Current situation of some major pests and diseases on potential exportable fruit crops from Vietnam and its proposed IPM strategy to overcome for the US market

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- **Southern Horticultural Research Institute (SOFRI) has 156 staff.**
- **We have: - Eight divisions:** Biotechnology, Plant Breeding, Postharvest technology, Pomology, Plant Protection (Ento., Path., Nematod.), Marketing information, Vegetable, Flower and Landscaping.

  - Two Centers: Transfer technology Center and Southeast Hort. Res.Center

  - Company: Company for Investment and Consultancy in Hort. Production
- **Plant Protection group: - PhD:** 2 Pathologists; 2 Entomologists

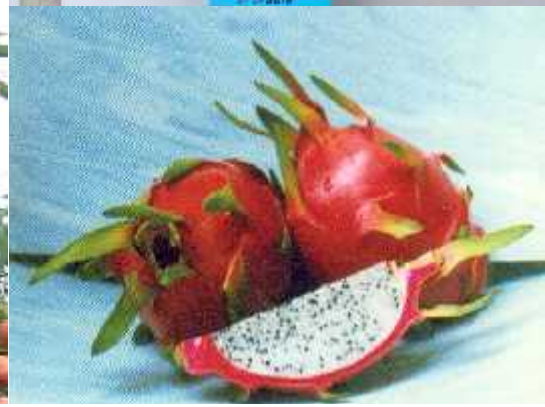
  - PhD scholars: 2 in Plant Pathology; 2 Entomology, 1 Nematology

  - MSc: 4 in Plant Pathology; 2 in Entomology.

