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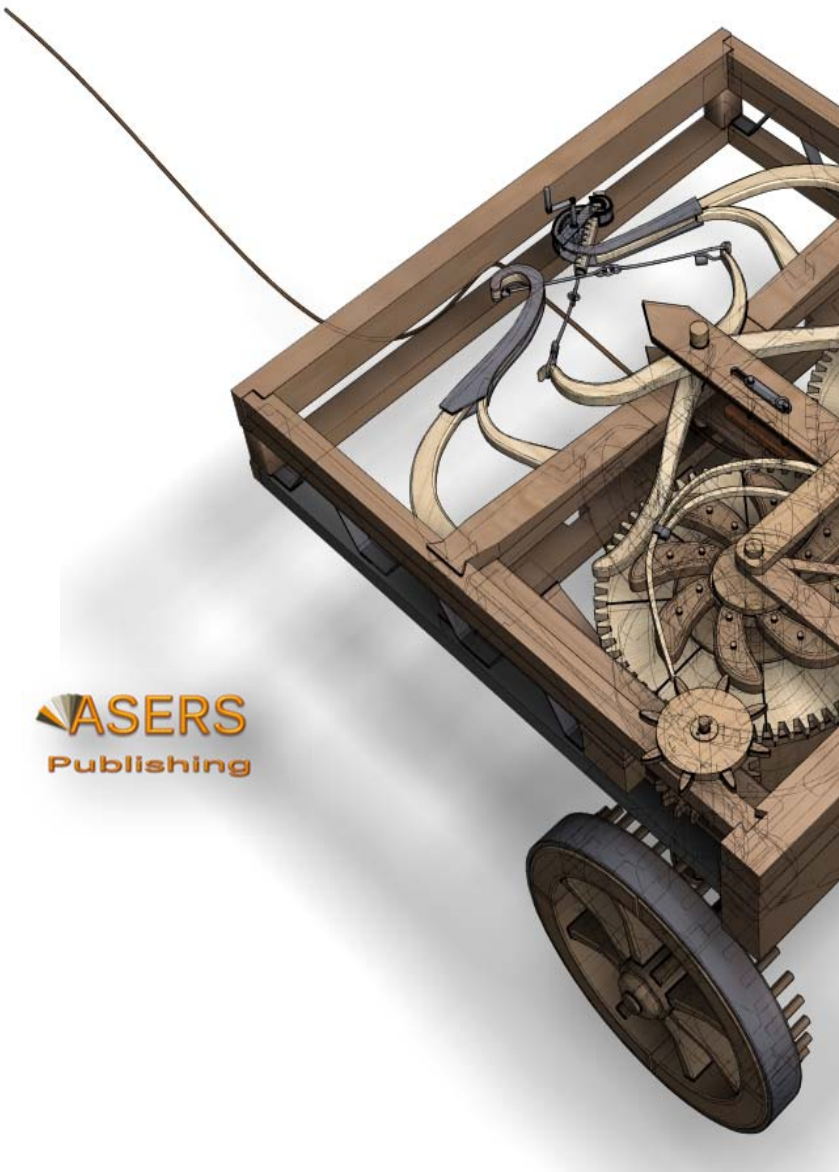
# Journal of Environmental Management and Tourism



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# Call for Papers
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# Journal of Environmental Management and Tourism

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# Prospects for the Development of Decorative Nursery in the Crimea

Anna Igorevna REPETSKAYA
V.I. Vernadsky Crimean Federal University, Russian Federation
anna.repetskaya@gmail.com

Irina Gennadievna SAVUSHKINA
V.I. Vernadsky Crimean Federal University, Russian Federation
limodorum2001@rambler.ru

Ekaterina Vasilievna GORODNYAYA
V.I. Vernadsky Crimean Federal University, Russian Federation
e.gorodnyaya@yandex.ru

Elena Alexandrovna KRAVCHUK
V.I. Vernadsky Crimean Federal University, Russian Federation
disa005@mail.ru

Stanislav Olegovich VISHNEVSKY
V.I. Vernadsky Crimean Federal University, Russian Federation
krympol@mail.ru

Natalya Vladimirovna NEVKRYTAYA
Research Institute of Agriculture of Crimea, Russian Federation
Nevkritaya@mail.ru

Roman Vasilievich SALOGUB
V.I. Vernadsky Crimean Federal University, Russian Federation
salogubroman@mail.ru

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Abstract:

Potential volume of planting material market for ornamental crops was calculated based on the analysis of master plans for the development of Crimean cities taking into account standards for planting trees and shrubs. Data were obtained on territorial belonging, purpose, production cycle, and range of peninsula nurseries. It was proposed to use plus trees growing in urban conditions as mother trees for production of planting material adapted to the urban ecological and climatic conditions of this area. We have previously proposed a basic recommended assortment to green the Piedmont zone of Crimea. On its basis a GIS of plus trees of large landscape objects of Simferopol was developed.

Keywords: Nursery; ornamental plants; greening; trees; Crimea.

JeL Classification: Q23; Q01.

## Introduction

Main directions of the Crimean Peninsula development are tourism and agriculture. Favorable climatic conditions, physical and geographical, biological, historical and cultural diversity create the prerequisites for attracting a large number of tourists to this region and for making Crimea a leader in the domestic market of recreational services. Intensive changes of recent years resulted in the active construction of both residential and resort recreational facilities and an increase in state and private orders for services in the field of landscape architecture. At the same time, local nursery breeding is in its infancy

after a long period of decline due to the replacing of the production of domestic planting stock by imported ornamental plants.

The aim of this work was to assess the potential size of the market and the state of nursery farms of the peninsula and to develop strategic directions for the development of decorative nursery as a separate branch of the Crimean economy.

