



Greening highway corridors to support butterfly metapopulations in protected areas:

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

Jan Mládek¹ and Tomáš Šikula²

¹Department of Ecology & Environmental Sciences, Palacky University, Czech Republic

²Department of Ecology, HBH Project, Czech Republic

Homogeneous wind-pollinated grassland

IENE - 5th IENE International Conference on Ecology and Transportation - 30th August to 2nd September 2016 - Lyon - France

- 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 m²

cost of establishment

STANDARD MIXTURE	15 000,- EUR
------------------	--------------

GRASS-HERB MIXTURE	21–27 000,- EUR
--------------------	-----------------

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



Species-rich grassland: return of investment

IENE - 5th IENE International Conference on Ecology and Transportation - 30th August to 2nd September 2016 - Lyon - France

- 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 m²

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

IENE - 5th IENE International Conference on Ecology and Transportation - 30th August to 2nd September 2016 - Lyon - France

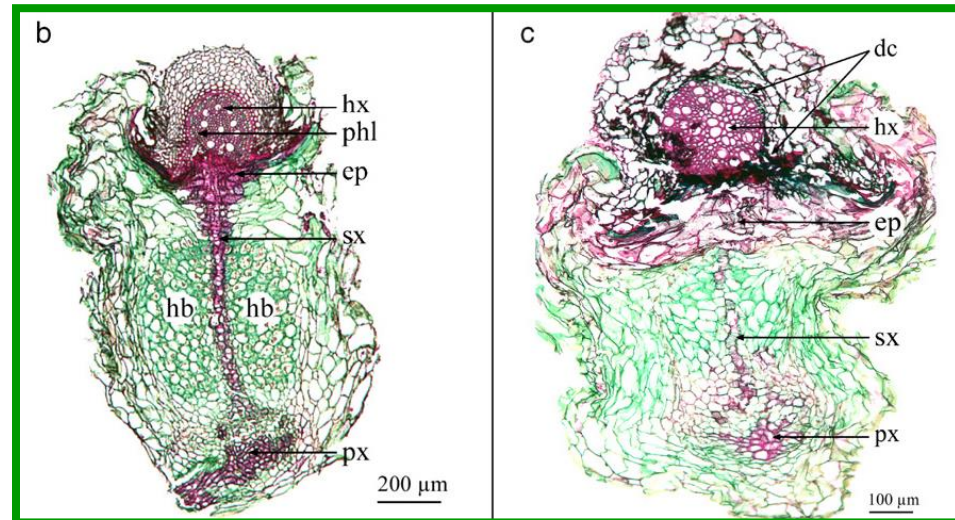
- green plants sucking water and nutrients from host species
- hemiparasites use special organ '**haustorium**' to connect with its host (grass)
- hemiparasites decrease competitive strength of grasses thus **supporting herbs**



Greater yellow rattle – *Rhinanthus alectorolophus*

IENE - 5th IENE International Conference on Ecology and Transportation - 30th August to 2nd September 2016 - Lyon - France

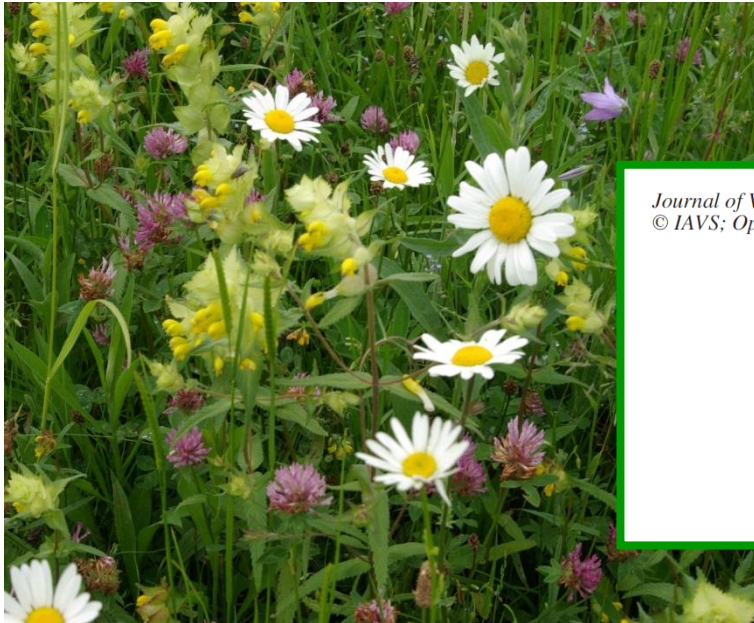
- annual plant with huge seed production (1 000 seed = 4 g)
- quickly establishes in grassland but also quickly disappears
... 500 seeds per 1 m² give rise to 5–10 000 next year
- **rosette plants (e.g. *Plantago*, *Centaurea*) effectively protect their roots against haustoria**



