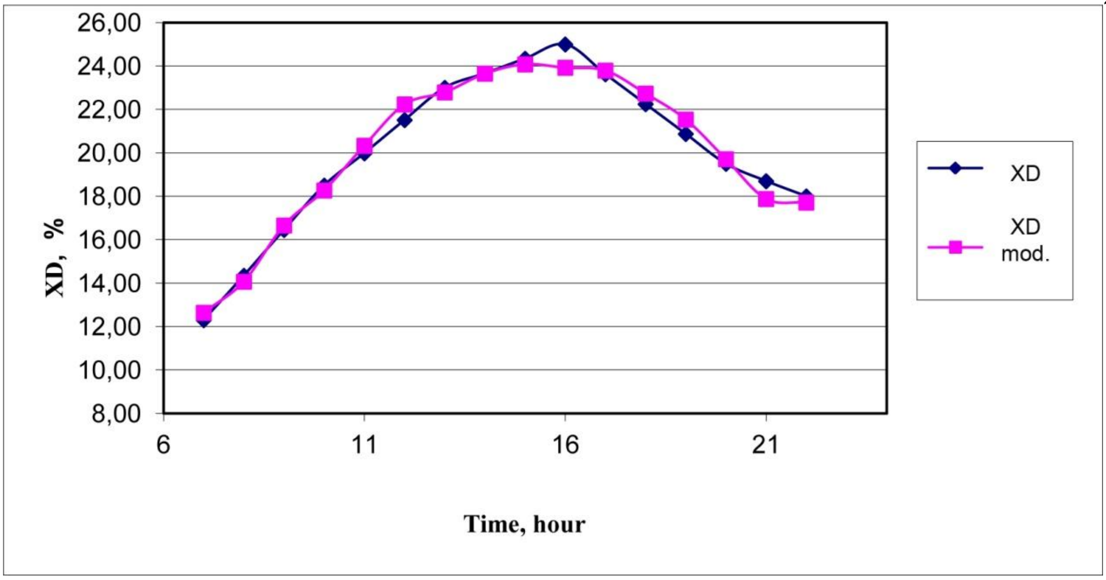

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Fig. 4 Diurnal variation of xylem moisture deficit
a) *Euonymus japonica*
b) *Aucuba japonica*

XD – experimental curve
XD mod. – theoretical curve

Taking into consideration the highest sensitivity of the method for determination of water stress coefficient while researching peculiarities of water regime and draught-resistance, at the same time determining xylem moisture level applying this sensor, we were measuring linear velocity of xylem stream [3]. This parameter allows find out correlation between coefficients of water stress and draught-resistance of study cultivars. The linear velocity of the stream was calculated by formula (2):

$$V=K/t_0 \qquad (2)$$

V - linear velocity, sm/h

K - constant coefficient with a definite configuration of sensor elements;

to – time of pulse advancing between heater and microthermocouple of the sensor (h).

Dependence of xylem stream linear velocity (Vst) to environment (X_1 – X_5 denotations are the same as in equalization of xylem moisture deficit XD) is denoted by regression equation:

For *P. Pittosporum heterophyllum*:

Vst, sm/h = -1,40379 - 1,0550×X_1 + 0,3832×X_2 + 0,9943×X_3 + 0,0893×X_4 - 0,0010×X_5,

R^2 = 0,9728 – coefficient of determination

B. sempervirens:

Vst, sm/h = 11,37 - 0,0732×X_1 - 0,0410×X_2 + 0,0447×X_3 + 0,1124×X_4 + 0,00003×X_5

R^2 = 0,8875.

