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# Effect of CMD on cassava root yield

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Cassava Production Systems Specialist

Project Inception Meeting

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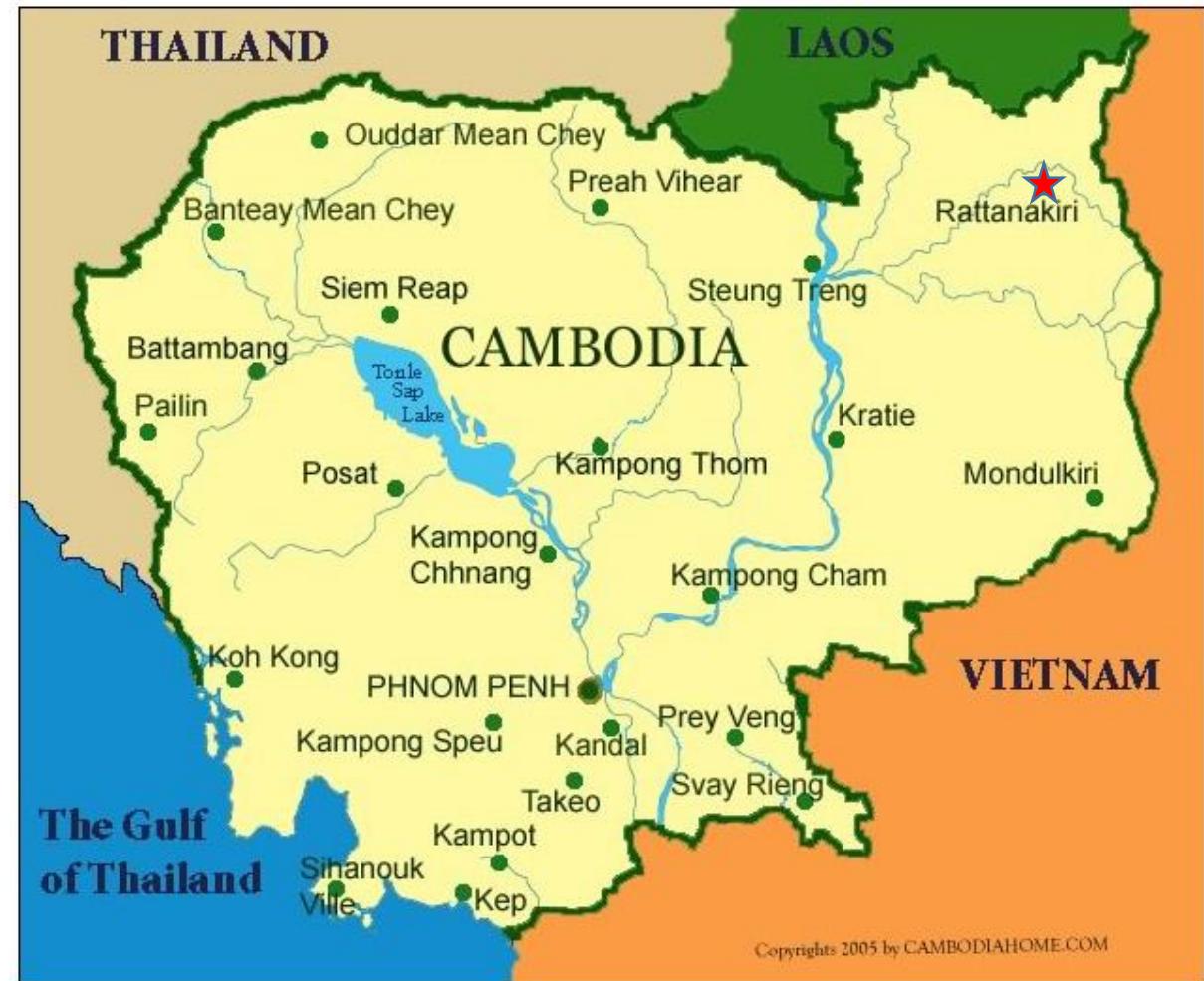
Australian Government  
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CIAT is a CGIAR Research Center

# Background

- Cambodia increased 40-fold, from 16,000 to 684,070 ha (MAFF, 2017)
- Ratanakiri Province (eastern Cambodia, 2015) - SLCMV was reported (Wang et al., 2016)
- Impact of CMD on yield
- CMD resistance varieties



