Vahl's Boxwood, (*Buxus vahlii* Baill.): A Federally Endangered Tree of St. Croix and Puerto Rico

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Abstract

Vahl's boxwood (*Buxus vahlii* Baill.) is a federally endangered tree that occurs on four sites in St Croix. It is related to the European ornamental bush common boxwood (*Buxus sempervirens* L.), which is often trimmed to make elaborate hedges or topiaries in temperate climates around the world. The University of the Virgin Islands produces containerized seedlings of Vahl's boxwood so they can be planted in protected areas on the island of St. Croix. This nursery stock, once planted in permanent sites, will augment the number of plants growing in the wild, thus reducing the possibility of this rare plant species going extinct. This article describes the species' characteristics and our techniques for growing it from seed and from cuttings.

Introduction

Vahl's boxwood (*Buxus vahlii* Baill.) is an evergreen shrub that is found in four sites on the island of St. Croix in the U.S. Virgin Islands and two sites in Puerto Rico. This tropical species has been federally endangered since 1985 (USFWS 1987). Vahl's boxwood is related to the common boxwood (*Buxus sempervirens* L.) of Europe. Many people will recognize the common boxwood from its scent and because it is a popular ornamental planted in temperate climates around the world for hedges. Sometimes it is trimmed into fanciful shapes called topiaries.

Vahl's boxwood grows on limestone-derived soils within tropical dry forest vegetation. Of the four sites on St. Croix, one population is within the Sandy Point National Wildlife Refuge, two populations are on the hills south and east of the town of Christiansted, and a single individual is located in a former industrial site close to the Henry Rohlsen airport. With the exception of the former industrial site with a single plant, the three other sites support populations with fewer than 500 individuals. There are also two known sites in Puerto Rico that support small populations of Vahl's boxwood (Carrera-Rivera 2001, Daley and Ray 2014, Daley and Valiulis 2013).

Vahl's boxwood is threated by urban development resulting in habitat fragmentation and destruction, competition with exotic plant species such as snake plant (*Sansevieria trifasciata* hort. ex Prain.) and coral vine (*Antigonon leptopus* Hook. & Arn.), as well as devastating human-caused wildfires. Moreover, the species is threatened by its own reproductive biology. Seed dispersion occurs when the seed capsules dry out and split. The tiny seeds contained inside simply drop to the ground. As a result, the seeds do not travel far from the parent plant.

Description

Vahl's boxwood is a small tree or bush that has a maximum height of 15 ft (5 m). The bark is gray and finely fissured. The leaves are dark green, leathery, and stiff and are oppositely arranged on the branches (figure 1).

Figure 1. Foliage of Vahl's boxwood occur in an opposite arrangement. (Photo by Michael Morgan 2018)

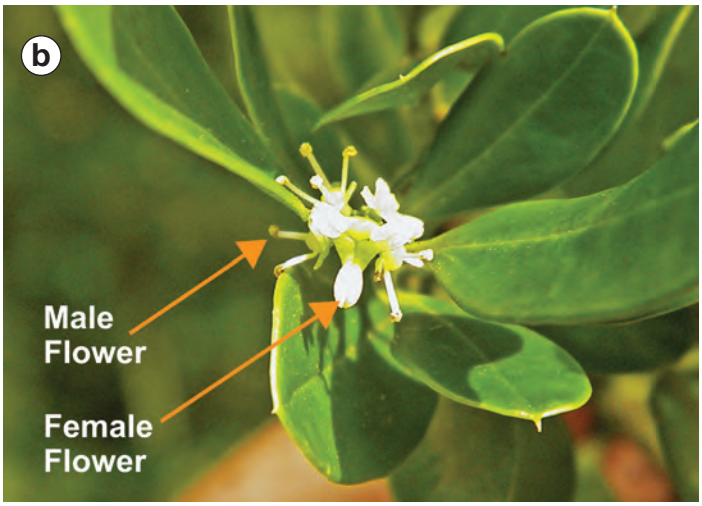

Figure 2. Male and female flowers of Vahl's boxwood. (a) The stigmas and ovary of the female flower develop into the seed capsule. (b) Note also the spike at the tip of the leaves. (Photos by Michael Morgan 2018)

The mid vein of each leaf is sunken and two slight side veins parallel the curve of the leaf edges (Little and Wadsworth 1964). Each leaf has a little spine at the tip (figure 2) which helps distinguish Vahl's boxwood from box-leaf stopper (*Eugenia foetida* Pers. formerly *E. buxifolia*), an unrelated, but similar-looking species that Vahl's boxwood grows in association with (personal observation, Morgan).

