



## ACP- ACTAE Project

### Agroecological Crop Protection

### Action 3. Minutes of the ACP Workshop



**Hanoi, Agricultural Genetic Institute (AGI), Pham Van Dong Str.**

**April 25-26, 2017**



## Acknowledgments

*Many thanks to VAAS and NOMAFSI (especially Ms. Cam Lien and Dr Pham Thi Sen and her colleagues) that locally organized and hosted the Workshop.*

*Thanks to ACTAE project and AFD (French Agency for Development) for having funded local charges during the Workshop and travel costs and accommodation of non-Northern Vietnamese participants.*

*Thanks also to CIRAD (UMR PVBMT) that contributed to the organization and funding of this Workshop.*

## 1. Background

In South-East Asia in general and especially in Vietnam, agriculture faces a wide range of constraints, including the rapidly changing demand for agricultural production (quantity, quality and safety), the impacts of climate change, the impacts of inputs on health and the environment. Crop Protection has relied for a long time on agrochemicals but is now at a defining moment. Although pesticides have been condemned for many years, the problems encountered with this type of Crop Protection are becoming more frequent and acute: inefficiency in many situations; resistance to pesticides; soil, water, and air pollution; hazards to human health; and loss in biodiversity.

In this context, the challenge of agronomic research is: ii) now to move from this chemical-based approach to that of pest prevention with more balanced and sustainable agroecosystems; ii) to answer both the current questions (in particular to improve the socio-economic viability of the stakeholders) and those of tomorrow (in particular to design and implement ecologically sustainable agroecosystems). Agroecology appears to be an appropriate and relevant way to respond to this challenge.

## 2. Agroecological Crop Protection

Agroecological Crop Protection (ACP) is the declension of Agroecology to Crop Protection and it is at the crossroad of Agroecology and Crop Protection. It aims at “replacing” chemicals, which have negative effects on the environment and on human health, by the services offered by functional biodiversity above and below soil surface. By focusing on preventive measures, it aims at establishing a bioecological balance between plant and animal communities within an agroecosystem in order to prevent or reduce the risk of infections or outbreaks of pests’ outbreaks. ACP is based on 2 axes: i) enhance biodiversity (vegetal/animal) and ii) soil health. It is therefore very consistent and complementary to Conservation Agriculture, devoted to agroecosystem soil management. ACP is another field of agroecosystem field study and management, devoted to prevention and management of pests. It is now well documented.

The three pillars of implementation of ACP are sanitation, habitat management and biological control. New scales of intervention are considered, both in terms of space and time in accordance with participatory, global and systemic approaches. The implementation of the ACP principles to the field reality have shown good results in different parts of the world and some success stories have been described, for example in horticultural crops or fruit crops. Keys of agroecological transition are now available and can be adapted to different contexts, for example SEA context.

### **3. ACP-ACTAE project**

ACTAE is a regional project, funded by AFD (French Agency for Development) and Cirad, aimed at promoting agro-ecological principles and practices in Cambodia, Lao PDR, Myanmar and Vietnam. The overall objective of ACTAE project is to build sustainable and effective mechanisms to facilitate synergies among initiatives contributing to an agroecological transition in South East Asia between Research, Extension and Farmers.

The overall object of the “Agroecological Crop Protection (ACP)” under ACTAE project is, by starting and promoting activities in a new field of Agroecology, to contribute to the global development of Agroecology in SEA through 3 specific purposes: i) Making a state of the art of Crop Protection in the zone and identifying the priority issues of Crop Protection that must be taken into account; ii) Training and information exchanging on ACP for stakeholders (including training sessions and the organization of a regional Summer Scientist School); iii) Building the foundation of a ACP medium term project, integrating research, training, education and extension support (including already identified deliverables) with CANSEA partners.

We have to consider this project as a framework to start basic activities (survey, exchange of information, training) and as a leverage to build a medium term ACP research project for CANSEA (2020-2024), the platform on research and education on Agroecology in South East Asia, with current and new technical and financial partners.

Meetings and seminars planned in this proposal are destined to all ACTAE countries (Vietnam, Myanmar, Laos, Cambodia), such as workshops and Summer School (see below). But, taking into account the limited amount of the requested budget, this ACP proposal will particularly focus on developing partnership with two countries: Vietnam and Myanmar.

### **4. ACP Workshop (Hanoi, 25-26<sup>th</sup> April 2017)**

This workshop is dedicated to gathering partners on the same level of information, both on the current working research axes in Crop Protection and on the knowledge of ACP and its ins and outs. It is made up of training on ACP (around the following questions: What is ACP? What are the experiences available? What are the keys of the agroecological transition?), exchange of information on the status of Crop Protection priorities and local research axis, discussion on the progress of the collective paper, and contribution to the identification of the possible future orientations and area of work for a medium term collaborations. The workshop is performed jointly by local partners (researchers and teachers) and by CIRAD, in charge of the coordination of the ACP-ACTAE project.

The financial charges of the WS have been supported by the different partners. ACP-ACTAE project supports logistical charges of the Workshop, lunch (25<sup>th</sup> and 26<sup>th</sup> April) and convivial diner on the 25<sup>th</sup> April, travel and accommodation of the participants coming from South Vietnam (Can Tho Univ, Nong Lam Univ, SOFRI, IFAM) or other places than Hanoi (NOMAFSI).

## Workshop agenda

### **Day1. Tuesday 25<sup>th</sup> April 2017. State of the art. Current situation (i.e. where we are)**

#### **am (9:00-12:00)**

Opening session

Presentations on specific topics and presentations of Institutions

#### **Collective Lunch**

#### **pm (2:00-6:00)**

Presentations on specific topics and presentations of Institutions (continued)

Conclusion and main perspectives

#### **6:30 Convivial Diner**

*Ca Lang Song Hong Restaurant*  
*189 – To Hien Street, Hanoi*

### **Day 2. Wednesday 26<sup>th</sup> April 2017. Deliverables & Perspectives (i.e. where we want to go, what do we want to do)**

#### **am (9:00-12:00)**

Action 1. ACP Collective paper: structure and repartition of activities

Action 2. ACP Brochures & Flyers (English & Vietnamese)

Action 3. ACP WS. Minutes of the 1st ACP WS; Organization of the 3<sup>rd</sup> WS in South Vietnam

#### **Collective lunch**

#### **pm (2:00-4:00)**

Action 4. ACP-SEA-Summer School 18'

Action 5. Final Seminar of ACP-ACTAE project

Experiences on Agroecological Crop Protection

Conclusion and main perspectives

Closing session

## Opening Session

Vaas hosts the Workshop. Everybody greatly thank Mrs. Cam Lien (Vass) and Dr Sen (Nomafsi) for the local organization of it. Dr Cao Van (Cirad, ACTAE project leader) thanks VAAS for the welcome and the people and the staff in charge of this organization. He gives some words on ACTAE project (see presentation). Then Dr Deguine presents the program of the WS and also thanks the local organizers.

### Participants (cf annex 1)

24 participants attend the Workshop. The 15 organizations represented are the followings.  
Research Institutes and organizations (6): VAAS, PPRI, NOMAFSI, FAVRI, SFRI, SOFRI  
Universities (4): Nong Lam University, Can Tho University, Hanoi National University of Education, Hue University of Agriculture and Forestry  
Other Vietnamese partners (2): VOAA (Vietnam Organic Agriculture Association), IFAM (Nu Hoang Institute for Fruit Trees and Macadamia),  
International Organizations (3): CIRAD (International Center of Agronomic research for Development), CIAT (International Center for Tropical Agriculture, ACIAR (Australian Centre for International Agricultural Research)

## Presentations on Specific topics

Below are the titles of the presentations, with the name of the presenters, and some quick and non-exhaustive comments. All available files (manuscripts) are presented in annex 2.

### 1. Agroecological Crop Protection: concepts (JP Deguine, CIRAD)

- concepts and main principles of agroecology and ACP
- importance of socio-economic aspects
- importance of management of transition period
- importance of policy makers
- importance to share with all the stakeholders
- humility to be ready only in few years, after a transition period

### 2. Status of Plant Protection after the Innovative Period in Vietnam (Dr Lai Tien Dzung, PPRI)

- Before 1986, few pesticides and extensive cropping
- After 1986 (implementation of the “Đổi mới” policy): the agriculture moved to intensive cropping systems based on large mono-cropping areas by small stakeholders which increased of problems of pests, diseases and virus, like in a lot of countries and then the increasing use of pesticides becoming widely available with the opening market. Increase of number of pesticides and increase of problems of pests and virus, like in a lot of countries
- Numbers of poisoning accidents
- Bad impacts in Mekong Delta and everywhere in the country

### 3. Overview of Soil Management for Agriculture in Vietnam (Dr Nguyen Duy Phuong, SFRI)

- many research programs and a lot of knowledge but often with separated objectives
- these programs have focused on improvement of productivity, on improvements of nutrient elements and on soil physical properties rather than micro-organism population, good health of the soil, transformation function or interactions with pesticides
- suggestions: soil ecology approaches, how ecology approach to fit with local context? How to up scale in region level?
- challenges to move from cognitive and small scale research to integrative and upscaling research.

#### **4. Organic Agriculture in Vietnam. Main achievements and issues (Dr Pham Thi Sen, Nomafsi and Pr Pham Thi Thuy, VOAA)**

- lack of organic fertilizers source; lack of pest control measures; delay in profit generation: 3-5 years are required for ‘cleaning’ the lands; low yield at the beginning
- high labour inputs: intricate protocols for crop management and recording; high cost: lower yield, longer growth duration, increased (labour) inputs;
- limited understanding and awareness on OA products: confusion between organic and VietGap/safe products; unstable markets: local consumers are not ready to buy OA products because of their low trust in the products’ quality and also due to the high cost
- lack of national standards system and a feasible legal framework for production, certification and quality control of organic products

#### **5. Status of Academic Teaching in Crop Protection at Can Tho University (Pr Le Van Vang, Can Tho University)**

- Mekong Delta is a key economically agricultural region of Vietnam
- requirement on agriculturally professional human resource is high
- agricultural education and training is an imperative demand (BSc, MSc and PhD)

#### **6. Academic Teaching in Crop Protection in Nong Lam University (Dr Le Khac Hoang, NLU)**

- established: 1955 - founding faculties of the University; 7 departments ( Plant Physiology and Biochemistry, Plant Genetics and Breeding, Plant Protection, Soil Science and Fertility, Water Management, Industrial Crops, Horticulture and Food Crops)
- Agronomy faculty: Education: Undergraduate programs (4 years) (Agronomy, Plant Protection); Master of Science & PhD programs (Crop Science, Plant Protection)
- International Cooperation: working with scientists, researching institutes, universities, NGOs: World bank; JICA, IRRI, ACIAR, CIAT, FAO...

