European Workshop on Control and Eradication of Invasive Alien Plant Species 19-21 April 2016

Is *Ambrosia artemisiifolia* L. able to expand its invaded range northward in Western Europe?

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- Context -

Ambrosia artemisiifolia L. (common ragweed, Asteraceae) is an invasive weed causing a **health crisis in Europe**, due to its highly allergenic pollen. In Western Europe, the invaded range covers most of central and southern France and northern Italy. Northward, **beyond the edge** of this range, occurrence of casual population have been described for years. However, these populations **do not appear to become invasive**, and the species does not seem to spread.

Has the invaded range reached a limit or will the species continue its invasion northward?

A flowering plant of *A. artemisiifolia*

To answer this question, we followed **two complementary approaches**. First, we set up an experimental garden to see how the species thrives with the climate of the northern areas. Second, we compared the in situ performance of the species in different areas to see if the species has reduced performance northward.

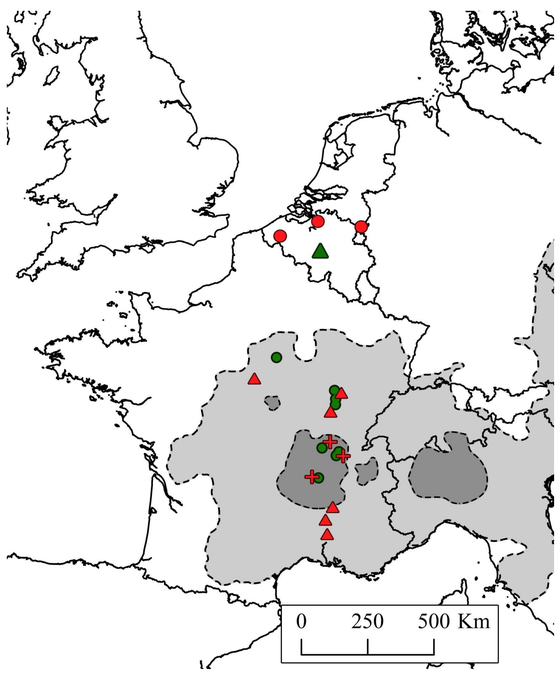

Fig. 1: The location of the studied populations of *Ambrosia artemisiifolia* and of the study site.

Experimental garden:
- Origins of the population studied in the garden
- Location of the experimental garden

Measurement campaign:
- Invaded range (>100 pollen grains.m^{-3}.year^{-1})*
- Highly invaded regions (>500 pollen grains.m^{-3}.year^{-1})*
- Populations of low invasion level
- Populations of moderate invasion level
- Populations of high invasion level

- The Experimental Garden -

Seeds from 8 populations were sown within experimental plots (2 m^2) placed in an **agricultural field in Belgium** (Fig. 1), with and without **sunflower competition** (4 replications). After two growing seasons, the population finite growth rate (λ) was calculated for each of the 64 plots, and the soil seed bank was assessed.

The results showed that the species was able to **establish populations with high growth rate** (346 ± 31; mean ± SE) an **important soil seed bank** (306 ± 51 seeds.m^{-2}), and totally suppressed the sunflowers. These findings suggest a **great potential for invasion northward.** Because of the links between the species' invasion and the sunflower cultivation, great caution has to be exercised if this production extends northward.

The experimental garden with the 64 plots

A plot with sunflower competition

The garden when the male flowers started to emerge

The "pollen cage" during the pollen production

The high density of offspring the following year

- The Measurement Campaign -

A flowering plant in Izegem, Belgium

The experimental garden showed that *A. artemisiifolia* was able to reproduce north to the current invaded range. However, is the plant as successful as within the range?

To answer this question, 12 **ruderal populations** were sampled across a ca. 1000 km transect, **in areas of contrasted invasion levels** (Fig. 1). On 25 plants within each population, we **measured performance-related traits**, e.g., aboveground biomass and seed number (Fig. 2). We performed ANOVAs to explore the effect of the invasion level on the performance. We also tested if the latitude or the local climatic data had an effect on the performance.

We used dust masks against the pollen

The results showed that the **performance-related traits were similar across all investigated areas** (Fig. 2). The hypothesis of a plant performance reduction in the low invasion level is thus rejected. The performance-related traits were not correlated with the latitude (P=0.480), or with the local climatic data (P=0.392).

This study demonstrated that the observed pattern of invasion (Fig. 1) is not explained by plant performance variation, neither by the latitude, or the climate. Because no performance reduction was highlighted among the considered areas, **there is no indication that the invaded range will be limited northward.**

A riverbank invaded by *A. artemisiifolia* (la Drôme)

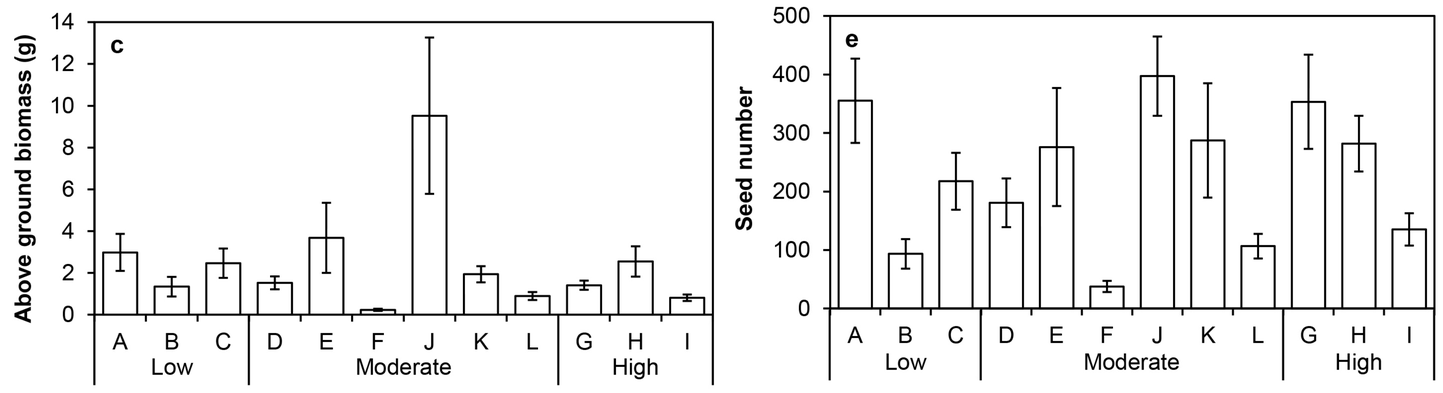

Fig. 2: Mean and standard errors of aboveground biomass and seed number among population and invasion levels (x-axis).

- Conclusion-

These two complementary studies highlighted **the capability of the species to overcome the climatic conditions** north to the current invasion front, establish populations, and express similar plant performance than within the invaded range. No evidence of processes constraining the invasion process was found, which suggests **a great potential for invasion north to the current invaded range**.

In this uncertain situation, **awareness actions should be considered** in the northern countries, to avoid the repeated occurrence of the species in the fields remaining unnoticed, and to allow control measures to be initiated in the early stage of the species' establishment.

Take-Home Messages

- *Ambrosia artemisiifolia* is able to overcome the climatic conditions north to the current invasion front.
- The species expressed similar plant performance across all invasion levels.
- If sunflower cultivation extends northward, early detection and awareness actions should be considered.

Need more info?
The paper about the measurement campaign is out!
Please, take a copy!