# SUBMISSION

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# The Monsampolo Organic VEgetable Long-Term field Experiment (MOVE LTE): the contribution of the development of vegetable organic production

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**Short abstract** *(50 words)*

A Long Term Experiment (LTE) was carried out to contribute in spreading the principles of organic farming and agroecology. In almost 20 years, the LTE produced important results (higher organic matter, more production stability, higher quality, etc.), but also increase the necessity of new solutions to develop organic vegetable production.

Key words: participatory breeding, tomato, MAGIC population

**Extended abstract** *(750-1000 words)*

The importance of long-term experimental (LTE) devices to improve the quality of research in the organic farming has been recognized by the scientific community since several years (Köpke, 2006). In fact, it is well known that in the LTEs it is possible to study organic practices at the cropping system level, combining holistic, long-term, scientific and practical approaches. Within this matter, the Monsampolo Organic VEgetable Long-Term field Experiment - MOVE LTE (Campanelli and Canali, 2012) started in 2001 at Monsampolo del Tronto (AP, 42° 53' N, 13°48' E) with the aims to provide information on the agronomic and environmental sustainability of the organic cultivation. The Monsampolo site is characterized by a thermomediterranean climate and the soil is Typic Calcixerepts fine-loamy, mixed thermic. The LTE experiment covers an area of about 2.000 $m^2$ and it is based on the following 4-year crop rotation: tomato (Lycopersicon esculentum Mill.), melon (Cucumis melo L.), fennel (Foeniculum vulgare M. var. azoricum), lettuce (Lactuca sativa L.), cauliflower (Brassica oleracea L. var. botrytis), and bean (Phaseolus vulgaris L.). Three different agro-ecological service crops (ASC) (Canali et al., 2015), commonly defined as cover crops or green manure, are included in the rotation of the organic system: hairy vetch (Vicia villosa R.), grown before tomato transplanting, barley (Hordeum vulgare L.), grown before melon, and radish (Raphanus sativus L.), grown before lettuce. The implemented agronomic management follows an agro-ecological approach for both conservation tillage and crop

diversification strategies. The MOVE LTE device reproduces a typical cropping system on organic vegetable farm (four-year crop rotation), including all the common crops in the area.

In almost 20 years of activity on conservative agriculture, the MOVE LTE device has shown that the application of such organic farming practices increased soil organic matter from 1.1 g $kg^{-1}$ to 1.7 g $kg^{-1}$ (Campanelli & Canali, 2012) compared with conventional agricultural production, enhanced the microbial mass of the soil (Stagnari et al., 2014) and also increased the soil arthropods both in terms of richness and biodiversity (Burgio et al., 2015).

Furthermore, during these years the principles of conservation agriculture in several horticulture crops were carried out and studied, in the MOVE LTE with the aim to improve their cultivation.

The MOVE LTE highlighted the critical issues that hamper the spread of horticulture. First of all is the lack of suitable varieties since most of those available have been obtained under high input conditions. LIVESEED is a Horizon 2020-funded project that runs from 2017 to 2021aiming at improving the performances and competitiveness of the organic seeds and the breeding program to develop varieties adapted to organic systems that are a key issue for realising the full potential of organic agriculture. In 2017 a tomato Multi-parent Advanced Generation Inter-Cross (MAGIC) population was developed by ISI Sementi SpA, using eight founders thoroughly genotypized by GBS (Genotyping By Sequencing) approach: seven *Solanum lycopersicum* lines and one wild accession of *Solanum cheesmaniae*, containing desirable traits for biotic and abiotic stress tolerance, yield, and resiliency (Nesbitt and Tanksley, 2002). The final 400 F2 (DCHF1) or F3 plants were cultivated, phenotypically evaluated and propagated by single seed descent (SSD) both at ISI Sementi (Fidenza, Italy) and at the MOVE LTE system at CREA. The relative offsprings of each individual is currently under progress by SSD approach. From a first year of evaluation, a broad variation in several traits including plant habit, time of flowering, ripening time, leaf and fruit shape, firmness, shelf-life, color, °Brix and pH was observed. The results obtained highlight the importance of this material, selected under organic management techniques, that represent a stable, long lasting collection and a resource for both scientific and farmers' community in order to face the new challenges of a worldwide sustainable tomato cultivation in the near future.

Furthermore, participatory breeding programs will be carried out by using all the 400 tomato plants (F2 (DCHF1) or F3) as a core population that represent a living gene bank, from where farmers, in collaboration with scientists, will select in their own fields and under the sustainable techniques normally used, the most desirable plants. The farmers will own genetic materials with unexpected and still unemployed but paramount potential in terms of adaptation to environmental conditions and specific agricultural management techniques (e.g. sustainable soil management, organic agriculture, etc). The GBS approach used for genotyping the 8 founder lines, developed millions of new molecular markers associated to important traits that will be used in all the lines developed from the MAGIC populations, allowing to follow the allelic frequencies evolution in the different environmental conditions.

The contribution of the long term experiment is important to develop and apply the principles which tend to minimize the farm external resources and to mimic, as much as possible, the natural ecosystem. However, even if the organic production is recognized as a way to increase the resilience and the capacity to adapt to climate change and, through its complex agroecosystem, the role of environmental dimension, its application is still limitated. This is because of there is an historical gap between the scientific knowledge of the organic farming production and its farm application. The MOVE LTE could be an important tool to reduce this distance, trying to meet the scientific results both on vegetable organic producion and sustainable development and the practical expectations of the farmers.

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