

# Density-dependent effects during re-establishment of rare arable plants

Lang, M., Kollmann, J., Prestele, J., Wiesinger, K., Albrecht, H.  
17th European Weed Research Society Symposium  
Montpellier, 24 June 2015



# Need of the study

- Strong decline in agro-biodiversity

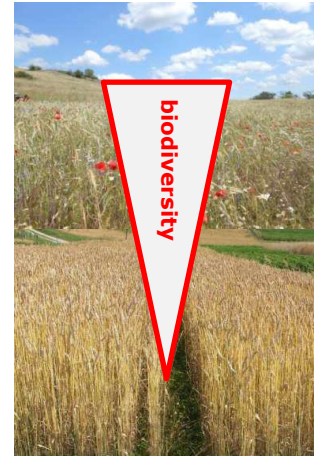
STORKEY et al. 2012

- Rare arable plants are largely absent from the seed bank

- Functional biodiversity and ecosystem-services

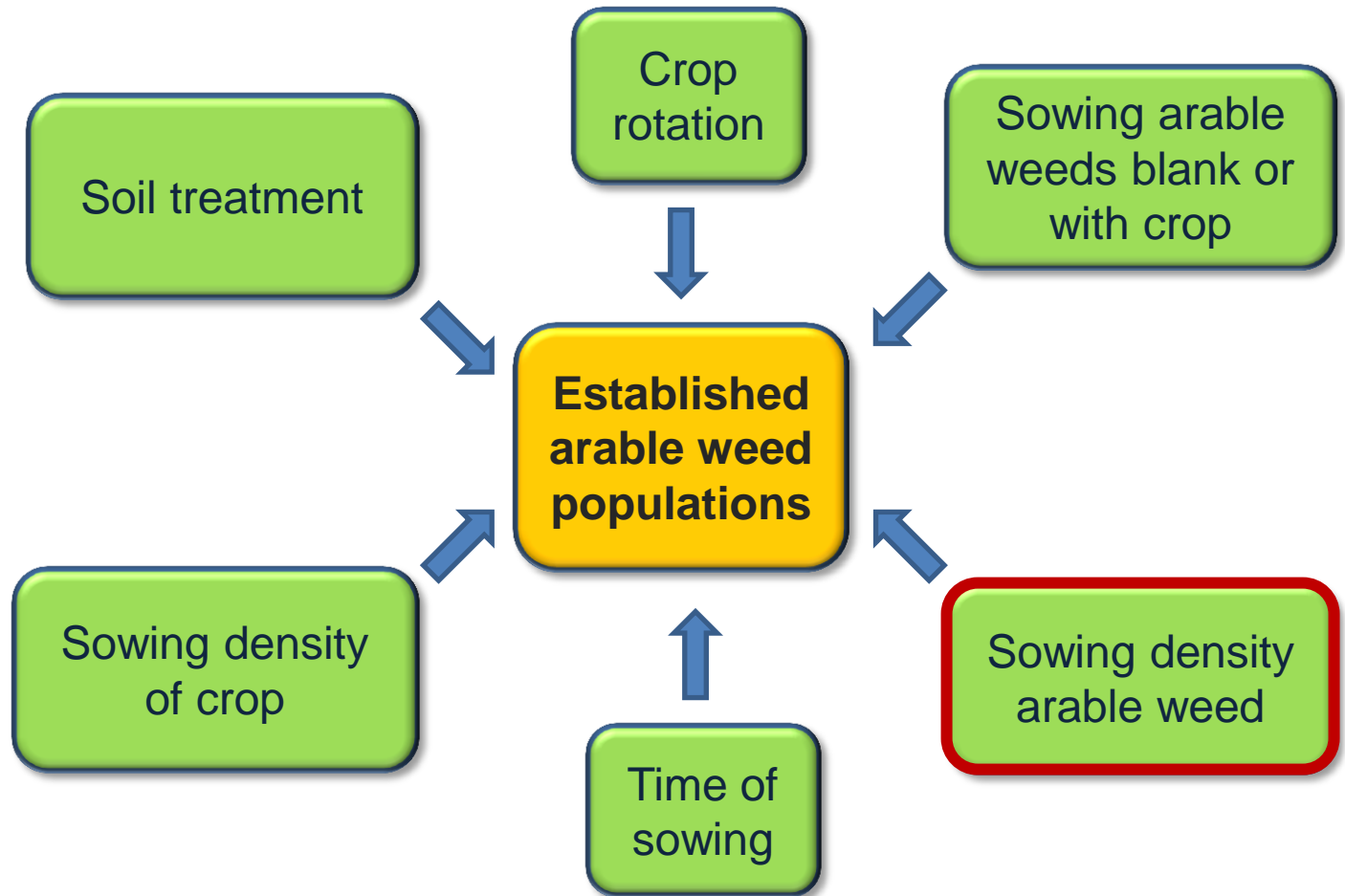
MARSHALL et al. 2003

➡ Re-introduction is necessary



# “Re-introduction of rare arable plants on organic farms”

Project period: 2011–2015



Gefördert durch:



Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz

aufgrund eines Beschlusses des Deutschen Bundestages

BÖLN

Bundesprogramm Ökologischer Landbau und andere Formen nachhaltiger Landwirtschaft



Ökologische Agrarwissenschaften  