E.japonica:

Vst, sm/h = -0,6976 - 0,5293×X_1 + 0,2158×X_2 + 0,5982×X_3 + 0,1379×X_4 - 0,00002×X_5

R^2 = 0,9658

Ch. Praecox:

Vst, sm/h = 2,5629 - 0,4506×X_1 + 0,1933×X_2 + 0,5415×X_3 + 0,0368×X_4 + 0,0008×X_5

R^2= 0,8866

V. tinus:

Vst, sm/h = 6,542 - 0,1909×X_1 + 0,0549×X_2 + 0,1934×X_3 + 0,1945×X_4 - 0,0004×X_5

R^2 = 0,9873

C. mas:

Vst, sm/h = 2,2083 - 0,3830×X_1 + 0,0759×X_2 + 0,4031×X_3 + 0,3779×X_4 - 0,0010×X_5

R^2 = 0,9785

L. officinalis:

Vst, sm/h = 2,1884 - 0,6604×X_1 + 0,2669×X_2 + 0,7351×X_3 + 0,0761×X_4 + 0,0019×X_5

R^2 = 0,9573

A. Japonica:

Vst, sm/h = 5,1957 - 0,6370×X_1 + 0,2482×X_2 + 0,6446×X_3 + 0,0207×X_4 + 0,0024×X_5

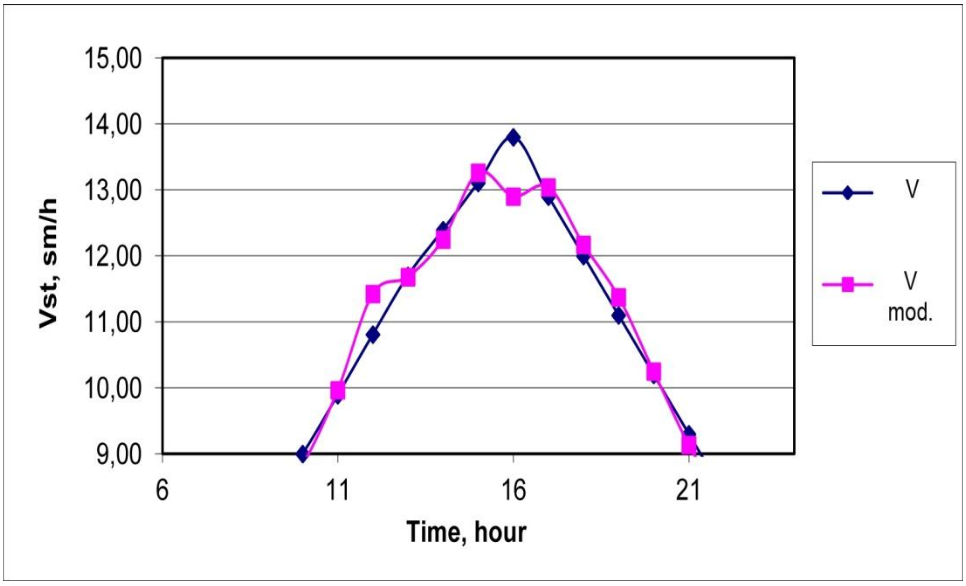
R^2 = 0,9446

Water stress coefficient of these cultivars under conditions of water moisture deficit (see linear regression equalization above) ranged from 0,68 (*C. mas*) till 0,90 (*A.japonica* and spread in decreasing order: *A. japonica* – 0,90; *Ch. praecox* – 0,83; *L. officinalis* – 0,80; *B. sempervirens*– 0,72; *E. japonica* – 0,708; *P. heterophyllum* – 0,703; *V.* tinus - 0,69; *C. mas* – 0,68.

Making conclusion of experiments at researching the correlation of xylem stream linear velocity to environmental factors it was denoted that genotypically the most drought-resistant cultivar out of study cases is C.mas, the least drought-resistant is Aucuba japonica.

Figures 5 and 6 show experimental and calculated variations of xylem stream linear velocity during the daylight for C.mas, *V.* tinus, E. japonica and A. japonica.

a)