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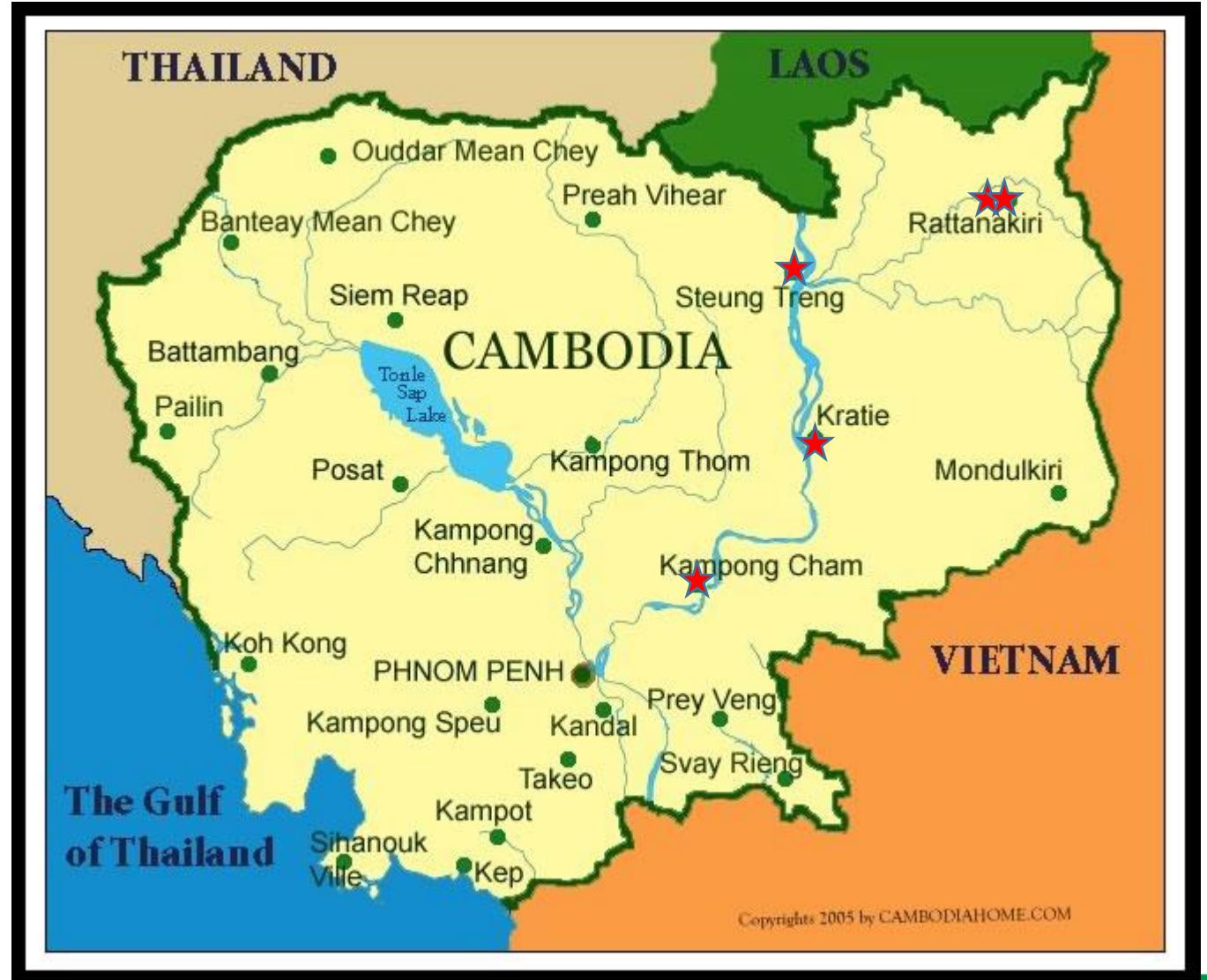
# Objective

- 1. Study variation in resistance to CMD**
- 2. Effect of fertilizer application**
- 3. Evaluate yield impacts on different varieties**

Variety	Origin	Genetic background
KU50	Thailand	R 1 x R 90
Rayong 11	Thailand	R 5 x OMR 29-20-118
SC8	China	CMR38-120-10
HuayBong60	Thailand	R 5 x KU 50
KM98-1	Vietnam	R 1 x R 5
Rayong 5	Thailand	27-77-10x R3