#### **7. Plant Protection on Fruits in the South of Vietnam (Tran Thi My Hanh, Nguyen Thanh Hieu, Dang Thi Kim Uyen and Nguyen Van Hoa)**

- some priorities: identify and develop technical protocols of some new emerging insects and diseases; develop commercial productions base on benefit microorganisms plant extracts, safety chemicals using, etc.; study on using mild virus strain to have cross-protection on a number of fruit species; develop biology products; increase pest resistance hybrids of fruits and vegetables; study and develop a concept “agroecological system crop protection” into production

## **8. Research in Plant Protection in Vietnam (Mr Nguyen Nam Hai, PPRI)**

- some issues: insect vector transmitted virus/bacteria, virus/Phytoplasma/bacteria diseases, soil-borne pests and diseases, climate change, resistance to pesticides;
- priorities for Research: conservation agriculture, novel approach to reduce pesticides, mass producing and application lab products, molecular diagnostic, breeding program, capacity building for young researchers.

## **9. Fruit and Vegetables health and proposals relevant with ACP in Sofri (Nguyen Thi Ngoc Truc and Nguyen Van Hoa)**

- . Biocontrol: Biocontrol for pre and postharvest pest and diseases on fruits and vegetables (Golden ant; Trichoderma, Cheatomium; Biocontrol bacteria)
- PGPR: Nitrogen Fixing Bacteria; Phosphate solubilizing bacteria; IAA releasing bacteria; Cellulose degraded bacteria; the combination of different clone of PGPR
- organic horticulture: Enhancing biodiversity is an important factor leading in the system of organic agriculture; Promoting research and application of crop varieties with high adaptability to climate change, extreme conditions; Increase strengthen the research process of sustainable organic farming for specific crops and specific regional land; Strengthening farmer training, organic demonstration.

## **10. Crop protection in the Central Highlands, Vietnam (Dr Dinh Thi Yen Phuong, IFAM)**

- Major crops: coffee, pepper, rubber, cashew, durian, macadamia, avocado, passion fruits...
- Major issues: Phytophthora, Colletotrichum, thrips, stinky – mealy - mosquito bugs, stem borers, nematodes, sunburn...
- Managements: free pathogen seedling, well-drain, mounding, mulching, balanced nutrients, bio-control, reasonable chemical control...
- Macadamia Queen and IFAM: produce at large scale, provide free-pathogen seedling, training, consultancy services, demonstration sites...

## **11. Some orientations in the activities in Nomafsi (Dr Nguyen Van Thiep, NOMAFSI)**

- before 2016: only tea, now we work also on other crops and production systems focusing on slopping land conservation while improving livelihoods, economic profits and environmental protection
- necessity to reduce pesticides, especially for tea (tea exportation / regulation for pesticide residues)
- develop organic tea
- develop some bio-organic pesticides and fertilizers for tea and also for other crops (Ketomium, Trichoderma...)
- shading trees with multi-use proposes

## **12. Training and Research on Crop Production in Hue University of Agriculture and Forestry (Pr Tran Dang Hoa, Hue UAF)**

- Proposals for ACP: education(integration in Agricultural Curricula (BSc and MSc) of ACP); training (ToT and FFS, extentionist and farmers); Research: Biological control, Botanical



pesticides, Bio-fertilizers, Pest resistant variety, climate change adaptation, Field demonstration

### 13. Activities promoted by ACIAR (Dr Oleg Nicetic, ACIAR)

- in ACIAR, PP activities are re-beginning
- important issue: to meet plant protection and soil management research activities

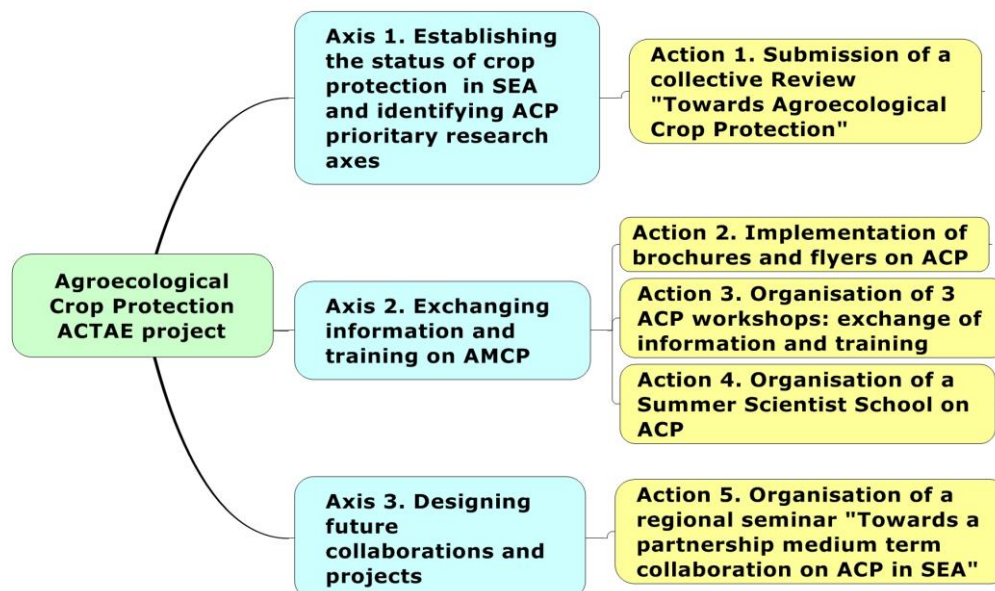
### 14. CIAT- Building critical response capacity to tackle invasive pests & insect-vectored diseases at the Southeast Asia regional level (Dr Kris Wyckhuys, CIAT)

- cassava phytosanitary update: invasive pests & emerging diseases (Cassava mealybug complex; Cassava witches broom; Cassava mosaic virus);
- current regional cassava IPM efforts: Benchmarking; Applied research; Capacity building; Agricultural extension & adult education)
- Fomenting strong partnerships and building critical capacity to prevent & mitigate pest attack

### 15. Main activities in Hanoi National University of Education (Dr Tran Thi Thuy, HNUE, Faculty of Biology)

#### Deliverables and perspectives

The three axis of the ACP-ACTAE project result from the three specific objectives listed above and give 5 actions.



## ACP-ACTAE project / Action1. Collective paper

During the Workshop, participants agreed on a proposed structure of the paper. The plan of the paper is given in annex 3. For each chapter, there are one or two coordinators, and several contributors. Each coordinator has in charge to submit a first draft of its chapter for the 15 August 2017. Another point will be done during the 3<sup>rd</sup> ACP Workshop in South Vietnam.

### Coordination and contribution for the collective paper

Part or chapter of the paper	Coordinators	Email address	Contributors*	Email address
Introduction	Dr Cao Van	<a href="mailto:Caovan@cirad.fr">Caovan@cirad.fr</a>	Dr Deguine	<a href="mailto:degumine@cirad.fr">degumine@cirad.fr</a>
1. An expected evolution from Green Revolution to Agroecology	Dr Le Khac Hoang	<a href="mailto:Lkhoang75@gmail.com">Lkhoang75@gmail.com</a>	Dr Wyckhuys Dr Phuong Dinh	<a href="mailto:k.wyckhuys@cgiar.org">k.wyckhuys@cgiar.org</a> <a href="mailto:phuong.dinh@wsu.edu">phuong.dinh@wsu.edu</a>
2. Chemical Crop Protection and impact	Colleagues from PPRI** Lai Tien Dung Nguyen Nam Hai	<a href="mailto:dung1172@gmail.com">dung1172@gmail.com</a> <a href="mailto:hainguyen309@gmail.vn">hainguyen309@gmail.vn</a>	Pr Thuy Thi Tran Pr Tran Dang Hoa	<a href="mailto:Thuy_tt@hnue.edu.vn">Thuy_tt@hnue.edu.vn</a> <a href="mailto:trandanghoa@huaf.edu.vn">trandanghoa@huaf.edu.vn</a>
3. IPM and IPM related experiences and limits	Pr Le Van Vang	<a href="mailto:lvvang@ctu.edu.vn">lvvang@ctu.edu.vn</a>	Tran Thi My Hanh Nguyen Thi Ngn Truc	<a href="mailto:Hanhvcaq7@gmail.com">Hanhvcaq7@gmail.com</a> <a href="mailto:trucsofri@gmail.com">trucsofri@gmail.com</a>
4. Basis of ACP and perspectives in Vietnam	Dr Deguine	<a href="mailto:degumine@cirad.fr">degumine@cirad.fr</a>	Dr Pham Thi Sen Dr Nguyen Duy Phong	<a href="mailto:phamthisenprc@gmail.com">phamthisenprc@gmail.com</a> <a href="mailto:ndpptn@yahoo.com">ndpptn@yahoo.com</a>
Conclusion	Dr Cao Van	<a href="mailto:Caovan@cirad.fr">Caovan@cirad.fr</a>	Deguine Jean-P	<a href="mailto:degumine@cirad.fr">degumine@cirad.fr</a>

\* *Everybody is welcome to add his name and to contribute to a part. He has to contact the coordinator.*

\*\* *When we discussed on the collective paper, no representative of PPRI was present. Dr Thi Sen (Nomafsi) proposed that this part could be coordinated by colleagues from PPRI and everybody agreed with that.*

Participants also agreed on the relevance to use the final collective paper (submission proposed at the beginning of 2018) for a declension to a booklet, that can be useful for policy makers, trainers, professionals,

## ACP-ACTAE project / Action 2. Brochure and flyers

A brochure on ACP in English was presented, proposed and agreed by the participants. The next step is to share this brochure by email, to modify it and to adapt to the Vietnam context, to valid it, and to translate it in Vietnamese. The first page of this brochure is given in Annex 4.

Some flyers can also be designed and implemented. Dr Pam Thi Sen proposed that we build a list of the potential topics of flyers that could be useful for professionals.

### **ACP-ACTAE project / Action 3. Workshops**

After the 1<sup>st</sup> Workshop held in Hanoi, the 2<sup>nd</sup> one will be organized in Nay Pyi Taw (Myanmar) on the 3<sup>rd</sup> and 4<sup>th</sup> May 2017.

The 3<sup>rd</sup> Workshop will be an International Workshop and it will be organized in the South Vietnam on the 29<sup>th</sup>, 30<sup>th</sup> and 31<sup>st</sup> August 2017. Participants from Myanmar, Laos, and Cambodia will attend the Workshop. In addition, some Vietnamese colleagues from the other parts of Vietnam than the South will also attend this 3<sup>rd</sup> Workshop. Some institutions (SOFRI, Nong Lam University, Can Tho University) proposed to host this Workshop. Dr Cao Van, head of the ACTAE project, will give soon the final decision.

