Management and Risk in the Frame of Ipm with Biological Control Methods

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ABSTRACT

The demographic development of human population, the pollution, with pesticides, the needs for better quality crops, determined the farmers, policy makers, scientists and the public to make steps further in order to adopt strategies, to issue laws, guides, directives to implement in practice the use of IPM and biological control of pests and Phyto-pathogens for implementing sano-genetic advanced agriculture**.** This is a short review paper discussing the modern and future IPM.

Indexing terms/Keywords: Agriculture, eco agriculture, biocontrol, plant protection, IPM

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1. INTRODUCTION

More and more countries and governments around the world have set up rules and legislation on the use of plant protection measures to eliminate plant health risks from plant plantations by introducing new, non-polluting methods of natural origin, preferring chemical pesticides that are themselves a risk to the environment, people and useful organisms

1.1.Legislation and recommendations

Since IPM (Integrated Pest Management) has become a mandatory approach since 1 January 2014 in the European Union countries, it is necessary to find alternative non-chemical alternatives (preferential) in EU Directive 128/2009 (Matyjaszczyk, 2017) biological) of crop plants, especially in sensitive areas such as Natura 2000 sites. All the same authors present in a conference in 2017 the problems related to the introduction of alternative products in IPM. In 2017, the principles for assessing the effectiveness of low-risk plant protection products were approved (EPPO PP 1/296) in 2017, indicating the products to be used in IPM, preferring biological products for the same purpose instead of chemical ones. Another document regulating this is European Pesticide Regulation (EC) No. 1107/2009 (Villaverde et al., 2014), recognizing two groups of bio-pesticides, namely living organism and natural products. Also, they will only need to be used as indicated on the label for safe handling, and policy and practical policy decisions will have to be taken at a lower cost of registration.

1.2. General facts

Tomasetto and coauthors (2017) consider that plant resistance and biological control are two important pillars in the future of crop protection. There is a tendency to use certified pesticides for organic crops and that do not affect the useful insect pests of pests (Biondi et al. 2012). Governments, agencies and ministries, organizations around the world are looking to develop IPM schemes for different cultures that rely on methods and substances that are harmful to the environment. In the USA, low-risk IPM schemes were developed to replace the classical organ chlorine and carbamate-derived schemes for pest control in order to protect entomophages in peach plantations (Biddinger et al., 2014). Another example is the piperonil butoxide in preservation of crops, which is suspected as oncogenic and endocrine disruptor, and can be replaced with vegetable oil with similar results (Marchand et al., 2017).

Different systems created for chemical pesticides are difficult to access for bio-pesticides due to the cumbersome and costly entry into the market of the latter (Chandler et al., 2011). Pesticides such as neonicotinoids and fipronil have been found to be harmful to environments and other insecticides (Chagnon et al., 2014, Bonmatin et al., 2015, Codling et al., 2018). The use of bio-pesticides leads to reduced waste in the food and the environment, but there are many problems with the approval and registration of these products, and their registration in the EU is currently based on the same criteria as active substances, which requires the development of new strategies and legislative regulations (Czaja et al., 2018). In the EU there are pesticides based on microorganisms containing different strains of Bacillus, and some entomo-pathogens and entomophages. Great efforts are being made to replace systemic insecticides (Furlan et al, 2018, Pisa et al., 2017). A thorough analysis of systemic insecticides is also made (Giorio et al., 2017). Due to the toxicity of chemical pesticides on the one hand and pest and phyto-pathogen resistance on the other hand, it is necessary to find new sources of pesticides based on natural products for the development of new agrochemicals (Sparks et al, 2016 , Sparks et al., 2017). Also increases the use of bio-pesticides. The integration of plants resistance obtained different methods; with biological control is one of the near future trend (Peterson et al., 2016). Comparing the use of chemicals in reduction of attack of *Plutella xylostella* and the use of alternative methods as biological control, plant resistance, cultural control, and so on (Shakeel et al., 2017), the benefits in the favor of the second one.

Use of herbicides incorporated in plants, semio-chemicals, microorganism substances, genetic modification, biological control, new methods and agrotechnic, new synthesis chemicals with reduced toxicity to non-organism organisms, persistently reduced in products and environment (Seiber, 2014). Although empirically used for a long time, natural means of plant protection, only recently, with the need for new, non-polluting pesticides, has made this trend even in this century, but under the conditions of a research (Loiseleur, 2017). These same authors state that intensive agriculture can favor resistance to biological control of pests and phytopathogens. Also, the use and amount of product applied from classical pesticides can limit their toxicity by imposing rules. Thus, the use of substances such as copper sulfate in vineyards is limited by EU directives and regulations at 6kg Cu metal / ha / year (La Torre et al., 2008). However, the protection knowledge plants are not correctly applied in practice, there is a difference in the recommendations and quantities used in crops that are usually higher, and the knowledge of plant protection by natural means is often not applied (Mall et al., 2018).

