

The Conservational Role of Qur'anic Botanic Garden of Medicinal, Desert and Tropical Plants in Qatar

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Abstract: The scientific program of the Qur'anic Botanic Garden (QBG) is concerning with agricultural, conservational, biotechnology and medicinal fields. The QBG not only focusing on the study of the plants mentioned in the *Holy Qur'an* and *Hadith*, but also the endogenous plants of the Flora of Qatar and potential medicinal plants of the Arabic world. In the *Hadith*, the Prophet's sayings, there are more than 20 plants mentioned in the occasions of cosmetic or medicinal uses. The garden is conserving special kinds of plants collected from different parts of the world to be restored at one place for preservation and study purposes. Both *ex-situ* and *in-situ* conservational programs are designed to collect and conserve plants inside and outside their natural habitats. The QBG plant nursery, herbarium, and seeds units are main components of the QBG that build to produce and preserve the plants at QBG. More than 59 plant species are preserved from three different geographical zones: desert, Mediterranean and tropical zones. The Garden also is collecting and preserving those traditional entities from the entire world in order to be exhibited in the Botanic Museum of the QBG. By following the Islamic principles of conservation, the QBG highlights these conservational ethics and explains them for all people. Garden emphasizes multi-activities, campaigns, events, fairs and exhibitions for the students and public in order to encourage people to preserve the natural resources through an ordinally oriented educational program which is based on plant conservation. Another side of QBG's conservation roles is the conservation based on community engagement and education. QBG's education programs, horticulture and conservation programs, dissemination activities, and partnerships are fundamental in ensuring the transfer of this knowledge to the global community.

Key words: Qur'anic Botanic Garden, *in-situ* conservation, *ex-situ* conservation, botanic museum, community engagement.

1. Introduction

Botanic gardens are a special category of garden, distinctive for their scientific basis, and play an important role in bringing together people and plants, providing inspirational planting for people, commitment to plant conservation [1]. Botanic gardens are institutions holding documented collections of living plants for the purposes of scientific research, conservation, display and education [2, 3]. All of the botanic gardens are collecting different kinds of the plant species, which may be grown naturally in the country of the botanic garden or collected from other countries for the sake of preserving the plants species. Moving the trees,

seeds and propagules from its original habitats to botanic gardens is considering a kind of conservation which is called *ex-situ* conservation. More than 100 countries have joined a union which is named Botanic Gardens Conservation International or BGCI which focuses on plant conservation, public engagement, services for botanic gardens and training. The botanical gardens inside the BGCI union are representing different types of ecosystems, habitats and concepts.

Human civilization has seen many prominent types of gardens. Archetypal examples include the English, Japanese, French and Islamic gardens [4]. The Islamic garden is widely recognized as being typified by the gardens established during the peak of the Muslim civilization [5]. Islamic gardens are a type of graders that include themes of water and

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shade. The Charbagh quadrilateral layout with four smaller gardens divided by walkways is the most identifiable architectural design reflecting the Islamic gardens.

Islam urges people to care for trees and cultivate the land, which are deeds to be rewarded. The *Holy Qur'an*, the book of Muslims, has many references to gardens and plants. The Qur'anic verses that mention plants, trees and fruits are there to encourage people to think about Allah's creation and to help them reach a level of faith based on conviction [6].

The Qur'anic Botanic Garden (QBG), member of Qatar Foundation for Education, Science and Community Development, exhibits the plants, botanical terminologies, conservational principles and environmental ethics that were mentioned in the *Holy Qur'an*, the book of Muslims, and the *Hadith*, the Saying of the Prophet Muhammed PBUH. The garden inspires appreciation of nature by encouraging respect and responsibility for the environment. The concept of the garden comes from a region-wide United Nations Educational, Scientific and Cultural Organization (UNESCO) [12]. The idea of the QBG started since it was inaugurated by Her Highness Sheikha Moza bint Nasser, chairperson of Qatar Foundation on September 17, 2008.

The QBG exhibits about 60 plant species belonging to three different types of habitats: desert, Mediterranean and topical habitats [6]. The QBG displays many plants such as date palm, olive, fig, citron, true senna, ginger, aloe, camphor and other plants. The harmony between plants and design of the garden is beautiful, and it reflects Islamic architecture and art.