### **ACP-ACTAE project / Action 4. ACP-SEA-SS18' (Agroecological Crop Protection – South East Asia – Summer School 2018)**

An International Summer School on Agroecological Crop Protection (ACP) will take place from 12 to 16 March 2018 in South-East Asia. Pr Le Van Vang proposed that Can Tho University hosts this event and the participants agreed with this proposal. The general objectives of the summer school are to know about and jointly exchange the principles of ACP and to understand the concepts, methods and tools for their implementation. Specific sub-objectives are to:

- Acquire the scientific principles of agroecology and ACP;
- Share practical experiences of ACP implementations and identify subsequent generic recommendations adaptable to different crops under various production situations;
- Adapt and prepare for the necessary changes in the profession of researcher: areas of knowledge to invest or to deepen; have a good command of tools (notably modelling); multidisciplinary approaches to adopt
- Engage in a collective dynamic of ACP and develop collaborations and research projects, with eventual deliverables - videos, articles, and training resources - consistent with this dynamic.

The programme of ACP-SEA-SS18' (12-16 March 2018) is the following (the detailed program will be available soon):

Day 1: introduction and ACP principles

Day 2: modelling for ACP

Day 3 : experiences and case studies - agroecological field trip

Day 4: development of research in ACP

Day 5: ACP-SEA-SS18' wrap-up and follow-up

### **ACP-ACTAE project / Action5. Final Seminar**

Finally, a regional final seminar will be organized at the beginning of 2018, the week after the ACP-SEA-SS18' (in order to reduce the costs), with 2 to 3 representatives per country and representatives from international organizations (about 14 participants) in order to identify perspectives of collaboration and structure of a medium term. This Seminar will be held in Vietnam from the 19<sup>th</sup> to the 21<sup>st</sup> Marc 2018.

## Closing session

In the closing session, thanks were addressed to the organizers of the Workshop, especially to Vaas (Mrs. Cam Lien) and to Nomafsi (Dr Thi Sen and her colleagues), and to all the participants. Then the session stressed on the quality of the exchange of information and the motivation of the participants during with Workshop.

*Group photography was done after the Workshop on the 26<sup>th</sup>, but a little bit too late: most of the participants had already leaved the Workshop to go back home...*



**Annex 1. List of participants (ACP-ACTAE Workshop, Hanoi, 25-26 April 2017)**

Name	Institution	Email
Ms Nguyen Phuoc Cam Lien	VAAS	<a href="mailto:camliennp@gmail.com">camliennp@gmail.com</a>
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Dr Nguyen Duy Hung	FAVRI	
Dr Lai Tien Dung	PPRI	<a href="mailto:dung1172@gmail.com">dung1172@gmail.com</a>
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Dr Jean-Philippe Deguine	Cirad	<a href="mailto:deguine@cirad.fr">deguine@cirad.fr</a>

24 participants, 15 institutions:

Research Institutes or organizations (6): VAAS, PPRI, NOMAFSI, FAVRI, SFRI, SOFRI  
Universities (4): Nong Lam University, Can Tho University, Hanoi National University of Education, Hue University of Agriculture and Forestry  
Other Vietnamese partners (2): VOAA (Vietnam Organic Agriculture Association), IFAM (Nu Hoang Institute for Fruit Trees and Macadamia),  
International Organisations (3): CIRAD (International Center of Agronomic research for Development), CIAT (International Center for Tropical Agriculture, ACIAR (Australian Centre for International Agricultural Research))

**Agroecological Crop Protection: concepts  
Jean-Philippe Deguine (CIRAD)**

**Applying Agroecology principles to Crop Protection**

The evolution of crop protection has been described by many authors; it has relied on different concepts, the most emblematic of which is certainly that of IPM. Since the last decades of the 20th century, researchers and practitioners have reduced the use of chemical pesticides in particular because of its economic, health and environmental costs (decreased efficacy, toxicity to producers and consumers, environmental pollution). This reduction in use of agropharmaceutical products has been accompanied by the development of so-called agroecological solutions based on ecology.

The agroecological design of an agroecosystem rests on two main guidelines: maintaining local biodiversity and soil health. These two key elements ensure the ecological dynamics of the agroecosystem and thus its sustainability. The basic principles of agroecology allow this sustainable approach. Human activity (agriculture) is considered a necessary disturbance of the natural ecosystem. A concerted and reflective agroecological action aims to minimize the impact of this disturbance by preserving or restoring the biodynamic balances that govern the sustainability of the agroecosystem.

Taking up these two main thrusts of agroecology, the application of agroecology to the protection of crops has been addressed since the early 2000s by various authors. It is based on two axes of management:

- incorporation of plant diversity in time and space (in the form of habitat management);
- improvement of soil quality (organic matter, biological function), through ecologically sustainable cropping practices unfavorable to pest development.

**ACP Definition and Implementation Strategy**

Deguine *et al.* (2009) define agroecological crop protection as a system of crop protection founded on the science of agroecology. By favoring preventive measures, it establishes bioecological balances between animal and plant communities within an agroecosystem with the aim of preventing or reducing infestations or outbreaks of pests. ACP covers all pests (insects, pathogens, weeds). It emphasizes (among the classical techniques mobilized within the framework of integrated pest management) optimization of cropping practices and management of plant populations to favor the maintenance or creation of habitats favorable to the useful indigenous fauna and / or unfavorable to crop pests. Agroecological protection, besides management of plant populations (crops and non-crop plants in the vicinity of plots, in the agroecosystem as a whole), also includes management of other organism populations, mainly arthropods such as pests, diverse natural enemies and pollinators and other soil invertebrates such as earthworms and collembola, as well as pathogen agents. It is known that diversified agroecosystems have fewer generalized or specialized pests and more natural enemies.

ACP involves concerted action between relevant professionals including farmers and other land managers. The use of curative techniques can only be considered as a last resort and only in the case of absolute necessity, as long as it does not disturb functional biological groups providing ecological services. The future of pesticides seems to be limited, at least in their present form; many are already subject to environmental and toxicological restrictions. Sanitation, through cropping management, habitat management and biological control, are the main effective components of crop protection.

IPM is a combination of techniques, and ACP uses the scientific understanding of agroecology (Gliessman, 1997), in particular knowledge of biology and ecology and integrating this knowledge into practices (taking account, at different spatial and temporal scales, of functional biodiversity, the ecological function of agroecosystems). In operational terms, this agroecological methodology results in a systemic and orderly approach.

Based on this agroecological approach, Deguine *et al.* (2009) propose a phytosanitary strategy adapted to the sustainable management of agroecosystems. In this approach, the essential stage, chronologically following on from regulatory measures and before considering curative approaches, is the priority implementation of preventive measures through the management of plant populations (cultivated or uncultivated):

- cultivate healthy plants and ensure good soil health, via sanitation, the use of adapted varieties, crop succession and crop rotation, technical itineraries such as direct seeding mulch-based cropping systems with minimal tillage, management of grass cover, fertilization, irrigation and organic amendments;
- reduce pest populations and increase natural enemy populations (at the scale of the plot, its surroundings, the farm and the whole agroecosystem) through crops or trap plants, refuge zones, associations and intercropping, push-pull techniques, field border management, development of ecological compensation structures (corridors, hedges, herbaceous and flower strips), techniques to promote plant diversity;
- encourage concerted practices, both in time and space, within agroecosystems.

In addition, ACP is systematically studied at different spatial and temporal scales, ranging from local agronomic practices to integration into the landscape, bringing it closer to the area-wide pest management concept which is strongly linked to landscape ecology. This is one of the reasons why its effectiveness must be measured in a farming environment, on small or large areas depending on the situation and on significant timescales. Figure 1.9 shows the seven main features of ACP.

### **Conservation Biological Control**

The IOBC (International Organization for Biological Control) defines biological control as the use of living organisms to prevent or reduce crop loss or damage caused by pests. Biological means available include, for example, living organisms (mites, insects, nematodes, bacteria, fungi and viruses). There are three types of biological control:

- classical biological control (or introduction / acclimation), which includes identification of indigenous and exotic natural enemies, introduction and acclimatization of exotic natural enemies, use of natural enemies to eliminate crop pests;
- augmentation biological control, including raising and releasing natural enemies (as many times as necessary), to eliminate pests when a natural enemy is present but its number insufficient to ensure elimination (three components: inoculation, augmentation, flooding);

- conservation biological control, including all measures taken to conserve indigenous natural enemies, preventing their destruction by other practices and increasing their effectiveness, in particular through habitat management. Intermediary measures or use of a mixture of the types of biological control are also possible (e.g. autocid control).

Long underused and less studied than augmentation biological control in agricultural environments (introduction and release of natural enemies), conservation biological control has become an essential component of biological control. It is based on the management of plant populations (management of arthropod habitats) in the same way that conservation biology is based (in natural environments) on the management of habitats or animal species to be protected or promoted. These two approaches can thus be brought together and the boundaries of biodiversity management in space can be reduced. Thus, agronomists protect crops, ecologists manage protected species, and hunters manage game populations and together they lead a concerted action in the management of habitats.

The implementation of conservation biological control relies on three techniques:

- eliminating or significantly reducing insecticide treatments on crops and herbicides in agroecosystems;
- introducing plant biodiversity into agroecosystems by creating unfavorable habitats for pests and / or favorable habitats for natural enemies, e.g. permanent ground cover, trap plants, refuge plants for natural enemies;
- adapting cropping practices for crop management and management of new habitats.

These examples focus on pest management, but it is important to note that ACP takes into account all crop pests and also targets weeds and pathogens responsible for different diseases. Promoting population management through sustainable organization of habitats, biological control is based on new agroecological ideas likely to increase its efficiency and reliability (Landis *et al.*, 2000; Nicholls and Altieri, 2004). This approach also supports the traditional methods of introduction-acclimatization or biological treatment, favoring the implantation of artificially introduced natural enemies in agroecosystems. It is likely to provide an operational response to the demand for the preservation of biological diversity and is respectful of the environment and valorizes landscapes. It requires a significant change in agricultural practices including uncultivated areas. The role of agronomists is thus determined by an adaptation of cropping systems and technical itineraries.

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# MAIN FINDINGS IN THE RESEARCH AND TECHNOLOGY TRANSFER ACTIVITIES OF PLANT PROTECTION RESEARCH INSTITUTE FROM 2013 TO 2015; AND RESEARCH ORIENTATION IN THE PERIOD OF 2016-2020

## 1. Introduction

The Vietnamese government has determined that agriculture sector would be the competitive advantage comparing to other agricultural products from other countries in the world. Recently, many agricultural products of Vietnam have been listed on the top exporting products in the world such as rice, coffee, black pepper, etc. And this has significantly contributed to national GDP. So far, many policies have been issued to develop agriculture sector which included crop restructuring. This effort was to increase product's value for the sustainable development based on the value chain. Also, technical standards have been published to facilitate production that meets VietGAP, GlobalGAP's demand serving for export, and adapt to climate change. However, Vietnamese agriculture is still dealing with many problems including epidemic pest and disease that reduced yield impacting to income and livelihood of the farmers.

