Climate Proofing and Integrated Crop Management (ICM) to enhance Vegetable profitability and food security in the Southern Philippines

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SEAMEO SEARCA

Australian Government
Australian Centre for International Agricultural Research

Outline

Climate Proofing/Protected Cultivation

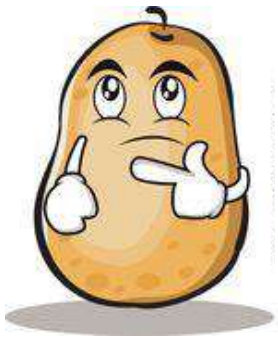
- Rationale
- Methodology
- Promising results
- Impacts
- Summary and Next steps

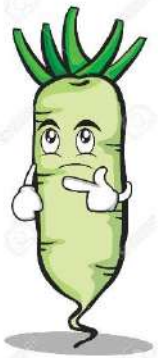
Outline

Integrated Crop Management (ICM)

- Methodology
- Promising results
- Impacts
- Summary and Next steps

What is a Vegetable?

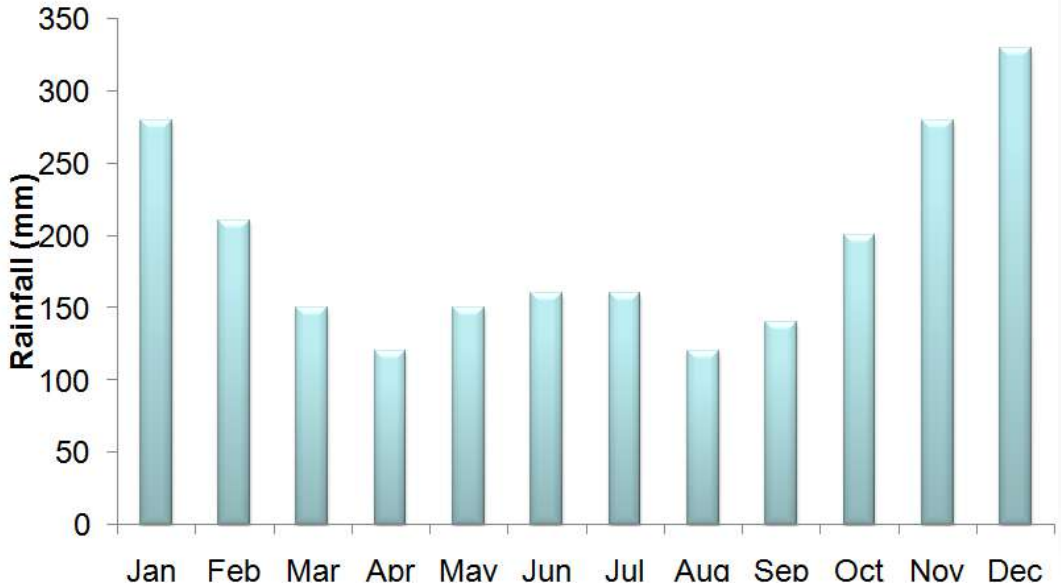



Why vegetables?

- Rich source of vitamins, minerals, dietary fibers and phytochemicals, hence a solution to malnutrition and micronutrient deficiency problem
- Strongly associated with reduced risk for some forms of cancer, heart disease, stroke, and other chronic diseases
- Generate income and create job opportunities
- Highly seasonal; hence difficulty in meeting consumers demand

The issue



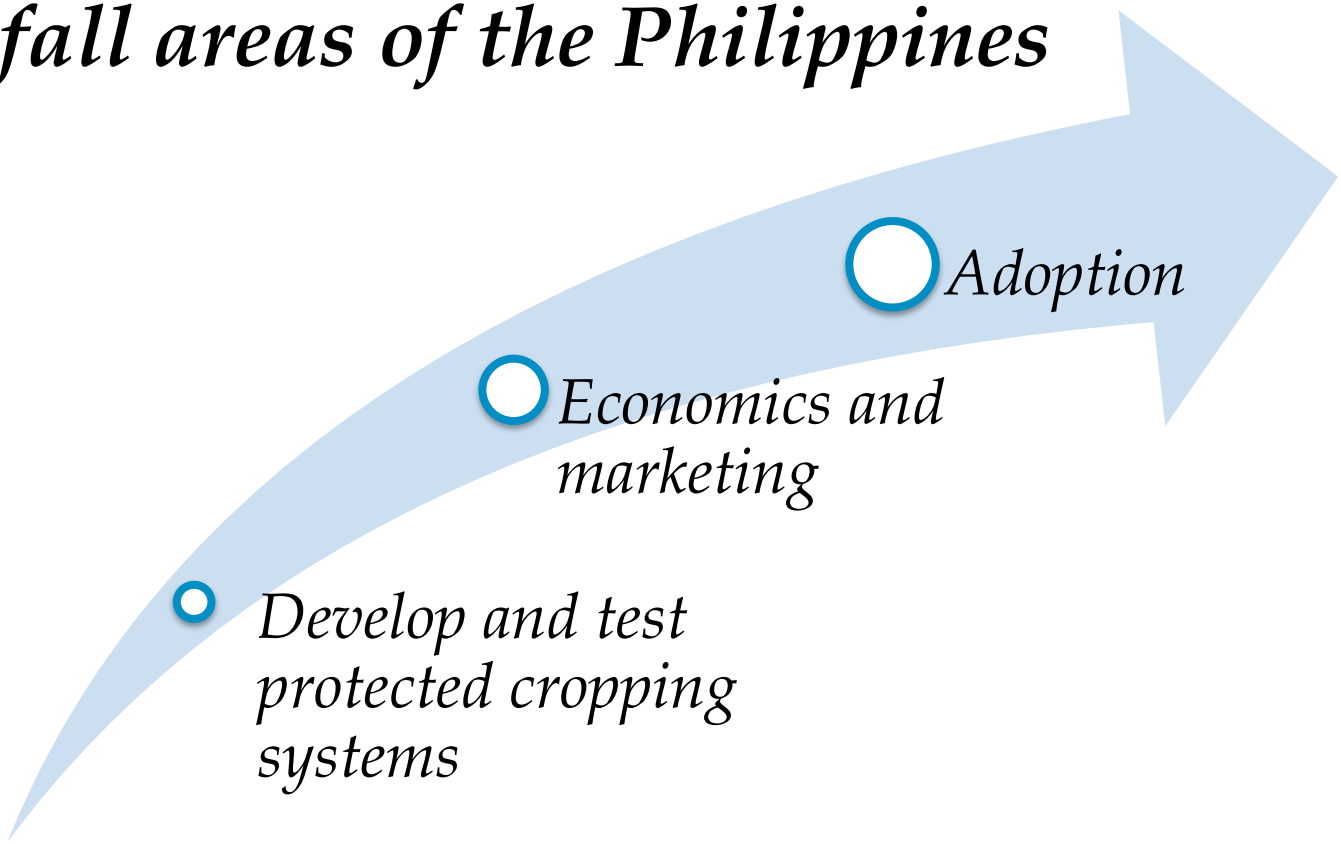
- High rainfall and Typhoons – Nov to Feb which makes vegetable growing difficult
- High vegetable prices during this time (double dry season prices)
- Only 45% of vegetable consumption is produced in Leyte – imports from Mindanao and Luzon
- Opportunity for higher quality under shelter
- Needs to be low cost for farmers to adopt

Advantages of Protected Cropping

- Produces vegetables year round
- Production of healthy and quality seedlings
- Less diseases
- Less weeds
- Less leaching of nutrients
- Allows reduction of fertilizers
- Better crop establishment
- Better soil conditions for plant growth
- Increase yield and income
- Supports production of safe and clean vegetables

Objectives – Climate Proofing/Protected Cultivation

Contribute to the development of profitable horticultural production in high-rainfall areas of the Philippines



Methodology

Overview

- 34 protected-cropping structures at five project sites in Leyte were constructed
- Two types of structures were evaluated:
  - House-type structures (bamboo or coco lumber) of 200 m2 (5 m × 40 m)
  - Tunnel-/igloo-types (bamboo or steel frames) with either plastic or net coverings of 60 m2 (1.5 m × 40 m).
- The experimental sites at the Visayas State University were used mainly for research on crop suitability, pest and disease impacts, and nutrition.
- The farmer test sites were used mainly to collect information on yield differences between crops grown under structures and in the open field to support the assessment of economic viability, and production challenges.



Promising Results

Climate Proofing


- VSU Site

Ampalaya grown under coco house structure 2 and open field at VSU site

- VSU Site

Number and weight of marketable and non-marketable fruits (kg) of ampalaya "Galaxy"

Treatment	Marketable fruits		Non-Marketable fruits	
	Number	Weight (kg/95m^2)	Number	Weight (kg/95m^2)
Coco-house	337.50a	84.67a	62.50	5.81
Open	60.00b	10.57b	63.00	3.22

- Ormoc Site at Cabintan, Ormoc (Noel)

Cauliflower "Albarich" at harvestable stage

Open field

House-type structure

- Ormoc Site at Cabintan

Number and weight of marketable and non-marketable curds (kg) of cauliflower "Albarich"

Treatment	Marketable curds		Non-marketable curds	
	Number	Weight (kg/23.2m^2)	Number	Weight (kg/23.2m^2)
Bamboo-house structure	122	21.47	10.00	2.740
Open field	0	0.00	32.33	0.937

- Ormoc Site at Cabintan

Quality of broccoli curd "Top green"

Open field

House-type structure

- Ormoc Site at Cabintan (Noel)

Number and weight of marketable and non-marketable curds (kg) of broccoli "Top green"

Treatment	Marketable curds		Non-marketable curds	
	Number	Weight (kg/23.2m^2)	Number	Weight (kg/23.2m^2)
Bamboo-house structure	61.67	13.125	23.67	5.325
Open field	0.00	0.00	10.00	0.772

- Ormoc Site at Cabintan (Noel)

Open Field

Bamboo house structure

Tomato grown under bamboo house structure and open field in Cabintan, Ormoc site

- Ormoc Site at Cabintan

Number and weight of marketable and non-marketable fruits (kg) of tomato "Diamante max"

Treatment	Marketable fruits		Non-Marketable fruits	
	Number	Weight (kg/39.2m^2)	Number	Weight (kg/39.2m^2)
Bamboo-house	7,898.33a	312.28a	176.67b	4.49b
Open	3,335.67b	151.57b	1,984.33a	84.25a

Amie Aragon – in Curva, Ormoc

Open field

House-type structure

- Maasin Site at Gutosan (Mundo)

Tomato "Atlas" at flowering stage

Open field

House-type structure

- Maasin Site at Gutosan (Mundo)

Number and weight of marketable and non-marketable fruits (kg) of tomato "Atlas"

Treatment	Marketable fruits		Non-Marketable fruits	
	Number	Weight (kg/37.5m^2)	Number	Weight (kg/37.5m^2)
Bamboo-house	4,152a	128.37a	39.00b	0.37b
Open	2,868b	69.48b	167.33a	3.30a

- Maasin Site at Gutosan (Jason and Mundo)

Open field

House-type structure

- Bontoc Site at Pamahawan (Engr. Boie)

Raised type structure

Open field

Jun Mendoza - Ormoc

Bamboo house structure

Open field

Joseph Sanchez - Ormoc

Bamboo house structure

Open field

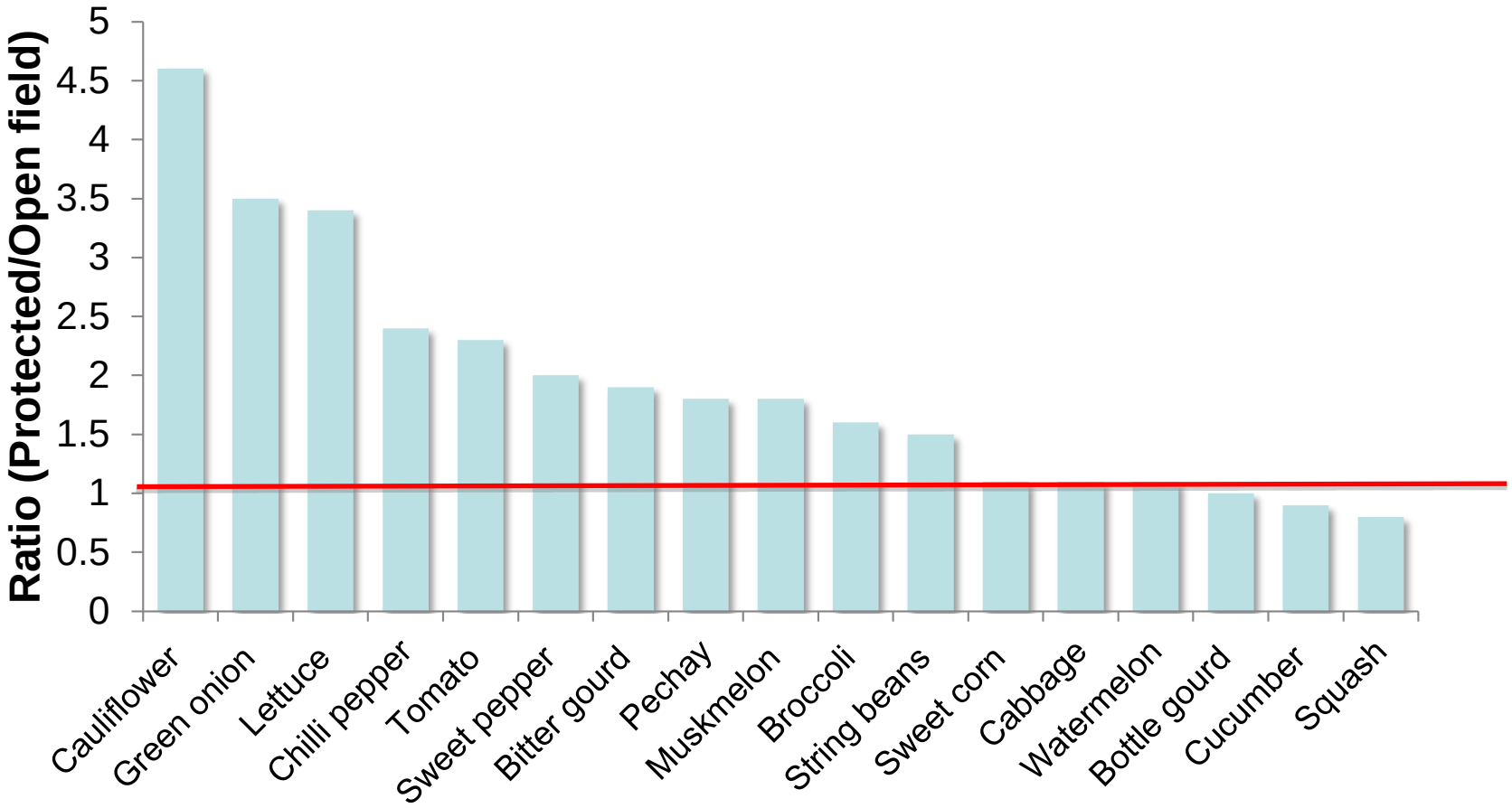
Mr Joseph Sanchez new house and baby

- Maasin Site at Libhu (Victor)