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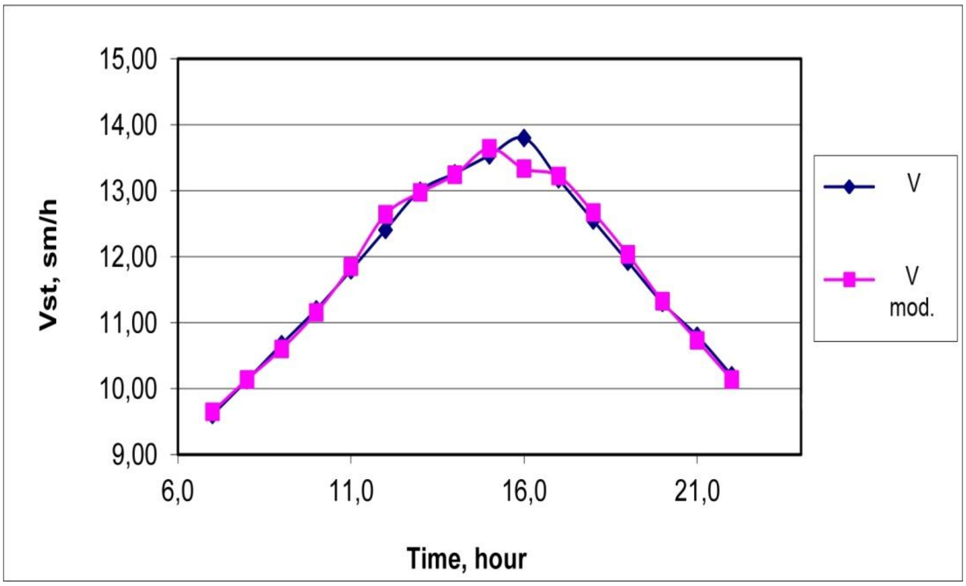
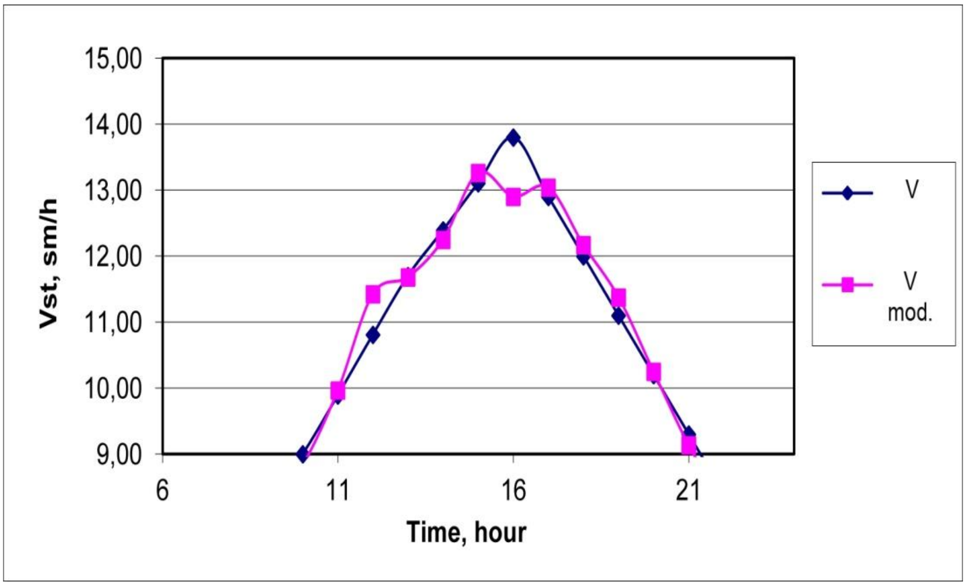


Fig. 5 Diurnal variation of xylem stream linear velocity
a) *Cornus mas*
b) *Viburnum tinus*

Vst. – experimental curve
Vst. mod. – theoretical curve

a)