The garden supports a very important Islamic vision and Allah's instructions, to value him and the world and all creatures he created. This is fundamental to the worship of Allah. It highlights the Muslims knowledge about Islam, environment and conservation and also helps in understanding the scientific aspects of the plants and their life.

2. Conservation Facilities of the QBG

Most definitions of conservation provided by conservationists reflect their authors' particular view of what conservation ought to be [7]. Leader-Williams *et al.* define conservation as "actions that directly enhance the chances of habitats and species persisting in the wild" [7, 8]. This emphasizes habitats and species, and persistence in the wild, which in turn suggests a particular set of actions intended to achieve these goals. Botanic gardens worldwide maintain approximately 80,000 species as living plants (nearly 30% of the known vascular plant species of the world) represented by more than four million living accessions (individual plant collections), and keep 250,000 seed bank accessions [3, 9].

The conservation strategy of the QBG has two main approaches: *in situ* and *ex-situ* conservation. The *in-situ* conservation maintains species in dynamic relationships with the habitat and allows gene flow and geographical distribution. The *ex-situ* conservation is referring to the preservation and maintenance of the plants species or outside their natural habitats; it is also including seeds collection and the production of plants inside the plant nurseries. The garden was able to increase the number of saplings inside the QBG nursery for the purpose of preservation, educational and planting "Ghars" campaigns. The *in-situ* conservation program of the QBG is including an ecological study, e.g., surveys, assessments and geographic information system (GIS) mapping of recorded plants of the QBG in Qatar and those indigenous plants of the Flora of Qatar. Restoration of the wild plant species at their original habitats is one of the activities of the young botanist educational program and *in-situ* conservation of the program of the QBG that aims to restore and rehabilitate the desert plants at their natural habitats in order to compact the desertification and engage the Qatari community to show their commitments towards the environment and protecting the endogenous plants of Qatar.

Natural history museums are integral to both sustainable economic development and to the promotion of science, culture, education, and natural and historical conservation [10]. The conservation strategy of the QBG is not only focusing on plants but it also collects the botanical items and tools from different parts of the world for the QBG's museum which is conserving the heritage based on planting and agriculture.

The QBG, member of Qatar Foundation, is running its conservation program through its three main units in addition to garden's educational program based on conservation program.

2.1 QBG Plant Nursery

QBG plant nursery is a part of the Qatar Foundation plant nursery (Fig. 1). The shaded and the conditioned plant nurseries allow QBG to run the agricultural and conservational activities of the garden and accommodate the 59 plant species of the QBG that belong to three different geographical zones: desert, Mediterranean and tropical habitats. In addition, the plant nursery is a great tool to provide practical botanical courses for students and public.

2.2 Herbarium & Seeds Unit

Herbarium & seeds unit (Fig. 2) is a part of the *ex-situ* conservation program of the QBG that preserves seeds and herbarium specimens of the plants of the *Holy Qur'an* and *Hadith* in addition to the endogenous plants of the Flora of Qatar. The herbarium & seeds unit offers good opportunities for students to be engaged in the conservation program of the QBG, and to deliver applied workshops for students and professionals on plant taxonomy, seeds and germinations.

2.3 Botanic Museum

The QBG indoor botanic museum (Fig. 3) displays more than 120 botanical items, i.e., modules of plant parts, traditional farming, traditional medicinal plants



Fig. 1 Part of plant nursery.



Fig. 2 Seeds lab of Qur'anic Botanic Garden (QBG).



Fig. 3 Part of botanic display.

and food & drinks tools. The QBG's botanic museum aims to fill the gap between generations who had practiced some of the traditional customs and among those who were not able to know about their culture heritage.

2.4 Oxygen Park

Oxygen park (Fig. 4) is one of the Qatar Foundation shared facilities that extends to 130,000 m² and contains many elements of the Botanic & Islamic Gardens such as water, fountains, shade and heritage areas which are the significant components of both botanic and Islamic garden designs. Oxygen park is an excellent



Fig. 4 Oxygen park, education city.

place to organize and host outdoor community engagement programs for schools and public campaigns, fairs and educational activities.

