SUBMISSION

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System redesign under agroecological approach: a Central Italy experience

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Short abstract

The system "re-design" represents a leading strategy to pursue the entire food system sustainability and the global food security. In 2017, a designing work following agroecological approach was addressed on an organic apricot experimental orchard planting, in Central Italy. This work retraces the process steps, focusing on biodiversity management issues.

Extended abstract

The negative externalities derived from the Green Revolution and Globalized agriculture drive to the need to change both production paradigm and food chain structure, aiming at converging agricultural sustainability and global food security (Frison, 2016). In this context, the agricultural "system re-design" approach represents a leading strategy for the sustainable transformation of food systems, overcoming the weaknesses of the agricultural models basically based on the "input substitution" strategy, also in organic (Darnhofer, 2010). The re-design practices, which are at higher levels of both technological and institutional innovation than the input substitution ones, implicate the "rethought" of the whole cropping system by means of the practices in question. These practices are essentially based on the application of agroecology principles, implemented at field, farm and landscape scale. Actually, redesign practices rely on technologies and devices able to emphasize the conservation-regeneration of soil, water and other resources, the organic matter loop cycling and the promotion of biodiversity and its functionality in space and time (Altieri, 1999). Focusing on system biodiversification, the agroecosystem re-design, could be intended as the introduction of "functional elements", able, by their proper management, to intensify the system diversity, provide ecosystem services and, consequently, sustain system resilience and yield. At field and farm scale, functional elements could be intended as diversified crop cultivars, crops in rotation (in vegetable production), agroecological service crops (ASC; i.e. cover crops, living mulch, functional herbaceous strips), intercrops, animals (i.e. agroforestry) and, at landscape scale, ecological infrastructures (i.e. hedgerows, groves, plant corridors and flower strips at field margins). The introduction of functional elements in the agroecosystem should be opportunely weighted on the basis of the positive interactions obtainable.

In 2017, the BIOPAC project, funded by the Italian Ministry of Agricultural, Food and Forestry Policies, has given the opportunity to design a new apricot (*Prunus armeniaca* L.) orchard in the MAIOR "MAIntenance of Organic oRchards" long term trial at CREA-Research Centre for Olive, Citrus and Tree Fruits, in Rome, central Italy, following the agroecological approach. The orchard designing has been studied from a field and landscape prospective. The aim was to compare the

performances of three systems at different levels of "agroecological intensification" (Wezel et al., 2015), relying on soil and biodiversity management strategies.
A Business As Usual (BAU) system, basically managed through the common standardized organic practices for fertilization and weed control (i.e. off farm fertilizers, soil tillage and weed mowing), based on an input substitution criterion - characterized by the substitution of synthetic inputs with those allowed by the organic rules - is compared with different combinations of agro-ecological practices. The two compared agroecological systems combine the use of on farm/system fertilizers (a green compost as base fertilizer at tree planting, and a Municipal Waste compost - MWC - as top dressing fertilizer, after plants establishment), with two soil management strategies, corresponding to two different approaches in agrobiodiversity management. From an agroecological perspective, the choice of the MWC, supplied by the "AMA Roma Spa" company and obtained from the organic waste collection of several areas of Rome and Fiumicino cities, followed the redesign of the organic matter loop cycle, directing its flow from the field to the society, closing the loop back to the field, encompassing the framework of the Circular Economy (EC, 2015). Agrobiodiversity management was faced comparing two agroecological approaches: a "conservative" strategy (CON) with a minimum tillage on the tree rows and no till on inter-rows, exploiting the functionality of the resident flora, and a "functional" strategy (FUN) in which the system biodiversity was driven toward proper ecosystem services by means of the introduction of functional elements (i.e. ASCs). In particular, two different ASC mix were sown: *i*) flower strips, as a mix of coriander (*Coriandrum sativum* L.) and purple tansy (*Phacelia tanacetifolia* Benth.), at the ratio 75-25% on seed weight basis, respectively, were introduced in the inter-row space for their potential attractive ability of Beneficials (Burgio, 2007); *ii*) a weeding mix on the row space, able to manage weed presence, especially couch grass (*Cynodon dactylon* (L.) Pers.). The weeding mix was composed by: italian rye-grass (*Lolium multiflorum* Lam. var. *italicum*), for its smothering effect on weeds, white mustard (*Sinapis alba* L.), for its biofumigant ability, and white clover (*Trifolium repens* L.), for the nutritional benefit provided, at the ratio 85-5-10% on seed weight basis. Italian rye-grass and white clover, being perennial species, were also chosen for their potential ability to colonize the apricot rows in the next ASC cycle. In each system, two apricot promising varieties for organic production and two rootstocks, with different vigour and sucker sprouting ability, were selected in order to test their attitude to produce under diversified management. At landscape level, BIOPAC allowed the introduction of new hedgerows separating each experimental unit (i.e. experimental block), in addition to the already present perimetric windbreak hedgerow of the MAIOR field. This designing work of the hedgerow aimed to create a connection among the agricultural landscape elements, functioning as ecological corridor and contributing to landscape fragmentation reduction, considered one of the main cause of loss of biodiversity (Krauss et al., 2010). The experimental farm of CREA-OFA is indeed part of the Regional Park "Parco dell'Appia Antica" of Rome, driving the choice of the hedgerow species toward native species recommended by the Park Institution.

The project aims to a double objective; *i*) test the effectiveness of agroecological practices within organic farming in terms of technical and productive aspects; *ii*) evaluate the ecological service provided by functional elements and fertilization strategy on soil fertility and weed management in yield provisioning systems.

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