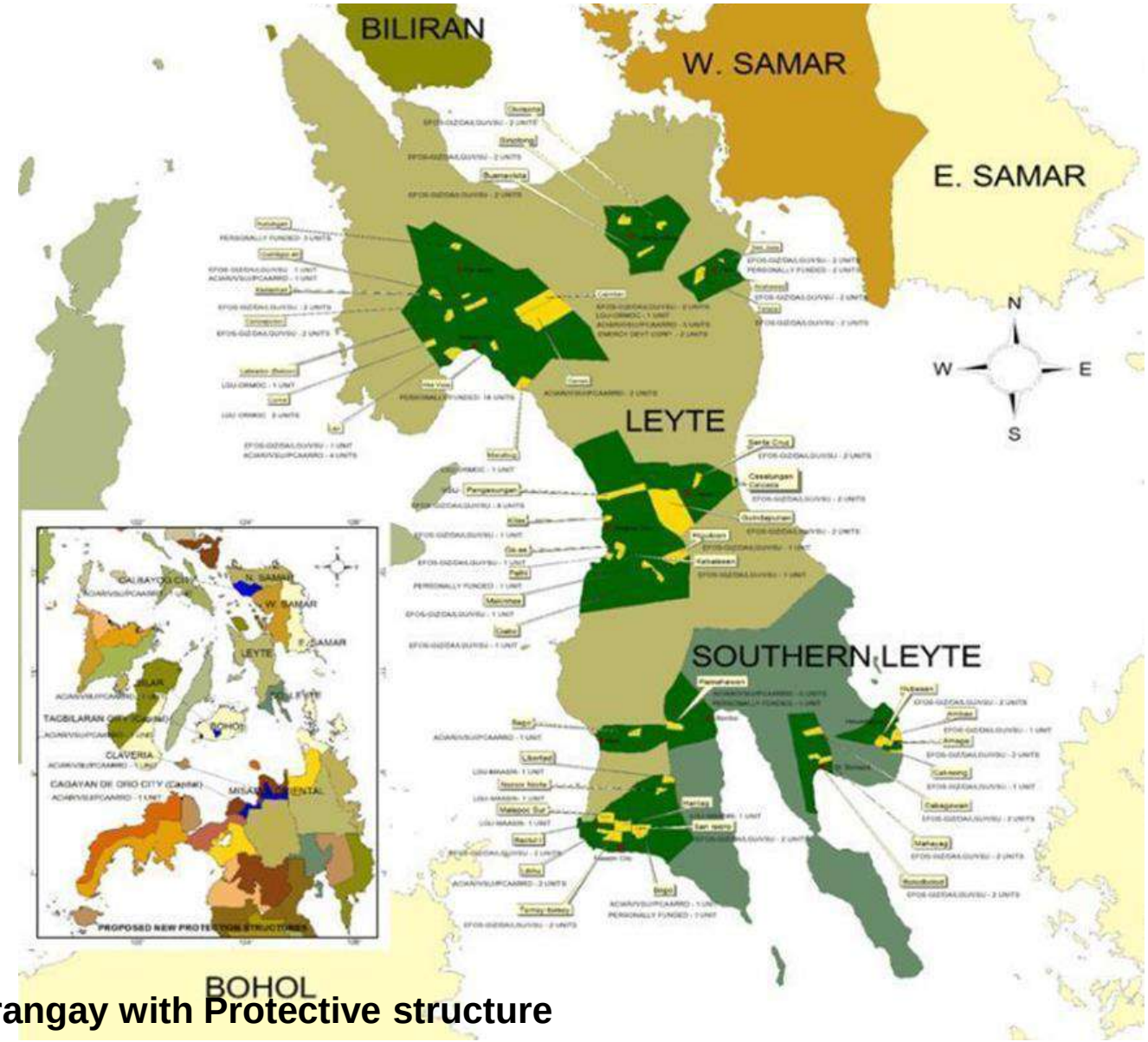
Vent type structure

Open field

Yield ratio protected cropping : open field



Location Map of Protective Structures in Leyte & Southern Leyte



LEGEND

Barangay with Protective structure

Municipalities with established Protective structure

Adoption and Expansion of Low-Cost Protective Structures

A total of 121 different protective structures have been built across Leyte and Southern Leyte:

- 29 by ACIAR/VSU/PCAARD
- 48 by EFOS
- 9 for LGUs
- 2 between LGU and EDC
- 7 poultry houses in Brgy. Concepcion converted into protective structures for vegetable production
- 8 structures personally funded
- 18 medium tech. structures built by Catholic Diocese in Palo

What's Next?

Integrated Crop Management (ICM)

Objectives - ICM

Improved livelihoods and food security of smallholder vegetable farmers

- To develop component technologies for management of key insect pests and diseases
- To develop component technologies for management of key agronomic constraints for each target site
- To increase vegetable farmer profitability through integrated crop management (ICM) in Leyte, Bohol, Samar and Mindanao
- To capacitize farmers and researchers

Methodology

Methodology

- ✓ Multi-disciplinary project team included scientists from five Philippine Universities or institutes (VSU, BISU, UTSP, UPLB, NwSSU)
- ✓ Training teams from East West Seeds and Landcare Foundation Philippines
- ✓ Scientists from two Australian State Departments of Primary Industries and an Australian private research provider.
- ✓ The project team scientifically evaluated various components of an ICM system for field and protected cropping of key high value vegetables in the Southern Philippines with 110 experimental trials conducted.

Promising Results on Integrated Crop Management (ICM)

Disease Inventory

Major diseases

Bacterial wilt

Cercospora leafspot

Phytophthora sp

"Namamarako" and Downy Mildew

New records

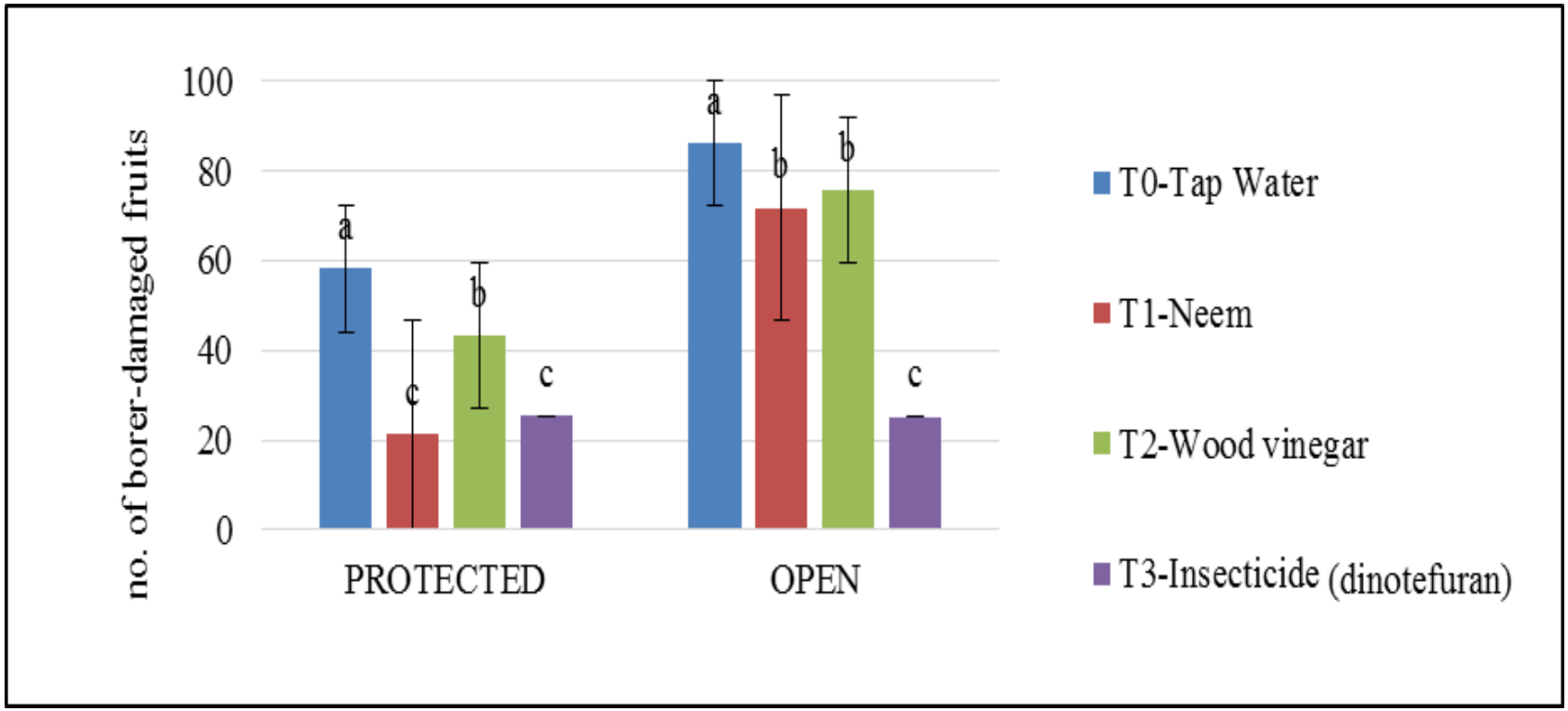
- Tomato: Bacterial canker (*Clavibacter michiganensis*)
- Tomato: Septoria leaf spot (*S. lycopersici*)
- Tomato: Target spot (*Corynespora cassiicola)*
- Ampalaya: little-leaf (*Phytoplasma)*
- Ampalaya: Bacteria wilt *(caused by Ralstonia, not Erwinia)*

Fusarium wilt incidence (%) in tomato with biofumigation, *Trichoderma*, cabbage rotation and fungicide application **(season 2)**

Treatments	21 DAT	28 DAT	35 DAT	42 DAT	49 DAT	56 DAT
Biofumigation	8.5 b	8.5 b	14 a	17.5 b	28.5 b	35 b
Trichoderma	10 ab	11.5 ab	13.5 a	20 ab	32.5 ab	42.5 ab
Crop rotation[1]	11.5 ab	11.5 ab	15.5 a	18 b	27.5 b	34 b
Fungicide	14 a	14 a	19 a	24 a	41.5 a	50.5 a

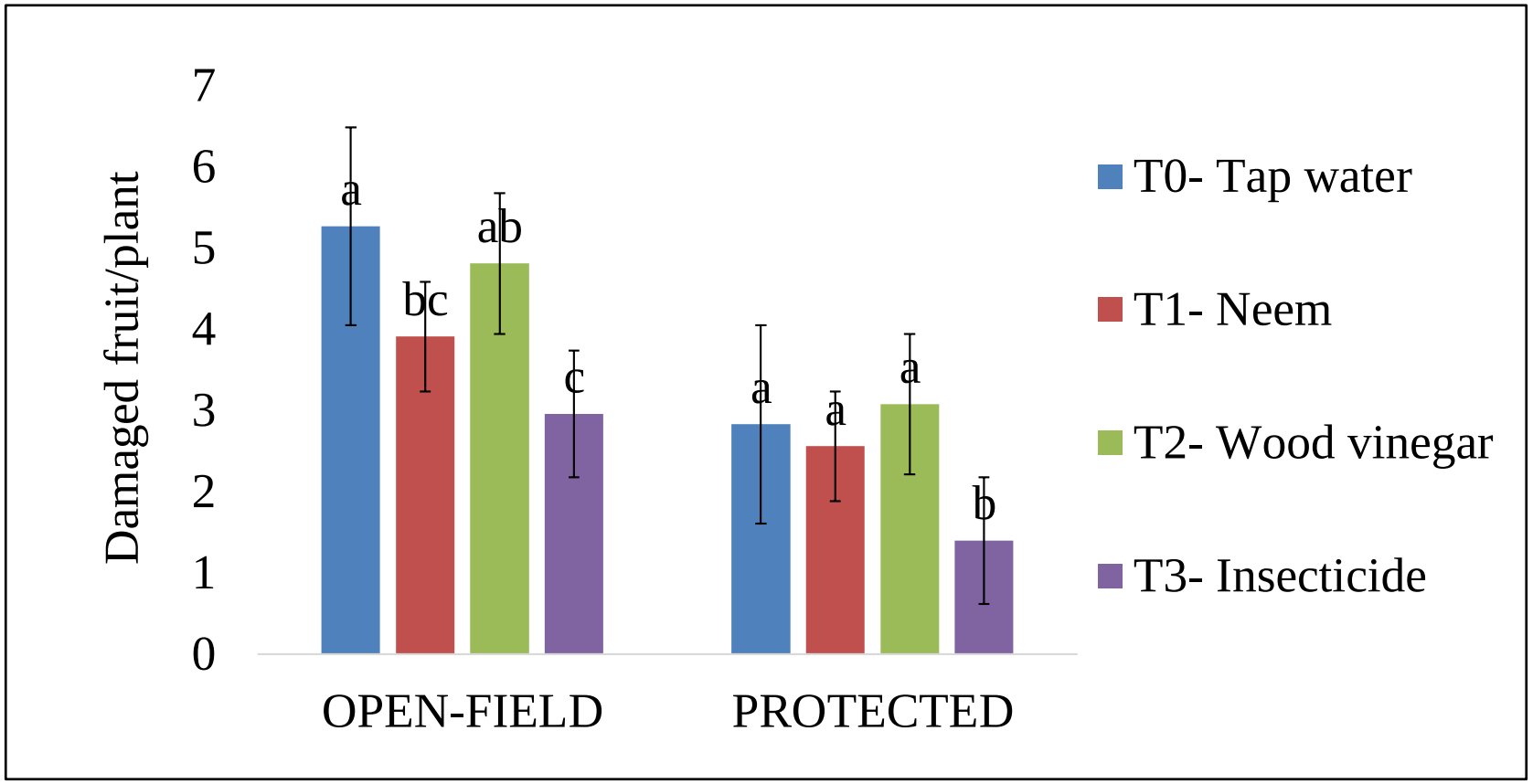
[1]Plots were previously planted corn and sweet potato

