Natural urban farming as a mean to connect community to sustainable food: the case of demonstration garden in Tor Mancina

Sara Spognardi

Dipartimento di Studi Aziendali,
Università degli studi Roma Tre,
Via Ostiense, 159, 00154 Rome, Italy
Email: sara.spognardi@uniroma3.it

Claudio Beni

Consiglio per la Ricerca e la Sperimentazione in Agricoltura,
Centro di ricerca per lo studio delle
Relazioni tra Pianta e Suolo (CRA-RPS),
Via della Navicella, 2, 00184 Rome, Italy
Email: claudio.beni@crea.gov.it

Ilenia Bravo, Enrica Iannucci and Patrizia Papetti*

Laboratorio di Analisi Merceologiche e Territoriali (LAMeT),
Dipartimento Economia e Giurisprudenza,
Università di Cassino e del Lazio meridionale,
Via Sant'Angelo, Località Folcara, 03043 Cassino, Italy
Email: ilenia.bravo@libero.it
Email: enrica.iannucci@unicas.it
Email: papetti@unicas.it
*Corresponding author

Abstract: Urban agriculture plays an important role to provide an innovative and different connection to food. Visitors, scholars, and generally participants of community gardens activities become 'food citizens', shift from being passive food consumers to becoming co-producers. To achieve this goal, the demonstration garden of Tor Mancina with the involvement of schools and of local communities tests innovative and more sustainable agricultural practices and carries out experiments to test the phytostimulant and pest repellent effects of aromatic and officinalis plants extracts used as basic substances in plant protection management. These experiments aim at inculcating positive values on food, agriculture and environment in growing youth, providing effective solutions to increase crop performance, to enhance the tolerance of plants against stressors, to safeguard the nature, biodiversity and food quality. These activities teach sustainable agriculture practices which form basis for stable livelihood and informed consumption habits. For this reason more initiatives should be in place, nationwide, aimed at encouraging the visit of the

community gardens and participation in their activities, in order to learn more about the provenance of food, agricultural processes, nutrition, safety and security, biodiversity and sustainability, and develop new skills.

Keywords: demonstration garden; sustainable production; community garden; urban agriculture.

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Biographical notes: Sara Spognardi received her Bachelor's of Science in Biology in 2006 and Master's of Science in Molecular and Cellular Biology in 2009 under the guidance of the Full Professor Gino Naclerio working on the research and optimisation of cellulosolithic activity in strains of Bacillus isolated by soil at University of Molise, Italy. After a period of research abroad and a Master's in 'Quality Production Management' in 2015 she started her PhD work in 'Consumers and Markets – Quality, Innovation and Sustainability' at the University of Rome Tre. Her thesis focused on the valorisation and protection of food quality. She completed her doctoral thesis at the Scottish Centre for Food Development and Innovation (SCFDI), Queen Margaret University of Edinburgh and awarded her PhD in September 2018. Her research interests are environmental pollution, sustainable development and food quality.

Claudio Beni has a degree in Agricultural Sciences and currently works as a researcher at the CREA. He has been coordinator or participant in many European and national research projects. He is an author of over 250 scientific publications. His skills concern sustainable agriculture, urban and social horticulture, phytoremediation of water and production and use of soil green amendments for agricultural purposes.

Ilenia Bravo has obtained her MSc in Biotechnology from the Sapienza-University of Rome. She is currently working with the University of Cassino and Southern Lazio on several projects and researches regarding to the quality control of the environment and food products.

Enrica Iannucci is a Full Professor at the Department of Economics and Law at the University of Cassino and Southern Lazio. She graduated in Chemistry on 24th May 1988 at the 'La Sapienza' University in Rome and in 1994 she received her PhD in 'Foodstuffs Market Technology'. Her research interests are market technologies, environment and economic development and alternative sources of energy. She is an author of more than 60 economic and technical papers published on national and international journals or presented at Italian and international conferences.

Patrizia Papetti is an Associated Professor at the Department of Economics and Law at the University of Cassino and Southern Lazio. Her education includes a degree in Druggist Chemistry and Technology at the 'La Sapienza' University in Rome and a PhD in 'Quality, Innovation and Sustainability' held at the University of Rome. She is a scientific manager of the Laboratory of Quantitative Agro-Alimentary Analysis (LAMeT). Her research experience is in the field of food safety, the consumer protection and the sustainability.

