# Methodology:

# Local Community Layering:

### 1.1.1. *In situ* conservation practices:

**Propagation by Layering:**

During this experiment, the simple layering method was used as a traditional vegetative method internationally recognized with a minimal adverse effect on wild populations and previously tested on the target plant (Abdullah et al., 2012). Three subpopulations were selected during the dormancy period (in November 2018) based on accessibility for daily monitoring, water availability, the number of individuals present, number of plant branches that are suitable for this experiment, the similarity between the laying site and the planting site, in terms of environmental conditions, derived from the preceding steps. As shown in the illustration, 20 branches of the *Rosa arabica* plant (from four individuals) were grounded into a hole 15-20 cm below the ground surface after wounded to facilitate the rooting process, leaving the top of the branch above the ground exposed to air. The underground branches were subsequently irrigated for 11 months each day. After this period, the soil above the branches was removed, the branches were examined, and the proportions of rooting were determined in each branch. After that, the branches that formed evident roots and whose vital state were suitable for translocation and cultivation in other areas away from the mother plant were selected and separated (Fig. 1).

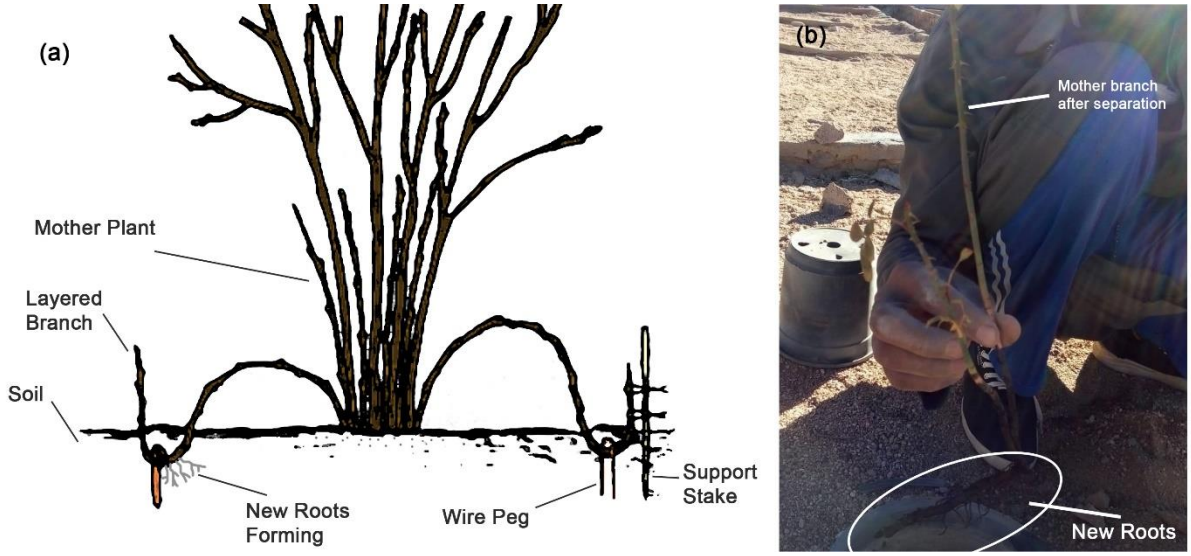


Fig. 1: Layering of *Rosa arabica*; (a) An illustration of the simple layering process, and (b) new separate individual with roots

**Site selection and species translocation:**

This recovery process aims to protect, maintain and sustain the target plant by multiplying it in the wild (increase in the number of individuals, EOO, and AOO) to reduce the impact of threats on it. After the layering process's success and selecting the branches that produced roots, they were translocated to the new sites for cultivation in the wild. To select these sites, some criteria have been set that mostly guarantee the success of the experiment especially in local level based on Dorner, (2002); and Heywood et al., (2018), as follows: a) The presence of the site in the range of species habitat suitability that derived from the previous steps, b) the similarity of the chosen site with the sites of the mother plant in terms of topography, microhabitat, climatic conditions and soil properties, c) representation, as far as possible, of the prevailing environmental variation associated with the distribution of the target species, d) accessibility for daily monitoring, e) protection from human activities and grazing, f) one of these sites must be slightly outside the known range of plant distribution in order to expand its geographical and environmental extent in the future, and g) and most importantly, the availability of an adequate water source for irrigation, which is one of the most critical challenges in these arid environments.

Based on the previous criteria and the results of SDM (habitat suitability ranks), three sites will tentatively have selected; a site in a high suitability area, a site in a moderate suitability area, and a site in a slightly unsuitable area. This selection was made to seek to expand the range of suitability for the species and the species' global population resilience in the future. At each site, climatic, topographic, and soil analysis were extracted based on the IUCN Red List data. Each site was then prepared to receive the new individuals as follows: For each new individual, a pit of 20 cm2 was prepared, and the pits were distributed at relatively spaced distances (not less than three meters) to ensure the opportunity for the individual to expand in width in the future. Rooted branches were placed in the pits and covered with soil, and a wooden cage surrounded some individuals for protection. An irrigation and monitoring plan has been developed and implemented for these individuals based on Abdullah et al., (2012); and Ahmed & Al-Dousari, (2017) so that the rate of irrigation is gradually reduced, leaving the plants to nature as adaptive as possible. In the first month, individuals were irrigated at a rate of 3 liters/day after day, followed by 3 liters / every three days for a month, followed by 3 liters / every 7 days for a month, followed by 3 liters / every 15 days for a month, followed by 3 liters / once a month, after that the irrigation was stopped and the individuals were left to nature. The irrigation process took place from November 2019 to February 2020.

During that irrigation period and the period that followed, and for a whole year (Nov. 2019-Dec. 2020), changes in the growth parameters of the cultivated individuals were monitored and recorded, including the survival rate of new individuals, height (cm), and width (diameter-cm), number of branches, number of leaves, and Growth Index (GI) "*$\pi$ x (Average width/2)2 x height" (Rezazadeh et al., 2016),* in order to track the success rate of the experiment in each site. The species Distribution Model (SDM) for the target species was carried out based on the new geographical distribution to determine habitat suitability changes.