- 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
© IAVS; Opulus Press Uppsala.

Seeds of change: The value of using *Rhinanthus minor* in grassland restoration

Westbury, D.B.^{1*}; Davies, A.²; Woodcock, B.A.^{1,3} & Dunnett, N.P.⁴



Spontaneous occurrence of *Rhinanthus* on roadsides

IENE - 5th IENE International Conference on Ecology and Transportation - 30th August to 2nd September 2016 - Lyon - France

- 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)

© 2006 Royal Botanical Society of Belgium

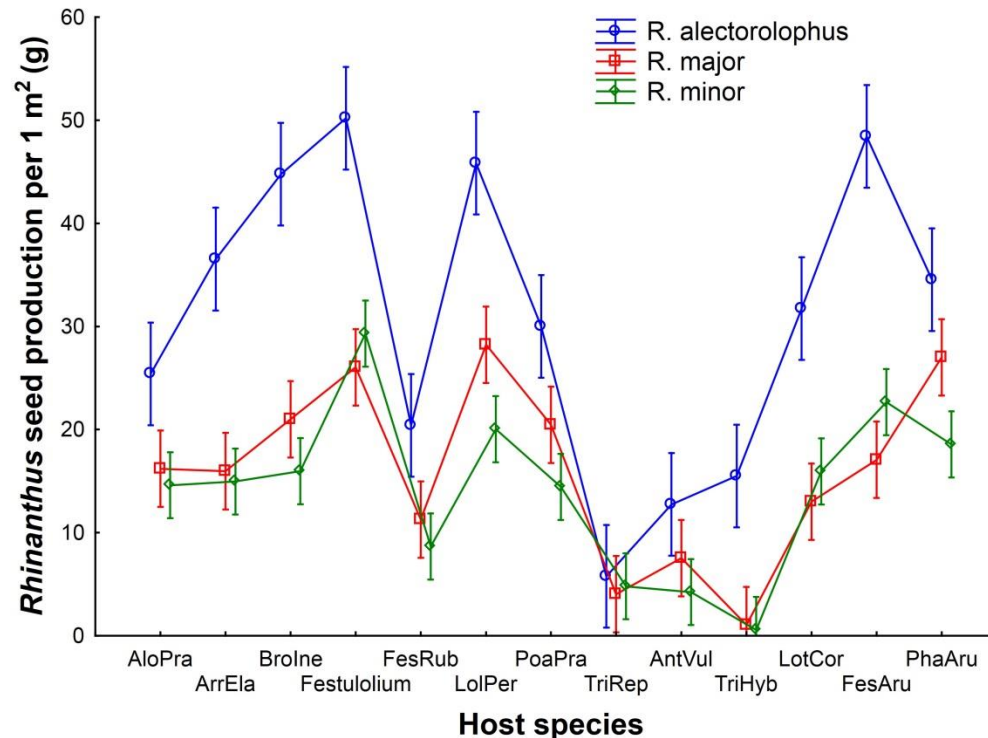
RHINANTHUS: AN EFFECTIVE TOOL IN REDUCING BIOMASS
OF ROAD VERGES? AN EXPERIMENT ALONG TWO MOTORWAYS

Els AMELOOT^{1,*}, Martin HERMY¹ and Kris VERHEYEN²

Looking for good host species of *Rhinanthus*

IENE - 5th IENE International Conference on Ecology and Transportation - 30th August to 2nd September 2016 - Lyon - France