## 1. Literature Review

Nursery of ornamental and fruit plants is an intensively developing branch of agriculture in all countries of the world. There are pressing issues concerning the profitability of production process, its automation, using new technologies in order to improve the quality of planting material and environmental friendliness of production (Jannat *et al.* 2019; Sartore *et al.* 2018, 2743; Bąbelewski *et al.* 2017, 1195; Faria *et al.* 2019. 1187).

During the period of mass urban greening in Crimea, in the 80s of the past century, the main producers of planting material were Zelenstroy city nurseries subordinate to the Ministry of Housing and Communal Services. Significant amount for greening were grown by permanent nurseries of enterprises of the Ministry of Forestry.

Characteristic features of the nursery industry of that period were:

- branching network of state nurseries covering all regions of the country;
- strict vertical subordination of enterprises (nurseries);
- planned management;
- sufficient budgetary financing of nursery activities;
- poor variety of cultivated tree species;
- uniformity of planting material (mainly seedlings with an open root system).

Socio-economic changes that occurred after the USSR collapse, transition from planned economy to the prevalence of market relations, declined production in almost all sectors of economy, limited financing of activities from the state budget, including landscaping works, led to a decrease in the need for planting material. These factors prevented decorative nursery, which was based on different principles, from developing. All this resulted in significant decrease in production volumes, loss of qualified specialists, weakening of material and technical base of nurseries, and often to their complete closing (Maurer 2006, 273).

Since the mid-90s, in Crimea, as well as throughout the territory of the former USSR, an increased need for planting stock of ornamental plants was noted; it happened due to the stabilization of economic situation and increasing volume of landscaping. However, the reorientation of landscape architects to the European assortment and quality standards of planting material seemed to have caught the most part of existing nurseries unawares. It led, on the one hand, to the formation of a new business area related to the import of floral and decorative products from Holland, Italy, Poland and other Western countries, and on the other – to the creation of new private nurseries. In the early 2000s, growing Russian market of landscaping services associated with active private construction led to the modernization and development of survived nursery farms, as well as to the foundation of new enterprises, i.e. manufacturers of ornamental plants products. In 2008, on the initiative of the owners of private plant nurseries, a public organization emerged that defended the interests of domestic nursery farming – the Association of Planting Material Producers (APMP). Nevertheless, problems caused by the expansion of foreign products and technologies have not been overcome in both decorative and fruit nursery in Russia up to this day (Kuznetsova *et al.* 2016, 74).

In Crimea, this industry developed in another direction. Until 2014, there was practically no domestic production; imported planting material of European origin predominated on the peninsula market.

The rapid development of the import of seedlings of decorative crops provided the needs of landscape gardening, led to a significant growth of the assortment of species and types of planting material and, in part, to the implementation of modern technologies for its growing completion. However, there were a number of negative traits, among them: supply of non-zoned planting material, impeding of own production, import of new pests and pathogens with plants. Negative effects of massive import of infected seedlings for greening of Olympic facilities in Sochi affected all southern regions of our country. The most resonant events include destruction of boxwood in the natural communities of Caucasus and in landscape gardening facilities in the South of Russia, including Crimea, as a result of damage by boxwood moth; death of palm trees damaged by red palm weevil and palm moth and others (Karpun *et al.* 2014, 40)

The problem of importing planting material with new pathogenic species is acute for the whole world. It is now recognized that plant import is one of the main ways for spreading pests and diseases (Kenis *et al.* 2018; Liebhold *et al.* 2012, 135). An acceptable solution, on the one hand, may be the organization of a network of international quarantine nurseries and centers.

On the other hand, the development of a high-quality domestic product in local nurseries of ornamental plants solves a number of issues. In addition to the economic benefits of developing own production, it allows growing adapted to local climatic conditions and healthy planting material (Kuznetsova *et al.* 2016, 74).

One of the most important factors in the production of high-quality planting material is obtaining seeds or parts of vegetative propagation (cuttings, buds, layers) from plants that have high decorative properties and are resistant to a set of environmental factors. In southern Russia, the main features are high drought resistance, frost resistance, and undamageability by pests and diseases. The best genotypes should be sent to mass production discarding from reproduction these that do not fully realize the potential of species or variety in a particular region.

In forestry, for the formation of the most productive forest stands with improved genetic and selection qualities, the harvesting of seed and vegetative material is carried out from plus trees. In forest seed farming, these include specimens that are significantly superior in one or in a complex of economically valuable traits to surrounding trees of the same species, age class and phenological form, growing under the same conditions (Rodin 2008, 321).

In nursery industry, the term mother plants is used applied to the donors of genetic material for the development of seedlings. Due to the significant spread of viral diseases among fruit crops (from 32 to 80% of examined samples according to the FSBSU All-Russian Institute of Horticulture and Nursery (Kulikov *et al.* 2018, 33), control of pathogens in source organisms whose cuttings or buds are used for vegetative reproduction is particularly topical.

For the purpose of urban gardening, selection of mother plants requires taking into account specific conditions of urban ecosystems, namely, gas contamination and dustiness of air, soil compaction, influence of reagents, higher summer temperatures compared to the natural environment, etc. In nurseries, mother plants grow outside the complex of urban ecological factors, and therefore genotypes with an unstudied level of resistance to these factors come into reproduction.

We proposed using the approaches of forest seed farming in relation to decorative tree and shrub species taking into account the signs that are of interest for mass gardening. Selection of plus trees as potential material donors in the production of seedlings for landscape construction in urban areas is recommended to be carried out at urban landscape objects within the same soil and climatic zone.

Digital technologies are becoming increasingly common in environmental management (Yu and Buchanan 2016, 423; Tereşneu *et al.* 2019, 461; Maksutova and Anisimov 2019, 345).