2.Metods of biological control

2.1.Use of genetically modified plants

With all the GMC discussions, however, a big step forward is represented by the Bth transgenic plants (Kumar et al., 2008) - now questionable.

2.2. Use of Plant extracts

The use of plant extracts, including essential oils to protect crops, is one of the strategies. For example, terpenic *Eucalyptus* essential oils can be used against *Tetranychus urticae* Koch (Ebadollahi et al., 2017) having an acaricidal effect. Oleum obtained from *Foeniculum vulgare* can be used to combat *Myzus persicae* (Pavela, 2018). Other oils essential such as *Hyssopus, Pinus nigra, Satureja montana, Aloysia citrodira*, *Pelargonium graveolens* are used against vectors for human parasites (Benelli et al., 2017). Eucalyptus oil has proved to be effective against *Tetranychus urticae* (Ebadollahi et al., 2017). Essential oils of *Myrtaceae* species are effective against various insects including *Drosophylla suzukii* (Jang et al., 2017). Essential oils and Nepenta's methanol extract can also be used against insect pests of malaria- *Anopheles stephensi* (Mahnaz et al., 2012). Other authors propose the use of essential vegetable oils for the preservation and control of fungi that cause the deposition of pears and other fruits in the deposit (Nikkhah et al., 2017) or other stored agricultural products (Santamarina et al., 2017).

Calceolaria extracts can be used as bio-pesticides due to the content of flavonoids, naphtol-quinone and phenyl-propanoid terpenes with obvious biological activity and known to be used not only against different pests (*Spodoptera*) but also with antifungal and antibiotic activity, and research will have to continue for reveal all the characteristics of these plants (Cespedes et al., 2014). The coumarins as osthol (with activity against *Magnaporthe oryzae, Sphaerotheca fuliginea, Fusarium graminearum*, and pyranocumarines and other derivatives are already used in China). Other compounds in this range have been tested and exhibit intense activity against *Sclerotinia sclerotiorum* and *Botrytis cinerea* (Song et al, 2017).Plant cultures such as tea are directly used in food, which requires free of toxic substances and pesticide residues, as India's second tea producer in the world (Roy et al., 2016) identified about 67 plants whose extracts are effective against pests of tea plants.

Of course, not all can be beneficial, for example pyrethroids, both synthesis and extraction may have a toxic effect (Bradberry et al, 2005). An interesting project is the use of extracts from hemp residues as organic insecticides (Benelli et al., 2018). Neem azal, extracts from this plant are studied for a long time, being considered an ideal natural insecticide, having an effect on pests and at the same time environmentally friendly (Benelli et al., 2017), and over 300 compounds have been identified so far.

The use of antifeeding substance such as long chain alcohols and secondary metabolism produced by fungi and plants are effective against pea aphid which is effectively attack and biological control (Aznar Fernandez et al., 2018). Rocaglamid is a compound having a plant extract, and the structure and insecticidal activity was investigated by Hall et al (2017). A ketono-lactonic sesquiterpenes has been isolated from the plant *Curcuma zedoaria* and has been shown to have potential against wheat brown rust (Han et al., 2018). Another example is that the obtaining extracts from pepper piperhabamide, piperoleine B and D, larvicidal effect against *Plutella xylostella* with (Hwang et al., 2017). Replacement of the essential oils include pepperoni buoyed was made due to the fact that the first has negative effects on humans and the environment, contaminating deposits harvest and volatile oils have not proved to be toxic (Marchland et al, 2017). *Curcuma long* extracts and substances of *Myristica fragrans* have been shown to have antifungal effect against pathogen *Colletotrichum acutatum, C. fragariae, C. gloeosporioides* (Radwan et al, 2014). Curcumin determined content, demethoxycurcumin, bisdemethoxy-curcumin, erythro dihydroxy-trimethoxyneolignan, eugenol and others. Following the tests, some compounds also had a controlling effect against *Phomopsis obscurans* and *Phomopsis viticola*. Fungi endofiti as *Talaromyces pinophilus* isolated from *Arbutus unedo* contain among other things, the antibiotic 3-O-methilfunicon which has at the same time insecticidal effect against *Acyrthosiphon pisum* (Homoptera Aphidiidae) is a good substitute for the classical insecticides (Vina et al., 2017). Endophytic fungi can be a source of anti-malarial compounds (Ibrahim et al., 2018).). It can be used some new compounds –glycosilated genidipin and derivatives which can be used against VMT, against fungi (*Sclerotinia, Rhizoctonia*, and so on) and insecticidal activity (Xia et al., 2018).

