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Biodiversity Congress 2017: Seed size, storage and germination requirements can shape plant community structure in arid Arabian deserts

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Abstract

Background & Aim: Seed size (mass) and growth forms can affect dispersal distance, position of diaspora storage and consequently affect seedling establishment, growth, and survival and can shape community structure. Fewer studies assessed the relationship between seed size and germination level among different growth forms. Here, we assessed the impact of plant growth form, seed storage, and seed size and masses on seed dormancy, and light and temperature requirements during germination of 23 desert plants with aerial seed bank. Location: Northern Emirates of the United Arab Emirates (UAE) was the setting taken for this study. Methods: Seeds of 23 species with aerial seed bank, representing different growth forms (6 herbaceous, 11 small shrubs and 6 trees) were collected from natural habitats of the arid deserts of the UAE. Average seed mass and size were determined for each species. Fresh seeds, and those stored both in room temperatures for 9 months were germinated at daily night/day temperature regimes of 15/25°C, 20/30°C and 25/35°C in both continuous darkness and alternating light/darkness. Pearson correlation coefficients were used to assess the significance of the relationship between seed mass and seed size with final germination, relative light germination (RLG) and germination rate index (GRI) for each growth form at each temperature and light condition. Results: Trees and shrubs have significantly larger, heavier seeds that are characterized with higher dormancy, compared to herbaceous plants. Germination at all storage conditions was positively photoblastic in herbaceous plant, but was neutrally photoblastic in both shrubs and trees. Field storage enhanced light germination in trees, but not in shrubs and herbs. The relationships between both seed size and mass and final germination at all light and temperature conditions was positive in herbaceous, but negative in shrubby species. The relationship between seed size and LGI was significantly positive in shrubs; but was significantly negative in herbs and trees. GRI was greater for bigger

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seeds of herbs, but the reverse was true for seeds of trees. Conclusion: Seed size and storage, and light requirement during germination of species belonging to different growth forms could explain their distribution in the community and consequently could help explain community structure and composition.

Seed dormancy is an adaptation of the many plant species in unpredictable heterogeneous environments, like arid desert. Dormancy advantage, delay seed germination until the arrival of favourable conditions that allow seedling establishment and minimize seedling mortality. Light, temperature and moisture are the foremost important factors that determine germination time and place in desert environments. Herbaceous plants have smaller and lighter seeds.Room temperature storage improved final germination. Germination of herbaceous and trees species was greater than that of shrubby plants. Germination in light was greater than darkly . Unlike light, temperature had limited role in seed germination .The relationship between seed size and LGI was positive in shrubs; but was negative in herbs and trees. GRI was greater for bigger seeds of herbs and shrubs. But in trees the greater was for little seeds Generally, shrubs and trees attained lower germination than herbaceous plants. this means that smaller seeds germinate far more than larger seeds. Smaller seeds of herbs have greater chance for dispersal with winds than larger seeds of the opposite growth forms and explore new favourable condition, especially within the unpredictable desert habitats. In herbaceous plants, the small-seeded herbs contribute their seeds to soil seed bank, but large seeded invest more in their regeneration.Herbs with small seeds distribute the danger along time and retain a fraction of un-germinated seeds for the longer term . Small-seeded herbs required more light for germination, but large-seeded ones germinated better darkly . Small seeds buried too deep within the soil avoid possible fatal germination. Small seeds have little resources that limit seedling emerge from a depth deeper than superficial soils.The more food reserves of larger seeds enable them to emerge even from a deeper soil. Germination of larger seeds at deeper soil ensures that they're going to be closer to the wet soil, which might increase the prospect of the seedling establishment. In shrubs, large-seeded species germinate but small-seeded ones. Fewer large seeds that would germinate do this mainly in light. Canopy of small shrubs are dense, rounded and laid over the bottom so heavier larger seeds are expected to be retained under the canopies would expose them to lower R:FR (red/far-red) ratio and consequently end in lower germination, especially in dark. Larger seeds of shrubby plants should be dispersed away from their canopies. the higher chance of small seed for

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germination under the canopies of nurse plants to supply shade protect them from direct thermal radiation. The reduction of germination of the larger seeds under the cover would scale back inter- and intraspecific competition. Large seeds that might germinate faraway from canopies can produce bigger seedlings that migh adapt to dryness of exposed soils. In trees, species with large-seeded trees germinated more in dark, but small-seeded ones germinated better in light. The result might be explained consistent with the mode of dispersal of the studied tree species. Heavy diaspore unit which dispersed primarily by gravity germinated under the canopies. Endozoochorous species would disperse within the feces of grazing animals and consequently germinate in darkness; either within the feces or when feces buried in soil.When large seeds germinated under tree canopies they're going to produce larger seedlings that would compete with the maternal trees within the future . Field storage didn’t improve germination of seeds of herbaceous and shrubby plants, but improved it in seeds of trees. Under field condition, physical dormancy of the many species is weakened by sand scarification. Diurnal fluctuations in day and night moisture and temperatures could end in break down physical dormancy.

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