Plant Protection Research Institute has a national mandate to solve the problems regarding pest issues with minimal environmental impacts, improve income for farmers, contributing to ensuring the national food security and national target program as well. Recently, our research activities are focusing on some main group of crops such as:

- Food crop: rice virus diseases (Rice Ragged Stunt Virus - RRSV, Rice Grassy Stunt Virus - RGSV...) in the south; Southern Rice Black-Streaked Dwarf Virus damages on rice and maize. Some common diseases that frequently cause damage on rice such as bacterial blight, blast, sheath blight. Virus transmitting vector: brown plant hopper (BPH), white back plant hopper (WBPH)... Witches' broom disease on cassava.
- Fruit crop: Huanglongbing and tristeza on citrus; witches' broom on longan; brown spot on dragon fruit; Fruit flies on fruit and vegetable (especially impact on export of citrus, dragon fruit, etc.)
- Black pepper: quick wilt and slow wilt disease are generating in the producing area in the Central Highland, Central, and Eastern part of the South.
- Coffee: nematode, mealy bugs, weevil currently are the serious epidemic pest.
- Rubber tree: white powder mildew, yellow falling leaf.
- Forestry industry: hairy caterpillar on pine and so on.

Those research have been timely contributing to catching up with recent bulging problems in the field production serving for crop protection.

## 2. Main findings from 2013 to 2015

### 2.1. Preserve and maintain national sample collection

#### **Preserve the national sample collection**

Identified and preserved some insect fungi on cicada such as *Paecilomyces cicadae*, *Normura cylindrospora*. Fungus *Metarhizium anisopliae* was found parasitizing on sugarcane beetle and capricornbeetle in Thanh Hoa and Gia Lai province.

Described the symptom and determined factor leading to brown spot disease on dragon fruit was *Neoscytalidium dimidiatum*. The wilt symptom on tomato, cucumber, chilli was a consequence of infestation by the soil-born fungus *Fusarium oxysporum*.

## Investigation of pests and diseases

Recorded the generating of brown plant hopper, small brown plant hopper, white-back plant hopper... on rice, bacterial leaf spot on cassava in Bia Ria Vung Tau, Dong Nai, Binh Duong, Binh Phuoc, Tay Ninh. Brown spot on dragon fruit was present in a wide range in Binh Thuan, Tien Giang. Sugarcane white leaf disease resulted from phytoplasma infestation was recorded in Khanh Hoa in 2013.

Two main Tephritids fruit flies damage on dragon fruit identified were *Bactrocera correcta* and *Bactrocera dorsalis*.

The outbreak of *Shizocera* sp. feeding on leaves of *Manglietia conifera* (Magnoliaceae) was recorded in Bac Kan in 2013 and black parasitic wasp *Epiclerus* sp. could be used for biological control of *Shizocera* sp.

The Crambids stem borer (*Chilo tumidicostalis*) caused serious damage on sugarcane in Tay Ninh province in 2014.

The spider mite *Eriophyes dimocarpis* Kuang was found on longan parallel with the appearance of witches' broom disease. 370 samples of scale belonging to 35 species have been collected in fruit crops. It included mango, citrus, coconut, avocado, banana, custard apple, guava, rambutan, durian cultivating in Hanoi, Hung Yen, Hai Duong, Bac Giang, Hoa Binh, Hai Phong, Vinh Long, Tien Giang, Ben Tre, Can Tho.. And gene sequencing has been analysed for 25 scale species.

### 2.2. Fundamental research

Studied on BPH collected from 17 provinces belonging to 7 ecological regions to determine BPH bio-types.

Identified the disease of rice transitory yellowing virus (RTYV) transmitted by green paddy leafhopper in Hiep Hoa, Bac Giang province

Sequencing 105 different locus gene of RGSV (30 P3, 30 PC3, 30 P5 and 15 PC5)

Cassava crop: concentrated on witches' broom and anthracnose (or black spot) disease.

Anthracnose disease caused by *Glomerella cingulata* (sexual period) and *Collectotrichum gloeosporioides* (asexual period). Witches' broom spread through propagation.

Fungi *Phytophthora infestans* causes late blight disease on tomato and chili, three other fungi *Colletotrichum gloeosporioides*, *Colletotrichum capsici*, *Colletotrichum nigrum* led to anthracnose symptom on chili can be isolated in PDA rearing environment in the condition of temperature 26°C-28°C, pH 6,5 and continuously illuminated.

Successfully reared peanut borer *Maruca vitrata* by artificial food.

The symptom of leaf yellowing and falling on rubber tree dues to fungus *Corynespora cassicola*. Potato Dextro environment can be used to culture this fungus.

And other research on cocoa, nematode on coffee and black coffee, mealy bugs on sugarcane.

### 2.3. Evaluation and selection of resistance varieties

- Rice varieties resist to BPH: results of evaluating 86 rice varieties in Nam Dinh, Phu Yen, ghe. An acquired three varieties that showed high resistance and 9 resistant varieties including N5- 05; N4-05; PC10; X38; X39; X40; TH3-3; BC15 and CR84-1.

- Rice varieties name Timuyang and Babelit could remain its resistance to RRSV and RGSV after three generations of infestation.

- Chilli variety Chang-la-qi-hao and Sakata could resist to late blight (*Phytophthora infestans*) and tomato variety Nun02258 was the best. Tomato varieties that resisted to bacterial wilt were 3963.

- Introduced three sugarcane varieties from Sri Lanka resisting to Ramu stunt disease caused by phytoplasma. It's now on test progress.

#### *2.4. Applied research*

Research focused on optimising procedure for mass producing bio-products including addition ingredients, preservation to keep the density of spore/ crystal in the products (fungus, bacteria, virus...). It concentrated on products for controlling pest on rice, chili, tomato, potato, groundnut, citrus, coffee, black pepper, cocoa...

Establishment of technical procedures for pest management was recognised by government, MARD...

Some varieties was certified such as upland rice LC93-4 (Decision no. 319/QĐ-TT-CLT on 31/7/2013 issued by MARD), groundnut TK10 (Decision no. 359/QĐ-TT-CCN on 23/9/2009 for testing process, and officially recognised in 10/2013)

Design map and model for pest prediction: ARIMAXX model for predicting outbreak of pest on rice, dragon fruit and coffee; 02 maps for drought distribution and adaptation of selected rice varieties; 03 maps with scale 1:1,000,000 for warning BPH dispersal on rice, brown spot disease on dragon fruit and scale on coffee based on climate change scenario.

#### *2.5. Transfer science and technology*

Organising five short training courses for delegations from university, college, PPSD, Local Science and Technology Department, other institute and center belong to VAAS.

Organising TOT, field trip.

Publish brochure, leaflet and issued scientific paper.

### **3. Research orientation in the period from 2016 to 2020**

1. Basic research of new pests.
2. Establish and implement research program on plant protection serving for crop restructuring and national target program.
3. Research to predict main pests on primary crops.
4. Research and propose scientific and technology solution for sustainable development for agriculture sector contributing to increasing crop productivity, quality that meet demand for safe product and friendly to the environment.
5. Selection and development of varieties that can resist to pest, disease and adapt to climate change.
6. Application of high technology in research. Establishment of procedures for mass producing of bio-product, botanical pesticide.
7. Strive to bring PPRI becoming the top leading research institute on plant protection in the region and actively involves in training activities for human resources.
8. Development of communication for Plant Protection (improve quality of Plant Protection Journal); establish the standard method for pest and disease research and selecting resistance variety.
9. Facilitating international cooperation, especially new research method that apply high technology.
10. Capacity building for staff in applying molecular biotechnology for research and transfer science and technology.

### **4. Propose to ACP.**

- Capacity building: gain knowledge on agroecological crop protection for farmers, extension officers, and young researchers.
- Establish ACP demonstrated trials
- Research and develop novel bio-products for multi purposes (fertilizer and pest control combined)

## Organic farming in Vietnam: main achievements and issues

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Organic agriculture (OA) is a very new concept in Vietnam despite traditionally our farmers practiced crop and animal production without use of any synthetic chemicals. Only until late 1990s organic products meeting the IFAOM standards started to enjoy attention in Vietnam, and initial focus was just on some widely growing plants products. According to FiLB, in 2010 Vietnam had 19.272 ha of OA, representing 0.19% of the total agricultural land. The figure increased to about 43.000 ha in 2014 and over 76.000 ha in 2015. Small amount of OA products have been exported to Japan, German, UK, America, Taiwan, Russia, and Singapore...[1; 2].

With growing concern about the food safety, environment pollution and land degradation, increasing efforts have also been spent for organic agriculture in Vietnam; more and more organic farms have been created and OA products supply systems established. Most efforts and achievements have been recorded for vegetables and rice, followed by some fruits and animals (pig, chicken, cow and fish). PGS Vietnam was established with support from the ADDA-VNFU organic project, and 5 provinces, including Ha Noi, Ha Nam, Hoa Binh, Quang Nam and Ben Tre, have developed PGS system. Preliminary survey data [3], show that there are 18 private enterprises obtained USDA-NOP certification, 12 others obtained EC 834/2007 certification (5 of them have both UADA-NOP and EC certifications). The government of Vietnam aims to promote OA as one of the main sustainable development orientations of agriculture, as specified by MARD and MOST leaders at the conference discussing measures to promote the production and consumption of organic products, held in Hà Nội on April 4, 2017.

### 1. Organic agriculture systems in practice

#### • Vegetables

So far vegetables enjoy the most attention for production and trading of organic products. This is because vegetables are largely consumed in Vietnam and their safety is of great concern of both consumers and decision makers. Estimated, annually 714 tones of organic vegetables have been produced and supplied to indoor markets, and the PGS-Vietnam has granted PGS certification for around 40 groups of 298 farmers who produce organic vegetables in a total area of 27.8 ha [3].

In the North, the most well known OA vegetable group in the North is Thanh Xuan cooperative (Soc Son district, Ha Noi city) which has over 150 members, around 17 ha of land and daily supplies about 2 tones (400 tones/year) of vegetables to Hanoi market and some small amount to Japan and France [4]. There are also other vegetables groups with PGS-Vietnam certification in the North, but with much smaller scale, such as the Trac Van group in Ha Nam province (19 members, 3 ha), and 16 groups in Hoa Binh (with 114 members, 6.6 ha of land in total) [5;6].

In the south, only Ben Tre province has PGS system, and in this province there are 3 organic vegetables groups, one is with 2 members and the other two each are with 4 members. In their relatively small land area (less than 1.000 m<sup>2</sup> per group) around 30 types of vegetables are produced and supplied to Ho Chi Minh City market [7].

In the Center, Thanh Đông group in Hoi An city, Quang Nam province (8 members, 6.500 m<sup>2</sup> of land), the only group with PGS certification in the region, produces and supplies vegetables to Hoi An market [8].

**There are also OA vegetables groups with USDA-NOP and/or EU certifications**, such as Organica in Long Thanh district, Dong Nai province [9], Organik Dalat farm in Lam Dong (Organik Dalat Co.), and Phu Dien Green Farm in Ca Mau province.