In urban management, GIS are used with different degrees of efficiency but they have not yet become common in the regions of Russia as a universal tool for working with spatially distributed data. Given the active development of technological and software tools for creating urban geographic information systems (Hasanova *et al.* 2019, 34), we should expect a general transition to unified repositories of basic information resources of municipalities in the coming years.

GIS can solve a number of problems in the field of landscape architecture including the prospective development of existing areas and planning of new green areas taking into account the influence of environmental and socio-cultural factors (Mingaleva *et al.* 2019, 197); monitoring of green spaces and maintaining registers of rare, protected and especially valuable plants, etc.

Creating the bases of plus trees with spatial localization within the urban territories of a certain climatic zone will allow not only keeping the most valuable samples, but also using them as mother plants for the production of local sustainable planting material of decorative crops.

## 2. Materials and Methods

The volume of the consumer market of planting material for landscaping public spaces in the cities of Crimea was defined for the next decade on the basis of the approved Master Plans of 12 municipalities: Alushta, Armyansk, Bakhchisaray, Belogorsk, Dzhankoy, Yevpatoriya, Kerch, Saki, Simferopol, Feodosia, Yalta. The need for planting material in order to create planned common areas was taken into account, as well as the maintenance of existing landscaping facilities.

When calculating the amount of required planting material, the normative density of planting trees and shrubs per 1 ha of green space was taken into account according to the “Norms for planting trees and shrubs of urban green spaces” (Ministry of Housing and Public Utilities of the RSFSR 1988, 81). Depending on the category of landscaped object and the climatic zone, values specified in Table 1 were accepted.

Table 1. Planting density of trees and shrubs per 1 ha of green area of urban objects

| Agroclimatic district of Crimea | Trees, pcs | Shrubs, pcs |
|---|---|---|
| Plain steppe | from 170 to 430 | from 1020 to 1720 |
| Northern and Southern macro slopes of the Crimean Mountains | from 150 to 400 | from 750 to 1600 |

The territory of Crimea is extremely different in terms of its soil and climatic conditions. Agroclimatic zoning of the Crimean Peninsula according to Vazhov is generally accepted for crop production and provides for dividing the peninsula into 20 regions and 3 districts (Vazhov 1971, 92). Regional effect on the ornamental assortment and need to grow ecologically adapted planting material is based on the conditions of a particular area.

Analysis of the nursery farms of Crimea was performed according to open sources.

When selecting plus trees, we relied on approaches accepted for forest tree breeding. Signs that are of interest for forestry are statutory (On approval of the Rules for the Creation and Defining of Forest Seed Objects (forest seed plantations, permanent forest seed plots and similar objects) 2015, 19). In forest breeding, trees that are characterized by

straightness, full wood, good clearing of trunks from knots, lack of bifurcations, and resistance to adverse environmental factors, pests and diseases are selected as plus ones. In uniformly growing, high-density stands of clear composition, plus trees should exceed the average height of stand (for the corresponding phenological form) by 10% or more, diameter – by 30% or more, meet all of the above requirements, have high yield, fruit and seeds quality, immunity, resistance to adverse natural and man-made factors.

Among the woody plants growing in urban environments, we classified abundant fruiting trees which were highly resistant to growing conditions, had better decorative parameters (height, crown architectonics) in comparison with other specimens of the same species under the same growing conditions as plus trees.

Plus-trees of basic recommended assortment of trees, shrubs and vines for landscaping the Piedmont Crimea were selected (Repetskaya *et al.* 2019, 236).

Selection and seed production GIS of ornamental tree mother plants were developed using Field-Map software and hardware complex which combines hardware (portable electronic measuring instruments) and software in a single mobile technology.

## 3. Results and Discussion

The nursery's task for seedlings production per year is defined by the need of the service region in different types of decorative planting material.

Table 2. Prospective development of greening public spaces in accordance with the Master Plans of Crimean municipalities

| No. | City | Document | Greening public spaces, ha | | | Dates for the implementation of the master plan |
|---|---|---|---|---|---|---|
| | | | actual | planned | new areas | |
| 1 | Alushta | Master plan of Alushta city district, Republic of Crimea | 2,317.69 | 1,152.85 | -1,164.84 | Estimated period – 2030 |
| 2 | Armyansk | Master plan of Armyansk city district | 28.68 | 30.52 | 1.84 | Phase 1 – 2020; estimated period – 2030 |
| 3 | Bakhchisaray | Master plan of the municipality Bakhchisaray urban settlement, Bakhchisaray district | 3,347.5 | 3,347.6 | 0.10 | Phase 1 – 2020; estimated period – before 2030 |
| 4 | Belogorsk | Master plan of the municipal district "Belogorsk city district" | 113.9 | 223 | 109.10 | Phase 1 – 2020; estimated period – before 2030 |
| 5 | Dzhankoy | Master plan of the municipal district "Dzhankoy city district" | 146.83 | 147.33 | 0.50 | Estimated period – before 2030 |
| 6 | Yevpatoria | Master plan of the municipal district "Yevpatoria city district" | 195.22 | 252.74 | 57.52 | Phase 1 – 2020; estimated period – before 2030 |
| 7 | Kerch | Master plan of the municipal district Kerch, Republic of Crimea | 231.82 | 252.74 | 20.92 | Estimated period – before 2030 |
| 8 | Saki | Master plan of Saki city district | 29.4 | 163.3 | 133.9 | Phase 1 – 2020; estimated period – before 2030 |
| 9 | Simferopol | Master plan of the municipal district "Simferopol city district", Republic of Crimea | 888.3 | 908.9 | 20.60 | Estimated period – before 2035 |
| 10 | Sevastopol | Master plan of the city of Sevastopol | 1,269.34 | 2,198.1 | 928.76 | Estimated period – before 2035 |
| 11 | Feodosia | Project on "Preparation of the master plan of the municipal district "Feodosia city district" | 1,756 | 2,000.6 | 244.6 | Not specified |
| 12 | Yalta | Master plan of the municipal district "Yalta city district", Republic of Crimea | 195.84 | 338.48 | 142.64 | Estimated period – before 2035 |

When determining market capacity, the following is considered: the volume of urban greening, reconstruction and repair of existing green spaces, the real state of production in the region and beyond it. Prospective landscaping area is estimated by the categories of: planting the objects of common use, limited use and for special purpose. The need in seedlings for compensation during survival period which is from 3 to 10% is additionally considered.