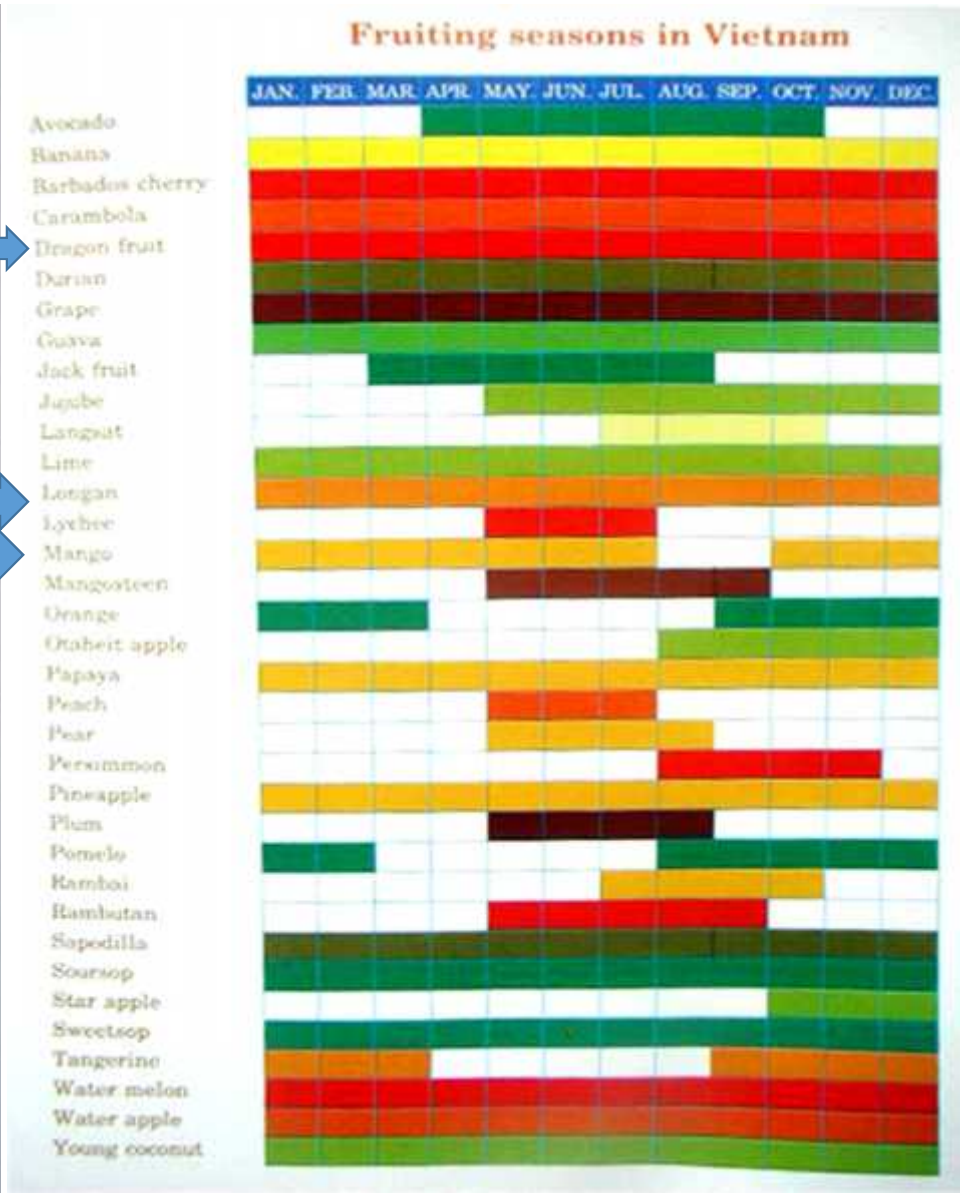
Major fruit crop production

- In the year 2014, total areas of fruit crops in Vietnam were about 843,700 hectares(MARD, 2014).
- In the South, the tropical fruits was about 466,700 ha
- Some economical important crops were **dragon fruit - Pitaya** (34,000ha), **mango** (43,000ha), **longan** (34,524ha) and **lychee** (80,000 ha)
- Dragon Fruit, Mango and Longan can be produced **year round**.
- For the US market: **opened** for Longan, Dragon Fruit, Lychee and **going to open** for Mango soon too.






Major fruit producing areas in Vietnam
VIETNAM
8.30° - 23.22° North
102.1° - 109.24° East
Longan
Lychee
Mango
Banana
Avocado
Pomelo
Orange
Tangerine
Mangosteen
Rambutan
Durian
Sweetsop
Soursop
Sapodilla
Grape
Papaya
Jack fruit
Langsat
Pineapple
Guava
Water melon
Dragon fruit
Young coconut
Passion fruit
Plum
Lime
Barbados cherry
Star apple


Fruiting seasons in Vietnam
JAN. FEB. MAR. APR. MAY. JUN. JUL. AUG. SEP. OCT. NOV. DEC.
Avocado
Banana
Barbados cherry
Carambola
Dragon fruit
Durian
Grape
Guava
Jack fruit
Jujube
Langsat
Lime
Longan
Lychee
Mango
Mangosteen
Orange
Otaheit apple
Papaya
Peach
Pear
Persimmon
Pineapple
Plum
Pomelo
Rambai
Rambutan
Sapodilla
Soursop
Star apple
Sweetsop
Tangerine
Water melon
Water apple
Young coconut

Key Pests and diseases on these 4 crops

- **Dragon fruit:** fruit flies, mealy bugs, stink bugs, canker, anthracnose, yellow cladode;
- **Mango:** fruit flies, leafhoppers, fruit borer, thrips, black spot and anthracnose;
- **Longan:** fruit flies, longan Witches' Broom, Eriophyoid mite, fruit borer, stink bug and fruit rot;
- **Lychee:** stem end borer, stink bug, downy mildew and anthracnose.

=> **Current situation, research and field Management practices**

1.Fruit Fly: *Bactrocera dorsalis* and *B. correcta*

- FF mainly attach on Mango and Dragon fruit.
- Control measures: Sanitation, Methyl eugenol and Cue lure, Protein bait (SOFRI – Protein), fruit bagging.