U N I K A S S E L



# Study species: Winter rye & three endangered rare arable plants

*Secale cereale*  
„Danko“



*Legousia*  
*speculum-veneris*



RL Bavaria 3  
RL Germany 3

*Consolida*  
*regalis*



RL Bavaria 3  
RL Germany 3

*Lithospermum*  
*arvense*



RL Bavaria 3

# Study questions

---

- (1) How many seeds must be sown to obtain optimum establishment and reproduction rates of the target species?
  - a) Equal establishment with chosen mixing ratio?
  - b) Impact of spontaneous weeds?
  
- (2) What is the impact of increasing sowing rates on crop yield?



# Field experiment with partial additive design

40 plots of winter rye (350 grains  $\text{m}^{-2}$ )

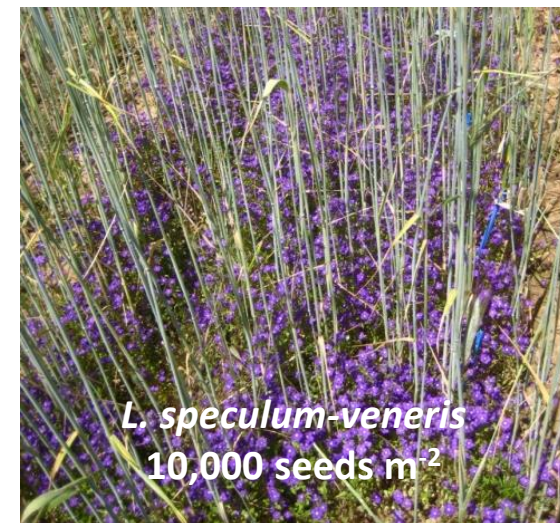
## Explanatory variables:

- Sowing density (1-10,000 seeds  $\text{m}^{-2}$ )
- Pure vs mixed sowing
- With vs without spontaneous weeds

