Effects of seed traits variation on seedling performance of the invasive weed, *Ambrosia artemisiifolia* L.

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COMMON RAGWEED – A SPECIES WITH HIGHLY VARIABLE SEEDS !

In the life cycle of annual plants, seeds represent a critical stage for the colonization process. In the highly problematic species *Ambrosia artemisiifolia* L, achenes (referred to as 'seeds' for simplicity) are particularly variable (see Fig. 1).

We aimed at better understanding how seed variability was structured and how it influenced early stages of seedling development.

Fig. 1: Illustration of the variability of *A. artemisiifolia* seeds. Note the differences in color, size, and outgrowth length.

OBJECTIVE ➔ Analyze the variability of seeds from different origins, and quantify the impact of seed traits on seedling phenotype.

SOURCES OF SEED VARIABILITY

We sampled three populations in each three geographical areas in Western Europe. We sampled 10 seeds on 10 plants, in each population.

To characterize seed variability, we measured three traits on standardized pictures of the 900 seeds (Fig. 2):

- Seed mass, to the nearest 10^{-4} g
- Seed functional area (area of the cotyledons)
- Seed coat lightness, on a scale from 0 (black) to 255 (white)

A two-ways nested (ANOVA) was performed for each trait using population as a random factor and the mother plant as a random factor nested in population:

Source of variation	df	*F*	*P*	Proportion of variance explained
Seed mass				
Populations	8	4.46	<**0.001**	16.52
Mother within populations	81	12.06	<**0.001**	43.84
Intra-mother (error)	810			39.64
Seed functional area				
Populations	8	9.57	<**0.001**	35.86
Mother within populations	81	16.89	<**0.001**	39.36
Intra-mother (error)	810			24.78
Seed coat lightness				
Populations	8	11.87	<**0.001**	40.37
Mother within populations	81	14.86	<**0.001**	34.63
Intra-mother (error)	810			25.00

EFFECTS OF SEED VARIABILITY

Each seed was then sown in a small container (Fig. 2). Five seeds per mother plant were placed in a COLD growth chamber (15°C day / 10°C night); the other five in a WARM growth chamber (25°C day / 20°C night).

The following variables were recorded:
- Time to germination
- Foliage cover 14 days after seed germination
- Dry aboveground biomass

Figure 3 shows the relationship between seed traits (x-axis) and seedling responses (y-axis).

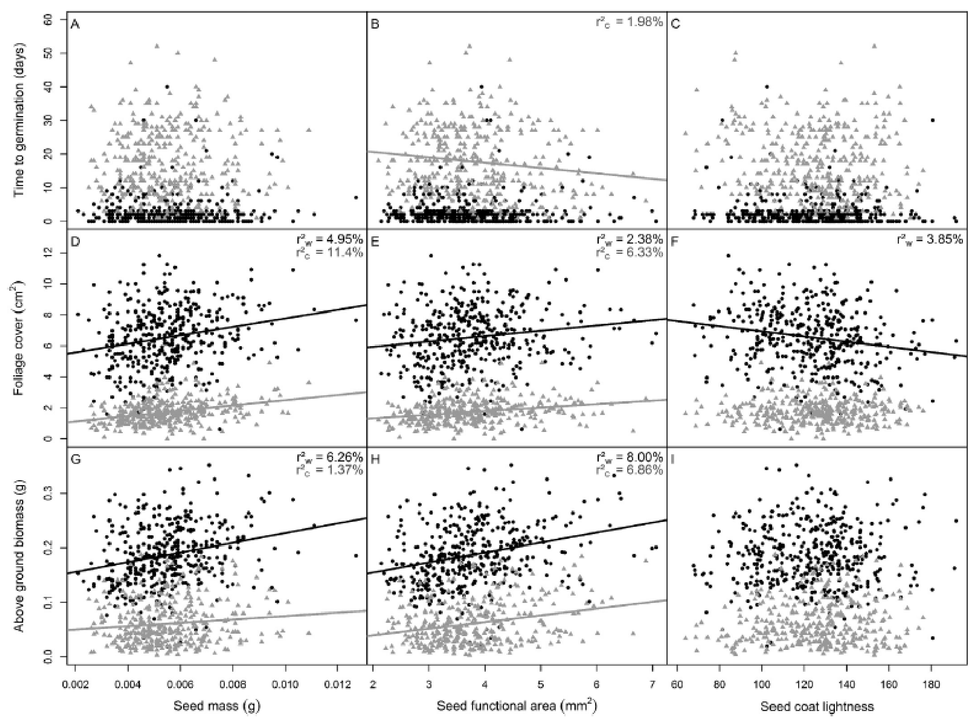

Figure 3. Relationship between seed traits (x-axis) and seedling responses (y-axis) of Ambrosia artemisiifolia, according to temperature treatment. Measurements performed on seedlings in warmer conditions are shown with black dots. Measurements performed on seedlings in colder conditions are shown with grey triangles. Significant regression lines are displayed in the respective colours. Coefficients of determinations are given for significant regressions in the respective colours at the top right of each graph.

Fig. 2: Illustration of the experimental process used to characterize seed variability and its effect on seedling performances

TAKE-HOME MESSAGE

- Variance in seed traits is attributable to populations and mother plants in comparable proportion
- Phenotypic variation of seedlings was influences by temperature but also modulated by seed traits
- In colder conditions, large seeds can be crucial to the invasion process due to the better performances of seedlings