GENERAL INFORMATION

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MATERIALS & METHODS

study area	3b
time period	2007–2009
goal	investigate whether - the four forest herbs show plastic responses to P and light availability, - light and P availability interactively affect the performances of individuals - the fast-colonizing species are more plastic than the slowly-colonizing species.
set-up	- four common herbaceous forest species with similar distributions in mesotrophic, deciduous forests in Western Europe - different life forms, flowering phenology, colonization capacity - pot experiment: soil from old and post-agricultural forest - canopy shade and extra shade (shadecloth) - P addition: control, 50 mg/pot, 200 mg/pot
data collection	plant performance measures: - vegetative traits (except for A. nemorosa): total number of leaves, leaf length, and total above-ground dry biomass. For A. nemorosa: leaf length and width, height of the leaf above the surface, and biomass - regenerative traits were: inflorescence height, number of inflorescences (not for A. nemorosa), and the number of flowers (G. urbanum, P. elatior) or the proportion of flowering ramets (A. nemorosa, C. lutetiana) P in the aboveground biomass
remarks	

ABSTRACT

The differential ability of forest herbs to colonize secondary forests on former agricultural land is generally attributed to different rates of dispersal. After propagule arrival, however, establishing individuals still have to cope with abiotic soil legacies from former agricultural land use. We focused on the plastic responses of forest herbs to increased phosphorus availability, as phosphorus is commonly found to be persistently bioavailable in post-agricultural forest soils. In a pot experiment performed under field conditions, we applied three P levels to four forest herbs with contrasting colonization capacities:
Anemone nemorosa, *Primula elatior*, *Circaea lutetiana* and *Geum urbanum*. To test interactions with light availability, half of the replicas were covered with shade cloths. After two growing seasons, we measured

aboveground P uptake as well as vegetative and regenerative performance. We hypothesized that fast-colonizing species respond the most opportunistically to increased P availability, and that a low light availability can mask the effects of P on performance. All species showed a significant increase in P uptake in the aboveground biomass. The addition of P had a positive effect on the vegetative performances of two of the species, although this was unrelated to their colonization capacities. The regenerative performance was affected by light availability (not by P addition) and was related to the species' phenology. Forest herbs can obviously benefit from the increased availability of P in post-agricultural forests, but not all species respond in the same way. Such differential patterns of plasticity may be important in community dynamics, as they affect the interactions among species.

RESULTS

Phosphorus addition had a strong effect on the P concentration and total P content in the aboveground tissue of the four forest herbs.

- In the blocks covered with a shade cloth, P concentrations in the two summer-flowering herbs tended to be higher compared to blocks without shade cloth. The P treatment was the most important factor explaining P concentrations in aboveground plant tissues of all species. The effect was most pronounced for *C. lutetiana*. The mean P concentrations of the species ranged from 260 mg P/100 g dry biomass in the control to 695 mg P/100 g dry biomass in the highest P addition treatment, a 2.7-fold increase.
- The P addition treatment was the main determinant of the variation in P content between individuals or ramets. The effect of shading was no longer significant for *C. lutetiana*, but tended to be still important for *G. urbanum*, which showed a higher total P content in blocks with just canopy shade. For the two geophytes *A. nemorosa* and *C. lutetiana*, the mean total P contents was higher in the soil originating from the post-agricultural stand because of the higher biomass, not because of higher P concentrations.

The vegetative performances of *P. elatior* and *C. lutetiana* were significantly higher in pots with experimental P addition; *A. nemorosa* and *G. urbanum* did not significantly react to the P treatment. Shading affected the vegetative performances of the two summer-flowering species; the vegetative performances of the spring-flowering species were unrelated to SHADE. The regenerative performance was largely unrelated to the P addition treatment, but shading did have an effect. The regenerative performances of the summer-flowering species were considerably lower in blocks covered by a shade cloth. The variation in vegetative performance was not independent of the regenerative performance.

Primula elatior was the only species for which the vegetative and regenerative performances after two growing seasons were still significantly related to its performances in the first growing season. For the other species, the initial performance differences were no longer found after two growing seasons. *Anemone nemorosa* showed clearly different vegetative and regenerative performances in pots with soils from the different forest stands: its performances were, on average, higher in pots filled with soil from the post-agricultural stand. *Circaea lutetiana* also seemed to have higher vegetative and regenerative performances in the pots with post-agricultural soil.