1 Introduction

Natural urban farming aim to test innovative and more sustainable agricultural practices (Gliessman and Ferguson, 2020) and carries out experiments to evaluate the phytostimulant and repellent effects of aromatic and officinalis plants extracts, also with the involvement of schools. At the same time, it aims at inculcating positive values on food, agriculture and environment in growing youth. It teaches guidelines about sustainable agriculture and nutrition which form basis for stable livelihood and inform consumer and other stakeholders. Authors have analysed benefits and limits of urban agriculture with reference to environmental, social and health aspects; the attention will instead be focused on the demonstration garden of Tor Mancina, an example of urban agriculture between sustainable production and social benefits, and on its activities.

In this garden, researchers grow traditional crop varieties at risk of genetic erosion, provide sites for composting organic matter for subsequent use as fertiliser and reduce the reliance on chemical or mined inputs (Ozores-Hampton, 2017).

One of the purposes of their experiments is to promote sustainable agriculture techniques, in order to stimulate horticulture development, to improve its defence or to fight directly parasites, minimising human exposure to toxic pesticides, maintaining the quality of environment and conserving natural resources (Gurjar et al., 2012).

Sustainable development imposes new methods and strategies of agricultural production as the use of natural extracts that have been evaluated effective solutions to increase crop performance, enhancing the tolerance of plants against abiotic and biotic stresses, safeguarding the nature and quality. Bio-sourced plant extracts used as crop enhancers are defined as basic substances, products which are used for other purposes, but which can also be used as a plant protection product (Marchand, 2017).

The application of bioactive components derived from natural source represents a sustainable option in crop protection; in fact natural plant products are easily degradable, safe to human health and environment without a widespread use of synthetic antimicrobial compounds.

In the following paragraphs the site, its location and its main activities will be analysed. Subsequently, one of the research studies conducted, with the participation of some schools, in the demonstration garden will be proposed with the results achieved.

Specifically, the phytostimulant and repellent effect of the aqueous extract of *Allium sativum* L. has been tested to prevent a range of plant pathogenic bacteria and fungi on plants of zucchini squash (*Cucurbita pepo* L.) var. Augusto in an open field test.

2 Description of site and experimental farm of CREA-RPS

Urban agriculture includes the production of food and non-food plants, as well as animal husbandry, in urban and peri-urban spaces. Urban agriculture infrastructures may be privately, publically, or commercially owned, of several forms, including household, school, and community gardens; urban farms; backyard chicken coops and beehives; aquaculture, hydroponics, and aquaponics facilities; and rooftop, vertical, and indoor farms (Santo et al., 2016). Between the forms listed above, it is possible to identify the demonstrative site of Monterotondo like a community garden or urban farm. Most of the literature on urban agriculture comes from research on community gardens (Guitart el al., 2012); probably it depends on the fact that gardens remain the dominant form of urban

agriculture. Instead, more technologically innovative forms of urban agriculture (i.e., rooftop gardens, greenhouses, indoor and vertical farms, edible green walls, and aquaponics facilities) are still in the early stages of research and practice (Specht et al., 2014; Love et al., 2015).

The demonstration site has been created in the experimental farm of CREA-RPS, located in Monterotondo (18 km North of Rome), with an area of about 300 m^2 and it consists of nine cultivation raised beds, with an height of 40 cm above soil level. It is located at the centre of a highly sensitive region, over approximately 20 km^2, constituted by areas of great environmental value and areas with strong human pressure, in a continuous equilibrium between them.

With regard to green infrastructure, many protected areas fall into this territory, the main ones are the Site of Community Interest (SCI IT6030015) that includes Park 'Gattaceca and Barco' and 'St. Angelo Romano', The Park of the Monti Lucretili, the River Reserve 'Nazzano – Tevere Farfa', the Natural Park of Vejo. All these areas are characterised by a wide diversity of plant, animal and microbial at high risk of genetic erosion.