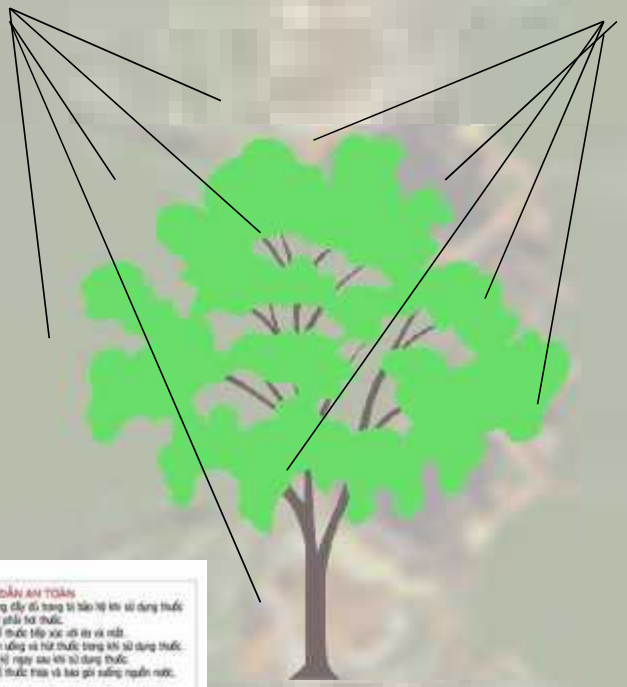
- Trap with ME or CL for monitoring the population

- Plant clinic for consultancy

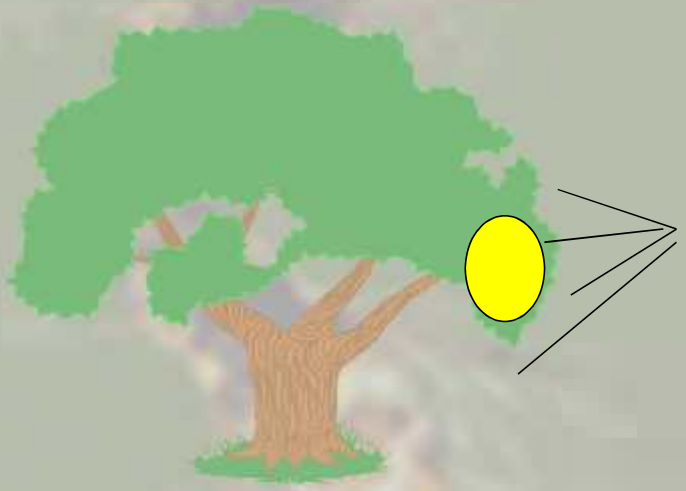
- SOFRI – PROTEIN can be produced 50.000 liters/year.
- USE: 1 liter/1 ha
- 2-3 Applications per season

Comparison between two methods of application (Insecticide & SOFRI Protein)

Insecticides application



Protein bait application



Bagging:

- In Dragon fruit: It just started.

- In Mango: it has been applied under commercial scale in the major production areas.
- It is also good for controlling of Anthracnose, Bacteria black spot disease, fruit borer, etc.

2. Mealy bug: *Dymicoccus neobrevipes.*

- Insecticide Spray at early stage and bag at mature stage of the fruits.

Using of Ant-bait (SOFRI – Trukien) to control ant in the orchard, which help to control the movement of mealy bug under pineapple field conditions very effective.

No	Treatment	% of Ant survival/30 pineapple plants			
		Before	3 DAT	7 DAT	14 DAT
1	SOFRI-tru kien	6,8a	4,3a	2,7b	3,7a
2	Sugar +SOFRI-tru kien (Success 1%)	4,0a	1,0b	1,7b	0,8b
3	Sugar+Success120SC	6,3a	1,0b	2,5b	0,1b
4	Control	7,0a	6,0a	5,4a	4,8a
	Cv (%)	-	34,8	48,0	37,5

=> This can be applied to Dragon fruit orchards under field conditions too.