In addition, there are also individual farmers and enterprises producing vegetables following organic protocol but have yet been registered. An example is an organic farm in Lâm Đồng [10], which was established in 2010 by Nguyen Quoc Thang. The JSC Kei's (Japan) recently started to invest for organic vegetables in the center of Vietnam (11).

- **Rice**

Organic rice is now being developed in many provinces in the south and center of Vietnam. In almost all provinces in the Mekong delta there is some organic rice area. In total, in winter-spring crop of 2016-2017 there are about 1.000 ha of organic rice in this delta [12]. Some amount of rice have been processed according HACCP standard and sold under the trademark “safe rice Tam Viet” [13]. The Control Union Vietnam has granted Bio organic certification and AUSDA certification for organic rice supplied by JSC Vien Phu (Ca Mau). In 2012 this JSC already supplied over 1.000 tones of organic rice [14].

**In the Center inputs have also been spent for organic rice in many provinces (Da Nang, Thua Thien Hue, Quang Tri, Quang Binh ...) with the support of Que Lam Ltd [15; 16].**

In the North, just few initiatives have been recorded in Ha Noi. In 2012 farmers in Chuong My district started to develop organic rice with support from a JICA project (PAMSI), and in 2017 in this district about 40 ha of organic rice are aimed at (20 ha in spring and 20 ha in summer crop).

- **Fruits and other crops**

Most inputs on fruits so far focused on citrus. With support from ADDA project, pomelo group with PGS certification have been developed in Hoa Binh [17] and Ben Tre [18]. Some farm without PGS certification have also been developed, such as 8.7 ha organic pomelo (Buoi Dien) farm of Mr. Luyen Huy Sao in Bac Giang [19]. Organic orange farm have been developed in Tien Giang [20], and organic litchi in Bac Giang [21].

Some other crops, such as tea and sugarcane have also gained some attention. Ecolink has obtained EU certification for Shan Tuyet tea. Nhân Ý Tra, an organic tea has been developed by a NOMAFSI research team. Of sugarcane, there are 20 ha of organic farm developed by Bien Hoa-Thanh Long farm in Tay Ninh province.

- **Animals**

So far pigs and chicken have enjoyed most attention. With support of ADDA projects organic chicken and organic pig groups with PGS certification have been developed in Hoa Binh province [1]. There are also others farms, such as Bao Chau organic pig farm, in Soc Son, Ha Noi; Mr. Tam's chicken farm in Ba Vi, Ha Noi [22].

Regarding cattle, the diary cow group in Trac Van (Ha Nam) has PGS-Vietnam certification and annually provides over 2 mil. liters of organic milk to Ha Noi market [7]. The only organic diary cow farm has recently been launched in Da Lat, Lam Dong by Vinamilk obtained EC and Control Union Ha Lan certification[23].

For aquaculture, since 2006, ADDA project has supported Hai Phong to develop a model of organic production involving 20 households. In the South, organic aquaculture products are produced in organic rice fields, either at the same time with rice crop or after harvest of rice

- **Integrated systems**

In addition to the above mentioned farms and groups producing and supplying certain products there are also integrated systems where diverse products (including vegetables, fruits, pigs, chicken, fish) are produced, such as Hoa Vien farm in Ha Noi [25], Vien Phu Green Farm in Ca Mau [26] and Orfarm in Luong Son, Hoa Binh [27]. Integrated systems may have diverse designs and are similar to VAC/VACR or mixed gardens systems.

- **Certification and markets**

Vietnam has not yet a feasible quality certification and control system. In 2015 MOST issued national standards TCVN 11041:2015 on production, processing and labeling OA products, but these standards have not been widely publicized, and not all in use. Currently not much organic products have been certified. The main certification is PGS-Vietnam (about 300 farmers of around 40 groups). Some producers got EU, and/or USDA-NOP certification, such as OrganikDalat in Lam Dong, Organica in Dong Nai...; and some got UNIDO Green products certification by SPIN project, e.g. Nguyen Van Thuan farm in Ba Vi, Ha Noi.

A number of enterprises (retailers, Ltd and JSC) have been involving in trading and supplying organic products. In Hanoi only, there are over 20 retailer systems for organic vegetables and fruits. For rice there are Saigon Co-op, Co May Ltd. and Phu Vien JSC in the South, Que Lam Ltd in the Center and some supermarkets in Ha Noi. In additions, organic farms themselves often have their own supply channels such as Orfarm, Organik Dalat, Mr. Tam, Ms. Thảo...

It takes time and efforts to develop links with markets and thus, at the beginning products have not been able to be sold at higher price. Therefore farmers may not be able to continue with organic agriculture. For example, in Ben Tre, many farmers were supported to produce organic vegetables, but now each group has only 2 or 4 members.

## **2. Institutions and communication**

With support of the ADDA - VNFU organic project, 2004 – 2012, PGS-Vietnam has been developed, and in 2012 VOAA (Vietnam Organic Agriculture Association) was formed and since then has been operating as a member of the International Federation of Organic Agriculture Movements (IFOAM).

Involved in research and development of OA are many research institutions, universities, farmers union, women association, extension network and decision makers at ministerial level (MARD, MONRE and MOST in particular) and at the provincial and district levels. There are also NGOs supporting farmers and institutions in this field, such as ADDA, VECO, GTZ and RDA. The Institute of Vietnam Organic Agricultural Economics (VOAEI) was formed a few years ago and is based in Ho Chi Minh City, and the Center for Organic Agriculture Promotion and Studies (COAPS) of VNUA is being developed.

Trainings (FFS and other training sessions) have been organized by projects, farms and institutions for farmers, students and extension officers. There are also newsletters of Vietnam PGS, fanpages of organizations (VOAA, VOAEI, VECO, ADDA, VAAS, FU...) and farms (Orfarm, Bac Tom, Mr. Tam...) in which guidelines and information on OA and OA products are disseminated.

A number of forums, dialogues, meetings and workshops have been organized to facilitate discussions for promoting OA in Vietnam. The first national workshop entitled “organic agriculture- current status and orientation” was organized on 27 Sept., 2013 in HCM city with the participation of over 300 participants from research institutions, farmers association, women union, universities, enterprises and decision makers at different levels [29]. Vietnam

also the hosted the regional workshop for promoting PGS in the 6 countries in the Great Mekong subregion on 4-6 March, 2014 [30]. Provincial workshops towards scaling-up and scaling-out the successful OA models and systems, have been organized in many provinces, such as Hoa Binh, Ha Noi, Ben Tre, Hau Giang, Ca Mau, Vinh Long... Nevertheless, OA and organic products have not yet well-known among society; there is confusion between organic products and VietGap or safe products.

### 3. Main issues and priorities

The most important issues hindering the development of OA in Vietnam, as mentioned by OA groups and farms are due to the following:

- Lack of organic fertilizers: growers now often produce fertilizers themselves by composting all kinds of possible materials (manure, plant residues, crop and animal by-products, coal residues) using trichoderma, EM of Japan, EM of AT.... Some bio-organic fertilizers such as the ones produced by Loc Troi Co. and by SFRI... are also used. Still, for large scale application organic fertilizers need to be purchased, and the price be too high for farmers to afford. In case of rice in Vinh Long for example organic fertilizers are imported from US.
- Lack of pest control measures: growers now use different safe 'hand-made' pesticides (using neem seeds, chilli, garlic...) and manual control method, but this requires increased labour inputs and can be low- effective [31].
- Delay in harvest of organic products: Normally 3-5 years are required for 'cleaning' the lands before OA products can be produced. The land 'cleaning' may be impossible when plots are small and scattered far one from another.
- High labour inputs: intricate protocols for crop management and recording.
- High cost: lower yield, longer growth duration, increased (labour) inputs
- Limited understanding and awareness on OA products: confusion between organic and VietGap/safe products
- Unstable markets: local consumers are not ready to buy OA products because of their low trust in the products' quality and also due to the high cost, while oversea markets have not been developed.
- Lack of national standards system and a feasible legal framework for production, certification and quality control of organic products [32].

#### • **Priorities**

As specified by MARD and MOST leaders at the conference discussing measures to promote the production and consumption of organic products, held in Hà Nội on April 4, 2017, these two ministers (MARD and MOST) will work together to develop a national standards system and a feasible legal framework for production, certification and quality control of organic products [2].

Besides, it is also important to adopt policies to support the (i) development of trademarks and markets for OA products; (ii) support research and production of organic fertilizers; (iii) support the links between farmers – researchers – traders (for both inputs and outputs) – decision makers; and (iv) facilitate the development of OA groups and/or land consolidation for developing OA production.

Inputs need also to be spent for training and awareness raising for all stakeholders involved (producers, traders, policy makers, researchers and consumers).

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## Status of Academic Teaching in Crop Protection at Can Tho University

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### I. INTRODUCTION

Mekong delta (MD) is located in the Southern Vietnam formed from alluvia of the Mekong river. Soil and subtropical climate conditions of the delta are favorable for agricultural production, 64.3% (2,607,100 ha) of the area (4,054,820 ha) is being agricultural soil (General Statistics Office of Vietnam, 2015). Annually, MD produces more than 30% value of agricultural product of Vietnam. According to a national social - economic development strategy approved on 12<sup>th</sup> February 2014 by the Prime Minister, by the year 2020, MD is going to be a key economic region with fishery and agricultural production are bases for the development (Resolution 254/QĐ-TTg). In order to realize the objective of the strategy, requirement on agriculturally professional human resource is high, and thus, agricultural education and training in MD is still an imperative demand.

### II. UNIVERSITIES IN THE MEKONG DELTA

To date, there are 17 universities locating in MD. Exception for Can Tho University which was founded in 1966, the other universities in the region were found after the national reunification (after 1975) (Table 1). Amongst these, seven universities are comprising of agricultural faculties/colleges, four of which are teaching crop protection program.

**Table 1.** Universities in the Mekong delta.

Entry	University Name	Founded year	Location (city/province)
1.	Can Tho University <sup>a,b</sup>	1966	Can Tho
2.	Can Tho University of Medicine and Pharmacy	2002	Can Tho
3.	Can Tho University of Technology	2013	Can Tho
4.	Tay Do University	2006	Can Tho
5.	Nam Can Tho University	2013	Can Tho
6.	Vo Truong Toan University	2008	Hau Giang
7.	An Giang University <sup>a,b</sup>	2001	An Giang
8.	Cuu Long University <sup>a,b</sup>	2000	Vinh Long
9.	Vinh Long University of Technology Education	2013	Vinh Long
10.	Mien Tay Construction University	2011	Vinh Long
11.	Tien Giang University <sup>a</sup>	2005	Tien Giang
12.	Kien Giang University <sup>a</sup>	2014	Kien Giang
13.	Tra Vinh University	2006	Tra Vinh
14.	Dong Thap University	2003	Dong Thap
15.	Bac Lieu University <sup>a,b</sup>	2006	Bac Lieu
15.	Tan Tao University	2010	Long An
16.	Long An University of Economics and Industry	2007	Long An

<sup>a</sup> Comprising of an agricultural faculty/college; <sup>b</sup> Teaching of a crop protection program

### III. TEACHING OF CROP PROTECTION AT CAN THO UNIVERSITY

The College of Agriculture and Applied Biology (CAAB) of Can Tho University (CTU) was founded in 1968, two years later the foundation of the university. Both undergraduate and graduate levels have been educated at CAAB with teaching programs including crop, animal and food sciences. In 2016, there were 3791 undergraduate students, 322 master students and 110 PhD students studying in 12 undergraduate programs, 7 master programs and 6 PhD programs at CAAB (Table 2). Since 2014, with the annually matriculated ca. 150 undergraduate students, crop (plant) protection is being one of the largest teaching programs at CAAB.

