

# Introducing and Cultivating Columnar Cacti with Medicinal Uses in the Arab Gulf Region

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## Abstract

The search for appropriate medicinal plant species able to grow in the Gulf region is an ongoing activity. Columnar cactus species characteristics fit with most of the requirements of a drought resistant medicinal plant. Columnar cacti have high water-use efficiency and could be ideal for establishing medicinal crop plantations in the Gulf deserts. Cacti proved to tolerant high temperatures and were found to be highly adaptable to new environments. Three columnar cacti species with medicinal uses were tested in UAE deserts. The tested species are *Carnegiea gigantea*, *Cereus validus*, *Pachycereus pecten-aboriginum*. Plants were propagated by cuttings in the greenhouse. Cuttings developed roots within 2-4 weeks of planting. The propagated plants were acclimatized and transplanted into the field in the desert. The introduced species showed differences in growth performance and *Carnegiea gigantea* was found to be promising as a new medicinal crop for the Arab Gulf region.

## INTRODUCTION

Natural features in the Gulf region are limited rainfall and high temperatures, which caused sparse vegetation. The agricultural activities encouraged through government-sponsored financial investments and urban landscaping are causing a significant depletion of water resources beyond the natural renewal capacity (Wilhite, 2000). The first major step in responding to imminent water shortages is the formulation and implementation of comprehensive water management plans that can offer viable alternatives for the reduction of imbalances between supply and demands. Such policies will contribute to better management of water resources and help curb rising demand (Rogers, 1994).

The search for appropriate plant species with economic value that are able to grow in the arid deserts is an ongoing activity in the Gulf region. Columnar cactus species characteristics fit with most of the requirements of drought resistant plants. Cacti are in the cactus family, Cactaceae, originated in North, Central, and South America (Mauseth, 2000). One potential for columnar cacti as economical crops lies in the production of medicinal compounds that can offer commercial opportunities.

The objectives of this study are introducing propagating and climatizing some columnar cacti with medicinal uses to the desert environment in the UAE. Growth and development of the introduced cacti were assessed under the new environment.

## MATERIALS AND METHODS

### Plant Materials and Propagation

Cuttings from three cacti species were obtained from private nurseries in Brazil, Mexico, Peru and the USA. The introduced species are *Carnegiea gigantean*, *Cereus validus* and *Pachycereus pecten-aboriginum*.

Cuttings were allowed to dry in a warm, dry area for ten days. Pots 60 cm in diameter were filled to about one-third full of potting mix consisting of 1 part peat moss: 2 parts soil. Each cutting was placed upright in the center of a pot. Pots were filled to two-

third full with the potting mix. Pots were kept in the greenhouse.

### **Orchard and Transplantation**

Soil and irrigation water samples were taken to determine salinity. In the fall, plants were taken out of a shaded section of the greenhouse and allowed to acclimatize for 10 days. The plants were then transplanted into the orchard in the Al-Oha area, UAE.

A hole was dug about 15 cm wider than the container and 5 cm deeper. The cactus was carefully removed from its container. Heavy gloves and 30 cm forceps were used to avoid injuring the technicians and the plants. Each cactus was carefully placed in a hole and soil was firmed lightly around it. Plants were watered thoroughly.

Drip irrigation system was used in the orchard. Plants were fertilized one month after transplanting into orchard and once a month thereafter.

### **Data and Analysis**

Data were collected as stem length and diameter and root development. Other observations on growth behavior were recorded.

## **RESULTS AND DISCUSSION**

Three species of columnar cacti with medicinal uses were introduced into a new arid environment in Al-Oha, UAE. High temperatures and limited rainfall characterize Al-Oha area. Maximum temperature reaches 49°C during the summer and average annual rainfall is 77 mm. Orchard soil is sandy with 2200 ppm of sodium chloride. An underground aquifer is the only source of irrigation water, which is also saline. Salt concentration in irrigation water reaches 2800 ppm. Plants of *Carnegiea gigantea*, *Pachycereus pecten-aboriginum* however, showed high adaptability to the new environment.

Plants of the family Cactaceae, a large group of succulents found almost entirely in the New World, are highly adaptable to the tested environment (Mauseth, 2000). Cacti not only have many adaptations to prevent desiccation but also are extremely resistant to desiccation (John, 2001). The water that is taken up into the stem is converted into a mucilaginous substance that does not evaporate as readily as water (Saag et al., 1975).

The modification of the stem for water storage, the reduction or absence of leaves, the waxy surfaces (John, 2001), nighttime opening of the tissues for carbon dioxide uptake, and the CAM process (Malda et al., 1999) enable the plants to tolerate harsh conditions. Two cactus structures, the ribs and tubercles, help the cactus stem expand and contract as water availability changes. These adaptations that help the plant to survive dry, hot conditions, apply to the aboveground plant. The roots are non-succulent and require small amounts of water. The roots are typically shallow. As the soil dries, fine lateral roots generally die, while larger roots become covered with a corky layer (periderm) (John, 2001). The root water conductivity decreases dramatically during soil drying, which reduces water loss from the plant tissues to the soil (Nobel and Cui, 1992).

Cacti can grow in marginal, infertile, dry lands where common crops fail. Several species of columnar cacti are known to be of economic significance as medicinal for native use in South America (Felger and Moser, 1974).

*P. pecten-aboriginum* growth, was at rates 3.9 and 0.7 cm/month in height and diameter, respectively. The stem showed 8-10 ribs. The plant developed bright reddish-brown spines on the new growth that turn white with age (Fig. 1). The central spine is 3.3 cm long surrounded with 7 to 8 spines each 1 cm long. It did not develop branches or sprouts during the first two seasons. However, *Pachycereus* species are known in the natural habitat to develop erect branches that form close to the ground and rise nearly straight up. Branches are nearly the size of the main stem (Anderson, 2001).

The introduced cuttings developed roots within 2-4 weeks of planting. Cacti could be propagated by seeds or asexually by cuttings (Lopez-Gomez et al., 2000). Multiplication of genetically identical copies of specific genotype by asexual reproduction gives rise to plants which are genetically identical to the parent plant and

thus permits perpetuation of the unique characters of a superior genotype (ElObeidy, 2001).

Cuttings were allowed to dry in a warm, dry area for ten days to permit the cut surface to heal and develop callus. The callus helps prevent rotting when the cutting is placed in the rooting material. The larger the cutting, the longer it needs to dry.

Excessive irrigation caused the stems to be cracked in the introduced species. Further watering of cracked plants led plants to wilt and eventually die. Cacti use succulence and the ability to store water in plant tissues as a strategy to survive water shortage, however too much water should be avoided. Waterlogged soil will also lead to rotting of the roots.

*Carnegiea gigantean*, as in its natural habitats, showed very slow growth. The plant developed 13 to 14 ribs, and two or three two cm central spines in the areole and 14-16 other spines with 1 to 1.5 cm long. Spines were reddish-brown and turned gray with age (Fig. 2).

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**Figures**



Fig. 1. *Pachycereus pecten-aboriginum*.



Fig. 2. *Carnegiea gigantea*.