Leg : Con : Lit = 3 : 1.3 : 1

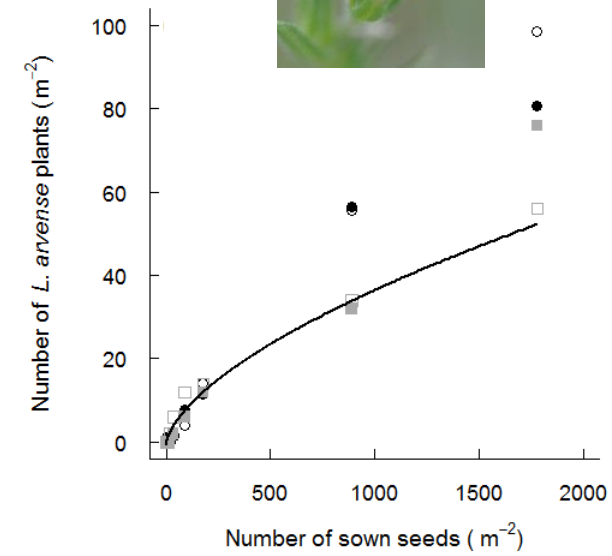
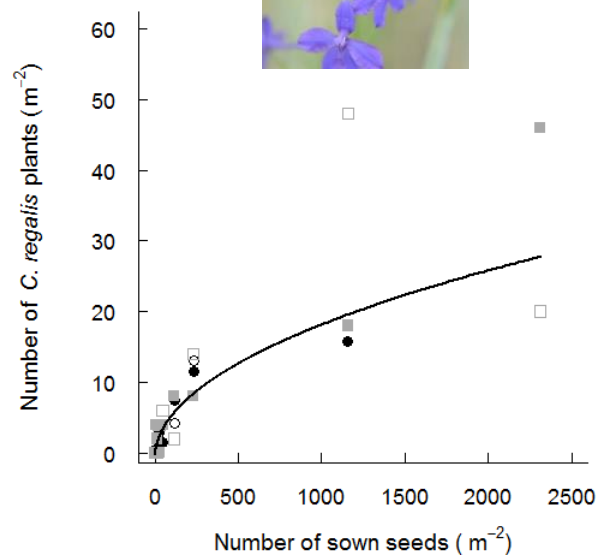
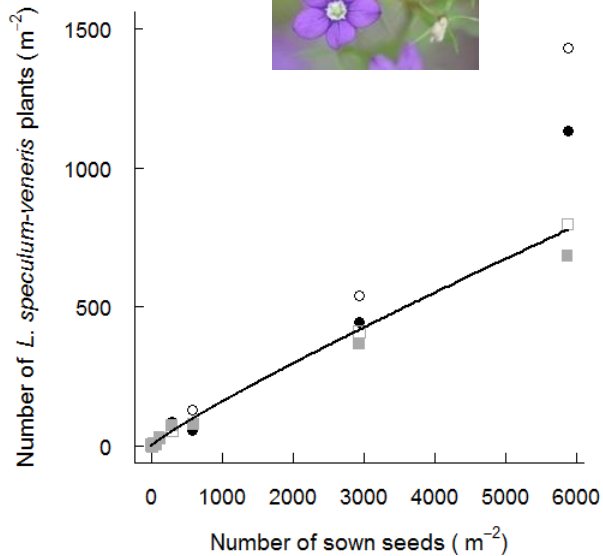
## Response variables:

- Plant numbers of target species
- Seed production of target species
- Grain yield of winter rye



# Plant numbers at harvest time

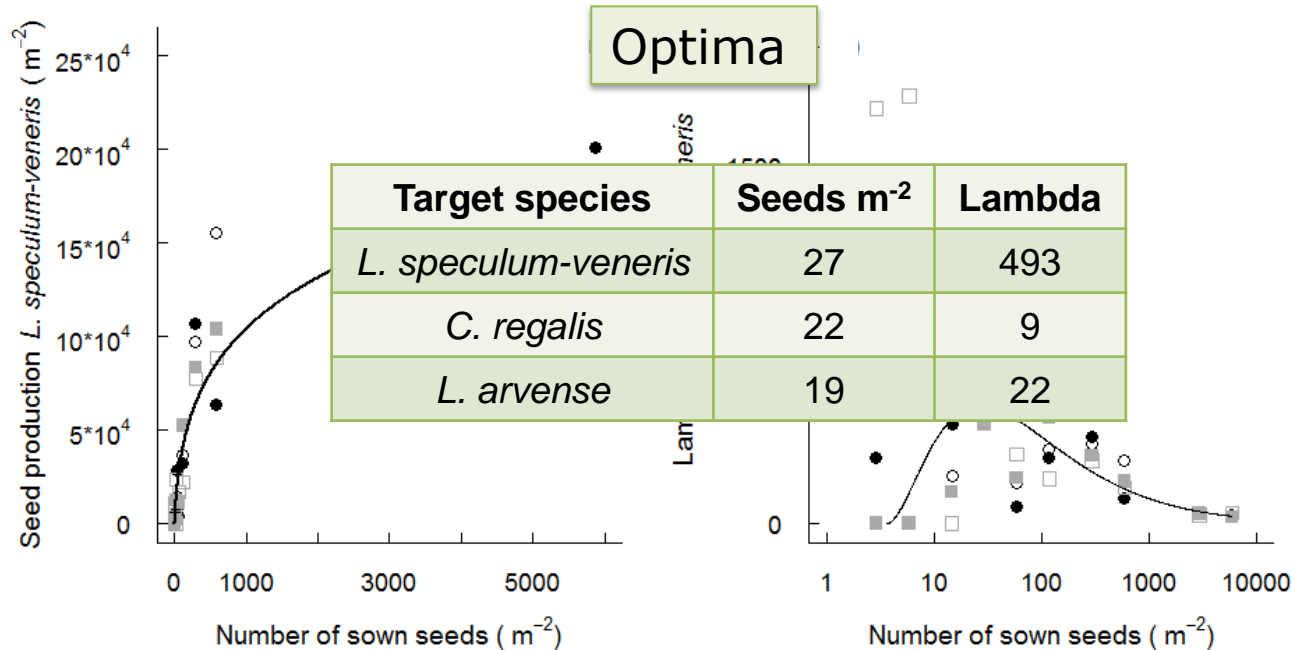
- (1) How many seeds for optimum establishment and reproduction rates?
  - a) Equal establishment with chosen mixing ratio?
  - b) Impact of spontaneous weeds?