Efficacy of Wood vinegar and neem leaf extract on fruit and shoot borer (*Leucinodes orbonalis* Guenee) of eggplant



Number of borer-damaged fruits under protected and open field cultivation as influenced by different treatments based on 12 plants

Efficacy of wood vinegar and neem leaf extract on the fruitworm *(Helicoverpa armigera* Hubner*)* of tomato

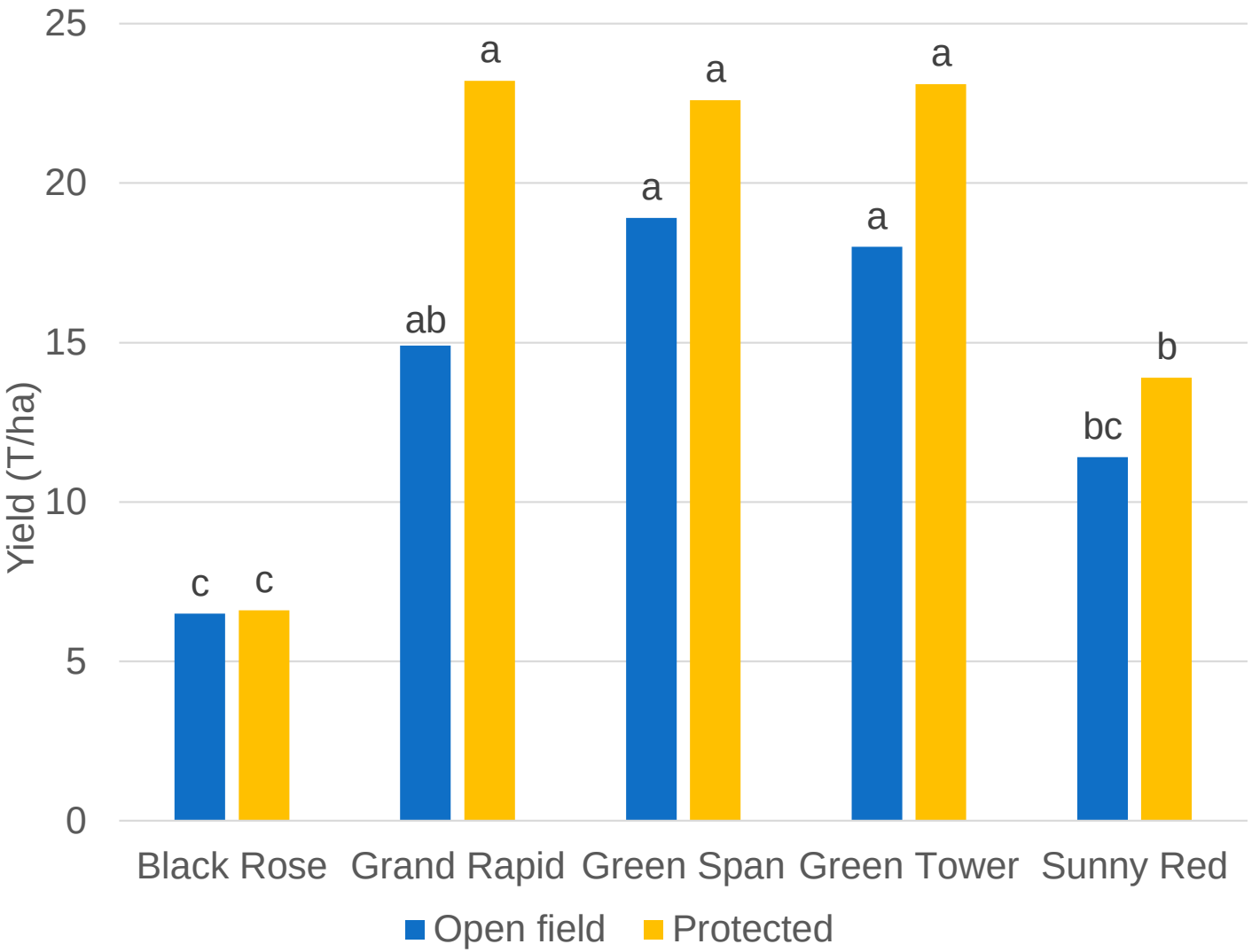


Horticultural/agronomic studies

Variety recommendations made for sweet pepper, head lettuce, leaf lettuce and fresh/processing tomatoes

Lettuce: varieties – open field/protected VSU

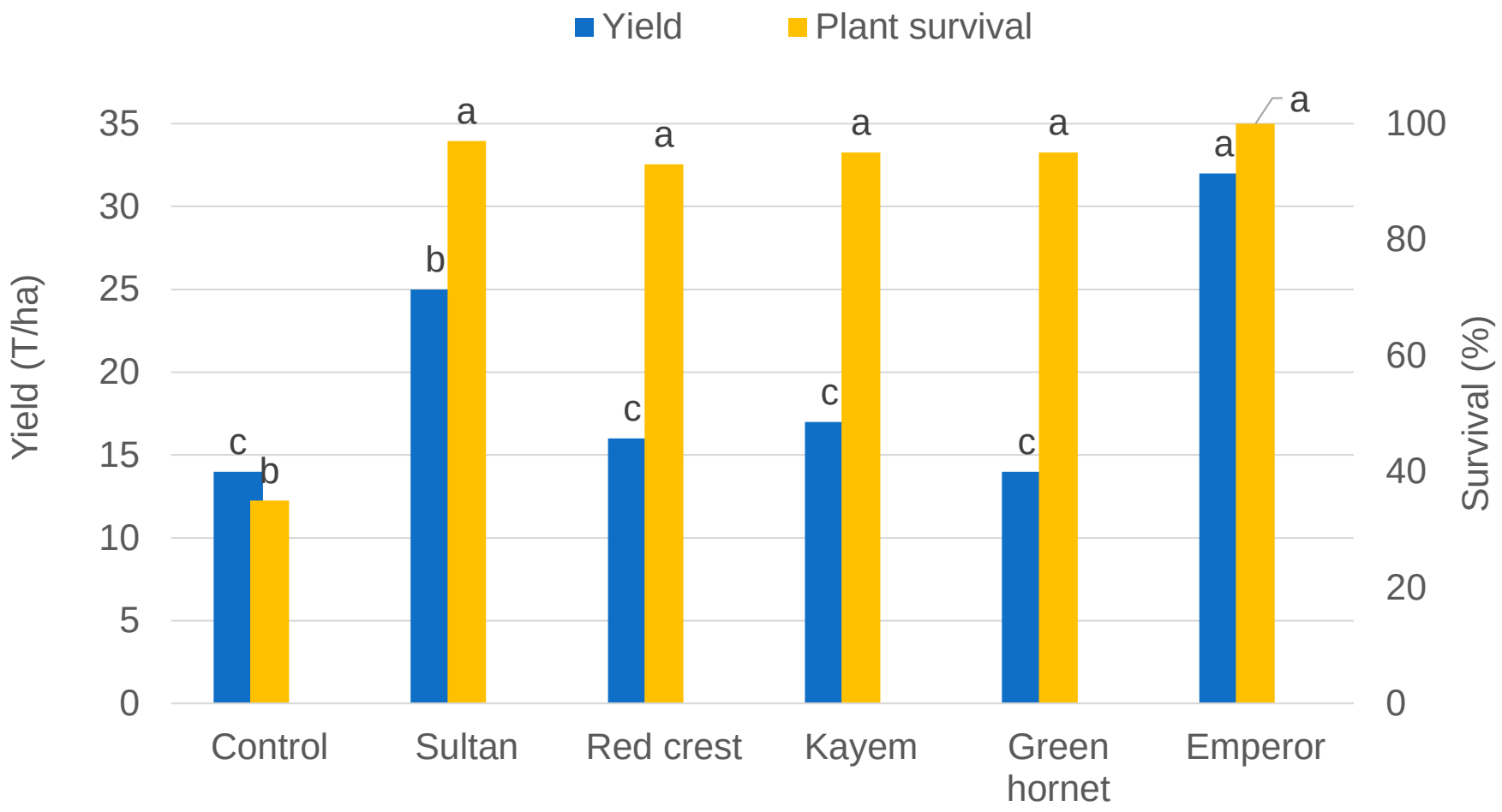
✓ Grand Rapid, Green Span or Green Tower recommended