# Experimental sites



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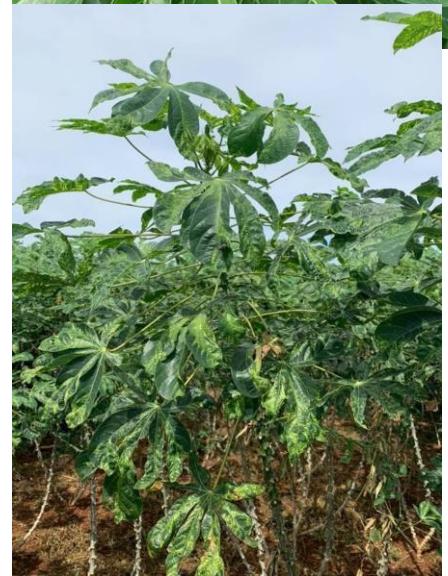


Healthy cassava crop 4 month growth



Healthy cassava crop 7 month growth

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Disease Symptoms



Close to 100% infected field by 7 month

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CIAT 50  
1967-2017

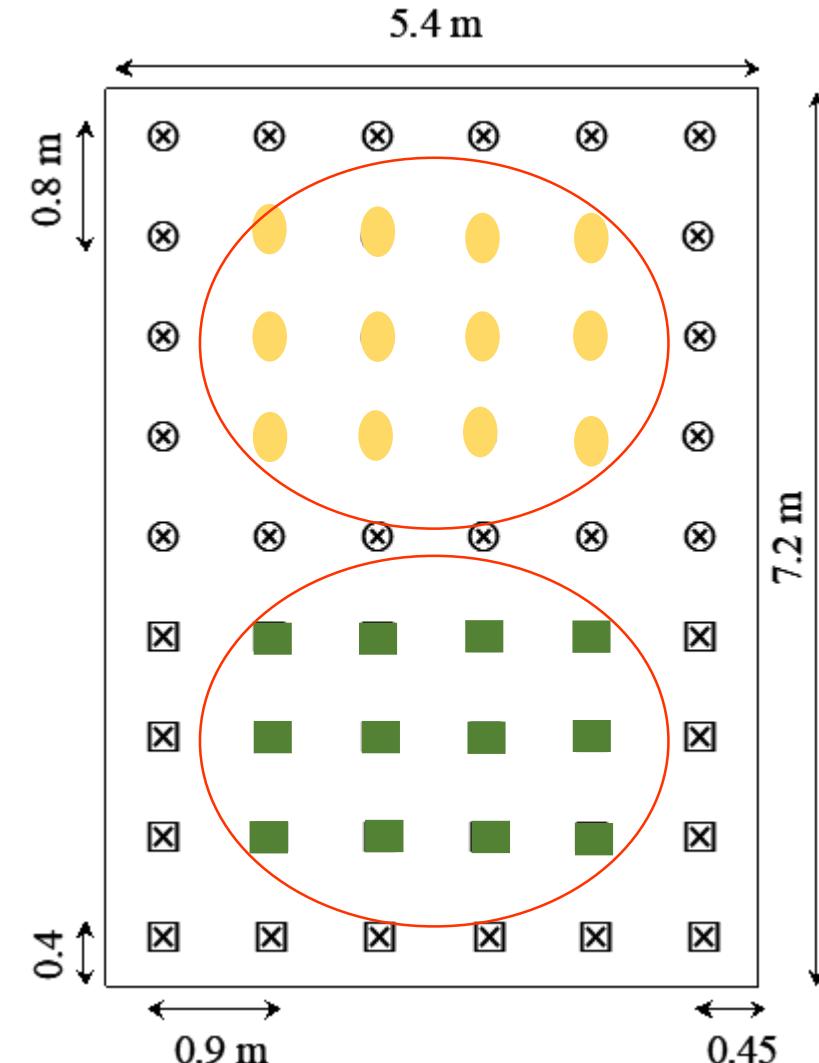
# Experiment Design

## Fertilizer:

1. No fertilizer applied 
  2. 80:20:80 ( $80 \text{ kg N ha}^{-1}$ ,  $20 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ ,  $80 \text{ kg K}_2\text{O ha}^{-1}$ ) 
- (Fertilizer was applied at 30 days after planting)