Vahl's boxwood is monecious, meaning its flowers are either male or female and both flower types are on the same plant. The flowers are greenish yellow with white anthers and occur in clusters at the leaf base (figure 2). Bees and other insects pollinate the flowers. The fruit are woody, green capsules about 0.25 in long (0.6 cm), with three "horns" on top (figure 3). When mature, the seed capsules turn brown then black and split open into three parts, ejecting the seeds.

The species is slow growing in height and diameter. Plants take approximately 2 years in a nursery setting to reach 12 in (30 cm) in height until they are ready to leave the nursery. Once planted outside the nursery, plants grow less than 1 ft (30 cm) per year. Two trees planted in the UVI Agroforestry plot are currently 6 years old and 66 in (165 cm) tall. They were 24 in (60 cm) tall when planted in 2014. This growth rate is an average of 7 in (17.5 cm) per year (Morgan, personal observation). Architecture of Vahl's boxwood can be influenced by site (Castellanos et al. 2011).

Figure 3. Seed capsules of Vahl's boxwood have 3 "horns" at the top of the capsule. (Photo by Michael Morgan 2018)

Flowering and fruiting of this species is precocious. Flowering and fruiting can begin the second or third year after being planted in the field. Containerized plants in a greenhouse setting can flower once they have reached a sufficient size of about 12 in (30 cm). Unlike plants growing in the wild, however, plants growing in a tree nursery get watered 2 or 3 times per week (personal observation, Morgan).

Propagation

The following section is based upon the experiences of the primary author growing this species at the University of the Virgin Islands Agricultural Experiment Station (UVI-AES).

Seed Propagation

Seeds can be collected year-round. In the U.S. Virgin Islands, flowering and fruiting of plants depends on local rainfall conditions. While there are "dry" and "wet" seasons in the Virgin Islands, the difference between the two seasons is not noticeable except during exceptionally dry or wet years. A little bit of rain will initiate flowering in Vahl's boxwood. However, flowering does not always lead to the production of seed capsules or viable seeds.

The woody seed capsules should be collected before they split open and eject their seeds. The best time is when capsules are turning from green to brown. Put the seed capsules in a dry, sunny place on a wire screen that is small enough to support the capsules, but big enough to allow seeds to fall through into a container below. Capsules take about 1 week to split and release their seeds. Seeds are extremely small (300,000 seeds per lb [660,000 per kg]) (figure 4). Once dried, seeds can be stored in a cool, dry place and will retain viability for at least 1 year (personal observation, Morgan).

It is sometimes recommended to rinse seeds in a weak bleach and water solution (1:10 ratio) to disinfect the seed surface of any harmful fungi or bacteria. Since Vahl's boxwood seeds are so rare and small, there is concern that the bleach rinse could damage the seeds. Sunlight is also an effective sterilizer, so we recommend exposing the seeds to direct sunlight for a day instead of rinsing with a bleach solution. The tiny size of the seeds also precludes physical scarification.