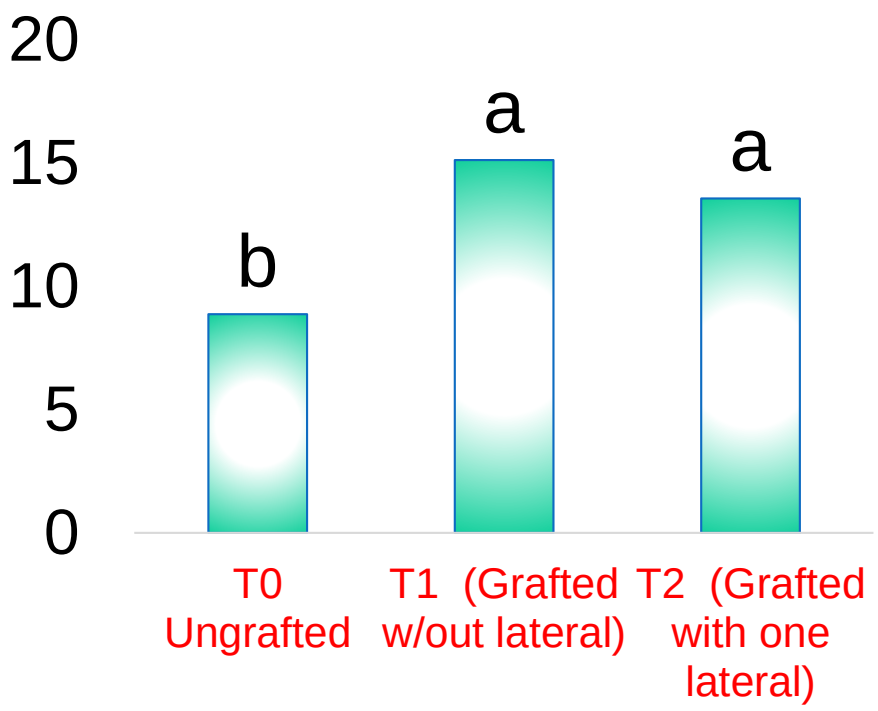
Vegetable grafting

Sweet pepper: varieties and grafting - VSU

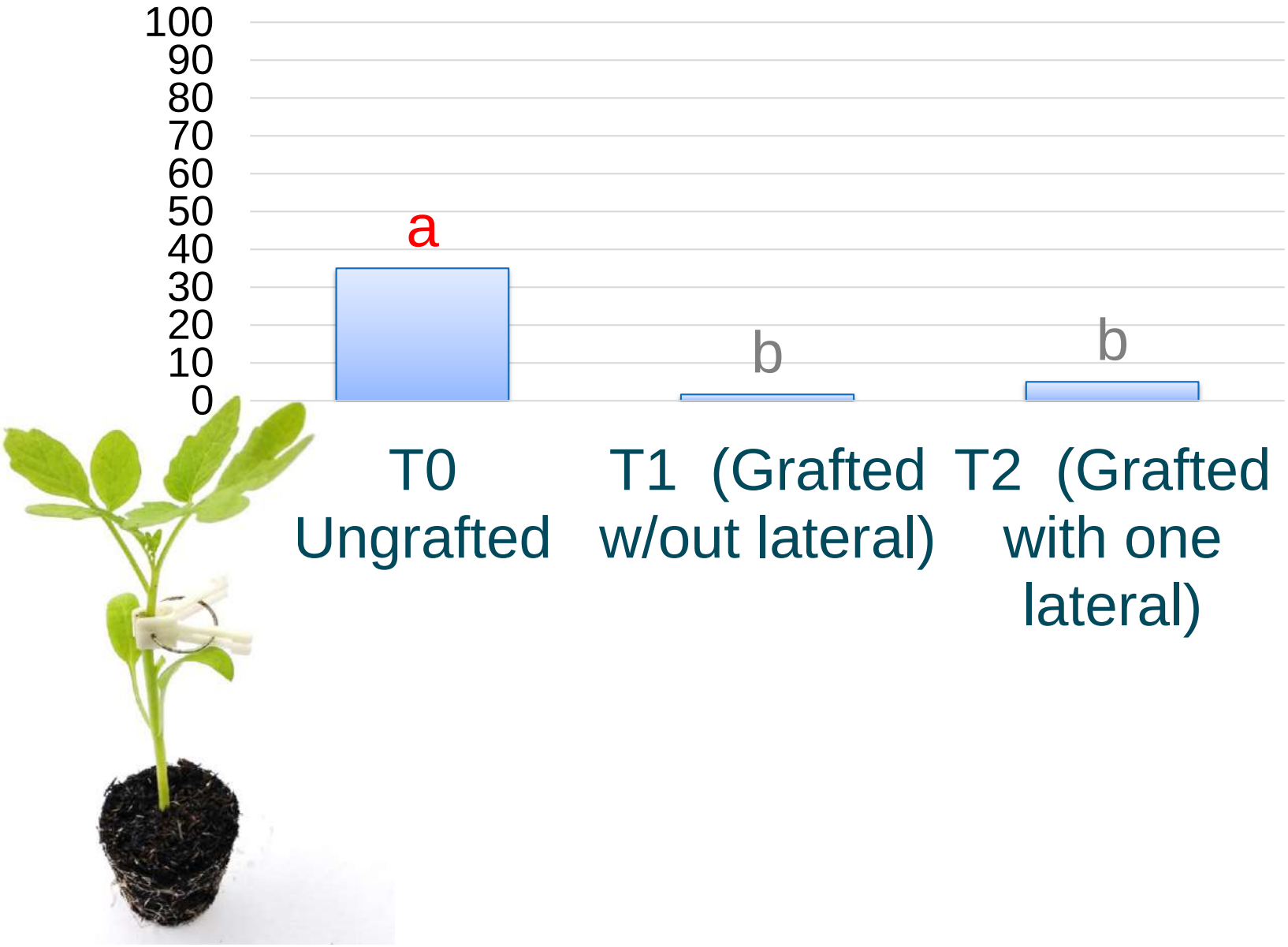
- ✓ Grafting increases tolerance to bacterial wilt
- ✓ Emperor and Sultan highest yielding



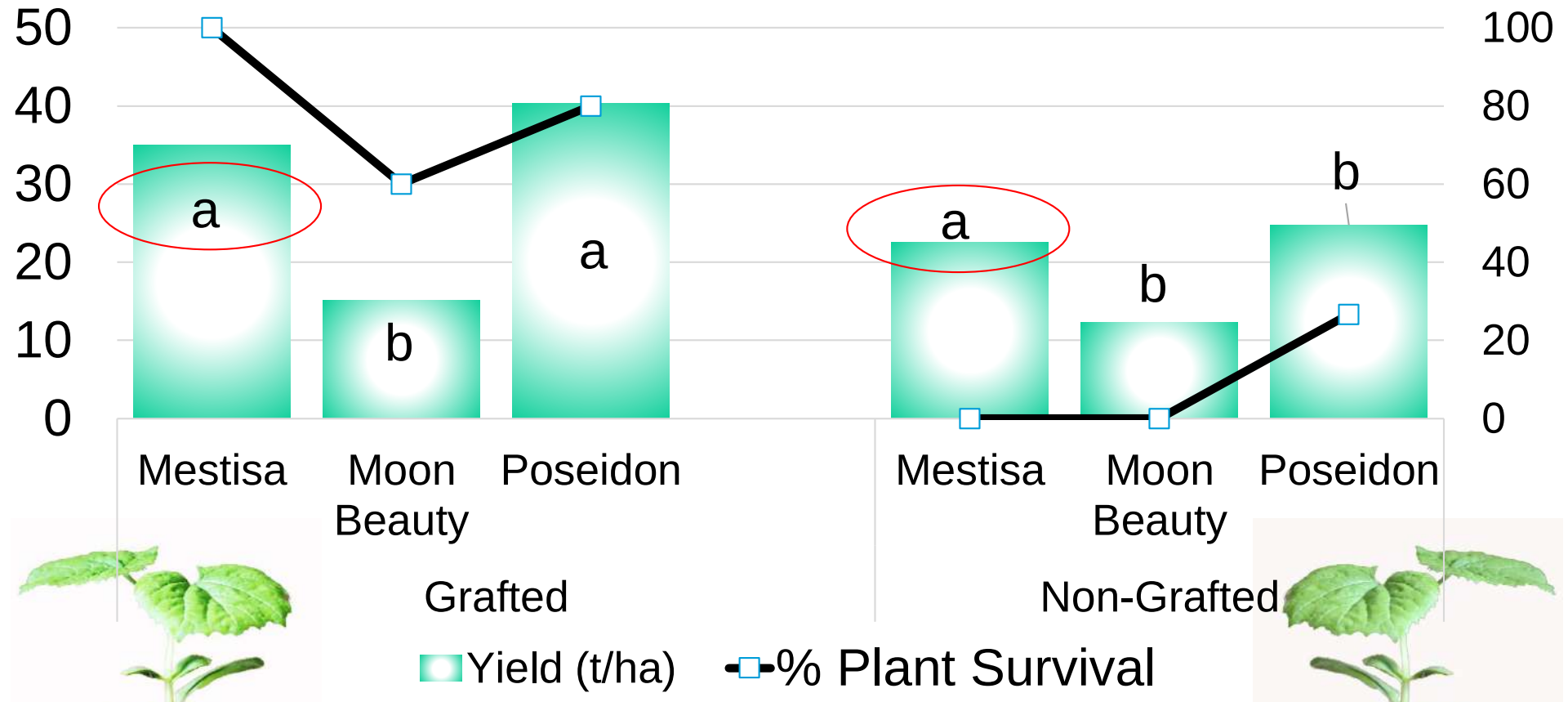
KAMLONG (*Kam*atis grafted to Ta*long*): Yield (ton/ha)



KAMLONG : Percent (%) Bacterial Wilt Infection

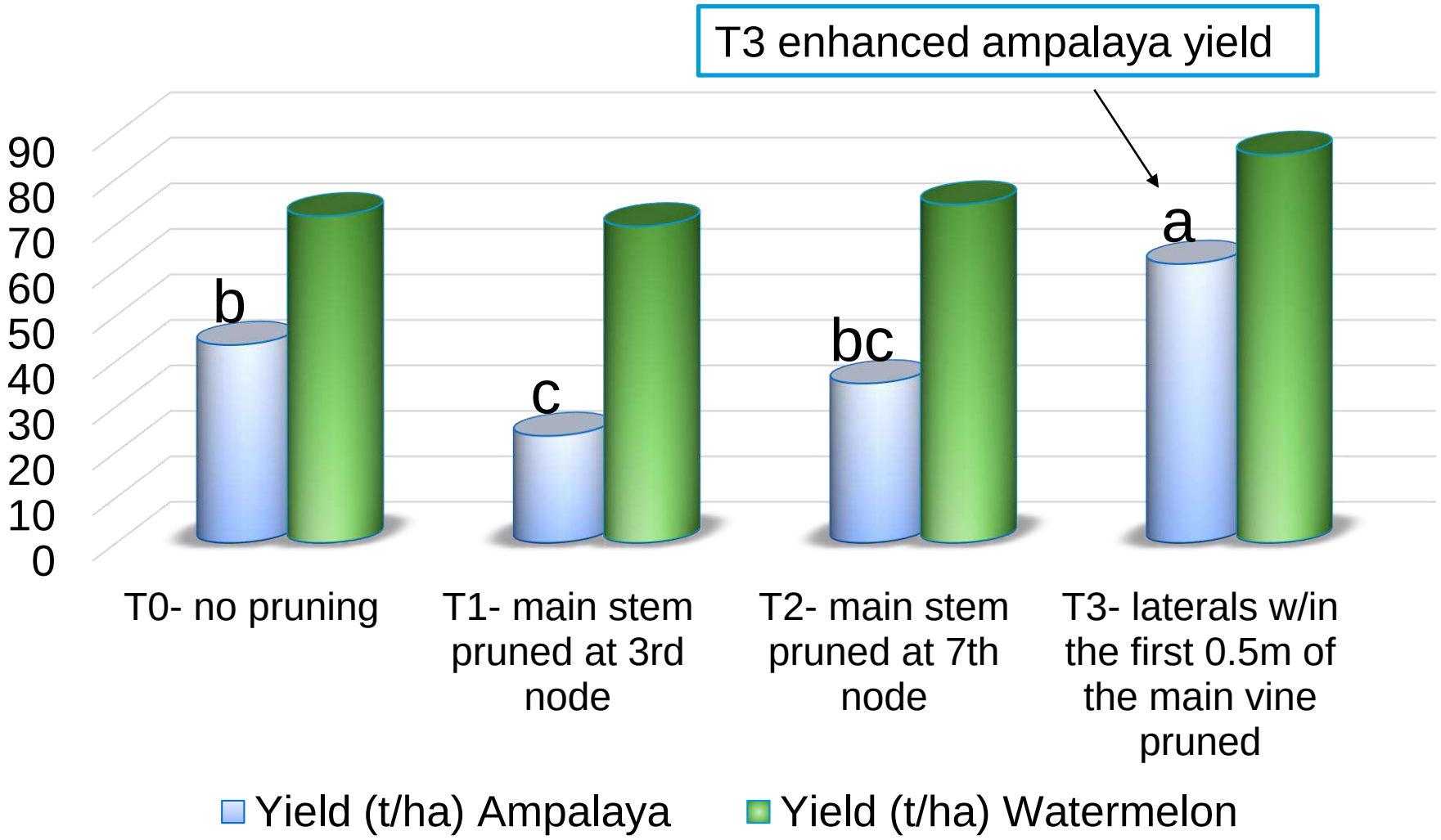


Ampatola (Ampalaya grafted to Patola): Varieties



- ✓ Mestisa – consistent High yield
- ✓ <u>High survival for ampatola</u>

Pruning technique



Irrigation Trial – Selected vegetable

Table 3. Number and weight (t/ha) of fruits of the selected vegetables as influenced by different water delivery systems planted in house-type protective structure of ACIAR-ICM project, VSU, Visca, Baybay City, Leyte.

Water delivery system	Yield (t/ha)	
	Tomato	Sweet pepper
Sprinkler	7.33 b	15.15 c
Drip Bottle	13.80 a	28.09 a
Drip Hose	8.75 b	21.69 b

Tomato Irrigation and **yield:** Claveria

TREATMENTS	FRUIT SIZE (cm)		NUMBER OF FRUITS PER PLANT		YIELD PER PLANT (kg)		YIELD (t ha^{-1})
	Polar	Equatorial	Marketable	Non-marketable	Marketable	Non-marketable	
Irrigation System (A)							
Manual	**4.80 b**	**3.55 b**	**47.54 b**	**12.62 a**	1.18	0.71	**20.28 c**
Drip	**5.39 a**	**3.97 a**	**60.77 a**	**8.01 b**	1.48	0.70	**31.66 a**
Overhead	5.15 b	3.93 a	49.10 b	11.14 a	1.33	0.71	25.17 b
F-test	*	*	**	**	ns	ns	**

✓ Drip irrigation increases yields and fruit size

Tomato Irrigation and **disease:** Claveria

TREATMENTS	DISEASE INCIDENCE		
	30 DAT	45 DAT	60 DAT
Irrigation System (A)			
Manual	1.04 b	1.74 a	2.53 a
Drip	**1.03 b**	**1.36 b**	**2.15 b**
Overhead	**1.22 a**	**2.03 a**	**2.60 a**
F-test	**	**	**

Disease Incidence Rating: 0 – none of the total population; **1** – 1-25 % of the population **2** – 26-50 % of the population; **3** – 51-75 % of the population; **4** – 76-100 % of the population

