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CURRENT STRATEGIES FOR THE PROTECTION OF ORGANIC CROPS IN VEGETABLES PRODUCTION

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Abstract

Development of disease resistance to conventional pesticides and environmental contamination problems created pressure on farmers to adopt new strategies for disease control in the production of vegetables. In addition, consumers demand to minimize pesticide residues in food products is forcing the growers and the pesticide producing companies to formulate and develop alternatives to the contentious inputs currently marketed. Products obtained from biologically active compounds extracted from plants will play an increasingly important role in crop protection strategies. Exploiting antimicrobial substances from plants that inhibit or halt the reproduction of pathogenic microbes, would become a more realistic and ecological method for the integrated management of plant diseases with the final goal of reducing or gradually phasing out contentious inputs without compromising the competitiveness of the organic sector. Obtaining, identifying, testing and physicochemical characterization of biologically active compounds with action to combat microbial diseases in vegetable crops shows both originality and complexity of activities proposed in the research work. The present study provides an overview of the current state of external inputs use and proposes a solution to the stricter European standards, by a systemic approach of biotechnological sciences and agricultural sciences, with immediate applicability of the obtained results in farm practices.

Key words*: organic systems, vegetables, natural products, crop protection, plant products.*

INTRODUCTION

The continuous growing of consumers demand for organic food lead to the need to develop solutions for increasing both production and quality obtained from organic systems.
Organic farming is a cultivation method that does not use pesticides or chemical fertilizers, and that replaces them with other methods including products obtained from plants or animals: purine, compost, mulch.
Organic production is defined as a holistic system that integrates cultural, biological, and mechanical practices that foster cycling of natural resources adapted to local conditions, promote ecological balance by avoiding external inputs with high resilience, and conserve biodiversity (IFOAM, 2009, Regulations of department of Agriculture US, 2011).
Development of pest and disease resistance to conventional pesticides and environmental contamination problems created pressure on farmers to adopt new strategies for disease control in horticultural production, both for conventional and organic systems.
It is expected that products obtained from biologically active compounds extracted from plants will play an increasingly important role in future crop protection strategies. The exploitation of antimicrobial substances from plants that inhibit or halt the reproduction of pathogenic microorganisms, would become a more realistic and ecological method for the integrated management of plant diseases and pests with the final goal of reducing or gradually phasing out contentious inputs, without compromising the competitiveness of the organic sector.
The present study provides an overview of the current state of external inputs use and proposes a solution to the stricter European standards, by a systemic approach of biotechnological sciences and agricultural sciences, with immediate applicability of the obtained results in farm practices. The high

degree of originality and innovation in organic research lies in testing by detailed analysis of the designed solutions and its conceptual framing in standards provided by Directive 91/414/CEE, 15 July 1991 for Plant Protection Product. This study puts together, in an original way, both material resources from the field of vegetable crops and from technology aimed to decrease the microbial diseases attack.

SUSTAINABLE STRATEGIES USED IN PLANT PROTECTION MANAGEMENT

Biological control

Biological control is defined as the use of living organisms to control pests or the use of microbial antagonists to suppress diseases. There is a growing demand for biologically based pest management practices. Recent surveys of both conventional and organic growers indicate an interest in using biocontrol products suggesting that the market potential of biocontrol products will increase in the future (Heydari et al., 2010).

Biocontrol agents may be predatory, parasitic, or pathogenic; they may also be either "natural" (from naturally occurring organisms in the ecosystem such as wild beneficial insects) or "applied" (meaning external organisms and microorganisms that are introduced in the agrosystem). Biocontrol agents include insects, mites, bacteria, fungi, viruses, and nematodes.

In the recent years, extensive research is being carried on beneficial bacterial isolates that proved to have antimicrobial effects against various phytopathogens.

In vivo tests pointed out *Paecilomyces variotii* as a broad spectrum biocontrol agent effective against both bacterial spot of tomato and *Fusarium* wilt of melon (*F. oxysporum* f.sp. *melonis* and *X. campestris*) (Suarez et al., 2013).

Several fungal and bacterial biocontrol agents have been used as seed and soil application to reduce the incidence of plant diseases caused by soil borne fungal pathogens (Heydari et al., 2010).

Plant extracts

Traditionally, the plant extracts were used in the form of plant extracts and volatile oils. Aromatic and medicinal plants have attracted interests in the field of plant disease control, particularly plant extracts with antimicrobial properties and contain a spectrum of secondary metabolites such as alkaloids, quinolones, flavonoids, glycosides, saponins, tannins and terpenoids (Sales et al., 2016). Reports on medicinal plants extracts have shown *in vitro* inhibitory effects against phytopathogens (Rodino, 2013; Harlapur et al., 2014; Prashith K.T.R. et al., 2010). Plant extracts have also been reported to have antimicrobial properties against plant pathogens including viruses, fungi, bacteria, nematodes and insects *in vitro* as well as *in vivo* (Duraisamy, 2015).