Source data for calculation include: the number of inhabitants, the need for trees and shrubs for new construction, the repair of existing and new plantings, the density of planting in certain zones and categories of objects, the ratio of trees to shrubs.

Analyzing the prospective development of Crimean municipalities in the field of green building according to the Master Plans, we established a reduction of the greening public spaces by almost 50% for the city district of Alushta (Table 2). In other settlements, it is planned not only to keep the existing green zones but also to increase their area due to other facilities or by expanding the boundaries of municipality.

According to the analysis of the master plans of Crimean urban settlements, the volume of production of tree seedlings for the planned increase in greening public spaces for the estimated period of 15 years (until 2030), taking into account loss during survival period (for trees 3%, for shrubs 10%), should be from 264397 to 699428, and for shrubs from 1455636 to 2987847 pcs (Table 3). The need for planting material for the maintenance and current repair of existing green spaces was defined for trees ranging from 42,480 to 112,837, and for shrubs from 503,117 to 1,053,145 pcs.

Of the 33 nurseries involved in the cultivation of ornamental and fruit crops, state ones are represented only by departments of Nikitsky Botanical Garden–Dzhankoy introduction and quarantine nursery (Medvedevka village), Crimean experimental gardening station (Malenkoye village), and “Primorskoye” experimental farm (Partenit).

Table 3. Need for planting material

| City | New landscaping objects taking into account the loss (trees 3%, shrubs 10%) | | Repair of existing objects | |
|---|---|---|---|---|
| | Trees, pcs | Shrubs, pcs | Trees, 3% | Shrubs, 7% |
| Alushta | - | - | from 5,188 to 13,834 | from 60,525 to 129,119 |
| Armyansk | from 322 to 815 | from 2,064 to 3,481 | from 146 to 370 | from 2,048 to 3,453 |
| Bakhchisaray | from 15 to 41 | from 82 to 176 | from 15,064 to 40,170 | from 175,744 to 374,920 |
| Belogorsk | from 16,856 to 44,949 | from 90,008 to 192,016 | from 513 to 1,367 | from 5,980 to 12,757 |
| Dzhankoy | from 88 to 221 | from 561 to 946 | from 749 to 1,894 | from 10,484 to 17,678 |
| Yevpatoria | from 13,502 to 34,152 | from 86,517 to 145,892 | from 996 to 2,518 | from 13,939 to 23,504 |
| Kerch | from 3,663 to 9,265 | from 23,472 to 39,581 | from 1,182 to 2,990 | from 16,552 to 27,911 |
| Saki | from 23,446 to 59,304 | from 150,236 to 253,339 | from 150 to 379 | from 2,099 to 3,540 |
| Simferopol | from 3,183 to 8,487 | from 16,995 to 36,256 | from 3,997 to 10,660 | from 46,636 to 99,490 |
| Sevastopol | from 143,493 to 382,649 | from 766,227 to 1,634,618 | from 5,712 to 15,232 | from 66,640 to 142,166 |
| Feodosia | from 37,791 to 100,775 | from 201,795 to 430,496 | from 7,902 to 21,072 | from 92,190 to 196,672 |
| Yalta | from 22,038 to 58,768 | from 117,678 to 251,046 | from 881 to 2,350 | from 10,282 to 21,934 |
| Total: | from 264,397to 699,428 | from 1,455,636 to 2,987,847 | from 42,480 to 112,837 | from 503,117 to 1,053,145 |

Analysis of location, in accordance with Figure 1, demonstrates the uneven distribution of nurseries on the peninsula. The most part of them is located in plain-steppe and foothill zones. Almost all farms within plain-steppe agroclimatic zone belong to three settlements – the city of Dzhankoy and urban-type settlements of Krasnogvardeiskoye and Nizhnegorsky. More even distribution of farms can be observed in the area of northern macro slope. However, the most part of nurseries here is located in Simferopol and Bakhchisaray regions. This concentration of farms is due to the presence of fertile soils and the availability of the most valuable resource for Crimea – water.

Within the agroclimatic zone of the southern macro slope of the Crimean Mountains, only two farms are located – “Primorskoye” experimental farm and a small private nursery of ornamental plants in the village of Morskoye. This region is one of the main consumers of planting material for landscaping. Most of resort and recreational facilities are concentrated on the southern coast of Crimea: large sanatoriums, boarding houses, recreation centers, medical, tourist and other institutions. An important component is green areas; without them it is impossible to create comfortable conditions for treatment and relaxation. Four cities and many resort villages have extensive landscaped areas that require annual supply of planting material for maintenance and repair of separate objects. Historical parks are located on the South Coast and also need planting stock of decorative crops.

