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Trade-Offs Among Parameters of Reproductive Efforts in Rapid Grow Radish

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ABSTRACT

Multiple reproductive parameters including flower number, pods initiated, pods matured, seeds matured and mass per seed each require a certain percentage of a plant's generated energy to ensure viable successive generations. In an attempt to determine the most important quality, these factors were documented over the span of several weeks as test rapid grow radish plants matured. Variables of reproductive effort would divide nutritional allocations in accordance of priority, with the effort of least variability being most critical to success. The quality held most constant among the test plants was seed mass. An established seed mass, irrespective of resources available or plant size, has competitive priority over the other reproductive variables.

INTRODUCTION

The selective intent of reproductive allowance in each plant is to ensure some contribution to consequent future generations (Sugiyama and Bazzaz 1998). Reproductive allocation is not a constant variable, but rather it is determined in great part by relative location and consequent resources available (Hirayama et al. 2008, Satake and Bjørnstad 2008). In times of resource limitation, plants must accordingly make adjustments (Arntz et al. 2002). In times of high stress, plants strategically increase the differentiation between parameters. Irrespective of variations in nutrient or other external factors, one reproductive quality will remain relatively constant (Jiang and Kadono 2001, Andersson 2005). Priority given to this variable has evolved over time, making it imperative to reproductive success. A steady maintenance of quantity versus quality is inherently viewed as posing a greater chance at maintenance and perseverance of plant progeny (Arntz et al. 2002).

All reproductive variables must work in a sort of give and take with one another for successful reproduction. Parameters of plants include flower number, pods initiated, pods matured, seeds matured and mass per seed. Of the following allocations, the factor of greatest importance will have the least variation.

METHODS

The subject of this study consisted of rapid-grow radish seeds grown in two 2-liter plastic pans that contained potting soil. One pan contained 11 plants, the other, 12. The difference in size sample can be attributed to one seed missing germination. Over the course of the experiment the seeds were under direct and constant light. This photoperiod was supported by four 122-cm, broad spectrum 40-watt fluorescent light bulbs. During the test, the radish seeds were removed only momentarily to record changes in counts of flowers, pods initiated, pods matured, seeds matured, and mass per seed throughout the duration.

The relative variation shown by each of the measures of reproductive yield were quantified by computing the coefficient of variation (CV= standard deviation/mean). The yield component having the lowest CV was assumed most important to maintain by the plant species. Contrarily, components having higher CVs were assumed to be more expendable in the forms of nutritional trade-offs.

RESULTS

Measurements are summarized in Table 1. The number of flowers and pods inflated approached significance. Only seed mass showed the least variation in the population of plants.

DISCUSSION

Seed mass showed the least variation in rapid growth radish, an observation also shown by other plants (Willis and Hulme 2004). This variable is integral to reproduction phenology (Vile et al. 2006). Much time and energy are necessary to create reproductively efficient seed mass (Bolmgren and Cowan 2008). Seed mass affects the output of seed numbers, significantly impacting not only the plant itself, but those surrounding it as well (Henery and Westoby 2001). Given more resources, plants produce more pods, and, consequently, more seeds rather than greater seed mass (Willis and Hulme 2004). When seed number is decreased due to environmental variances, reproductive success is severely impaired (Allison 2002).

The probability for the greatest growth success affects individual seed characteristics (Tungate et al. 2002). The percentage of biomass and resources apportioned to reproduction is dependent on the relative size of the vegetation (where larger plants delegate a larger fraction (Hirayama et al. 2008). The size of seeds is not proportionate to larger plant size as it is in smaller plants despite having the physical capability to do so (Aarssen 2005).

Natural selection favors smaller seed size for their ability to germinate faster than their larger counterparts (Tungate et al. 2002). Smaller seeds allow for greater fecundity allotment and are more energy efficient (Aarssen 2005). It allows for stronger competition in limited resources for flourishing. Seeds are more easily dispersed by animals or nature in a symbiotic relationship when they are smaller in size (Stevenson et al. 2005). Larger seeds, though, contain more nutritional value and grow at a comparatively faster rate (Tungate et al. 2002). However, this size though impedes on the energy allocation for reproduction for other variables (Bolmgren and D. Cowan 2008). Larger seeds are advantageous only in areas with low disturbance (Stevenson et al. 2005). The greater number of smaller seeds counterbalances all of the positives of larger seed size (Moles and Westoby 2004). Other reproductive factors like flower production is directly dependent on seed mass (Bolmgren and Cowan 2008).

