Effect of Increased Temperature and Carbon Dioxide on Cheatgrass and Ventenata

Ventenata (left) and cheatgrass (right) are two non-native winter annual grasses.

Introduction Climate change is expected to increase the abundance and distribution of cheatgrass (*Bromus tectorum*), a non-native winter annual grass. Cheatgrass was introduced to North America in the late 1800s and is now the most widespread invasive plant in the western U.S. Ventenata (*Ventenata dubia*), another non-native winter annual grass, was first found in North America nearly 100 years later than cheatgrass and has rapidly expanded its distribution in the intermountain Pacific Northwest. In some areas where the two species' distributions overlap, cheatgrass abundance declines while ventenata abundance increases.

Increased temperatures, especially elevated winter temperature and early onset of warmer temperatures in spring, are expected with climate change. These conditions are especially beneficial for winter annual grasses like cheatgrass and ventenata. Increased carbon dioxide (CO_2) in the atmosphere has been found to increase cheatgrass growth, but its effect on ventenata has not been tested. We tested the effect of temperature and CO_2 on growth of cheatgrass and ventenata seedlings to improve our understanding of whether climate change could be contributing to ventenata's expansion and future success.

Collage of photos showing methods used in study, from planting seeds to harvesting seedlings.

Methods Our study was conducted in a growth chamber where we could regulate temperature and CO_2. We examined cheatgrass and ventenata seedling growth under current and elevated temperature and CO_2 conditions. For current conditions, we used the 30-year average temperature in September for southwestern Montana [23° C (day) and 4° C (night)] and 400 parts per million (ppm) CO_2. For elevated conditions, we used end-of-century "business as usual" predicted values [29.6° and 10.6° C, 800 ppm CO_2]. Plants were started from seed and grew for 3 weeks after they emerged. We then harvested above- (shoot) and below (root) ground biomass.

Results Cheatgrass grew larger than ventenata across treatments, but ventenata allocated more growth to its roots. Dedicating growth to roots instead of shoots allows plants to maintain growth while minimizing water loss and could be beneficial to ventenata in elevated temperature and CO_2 conditions associated with climate change. Both species were smaller when grown in elevated conditions, but ventenata growth decreased less than that of cheatgrass. Our results indicate that ventenata may be a better competitor than cheatgrass in the future, but additional research should look at how changing conditions affect adult plants and seed production. Understanding how these two invasive annual grasses will respond to climate change relative to each other, and to native plants, is important for guiding their management now and into the future. Read the entire journal article Harvey, Rew, Prather, and Mangold (2020).