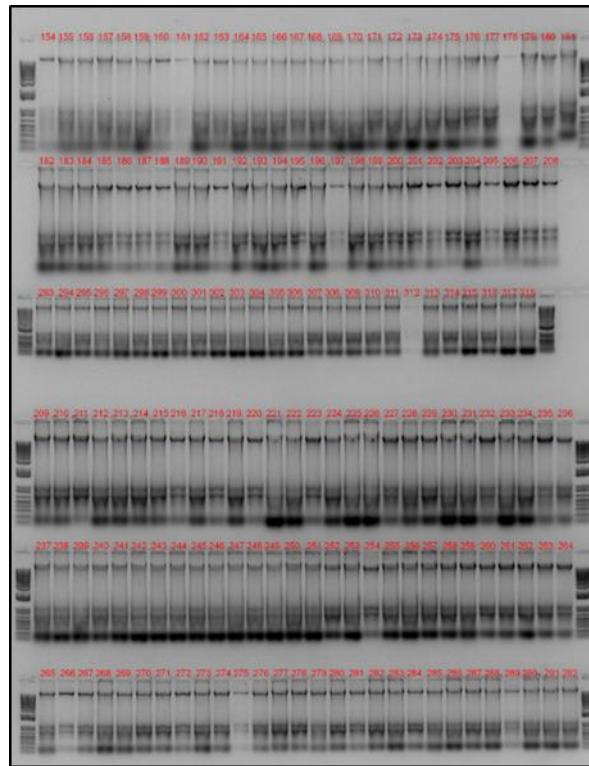
Planting distance Plant to Plant:  $90 \times 90 \text{ cm}$

Replication : 3



# Measurements

1. Disease symptoms at 60, 150 and 270 DAP
  2. Assess asymptomatic plants –presence or absence of virus
  3. Yield and starch content



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# CMD symptomatic plants after different time