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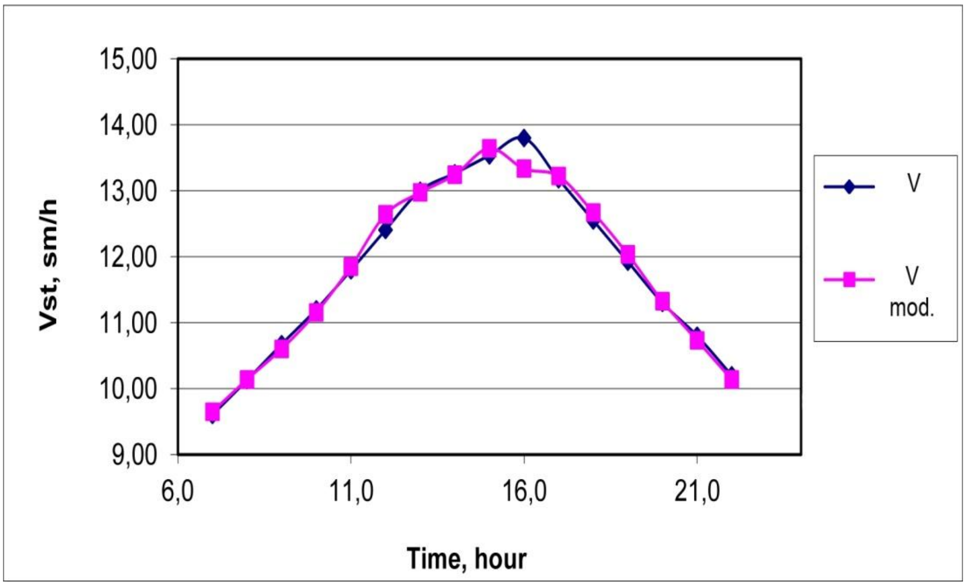
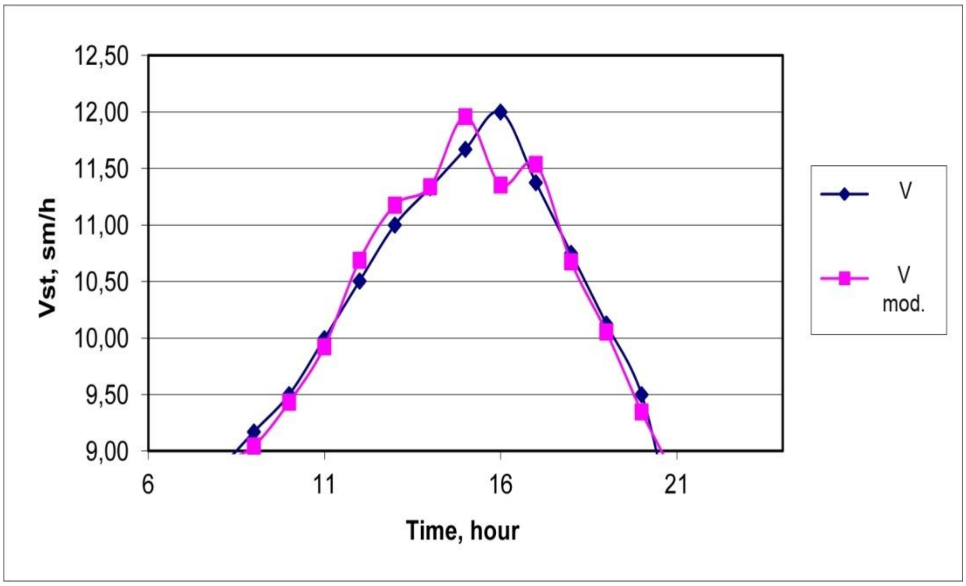


Fig. 5 Diurnal variation of xylem stream linear velocity
a) *Cornus mas*
b) *Viburnum tinus*

Vst. – experimental curve
Vst. mod. – theoretical curve

a)



b)