Production of SOFRI-*Paecilomyces* and use for testing under Greenhouse conditions to control Mealy bug

Ratio of Mealy Bug death at 3, 5, 7, 9, 11 days after treated with *Paecilomyces* at Greenhouse conditions (SOFRI, 2008)

Treatment	Mealy Bug death ratio (%)				
	3NSKC	5NSKC	7NSKC	9NSKC	11NSKC
A –RS M	35.00 b	43.00 b	52.00 b	59.00 b	70.00 b
P- RCC	34.40 b	51.40 b	60.80 b	68.40 b	76.00 b
Control	4.00 a	9.00 a	9.00 a	9.00 a	9.00 a
Cv(%)	30.4	25.9	23.6	22.3	20.0

(P – RCC: Paecilomyces isolated from citrus psylla)

=> It need to be tested under field conditions for controlling of the mealy bug

Using Entomopathogenic fungi for controlling of Mealy Bug (*Pseudococcus* sp.) on Longan under Greenhouse conditions (2013)

No	Treatment	Effectiveness of Entomopathogenic fungi on mealy bug (%)		
		3DAT	7DAT	10DAT
1	*Paecilomyces* sp.	34.00 b	47.34 c	64.69 c
2	*Metarhizium anisopliae* Sorok	51.00 b	78.98 b	**89.25 b**
3	*Beauveria bassiana* Vuillemin	5.50 c	5.54 d	6.58 d
4	Proclaim 1.9 EC	96.75 a	99.77 a	100.00 a
	CV (%)	13.94	10.80	5.77
	Significant different level	**	**	**

Note: DAT: day after tested

3. Longan Witches Broom (LWB)

Recently, the Longan Witches' Broom become more popular and caused much lost to this crop. It is a very serious problem especially to Tieu Da bo variety.

Many studies including biological and molecular levels have been conducted since 2005 to identify the causal agent and the vector of the disease and its management options.

Graft transmission

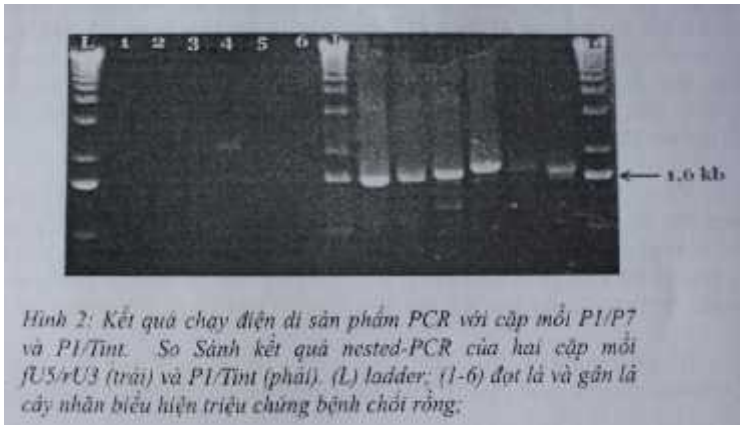
Buding
(6 months)

Inarching

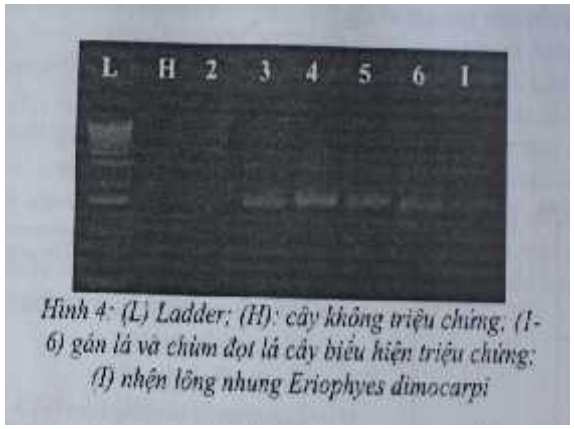
Dodder and other hosts => NO TRANSMISSION

Molecular study on the causal agent studies:

Using Primers from Phytoplasma (P1 & P7) and then primers P1/Tint for detection



Hình 2: Kết quả chạy điện di sản phẩm PCR với cặp mồi P1/P7 và P1/Tint. So Sánh kết quả nested-PCR của hai cặp mồi fU5/rU3 (trái) và P1/Tint (phải). (L) ladder; (1-6) đọt lá và gân lá cây nhãn biểu hiện triệu chứng bệnh chổi rồng;