**Site 1**

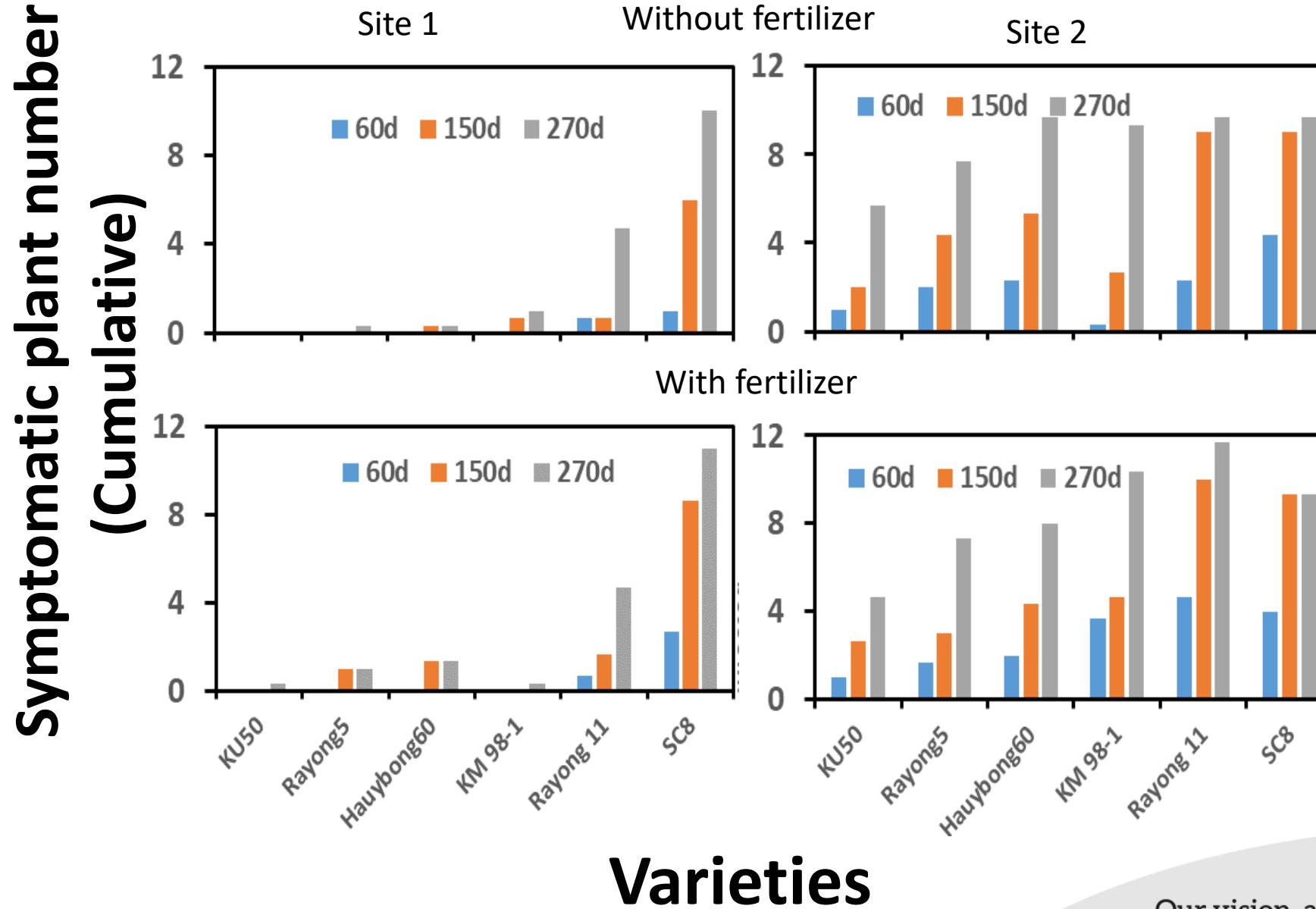
KU50 (V1)		R1	R2	R3	R4	R5	R6	R7	R8	R9	Rayong11 (V2)		R1	R2	R3	R4	R5	R6	R7	R8	R9	SC8 (V5)		R1	R2	R3	R4	R5	R6	R7	R8	R9
P1											P1	X	X	X	X		X	X	M		P1	X	x	X	X	x		X	X	X		
P2	M		M	M							P2	X	X				X	X	M		P2	X	X	X	X	X	X	X	X	X		
P3	M			M	M						P3	M	X	X	x		x	x			P3	X	X	X	X	M	X	X	x	x		
P4	M			M	M						P4	X	M	X			X	X	X		P4	x	X	X	X	M	X	X	X	x		
P5	M	M									P5	X	X	X		M	X		X	X	P5	X	X	X	M	X	X	X	X	X		
P6											P6	X	X	X	X	X	X	X	M	X	P6	X	X	X	X	X	X	M	X	X		
Rayong11 (V2)		R1	R2	R3	R4	R5	R6	R7	R8	R9	Rayong5		R1	R2	R3	R4	R5	R6	R7	R8	R9	Hauybong		R1	R2	R3	R4	R5	R6	R7	R8	R9
P1	X	X		X	X	X	X				P1	X		X	M						P1									M		
P2	M		M		X	X	X				P2						M				P2											
P3	X	X									P3						M				P3											
P4	X	X	x	M	M						P4						X	X	M		P4											
P5	X			X	X	X					P5						M				P5									M		
P6	M										P6						X	X	M	X	P6	X	X	x	x	M	X	X	X	M		
Hauybong60 (1)		R1	R2	R3	R4	R5	R6	R7	R8	R9	KU50 (V1)		R1	R2	R3	R4	R5	R6	R7	R8	R9	Rayong5		R1	R2	R3	R4	R5	R6	R7	R8	R9
P1		X	M			M	M				P1										P1									M		
P2	M			M	M	M					P2										P2											
P3	M			M	M	M					P3	M				M					P3	X	X	X	X	M						
P4	M	M	M								P4						X	X			P4	X	X	X	X	X						
P5	M	M	X			x	M				P5	M				M					P5	X	M	X	X	X						