→ Density-dependent establishment

# Seed production at harvest time

- (1) How many seeds for optimum establishment and reproduction rates?
  - a) Equal establishment with chosen mixing ratio?
  - b) Impact of spontaneous weeds?

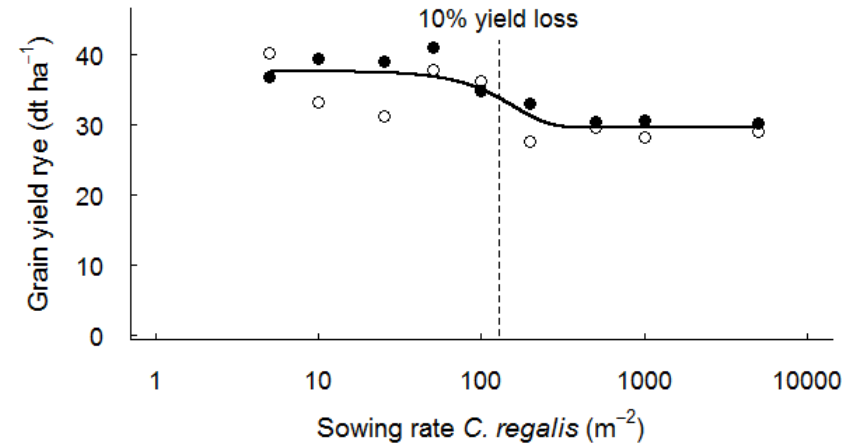
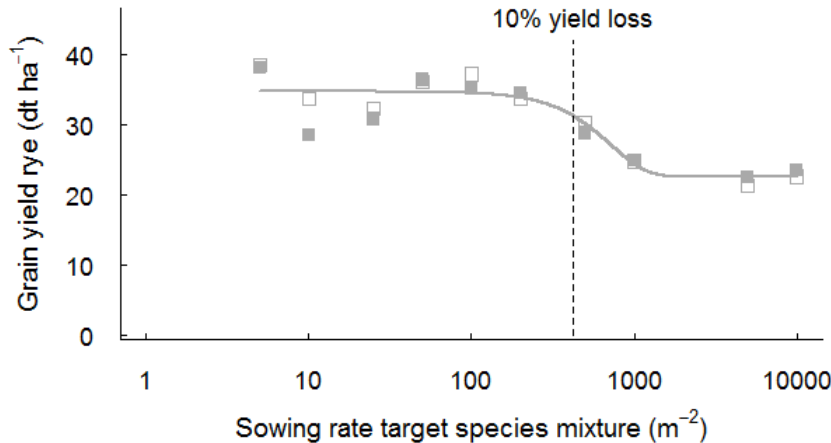


→ Density-dependent seed production



# Impact on crop yield

(2) What is the impact of increasing sowing rates on crop yield?