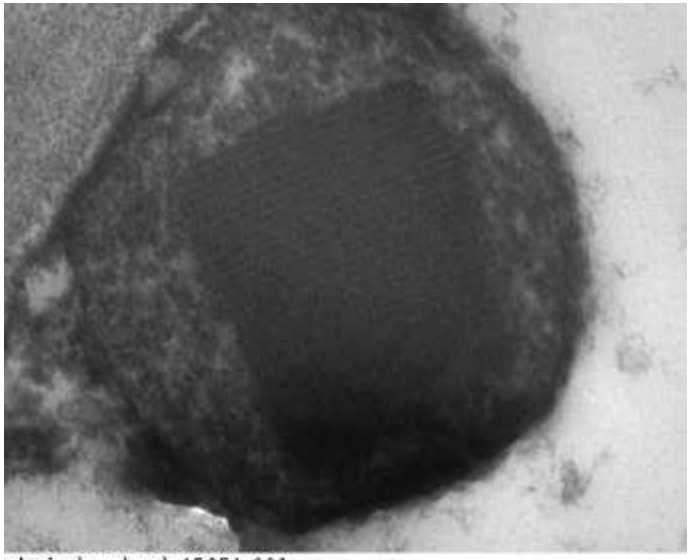
Hình 4: (L) Ladder; (H): cây không triệu chứng. (1-6) gân lá và chùm đọt lá cây biểu hiện triệu chứng; (I) nhện lông nhung Eriophyes dimocarpi

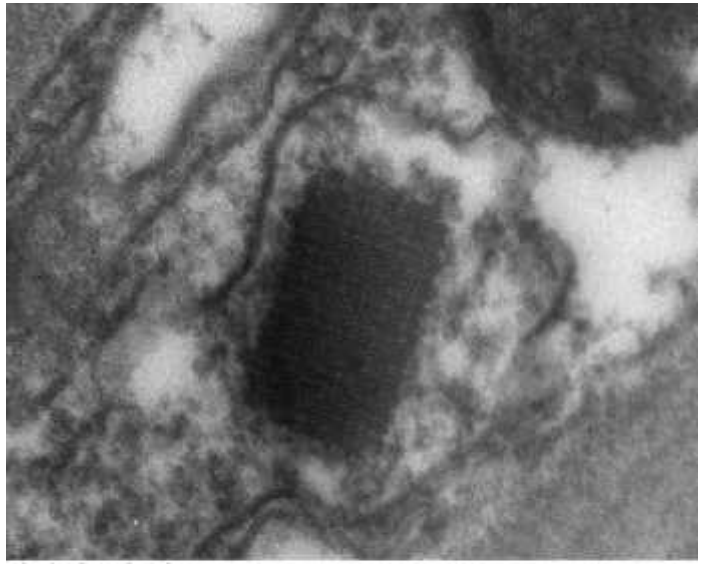
PCR amplification on both diseased leaves and mites' body

The sequences has been used to blast with other sequences from NCBI => Gamma Proteobacteria

The same set of primers, Thuy et al., 2012, reported that the disease due to Phytoplasma. => So **it needs to be confirm again by Molecular tools and Bioassay**???

Under Transmission Electron microscope (TEM) – the inclusion body was found





Untill now, the causal agent is still not yet identified

Mite (Eriophyes dimocarpi) transmission

Table: LWB symptoms expression using mite transmission under glasshouse conditions (2006)

Inoculated Seedling	Symptoms expression after inoculation (day)			
	10	20	30	60
1	-	-	++	++++
2	-	+	++	++++
3	-	-	+	++++
4	-	-	0	++++
5	-	-	0	+++
6	-	-	0	+

