Scientific bases of biodiversity conservation in the conditions of educational and experimental farm of GBPEI “Ufa Forestry Technical College”

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Abstract. The Article is devoted to the methods of biodiversity conservation in the educational and experimental farm of GBPEI “Ufa Forestry Technical College”, where a collection of resource species of different climatic zones is preserved. The main decorative-deciduous, beautiful-flowering, wild-growing, fruit, medicinal species and families of the collection are presented, their generalized characteristic is given. Some results of studying of features of biology and reproduction at introduction in the open and closed soil in the context of the southern Urals are given.

1. Introduction

The most important task of our time is the preservation of biodiversity. National and international strategies and programs "national strategy for biodiversity conservation of Russia" (2001), "Strategies for the conservation of rare and endangered species of animals, plants and fungi in the Russian Federation for the period up to 2030" (Order Of the government of the Russian Federation of February 17, 2014 N 212-p), "global strategy for plant conservation" (2002), etc. Conservation of plant biodiversity is a priority. It is carried out in different regions in relation to species and varieties using a wide range of methods in situ (protection in protected areas) and ex situ – (introduction and collections in Botanical gardens and greenhouses, biotechnology, breeding, banks).

Purpose of the research: to assess the collection Fund of the educational and experimental economy of the Ufa forestry College.

Ufa lemon tree nursery was founded in 1990 and since 1992 it has become an educational and experimental farm Ufa forestry College. So far, a collection of resource species of plants has been gathered in the educational and experimental farm GBPEI "Ufa forestry College". The area of the educational and experimental farm is 3.9 hectares, including the open ground of 1.5 hectares and protected ground of 1 hectare, represented by a year-round greenhouse.

The territory of the educational and experimental farm is located in the temperate continental climatic zone of the Northern forest-steppes. South, southwest, north, northwest winds are prevailing. January is one of the coldest months (−14.5−(−17.5) °C), the warmest month is July (+19.7 °C). In some years, there are droughts. The total rainfall is 550–600 mm on average, the frost-free period is 105–110 days. The average height of the snow cover is 30–60 cm [3]. In greenhouse environments, optimal conditions for growth and development of subtropical and tropical crops are maintained all
year round. The minimum temperature is 10–12 °C, in summer windows are provided for ventilation. The humidity regime is maintained with the help of sprinkler installations, and on average is 60–70 %.

In total, the farm grows more than 512 species of plants in 117 families, and 330 genera, including decorative-deciduous, beautiful-flowering, wild-growing, fruit, medicinal plant species (Fig. 1). The General list of species is presented in table 1.