Small size of the Crimean Peninsula and convenient logistics could offset the territorial division of the centers of production and consumption of planting material provided that the soil and climatic conditions are aligned. However, dry subtropical climate of the South Coast differs sharply from moderately continental climate of the lowlands of peninsula. In the nurseries of the steppe and piedmont Crimea, it is impossible to establish the production of most exotics while southern

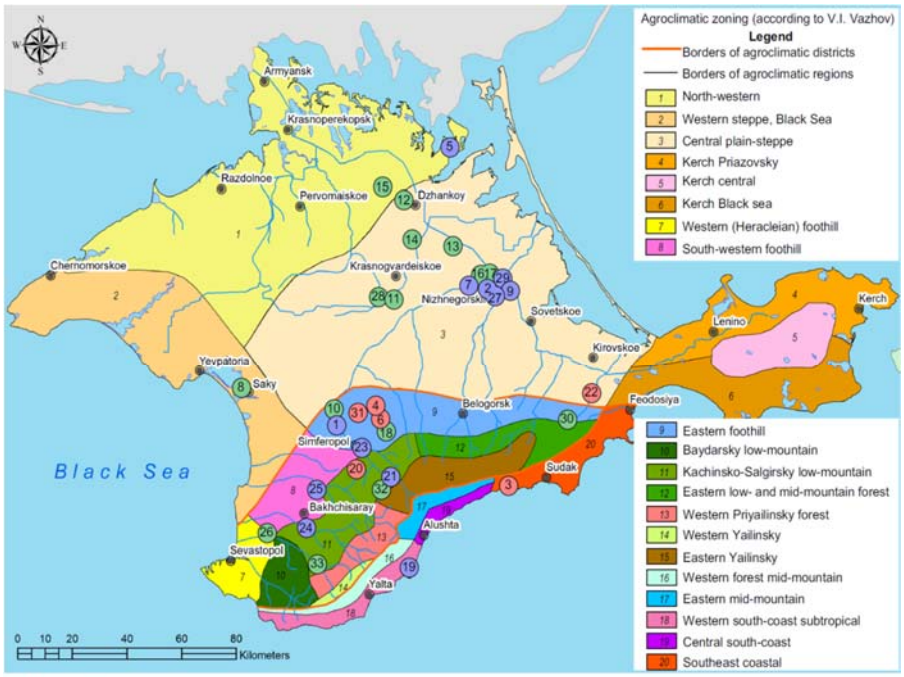
coniferous and evergreen deciduous tree and shrub species are the basis of landscape gardening complexes of the South Coast.

According to their intended purpose, 49% of all analyzed nurseries are non-specialized and are focused on growing planting material of both ornamental plants and seedlings of fruit trees and berry bushes. A third are fruit nurseries. Three of them have narrow specialization and are focused on growing seedlings of one culture – grapes. Share of decorative nurseries is only 18% of all farms.

Current situation is largely determined by the fact that Crimea due to the favorable combination of soil and climatic conditions is an important region for the development of market gardening. Total area of gardens at the moment is about 40 thousand hectares, including 12 thousand hectares of fruit-bearing stands (Plowatar *et al.* 2015, 5). Decorative nursery farming is a less developed sphere. State subsidy programs for foundation are provided exclusively for fruit nurseries (Belova 2018, 13). It is not surprising that a significant part of farms considers ornamental plants as a secondary source of income and provide them with a small part of the plot.

Preference is given to well-proven fruit and berry plants which are in large demand for planting gardens and berry plantations in the presence of state support mechanisms.

Figure 1. Location of Crimean nursery farms in accordance with the agroclimatic zoning of peninsula




- fruit and berry nurseries
- decorative nurseries
- non-specialized nurseries growing ornamental and fruit and berry crops

1. "AGROVIR"
2. Arysti-Sad
3. Tree nursery - "Marine tree nursery"
4. "Darles"
5. Dzhankoy introduction and quarantine nursery of Nikitsky Botanical Garden
6. "Dobry zhuk"
7. "Koroleva sada"
8. V.M. Tsykalo personal subsidiary plot
9. "Sad budushego" agricultural enterprise
10. Crimean experimental gardening station
11. "Ariya-N" agricultural enterprise
12. Moroz A.I. agricultural enterprise
13. L.V. Avina
14. Ilykhiny personal subsidiary plot
15. Makhotka personal subsidiary plot
16. "Prometey" personal subsidiary plot
17. OOO "Sovkhoz Nizhnegorsky plodopitomnik"
18. Volkovs' Nursery
19. "Primorskoye" experimental farm
20. "Renaissance" nursery of ornamental plants
21. "Zelyony Kontinent"
22. "Izobilny"
23. "Klematisy"
24. "Pervotsvet"
25. "Sadovye traditsii"
26. AO "Artvin"
27. "Sazhentsy KRYM.RF"
28. OOO ""Agro-Krym plant nursery"
29. "Sadovod Krym"
30. Crimean seedlings
31. OOO "Fleur" greenhouse complex
32. "Krasnolesye"
33. "Lavanda"

Most local seedlings of ornamental plants do not have the same characteristics as the imported planting material: it is not aligned, small in size, grown with an open root system, does not meet the standards. Poor quality is due to the long payback period for the implementation of advanced cultivation methods and the lack of stable demand from large government customers. As a result, when such orders appear the farm cannot provide sufficient amount of large-sized standard planting material, so, the buyer turns again to nurseries located outside the Crimea. Scheduled management and pre-orders for planting material are very problematic in the realities of modern market relations and competitive public procurement procedures.

