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The Effects of Light, Water and Nutrient Availability on the Interspecific and Intraspecific Competition of *Heracleum moellendorffii* and *Adenophora divaricata*

Woo Bin Youn[1], Si Ho Han[1], Byung Bae Park[1]

[1][Department of Environment and Forest Resources, Chungnam National University, Republic of Korea; bbpark@cnu.ac.kr]

Abstract

Since it takes at least 50 years to harvest timber after reforestation in temperate forests, foresters are very interested in cultivating wild vegetables in the forest. In the forests of South Korea, the slope varies greatly, and the amount of light, moisture, and soil nutrients available to wild vegetables differ depending on whether thinning is performed. Therefore, it is necessary to study the response of wild vegetables in these environments.

In this study, we tried to find a suitable growth environment while examining the effects of inter- and intraspecific competition on wild vegetables. To investigate the inter- and intraspecific competitive effects, *H. moellendorffii* and *A. divaricata* were planted in two ways. For the competitive effect of resource availability, shading, irrigation, and fertilization treatment was performed. And we measured the height, root collar diameter, leaf specific weight, biomass, and relative yield.

As a result, shade significantly increased the height growth of *H. moellendorffii* regardless of planting methods, particularly those grown in high soil moisture and nutrients. Contrarily, the aboveground biomass of *A. divaricata* was significantly suppressed by shading, particularly when planted with the other species without fertilizer. When planted together, the interspecific competitiveness of *H. moellendorffii* tended to be stronger than that of *A. divaricata* across light conditions. The amount of light, soil moisture, and nutrients and their interactions have been shown to significantly affect the growth of the seedlings, resulting in asymmetric interspecific competition between species. The findings of the present study should provide us with a better understanding of the environmental factors affecting plant growth that are necessary to make forest farming in the understory more ecologically and socio-economically feasible and appealing.

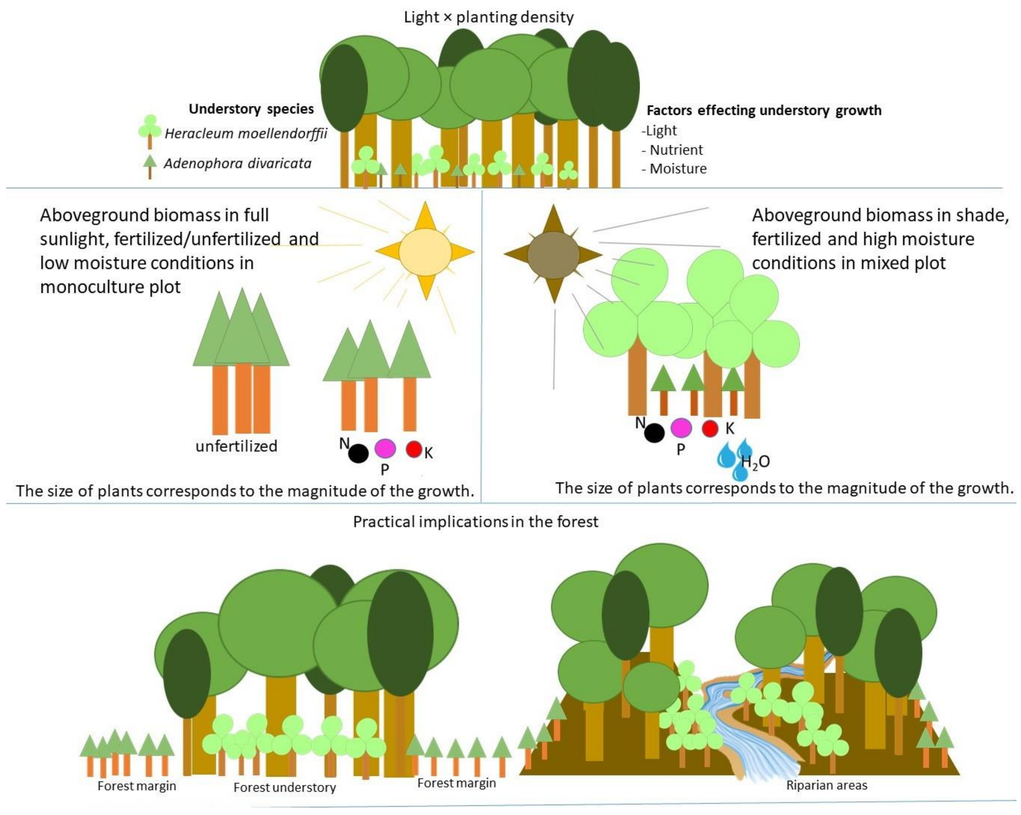

Figure 1. Graphical abstract

Main objective

- To find a suitable growth environment considering the resource availability and competition on wild vegetables

Results

- Shade significantly increased the height growth of *H. moellendorffii* regardless of planting methods, particularly those grown in high soil moisture and nutrients.
- The aboveground biomass of *A. divaricata* was significantly suppressed by shading, particularly when planted with the other species without fertilizer.
- When planted together, the interspecific competitiveness of *H. moellendorffii* tended to be stronger than that of *A. divaricata* across light conditions.
- The amount of light, soil moisture, and nutrients and their interactions have shown to significantly affect the growth of the seedlings, resulting in asymmetric interspecific competition between species.