Allelopathy

The term of allelopathy was first used in 1937 by Molisch, defining the chemical interaction (both stimulation and inhibition) between all types of plants, including microorganisms (Kalinova J., 2010; Bostan et al., 2013). Allelopathic plants are basically used as catch crops or trap crops. They are used in plant protection of tropical regions against parasite weeds, reducing the parasite seed bank by 72%. Allelopathic compounds can act as insects repellent (Kalinova J., 2010). Good results were also obtained for parasite weed control.

Intercropping

Intercropping is the planned mixed growing of more than two species at one area of land in the same period of time. A prerequisite for the success of intercropping is the interdependence of the selected crops in growth and development due to their biological particularities. The method is based on complex interactions between companion species with good results in trap cropping, weed suppression, physical-spatial interactions.

Intercropping effects are not only reducing pest populations, it proved to be efficient. in controlling plant diseases. The grain intercrop reduced humidity in the canopy and reduced the raindrop splash effect, those two conditions being the favorable to fungal spores spread (Schoeny et al., 2008). Moreover, studies showed that intercropping system is more productive than single cultivation system due to complementing effects of the companion crops.

CURENT CHALLENGES

The complexity of organic farming principles requires farmers to achieve a high level of knowledge and skills. The resources available in organic agriculture are presently limited due to very strict rules in force. Basically, crop protection solutions are limited to Integrated Pest Management solutions and the use of crop protection chemicals is drastically fenced, being allowed only few basic substances.

Basic substances allowed in organic agriculture are set by EU commission, and they consist of materials that are covered by the definition of food stuff Regulation (EC) No 178/2002 and have plant or animal origin. Basic substance is defined as active substance simultaneously fulfilling the criteria:

a) is not a substance of concern;

b) does not have an inherent capacity to cause endocrine disrupting, neurotoxic or immunotoxic effects;

c) is not predominantly used for plant protection purposes but is useful in plant protection either directly or in a product consisting of the substance and a simple diluent;

d) is not placed on the market as a plant protection product (EC, 2009).

Products based on natural components used against phytopathogens gained attention in search of environmentally friendly solutions usable either for mass production or for organic and low-input farming systems. After validation of antimicrobial effects of medicinal plants used in traditional medicine, the research aim expanded to evaluation of plant based products against phytopathogens (Rodino et al, 2013). Research on medicinal plants extracts and oils showed the inhibitory effects against various phytopathogenic fungi

In vitro studies on some species of plants such as weeds or trees with less known medicinal value, that could be used to control plant diseases and pests were also reported (Srivastava et al., 2011; Mahlo et al., 2010).

It was demonstrated the antifungal bio-capacity on powdery mildew, downy mildew and botrytis of grape cane extracts in greenhouse and field assays (Houille B. et al., 2015). These extracts were obtained after a long alcoholic extraction by hot soxhlet using large amounts of solvents. A recent study (Soural I. et al., 2015) describes best extraction techniques, but the results show importance of methanol, a toxic laboratory solvent not usable in green technology and prohibited in the homologation category as basic substances.

FUTURE TRENDS

Scientific knowledge on the preparation mode of plant based products and how to use them are rather rare and incomplete. Therefore, it is important to optimize the extraction and manufacturing process, the stabilization of these preparations, dates and rates of application.The support of the use of these natural preparations or substances, as well as their market authorisation, requires their evaluation and registration within Plant protection Products Register. Plant protection product data must be collected from research on alternative or traditional crop protection methods (Marchand, 2015).

Another promising hypothesis for organic farming is the use of bacterial preparations based on nitrogen-fixing microorganisms. They are introduced into the root zone of plants, thus enriching the soil with biological nitrogen.

CONCLUSIONS

Development of pest and disease resistance to conventional pesticides and environmental contamination problems created pressure on farmers to adopt new strategies for disease control in horticultural production, both for conventional and organic systems.

Obtaining, identifying, testing and physico-chemical characterization of biologically active compounds with action to combat microbial diseases in vegetable crops implies both originality and complexity of activities proposed in the research work.

Moreover, plant protection product data must be collected from research on alternative or traditional crop protection methods.

Preliminary trials concerning antimicrobial potential of plant extracts are encouraging but full characterization and optimization is still required. However, to be fully efficient at farm level, proof of concept functionality has to be tested, and technical data sheets have to be produced.

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