Plant Communities in Field Margins of Agricultural Landscapes: Species Distributions, Functional Traits, and Contributions to Landscape Function

Hamada Elsayed Ali, Bernd Huwe, John Tenhunen, Björn Reineking

University of Bayreuth

BayCEER

Contact: hamada.ali@uni-bayreuth.de

TERRECO

26

Introduction

Field margins are a key feature of agricultural landscapes, present at the edges of all agricultural fields (Marshall, 1989). These margins can be separated technically into a number of elements as illustrated in Fig. 1.

The plant communities of field margins are an important aspect of agroecosystem ecology. A major research challenge is to understand the determinants of species distribution and field margin biodiversity patterns and to link these to functioning of agricultural landscapes.

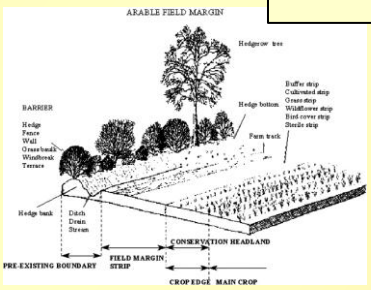

Fig.1. Principal elements of a field margin (Greaves and Marshall, 1987)

Research Questions

The research is structured according to the following research questions:

- What types of field margins can be identified, and how are they influenced by management?
- How do local site conditions and landscape context affect plant communities and plant species diversity of field margins?
- Can species traits explain the observed distribution of species in the landscape? At what spatial scales are these community and trait patterns best predictable?
- How do plant communities, species diversity, and plant functional trait distributions relate to the supply of ecosystem services from field margins?
- What management guidelines can be derived in order to preserve and possibly enhance the ecosystem services provided by the plant communities in the field margins?

Materials and Methods

1. Field Margin Survey: In a first step, a botanical survey of the field margins of Haean Catchment was conducted (Fig. 2), comprising one hundred sampling sites, and covering the entire catchment. Each site was sampled in three plots, each plot was 1 m^2 in size, and plots were spaced 4 m apart (Fig. 3). In each plot, the cover percentage of species was estimated, and plant height, plot exposure and slope were measured.

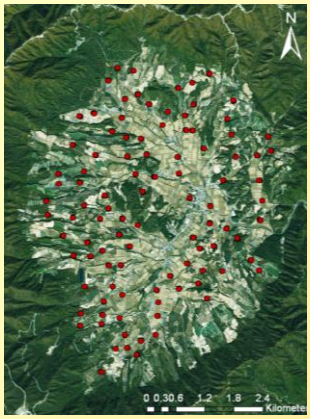

Fig 2. Botanical survey sites

2. Plant Functional Traits (PFTs): In this step, we measured a set of the plant functional traits of the field margin plant species and key soil properties related to erosion control. Based on the botanical survey, we chose 10 widely distributed plant species for intensive study, in order to examine average height, plant growth form and growth habit (see Table 1). For each of the species we measured a set of relevant PFTs along with soil parameters (Table 1) in 30 different field margins (Fig. 3). These will be related to soil erosion in the study area.

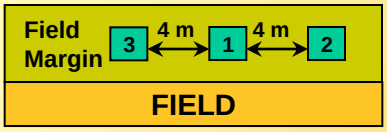

Fig. 3. Field margin survey scheme.

3. Field Experiment and Modeling

In order to evaluate soil erosion control as one of the ecosystem services provided by the field margin plant communities, experiments will be conducted in 2013. The results of the experiments will allow examination of scenarios with erosion models. We plan to employ two main erosion models, Morgan-Morgan-Finny (MMF) (Morgan and Duzant, 2008) and Erosion 3D (von Werner, 1995) in our analysis.

Table 1. Plant species, PFTs and soil parameters measured.

Plant Species	PFTs	Soil Parameters
1.*Artemisia princeps*	1.Plant height	1.Bulk density
2.*Chelidonium majus*	2.Root length	2.Soil texture
3.*Conyza canadensis*	3. Root diameter	3.Soil carbon content
4.*Equisetum arvense*	3.Specific root length	4.Aggregate stability
5.*Erigeron strigosus*	4.Root horizontal width	5.Penetration resistant
6.*Humulus japonicus*	5.Root dry mass	6.Shear van test
7.*Oenothera biennis*	6.Root/Shoot ratio	7.Wetability
8.*Persicaria vulgaris*	7.Leaf size	
9.*Phragmites japonica*	8.Growth Form	
10.*Rorippa palustris*	9.Life form	

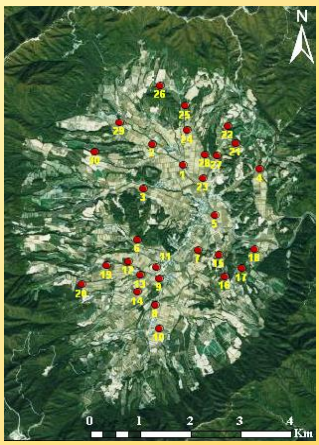

Fig. 4. PFT survey sites

References

Greaves M.P., Marshall E.J.P. (1987) Field margins: definitions and statistics. Way, J.M., Greig-Smith, P.J. (Eds.), Field Margins, Monograph no. 35. British Crop Protection Council, Thornton Heath, London, UK:3-10.

Marshall E.J.P. (1989) The ecology and management of field margin floras in England. Outlook Agriculture 17:178-182.

Morgan R.P.C., Duzant J.H. (2008) Modified MMF (Morgan–Morgan–Finney) model for evaluating effects of crops and vegetation cover on soil erosion. Earth Surface Processes and Landforms 33:90-106. DOI: 10.1002/esp.1530.

von Werner M. (1995) GIS-orientierte Methoden der digitalen Reliefanalyse zur Modellierung von Bodenerosion in kleinen Einzugsgebieten, Freie Universität Berlin, Berlin.