Instead, referring to the hydrological basins, the territory is crossed by the third largest river in Italy, the Tiber, and its major tributary, the Aniene. In addition, there are two important thermal sources, Bagni di Tivoli and Cretone. Metropolitan areas or large urbanisation sites: the Italian capital, Rome, with over 3.5 million inhabitants and its peri-urban towns are characterised by an index of human settlement and by a degree of land use very high. The territory of Monterotondo, which is the demonstration site, bordered by the municipality of Rome and the town of Monterotondo is part of suburban circle of Rome, with its 60,000 inhabitants.

Moreover, in these areas there are many roads, railways and airports, including the train line FM1 connecting Monterotondo to Rome and Fiumicino airport, a motorway which connects Rome to Milan, Naples and the big cities located on the Apennine Mountains and on the coast of the Adriatic Sea. In addition, two airports (Urbe, and Guidonia) are placed at the edge of the area. Many health infrastructure are present in the area: there are three major hospitals, one in Monterotondo and two in the municipality of Rome, S. Andrea and Sandro Pertini. Territory hosts centres for monitoring and protecting the territory and the population: Agency for Civil Protection is located a few kilometres from the farm of the CREA-RPS.

2.1 Sustainable agricultural practices

The demonstration garden of Monterotondo has been created and is maintained with conservative natural farming techniques (Shyam et al., 2019). The cultivation beds were set up by green manuring with leguminous straw mulch in the first year, followed by horticultural species (belonging to at least three different botanical families) consociated with plants of the *Lamiaceae*, *Asteraceae* and *Liliaceae* families to increasing the level of plant diversity and, consequently, animal and microbial diversity. The plants of these families have attractive effects on pollinators (bees, bombs, etc.) and repellent effects on some phytophagous insects, including aphids, through which they increase the self-defence capability of garden (Rezendes et al., 2020).

The system is also based on soil self-composting, on the lack of mineral or synthetic fertiliser inputs. In fact, through the cultivation of leguminous plants, which fix

atmospheric nitrogen, and the use of mixed green mulching (straw, hay, shredded wood, crop residues and grass mosses), a superficial humogenic layer is created, in order to guarantee both the balance between mineralisation and humification of organic matter and the good level of physical, chemical and biological fertility.

The vegetable garden was integrated with mixed perimeter hedges consisting of perennial plants of *Lamiaceae* and *Asteraceae* families, with the function of windbreak and anti-pest barrier, and some fruit trees. In addition, a dry stone wall was built to accommodate the small reptiles, predators of insects and slime. A small pond was created to ensure the presence of predatory amphibians and bird nests that feed on mites and insect larvae to increase the self-defence level of the vegetable garden. The garden is served by an irrigation system, a composting platform, and a greenhouse-tunnel for seedling and seed propagation. In this period, a prototype of a thermo-composting plant is being built to produce a warm bed in the greenhouse tunnel to reduce plant germination and propagation times.

The demonstration garden provides training and apprenticeship activities for practitioners of schools, associations and universities. Community gardens play an important educational function allowing to better describe concepts of not only biology and agronomy but also mathematics, physics, and chemistry (FAO School Gardens, 2005; Smit and Bailkey, 2006; Mezzetti et al., 2010).

Participants of community gardens activities become 'food citizens' (Baker, 2004; Renting et al., 2012), gain increased control over how their food is produced and processed.

It is carrying out research activities, financed by the Ministry of Foreign Affairs in the framework of the Italy-Brazil cooperation, on the use of natural extracts in conservative and organic agriculture. Besides, in this demonstrative site experiments are conducted for horticulture and thermo-composting.

Since March 2017, it has been recognised an educational-social site by the 'National Rural Network' with the involvement of farmers' and consumers' associations and education assessors of neighbouring municipalities.

3 An example of sustainable practices: results and discussion

The excessive use of synthetic pesticides impacts on the environment and on human health, due to the high toxicity and the non-biodegradability of the major part of these products, and to the resistance induced on some parasites against more classes of pesticides. Therefore it is necessary to find new highly selective and biodegradable pest prevention products and develop sustainable agricultural practices to reduce their use, while maintaining high productivity (Ceccarelli, 2014).

According to Curtis et al. (2004), Krebs et al. (2006), Latha et al. (2009) and Nashwa and Abo-Elyousr (2012) the extracts of *Allium sativum* L., can be used for biological control of early blight caused by the fungus *Alternaria solani* (late blight), because are effective in reducing disease and suppressing the mycelial growth. Garlic can be used to produce 100% natural organic pesticides (green pesticides) to spread directly on the leaves of plants, except for the legumes. The use of plant extracts to protect plants is of

considerable interest, because of their lower toxicity compared to chemicals, and, above all, for their reduced environmental impact due to the use of molecules already present in nature.