One can hardly obtain reliable information about the degree of independent production development in nurseries from open sources. As a rule, they position themselves as producers of planting material of a full cycle – from sowing or rooting of cutting to realization. In fact, imported or grown plants acquired in other farms are often passed off as their own planting material. Many enterprises do not have a enough mother plants base. Only four nurseries out of all analyzes specify the presence of a mother plants farm, and two of them ("Koroleva sada" and "Renaissance") sell unrooted or rooted cuttings. Standardization of planting material is a significant problem. Currently in Russia, the quality of ornamental plants is regulated by state standards (GOST 24909-81 1994, 10; GOST 25-769-83 2007, 11; GOST 26869-86 1996, 12; GOST 28829-90 1991, 10; GOST 34231-2017 2017, 11). They contain several shortcomings and contradictions with modern approaches to the industrial cultivation of planting material of decorative crops. The possibility of dividing production cycle and specialization of producers of the different types of planting material was not considered. Previously, plant cultivation took place in nurseries operating on a full cycle, i.e. from seed to adult tree or shrub. At the modern market, only a small part of manufacturers works like this.

Regulation of the parameters of large-sized plants is not relevant. So, according to GOST 24909-81, the size of a ball of soil should be 1.3 × 1.3 × 0.6 and 1.5 × 1.5 × 0.65 m with a plant height of 4 to 5 m and more than 5 m for seedlings of the fourth and fifth groups, respectively. Modern technologies make it possible to obtain high-quality material of this size with a diameter of 0.85 m for the fourth and 0.95 m for the fifth group.

As a result, in the course of developing technical specifications for state and municipal procurements, the requirements of state standards conflict with actual market situation. Producer of planting material is forced to focus on the demand of private customers what reduces the opportunities for the intensive development of decorative nursery.

An attempt to solve the problem was made by the Association of Planting Material Producers. In 2013, "Standards for planting material of ornamental and fruit plants recommended in the Russian Federation" were developed (Savvateeva 2013, 106). They include current ornamental assortment (for Central Russia), types of planting material and up-to-date growing technologies. This document accepted as industry standard could serve as a guideline for producers, suppliers and buyers regarding the quality of seedlings, unified measurements, abbreviations and specification codes. Unfortunately, in contrast to the current international standard for planting material of fruit and berry plants (GOST 34231-2017 2017, 11) which entered into force on 01.01.2019, they are non-regulatory and are not approved at the legislative level.

The assortment of plants in the nurseries of the Crimean Peninsula is quite wide.

Fruit and berry seedlings include many local and recognized varieties of grapes, apple trees, pears, plums, apricots, quinces, peaches, currants, gooseberries, raspberries and strawberries. Less common plants are also widely represented, for example, dogwood, hazel, jujube, actinidia, mulberry, persimmon, blackberry, nectarine.

The most common ornamental plants are tree-shrub species, namely juniper, thuja, cypress, false cypress, spruce, pine, rose, barberry, hydrangea, hibiscus, buddley, spirea, willow, maple, honeysuckle, lilac, birch and others. Annual grassy and perennial flower and ornamental plants are produced in only a third part of nurseries.

The problem of the Crimean market of decorative planting material is not so much in the vastness of range, but in its regionalization.

Urban public spaces greening carried out for budgetary funds should be based on a scientifically based ornamental assortment which is approved at the level of the region or municipality. The lack of a documented list of ornamental species leads to contractor errors in landscape design, excessive plant loss and inappropriate spending of budget funds during the creation and reconstruction of green areas.

District assortments for landscaping in the former Soviet Union were based on the fundamental work "Decorative dendrology" by A.I. Kolesnikov (Kolesnikov 1974, 703). Here the author provides a list of decorative tree and shrub species for areas of application and types of planting. To date, thanks to introduction and selection studies, it has become possible to significantly expand this list what is reflected in the recommended assortments for separate regions (Sorokopudov *et al.* 2009, 178; Kozlovsky *et al.* 2009, 416; Karpun 2010, 580).

Zonal assortments of wood-shrub and flower-decorative plants for the Crimea were developed in Bagrov Botanical Garden (Repetskaya *et al.* 2019, 236).

Basic regulatory documents governing landscaping at the municipal level are "Rules for the Creation, Maintenance and Protection of Green Spaces". They are accepted by all city settlements of the Republic of Crimea. However, regional assortments that should be an integral part of the document are either absent, out of date, or transferred from the standard "Rules for the Creation, Maintenance and Protection of Green Plants of the Russian Federation" (Order of the Gosstroy of Russia No. 153 as of 15.12.1999) what eliminates their mandatory regional character.

The main and additional list of ornamental plants for landscaping urban and rural settlements in due legal form creates the basis for the formation of a range of decorative nurseries in the region allowing planning a potential request from a budget customer in the long-term perspective. In turn, available and adapted local planting material is beneficial to the consumer, since it reduces cost and increases the survival rate of seedlings in soil and climatic conditions of the area.

Table 4. Plus trees of the basic (assortment) of trees in gardens and parks of the city of Simferopol