**Table 2.** Numbers of students were studying at College of Agriculture and Applied Biology of CTU in 2015 and 2016.

Entry	Program	Number of students					
		BSc.		MSc.		PhD	
		2015	2016	2015	2016	2015	2016
1.	Plant Protection	458	585	61	65	9	18
2.	Soil Science	201	233	22	24	10	18
3.	Crop Science	392	469	75	81	15	30
4.	Plant Breeding Engineering	209	207	-	-	-	-
5.	Good Agriculture Practice	98	-	-	-	-	-
6.	Applied Biology	59	122	-	-	-	-
7.	Horticulture and Landscape Design	192	200	-	-	-	-
8.	Agronomy	316	317	-	-	-	-
9.	Animal Science	318	390	41	33	7	13
10.	Animal Breeding Engineering	41	-	-	-	-	-
11.	Veterinary Medicine	349	399	51	43	-	-
12.	Pharmacology Veterinary Medicine	262	261	-	-	-	-
13.	Animal Pathology and Treatment	-	-	-	-	13	16
14.	Food Technology	364	527	39	57	12	15
15.	Post Harvest Technology	-	81	19	19	-	-

- *unenrolled.*

In CTU, crop protection (namely plant protection) is educated at undergraduate and graduate levels with bachelor, master and PhD degrees. In that, undergraduate program with 140 credits takes 4 - 8 years, the master program with 60 credits takes 2 - 4 years and the PhD program with 17 credits (it is not involved the conduction of researches of the thesis) for the training time (Table 3). Amongst teaching programs, the undergraduate teaching program was established with the participation of staffs from other universities in MD. Therefore, teaching interlink ability between universities for undergraduate crop protection program in MD is high.

**Table 3.** Information about crop protection education at CTU.

Level	Degree	Number of credits	of Training time (year)	Annual number of Enrollment
Undergraduate	BSc.	140	4 - 8	150
Graduate	MSc.	60	2 - 4	40
	PhD	17*	3 - 6	10

\* *not involves thesis*

Table 4 shows teaching knowledge on crop protection education at CTU. For undergraduate program, the knowledge is divided into three groups, basic, fundamental and special knowledge and thesis conduction. It take two years (33.6% of credits) for studying the basic knowledge and the other two years for studying the fundamental and especial knowledge and conducting thesis. For graduate programs, the basic knowledge is reduced (8.3% at master program and 0% at PhD program) and replaced with seminars, contrarily researches for thesis is required more intensive and takes more time to conduct.

**Table 4.** Knowledge of teaching on cop protection programs in CTU.

<b>Knowledge</b>	<b>Credits</b>	<b>Ratio (%)</b>	<b>Courses in</b>
<i>* For undergraduate program:</i>			
- Basic	47	33.6	Social sciences, Foreign language, Philosophy, Physical education, National defense education, Information technology, Mathematics, Chemistry and Biology.
- Fundamental	36	25.7	Plant physiology, Plant genetics and breeding, Soil science, Crop science, Agro-ecological systems, Scientific method and Experimental design, Microbiology, General entomology, General plant pathology.
- Special	47	33.6	Law on plant protection and quarantine, Agricultural insects, Plant diseases, Weeds, Agricultural nematodes, Ago-chemicals, Store insects, Agricultural damage animals, Biological control of insect pests and diseases and Integrated pest management.
- Thesis	10	7.1	Conduction of scientific researches on crop protection (one semester, about 6 months).
<i>* For master program:</i>			
- Basic	5	8.3	Foreign language, Philosophy, Scientific method and Experimental design, Interaction between pests – crops – natural enemies, Farming systems.
- Fundamental	18	30.0	Advanced knowledge on insect, plant diseases, weeds, nematodes, agricultural damage animals, plant physiology and plant nutrition; chemical ecology, Plant origin compounds.
- Special	27	45.0	Pest management strategies, Seminars
- Thesis	10	16.7	Conduction of scientific researches on crop protection (about one year).
<i>* For PhD program:</i>			
- Seminar	9	29.6	Reports on crop protection researches
- Special	18	70.4	Physiology and ecology of insects, Physiology and ecology of fungi and other microorganisms, analysis techniques.
- Thesis	-	-	Conduction of scientific researches on crop protection (about two years)

## **INTRODUCTION OF AGRONOMY FACULTY**

### **NONG LAM UNIVERSITY- HO CHI MINH CITY**

The faculty of Agronomy was established in 1955. The precursors of the faculty are respectively the Department of Agriculture at the College of Agriculture – Forestry – Animal (1955); the Faculty of Agriculture at National Center for Agriculture (1968), the Institute of National Agriculture (1974); and the Faculty of Farming at the University of Agriculture No. 4 (1975). In 1990, the faculty was renamed the Faculty of Agronomy, a faculty at the Nong Lam University – Hochiminh City.

The Faculty of Agronomy has three main mandates as below:

- Providing undergraduate and postgraduate academic programs
- Researching on related areas
- Transferring advanced technologies for production and developing international cooperation

#### **OBJECTS**

The faculty's fundamental aim is to provide advanced and modern technologies and knowledge for the society in the two main majors: Agronomy and Plant Protection. The faculty offers both undergraduate and postgraduate degrees with high quality to meet the requirements of human resources for the industrialization and modernization in Vietnam. The graduates from the faculty have specialized knowledge and experiences, and are able to do research on related areas.

#### **ACADEMIC PROGRAMS**

- Undergraduate programs (4 years) in two majors: Agronomy and Plant Protection for both fulltime and part time students.
- Undergraduate programs in Horticulture and Marketing would be first introduced in the academic year of 2010.
- Postgraduate programs (Master's and Doctoral degrees) in three majors: Crop Science, Plant Protection and Soil Science.

#### **ORGANIZATION**

The faculty has approx. 50 employees, of this approx. 42 staff members (5 Assoc. Professors, 5 Doctors, 15 Masters and 9 Bachelors).

The faculty comprises 7 departments: (1) Plant Physiology and Biochemistry, (2) Genetics and Plant Breeding, (3) Plant Protection, (4) Soil-Agro Chemistry, (5) Water Management, (6) Industrial Crops, and (7) Food – Vegetable – Flower and Fruit Crops. The faculty has an area of approx. 12 hectares for research, experiments, and practicing.

#### **RESEARCH**

Our on-going and productive research programs focus on improving of crop production and supporting the agricultural and environmental sustainability with the main areas as below:

- Selection and introduction of new plant varieties
- Water – soil resources management
- Cropping systems in the Mekong Delta, East Southern areas and the highlands
- Agricultural chemical residues
- Heavy metals and Nitrate in agricultural products and environment

- Microorganism contamination in agricultural products
- Safe and organic vegetable production
- Irrigation and drainage systems
- Plant nutrition and soil fertility
- Pest management

### **PLANT PROTECTION SPECIALIST:**

Nong Lam University is located in Hochiminh city which surrounding of provinces produce many crops such as fruit, vegetables, rubber, coffee and rice. These crops are damaging by several key pests, the abuse of using pesticides for controlling pests has been raised concerns for the whole society.

Every year, Agronomy faculty has more than 120 bachelor and around 25 master students and candidates of Ph.D who are specialists on crop protection. We are giving priorities on pest biological control in order to limit of using chemical pesticides.

### **COOPERATION**

#### **Domestic cooperation**

The faculty has had strong cooperation with the Department of Science and Technology, and the Department of Agriculture and Rural Development in Hochiminh City and surrounding provinces: Ninh Thuan, Binh Thuan, Binh Phuoc, Ba Ria Vung Tau, Dong Nai, Lam Dong, Long An, Dong Thap, Ben Tre and Tra Vinh. The faculty also has active cooperation with the Southern Institute of Agriculture, the Southern Institute of Fruit Trees, the Cuu Long Delta Rice Research Institute.

#### **International Cooperation**

The faculty has conducted many projects in related areas with organizations from various countries over the world. Some remarkable projects carried out by the faculty in recent years are (1) the Vietnam-Netherland Higher Education Project, (2) World Bank Project, (3) the Assessing the loss of rice yield in unirrigated fields (GTZ), (4) the Planning for Irrigation and Drainage systems in the Camau peninsula (IRRI), (5) Dry rice-seeding technique in unirrigated areas (IRRI), (6) Improving acid sulfate soils (IRRI), (7) Rice – Shrimp program (ACIAR), (8) Cassava Asian Regional Program (CIAT), (9) Rural development program (Switzerland), (10) Natural Resources Protection in highlands (Ford Foundation), (11) Cocoa Program (ACRI, USA), (12) Effects of agro-chemicals on soil microorganism communities (IRRI), (13) Soil and Plant contamination program (ACIAR), (14) Coconut Beetle program (FAO) and (15) Seed Conservation (Darwin Initiative and Reading University, UK).

### **EXTENSION**

The faculty has disseminated research results as well as advanced technologies on new varieties, procedures for producing safe vegetables, procedures for intensive cultivation of various crops in the East and West Southern areas, highlands and the Central areas. Besides, the faculty has conducted short training courses for the local scientists as well as farmers.

## Some research and practice activities related to Agroecological plant protection in Northern mountain of Vietnam

Nguyen Van Thiep  
NOMAFSI

### *1. Introduction*

Tea (*Camellia sinensis*) is popular crop in the Northern mountain of Vietnam; the characteristics of tea cultivation are a system of monocultures for a long period from the 1970s through the 2000s. At this period, chemical fertilizer is abused to increase productivity. Tea plucking mostly use technique "san trậ", this means that when 30-40% of the tea buds meet a standard one bud and 2-3 young leaves, they are plucked; with regards to tea buds that are not qualified, shall be plucked latter. With this technique, in the main season from late June to late September can harvest 3-4 times per month. The plucking technique that left 60-70% of the unqualified buds is one of the condition that facilitate the pests, such as Tea green leaf hopper, Tea thrips, Tea mosquito bug have always been maintained and become more dangerous. On the other hand, chemical fertilizers causing degraded soils, Tea grows stunted, productivity has decreased, diseases are more difficult to control such as Root rot, Canker, Anthracnose, etc.