3. QBG Efforts in Heritage Conservation

One of the main targets of the QBG is to identify and display the plants and botanical terms that have been mentioned in the *Holy Qur'an* and *Hadith*. Although, these plants are mentioned in the holy book of Muslims, many people including religious people, do not identify those plants or recognize them. The garden has compiled and highlighted the plants in one volume of *Holy Qur'an* and *Hadith* as a part of its role towards heritage conservation. In addition, the QBG is collecting the plants tools, items and terminologies related to plants and agriculture in the Arabic and Islamic heritage in order to be displayed in the botanical museum and exhibitions of the garden.

In addition to serving as a plant conservatory, the QBG is also a centre of knowledge that preserves and maintains the natural, spiritual and cultural heritage of the Islamic world. The garden aims to promote environmental awareness and to help integrate the Qatari Arab/Islamic cultural heritage into modern botanical sciences. The garden's goal is to develop into an international center for education and research and to serve its mission in bridging cultures and promoting social responsibility toward the environment. The mission of the QBG is to promote knowledge of the plants and conservation principles

that are mentioned in the *Qur'an* and the *Sunnah*. These goals are achieved through scientific innovation, natural and cultural heritage preservation and providing unique opportunities for learning and discovery.

3.1 Conservation of Knowledge: Illustrated Book of the Plants of the Qur'anic Botanic Garden

Illustrated Book of the Plants of the Qur'anic Botanic Garden is the first illustrated book that catalogues all the plants mentioned in the *Holy Qur'an* and *Hadith* in one volume. The book is intended to fill a real gap in the international library, as there are limited publications on this related topic.

In addition to the Arabic and English scientific names of these plants, the book provides basic information about them, such as their growth, habitat and geographical distribution, as well as discussions of the *Qur'anic* and *Sunnah* contexts where they occur. The book also includes high-resolution photographs of the plants in their natural habitats.

Illustrated Book of the Plants of the Qur'anic Botanic Garden includes 59 plant species (Fig. 5). Of those, 20 are mentioned in the *Qur'an*, including unknown plants for the human, Al-Zaqqum and Al-Daria, both of which are plants that grow in hell. Since Al-Zaqqum is not a common name for a particular plant, it is decided not to include entries for the species scientists claim to be its earthly counterparts. As for Al-Daria, it refers to a plant known to Arabs as Al-Shubruq, which is called Al-Daria when it dries up. It is also important to note that some plant names actually refer to families of plants such as Al-Yaqtin, which refers to several types of gourds.

The Prophet's *Hadith* and tradition refer to 51 plants, including 38 that do not occur in the *Qur'an* and 13 that occur in both. In addition to the plants of the hell, namely Al-Zaqqum and Al-Daria, the *Qur'an* mentions five plants that do not occur in the *Sunnah*. These are fig trees, gourds, banana, lentil and ginger.

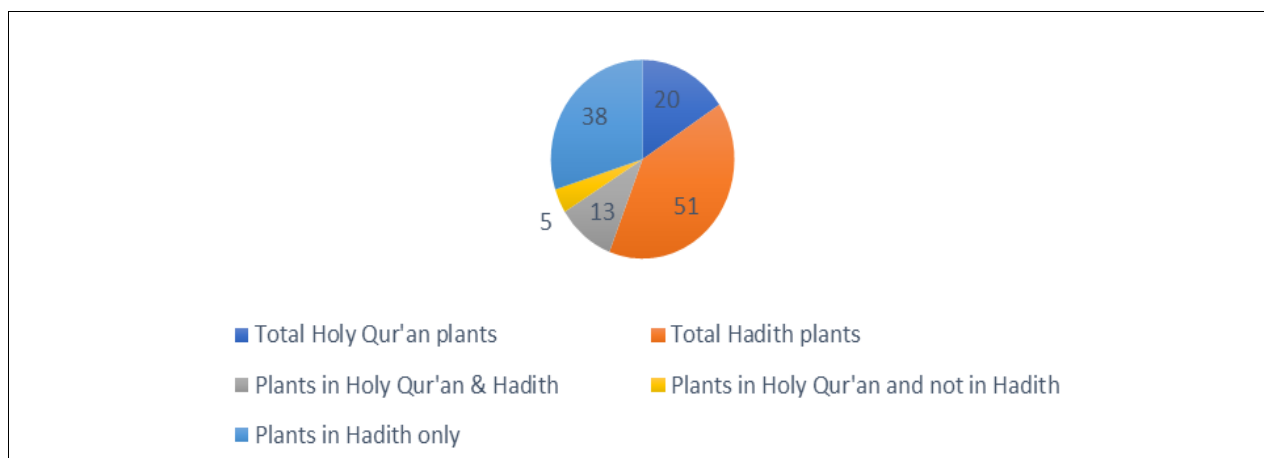


Fig. 5 Plants in the *Holy Qur'an* and *Hadith*.