The experimental design set up by researchers of the demonstration site of Tor Mancina was based on two basic elements: the characterisation of the garlic aqueous extract with the determination of amount of alliin, and the field test, in order to value its phytostimulant effects on treated plants compared to control plants.

At the beginning of the test, the chemical characteristics of the soil were analysed according to the official methods of soil chemical analysis (Latha et al., 2009).

The results showed that the soil had a clay-loamy texture, with sub alkaline pH (7.6), and a high cation exchange capacity (31.41 meq 100 g^{-1}).

The plants were treated weekly with different concentration of garlic aqueous extract (1%, 3%, 5%) and the minimum effective concentration was found at 1%. The fruits were collected during the months of June and July (12 harvests), weighed and measured (length and size). The plants of each plot were also inspected daily to check for outbreaks of fungal infection (*Oidium* sp., *Peronospora* sp.), or the disease derived from insects (aphids, aleurodid flies), and nematodes attack.

The results of field test showed a higher fruit yield, with higher diameter and lengths in treated plants compared to control plants, due to the phytostimulant and nutritional effect of the garlic extract. Moreover, the plants of zucchini treated with garlic extract had higher vegetative vigour, upper chlorophyll content in leaves and better flower induction.

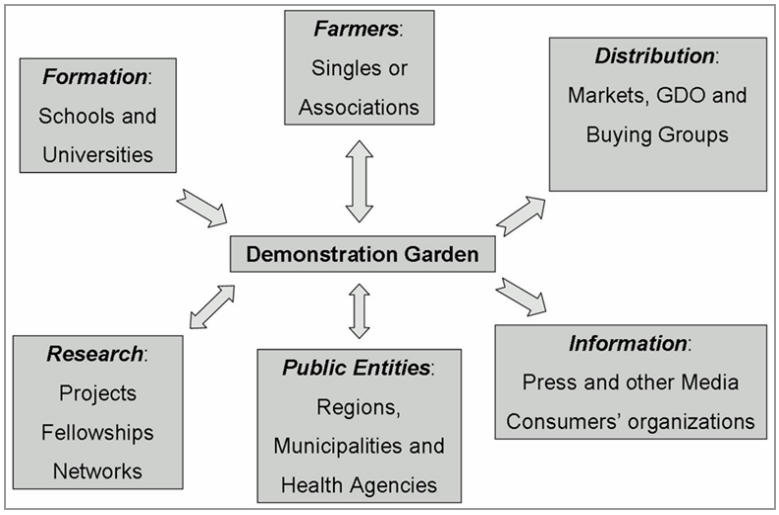
4 Conclusions

The overuse of synthetic agrochemicals often causes environmental hazards, an imbalance of soil biodiversity, nutrient deficiency, and change of soil physicochemical properties, resulting in a decrease of crop productivity. The integration of plants extracts containing allelopathic substances into agricultural management may reduce the use of synthetic herbicides, fungicides, and insecticides and lessen environmental deterioration. Bio-sourced and biologically active substances derived from plants are expected to play an increasingly significant role in crop protection strategies.

In this context, the demonstration site of Tor Mancina, with the involvement of universities and schools, promotes sustainable agricultural practices. Its experiments, carried out in a territorial network context, aim at inculcating positive values on food, agriculture and environment in growing youth and sector stakeholders. Sustainable agriculture and nutrition are both major challenges for stable livelihood and informed consumption habits.

Urban agriculture linked to substainable production plays an important role to provide an innovative and different connection to food. Participants of community gardens activities become ‘food citizens’, gain increased control over how their food is produced and processed. For this reason more initiatives should be in place, nationwide, aimed at encouraging the visit of the community gardens and participation in their activities, in order to learn more about the provenance of food, agricultural processes, nutrition, safety and security, biodiversity and sustainability, and develop new skills (Figure 1).

Figure 1 Integration of urban garden activities



Source: Authors' elaboration

The creation of a multi-actor network allows to expand the knowledge related to this type of production management to all those involved from production to consumption of food, including local legislators and administrators.

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