| Table 1. The collection of educational-experimental farm of the GBPEI “Ufa Forestry Technical College” |
|---|---|---|---|
| no. | Family | Open ground | Protected ground |
| | | Number of species, pcs. | Family | Number of species, pcs. |
| 1 | Aceraceae | 1 | Acanthaceae | 7 |
| 2 | Actinidiaceae | 1 | Actinidiaceae | 1 |
| 3 | Adoxaceae | 3 | Aizoaceae | 2 |
| 4 | Alliaceae | 5 | Alstroemeria | 1 |
| 5 | Amaryllidaceae | 1 | Amaryllidaceae | 2 |
| 6 | Anacardiaceae | 1 | Amaryllidaceae | 6 |
| 7 | Apiaceae | 2 | Anacardiaceae | 1 |
| 8 | Apocynaceae | 1 | Annonaceae | 1 |
| 9 | Asparagaceae | 6 | Apocynaceae | 7 |
| 10 | Asphodelaceae | 1 | Asphodelaceae | 6 |
| 11 | Asteraceae | 15 | Asteraceae | 4 |
| 12 | Berberidaceae | 3 | Aracnidae | 1 |
| 13 | Betulaceae | 3 | Aracnidae | 6 |
| 14 | Bignoniaceae | 1 | Asclepiadaceae | 5 |
| 15 | Buxaceae | 1 | Asparagus | 23 |
| 16 | Carpinus | 12 | Asphodelaceae | 6 |
| 17 | Caryophyllaceae | 10 | Asplenium | 1 |
| 18 | Cistaceae | 1 | Asteraceae | 6 |
| 19 | Cornaceae | 1 | Balsaminaceae | 1 |
| 20 | Crassulaceae | 7 | Begoniaceae | 9 |
| 21 | Cupressaceae | 9 | Berberidaceae | 2 |
| 22 | Elaeagnaceae | 2 | Bignoniaceae | 2 |
| 23 | Ericaceae | 9 | Bromeliaceae | 9 |
| 24 | Fabaceae | 4 | Cactaceae | 10 |
| 25 | Fagaceae | 2 | Caprifoliaceae | 1 |
| 26 | Grossulariaceae | 4 | Caricaceae | 1 |
| 27 | Hamamelidaceae | 1 | Caryophyllaceae | 1 |
| 28 | Hydrangeaceae | 10 | Celastraceae | 1 |
| 29 | Iridaceae | 11 | Commelinaceae | 7 |
| 30 | Juglandaceae | 2 | Convulvulaceae | 1 |
| 31 | Lamiaceae | 1 | Costaceae | 1 |
| 32 | Liliaceae | 2 | Crassulaceae | 16 |
| 34 | Malvaceae | 1 | Cupressaceae | 2 |
| 35 | Marantaceae | 1 | Cyperaceae | 1 |
| 36 | Oleaceae | 6 | Davallia | 3 |
| 37 | Paeoniaceae | 1 | Droseraceae | 1 |
| 38 | Papaveraceae | 2 | Ericaceae | 3 |
| 39 | Pinaceae | 9 | Euphorbiaceae | 10 |
| 39 | Poaceae | 3 | Fabaceae | 8 |
| 40 | Polemoniaceae | 2 | Geraniaceae | 3 |
| 41 | Polygonaceae | 2 | Gesneriaceae | 4 |
| 42 | Ranunculaceae | 3 | Ginkgoaceae | 1 |
| 43 | Rosaceae | 33 | Hydrangeaceae | 1 |
| 44 | Rutaceae | 1 | lauraceae | 4 |
| 45 | Salicaceae | 2 | Lauraceae | 2 |
| Number | Family     | Quantity |
|--------|------------|----------|
| 46     | Sapindaceae| 1        |
| 47     | Saxifragaceae| 2       |
| 48     | Tamaricaceae| 1       |
| 49     | Taxaceae   | 1        |
| 50     | Valerianaceae| 1      |
| 51     | Violaceae  | 1        |
| 52     | Vitaceae   | 1        |
| 53     | Sapindaceae| 3        |
| 54     | Malvaceae  | 5        |
| 55     | Moraceae   | 5        |
| 56     | Malvaceae  | 2        |
| 57     | Melastomataceae| 1      |
| 58     | Myrtaceae  | 6        |
| 59     | Myrtaceae  | 6        |
| 60     | Myrtaceae  | 1        |
| 61     | Myrsinaceae| 3        |
| 62     | Myrtaceae  | 4        |
| 63     | Myrtaceae  | 1        |
| 64     | Myrtaceae  | 6        |
| 65     | Myrtaceae  | 4        |
| 66     | Myrtaceae  | 2        |
| 67     | Myrtaceae  | 26       |
| 68     | Myrtaceae  | 1        |
| 69     | Myrtaceae  | 2        |
| 70     | Myrtaceae  | 1        |
| 71     | Myrtaceae  | 3        |
| 72     | Myrtaceae  | 4        |
| 73     | Myrtaceae  | 2        |
| 74     | Myrtaceae  | 1        |
| 75     | Myrtaceae  | 1        |
| 76     | Myrtaceae  | 2        |
| 77     | Myrtaceae  | 26       |
| 78     | Myrtaceae  | 3        |
| 79     | Myrtaceae  | 5        |
| 80     | Myrtaceae  | 2        |
| 81     | Myrtaceae  | 2        |
| 82     | Myrtaceae  | 1        |
| 83     | Myrtaceae  | 6        |
| 84     | Myrtaceae  | 6        |
| 85     | Myrtaceae  | 3        |
| 86     | Myrtaceae  | 2        |

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**Figure 1.** The percentage of the resource types of the educational-experimental farm of GBPEI “Ufa Forestry Technical College”

The farm is dominated by deciduous, flowering and fruit crops. Wild and medicinal species are represented in smaller numbers.
The name of the families was determined by S.K. Cherepanov (1995), greenhouse species—according to the catalogue of greenhouse plants of the Botanical garden of the Botanical Institute, named after V.L. Komarov [1, 8].

Maximum number of species of families Rosaceae (34), Asparagaceae (29), Rutaceae (27), Crassulaceae (23), Asteraceae (21), Caprifoliaceae (13), Fabaceae (12), Caryophyllaceae, Cupresaceae, hydrangea, Iridaceae (11), Cactaceae (10), Bromeliaceae, begonias, Pinaceae (9), apocynaceae (8), Agavaceae, amaryllidaceae, Asphodelaceae, Commelinaceae, Oleaceae (7), urticaceae, verbenaceae, Arecaceae (6), Lamiaceae, Asclepiadaceae, Alliaceae, berberidaceae (5), Piperaceae, pteridaceae (4), the remaining families are represented in the number of 3 to 1 Species.

Among the diversity of cultures, plants listed in the Red book of the Russian Federation (2008) [6], the Red book of the Republic of Bashkortostan (2011) occupy a special place [7] (table 2).