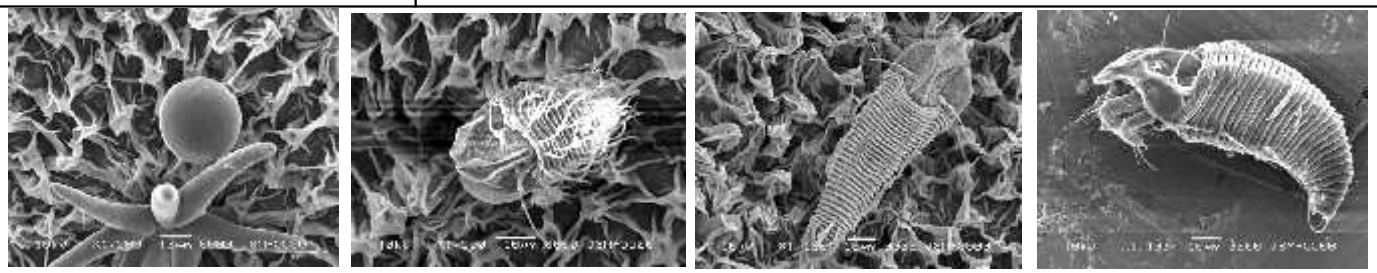


Fig: Eggs, Nymphs 1, 2, Adults of *Eriophyes dimocarpi*. (From leaf)

Current control Measure

- Twig pruning off at 40-50cm long from infested shoot could reduce the incidence of LWB.
- Acaricides plus petrolium oil was effective control of mite and reduced the LWB under field conditions.
- Use of high pressure water application during dry season
- Use of Tolerant cultivars eg. Xuong Com Vang and Long for topworking on Tieudabo cultivar.
- Tree health care by using sufficient nutrients

NOW, IT IS ALSO OCCURRED ON RAMBUTAN FLUSH AND FLOWER

IPM TOOLS HAVE BEEN TESTED for controlling of mite

Experiment**:** Using ***Paecilomyces* sp.** for controlling of mite **(*Eriophyes dimocarpi*)** under Lab conditions

Table: **Mite population after treating, 2010)**

No	Treatment	Dosage	Mite population (mite/0.5 cm^2 of leaf)			
			1 DAS	3 DAS	5 DAS	7 DAS
1	*Paecilomyces* sp.	40 g/8 lit water	16.30	08.70	2.40	0.90
2	Ortus 5SC	20 ml/8 lit water	14.30	08.40	2.00	1.00
3	Control	Clean water	24.90	18.10	8.40	4.90

Note: DAS – Day after spray

Tests of different Plant extracts against *Eriophyes* sp. Under Lab. conditions (2012)

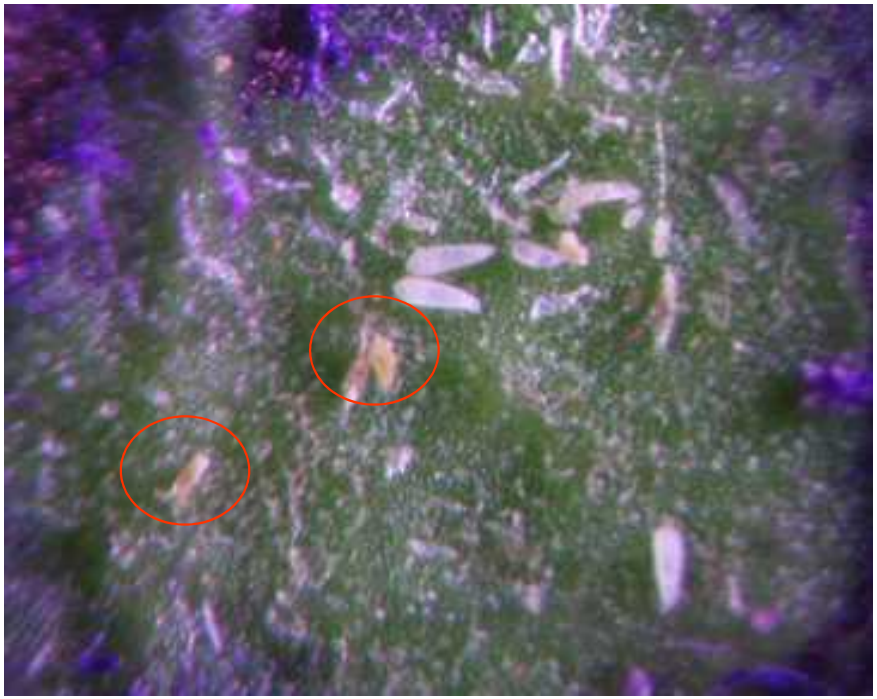
No	Treatment	Dose used (%)	Average number of mite/leaf			
			2HAT	8HAT	24HAT	30HAT
1	Water control	-	48,67b	45,67b	43,33c	41,67c
2	Red chili extract	0,100	47,67b	42,33b	31,67bc	14,67b
3	Green chili extract	0,100	42,33ab	30,67b	15,67ab	**10,67ab**
4	Ginger extract	0,100	45,67ab	33,67b	17,33ab	14,33b
5	Marigold extract	0,100	47,33ab	41,63b	26,67bc	17,00b
6	Onion extract	0,100	47,33ab	30,00b	13,00ab	**3,00a**
7	Crocus extract	0,100	48,00b	35,33b	17,67ab	**6,67ab**
8	Prodife's 6WDG	0,075	40,67a	24,67a	4,67a	**1,33a**
	CV (%)		5,53	27,61	33,89	31,76
	Significant level		**	*	**	**