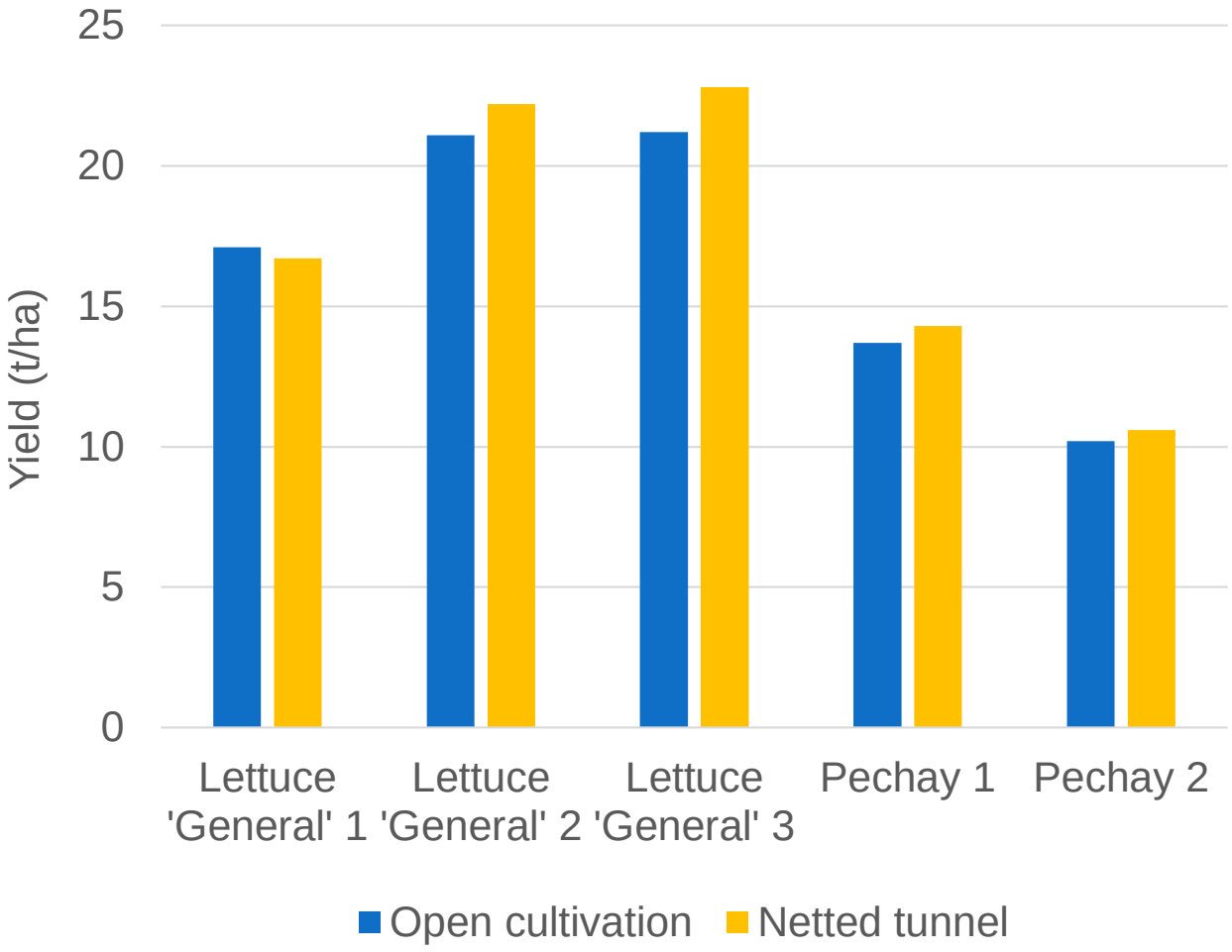
- ✓ Drip irrigation reduces disease incidence

Net covered low tunnels

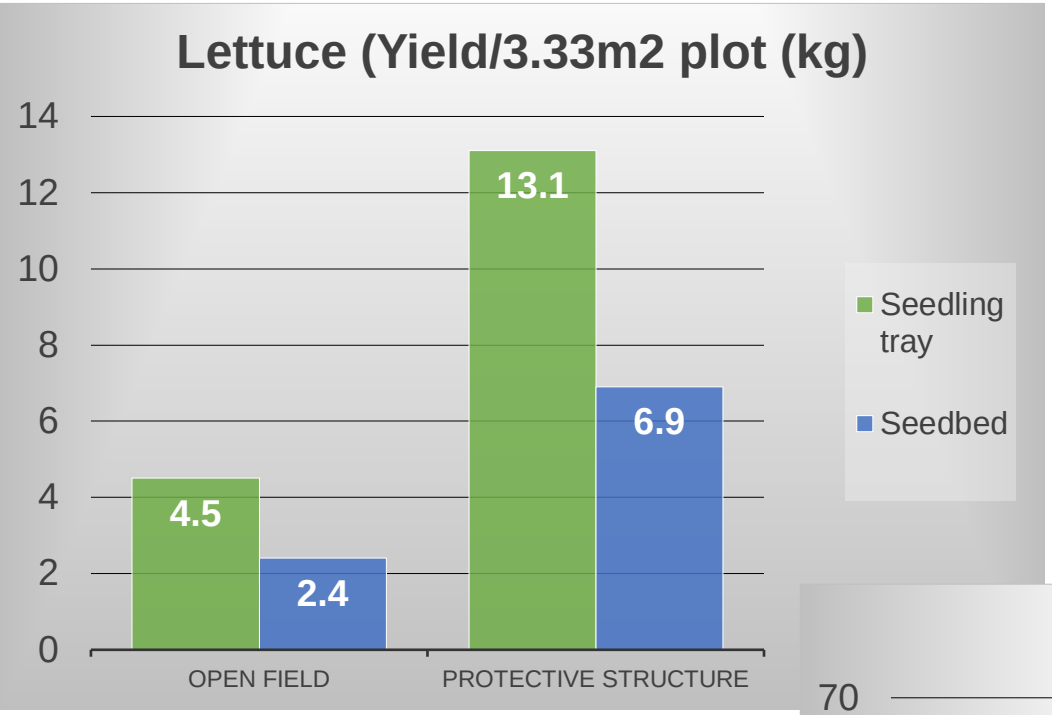
- VSU trials: 6 x lettuce and pechay
- Bohol: 2 trials
- Samar:1 trials

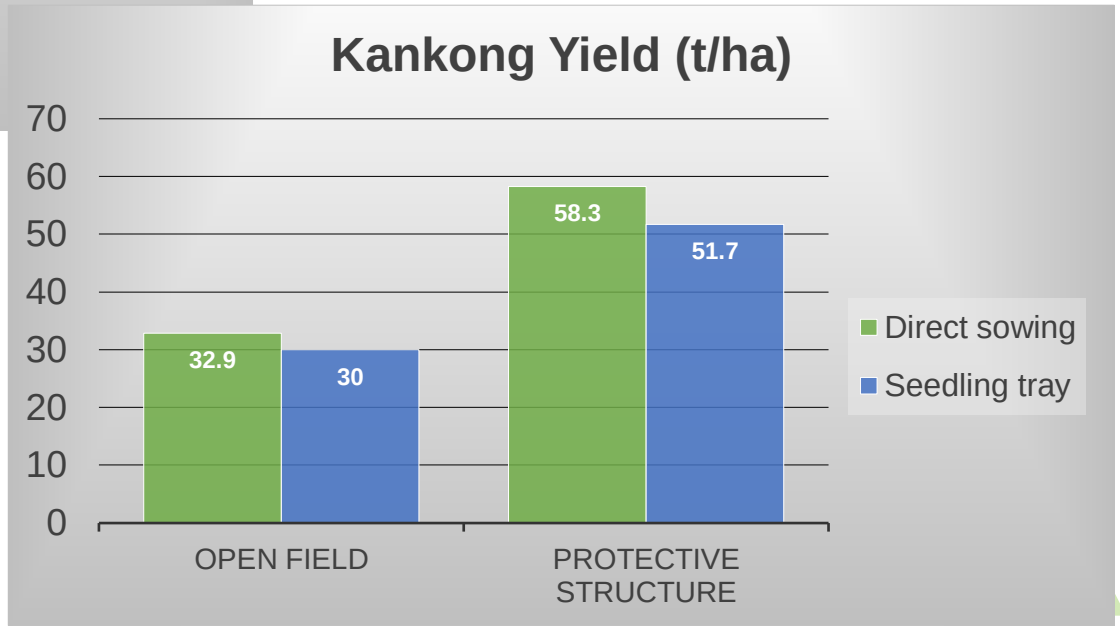
Leafy vegetables under low tunnels:

Good weather during the dry season = No effect of protected cropping, however…



***Rainy season*: low tunnels are <u>much better</u>**





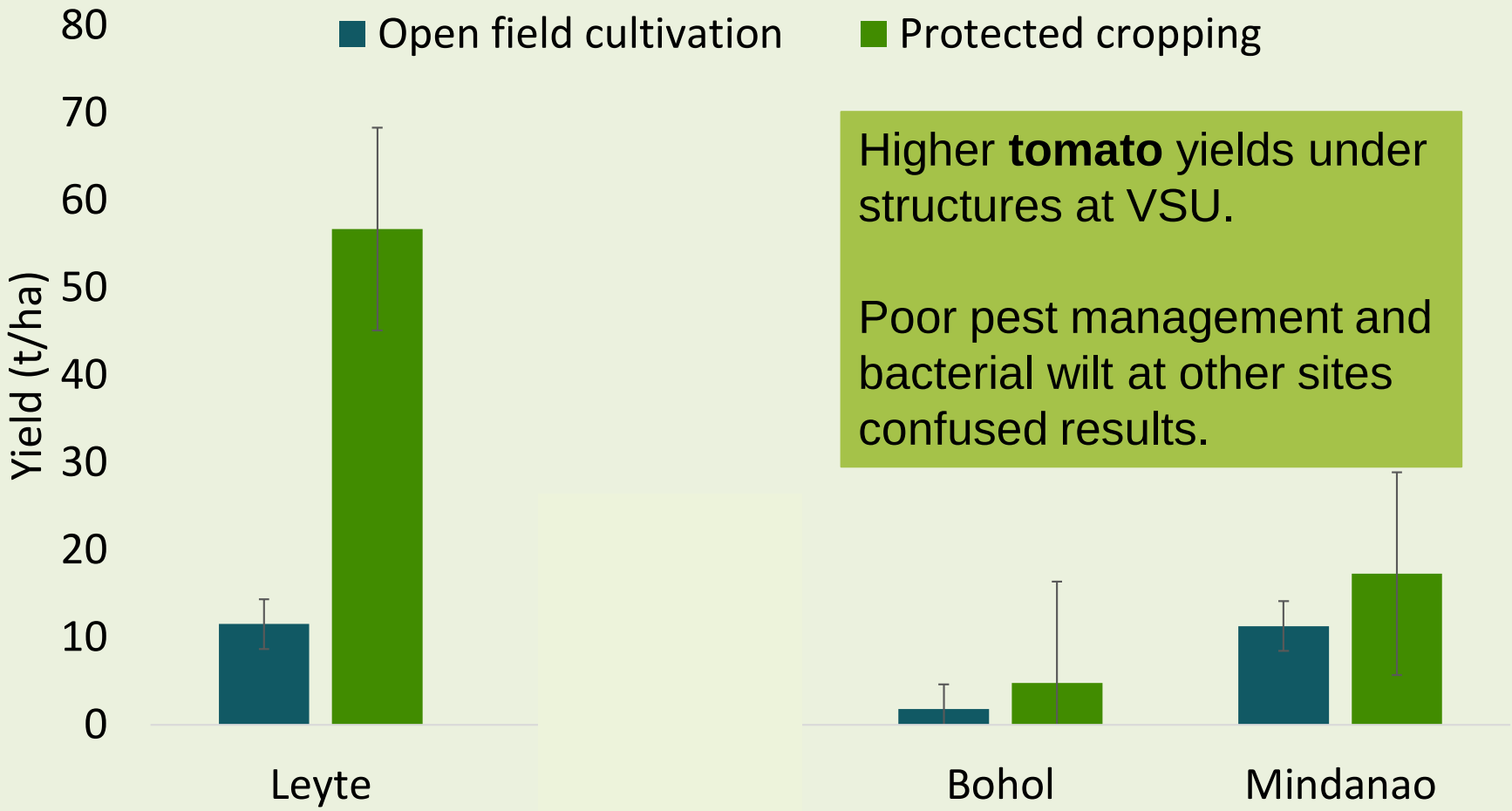
Protected cropping in Samar and Bohol

Benefit of house type protected ***cropping confirmed for Leyte***.

Poor pest and disease control in Bohol and Claveria masked results (very low yields and high variability)

- Trials:
  - VSU: 7 trials
  - Samar: 1trial
  - Bohol: 2 trials
  - Clavaria: 6 trials

Tomato yield under house type protected cropping across three sites



Higher **tomato** yields under structures at VSU.

Poor pest management and bacterial wilt at other sites confused results.

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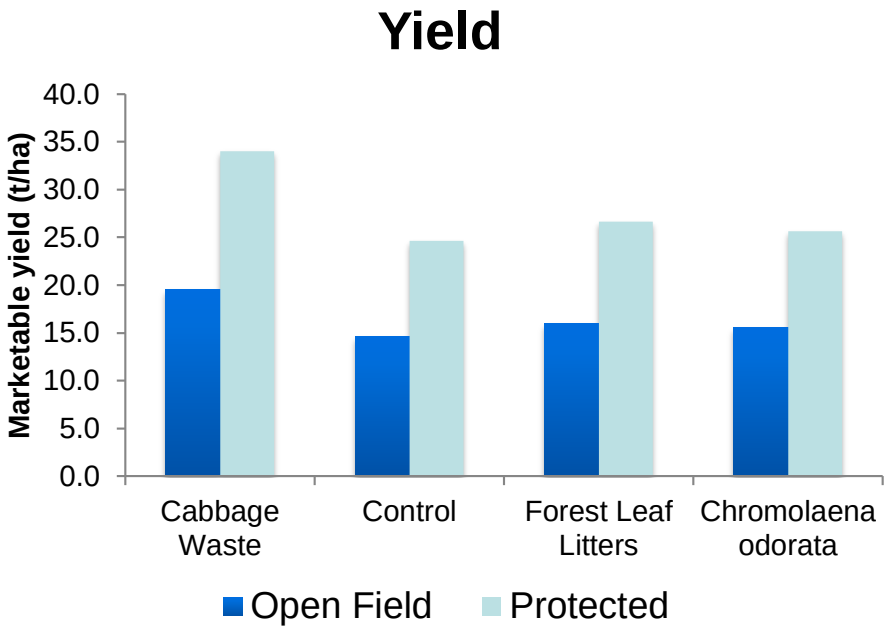
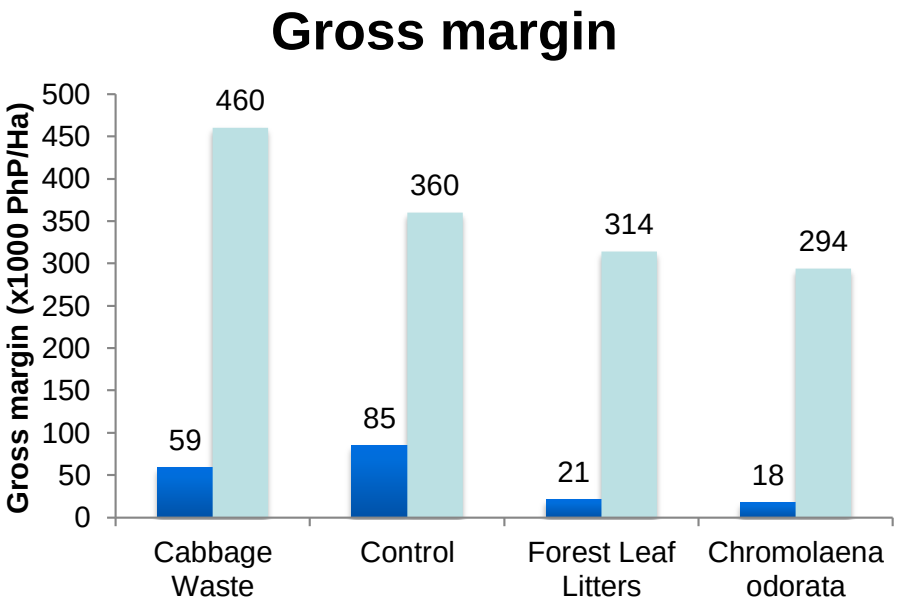
Tomato: open field v's protected cropping at VSU