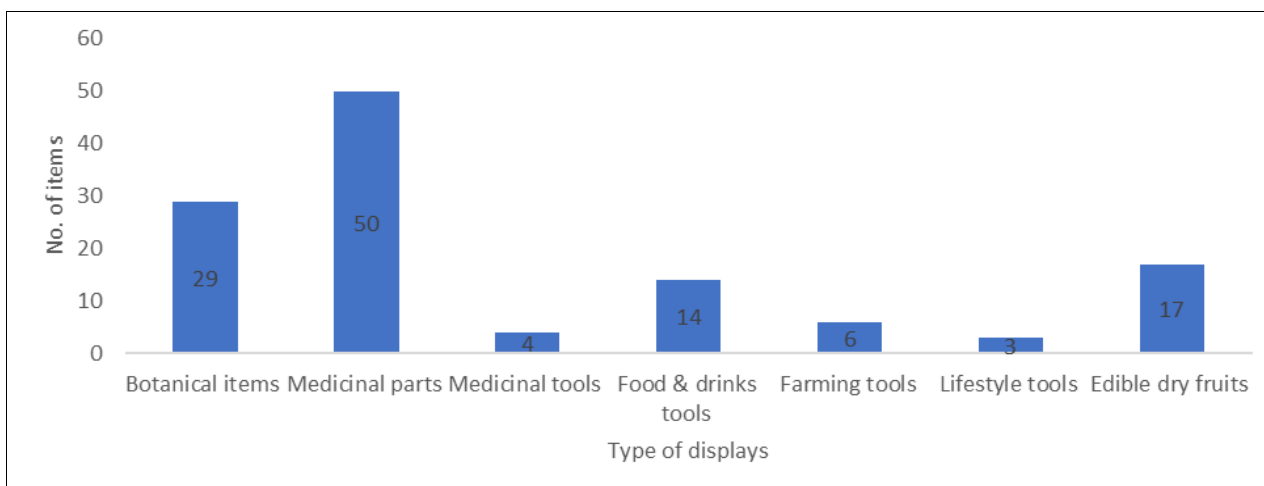


Fig. 6 Botanic display items collected in 2018.

3.2 Traditions Conservation: Botanic Display of the QBG

The botanic display is integrated collections and its displays are based on plants and traditions. It provides areas for exhibition of tools, medicinal, cultural and botanical aspects of the QBG. In addition, it displays modules of plant parts, ancient agriculture, and traditional tools made of plants, old-style medicine, food and drinks tools that may be still used in the daily lives.

The botanic display provides various types of information about plants in the *Holy Qur'an* and *Hadith*, environment in Islam, ethics and culture heritage. It also aims to fill the gap between generations who had practiced some of the traditional

customs and among those who did not enable them to know about their cultures.

More than 120 botanical items, tool and parts have been collected locally regionally and internationally including farming tools, medicinal tools, plants dry parts, food and drinks tools and edible dried fruits (Fig. 6). In addition, the botanic display of the QBG shows various types of information about plants in the *Holy Qur'an* and *Hadith*, environment in Islam, and culture heritage collected from the Arabic lexicons, manuscripts and people aware of culture heritage. Information and items provide a multi-level, interactive introductory tour of the highlights of the QBG collections.

The QBG collections are stored at the QBG and have been used to organize temporary exhibitions and



Fig. 7 Part of Al-Andalus gardens exhibition in Qatar.

displays inside and outside the education city. In addition, the QBG is hoisting international displays based on the cultural and botanic aspects in collaboration with international organizations and foundations related to botanic gardens, museums and culture preservation.