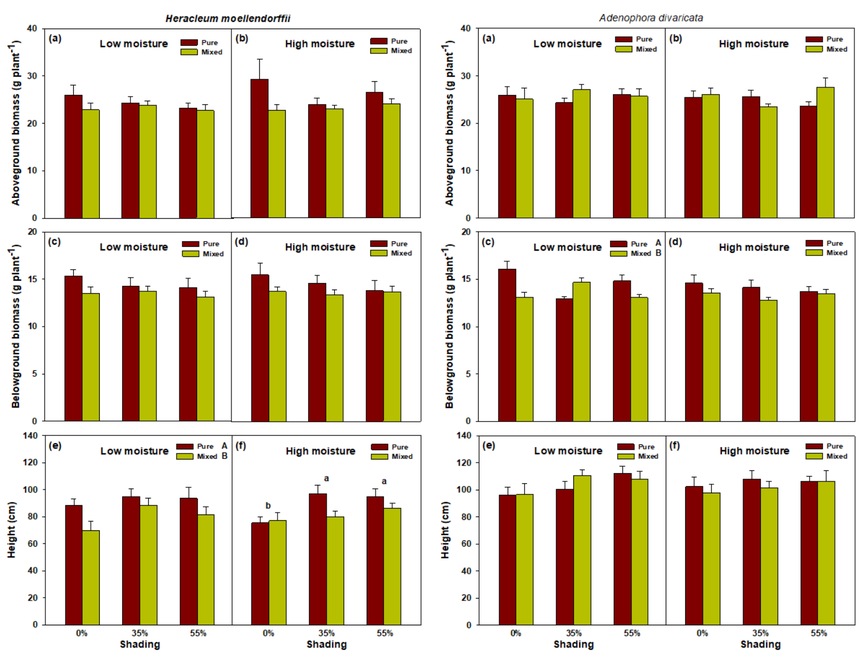

Figure 2. Aboveground biomass, belowground biomass, and height of *H. moellendorffii* and *A. divaricata* in different light and soil moisture conditions

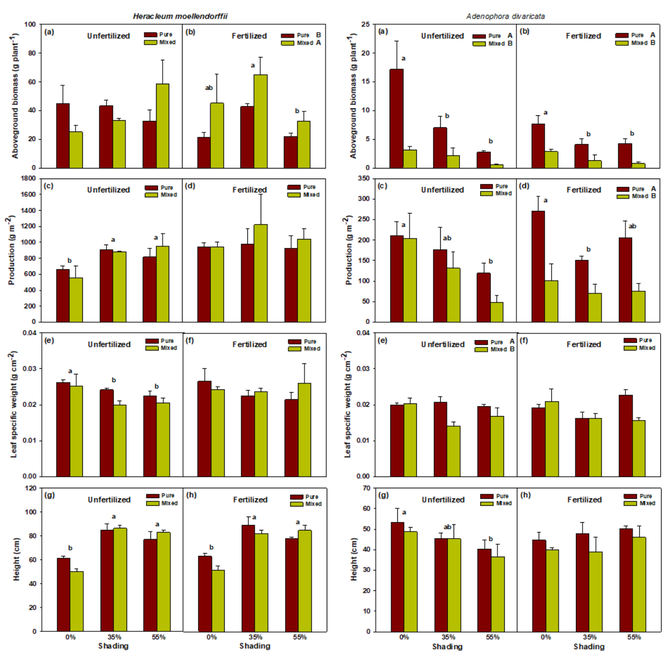

Figure 3. Aboveground biomass, shoot production, leaf specific weight, and height of *H. moellendorffii* and *A. divaricata* in different light and fertilization conditions

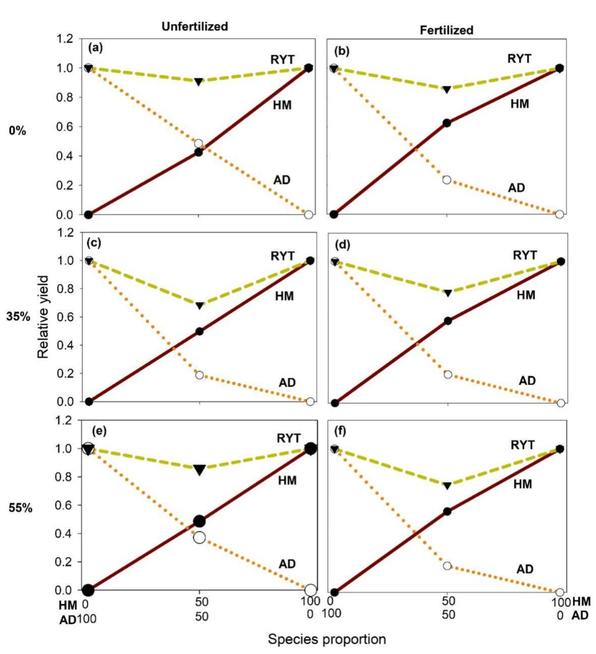

Figure 4. Relative yield total (RYT) of unfertilized and fertilized *H. moellendorffii* (HM) and *A. divaricata* (AD) in 0%, 35%, 55% shade treatments.

Conclusions

- Considering that the two studied species are useful as food and medicinal herbs in some countries, including Korea, China, and Japan, the findings of the present study can support sustainable forest management through forest farming in the understory.
- *H. moellendorffii* can be planted at low light, high soil moisture and nutrients, and intercropped conditions.
- *A. divaricata* is more suitable in full sunlight, low soil moisture and nutrients, and monoculture conditions.
- Planting of *H. moellendorffii* is more suited in the forest understory in riparian areas, particularly in mountainous regions where most of the nutrients are usually leached and eroded towards riverbanks by water and wind on steep slopes.
- *A. divaricata* may suit in the understory in forest margins where light and soil moisture and nutrients are relatively limiting compared with those in the middle and/or riparian areas in the forest.
- The findings of the present study should provide us with a better understanding of the environmental factors affecting plant growth that are necessary to make forest farming in the understory more ecologically and socio-economically feasible and appealing.

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