- 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

IENE - 5th IENE International Conference on Ecology and Transportation - 30th August to 2nd September 2016 - Lyon - France

- 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

IENE - 5th IENE International Conference on Ecology and Transportation - 30th August to 2nd September 2016 - Lyon - France

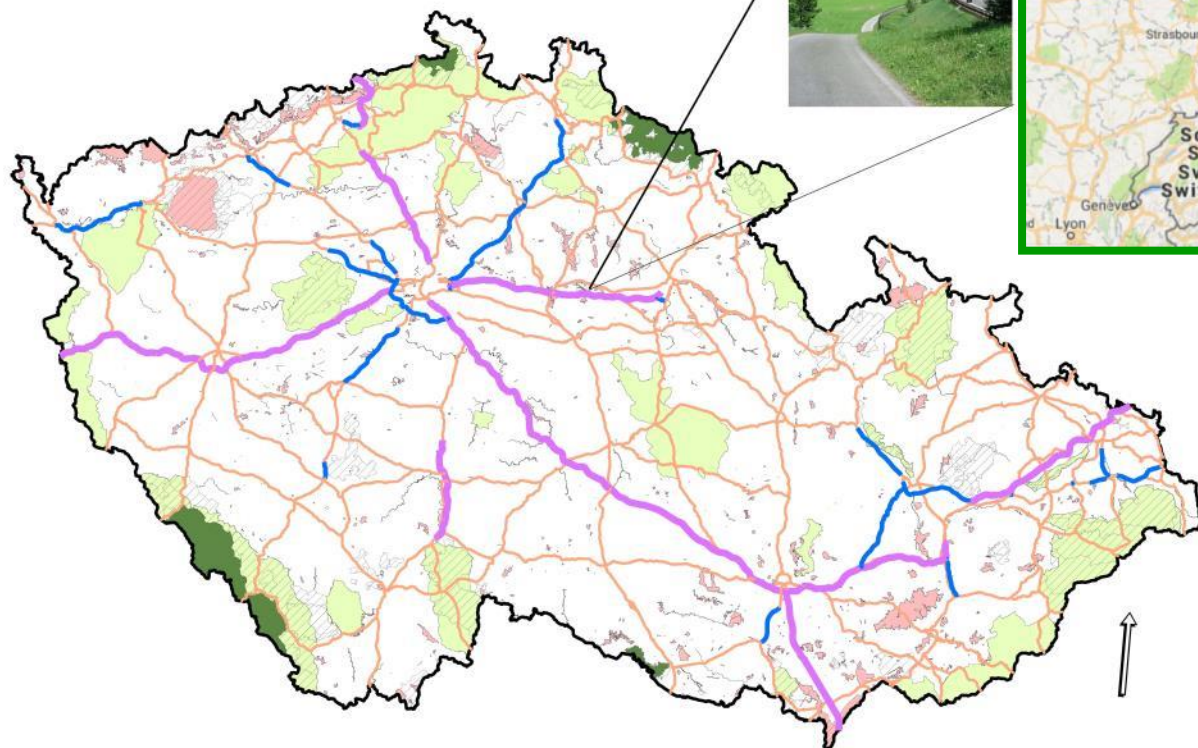




Identification of target sites

IENE - 5th IENE International Conference on Ecology and Transportation - 30th August to 2nd September 2016 - Lyon - France

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





- 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 m²

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

IENE - 5th IENE International Conference on Ecology and Transportation - 30th August to 2nd September 2016 - Lyon - France



... 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

IENE - 5th IENE International Conference on Ecology and Transportation - 30th August to 2nd September 2016 - Lyon - France

- 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“

- we thank our project partners (Mendel University, DLF Seeds)
- we are grateful to our colleagues (S. Hejduk, T. Kuras, J. Těšitel, V. Hula, J. Niedobová, J. Suchomelová, A. Lepková, V. Černoch, L. Jalůvka) for pleasant and fruitful cooperation



Palacký University
Olomouc