Because of the frequently outbreak of pests, on the main tea season, farmer usually use pesticide 2-4 times/month, this lead to environment and tea product pollution. In fact, many shipments of exported tea were rejected by customers due to pesticide residues higher than permitted. In order to limit pest damage, studies on insect and diseases and tea field management were carried out.

### *2. Research achievements related to AE plant protection*

Research to prevent Tea mosquito bug (Nguyen Khac Tien, 1976); research on red spider on tea (Nguyen Thai Thang, 1998); research on biology and Ecology of Tea green leaf hopper, Tea thrips (Thiep NV, 1997, 2000, 2006); research on planting shade trees for tea (Thiep NV, 1996, 1998, 2000); Research on natural enemies of tea pests (Thiep NV, 1998); Study on control of tea-blight disease (Nguyen Van Hung, 1996); Research on Chaetomium production to prevent disease on tea, coffee and rubber (Thiep NV, La NH, 2012-2015).

### *3. Some results were applied*

- **Planting shade trees for tea:** Due to light preferred characteristics of the pests such as Red spider, Tea green leaf hopper, Tea thrips, plant *Indigofera teysmanni* Miq. as a shade tree for tea to reduce density and harm of these pests. The results showed that planting *I. teysmanni* with a density of 200 - 250 trees /ha was beneficial for tea tree growth, while limiting the percentage of tea buds damaged from 20-40% (Thiep NV, 2000).

Planting shade trees for tea increase the density of Tea mosquito bug in some tea garden near woods, residential areas with perennial planting forest belt. To overcome that limitation of shade trees, NOMAFSI is testing a plant that is capable of inducing mosquito

bugs. That plant is a kind of ornamental plant - *hypericum*. Use that plant to attract mosquito bugs to control them.

**- Techniques to pluck all the tea buds at the plucking cycle**

Different to “san trậ” technique, according to this technique, farmer will pluck all tea buds that meet standard or not after leaving the appropriate foliage in the spring. With this method, a large number of eggs and larvae of Tea green leaf hopper and Tea thrips were removed, reduce the rate of tea buds that were damaged by green leaf hopper and thrips around 11% (Thiep NV, 2000).

**- Research on natural enemies of tea pests:** For tea insects, identify important predatory species of Tea green leaf hopper, Tea thrips, Tea leaf roller are some predator species such as *Oxyopes* sp., *Clubiona* sp., *Phydippus* sp., these big spider species were able to feed 10 - 20 green leaf hoppers/day (Thiep NV, 2000); natural enemy of red spider is Phytoseid group. An experiment on the tea garden has been done for many years in TRI at Phu Ho, Phu Tho province. Experiment on field sprayed pesticide and field that untreated after 2 years, the density of Tea green leaf hopper, Tea thrips and Red spider in field that sprayed pesticide are higher than in field that untreated from 20 - 50%, the density of natural enemies (Predator group) in field that sprayed pesticide are higher than in field that untreated 2 - 3 times (Thiep NV, 2000).

About disease on tea and coffee, NOMAFSI has researched and produced bio-products to control the disease. The product is called CP2-VMNPB. Main active ingredient of this bio-product is 2 strain fungal antagonistic *Chaetomium globosum* and *Chaetomium bostrychoidis*, which are used to control root disease on tea and coffee causing by *Phytophthora*, *Fusarium*, *Rhizoctonia*. Besides, they can control leaf disease causing by *Colletotrichum* on some other plants (Thiep NV, La NH. 2015). This bio-product was also used in experiment on control root disease on orange in Ha Giang and Tuyen Quang provinces.

**Organic tea production:**

From 1995 - 2002, collaborate with KWT (One of NGO from Netherland) established organic tea production area in Van Chan, Yen Bai province. Tea area selected was Shan tea on mountain of Dong Khe and Nam Lanh commune. Skal International organization had certified organic for tea area and green crude tea products. KWT organization connected customers and sell crude products to a number of companies from Gecmany, Netherland and France. Beside of tea, some crude products from cinnamon, anise, ginger, saffron and upland rice were also certified organic.

Participating in the organic production system as a production organization, technical training, internal control. Overcome the lack of organic fertilizer for the high mountains: We have guided farmers to plant legumes in the tea plantations, help farmer to produce compost to provide nutrition for tea.



## **Crop protection in the Central Highlands, Vietnam** **(Dr Dinh Thi Yen Phuong, IFAM)**

The agriculture in the main land of Vietnam is divided into 7 areas: Northern Midlands and Mountains, Red River Delta, North Central Coast, South Central Coast, Central Highlands, Southeast and the Mekong River Delta. Among them, Central Highlands has cool weather and deep rich nutrition basaltic soil that raise great potential for perennial cash crops. Central Highlands mainly cultivate coffee (573,400 ha), black pepper (43,939 ha), rubber (261,000 ha), cashew (70,700 ha), avocado (5,000 ha) and durian (about 6,000 ha). Recently, Macadamia, indigenous from Australia, and passion fruits have been introduced to Central Highlands with about 9,000 ha (90% macadamia in Vietnam) and 2,603 ha, respectively.

With these major crops, common diseases have been found in Central Highlands including *Phytophthora* spp. causing root rot, canker, fruit rot and bleeding; *Fusarium* causing damping off, fast decline and root rot; *Alternaria* causing leaf spots, virus causing leaf crinkle, mosaic, woodiness, and *Colletotrichum* causing anthracnose diseases. In addition, many common pests have been recorded in this area such as thrips, mealy bugs, stinky bugs, mosquito bugs, plant parasitic nematodes including *Meloidogyne* spp., *Pratylenchus* spp. and *Ditylenchus* spp. that create entry points for secondary infection. More important, Ambrosia beetles (*Euwallacea fornicatus*) that transmit *Fusarium euwallaceae* has been found in avocado orchards in DakNong. This symbiotic association is a serious threat for avocado production. Another threat for avocado production in the Central Highlands is sunburn. Sunburn decreases plant health, induces the secondary infection, downgrades fruit quality.

With the favored weather and soil nutrition conditions but high risks of pests and diseases in Central Highlands, the Macadamia Queen company strictly follows recommend cultivation procedures as well as pest and disease managements to achieve high returns. MQ was established in 2013 with currently about 20 ha macadamias, 7 ha avocados, 5 ha pomelos and 25 ha passion fruits. Moreover, MQ also intended 3 ha for nursery to self-support pathogen-free seedlings at first and then extend to provide for local orchards. The Nu Hoang Institute for Fruit and Macadamia Trees (IFAM), which was established and joined the Vietnam Union of Science and Technology Associations in 2015, responsible for cultural technologies, pest and disease managements of MQ. The roles and the proposal/planning of IFAM are research, develop and transfer cultivation procedures, pest and diseases control tools for fruits and macadamia production of MQ and local orchards. IFAM provides consultancy for all stages of fruit production from nursery, planting, disease and pest managements, harvest, post-harvest and marketing. IFAM also promotes IPM strategy in which cultural practices and biology products are highly emphasized. Furthermore, IFAM always co-operate with domestic and international organizations, institutes and universities.

Therefore, current activities of IFAM include screening rootstocks for disease resistance, ensuring the nursery, farms and orchards following recommended cultivation procedures and IPM strategies. For nursery management, plant/seedling are required off the ground, are grown in well-drained and sterilized soil. Nursery should have balanced nutrient supply and sufficient water program. Resistant rootstocks are also highly concerned to develop good quality seedling for fruit production in the Central Highlands. Before fruit crops are grown in the fields/orchards, the soil need to be well-drained, well-aerated and well-prepared with lime and manure. Different to traditional cultivation that almost farmers in this area are following. fruit crops are planted with mounding and mulching to protect trees from water-logging and

over-heat/evaporated on the surface soil. In addition, farmer in this area do not concern about improving soil nutrient richness and erosion, which might be serious in the highland. In contrast, IFAM promotes that crops should be inter-planted with *Tephrosia* sp. plant (belong to pea family, a legume) to have close wind-break, to avoid soil erosion, to increase nitrogen-fixation in soil and to be harvested for mulching. In the cultivating procedure, water and fertilizers (both manure and chemicals) are well-regulated depend on the demand of each crop. Over-irrigation and overuse fertilizers not only increase production cost but also cause serious damages for crops. *Phytophthora* epidemic as an example of adverse effects from water-logging and too much nitrogen in soil. The growth and health of root systems are also promoted by bio-products. The infected branches or trees are removed as soon as possible to limit the spread of disease. For disease management, besides cultural and sanitation practices as mentioned, biological control are always concerned such as applying *Enterobacter cloacae* against *Phytophthora cinnamomi*. At last, chemical control are also considered to control diseases at high pressure. In the case of *Phytophthora*, copper based and phosphorus based products as well as metalaxyl active ingredient are applied to eliminate the damages.

Not only for MQ production, IFAM are going to provide consultancy and training courses for farmers in the Central Highland and use MQ farms as demonstration sites. Therefore, with the cooperation of partners from CIRAD in the framework of ACTAE regional project, we hope to play a role to assist the Central Highland Agriculture sustainably, conservatively and eco-friendly develops.

## **Fruits and vegetables health and proposals relevant with Agroecological crop protection of Southern Horticultural Research Institute, Vietnam**

*Nguyen Thi Ngoc Truc and Nguyen Van Hoa  
Box 203. My Tho, Tien Giang, Vietnam*

### **Fruits and vegetables health**

In the South of Vietnam, there are many different kinds of fruits and vegetables such as mangosteen, rambutan, durian, longan, mango, citrus, banana, tomato, cucumber...all of them are very tasty, beautiful and very good for health. However, pest and disease always attach those fruits and vegetables. Some main causes of pest and disease are listed below:

**Insect:** One of the most serious pests of fruits and vegetables is the fruit fly (Tephritidae), which causes substantial losses in terms of both quantity and quality. In Vietnam, there are three important species: *Bactrocera dorsalis* Hendel, *Bactrocera correcta*, *Bactrocera cucurbitae*. Among them, the most hazardous is *Bactrocera dorsalis* Hendel, because it is subjected to plant quarantine.

A first inventory was made of the fruit fly species found in Vietnam. In northern Vietnam, a total of 20 species were trapped. In southern Vietnam, 17 species were found. Of these, 10 species occur in both the north and the south. Six species were bred from commercial fruits and vegetable fruits collected in the north and south.

**Six Important Fruit FLY Species in North Vietnam:** The fruit fly species of greatest economic importance in the north of Vietnam are *Bactrocera dorsalis*, *B. correcta*, *B. pyrifoliae*, *B. cucurbitae*, *B. tau* and *B. latifrons*.

**Five Important Species in South Vietnam:** There are five species of economic importance in the south of Vietnam. These are *Bactrocera dorsalis*, *B. correcta*, *B. cucurbitae*, *B. tau* and *B. carambolae*.

Besides fruit fly, mealy bug, red mite, aphid, fruit borer... also caused big problems for fruits and vegetables in south, Vietnam.