P6	M	M		M	M	M					P6						X				P6	X										
Rayong5		R1	R2	R3	R4	R5	R6	R7	R8	R9	SC8 (V5)		R1	R2	R3	R4	R5	R6	R7	R8	R9	KM 98-1 (6)		R1	R2	R3	R4	R5	R6	R7	R8	R9
P1		X				X	M	X	X		P1	X	X	X	X	X					P1	M										
P2		X		X	X	X					P2	x	X	X	X	X	X				P2	M										
P3		X		X	X	X	X	X			P3	X	M	X	X	X	X				P3	X	X	X	X	M						
P4	X										P4	M	X	X	X	X	X				P4	X	X	X	X	X						
P5											P5	M	x	X	X	X	X				P5	M										
P6	M	X	M		X	X	X	X			P6	X	M	X	X	X	X				P6	M										
SC8 (V5)		R1	R2	R3	R4	R5	R6	R7	R8	R9	KM 98-1 (6)		R1	R2	R3	R4	R5	R6	R7	R8	R9	Rayong11 (V2)		R1	R2	R3	R4	R5	R6	R7	R8	R9
P1	x	X			X	M	X	X			P1	X		X	X	X	M	X			P1	X	X	X	X	X	X	X	X			
P2	X	X	X	X	X						P2	X	M								P2	X	X	X	X	X	X	X				
P3	x	X	X	X	X	X					P3	X	M	X	X	X	X				P3	X	X	X	X	X	X	X				
P4	X	X	X	X	X	X					P4	X	M	X	X	X	X				P4	X	X	X	X	X	X	X				
P5	X	X	X	X	X	X					P5	X	X	X	X	X	X				P5	X	X	X	X	X	X	X				
P6	M	X	M	X	X	X	X				P6	X									P6	X										
KM 98-1 (6)		R1	R2	R3	R4	R5	R6	R7	R8	R9	Hauybong60 (V)		R1	R2	R3	R4	R5	R6	R7	R8	R9	Rayong11		R1	R2	R3	R4	R5	R6	R7	R8	R9
P1		M									P1	M									P1	X										
P2											P2	M					M				P2	X										
P3		M									P3	M					M				P3	X										
P4	X										P4	M					M				P4	X										
P5											P5	M	M				M				P5	X										
P6	Xm	M	M	X	X	M					P6	M	M				M				P6	X										

