



Integrating  
Transport Infrastructure  
with Living Landscapes  
IENE



# Greening highway corridors to support butterfly metapopulations in protected areas:

new technology for restoration of semi-natural vegetation  
using root hemiparasites

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# Homogeneous wind-pollinated grassland

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- road verges are established using the cheapest forage varieties of cultivated grasses
- pure grass community sensitive to invasion by alien species
- no support for pollinators





- nature conservation authorities would prefer species-rich road verges including herbs for insect (e.g. butterflies, bees)
- cost of grass-herb seed mixtures 8 – 15 times more than standard ... **argument???**



## EXAMPLE

1 km long highway with 12 metre wide road verges on both sides = 24 000 m<sup>2</sup>

### cost of establishment

STANDARD MIXTURE 15 000,- EUR

GRASS-HERB MIXTURE 21–27 000,- EUR

total cost of establishment **140–180% of standard**



- standard mixture produces **dense and tall vegetation** with the need of frequent cut or mulching (2 – 3 times a year)
- grass-herb mixture creates **low and sparse vegetation** which requires only 1 cut per year



## EXAMPLE

1 km long highway with 12 metre wide verges on both sides = 24 000 m<sup>2</sup>

### cost of annual maintenance

STANDARD MIXTURE                      7–10 500,- EUR

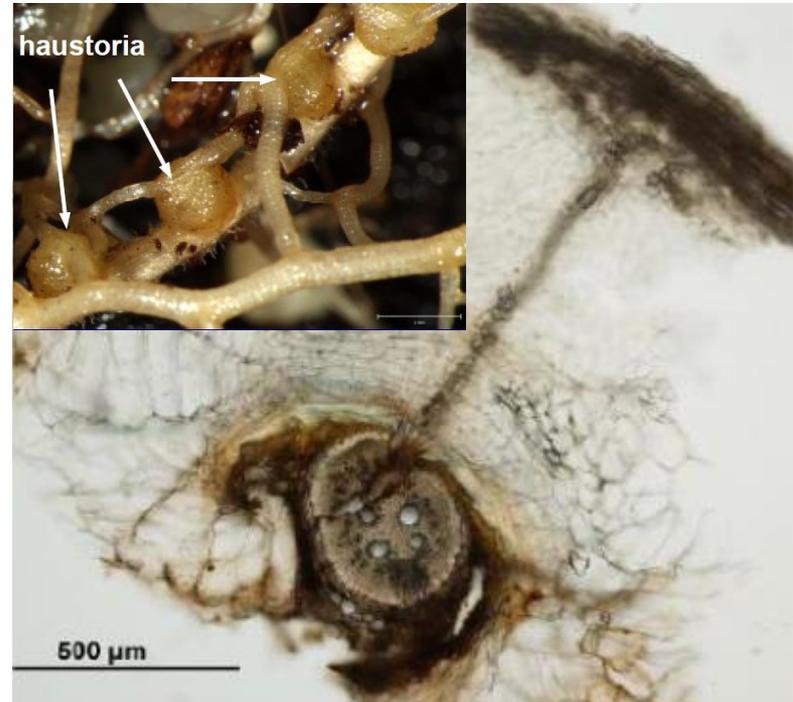
GRASS-HERB MIXTURE                      3 500,- EUR

**return of higher initial investment in 2–4 years**

# Root hemiparasites suppressing grasses

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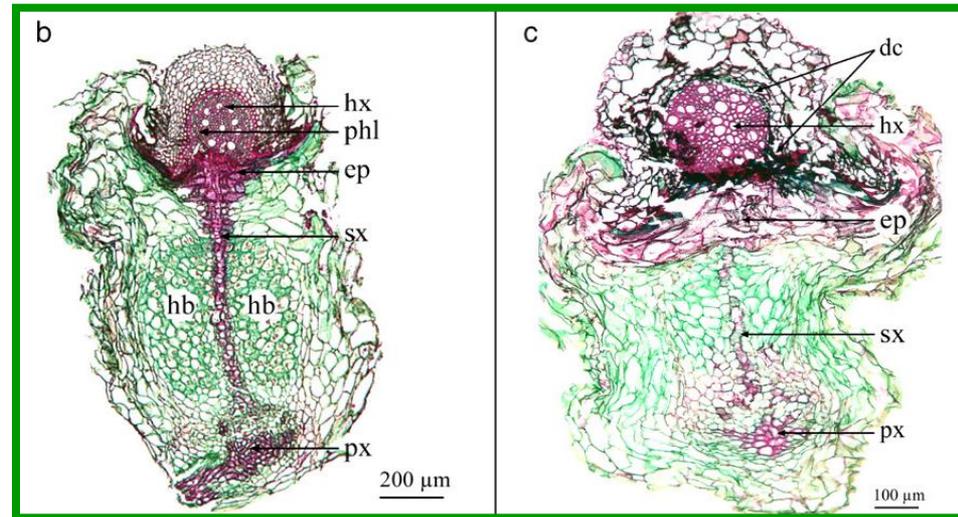
- green plants sucking water and nutrients from host species
- hemiparasites use special organ '**haustorium**' to connect with its host (grass)
- hemiparasites decrease competitive strength of grasses thus **supporting herbs**