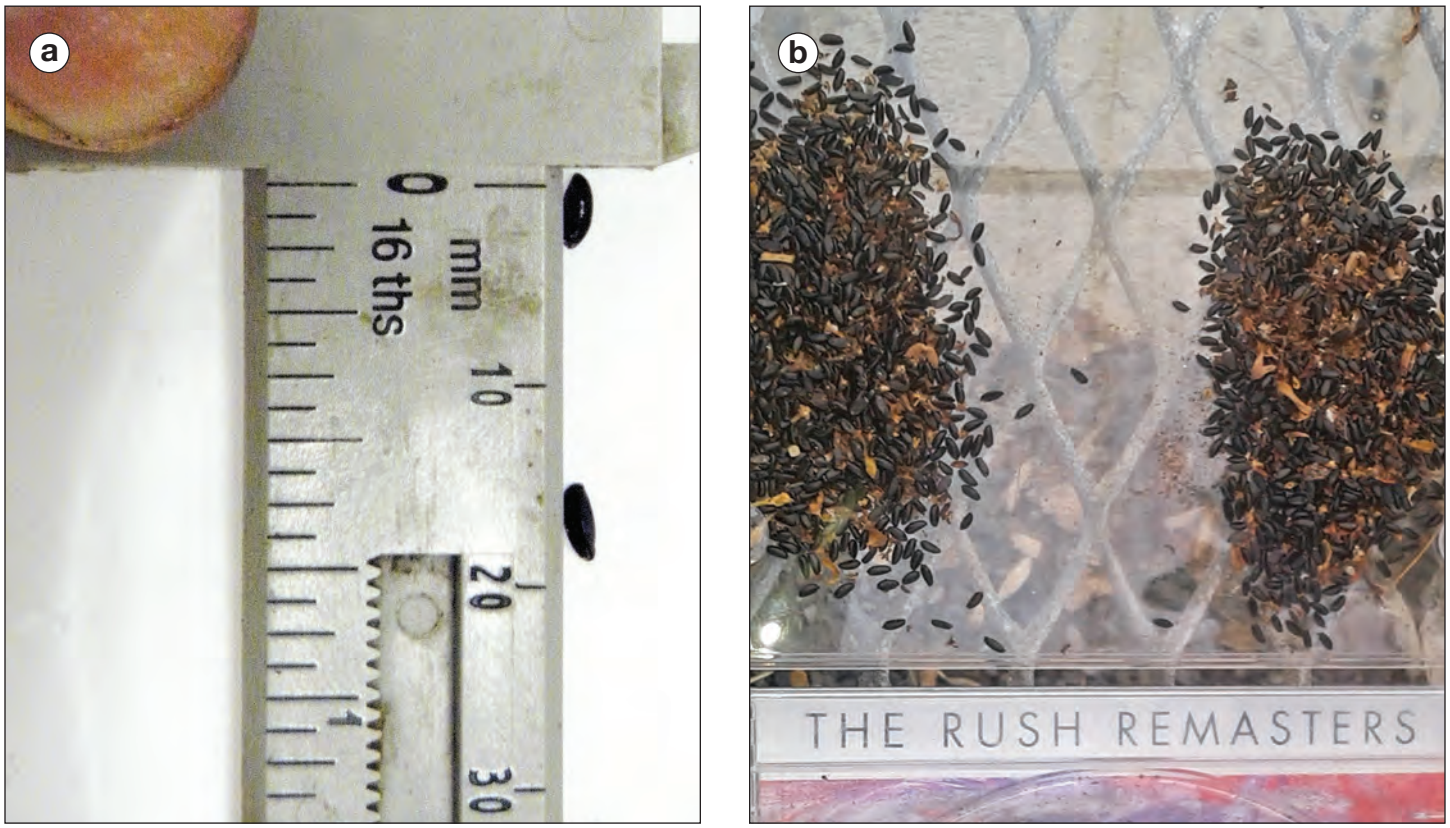

Figure 4. (a) Vahl's boxwood seeds are very small. (b) Each of these two piles contain approximately 900 seeds and are placed on a CD case for scale. (Photo by Michael Morgan 2018)

Vahl's boxwood seeds have an exceptionally low and slow germination rate (figure 5). Germination rate seems to be related to when and where the seeds were collected. Our best germination has been 10 percent and our worst was when only 3 seeds out of 5,000 germinated after 7 months. Germination of 5 or 6 percent is typical. It appears that this species compensates for its low germination rate by producing an abundance of seed.

The cause of low germination rate in Vahl's boxwood is unknown. We performed a tetrazolium test on seeds from three of the four populations on St. Croix to determine viability. Living seeds turn pink when exposed to tetrazolium. We compared the seed samples with seeds of roselle (*Hibiscus sabdariffa* L.) which has a high rate of germination. Roselle, locally called sorrel, is an agricultural crop in the U.S. Virgin Islands. The swollen sepals of the roselle flower are used for making juices and teas. The viability percentages of Vahl's boxwood seeds from the three populations were 37, 23, and 14 percent, respectively. Most of the roselle seeds were viable. Notably, the roselle seeds were a bright pink compared with a pale pink observed in Vahl's boxwood seeds, hinting at a certain lack of vigor. Seeds germinated after 39, 60, and even 114 days after sowing. On occasion, lost and forgotten seeds will germinate years after planting in containers with other plants when old planting substrate was recycled, or even on the gravel floor of the UVI-AES greenhouse (figure 5c).

Figure 5. (a) and (b) germination progression of Vahl's boxwood can be slow and uneven. In fact, germination can be delayed significantly as shown by (c) seedlings that germinate over time on the greenhouse floor. (Photos by Michael Morgan 2018)

Figure 6. In a trial of vegetative propagation of Vahl's boxwood, cuttings were regularly sprayed by misting nozzles. (Photo by Michael Morgan 2018)

Vegetative Propagation

We tried to propagate Vahl's boxwood via cuttings but only 14 percent of the cuttings put out new leaves and roots. Unfortunately, these plants remained stunted. During the following year, they never increased growth in height or diameter, so we disposed of the plants.

