Along-invasion evolution of an invasive plant : altitudinal differenciation in germination, phenology and growth

Arnaud Monty (F.N.R.S. PhD Student), **Grégory Mahy**
Laboratory of Ecology, Gembloux Agricultural University, Passage des Déportés 2, 5030 Gembloux, Belgium

Introduction

Senecio inaequidens DC. (Asteraceae) is a perrennial herbaceous shrub bearing numerous yellow capitulae. It was introduced from South Africa to Europe more than one hundred years ago, in a few precise locations linked to wool industry. It then extended its distribution throughout Europe across contrasted climate conditions. In a context of global warming, the potential evolution in germination, growth and phenology during the invasion process was studied in relation to altitude and climate. The aim was to know how the species can evolve in response to climate variation in a length of time of several decades.

Material and Methods

Seeds were collected along two transects, both altitudinal and climatic, in Belgium and France (Fig.1). Respectively four and five climatic zones per transect, two populations per zone and ten randomly selected individuals per population were sampled. Seeds were sorted in order to discard maternal effects. Ten seeds per parent individual were thereafter sown in pots in a common garden experiment in Gembloux (Belgium) and one plant was kept (Fig.2). Germination was checked every two days. Blooming was checked everyday. Height and diameter of plants, enabling the calculation of plant volume, were measured every 25 days (Table1).

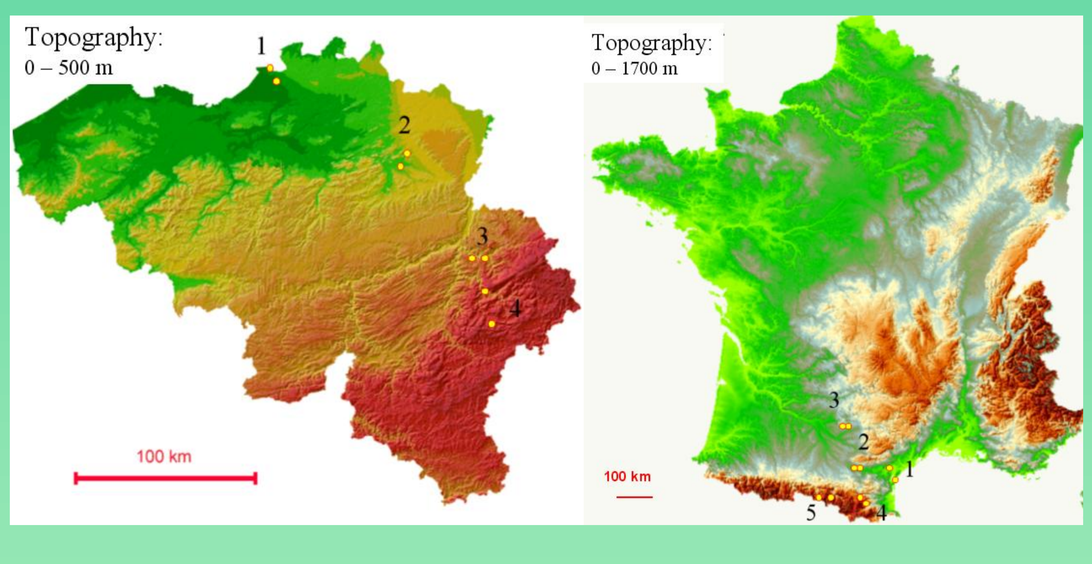

Fig.1: Belgian (left) and French (right) transects for seed collection. Numbers represent climatic/ altitudinal zones. Dots represent populations.

Table1: Life traits measured in the common garden experiment and measurments periodicity

Life trait	Measurment periodicity
Germination delay	2 days
Germination window	2 days
Germination rate	2 days
Flowering delay since germination	1 day
Flowering delay since sowing	1 day
Plant height	25 days
Plant volume	25 days

Fig.2: Common garden experiment (random block design)

Results

Almost no difference was found along the Belgian transect, but a clear differenciation of the species was shown along the french transect (more contrasted) : plants from higher elevations tend to germinate later, bloom earlier and remain smaller in height and volume (Fig.3, 4, 5). This reflect a rapid evolution phenomenon, correlated with altitude and climatic zones.

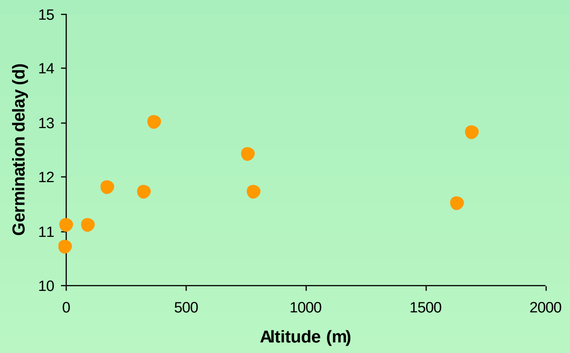

Fig.3: Non-linear increase of populations mean germination delays with altitude along the French transect (Spearman's R= 0.640; p = 0.046).