1. **Cabbage waste**
2. **Leaf litter**
3. **Siam Weed**

+ Protected cropping

Less Bacterial Wilt



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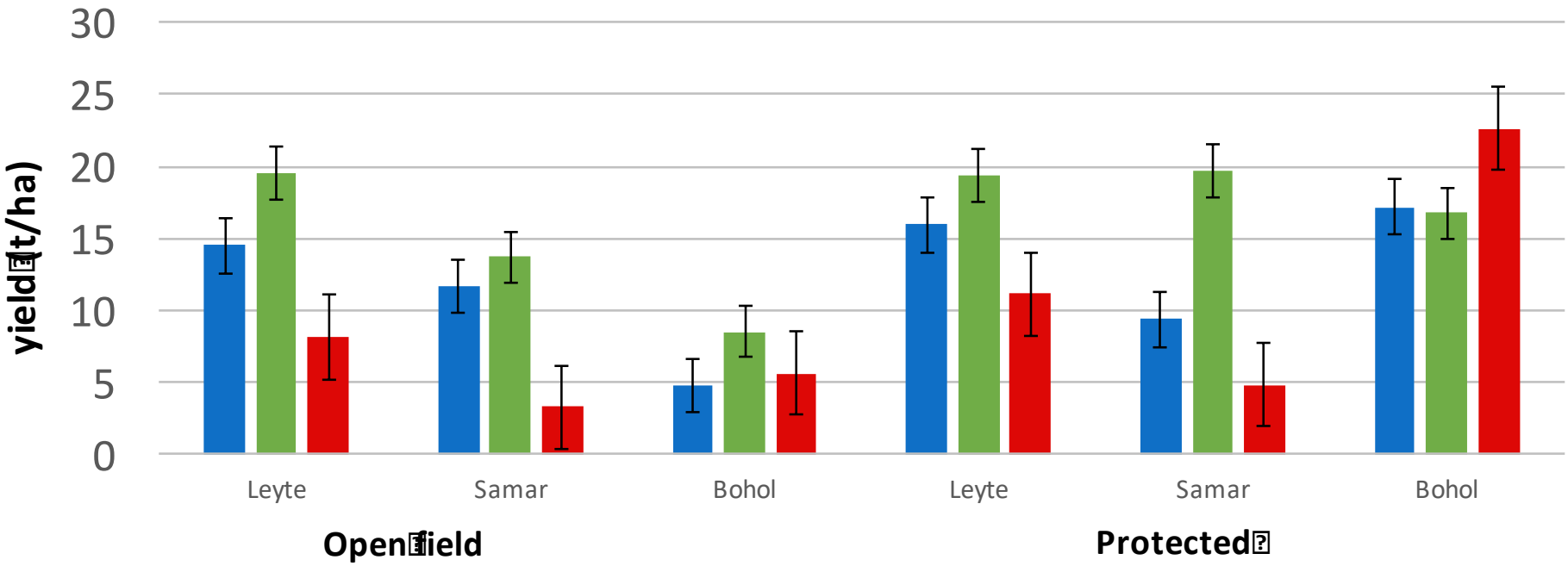
Crop establishment

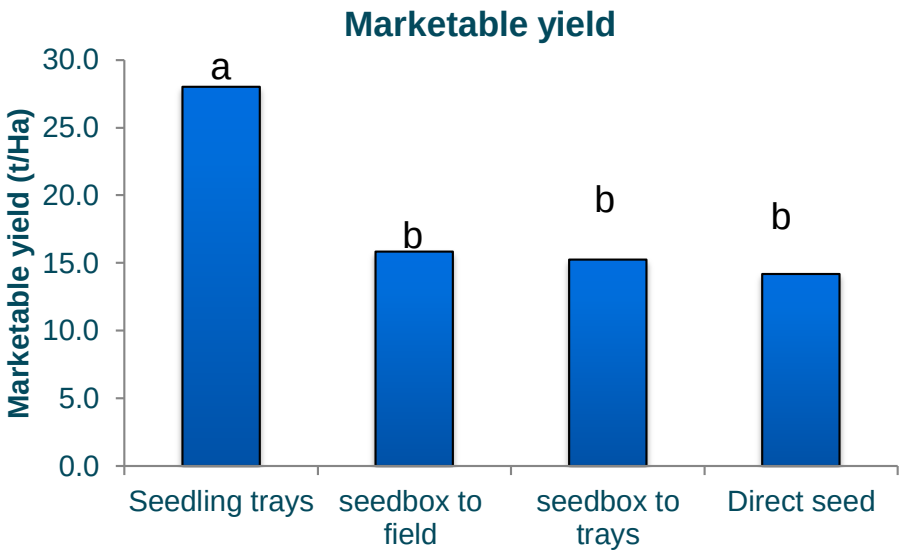
- Seedling trays, seedbox to field, seedbox to trays, direct seeding

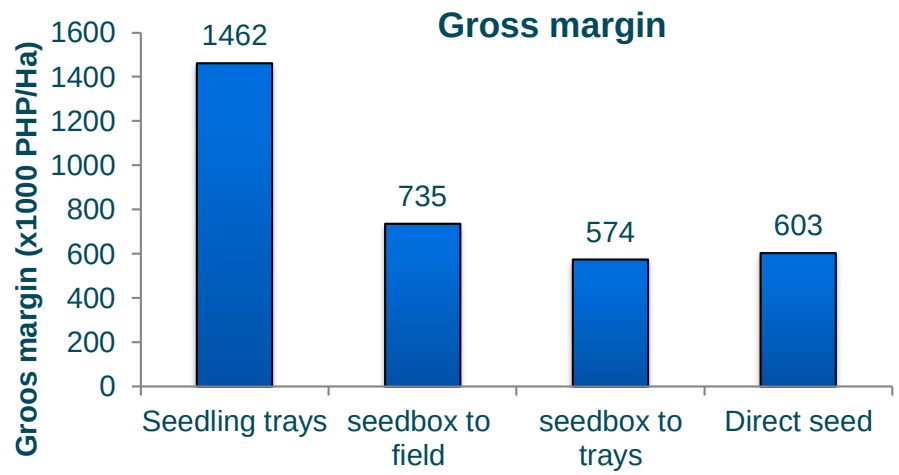
✓ Lettuce: Seedling trays
✓ Pechay: Seedling trays
✓ Kangkong: Direct sowing

