LIÈGE université
Gembloux
Agro-Bio Tech

Le Corps professoral de

Gembloux Agro-Bio Tech - Université de Liège vous prie

de lui faire l'honneur d'assister à la défense publique de la dissertation originale que

Monsieur UYTTENBROECK Roel,

Titulaire d'un diplôme de *Master of Science in Bioscience Engineering: Land and Forest Management*

présentera en vue de l'obtention du grade et du diplôme de

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 4 septembre 2017, à 13 heures précises (personne ne sera admis après cette heure),

en l'auditorium GP (Géopédologie, bât. 52),

Avenue Maréchal Juin, 27 à 5030 GEMBLOUX.

Cette dissertation originale a pour titre :

« Functional diversity and mowing regime of flower strips as tools to support pollinators and to suppress weeds ».

Le jury est composé comme suit :

Président: Prof. P. LEJEUNE, Président du Département BIOSE,
Membres: Dr A. MONTY (Promoteur), Prof. F. FRANCIS (Copromoteur), Prof. B. BODSON, Prof. G. MAHY, Prof. M. DUFRENE, Dr J. PIQUERAY (Natagriwal asbl), Prof. D. BONTE (UGent).

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Summary

Intensification of agriculture during past decades is one of the causes of biodiversity declines. Ecological intensification has been proposed as a more sustainable alternative of intensive agriculture that should be able to fulfill worldwide demands of food, by optimizing ecosystem functions and services and reducing environmental impacts. One way to restore ecosystem functions and services in arable fields is creating flower strips in field margins. These flower strips enable wild plant communities to thrive and provide food and shelter to associated fauna. It is often suggested that increasing plant functional diversity could be a tool to optimize ecosystem functioning and ecosystem service delivery, and it could thus be a goal for the creation and management of flower strips. An example of ecosystem functioning studied in this manuscript, is the mutualistic interaction between plants and pollinators.

To convince European farmers to implement flower strips, they are included in the subsidized Agri-Environment Schemes. However, there exists no clear appraisal of the pros and cons of flower strips for farmers. By systematically reviewing the literature for pros and cons, we found that most studies concerned agronomical and ecological processes related to flower strips, but few or no studies were dedicated to the social and economic aspects. Furthermore, pollination appears to be an important pro, and weed infestation a possible con, depending on flower strip creation and management. We focused on these two examples in the further study. We investigated (1) whether the increase of plant functional diversity can be used as tool to optimize flower strips for pollinators, (2) whether forb competition and adapting timing and frequency of mowing can be used as tools to limit weeds in flower strips, and (3) whether flower strips perform equally in supporting pollinators as the natural habitat for which they are thought to be a surrogate.

To use functional diversity as a tool to optimize flower strips for pollinators, we first tested whether it is possible to create a flower strip with a desired functional diversity level. We sew experimental flower strips with increasing functional diversity, based on visual, morphological and phenological flower traits and surveyed the vegetation composition the first year after sowing. The sown gradient of functional diversity was present, but with lower absolute values due to unequal cover of sown species and due to the presence of spontaneous species. To test the effect on pollinator support, we monitored the plant-pollinator networks in the experimental strips during two years. In contrast to our expectations, pollinator species richness and evenness were not influenced by functional diversity, and increasing functional diversity even resulted in lower flower visitation rates. To investigate the effect of forb competition and timing and frequency of mowing on weed infestation, we created experimental flower strips either with grass and forb species in the seed mixture, either with only grass species. Three different mowing regimes were applied: summer mowing, autumn mowing and mowing both in summer and autumn. The cover of important weed, *Cirsium arvense*, was limited by adding forbs to the seed mixture and by mowing in summer or in summer and autumn. At last, by surveying plant-pollinator networks in perennial flower strips and natural hay meadows in the same landscape context, we observed that both the plant and the pollinator communities differed between the flower strips and the meadows. Perennial flower strips can thus be considered as a complementary habitat in the landscape and not a hay meadow surrogate.

This study suggests that it is possible to manipulate the vegetation as well as infestation by certain weeds in flower strips by adapting the seed mixture and the mowing regime. However, to promote pollinators in flower strips, increasing plant functional diversity appears not to be the key, and the abundance of certain attractive plant species can be more important. Moreover our results suggest that pollinators perceived a lower redundancy of functional plant trait values when functional diversity was higher, as they had more separate feeding niches (less visited flower species in common). Our results also suggest that there could be a trade-off between the increase of functional trait diversity and the floral resource abundance per niche or functional trait combination.

With the results of the tested flower strip creation and management methods and their effect on pollinator support and weed infestation, farmers and administrations can try to create and manage flower strips with the desired balance between pros and cons, and researchers can try to refine these methods and test the effects on other pros and cons.