Through its annual exhibitions based on conservation of heritage, the QBG is raising the public awareness of values of plants in the cultural heritage, natural resources and agriculture in order to support the sustainable development and environmental responsibility. In 2018, the QBG hosted Hosting and Organizing of Al-Andalus Gardens Exhibition in Qatar in collaboration with the Islamic Culture Foundation (FUNCI) Madrid that reflected the garden's historical heritage and was attended by more than 2,000 multinational persons in Qatar (Fig. 7).

This kind of exhibitions is an expression of the peaceful coexistence among different cultures, showing respect for the environment and historical heritage through the display of achievements of a stage in the past, Al-Andalus, which constitutes a scientific and cultural milestone and a reflection of one of the most fertile periods of history.

4. QBG Efforts in Plants Conservation

The QBG conservation unit is composed of three main units: plant nursery, herbarium and seeds unit which are the pillars of the garden's conservation program. The mission of QBG conservation program is to document and preserve all the plant species mentioned in the *Qur'an*, *Hadith* and the prophetic

tradition. The mission of conservation unit of the QBG extends to preserve the endogenous plant species via conserving local flora by studying, rehabilitating, collecting and preserving specimens and seeds. The QBG collaborates with national organizations, non-governmental organizations (NGO), regional and international botanical agencies to preserve the plants specimens, exchange information and expertise.

4.1 Plant Nursery: Plants Propagation Program

The plants in the QBG fall into three categories according to their natural habitats. These are:

(1) Desert plants: These are plants that naturally grow in the Arabian Desert, such as tamarisk trees, Sidr trees, acacia trees, arak trees and camel's grass. When planted, they require full sun, and they are hardy when it comes to heat and dry weather.

(2) Mediterranean plants: These grow in the northern and southern coasts of the Mediterranean. They are mostly fruit trees, such as grape vines, fig trees, olive trees, black seeds, safflower and pomegranate trees. They typically require partial shade to survive the summer heat.

(3) Tropical plants: These grow naturally in warm rainy climates, and most of them are traditionally used as medicinal herbs or in making natural cosmetics. These include camphor, *Costus*, ginger, saffron and agar-wood.

QBG nursery contains two types of greenhouses that semi and fully controlled to cover the plants' requirements in terms of their climatic conditions, in additions, seedbeds were prepared and big pots were filled with mixture of soil; this allowed plants to grow in smooth way for many years. The facilities in QBG nurseries provide not only housing and care for life forms of plants, but also have an educational, research and atheistic value. Currently, QBG nurseries contain 21 desert species, 30 Mediterranean and nine tropical plant species (Fig. 8). The current number of stocked plants is 6,825, where 67% are trees, shrubs and perennial plants and 30% are annuals.

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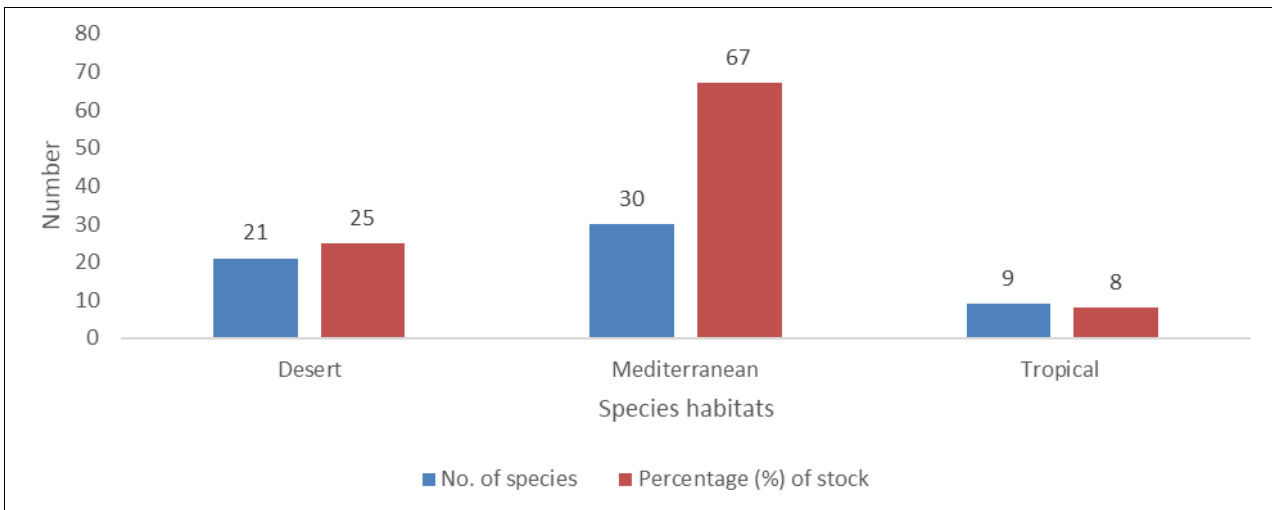


