

## GENERAL INFORMATION

<b>author(s)</b>	Baeten L
<b>year</b>	2010
<b>English title</b>	Recruitment and performance of forest understorey plants in post-agricultural forest
<b>original title</b>	
<b>reference</b>	PhD thesis, Ghent University, Ghent
<b>pages</b>	169
<b>type</b>	dissertation (d1)
<b>ecosystem service</b>	supporting – forest dynamics, biodiversity, nutrient cycling
<b>keywords</b>	post-agricultural forest, old forest, recruitment, performance, forest herbs, dispersal, establishment, bottleneck
<b>taxa</b>	plants
<b>project</b>	PhD Baeten_2010
<b>supervisor</b>	Verheyen K, Hermy M
<b>institution</b>	Laboratory of Forestry
<b>location</b>	pdf, hardcopy
<b>data</b>	

## MATERIALS & METHODS

<b>study area</b>	3a, 3b, 5b, 5n (scientific zone)
<b>time period</b>	2007–2009
<b>goal</b>	Investigate whether plant recruitment and performance are influenced by former agricultural land use with particular attention for the direct and indirect effects of its fertilization legacy.
<b>set-up</b>	see papers below
<b>data collection</b>	see papers below
<b>remarks</b>	C4: Former land use affects the nitrogen and phosphorus concentration and biomass of forest herbs: a field study (Baeten_etal_2011_PlantEcol) C5: Plasticity in response to phosphorus and light availability in four forest herbs: a pot experiment (Baeten_etal_2010_Oecol) C6: Land-use legacies can affect the production of germinable seeds in <i>Primula elatior</i> and <i>Geum urbanum</i> (Baeten_etal_2010_Ecosc) C7: unexpected understorey community development after 30 years in ancient and post-agricultural forests (Baeten_etal_2010_JoEc)

## ABSTRACT

The distribution and abundance of forest understorey plant populations has been strongly influenced by human land-use history. Current and historical forest management may largely affect the understorey diversity, but the most radical impact probably comes from past agricultural land use. In forests growing on abandoned agricultural land, many species fail to (re)colonize after the forest vegetation was completely removed during the period of cultivation. Dispersal limitation initially causes the low colonization capacity of many forest understorey plant species, but low establishment rates may additionally reduce colonization success. Establishment limitation may arise if the environmental legacies of the former agriculture impede (stages of) plant recruitment or reduce plant performance. In this thesis, we studied whether plant recruitment and performance are influenced by former agricultural land use with particular attention for the direct and indirect effects of its fertilization legacy.

The recruitment rates of ten different forest plant species in post-agricultural valley forests and plateau forest were determined with a seed sowing experiment. The established vegetation and litter were cleared in half of the experimental plots. After two growing seasons, only a small fraction of the seeds had germinated (often < 5 %) and competition with the established vegetation significantly reduced the number of seedlings of non-vernal species in the valley forest sites. Post-seedling mortality further decreased the number of seedlings that effectively recruited into the adult life stage. Low recruitment rates may apparently limit the colonization success of forest plants, especially if high nutrient levels support a vigorously growing established vegetation. In a similar introduction experiment, we focused on two forest herbs and performed a detailed monitoring of their recruitment and longevity during eight growing seasons. Seeds and adults of the slowly colonizing *Primula elatior* and the fast colonizing *Geum urbanum* were introduced in post-agricultural and ancient forest sites. An important result of this experiment was that the longevity of both species was significantly lower in post-agricultural compared to ancient forest, which was partly an effect of strong competition, and that *P. elatior* could not counterbalance the lower longevity because of its low germination and low recruitment into the adult stage. A germination experiment indicated that the low germination of *P. elatior* in post-agricultural forest was not due to a low seed quantity or germinability in the experimental population; the past agriculture and P supply were even beneficial. Slowly colonizing species are thus not only limited by dispersal, but also by establishment if particular stages of recruitment are reduced in post-agricultural forest.

Once a forest plant has recruited, the former land use may affect its performance. We determined whether a soil nutrient legacy of past agriculture (here N and P supply) is related to differences in plant performance between post-agricultural and ancient forest. Seven forest plants species with varying colonization capacity showed much higher tissue P concentrations in post-agricultural compared to ancient forest; the N concentrations were unrelated to past land use. Both N and P concentrations varied among species, but this variation was unrelated to their colonization capacity. Six species had a significantly higher biomass in post-agricultural compared to ancient sites and the degree to which the species increased their biomass was positively related to their colonization capacity. In a pot experiment with four forest herbs, we similarly showed that higher P supply increased tissue P concentrations and increased the vegetative performance of two species (*P. elatior* and *Circaea lutetiana*). Differences in generative performance were rather related to differences in light supply. In sum, we showed that an agricultural soil nutrient legacy, and P availability in particular, may be beneficial for plant performance, but with the fastest colonizers potentially showing a stronger response.

If dispersal alone limits the colonization of forest plants, species diversity in post-agricultural forests will gradually increase over time and the community composition will converge to ancient forest vegetation. In a vegetation resurvey, we found no evidence for such community development after 30 years. In fact, strong community changes in both ancient and post-agricultural forest were associated with an increase of common, competitive species, which might provoke stronger establishment limitation. Moreover, as populations of ancient forest indicator species declined, source populations were depleted and dispersal limitation might have increased as well.

Our results provide insight into the effect of past land use and its fertilization legacy on the recruitment and performance of forest understorey plants. While some stages of plant establishment are enhanced in post-agricultural compared to ancient forest, others are rather reduced. The latter stages may form important bottlenecks for plant colonization.

## RESULTS

While some stages of plant establishment are enhanced in post-agricultural compared to ancient forests, others are rather reduced. The latter stages may form important bottlenecks for plant colonization.