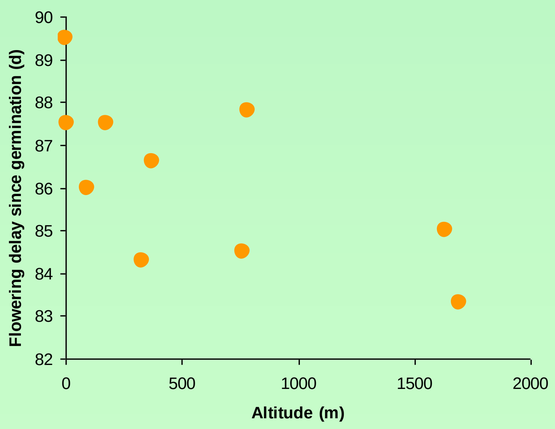

Fig.4: Linear decrease of populations mean flowering delays (since germination) with altitude along the French transect (Pearson's r = -0.654; p = 0.040).

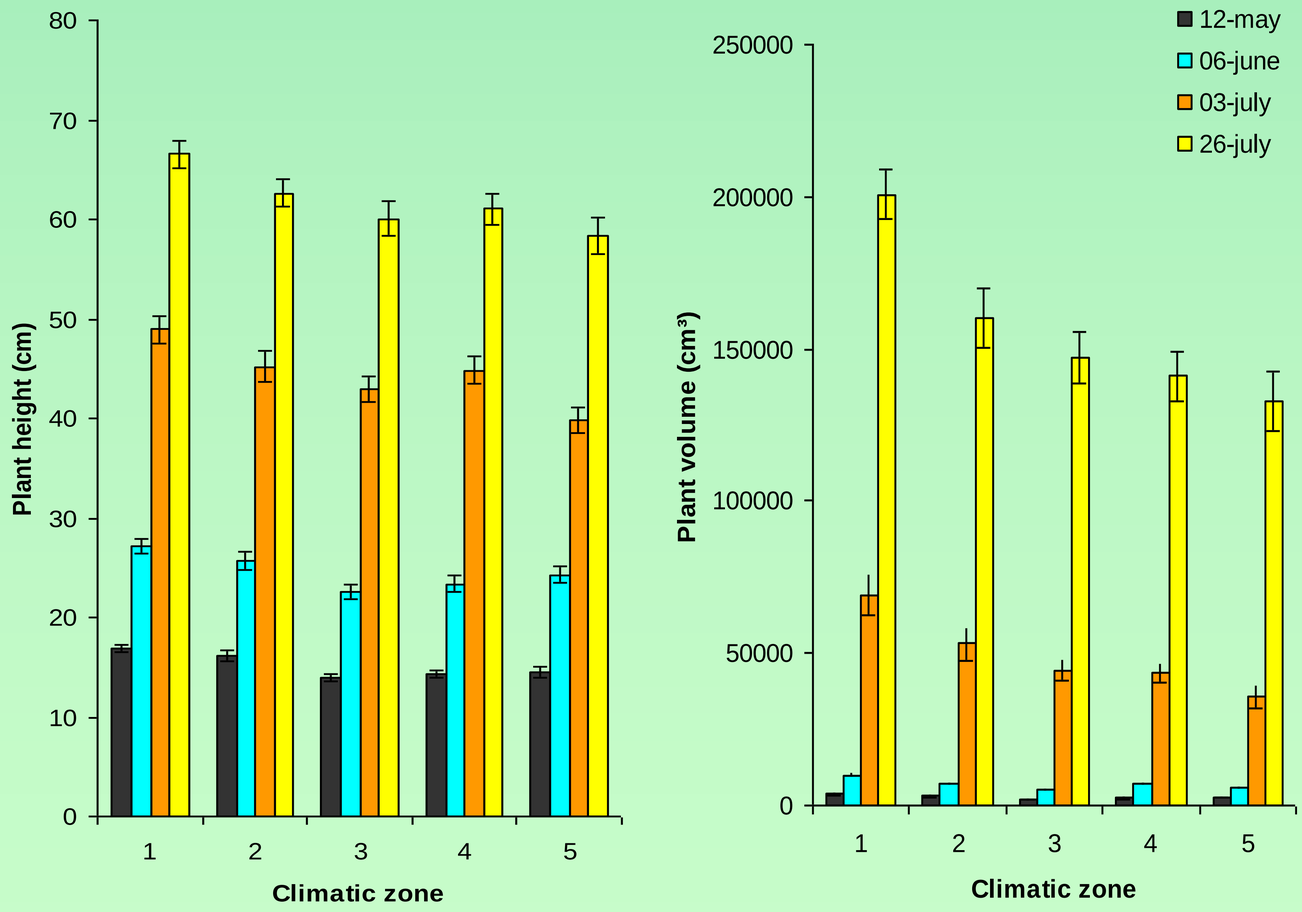

Fig.5: Evolution of populations mean plant height (left) and mean plant volume (right) with climatic zones along the French transect. Plant height: decrease is significant for all the measurment dates (p varying from 0.044 to 0.003). Plant volume: decrease is significant for the last two measurment dates ($p \leq 0.001$).

Conclusion

These preliminary results show that contrasted climatic conditions along the French gradient, from the Mediterranean coast to the Pyrrenean high elevations led to genetic differenciation of *Senecio inaequidens* populations during invasion in southern France. Later germination, earlier blooming and smaller development can be seen as adaptations to shorter vegetation period and harsher environmental conditions encountered at higher elevations. Contrarily, plants originating from the Mediterranean coast encounter milder climatic conditions and show the opposite trend.