Amphicarpy in perennials: *Centrosema rotundifolium*

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Introduction

Amphicarpy is an evolutionary adaptation which contributes to the increase of a plant's fitness under varying conditions. It consists of a dual reproductive strategy, with formation of subterranean seeds on specialized reproductive structures in addition to aerial seeds, on the same individual (Fig. 1). So far, research on this phenomenon has been limited to annual species. The objective of this work was to investigate amphicarpy in a *Centrosema* species, a perennial trailing legume with potential for use on marginal tropical soils.

Fig. 1 Aboveground and subterranean pods of *Centrosema rotundifolium* Mart. ex Benth.

Methods

- Growth experiments in a split-plot design were established in the field in Venezuela, on a poor sandy soil; *C. rotundifolium* accession CIAT 5260 was used;
- Germination test of two seed types over 7 months in the laboratory;
- Statistical analyses by non-linear models.

Results

Like annual amphicarps, *C. rotundifolium* reacts to imposed stress by shifting the generative resource allocation towards subterranean reproduction (Fig. 2). Phosphorus fertilization improved overall growth, and densities >1 plant/m² already negatively affected reproductive biomass. High competition stress (>16 plants/m²) increased subterranean reproduction on the expense of both vegetative and aerial generative biomass, irrespectively of P fertilization.

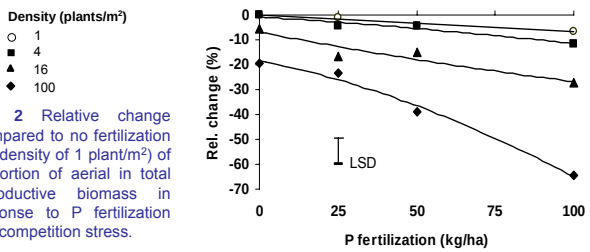


Fig. 2 Relative change (compared to no fertilization and density of 1 plant/m²) of proportion of aerial in total reproductive biomass in response to P fertilization and competition stress.

Shift towards subterranean reproduction might have some long-term ecological implications:

Germination behaviour

Aerial and subterranean seeds have different germination patterns (Fig. 3); about 40% of subterranean seeds remained hard, presumably due to testa structure.

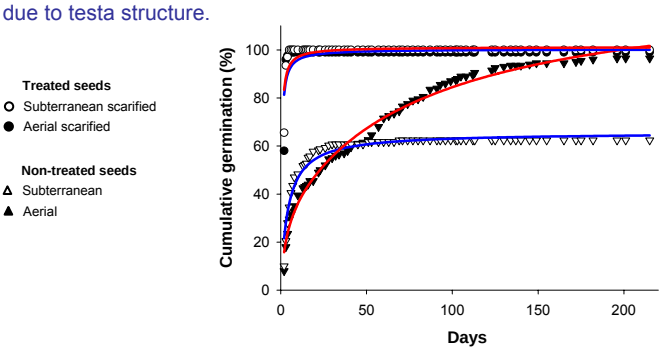
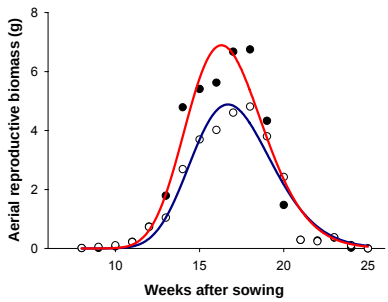


Fig. 3 Germination behaviour of aerial and subterranean seeds.

Aerial/subterranean reproductive allocation

Phenology and general growth patterns of plants from the two seed types did not differ significantly. Though total reproductive biomass did not differ, plants originating from aerial seeds produced significantly more aboveground reproductive structures than plants from subterranean seeds (Fig. 4).

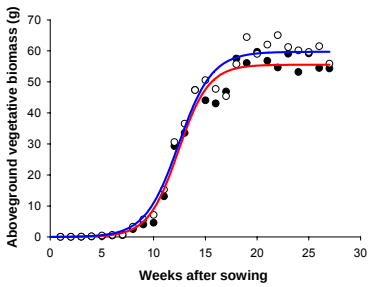


The 95% confidence limit for the difference of these two curves throughout the growth period is 19.2-48.2% (fitted Generalized Linear model with log-link).

Fig. 4 Plants from aerial seeds tend to allocate more resources to aboveground reproduction.

Vegetative/generative allocation

Subsequently, plants from aerial seeds tended to allocate less resources in vegetative growth; they had a slight lag in growth of tuberous (storage) roots, and about 7% less aboveground vegetative biomass (Fig. 5).



The sigmoid curves were fitted by logistic function (PROC NLMIXED, SAS). Only the two plateaux differ significantly (p=0.02).

Fig. 5 Plants from subterranean seeds tend to allocate more resources to vegetative growth.

Conclusions

Contrary to annual amphicarps, *C. rotundifolium* starts aerial flowering early in ontogeny. Underground reproduction, which is delayed but has about seven times higher generative biomass, remains the major survival mechanism.

Acknowledgements
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