Of the total number of species introduced species are: in open ground-40 species, in protected-89 species. 36 species pass a full cycle of development (bloom and bear fruit), 11 of them in the open ground, 25 – in the protected one. In conditions of vitro culture 9 species and varieties were introduced.

Table 2. Nature protection status of rare species of plants of educational and experimental economy GBPEI “Ufa Forestry Technical College”

| Rarity category                                      | Open ground, pcs. | Protected ground |
|------------------------------------------------------|-------------------|------------------|
| Red Book of the Russian Federation                   | 13                | 5                |
| Red Book of the Republic of Bashkortostan             | 15                | –                |

In the collection Fund 40 species are included in the collection of subtropical cultures of fruit, nut (except Juglans and Corylus), oil and spice-flavored plants of the Russian Federation, the Republic of Abkhazia and the Republic of Belarus [5].

The collection Fund is represented by various life forms. In protected ground, shrubs make up the majority (42%), followed by grasses (25%) and trees (25%), lianas (3%) and rhizomatous plants (5%). In protected ground, herbaceous plants (38%) are in the lead, there are fewer trees (32%), shrubs and lianas are represented in the share ratio by 15%.

Special attention is paid to fruit and medicinal species to preserve the diversity of the collection. The main families whose representatives are in the greatest demand and are widely used in gardening and medicine include Rosaceae, Asteraceae, Valerianaceae, Vitaceae, Sapindaceae, Rutaceae, Lauraceae, Fabaceae, Myrtaceae, Grossulariaceae, Caricaceae.

Of the species of the Rosaceae family (Rosaceae Juss.) Eriobotrya japonica (Thunb.) Lindl., Chaenomeles japonica (Thunb.) Lindl., Amelanchier ovalis Medik., Amygdalus nana Batsch, Sorbus aistragia L. various varieties, etc.

Of the species of the Asteraceae family (Asteraceae Bercht. & J. Presl. or Compositae Giseke) Stemmacantha serratuloides (Georgi) M are cultivated in the educational and experimental farm. Ditrich, Calendula officinalis L., Helianthus tuberosus L., et al.

Of the species of the Vine family (Vitaceae Juss.), Vitis vinifera L., Parthenocissus quinquefolia Planch. and others are grown in the educational experimental farm.

Of the species of the Legumes family (Fabaceae Lindl. or Papilionaceae) in the educational and experimental farm Ceratonia siliqua L., Tamarindus indica L., Sagadapa arborescens Lam, Sophora japonica (L.) Schott, etc. are grown.

The Sapindaceae family (Sapindaceae Juss.) is represented by Dimocarpus longan Lour., Nephelium lappaceum L., Aesculus hippocastanum L., etc.

The Laurel family (Lauraceae Juss.) in the farm are Persea americana Mill., Laurus nobilis L.

Of the Myrtle family (Myrtaceae Juss.) in the educational and experimental farm Myrtus communus L., Psidium littorale Raddi, Acca sellowiana (Berg) Burret, Eucalyptus citriodora Hook are cultivated.

The gooseberry family (Grossulariaceae DC.) in the educational and experimental farm is represented by Ribes nigrum L., Ribes rubrum L., Ribes aureum Pursh.
Of the species of the caricaceae family (CaricaceaeDumont.) seedlings and fruits of Carica papaya L. are in great demand in the educational and experimental farm.

Members of the genus Valeriana are widely used in the Pharmacopoeia. In order to expand the raw material base of V. officinalis L., Valeriana wolgensis Kazak is cultivated as an additional source of medicinal raw materials on the territory of the educational and experimental farm.

The Rutaceae family (Rutaceae Juss.) is represented by Citrus limon (L.) Osbeck различных сортов, Citrus medica L. различных сортов, Citrus sinensis (L.) Osbeck., Citrus aurantiifolia (Christm.) Swingle, Citrus paradise Macfad., etc.

Tropical and subtropical species predominate in the collection of the farm in protected ground. The main crop of the farm is citrus crops. About 30 years of work on breeding and study of cultivation technology in the Southern Urals, as in the northernmost point of cultivation: phenorhythms of development (table.3), morphological characteristics of introducers, characteristics of raw materials, features of reproduction and cultivation in vitro [2] are investigated.