Reproductive parameters and their consequent effects on overall success in fecundity offer perspective on the allocations of energy. This experiment provided insight to the importance of seed mass to plant reproductive success through showing the least variation of all tested variables.

Literatures Cited

Allison, V. J. 2002. Nutrients, arbuscular mycorrhizas and competition interact to influence seed production and germination success in *Achillea millefolium*. Functional Ecology **16**: 742-749.

Andersson, S. 2005. Floral costs in *Nigella sativa* (*Ranunculaceae*): Compensatory responses to perianth removal. American Journal of Botany **92**: 279-283.

Arntz, A. M., E. M. Vozar and L. F. Delph. 2002. Serial adjustments in allocation to reproduction: effects of photosynthetic genotype. International Journal of Plant Sciences **163**: 591-598.

Bolmgren, K. and P. D. Cowan. 2008. Time – size trade offs: a phylogenic comparative study of flowering time, plant height and seed mass in a north-temperate flora. Oikos **117**: 424-429.

Henery, M. L. and M. Westoby. 2001. Seed mass and seed nutrient content as predictors of seed output variation between species. Oikos 92:479-490.

Hirayama, D., S. Nanami, A. Itoh, and T. Yamakura. 2008. Individual resource allocation to vegetative growth and reproduction in subgenus *Cyclobalanopsis* (*Quercus*, *Fagaceae*) trees. Ecological Research **23**: 451-453.

Jiang, M. and Y. Kadono. 2001. Growth and reproductive characteristics of an aquatic macrophyte *Ottelia alismoides* (L.) Pers. (*Hydrocharitaceae*). Ecological Research **16**: 687-695.

Moles, A. T. and M. Westoby. 2004. Seedling survival and seed size: a synthesis of the literature. Journal of Ecology **92**: 372-383.

Satake, A and O. N. Bjørnstad. 2008. A resource budget model to explain intraspecific variation in mast reproductive dynamics. Ecological Research **23**: 3-10.

Stevenson, P. R., M. Pineda, and T. Samper. 2005. Influence of seed size on dispersal patterns of woolly monkeys (*Lagothrix lagothricha*) at Tinigua Park, Colombia. Oikos **3**: 435-440.

Sugiyama, S. and F. A. Bazzaz. 1998. Size dependence of reproductive allocation: the influence of resource availability, competition and genetic identity. Functional Ecology 12: 280-288.

Thürig, B., C. Körner, and J. Stöcklin. 2003. Seed production and seed quality in a calcareous grassland in elevated CO_2. Global Change Biology **9**: 873-884.

Tungate, K. D., D. J. Susko, and T. W. Rufty. 2002. Reproduction and offspring competitiveness of *Senna obtusifolia* are influenced by nutrient availability. New Phytologist **154**: 661-669.

Vile, D., B. Shipley, and E. Garnier. 2006. A structural equation model to integrate changes in functional strategies during old-field succession. Ecology **87**: 504-517.

W. Aarssen, L. 2005. Why don’t bigger plants have proportionately bigger seeds? Oikos **1**: 199-207.

Willis, S. G. and P. E. Hulme. 2004. Environmental severity and variation in the reproductive traits *oflmpatiens glandulifera*. Functional Ecology **18**: 887-898.

Table 1. Statistical summary (mean ± standard deviation (sample size) and coefficient of variation) of the components of reproductive yield.

Component of Reproductive yield	Mean ± standard deviation (n)	Coefficient of variation
Flower count/plant	35.0 ± 22.9 (23)	0.65
Pods inflated/plant	11.9 + 5.8 (23)	0.49
Pods matured/plant	3.5 + 4.4 (23)	1.25
Seeds matured/plant	15.8 + 18.1 (23)	1.14
Mean mass/seed	2.4 + 0.8 (16)	0.32