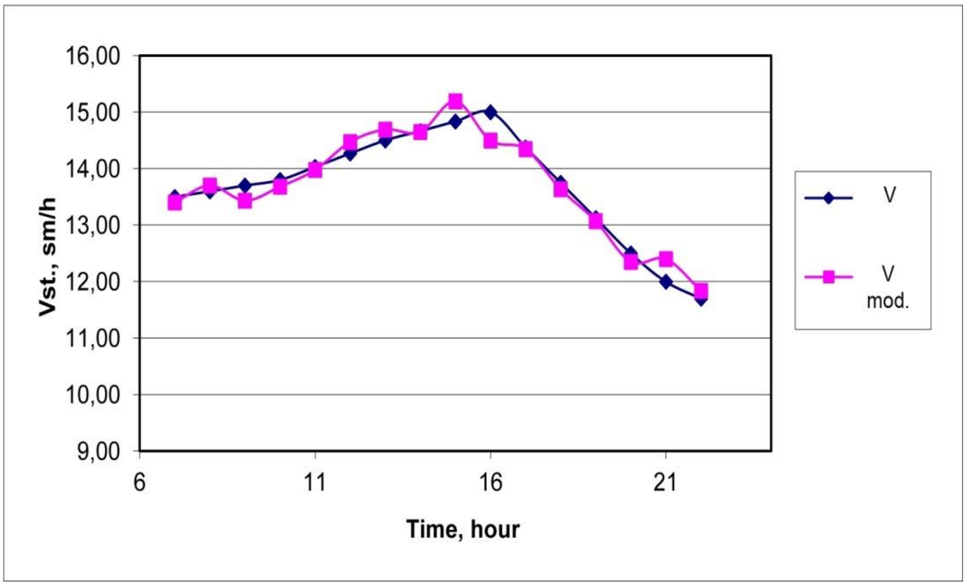


Fig. 6 Diurnal variation of xylem stream linear velocity
a) *Euonymus japonica*
b) *Aucuba japonica*

Vst. – experimental curve

Vst. mod. – theoretical curve

Analysis of curves displays, that difference between experimental and calculated values isn`t larger than 10-15% that is quite acceptably for calculation of biological objects` simulator.

Researches results allow specify well-known scientific facts about peculiarities of water regime and drought-resistance of study plant cultivars and further recommend them for cultivation in a definite geographical region.

Conclusions

1. Assessment of environmental factors changes under crowns of study bush cultivars was carried out (illumination, air temperature and humidity, soil moisture level).

2. Applying phytomonitoring methods allowed investigate physiological characteristics of water regime of the study cultivars and reveal common regularities in their water regime changes correlated to the principle environmental factors. It was presented possibility of phytomonitoring methods appliance in organization of systems analysis of water stress and development of life-time diagnostics methods for researching of plant relative drought-resistance.

3. Rapid methods were suggested to prognosticate water regime and relative drought-resistance peculiarities of study cultivars, one of them was patented (Method for determination of xylem deficit moisture).

4. Correlation between ecophysiological characters of the study cultivars and principal environmental factors were researched, developed dynamic models of these correlations were developed. Difference between experimental and calculated values doesn`t exceed 10-15%, what is quite acceptable for prognostic purposes in Biology.

5. Research results play a considerable role for Biology in general and can be a source of extra information while making a comparative assessment of plant drought-resistance, moreover they can be applied to develop assessment criterion of genotypical drought-resistant cultivars and sorts, what allows differentiate them during future certification.

6. Developed prognostication methods of relative drought-resistance are advisable for applying to assess properties and select the most adaptive species for certain conditions of cultivation.

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17.

Plugatar Yu.V., Ilnitsky O.A., Kovalyov M.S., Korsakova S.P. A dynamic model of the water relationships of some bush cultivars growing in lower layer under conditions of park phytoclimate on South Coast of the Crimea // Works of the State Nikit. Botan. Gard. – 2014. – V. 139 – P. 11 – 28.

This article covers analysis of peculiarities of water relationships and drought tolerance of eight bush cultivars in Arboretum of Nikitsky Botanical Gardens, which grow under phytoclimate conditions of the lower layer. With this purpose two rapid methods of phytomonitoring were applied to get their ecophysiological characteristics. As a result of researches the dynamic models of dependence between ecophysiological characteristics of study plant cultivars and main environmental factors were developed, some peculiarities of their water relationships and drought tolerance were detailed. Revealed dependence makes it possible to differentiate these plant cultivars in accordance to drought tolerance that will allow recommend them for cultivation in the conditions of a particular region on South coast of the Crimea, taking into consideration its microclimatic features.

Key words: *rapid methods, the peculiarities of the water relationships, xylem moisture deficit, relative drought resistance, simulator.*