**Table 3. Phenorhythms of development of different varieties of Citrus limon in the conditions of protected ground of Ufa in the autumn period (September-November)**

| Phenophase            | Lemon variety / Average phenodate (± number of days) |
|-----------------------|------------------------------------------------------|
|                       | Jubilee     | Tashkent  | Leysan    | Salavat  | Urman    |
| Budding:              |             |           |           |           |           |
| Start                 | 24.09±16    | 18.09±16  | 17.09±17  | 25.09±16  | 26.09±15  |
| End                   | 19.10±13    | 10.10±15  | 16.10±13  | 22.10±15  | 23.10±11  |
| The duration of the budding phase (average ± number of days) | 28±4        | 22±3      | 29±2      | 28±4      | 28±5      |
| Bloom:                |             |           |           |           |           |
| Start                 | 09.10±12    | 30.09±14  | 30.09±13  | 09.10±15  | 12.10±11  |
| massive               | 26.10±9     | 13.10±11  | 18.10±15  | 24.10±13  | 29.10±12  |
| end                   | 12.11±10    | 30.10±16  | 02.11±10  | 15.01±10  | 17.11±8   |
| Duration              |             |           |           |           |           |
| Flowering phases (mean ± number of days) | 35±3        | 26±8      | 35±2      | 36±3      | 37±4      |
| Fruiting:             |             |           |           |           |           |
| Start                 | 11.11±14    | 24.10±15  | 28.10±14  | 03.11±13  | 08.11±13  |
| end of fruiting and harvesting | 04.05±4    | 13.04±20  | 28.05±5   | 07.05±6   | 06.05±4   |

As a result of the carried out researches the variety specificity of duration of phenophases of plants from budding to fruiting is revealed, features of phenophase onset in the conditions of the Southern Urals at C. limon varieties are defined.

On the basis of morphometric characteristics of taxa introduced in the farm, it is shown that varietal properties are preserved during further reproduction. In protected ground under conditions approached to natural, many cultures successfully develop and begin to bear fruit.

In educational and experimental farm works on research and features of reproduction of many species are conducted (Citrus limon (L.) Osbeck, Citrus medica L., Carica papaya L., Punica granatum L., Juniperus communis L., Juniperus Sabina L., Valeriana wolgensis Kazak., Stemmacantha serratuloides Georgii) M. Dittrich, Berberis vulgaris L., Populus nigra L. x P. nigra f. Italica Duroi, Juglans mandshurica Maxim, Aesculus hippocastanum L., etc.), with the selection of substrates and growth regulators for each culture (table 4).

In educational and experimental farm various ways of reproduction of the grown-up cultures are developed. Cuttings with green and semi-woody cuttings are widely used for all plant groups (87.5 %), with the exception of herbaceous crops. All species on the farm are propagated by seeds, except for decorative leafy and a group of essential oil crops (75 %). Decorative-leaved, herbaceous and beautiful-flowering crops (37.5 %) are also propagated by dividing the bush. Specialized organs are used in the propagation of herbaceous and flowering crops (25 %). Microclonal reproduction in _vitro_ is used in a group of citrus and herbaceous crops (25 %). Different methods of grafting _Citrus_ species are used (12.5 %).
Table 4. The percentage of the resource types of the educational-experimental farm of GBPEI “Ufa Forestry Technical College”

| Group of plants                        | Seed | in vitro | grafting | vaccination | Vegetative division | specialized plant organs |
|----------------------------------------|------|----------|----------|-------------|---------------------|-------------------------|
| Citrus crops                           | +    | +        | +        | +           |                     |                         |
| Fruit crops                            | +    |          | +        |             |                     |                         |
| Conifers crops                         | +    |          |          |             |                     |                         |
| Decorative leafy crops                 | +    |          | +        |             |                     |                         |
| Grassy crops                           | +    |          | +        |             |                     |                         |
| Essential oil crops                    | +    |          |          |             | +                   |                         |
| Deciduous crops open ground            | +    |          |          |             |                     |                         |
| Flowering crops                        | +    |          |          |             | +                   |                         |

Methods of clonal micro-reproduction in vitro are developed, the optimal sterilization regime for Citrus limon (L.) Osbeck and Citrus medica L., Stemmacantha serratuloides Georgi) M varieties are selected. Dittrich, Valeriana wolgensis Kazak. When studying the stages of microclonal reproduction of crops, a high percentage of Explant viability was revealed, which makes it possible to obtain a large number of healthy planting material. Differences in growth rates were revealed when growing rootstocks in the substrate in greenhouses and in vitro culture.

The collection is systematically replenished. Since 2009, Citrus limon (L.) Osbeck varieties have been described and included in the state register of the Russian Federation. Urman, Salavat, Leysan and Citrus medica L. Uraltau and Zilya of Bashkir selection [4].

The farm conducts regular agrochemical studies of the soil, calculated irrigation rates and doses of necessary fertilizers for different crops. Agricultural practices of cultivation in the conditions of open and protected ground are developed.

2. Conclusion

The collection of the farm is used for educational purposes, for aesthetic, environmental education of the population. Today, the lemon tree nursery is the basis for practical and theoretical training of students of specialized educational institutions of Ufa. Lemon tree nursery annually visited by more than 30 thousand people, including guests of the city, the Republic and the country. Specialized (floral, botanical) excursions are held for visitors.

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