We took 6-in (15-cm) cuttings and tested them with and without dipping the cut end in rooting hormone. The rooting powder we tested had a concentration of 0.01 percent of the auxin indole-3-butyric acid (IBA). For planting substrate, we used a 50:50 mix of sand and Promix™, an amended peat moss. After placing in the substrate, cuttings were kept moist for a month by using a humidity tent or a mist bench. A humidity tent is simply a transparent plastic bag over the cutting and its container. The plastic bag recycles the water that evaporates from the moist planting substrate or is produced as a by-product of photosynthesis. The vapor condenses on the plastic and falls back into the planting substrate. If the planting substrate dries out, it must be rewatered. A mist bench sprays the cuttings with mist 2 times daily using a timer and misting spray heads (figure 6). We set our mist bench to spray for 4 minutes, at 4 p.m. and 4 a.m.

In our experience, it appears that there is no difference in propagation success between using hardwood or softwood cuttings, nor does there appear to be an effect of using rooting hormone.

We found that both the mist benches and the humidity tents gave the same results. Cuttings may put out new leaves (figure 7), but then die if they fail to initiate new

Figure 7. Only 14 percent of cuttings in the propagation trial put out new leaves. (Photo by Michael Morgan 2018)

Figure 8. (a) Successfully propagated planting stock was (b) planted at Sandy Point National Wildlife Refuge. (Photo by Michael Morgan 2018)

roots. In our experiment, the cuttings that survived remained stunted, even if they developed roots and new leaves, and did not reach sufficient size to be planted outside the nursery. Thus, refinement of vegetative propagation techniques is still needed for Vahl's boxwood. A stronger concentration of IBA may be worth testing.

Uses

The main reason for growing Vahl's boxwood is for the conservation of biodiversity (Lindsay et al. 2015) and restoration ecology. To that end, 40 plants were planted in the Sandy Point National Wildlife Refuge: 28 individuals at the end of 2015 and 12 more at the beginning of 2018 (figure 8). Additionally, there is potential to use this species in a landscape setting. The dense, dark green foliage of Vahl's boxwood is attractive and could therefore be desirable for use in hedges, and possibly for topiary like its temperate-zone relative, the common boxwood. Experiments are necessary, however, to determine how the species responds to pruning.

Prior to the discovery of quinine in the Americas, leaves of the European common boxwood were used as a fever reducer (Rushworth 1999). Perhaps the Tainos and Caribs, the indigenous peoples of the Caribbean, had a similar use for the leaves of Vahl's boxwood. Also, because the wood of common boxwood is light-coloured, hard, and dense, yet carves well, it is used for specialty products such as chess pieces, flutes, and oboes. The rarity of Vahl's boxwood, however, precludes such consumptive uses.

The Endangered Species Act forbids the destruction of Vahl's boxwood trees, and collection of botanical samples and seeds are regulated by permit. Overall, the most important role of the species is to provide intangible environmental ecosystem services such as biodiversity and the conservation of soil, pollinators, and habitat.

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REFERENCES

Carrera-Rivera, G. 2001. Population ecology and reproductive biology of the endangered *Buxus vahlii* Baillon (Buxaceae). San Juan, PR: University of Puerto Rico.104 p. M.S. thesis.

Castellanos C.; Kolterman, D.A.; Vester, H.F.M. 2011. Architectural analysis of *Buxus vahlii* Baill. (Buxaceae) in two different environments in Puerto Rico. Adansonia, sér. 3, 33(1): 71-80.

Daley, B.; Ray, G. 2014. Bio survey and endangered species assessment: borrow area #1 Estate Anguilla, St. Croix, U.S. Virgin Islands. Report for Virgin Islands Department of Planning and Natural Resources. Christiansted, VI: Geographic Consulting L.L.C. 17 p.

Daley, B.; Valiulis, J. 2013. Rapid assessment of four endangered plant populations of St. Croix, U.S. Virgin Islands, *Buxus vahlii* and *Catesbaea melanocarpa*. Report for Virgin Islands Department of Planning and Natural Resources. Christiansted, VI: Geographic Consulting L.L.C. 14 p.

Lindsay, K.C.; Gibney, E.; Thomas, T.; Bacle, J-P. 2015. Plants of conservation concern: herbs and plants of the United States Virgin Islands. Washington, DC: Island Resources Foundation. 115 p.

Little, E.L.; Wadsworth, F.H. 1964. Common trees of Puerto Rico and the Virgin Islands. Agricultural Handbook No. 249. Washington, DC: U.S. Department of Agriculture, Forest Service. 548 p.

Rushforth, K. 1999. Trees of Britain and Europe: a photographic guide to the trees of Britain and Europe. Collins Wildlife Trust. 1336 p.

U.S. Fish and Wildlife Service (USFWS). 1987. Vahl's boxwood recovery plan. Atlanta, GA: U.S. Department of the Interior, Fish and Wildlife Service, Southeast Region. 34 p.