| No. | Name | Geographical coordinates | Plant height (m) | Stem diameter (m) (at the height of 1.3 m) |
|---|---|---|---|---|
| Gagarin Recreation Park | | | | |
| 1 | Platanus orientalis L. | 44.963834, 34.100745 | 21.9 | 0.64 |
| 2 | Tilia cordata Mill. | 44.964527, 34.101805 | 19.9 | 0.57 |
| 3 | Gleditsia triacanthos L. | 44.965164, 34.101012 | 18.0 | 0.35 |
| 4 | Gleditsia triacanthos L. | 44.965417, 34.10051 | 26.5 | 0.58 |
| 5 | Platanus orientalis L. | 44.965417, 34.100513 | 28.8 | 0.92 |
| 6 | Acer pseudoplatanus L. | 44.965670, 34.098050 | 18.0 | 0.53 |
| 7 | Taxus baccata L. | 44.965580, 34.096970 | 6.5 | 0.10 |
| 8 | Juniperus virginiana L. | 44.963805, 34.096802 | 10.2 | 0.35 |
| 9 | Cupressus arizonica Greene | 44.962985, 34.095279 | 19.0 | 0.58 |
| 10 | Acer platanoides L. | 44.963228, 34.094494 | 19.0 | 0.97 |
| 11 | Pinus nigra subsp. pallasiana (Lamb.) Holmboe | 44.962429, 34.093912 | 16.0 | 0.60 |
| 12 | Cedrus libani A.Rich. | 44.961741, 34.093613 | 21.0 | 0.80 |
| 13 | Cedrus libani A.Rich. | 44.961695, 34.093232 | 24.0 | 0.73 |
| Shevchenko Park | | | | |
| 14 | Platycladus orientalis (L.) Franco | 44.934744, 34.090844 | 7.2 | 0.18 |
| 15 | Fraxinus excelsior L. | 44.935293, 34.091913 | 23.0 | 0.70 |
| 16 | Acer platanoides L. | 44.935636, 34.091836 | 17.3 | 0.41 |
| 17 | Gleditsia triacanthos L. | 44.935882, 34.092039 | 14.3 | 0.40 |
| 18 | Gleditsia triacanthos L. | 44.935000, 34.091681 | 23.0 | 0.63 |
| 19 | Styphnolobium japonicum (L.) Schott | 44.934821, 34.091487 | 17.1 | 0.66 |
| 20 | Pinus nigra subsp. pallasiana (Lamb.) Holmboe | 44.933351, 34.090239 | 11.2 | 0.51 |
| 21 | Gleditsia triacanthos L. | 44.933463, 34.090771 | 14.8 | 0.49/0.40 |
| “Yekaterininsky garden” | | | | |
| 22 | Platycladus orientalis (L.) Franco | 44.952083, 34.105019 | 5.9 | 0.10/0.19 |
| 23 | Celtis occidentalis L. | 44.952337, 34.105669 | 10.0 | 0.33 |
| 24 | Gleditsia triacanthos L. | 44.952330, 34.106192 | 16.9 | 0.37 |
| 25 | Acer pseudoplatanus L. | 44.952602, 34.105053 | 15.1 | 0.47 |
| Play park | | | | |
| 26 | Platanus orientalis L. | 44.955935, 34.108007 | 24.2 | 0.75 |
| 27 | Platycladus orientalis (L.) Franco | 44.954479, 34.109776 | 12.7 | 0.28/0.26/0.22/0.21/0.16 |
| 28 | Acer pseudoplatanus L. | 44.955440, 34.110992 | 20.6 | 0.53/0.47 |
| 29 | Platanus orientalis L. | 44.955877, 34.111130 | 24.2 | 0.94 |
| 30 | Cedrus libani A.Rich. | 44.955557, 34.110078 | 22.0 | 0.66 |
| Bagrov botanical garden, Vernadsky Crimean Federal University | | | | |
| 31 | Prunus cerasifera subsp. pissardii (CarriŠre) Dost l | 44.943486, 34.127512 | 8.3 | 0.15 |
| 32 | Cupressus arizonica Greene | 44.945266, 34.127612 | 7.5 | 0.42 |
| 33 | Quercus castaneifolia C.A.Mey | 44.944349, 34.129475 | 15.0 | 0.86 |
| 34 | Robinia pseudoacacia L. | 44.944588, 34.129408 | 12.5 | 0.22/0.22/0.26 |
| 35 | Robinia pseudoacacia L. | 44.944617, 34.129597 | 11.5 | 0.25 |
| 36 | Platycladus orientalis (L.) Franco | 44.943404, 34.129692 | 5.5 | 0.20/0.22/0.18 |
| 37 | Platycladus orientalis (L.) Franco | 44.943420, 34.129742 | 6.1 | 0.19/0.24 |
| 38 | Cedrus libani A.Rich. | 44.943305, 34.128754 | 12.8 | 0.72 |
| 39 | Fraxinus excelsior L. | 44.943228, 34.129309 | 10.7 | 0.37 |
| 40 | Acer pseudoplatanus L. | 44.942462, 34.129534 | 12.0 | 0.55 |
| 41 | Platanus orientalis L. | 44.942861, 34.130206 | 19.0 | 1.7 |
| 42 | Acer platanoides L. | 44.943116, 34.129557 | 15.0 | 0.42 |
| 43 | Taxus baccata L. | 44.942609, 34.130062 | 6.3 | 0.40/0.38 |
| 44 | Koelreuteria paniculata Laxm. | 44.940041, 34.131298 | 7.5 | 0.42 |
| 45 | Acer pseudoplatanus L. | 44.940833, 34.130197 | 16.2 | 0.40 |
| 46 | Abies pinsapo Boiss. | 44.941006, 34.131808 | 10.2 | 0.43 |
| 47 | Pinus nigra subsp. pallasiana (Lamb.) Holmboe | 44.941893, 34.132705 | 8.5 | 0.34 |

| No. | Name | Geographical coordinates | Plant height (m) | Stem diameter (m) (at the height of 1.3 m) |
|---|---|---|---|---|
| 48 | Pinus nigra subsp. pallasiana (Lamb.) Holmboe | 44.941954, 34.132782 | 9.1 | 0.35 |
| 49 | Tilia cordata Mill. | 44.941606, 34.130472 | 8.3 | 0.32 |
| 50 | Juniperus virginiana L. | 44.940169, 34.132105 | 4.8 | 0.28 |
| 51 | Gleditsia triacanthos L. | 44.940993, 34.132944 | 13.3 | 0.38 |

In 2018-2019, we examined the largest areal garden and park objects of Simferopol (Yuri Gagarin Recreation Park, Play Park, Central Recreation Park (Yekaterininsky sad), Shevchenko Recreation Park, Bagrov Botanical Garden) as the city with the highest variety of cultivated dendroflora in the Piedmont zone of Crimea.