60 DAP X 150 DAP X 270 DAP X

**Site 2**

KU50 (V1)		R1	R2	R3	R4	R5	R6	R7	R8	R9	Rayong11		R1	R2	R3	R4	R5	R6	R7	R8	R9	SC8 (V5)		R1	R2	R3	R4	R5	R6	R7	R8	R9
P1		X		x		M	X	X	X		P1	x	X	X	X	x	X	X	X		P1	X	x	X	x	M	X	X	M	M		
P2		X		X	X	M	X	X	X		P2	x	X	X	X	X	X	X	X		P2	X	x	X	X	X	M	X	X	M		
P3	M	X	X	X	X	X	X	X	X		P3	X	X	X	X	X	X	X	X		P3	x	X	X	X	X	X	X	X	M		
P4	M	X	X	X	X	X	X	X	X		P4	X	X	X	X	X	X	X	X		P4	X	X	X	X	X	X	X	X	M		
P5		X	X	X	X	X	X	X	X		P5	X	X	X	X	X	X	X	X		P5	X	X	X	X	X	X	X	X	M		
P6	M	X	X	X	X	X	X	X	X		P6	M	X	X	X	X	X	X	X		P6	X	X	X	X	X	X	X	X	M		
Rayong11 (V2)		R1	R2	R3	R4	R5	R6	R7	R8	R9	Rayong5		R1	R2	R3	R4	R5	R6	R7	R8	R9	Hauybong		R1	R2	R3	R4	R5	R6	R7	R8	R9
P1	M	x	X	X	X	X	X	X	X		P1	X	X	X	X	X	X	X	X		P1	X	X	X	X	X	X	X	X	M		
P2	X	X	X	X	X	X	X	X	X		P2	X	X	X	X	X	X	X	X		P2	X	X	X	X	X	X	X	X	M		
P3	X	X	X	X	X	X	X	X	X		P3	X	X	X	X	X	X	X	X		P3	X	X	X	X	X	X	X	X	M		
P4	X	X	X	X	X	X	X	X	X		P4	X	X	X	X	X	X	X	X		P4	X	X	X	X	X	X	X	X	M		
P5		X	X	X	X	X	X	X	X		P5	X	X	X	X	X	X	X	X		P5	X	X	X	X	X	X	X	X	M		
P6	M	X	X	X	X	X	X	X	X		P6	M	X	X	X	X	X	X	X		P6	X	X	X	X	X	X	X	X	M		
Hauybong60 (1)		R1	R2	R3	R4	R5	R6	R7	R8	R9	KU50 (V1)		R1	R2	R3	R4	R5	R6	R7	R8	R9	Rayong5		R1	R2	R3	R4	R5	R6	R7	R8	R9
P1	X	M									P1	M	X	X	X	X	X	X	X		P1	X	X	X	X	X	X	X	X	M		
P2	X	M									P2	M	X	X	X	X	X	X	X		P2	X	X	X	X	X	X	X	X	M		
P3	X	M									P3	M	X	X	X	X	X	X	X		P3	X	X	X	X	X	X	X	X	M		
P4	X	M									P4	M	X	X	X	X	X	X	X		P4	X	X	X	X	X	X	X	X	M		
P5		M	</td																													

