Investigating the Seed Bank of the Rarest Morning Glory
(Bonamia ovalifolia, Convolvulaceae)

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Abstract

A natural plant seed bank is a reservoir of seeds stored in the soil. Seed banks are important because they provide a source for new offspring to maintain populations and survive catastrophic events; they also conserve genetic diversity from previous generations. Lastly, the number of viable seeds in a seed bank can provide an estimate of the potential for species survival. The big pod bonamia (Bonamia ovalifolia) is a rare morning glory currently known from only five sites in Big Bend National Park, Texas. All populations occur in habitats vulnerable to flooding and/or erosion. The primary objectives of this investigation were: (i) determine if Bonamia ovalifolia (BOOV) has a seed bank, and (ii) if present, compare the size and viability of the seed bank at two seasons during the year.

After surveying existing populations, we selected Maverick Road population for our study site since it was one of the largest populations, was composed of healthy plants, and provided a suitable habitat for seed retention. In August 2014, we selected 31 BOOV plants of reproductive age for study. The size of each plant was measured and the data used to calculate the canopy surface area. The location of each plant was recorded using a Trimble XL GPS unit. We then collected four soil samples from each plant by hammering a metal ring into the ground 5cm deep at the outer edge of the plant, which represented a soil volume for each sample of 397cm³. Placement of the ring was determined by compass readings of 0, 90, 180, and 270 degrees from the center of each plant. The soil was spooned from the ring into a labeled paper bag; each sample was processed separately. In December, we returned to the site and again collected four soil samples from each of the 31 plants but shifted the sample locations 45° from the August locations (i.e. NE, SE, SW, NW). Seeds were filtered from soil samples from both collections using a series of sieves with progressively smaller grid openings.

Only ten B. ovalifolia seeds were harvested from August soil samples; the seeds were from seven plants. A total of 17 seeds were harvested from the 124 December samples; seeds were found at six of the plants. Two plants yielded seeds at both samplings. The number harvested is far below seed bank counts for reports from other members of the morning glory family. The small number of seeds may be a result of a depleted soil bank after several years of severe drought reduced flower and fruit production; plants flower after summer or early fall rains. In addition, based on previous studies, the seed rain for this species is limited by the number of seeds produced per flower. Each flower has the potential to form four seeds but production of one or two seeds from each fruit is common. The species may have a small transient seed bank
or seeds are more widely dispersed from the plant and not captured in our sampling design. Capsules dry on the plant and, when mature, are released from the plant by an abscission zone on the peduncle. Fruits appear to be easily blown or washed away from the plant. Evidence supporting this hypothesis is the presence of multiple BOOV plants along the edge of small washes. Additional investigation is needed to better define the seed bank.

To determine the most effective method for estimating seed viability, we conducted pilot studies on seeds collected in August 2014 by investigators from the Boquillas Canyon BOOV site and older seeds (1997) obtained from the Desert Botanical Garden. Initially we tested seed viability on 15 seeds using a 0.6% tetrazolium solution; 14 of the seeds stained red, indicating a viable embryo and high viability (93%).

Germination trials were conducted for additional evidence of viability and to test for seed dormancy. Because morning glory seeds often have very hard, water impermeable seed coats, we tested the impermeability of the seed coat. We weighed both old (1997; N = 20) and young seeds (2014; N = 10) and then placed the seeds in water and weighed them again after 24 hours. None of the 30 seeds gained appreciable weight. Each seed was maintained separately in a labeled petri dish with moistened germination blotters below and above the seed. Petri dishes were incubated at 30/20°C (12hr light/12hr dark). Each seed was observed daily and reweighed upon appearance of the radical. Percentage of weight gain ranged from 143% to 257%, with an average increase of 173%. Eleven of the 30 seeds did not germinate; four of these died. Time from soaking in the water to germination varied greatly, ranging from 2 days to 106 days. The average number of days to germination was 41 with a bimodal distribution of 34 and 70. Based on these results, BOOV seeds have a physical dormancy from an impermeable seed coat as reported in other members of this family.

Several pre-treatment tests (i.e. dipping seeds in concentrated sulfuric acid, placing seeds in boiling water in varying intervals, piercing the seed coat) produced an increase in germination rate but not in overall number of germinations. Germination rates were slightly higher when a small hole was made through the seed coat using a dissecting needle. Nine germination experiments were conducted to determine germination percentages; germination percentages ranged from 20% to 56% with an average of 40% (N=105/260). Results were not significantly different between the old and young seeds, showing a potentially long life for seeds, at least in laboratory conditions. Germination tests were then conducted on the 27 seeds from the soil samples; each seed coat was pierced as a pretreatment. Five of the 10 seeds (50%) from the August sampling germinated while only 3 of the 17 seeds (18%) from the December sampling germinated for an overall average of 30%. The experiment only lasted five days because seeds that did not germinate were quickly overcome by fungal growth and died; this was a problem that was not encountered in any of the other germination tests.

Based on the results of our investigation, BOOV has an extremely small seed bank with low germination. Our results may show unique conditions for BOOV or, we may be recording how a multiple-year drought can impact a rare plant’s seed bank and its
potential for survival. In future investigations we will test seed longevity in field conditions, measure seed rain over multiple years, map seedling production, and continue to study what conditions are needed for BOOV seed germination.

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