PS-6.2-01

Crucifer-Legume Bispecific Cover Crop Mixtures Provide Efficiently Various Ecosystem Services

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Abstract: Cover crops grown in rotation with cash crops provide ecosystem services by reducing pollution and anthropogenic inputs. Among cover crop families, crucifers can efficiently prevent nitrate and sulphate leaching by catching residual soil mineral nitrogen (N) and sulphur (S) (N and S catch crop services). Crucifers also have a unique capacity to suppress pathogens due to the biocidal hydrolysis products of endogenous secondary metabolites called glucosinolates (GSL). However, compared to legume cover crops, crucifers provide less mineralised N to the subsequent main cash crop (N green manure service). Bispecific crucifer–legume cover crop mixtures can be seen as a potential solution to increase biodiversity and to combine ecosystem services of both species. However there is a lack of information on the impact of plant–plant interaction on levels of ecosystem services linked to the N and S cycles and GSL production compared to sole crops. The aim of our study was to assess production of all these ecosystem services for a wide range of bispecific crucifer-legume mixtures in comparison to sole crops.

Experiments were conducted at two sites (near Toulouse and Orléans, France) over two years where few cultivars from eight crucifers (rape, white mustard, Indian mustard, Ethiopian mustard, turnip, turnip rape, radish and rocket) and nine legumes (Egyptian clover, crimson clover, common vetch, purple vetch, hairy vetch, pea, soya bean, faba bean, and white lupin) were tested in sole-crop and in 98 bispecific mixtures (substitutive design of 50%-50% sole crops).

Crucifer - legume bispecific mixtures provided the same N and S catch crop service (mean soil acquisition of 50 kg N ha^{-1} and 12 kg S ha^{-1}) and significantly increased the N green manure service (mean mineralisation of 22 kg N ha^{-1}) compared to pure crucifers (mean mineralisation of 8 kg N ha^{-1}). Despite half the density of crucifers, S green manure service was only reduced by 15% in the mixture (mean mineralisation of 5.5 kg S ha^{-1}). Furthermore, crucifers in mixtures have the same GSL types and concentrations as in sole crops while they tend to have more biomass per plant. As a result, despite halving the crucifer density, GSL production on an area basis declined by only 19% in mixtures.

On a species basis, despite the high and variable competition for abiotic resources generated by crucifers, no incompatibility of development was observed in mixtures. Overall crucifers and legumes are sufficiently complementary to provide the expected multi-ecosystem services.

Our study confirms for a wide range of cover crop species and on 4 sites x years that crucifer-legume mixtures can provide multi-ecosystem services beyond well-known N management services. Therefore it can be recommended to diversify the species included in cover crops in order to provide a high level of multi-ecosystem services and to secure the success of cover cropping.

Keywords: nitrogen cycle, sulphur cycle, biofumigation, glucosinolates, bispecific mixtures

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Agroforestry Enables High Resource (Land, Light, and Water) Use Efficiency

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Abstract: Agroforestry is an intensive land use that combines woody perennials with agricultural crops. Integrating trees into the agricultural landscape provides opportunities to enhance agricultural sustainability, conserve biodiversity and provide ecosystem services such as erosion control. Because of the substantial potential of agroforestry for food security, climate change adaptation and mitigation, tree-based agricultural systems are currently being studied in regions where there is limited prior experience with agroforestry. Joint work in China between China Agricultural University and Wageningen University has focused on studies on mixed systems of jujube (*Zizyphus jujube*) and cotton (*Gossypium hirsutum*) in Xinjiang autonomous region (NW China), and apricot with millet, peanut or sweet potato in Lianoning province (NE China). These studies focused on:

- Light interception in relation to planting density (dx.doi.org/10.1016/j.fcr.2014.09.001)
- Crop yield and yield components related to planting density (dx.doi.org/10.1016/j.eja.2016.05.009)
- Advantages of agroforestry for land and water use efficiency (dx.doi.org/10.1016/j.agwat.2016.10.007)
- Spatial configuration drives complementary capture of light in the understory crop (dx.doi.org/10.1016/j.fcr.2017.07.016)
- Increase in light capture, photosynthesis and dry matter production (doi.org/10.1016/j.eja.2018.01.001)

Yield and light utilization of cotton in jujube-cotton agroforestry can be increased by optimizing cotton plant density. Shading effects on cotton yield were diminished at higher plant density which as a result of greater boll numbers per unit ground area. A study on spatial configuration of cotton in jujube-cotton agroforestry showed that increased row widths of cotton reduced intra-specific competition in cotton more than interspecific competition with trees, resulting in greater leaf area index (LAI), total light interception and dry matter accumulation of cotton. However, light-use efficiency was higher at high levels of inter-specific competition especially in the rows close to the tree line, associated with a higher fraction of diffuse radiation. Mixing crops and trees in apricot agroforestry did not increase water extraction from the top soil profile compared to sole tree stands. Water equivalent ratios were higher than 1 in mixtures of apricot and annual crops, indicating that the water use efficiency was improved in the mixed system. Agroforestry systems with apricot trees and annual crops, especially millet, can improve light utilization in semi-arid climates and contribute to regional sustainability and adaptation to climate change.