Fig. 8 Plants stock in QBG nursery, 2018.

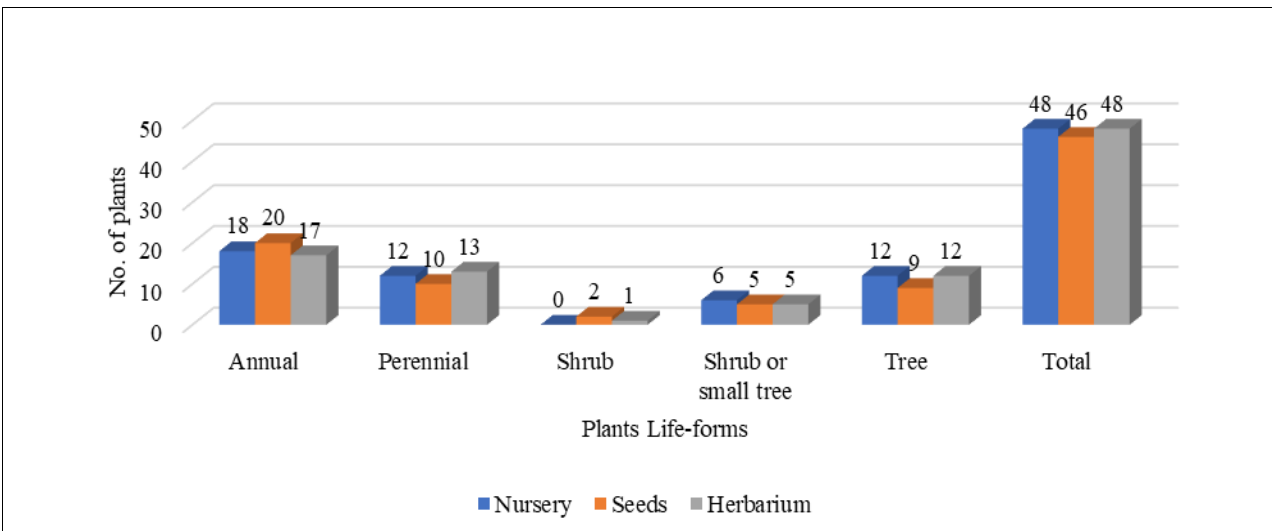


Fig. 9 QBG plant species representation in nursery, herbarium and seeds unit.