# Greater yellow rattle – *Rhinanthus alectorolophus*

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- annual plant with huge seed production (1 000 seed = 4 g)
- quickly establishes in grassland but also quickly disappears ... 500 seeds per 1 m<sup>2</sup> give rise to 5–10 000 next year
- **rosette plants (e.g. *Plantago*, *Centaurea*) effectively protect their roots against haustoria**





- the most species-rich grasslands throughout Europe include *Rhinanthus* species
- last 20 years *Rhinanthus* was locally used in the Great Britain and Belgium to restore grasslands

*Preslia* 87: 217–278, 2015

## The most species-rich plant communities in the Czech Republic and Slovakia (with new world records)



*Journal of Vegetation Science* 17: 435-446, 2006  
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## Seeds of change: The value of using *Rhinanthus minor* in grassland restoration

Westbury, D.B.<sup>1\*</sup>; Davies, A.<sup>2</sup>; Woodcock, B.A.<sup>1,3</sup> & Dunnett, N.P.<sup>4</sup>



- suppression of grasses creates low and sparse sward of dicotyledonous herbs
- grasslands including *Rhinanthus* produce **substantially less biomass** (up to 1/2 of the original)
- require cutting or mulching **only once a year**



*Belg. J. Bot.* **139** (2) : 173-187 (2006)

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*RHINANTHUS*: AN EFFECTIVE TOOL IN REDUCING BIOMASS  
OF ROAD VERGES? AN EXPERIMENT ALONG TWO MOTORWAYS

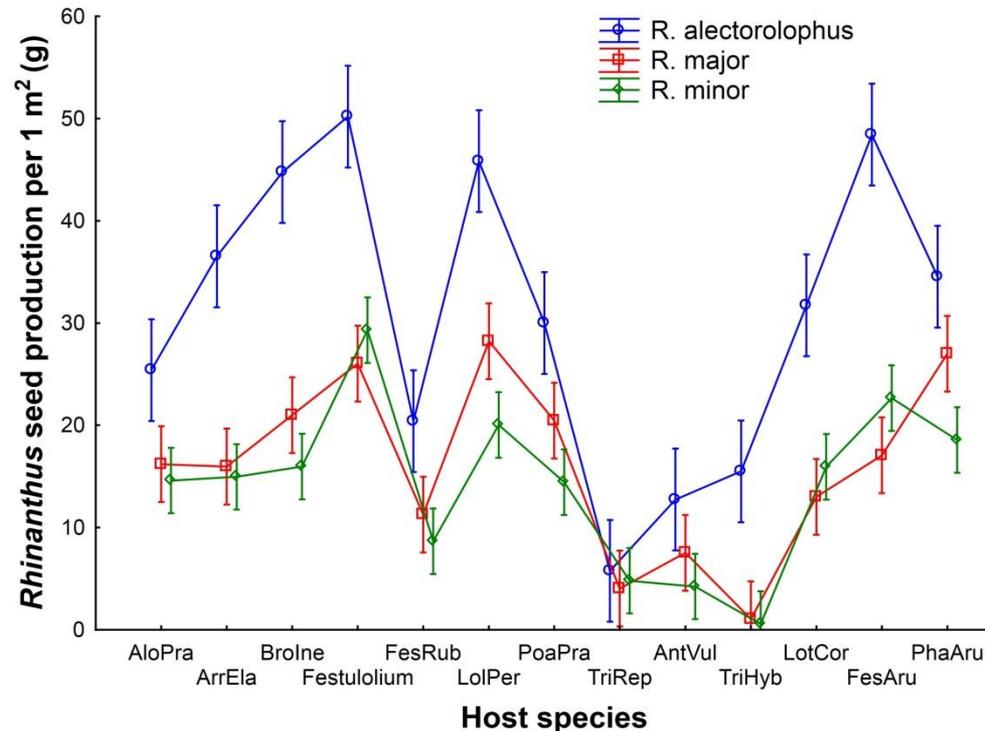
Els AMELOOT<sup>1,\*</sup>, Martin HERMY<sup>1</sup> and Kris VERHEYEN<sup>2</sup>