→ Sigmoidal functions

→ Yield loss at > 100-1000 seeds m<sup>-2</sup>

# Recommendations for farming practice

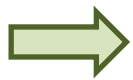
---

- Optimal sowing densities:

*L. speculum-veneris* 50 seeds m<sup>-2</sup>

*C. regalis* 100 seeds m<sup>-2</sup>

*L. arvense* 100 seeds m<sup>-2</sup>



Establishment without negative density effects  
Crop yield loss < 7 % and procedural costs < 1000 € ha<sup>-1</sup>

- Mixed sowing with adjusted densities

# Conclusion and outlook

## Re-introduction of rare arable plants in extensive managed fields

- Time of sowing
- Cover crops and crop rotations
- Species-specific requirements



Impact of cover crops and crop rotations on the re-establishment of threatened arable plants

Albrecht, H.<sup>1</sup>, Lang, M.<sup>1</sup>, Rieblinger, A.<sup>1</sup>, Prestele, J.<sup>1,2</sup>, Wiesinger, K.<sup>2</sup>, Kollmann, J.<sup>1</sup>

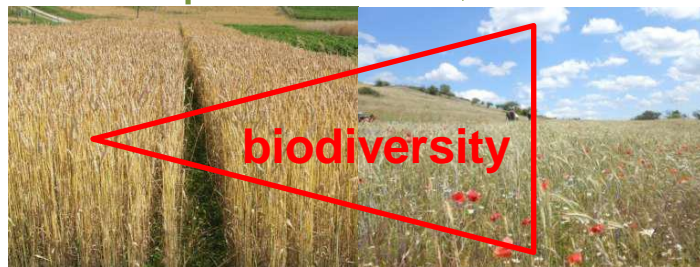
<sup>1</sup> Restoration Ecology, Technische Universität München, 85354 Freising, Germany

<sup>2</sup> Bavarian State Research Centre for Agriculture, 85354 Freising, Germany

(Corresponding author: [albrecht@wzw.tum.de](mailto:albrecht@wzw.tum.de))



## Food production, biodiversity & ecosystem services



# References

---

Hofmeister, H. & Garve, E. (2006) Lebensraum Acker. Reprint der 2. Auflage, Remagen, Deutschland.

Korneck, D., Schnittler, M. & Vollmer, I. (1996) Rote Liste der Farn- und Blütenpflanzen (Pteridophyta et Spermatophyta) Deutschlands.  
In: Schriftenreihe für Vegetationskunde 28, Landwirtschaftsverlag, Münster, Deutschland, S. 21-187.

Marshall, E.J., Brown, V.K., Boatman, N.D., Lutman, P.J., Squire, G.R., Ward, L.K. (2003): The role of weeds in supporting biological diversity within crop fields. *Weed Res.* 43: 77-89.

Storkey, J., Meyer, S., Still, K.S. & Leuschner, C. (2012) The impact of agricultural intensification and land-use change on the European arable flora. *Proceedings of the Royal Society B: Biological Sciences* 279: 1-9.

Pictures (all others own pictures):

[http://www.joechner-gemuenda.de/resources/\\_wsb\\_294x194\\_RG000089.jpg](http://www.joechner-gemuenda.de/resources/_wsb_294x194_RG000089.jpg)

Contact: Marion Lang, Lehrstuhl für Renaturierungsökologie, TUM  
Emil-Ramann-Str. 6, 85354 Freising  
Tel.: 0049 - (0)8161 - 712570  
E-Mail: [LangMarion@gmx.de](mailto:LangMarion@gmx.de)

Homepage: [www.ackerwildkrautschutz.de](http://www.ackerwildkrautschutz.de)



Thank you!

Funded by:  
Seidlhof-Stiftung  
Federal Ministry for Nutrition, Agriculture and Consumer Protection (BMELV)  
based on a decision of the German Parliament within the Federal Programme  
`Organic Farming and Other Forms of Sustainable Agriculture` (BÖLN)  
(06OE254, 06OE355, 06OE356)

Thanks to:  
Marco Zehner, Stefanie Zehner, Georg Salzeder, Adalbert Bund, Hans Krimmer,  
Eberhard Heiles, Ulrich Dörfel