These results show the potential of agroforestry for adapting to regional sustainability and climate change. Wider practice of agroforestry can be

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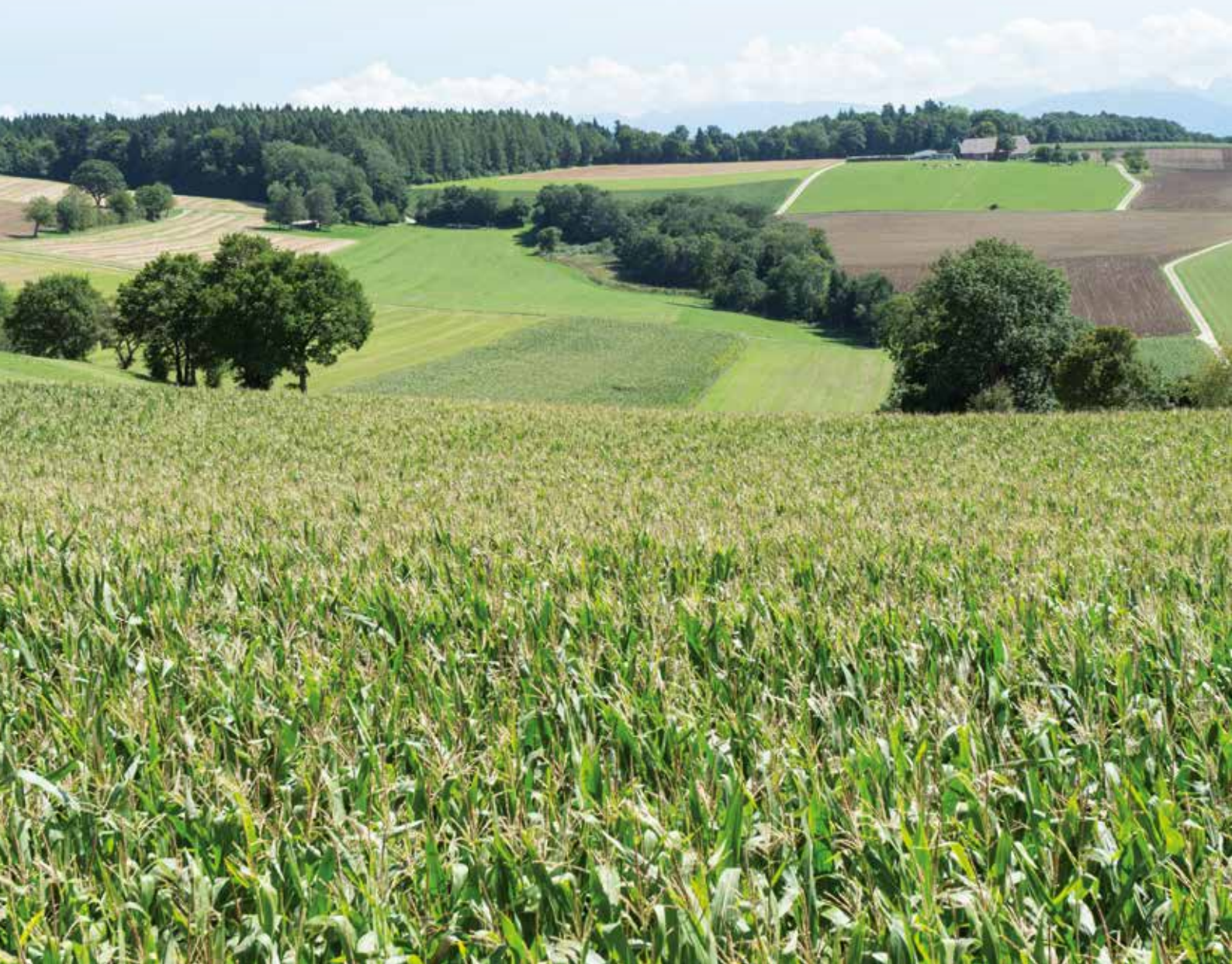
ABSTRACT BOOK



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