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Towards agroecological cropping systems: the role of diversification in time and space for supporting the crop production

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ABSTRACT BOOK



II. THURSDAY, 30 AUGUST 2018

A. PLENARY SESSIONS

PLENARY SESSION D

PI-D-01

Leveraging plant diversity for multifunctionality in agroecosystems

Meagan Schipanski

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Abstract: In natural systems, biodiversity offers benefits for biomass production and environmental benefits. The timeframe of annual agriculture, however, is more similar to early successional ecosystems where competitive species interactions may be more common than facilitative interactions, which can be more common in perennial systems. This presentation will highlight research across different scales and climate contexts to demonstrate the potential for utilizing plant diversity in agricultural systems to achieve production and environmental goals. At the rhizosphere scale, recent research evaluating canola (*Brassica spp.*), wheat (*Triticum aestivum*), and other crops demonstrate that different crop genotypes can select for specific rhizosphere communities that differentially influence belowground carbon allocation and nutrient cycling. At the field scale, crop rotations and cover crop mixtures can be designed to utilize different plant traits and species interactions to provide multiple functions including water and nutrient use efficiency. At the food system scale, obstacles and opportunities exist for diversifying the types of crops produced across the landscape.

Keywords: biodiversity, nutrient cycling, soil carbon, cropping systems

PLENARY SESSION E

PI-E-01

Towards Agroecological Cropping Systems: the Role of Diversification in Time and Space for Supporting the Crop Production

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Abstract: The optimization of cash crop successions and rotations is crucial for designing efficient cropping systems providing supporting ecosystem services instead of using external chemical inputs. The reintroduction of legumes is a relevant means for increasing the nitrogen resources. The interests of legumes are well known, however, they have also some weaknesses that strongly limit their adoption by farmers. One way to avoid these difficulties is to choose species and cultivars tolerant to pests and diseases and adapted to the pedoclimatic conditions. Nevertheless, when they are grown as sole crop their agronomic performance is often insufficient to obtain profitable and stable yields. Another solution is to grow legumes in intercrops with non-legume companion crops, such as cereals, in order to mitigate their poor performance.

The evaluation of low input and agroecological cropping systems was carried out at INRA in the experimental station of Toulouse-Auzeville (South-West France) where 6 prototypes were compared since 2003 in 2 successive periods of 6 years. Three prototypes corresponding to

0 (control rotation: sorghum, sunflower, durum wheat), 1 (sunflower, winter pea, durum wheat) or 2 (soybean, spring pea, durum wheat) grains legumes in the 3-year rotation were compared. The same 3 rotations including multi-service cover crops (white mustard, oat/vetch, vetch or lucerne) during the fallow period between two main cash crops were also tested. Afterward a second period aiming at strongly reducing the use pesticides was carried out by redesigning 2 novel rotations based on a diversification of cultivars and species mixtures versus the control cereal-based rotation.

This cropping system experiment was completed by factorial annual experimentations carried out since 2005 aiming at analyzing various types of bi-specific intercrops in order to optimize the spatial design and species and cultivars assemblages. We demonstrated that species mixtures are often effective for producing biomass in low input conditions. Moreover, intercrops are also more productive in organic farming with higher yield and greater protein content in cereals associated to grain legumes. Recently we also show that in organic farming, growing lentil with spring bread wheat was more profitable than growing lentil in sole crop.

All these results shown that prototypes of agroecological cropping systems could be profitable despite a slight decrease in yields that was compensated by reduced costs. However the rotations with intercrops was less profitable under current economic conditions and European subsidy policy. The introduction of cover crops induced an increase of costs due to seed inputs and soil additional tillage, since we choose to avoid the use of glyphosate. Then we demonstrate that there is a great potential of using species diversification in space and time for improving yield and cereal grain quality in low input and organic farming.

Keywords: species diversification, grain legumes, cover crops, intercropping, crop rotation, ecosystem services

PLENARY SESSION F

PI-F-01

Navigating Agricultural Transitions: The Role of Ecosystem Services, Biodiversity, and Human Management for Sustainable Farming Systems

Janne Bengtsson

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Abstract: In his thought-provoking book “Against the grain”, James C. Scott describes the landscape that agriculture, as we know it, created already at its origin some 6000 years ago: “It rested on an extremely slender and fragile genetic foundation: a handful of crops, a few species of livestock, and a radically simplified landscape that had to be constantly defended against a reconquest by excluded nature. At the same time ... (it) was never even remotely self-sufficient. It required a consistent subsidy ... from that excluded nature: wood for fuel and building, fish, mollusks, woodland grazing, small game, wild vegetables, fruits and nuts. In a famine, farmers resorted to all the extradomus resources that hunter-gatherers relied on. ... Its very concentration and simplicity made it uniquely vulnerable to collapse, ... far more fragile than hunting and gathering or even shifting cultivation.”

It is striking how apt this description of early agriculture is for present-day intensive agriculture, although we need to exchange some aspects, like fossil fuels having replaced wood as the driver of much of agricultural production. Also, the possibility to resort to wild