# Looking for good host species of *Rhinanthus*

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- seed multiplication in forest clearings on vigorous clonal grass *Calamagrostis epigejos*
- multiplication rate 10times of the seeding (2016: harvested 60 kg – 15 mil. seeds)
- field experiment testing the suitability of the cultivated grasses as host species





# Harvest of *Rhinanthus* plants and drying

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- plants need to be harvested fresh to prevent loss of seeds on the ground
- transport after air-drying to avoid overheating
- capsules ripe in 2 weeks and release seeds





# Seed cleaning process

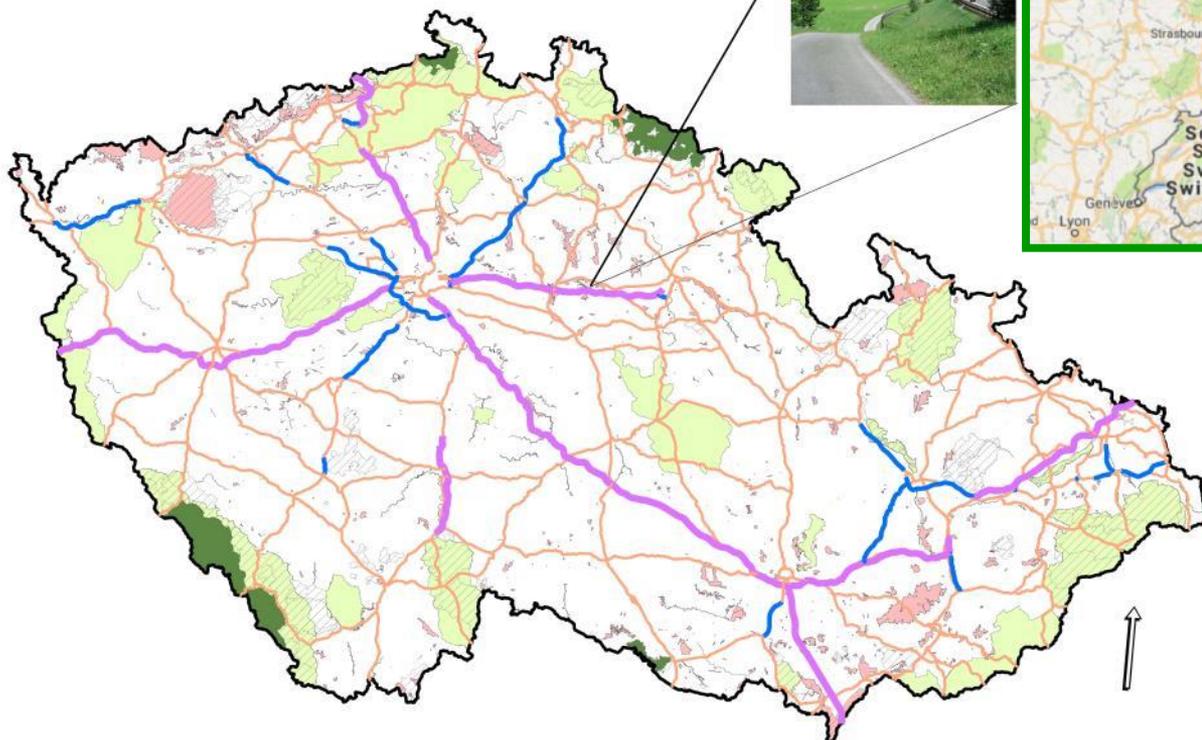




# Identification of target sites

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Lokality silničních a dálničních těles v ZCHÚ  
vymezené pro aplikaci nových technologií  
ozelenění svahů



0 25 50 100 150 200  
Km



- 10 model sites along highways and major roads
- autumn litter removal and seeding to ensure spring germination
- fencing of the area against deer browsing





- *Rhinanthus* established the best on the nutrient poor sites
- in the 1st season suppressed tall grasses
- decreased the biomass production significantly

## EXAMPLE

1 km long highway with 12 metre wide road verges on both sides = 24 000 m<sup>2</sup>

### cost of establishment

*RHINANTHUS* SEED APPLICATION      6 000,- EUR

### savings in annual maintenance

CUTTING / MULCHING                      - 3 500,- EUR

**return of initial investment in 2 years**





# Popularization work



... these 2 leaflets are distributed on petrol stations along the highways

LEFT

„Highway, the chance for nature?“

RIGHT

„How *Rhinanthus* can help with the maintenance of road verges“



# Acknowledgement

- this applied research was supported by Technology Agency of the Czech Republic grant number TH01030300 (2015 – 2019)

*„New technologies landscaping slopes of highway and road corridors to enhance the long-term effectiveness of specific territorial nature protection“*

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