Note: HAT: hour after treated

Preliminary result on Entomopathogenic fungi study

- Study entomopathogenic fungi on *Eriophyes* sp.under Lab. conditions

Metarhirium anisopliae killed Eriophyes mite



Paecilomyces sp. killed Eriophyes mite

=> Test under field conditions and use for IPM package

Predator study on Eriophyes mite

Larva of Gall fly (Diptera:Cecidomyiidae) on Eriophyes mite

=> More studies for use of this predator in future IPM package

Breeding programme for tolerant to Longan Witches Broom disease

Variety/Clone	Disease incident (%)	Disease severity	Evaluation
New Line –NL 1-23	7.00	0.90	Less Suscep
Tieu Da Bo (positive control)	71.00	3.20	Heavily Susc.
Xuong Cơm Vang (Negative control)	0.00	0.00	NO infection

4. Dragon Fruit Stem Canker disease - *Neoscytalidium dimidiatum* (Penz.)

Disease developed well under high humidity with young shoots, fruits. However, many characteristics of the fungus are still not been thoroughly understood

Temporary management programme

+ *Field sanitation:* **(i)** all infected parts the plant must be pruned and destroyed or chopped to small pieces for faster decomposed using EM, limes; **(ii)** heavy pruned after each harvesting time.

+ *Cultural practices:* **(i)** in the rainy season, new shoots should be removed to avoid spread of the innoculum; **(ii)** apply NPK, other macro, micro nutrients and organic manure plus *Trichoderma*, try to avoid of excess nitrogen used; **(iii)** avoid using of unclean water for canopy irrigation; **(v)** avoid over flowering manipulation during rainy season.

+ *Chemical use:* **(i) Heavy pruned after** each harvesting time and then spray with **copper fungicide** for prevention for the disease; **(ii)** The **cover spray** should be applied as soon as the disease appears (white tiny spots), the spray with either **Mancozeb, Difenoconazole + Propiconazole** at 7-10 days interval; **(iii)** It can be **combined** with the wetting agent such as Siloxane polyalkyleneoxide.

⇒ Go for **biological control** and other **more sustainable IDM tools for both Canker and Anthracnose diseases**:

- Test and use **Trichoderma and other microorganism** for faster decompose the pruned branches, mitigate the inoculum.
- Test and use **antagonistic fungi and/or bacteria** for killing the spores of *N. dimidiatum* on the canopy and on the round level.
- Test and use more selective fungicides which can kill the spores
- Study and **design suitable bags** for Dragon fruit.
- Train the farmers to use IPM approach.

Future works for IPM package to target fruit crops.

- Situational analysis on current fruit production, pest lists, issues and effectiveness of prevalent pest management measures, and then develop a PMSP (Pest Management Strategic Plan) for each target crop.
- Refining, out-scaling and upscaling of successful locally developed IPM tactics in multi-locations.
- Research and development of new, bio-rational IPM technologies and putting research into use (RIU) to fulfill the market (USA) needs incorporating VietGAP procedures and SPS compliance
- Technology transfer and extension using innovative frameworks (plant clinics, fact sheets, pest management decision guides, mobile technology driven agro-advisory services and mass media/entertainment education).

Acknowledgments

- Thank you very much to Dr. Muniappan, the USAID for inviting and sponsoring me to be here to attend the important symposium and present to you our works and plan.

THANK YOU FOR YOUR ATTENTION!