Demography of an allergenic European invasive plant: *Ambrosia artemisiifolia*

B Fumanal, B Chauvel, F Bretagnolle  
INRA, UMR BGA, 17 rue Sully, BP86510, 21065 Dijon cedex, France  
Email: fumanal@dijon.inra.fr

**INTRODUCTION**

Common ragweed (*Ambrosia artemisiifolia*) (Asteraceae) is an annual plant, introduced from North America to Europe over 100 years ago, and is now widespread in numerous countries (Dechamp & Meon, 2002). Problems with this invader are varied. It is considered a weed of spring crops such as sunflower, but also invades a wide range of non-crop areas, such as open disturbed (ruderal) habitats or river banks (Basset & Crompton, 1975). Moreover, this plant causes problems for human health, as it produces an abundance of allergenic pollen (Laaidi *et al.*, 2003). In North America, common ragweed is the first cause of hay fever (Basset & Crompton, 1975).

 Whereas many studies focusing on human health were carried out on common ragweed, comparatively few new data have been published on its biology and ecology within its introduced range. To our knowledge, only one demographic study in field crops in Canada have been published (Deen & Swanton, 2001). The demographic processes governing the colonization and the maintenance of invasive species are considered a key parameter of biological invasion. In France, in 2004, a 3-year study was initiated on the demography of different common ragweed populations established in various environmental situations (namely: field crops, but also ruderal and naturally invaded habitats). Data from these studies may eventually help towards understanding the adaptive strategies of this invasive plant; factors that control populations in relation to management perspectives will also be studied.

**MATERIALS AND METHODS**

Ten populations of common ragweed were studied in 2004. Populations were chosen according to their French geographic distribution (from the centre to the periphery of colonization) and also to the types of invaded habitats. There were two northern populations in old and recent gravel pits, six central populations on embankments and in fallows and spring crops (one faba [= field] bean, one maize and two sunflower), and two southern populations in fallow and river. For each site, and during the weed’s lifecycle, plant density was recorded using 10 plots (each of 1 m²) and demographic parameters (i.e. plant height, width, shoot dry biomass, shoot number, pollen and seed production) measured for a 100 individuals. Mean plant density was compared throughout the lifecycle, and the demographic parameters were analyzed with ANOVA and linear regression analysis, using Statistica 5.5 software.

**RESULTS AND CONCLUSIONS**

Initial common ragweed population densities ranged from 0.3 to 630 plant/m², with the lowest ones observed in field crops (0.3 to 18 plant/m²); densities in ruderal/natural sites
ranged from 10 to 630 plant/m². This distribution pattern in field crops can be easily explain by the annual soil perturbation, that scatters and hides seeds compared with other soil-stable populations. This mode of disturbance can also explain the spatial pattern of seedling distribution observed: from random (in field crops) to clumped (in old fallows).

Plant density also fluctuated over time, according to their habitat. Populations in field crops did not show any density variation after initial germination, whereas there was a density-dependent mortality (self-thinning) in others. Differences were also observed for demographic parameters. Height of plants from field crops populations increased, and then slowed down to their maximum one month before other populations. In contrast, ruderal/natural populations showed a continuous increase in plants height until the end of the vegetative growth phase (beginning of fructification). Final heights were significantly different between populations ($P < 0.001$), except for two populations in sunflower and faba bean crops ($P = 0.061$). Plant height (but also life-history traits such as plant volume, dried weight and shoot number) was greater for populations in field crops than for those in ruderal/natural sites. In field crops, there was a positive correlation ($R^2 = 0.84$) between the heights of common ragweed plants and the related crop, that can be directly explained by light competition. In ruderal/natural sites, the same general pattern related to plant competition for volume and dried weight can be observed, but not for the other life-history traits (owing to additional constraints).

A comparative study of these life history traits can help to detect phenotypic plasticity and local adaptation. These two components may explain the ability of common ragweed to colonize new areas. For example, linear regression of plant volume and weight showed different slopes according to the populations, suggesting phenotypic plasticity. In addition, there was a positive correlation between shoot dry biomass of plants and pollen production ($R^2 = 0.72$), and between biomass and seed production ($R^2 = 0.86$). Seed production gives an estimate of the degree of lifetime reproductive success (fitness), and its correlation with trait values suggests that directional phenotypic selection may act in populations.

Preliminary results suggest a high variability of life-history traits between populations, associated with differences in fitness. Two different demographic patterns take place in field crop and ruderal/natural populations. The observed high degree of phenotypic plasticity could help to explain the plant’s capacity to colonize and become self-maintaining on disturbed areas.

REFERENCES