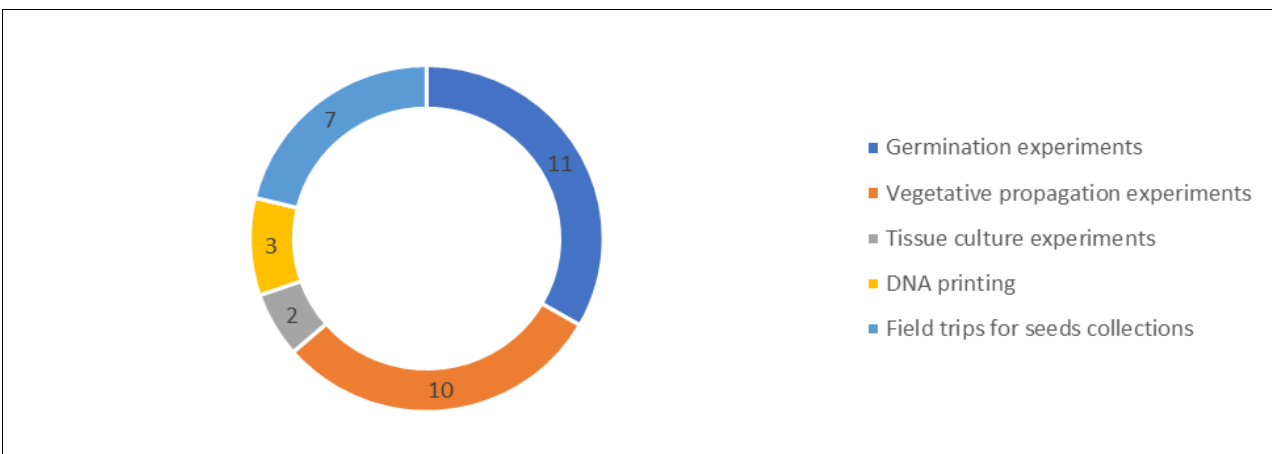


Fig. 10 Conservational activities of the QBG, 2017.

4.2 Herbarium and Seeds Unit: Conserving Seeds and Identifying Plants

The herbarium and seeds unit is one of the main components of the QBG's conservation program. The mission of the herbarium and seeds unit is to document all plants species that occur in the *Qur'an* and the prophetic tradition whether they are from Qatar and abroad. The herbarium and seeds unit also collects and preserves medicinal dry parts and traditional tools related to the plants, and is used to educate students about them.

The herbarium and seeds unit is not limited to the plants mentioned in the *Qur'an* and the *Sunnah*. Rather, the unit's mission extends to conservation work on endogenous plant species via conserving local flora by collecting and preserving specimens and seeds. The unit collaborates with national organizations and environmental agencies on herbarium and seed bank activities. The garden also collaborates with regional and international botanical agencies to, in terms of suitability, collect specimens and exchange information and expertise.

The seeds unit contains 129 accessions of seeds that belong to 46 plant species that have been mentioned in the *Holy Qur'an* and *Hadith* of seeds categorized into annuals, perennial herbs, shrubs and trees while the unit preservers, of 48 herbarium sheets for 48 plant species of the *Holy Qur'an* and *Hadith* including the desert, Mediterranean and tropical plant propagated at the QBG or collected from the desert (Fig. 9).

By late of 2017, the collection program of the seeds of the Flora of Qatar has been started, and 20 species of the desert plants have been collected. By 2018, 11 germination experiments have been proceeded for 11 plant species that adding 520 new saplings to the QBG (Fig. 10). The germination experiments include desert plants (first time to be propagated by seeds), i.e., henna, shubrum, siwak, hanzal, salam, samor, qarz saddan. In addition, germination experiments include Mediterranean plants, i.e., pomegranate, citron and yaqtin.

Biochemical profiling of seeds and its correlation with their physiological quality is of crucial importance in breeding programs the aim of which is seeds of better quality [11]. Seeds' profiling, is an important task of the QBG's seeds unit; it is to study the timing of seeds' growing seasons and maturity, i.e., flowering, fruiting and collection seasons (Fig. 11). In addition, seeds profiling helps to document seeds' morphology and biometrics that are required for seeds preservation. Seeds profiling process needs certain kinds of tools, i.e., stereomicroscope, seeds counter and other relevant tools which are equipped in the QBG's herbarium & seeds unit. Seeds germination is one of the important tasks at the seeds unit of the QBG. QBG aims to germinate all the seeds, e.g., desert plants and other tropical and Mediterranean plant species.

Senna italica Mill. is one of the plants that grows naturally in the desert of the Arabian Peninsula and Qatar. It is also one of the plants that had been mentioned in the *Hadith* (sayings of the Prophet Muhammed PBUH) as a medicine against constipation.

The seeds of *S. italica* or true senna (AR. Ishariq) have been tested and germinated by using two different kinds of treatments: one is the cut of a small piece of the outer seed coat and the other treatment was using the concentrated H₂SO₄ (sulfuric acid). In addition to the blank experiment, no treatments occurred for seeds before the germination.

4.3 Restoration Program

This initiative is one of the joint *in-situ* conservation programs based on community with the Ministry of Municipality & Environment in Qatar that aims to combat the desertification by engaging the Qatari community to restore and rehabilitate the desert plants at their natural habitats (Fig. 12).