Seedling trials: Pechay across three sites



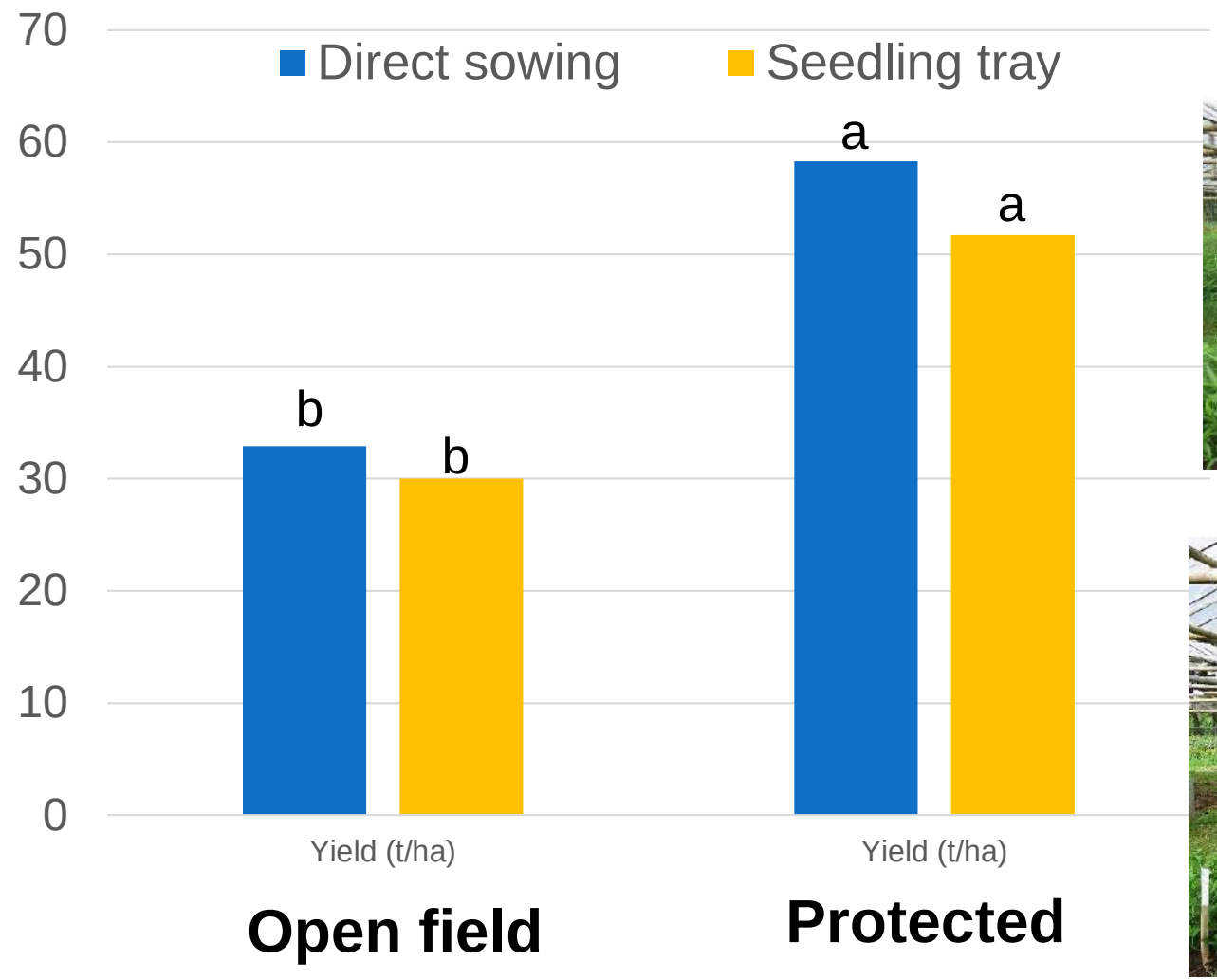
Seedling trials: Lettuce





✓ Use of Seedlings trays is the best

Seedling trials: Kangkong



Open Field

Protective Structure

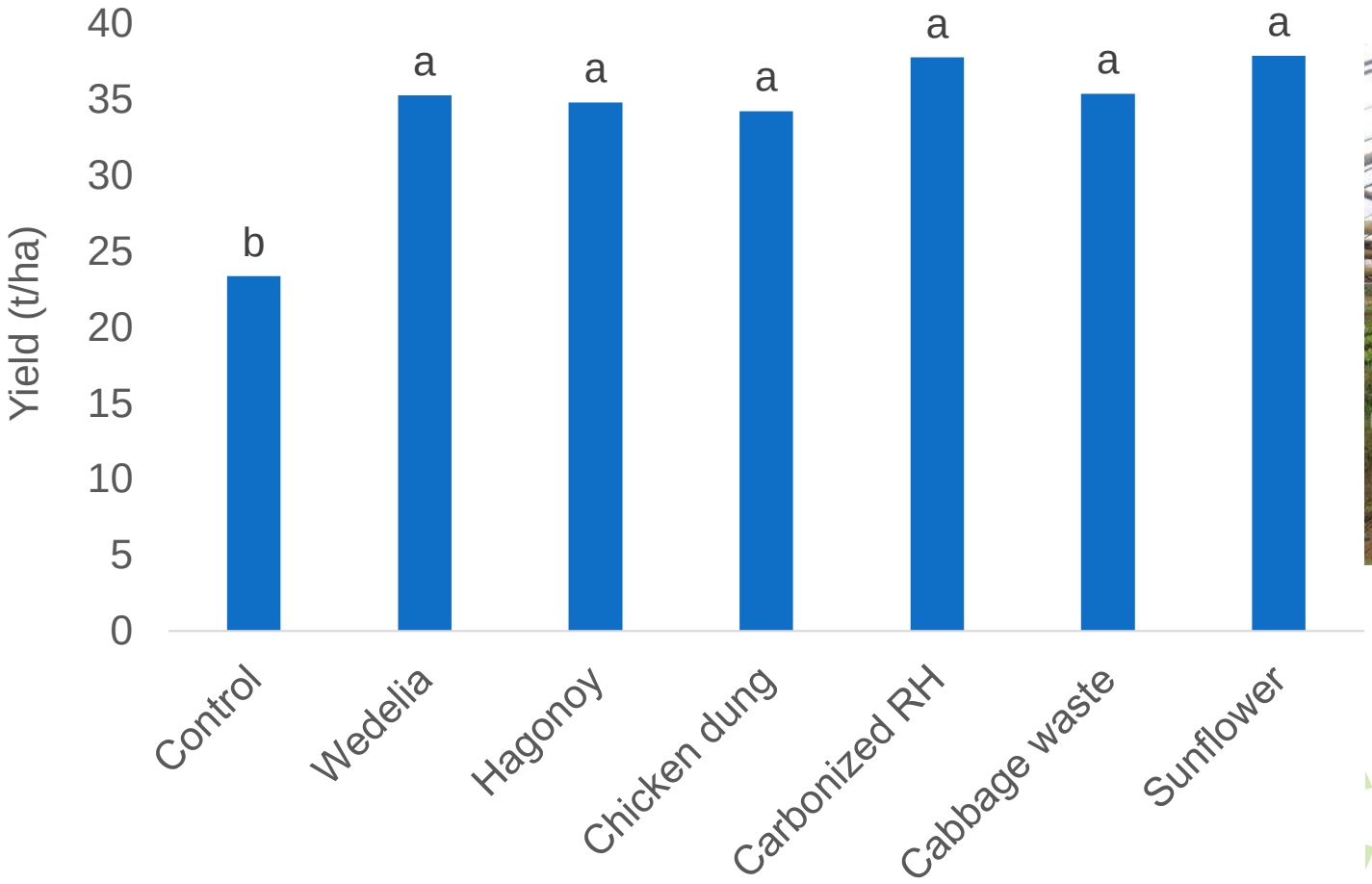
✓ Direct sowing gave similar result

Mulches and amendments

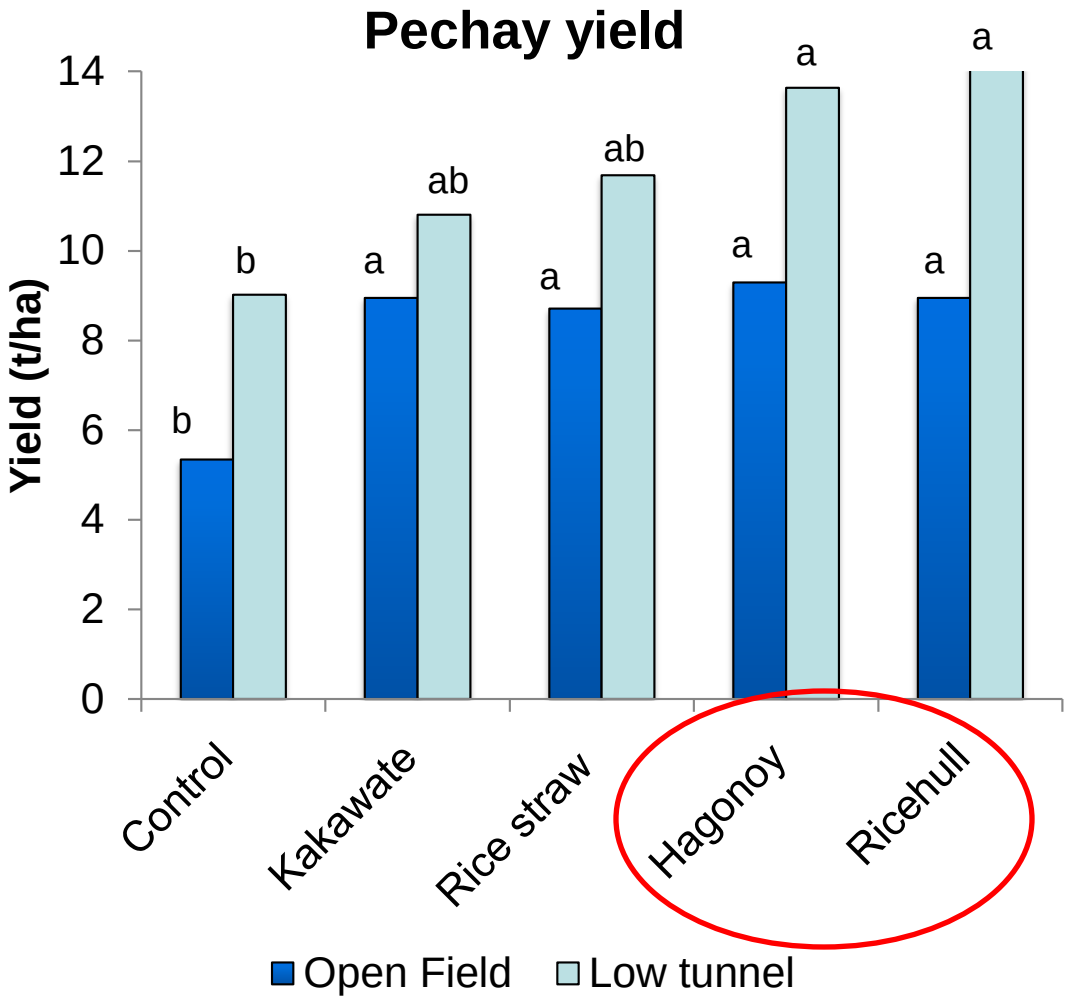
- 18 trials across VSU, BISU and MOSCAT
- Coloured plastic mulches, organic amendments; hagonoy (*Chromolaena odorata*), rice straw and hull, sunflower (*Helianthus annus* L.), wedelia (*Wedelia trilobata* L.), kakawate (*Gliricidia sepium* Jacq.)
- Sweet pepper, tomato, ampalaya, cabbage, pechay and lettuce

Organic amendments: tomato - VSU

- ✓ Higher yields with soil amendments
- ✓ Increased plant survival

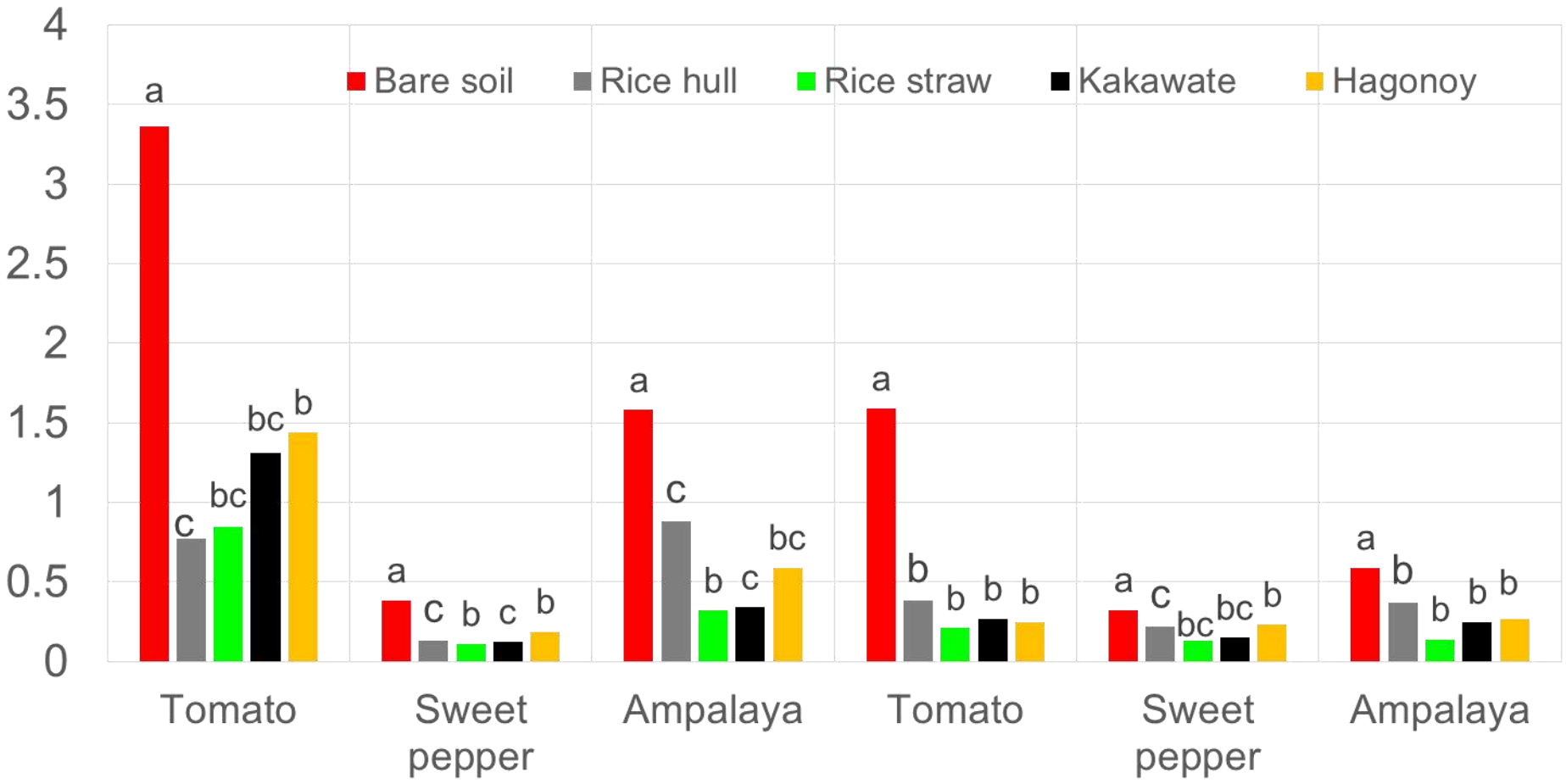


Organic amendments: Pechay (low tunnels)