Cartographic data of the spatial localization of plus trees were combined with attribute tables containing gps-coordinates and morphometric parameters of individuals (Table 4). Geoinformation system plus trees growing on the territory of the areal park facilities of Simferopol was obtained.

In the surveyed territories with a total area of about 100 hectares, 51 plus of 19 tree species of the main recommended assortment for landscaping the Piedmont zone of Crimea were found. They are valuable as potential donors of seed and vegetal material for the production of seedlings of decorative trees adapted to the urban and environmental conditions.

It is logical that the largest number of plus trees was selected on the territory of the introduction point - Bagrov Botanical Garden – 21 specimens of 17 species.

## Conclusion

Thus, the main problems of modern decorative nursery farming in Crimea are the following:

- territorial disunity of the centers of production and consumption of planting material; this, together with the agroclimatic differentiation of the peninsula, entails a lack of production of exotics which are in demand at the landscape gardening facilities of the South Coast;
- absence of the assortments of decorative crops for gardening urban and rural settlements of the Republic of Crimea and of the city of Sevastopol approved at the municipal or regional level;
- contradiction of the current GOSTs to modern technologies of planting material production;
- lack of own funds at private nursery farms for the maintenance of mother plants base, implementation of modern technologies, and the difficulty of long-term planning which, as a result, limits the ability of Crimean producers to provide adapted (primarily, large-sized) planting material for decorative crops for the needs of the peninsula.

Some of the above problems are of national level; they should be solved at the federal level.

At the level of the Crimean region, a number of events will contribute to the development of decorative nursery as a separate industry:

- Development of a network of large municipal nurseries (including, based on the principles of public and private partnership) that are focused on programs for the creation and operation of urban green areas and recreational complexes. The South Coast of Crimea should be among the priority areas in order to fill the deficit in the production of decorative subtropical crops.

- Approval of modern regional assortments of decorative cultures at the level of municipalities. Lists of the main and additional assortment should form the basis for the organization of nurseries.

- Creation of seed and mother plants base as result of a survey of green areas in order to find plus trees and plantings. Formation of a reserve seed fund, seed and cuttings plots.

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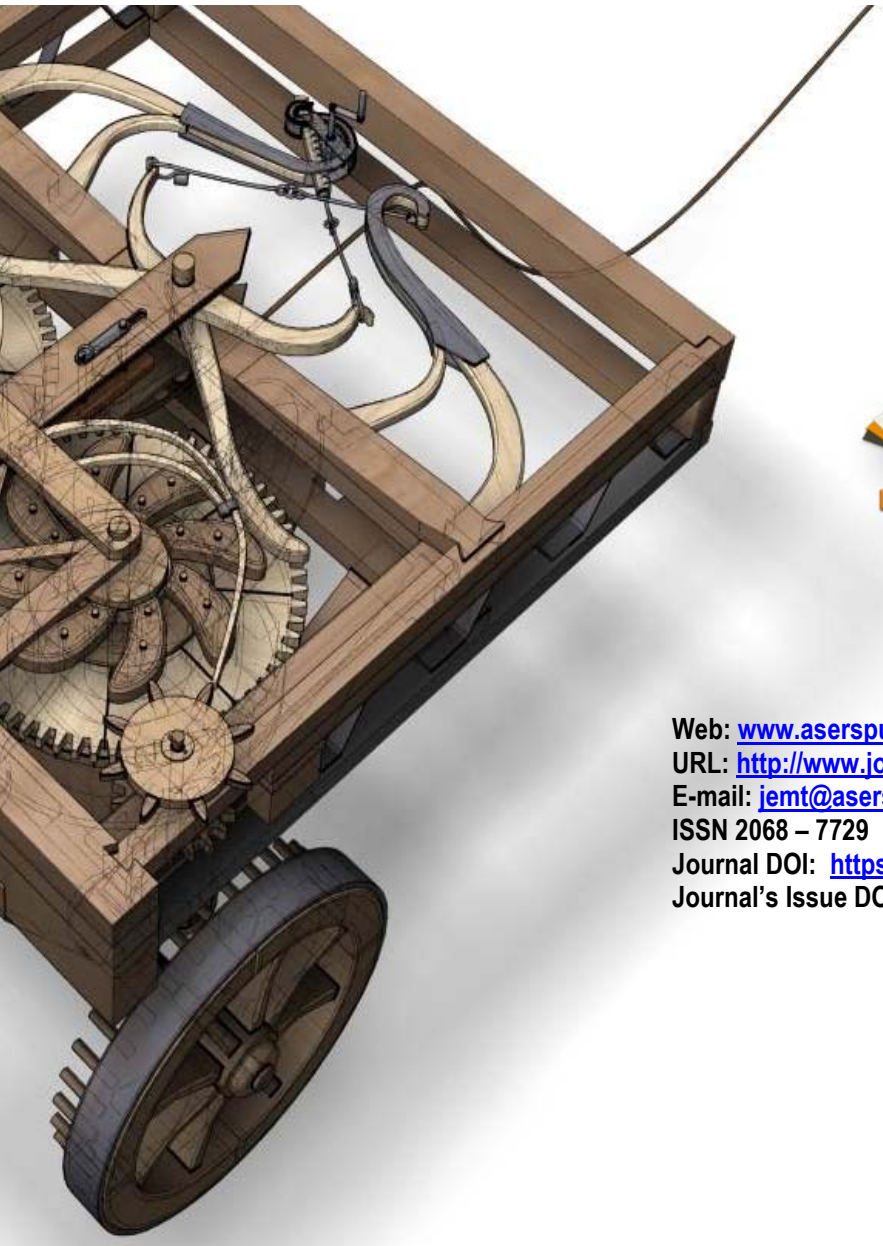

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