Progress of restoration program in 2018:

(1) Engaging 400 Qatari persons in restoring 600 native trees to their natural desert habitats in Qatar.

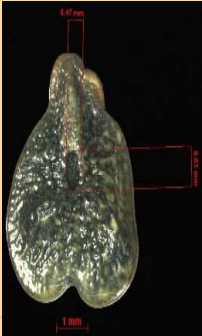
<p>Names</p> <ul style="list-style-type: none"> Scientific name: <i>Senna italica</i> Mill. Vernacular name(s): Eng.: True senna, AR.: عشوق - سنا / سنا/إشاريغ <p>Seasons</p> <ul style="list-style-type: none"> Flowering: late March to May Rare flowers are observed in Sep. and Oct. Fruiting: May-June. <p>Collection Data</p> <ul style="list-style-type: none"> Date of collection: June 2016; late season, 80% of pods collected from the ground and 20% of pods collected from the plant. Place of collection: Rodat Rashid, Qatar. <p>Seeds Measures</p> <ul style="list-style-type: none"> No of seeds per fruit "pod": 8-10 seeds Weight of 100 seeds: 2.2 g (± 0.3) No of seeds per gram: 45 seeds (± 2) Seed length (mm): 5.2-6.00 mm Seed width (mm): 3.2-3.5 mm Seed thickness (mm): 1.7-2.00 mm Equilibrium relative humidity (ERH)* of the seeds: 42%-47% <p>*ERH % = aw (active water) \times 100</p>	
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Fig. 11 Biometrical data of *Senna italica*.



Fig. 12 Flora restoration.

(2) Spreading seeds of five native plant species at the desert to increase the soil seed bank for the coming seasons.

5. Conclusions and Recommendation

The QBG exhibits about 60 plant species belonging to three different types of habitats: desert, Mediterranean and topical habitats. The harmony between plants and design of the garden is beautiful, and it reflects Islamic architecture and art. It highlights the Muslims knowledge about Islam, environment and conservation and helps in understanding the scientific aspects of the plants and their life.

The garden is a centre of knowledge that preserves and maintains the natural, spiritual and cultural heritage of the Islamic world. It has compiled and highlighted the plants mentioned in *Holy Qur'an* and *Hadith* in one volume as a part of its role towards heritage conservation. In addition, the QBG is collecting the plants tools, items and terminologies related to plants and agriculture in the Arabic and Islamic heritage in order to be displayed in the botanical museum and exhibit the garden. The garden aims to promote environmental awareness and to help integrate the Qatari Arab/Islamic cultural heritage into modern botanical sciences.

The QBG conservation unit is composed of three main units: plant nursery, herbarium and seeds unit which are the pillars of the garden's conservation program. The mission of QBG conservation program is to document and preserve all the plant species that are mentioned in the *Qur'an*, *Hadith* and the prophetic tradition in addition to preserve the endogenous plant species via conserving local flora by studying, rehabilitating, collecting and preserving specimens and seeds. The QBG collaborates with national organizations, NGOs, regional and international botanical agencies to preserve the plants specimens, exchange information and expertise.

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various types of information about plants in the *Holy Qur'an* and *Hadith*, environment in Islam, and culture heritage collected from the Arabic lexicons, manuscripts and people aware of culture heritage. More than 120 botanical items, tool and parts have been collected and displayed at the QBG botanical museum.

Illustrated Book of the Plants of the Qur'anic Botanic Garden is one of main sources that documents all the plants mentioned in the *Holy Qur'an* and *Hadith* in one volume. The book is envisioned to fill the gap in the international library, where limited publications on this related topic have been published.

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By late of 2017, the QBG started to collect the seeds of the native Flora of Qatar, as a part of its conservation program, where 20 plant species have been collected. By 2018, 11 germination experiments have been proceeded for 11 plant species that adding 520 new saplings to the QBG.

Restoration of desert plants is an initiative of the QBG's *in-situ* conservation program based on

community in collaboration with the Ministry of Municipality & Environment in Qatar that aims to combat the desertification by engaging the Qatari community to restore and rehabilitate the desert plants at their natural habitats.

The QBG restoration program has engaged 400 Qatari persons in replanting 600 native trees to their natural desert habitats in Qatar in 2018.

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