✓ Hagonoy and ricehull best under structures

Organic mulch and *weed control*

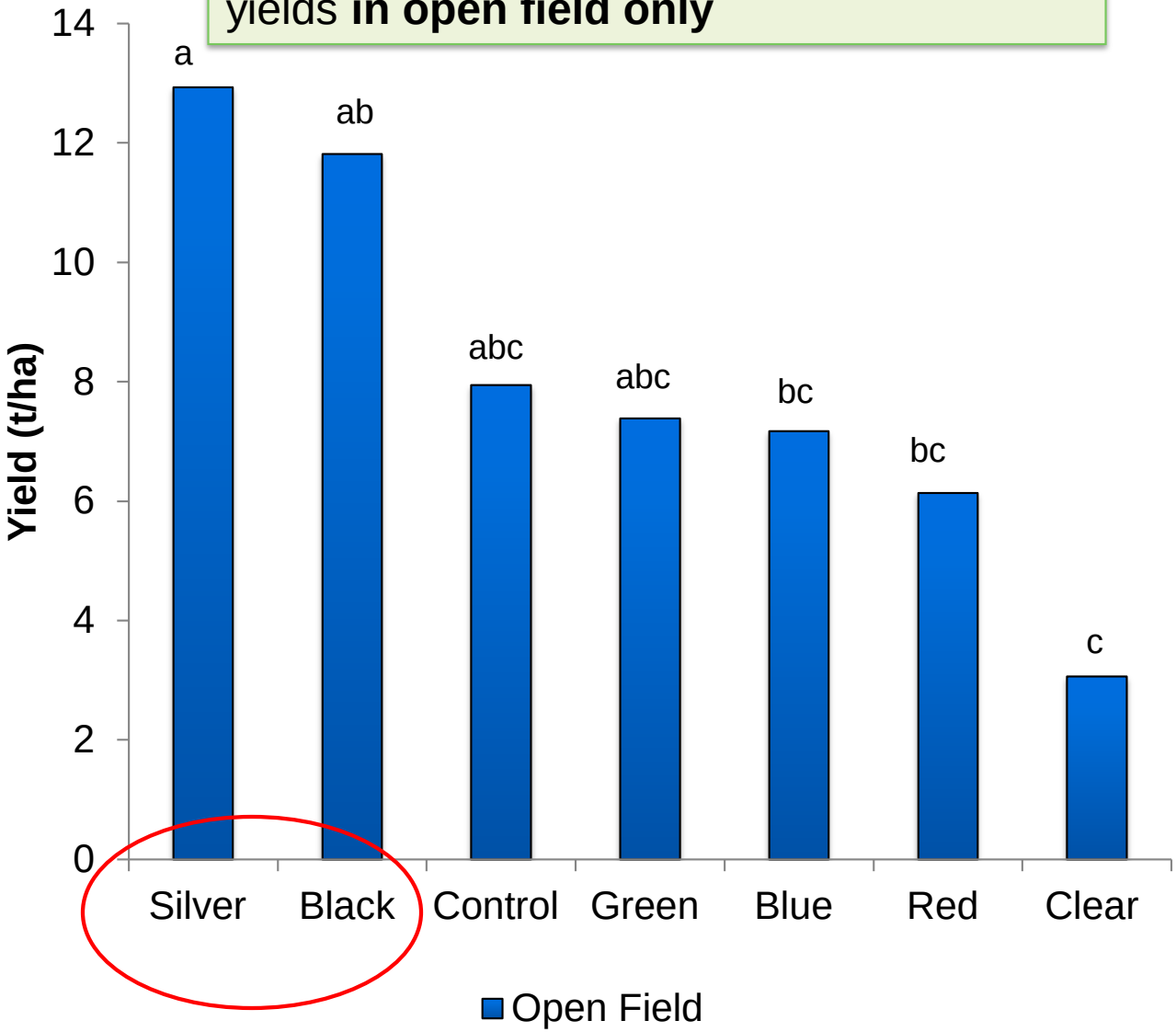


Open field

Protected

Plastic mulch: Sweet pepper

Silver and black plastic resulting in higher yields **in open field only**



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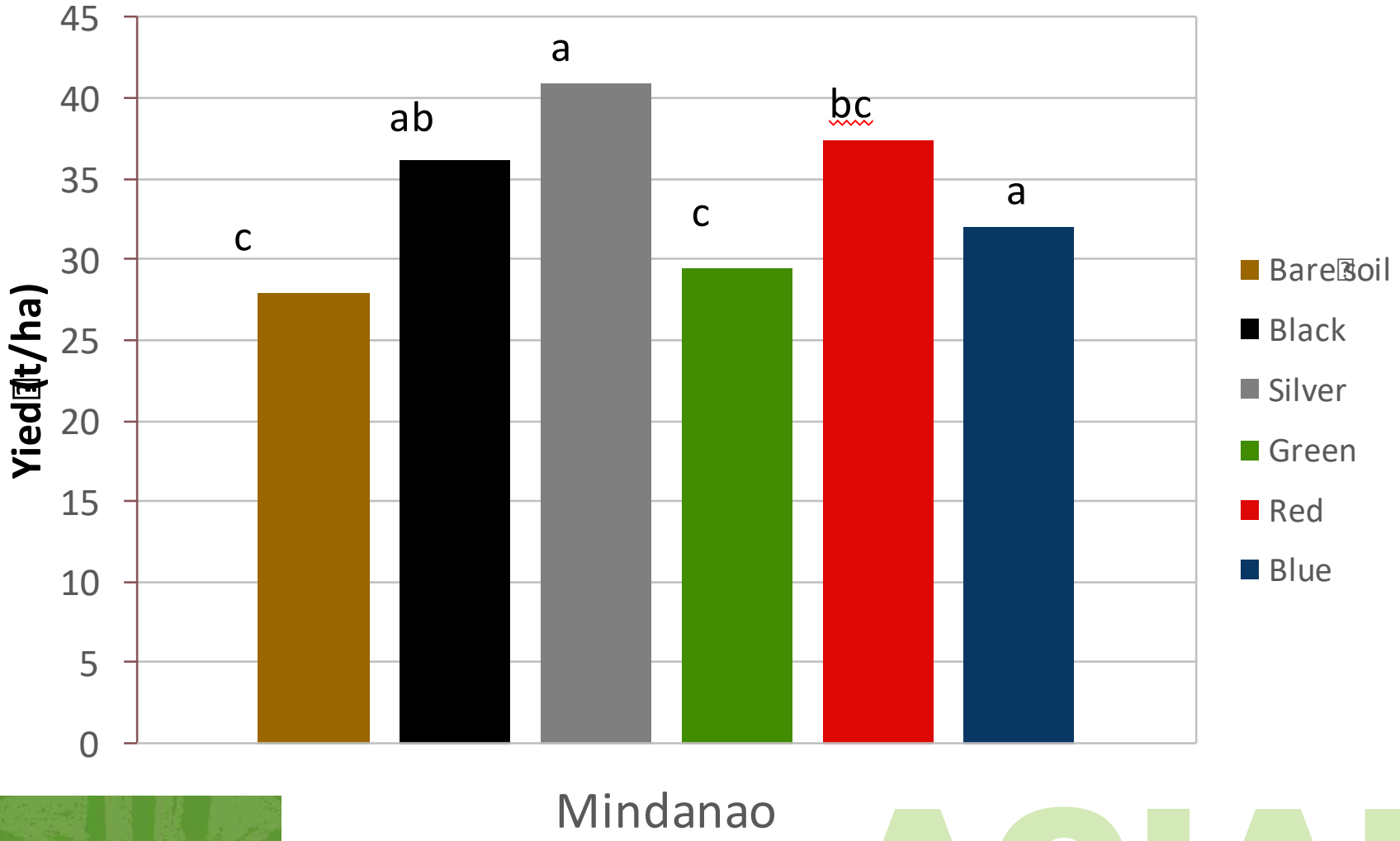
Plastic mulch: Tomato yield open field



ACIAR

Structures: new developments/modifications

High tunnels: light bamboo or steel frames.

Light framed house type structures with easily detachable plastic roof

Protective structure served as trellis

GROSS MARGIN ANALYSIS OF VSU SET-UP

Crop	Revenue	Variable Cost			Gross Margin
		Materials	Labor	Overhead	
Sweet Pepper grafted to Chili Pepper					
Protected	22,904.00	3,884.10	9,546.88	79.65	9,393.38
Open Field	21,308.00	3,884.10	10,684.38	79.65	6,659.88
Lettuce					
Protected	32,266.67	872.31	4,401.04	77.97	26,915.34
Open Field	26,400.00	872.31	4,713.54	77.97	20,736.17
Tomato					
Protected	25,940.00	3,000.44	8,527.08	76.29	14,336.19
Open Field	4,990.00	3,000.44	9,102.08	76.29	-7,188.81

ICM skills and research capacity building

ICM Master Class

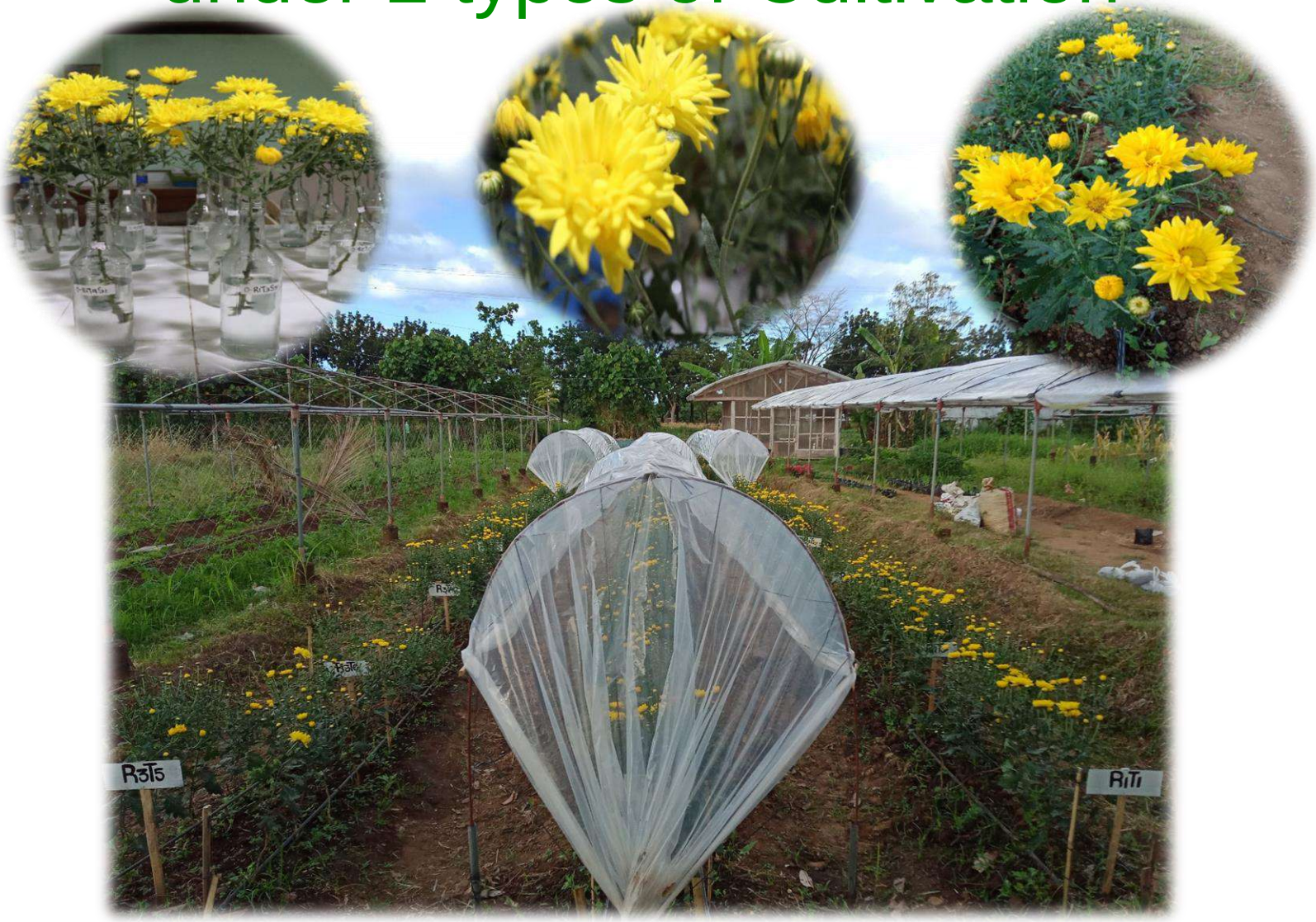
Dr. Gordon Rogers presentation on plant nutrition

Dr. Len Tesoriero showed pictures of different diseases and other stresses of vegetables

Dr. Sukvhinder Singh presentation on food safety

Hands-on collection of soil samples by participants

Chrysanthemum – Organic Amendments under 2 types of Cultivation



Impacts

- ***Integrated crop management*** developed best practice materials, pest and disease and agronomic methods to produce high quality vegetables.

The project improved annual farm income by 50% with farmers participating in project-run farmer field schools (FFS)

TAMDANAN SA MAG-UUMA

ATSAL
Inaptan nga Pagpananum

Pamilya o Grupo sa mga Tanom: Solanaceae
(atsal, kamatis, talong)

Pag-ilis-ilis sa Tanom

Human sa pagtanum sa atsal, pulihi kini sa pagtanum sa pipino, kalabasa, melon, cauliflower, broccoli ug mais ug uban pang utanon nga dili parehas ang pamilya.
Ayaw na ibalik ug tanum ang atsal sa sunod tingtanum. Dili usab mahimong itanum ang kamatis ug talong kay kauban ra kini sila sa pamilyang Solanaceae.

Klima ug Matang sa Yutang Tamnan

Ang atsal motubo sa initon nga klima nga may kalandungon nga 45 porsiyento ug dili kaayo kusog nga ulan nga anaa lamang sa 600-1250 mm. Pinakamaayo ang tubo sa atsal sa tabunok o bukagay nga yuta nga may kaaslumon (pH) nga 5.5-6.8. Ug muangay sa init-init nga klima nga may temperatura nga 18–35°C.

Inaptan nga Estruktura

Ang pinaka-malumposong porma o desinyo sa estruktura nga gigamit dinhi sa Pilipinas aron maprotektahan ang atsal batok sa kusog nga ulan mao ang sama sa balay nga estruktura nga inaptan. Mahimong mugamit ug UV-stabilized nga plastik o pino ba hinuon nga pukot sa atop aron mamenosan ang kusog nga patak sa ulan direkta sa tanom. Sa ingon niining paagiha, mabisbisan gihapon ang tanom ug mamenosan pa ang tubig nga kinahanglan pangbisbis.

Ang estruktura mahimong hinimo gikan sa kawayan nga makuha lamang sa atong lugar. Ug ang maong estruktura mulungtad sa gidugayon nga 3-5 ka tuig. Napamatud-an nga ang abot sa atsal diin gitanum sulod sa maong estruktura muusbaw nag abot ug 50 porsiyento kon itandi kini sa abot sa atsal nga gitanum sa gawas o hawan nga luna.

Ang nahaunang rason nganong mas daghan pa ang maani nga bunga sa atsal nga naa gitanum sulod sa ilawom sa estruktura mao ang makanunayon pa nga pagpamunga niini tungod kay menos man ang tsansa nga mataptan kini ug sakit, mas niindot ang kondisyon sa pagtubo sa tanom labi na sa panahon sa ting-ulan nga kusog ang bunok niini kon itandi kini sa ani sa atsal nga gitanum sa gawas o hawan nga luna.

Alang sa dugang pang detalye ug kasayuran kon unsaon

Tinanom nga atsal ilalum sa inaptan nga estruktura

pagtukod ug estruktura sa pagpananum ug utanon dinhi sa Pilipinas, basihi lang ang lain nga tamdanan nga anaa gihapon niini nga serye sa basahon.

Pag-andam sa Yuta nga Tamnan

Limpyohi ug gunaha ang sagbot sa yuta nga tamnan. Andama ang luna ilalum sa gitukod nga estruktura pinaagi sa pagdaro ug pagsudlay niini makaduha ka higayon sulod sa duha ka semana. Kon ang kaaslumon (pH) sa yuta ubos sa 5.5, butangi ug apog sa usa ka bulan sa dili pa magtanum sa atsal sa may gidaghanon nga 3-5 ka tonelada kada hektarya. Saguli kini ug lata na nga biya sa hayop o kompost sa may gidaghanon nga 1 ka kilo kada metro kwadrado.

Pagsukod ug usa ka metro nga saburan nga may tunga sa metro nga distansya sa matag usa niini ug may gihabugon

What's next?

- Developing vegetable value chains to meet evolving market expections in the Philippines
- Vegetable-GAP

Acknowledgement

Australian Government

Australian Centre for
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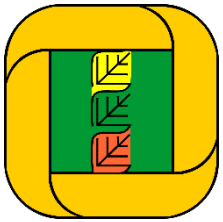

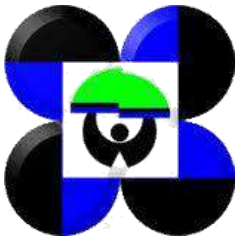

SEAMEO
SEARCA

THANK YOU!