Condition-dependent sexual dimorphism in a dioecious plant

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ABSTRACT

Theory predicts that selection favoring the sex-specific exaggeration of traits will lead to the evolution of sexual dimorphism, with traits in one sex becoming more pronounced than homologous traits in the opposite sex. Such trait exaggeration may come at a viability cost, however, and theory predicts that highly sexually dimorphic traits should evolve an increased sensitivity condition, whereby the expression of sexual dimorphism reflects the availability and processing efficiency of resources. This predicts a positive correlation between the extent of sexual dimorphism and the strength of condition dependence. Although both sexual dimorphism and condition-dependent trait expression have been widely documented, the extent to which these forms of plasticity co-vary is not well known. Moreover, evidence for the coevolution of condition dependence and sexual dimorphism is predominantly from animal species with highly exaggerated male traits, and the extent of covariation of these traits in plant species, where sexual dimorphism is typically less pronounced, remains unclear. Here, using a common garden experiment, we manipulated condition via soil nutrients and investigated sex-specific responses in plant height, plant biomass, and flowering time in the sexually dimorphic dioecious wind-pollinated plant *Rumex hastatulus*. We found evidence for significant sexual dimorphism in reproductive traits (e.g., flower number and reproductive mass), which were on average 20% more dimorphic and 80% more condition-dependent than vegetative traits (including leaf number and size, and total vegetative mass). As predicted by theory, our experiment also revealed that the strength of condition-dependence increased with the degree of sexual dimorphism, suggesting that traits that have evolved sexual dimorphism have also evolved condition dependent expression. However, in contrast to previous studies in animals we found that both males and females exhibited similar responses to the manipulation of condition, suggesting that there may be differences between plants and animals in the expression of sexually dimorphic trait variation. We conclude that differences between males and females in absolute and proportional allocation to reproduction may have important consequences affecting how sexually dimorphic traits respond to variation in condition in dioecious plants.