Three important species of fungus for fruits in South are: *Fusarium*, *Phytophthora*, *Rhizoctonia solani*.

Three important virus are: Banana bunchy top virus, Citrus tristeza virus, Passion fruit woodiness virus

### **Priorities for research and training in crop protection**

Conservation and development of natural enemies (ants, ladybugs...).

Strengthen research and training on use of antagonistic fungi and bacteria.

Increased use of resistant varieties.

Development GAP and organic farming.

## **Proposals relevant with Agroecological crop protection of Southern Horticultural Institute, Vietnam**

### **Biocontrol:**

#### **Fungy: *Trichoderma* sp, *chaetomium* sp...**

Recently, the application of biological control agent in plant disease management is gaining huge momentum in crop production systems in Vietnam. Various studies have been conducted to focus on application of plant growth-promoting microorganism to improve plant health and productivity in various crops. *Trichoderma* spp. were reported have the ability to reduce several plant diseases by inhibiting plant pathogens mainly found in the soil roots, through antagonistic and mycoparasitic potential. For instance, studies conducted in South Vietnam, indicated that *Trichoderma* spp. had the ability to suppress growth of fungal pathogens and enhance plant growth.

To reduce the dependence of agriculture production on noxious synthetic pesticides, the search for effective biological control agents (BCAs) against plant pathogens has been carried out worldwide. *Chaetomium* species are ubiquitous fungi of which more than 350 species exist. Some of these fungi can act as antagonists against various plant pathogens through the production of lytic enzymes and metabolites.

#### **Insect: Goldent ant**

In south Vietnam, the livelihood of millions of smallholders depends on fruits and nut grown in relatively undisturbed perennial agro-ecosystems that offer opportunities for biodiversity conservation, Orchards, which are traditionally small- scale and diversified, often function as refugia for wildlife. But these ecosystems are increasingly replaced with monocultural tree cropping systems dependent on pesticide use which harm public health and natural resources. Agrochemical companies are now targeting high value fruit crops for their sales of the most toxic group of pesticides: insectides.

Barzman (1996, 2000) and Van Mele et al (2002) showed that some Vietnamese farmers successfully use traditional practices that rely on biodiversity rather than pesticides. The key element in this ecological approach to fruit farming is the use of *Oecophylla smaragdina*, a tree dwelling ant. The ant preys on a variety of pests while a host of other natural enemies regulate other noxious species. By providing an ant- friendly habita, fermers also create environtment favorable to wild fauna and flora. By adapting this Vietnamese practice to local conditions, eco-innovating fruit producers and agricultural researchers in this project could develop alternative practices.

#### **Plant growth-promoting bacteria (PGPB)**

Plant-microbe interactions in the rhizosphere are the determinants of plant health, productivity and soil fertility. Plant growth-promoting bacteria (PGPB) are bacteria that can enhance plant growth and protect plants from disease and abiotic stresses through a wide variety of mechanisms; those that establish close associations with plants, such as the endophytes, could be more successful in plant growth promotion. Several important bacterial characteristics, such as biological nitrogen fixation, phosphate solubilization, ACC deaminase activity, and production of siderophores and phytohormones, can be assessed as plant growth promotion

(PGP) traits. Bacterial inoculants can contribute to increase agronomic efficiency by reducing production costs and environmental pollution, once the use of chemical fertilizers can be reduced or eliminated if the inoculants are efficient. For bacterial inoculants to obtain success in improving plant growth and productivity, several processes involved can influence the efficiency of inoculation, as for example the exudation by plant roots, the bacterial colonization in the roots, and soil health. In this project, we need to apply more Plant growth-promoting bacteria (PGPB) such as: Nitrogen fixing bacteria, Phosphate solubilizing bacteria, IAA releasing bacteria, Cellulose degraded bacteria and the combination of different clone of PGPB.

Besides that, to develop organic horticulture, we need to:

Enhancing biodiversity is an important factor leading in the system of organic agriculture.

Promoting research and application of crop varieties with high adaptability to climate change, extreme conditions.

Strengthen the research process of sustainable organic farming for specific crops and specific regional land.

Strengthening farmer training, organic demonstration.

## "Crop Protection in Vietnam: from Agrochemistry to Agroecology?"

### Introduction

#### *intensive agriculture*

increasing then decreasing yields  
negative impacts  
unsustainability

#### *necessity to change*

passing Green Revolution  
towards AE  
for actors  
including consumers

#### *In Crop Protection*

excessive use of pesticides  
impacts: flora, fauna, environment, water, human

#### *it's the case in VN*

it's the case in SEA  
Vietnam is a large user of pesticides  
officially  
reglementation  
illegal pesticides  
réglementation ?  
lot of impacts  
cf Mekong Delta  
issue to move  
Status of policies in Vietnam

#### *objective of the review*

- to make a status of the situation in Crop Protection with a focus on Vietnam
- to review the evolution of Crop Protection in the recent years or decades
- to list the main limits of current protection
- to appropriate the need to change in the aims, in the concepts, in the practices
  - from an unsustainable agriculture to a sustainable one
  - with good performances for socio-economical, environmental criteria
  - and also taking into account health and ecology
  - and limiting the use of pesticides
- to identify the keys of the transition period

#### *announcement of the plan*

# Chapter 1. An expected evolution from Green Revolution to Agroecology

## *In the world, in SEA*

in Asia, evolution of the demand

high increase of the demand

high increase for

*cereals*

*fruits and vegetables*

cf Muniappan et al 2012

production losses by pests

in particular in SEA

## *evolution and status of CP*

excessive use of pesticides

for a long time: Thailand, Vietnam

exponential increase in Cam, Lao, MM

in quantity and in quality

negative impacts

promotion of IPM, training, FFS, but during projects and in some experiences

today: IPM is the reference, but limits in considering and practicing

unstable AES

questioning the use of pesticides

everywhere

ONU

*not only FAO*

*but also for Human rights*

## *promotion of AE and AE in CP*

promotion AE

ONU de Schutter

*FAO Rome 2014*

*FAO Bangkok 2015*

ONU human rights 2017

in CP

IPM presented as a way belonging to AE (FAO 2015; Pretty et al 2014)

*because it could reduce pesticides*

*but unstable AES in most of the cases (false IPM, low IPM)*

ACP Deguine et al 2009 and 2016

*delusion of AE to PC*

## Chapter 2. Chemical Crop Protection and impacts

*worldwide and dominant*

in developing countries and in developed countries (de Bon Africa)

*status of the situation in SEA and V?N*

study of GRET on pesticides used in SEA

data

evolution of the quantities used during the last 10 years

*data available in literature*

data of use, country per country in SEA

*available in literature*

situation per crop

*what are the main problems and what are the way to answer*

*which research axes are implemented?*

Ccl : evolution

increasing

*cf China production and consumption*

*negative risks and impacts*

impacts: flora, fauna, environment, water, human

cf litterarture

*need to significantly reduce pesticides*

some experiences show it is possible

IPM Pretty

way of OA

some experiences in SEA (Thailand, ...

in Vietnam



## Chapter 3. IPM and IPM related experiences and limits

*FAO bangkok 2015*

IPM = 1 of the 6 AE approaches  
because it can reduce pesticides  
but limits  
cf sustainability

*IPM in SEA and Vietnam*

a lot of papers  
Pretty et al 2014  
developed in Asia in the 80s  
ie Indonesia (FFS)  
in Vietnam also  
description of success stories (rice?)

*IPM limits*

paradigm of CP for 60 years :harmonise CC & BC  
today: promoted in the words,  
*false IPM*  
CC easier and cheaper  
low adoption  
in North and South Parsa et al 2014  
in SEA like elsewhere  
cf Delta Mekong

*poor adoption*

numerous definitions

more than 100: confusions of understanding & implementing

Intelligent Pesticide Management?

no Management of populations

in the practices : chemicals

Deguine et al 2016

chemical= basis of IPM in the fields

there is a threshold of reduction that we cannot reach

*ESR*

## Chapter 4. Basis of ACP and perspectives in Vietnam

### *aim: declension of AE in CP*

to take into account the Sustainable Development criteria  
but also two other issues  
health : cf ONU  
ecology AGROECOLOGY!

### *description of ACP*

ordoned approach and systemic startegy in the field  
possibility to use pesticides but only on a last resort and carefully

### *positive impacts*

for health, sustaibility, environment, socioeconomy  
high reduction of pesticides  
to do our best to not use them  
but possibility at the end

### *what are the priorities or the proposals for ACP in Vietnam?*

crops ?  
areas?  
cropping systems?  
partners?

### *what are the difficulties and the keys of the transition?*

research into questions?  
new perimeters  
new fields  
new tools, new approaches, ...  
training and teaching  
public support, policies and reglementation

## Conclusion

### *need to include AE in CP*

to improve sustainability of AES  
to reduce pesticides  
ESR  
to reduce negative impacts  
AE is in process, including AE in CP

### *generic keys to move*

cf book

### *proposals in Vietnam*

priorities  
to test the pricniples in the firlds  
to manage the transition perido  
concrete proposals

## Annex 4. First page of the proposal of ACP brochure to adapt in Vietnamese (ACP-ACTAE Workshop, Hanoi, 25-26 April 2017)

Agro-ecology >> Using functional biodiversity  
to boost agrosystem performance



### Agro-ecological crop protection Applying the principles of agro-ecology to crop protection



*Diversinervus sp.*, a parasitoid of *Saissetia hemispherica* on custard apple  
© A Franck/CIRAD

Agro-ecological crop protection (ACP) is an innovative, ordered approach that stems directly from applying the principles of agro-ecology to crop protection, in which ecological aspects are truly centre-stage. ACP aims to reconcile efficient crop protection against pests and diseases with the socioeconomic, ecological, environmental and sanitary sustainability of agro-ecosystems. It is also intended to make a substantial contribution to the switch from agrochemical-based practices to agro-ecological practices within cropping systems.

#### >> Crop protection lies at a crossroad

In the field of crop protection Integrated Pest Management (IPM) has been the prevailing paradigm since the 1950s, based on a concept devised by Californian entomologists. IPM has contributed to the positive changes in crop protection since the 1950s. However, without questioning the reasoning behind the concept, it is now appropriate to wonder about the coherence between current concerns about crop protection, notably with a view to promoting the principles of agro-ecology, and current practice in the field, which often centres on using agrochemicals, in both North and South.

Agro-ecological crop protection (ACP) lies at the crossroads between several research and management concepts and fields:

- agro-ecology, which can be seen as both a scientific discipline in its own right (it involves integrative studies relating to agronomy, ecology, sociology and economics, on various scales) and an agro-ecosystem management method;
- integrated crop protection, which has meant pooling the efforts of researchers and practitioners for the past 50 years or more, but which is now showing its limitations in the field;
- biodiversity management within agro-ecosystems, which for both research and management purposes draws on conservation biology within natural ecosystems.

ACP-ACTAE Project