2.3. Use of biotech

Micro-organisms isolated from the environment have the ability to develop chitinolytic enzymes that can attack pathogenic fungi by reducing the use of chemical fungicides (Brzezinska et al., 2014). They are producing numerous secondary metabolites, some of which can inhibit phytopathogens such as rust, cyclopalic acid and epiepoformin (Barilli et al., 2017). Some authors recommend the use of organic acids in the fight against phytopathogens (Morgunov et al, 2017).). It can be used some new compounds –glycosilated genidipin and derivatives which can be used against VMT, against fungi (*Sclerotinia, Rhizoctonia*, and so on) and insecticidal activity (Xia et al.,2018).

2.4. Use of biocotrol organisms

2.4.1. Antagonists of phytopathogens

The use of bacteriophages has been proposed for medical treatments against antibiotic-resistant infectious agents. Recently, such treatment has also been proposed for some bacterial plant diseases such as the *Erwinia tracheiphila* pathogen (Alvarez et Biosca, 2017). Another system that is expected to be used is the use of bacteriophages against potato rot (Wei et al., 2017). Antagonists of various microorganisms that attack the fruits and after harvesting have been identified (Dukare et al., 2018). Endophytic fungi are of great diversity producing secondary metabolites that can be used both in plant protection and other areas of interest as industry, and the problem medicine is being reviewed by Nisa and collaborators (2015), but there are many investigations to be made in this domain. The development of culture of bacteria producing chitinases can lead to the control of phytopathogenic fungi (Neeraja et al., 2010). Chitinases are produced by numerous microorganisms from the genus *Serratia, Bacillus, Flavobacterium*, *Cytophaga, Pseudomonas* and fungi such as *Aspergillus, Mucor, Mortierella* (Swiontek-Brzezinska et al., 2014).

2.4.2.Entomopathogens

There are entomopathogenic agents that are fungi that parasite the different insects, but which are sensitive to certain environmental stressors and that they must be genetically modified to be more effective for use in combat schemes (Fang et al., 2016; Zhao et al., 2016). Some products such as bio-pesticides for plant protection are based on a microbial preparation obtained by growing these entomopathogenic bacteria in the laboratory and then applied to crops (Moran Diez 2016).

2.4.3. Entomophagous agents

Entomophagous agents like *Trichogramma brassicae* for example are used against *Ostrinia nubilaris* to reduce their attack in maize cultures (Razinger et al., 2014). Integration into IPM requires advanced knowledge and facilities for insect growth and spreading.

3.Use of new treatment methods and new compounds

A method that reduces the exodrift and the spread of pesticides in the environment would be their formulation as nanoparticles (Baker et al., 2017). Normal and nonoemulsion were used and compared to apply pulegone in stored grains deposits (Golden et al., 2018) against *Sitophilus oryzae* and *Tribolium castaneum*, the nanoemulsion being the most effective and with longer effect.

It is expected to synthesize new pesticides similar to those obtained from nature such as spinosin by fermentation, an insecticide of macrolide nature (Crouse et al., 2018). All spinosine insecticide family has been extensively studied in recent years (Kirst, 2010).*Azadirachta indica* (*Azadirachta indica*) is a well-known natural insecticide for a long time and an innovation has been proposed, namely use as nano-capsules to avoid the damage to organisms such as *Trichogramma* sp. (Rampelotti-Ferreira et al., 2017). The application of these modern systems would aim at obtaining 1. Controlled release of substances; 2. Delivering to the target organisms of the active product, 3. Reducing the use of pesticides, 4 5. Detection of chemical residues, 5. Degradation of pesticides, 6. Nucleic acid release and avoidance of post-harvest damage (Khandelwal et al., 2016). New alkaloids have been discovered as topsentin and its compounds (Ji et al, 2016) that are effective against VMT, but also against 14 phytopathogens such as *Sclerotinia*.

Conclusions

The future of Integrated Pest management will include the use of bio control in order to reduce chemical pesticides. Main threat are the poor (yet) knowledge on mechanisms of action and long term impact evaluation, and the lobby of the powerful chemical pesticides companies. Anyway, the regulations at country level, and EU regulations and recommendations which are encouraging the use of biological control, support the idea of a future clean agriculture, better crop and quality products, required by food companies and by general public, consumers and NGO’s.

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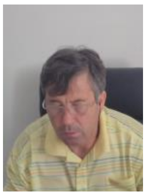

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