# Number of CMD symptomatic plants

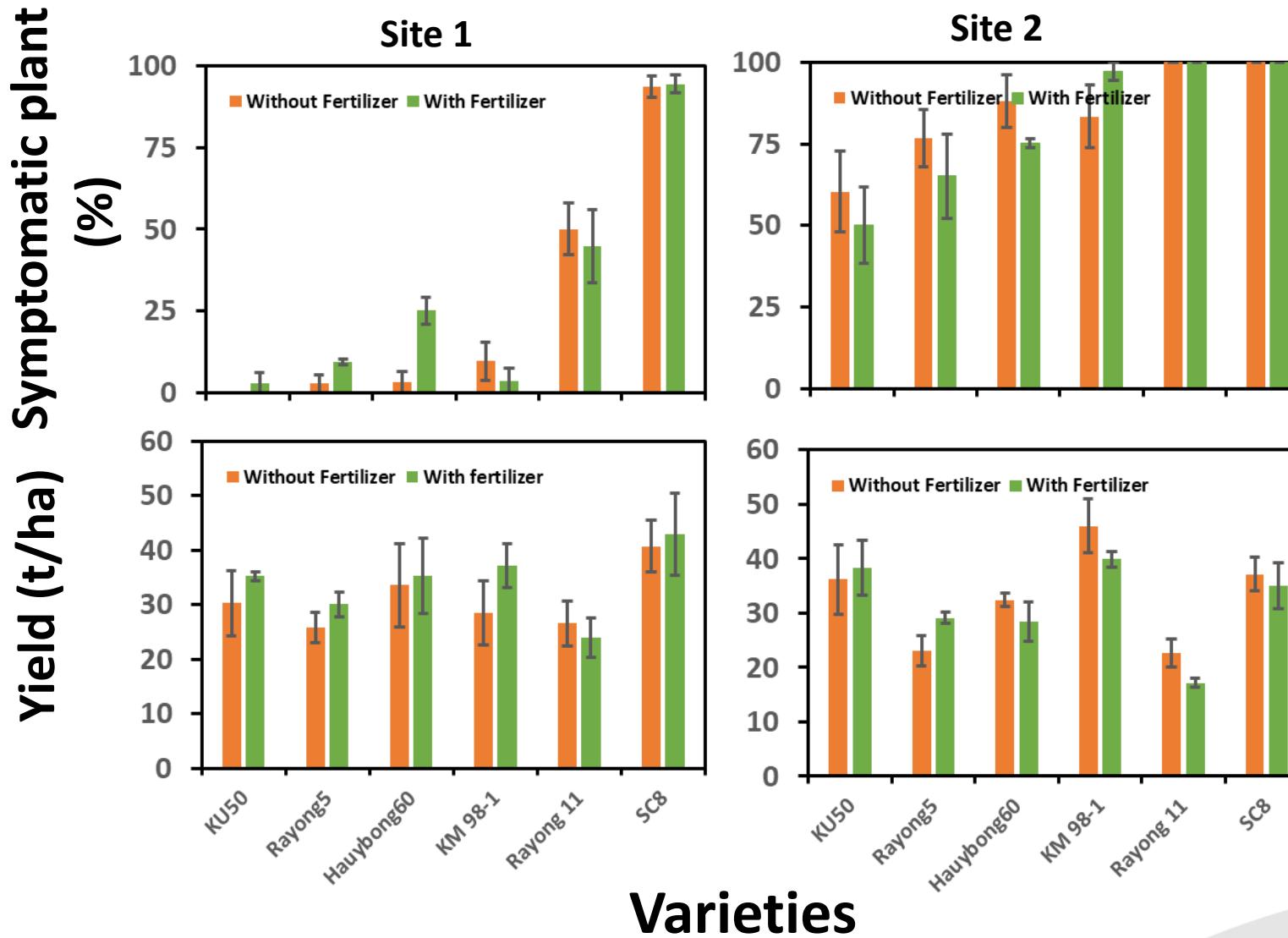


**Number of CMD symptomatic plants increased with time**

**Varieties**

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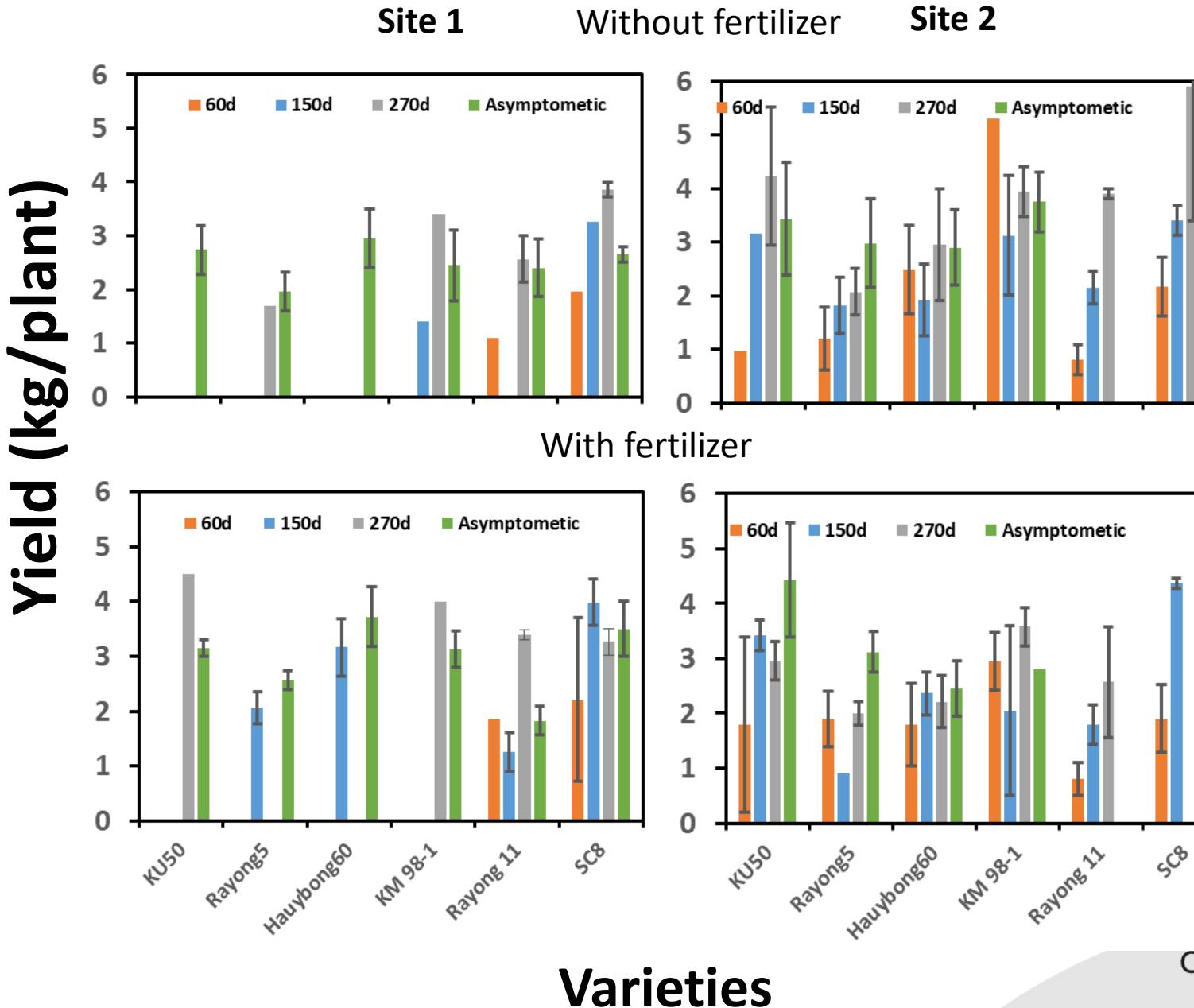
# CMD symptomatic plants and impact on yield



**No effect of fertilizer on disease severity**

**Variety SC8 yielded highest in both treatment at site 1, however, in site 2 KM 98-1 produced highest. Rayong 11 yielded lowest in both treatment and both site.**

# Early infection reduces yield

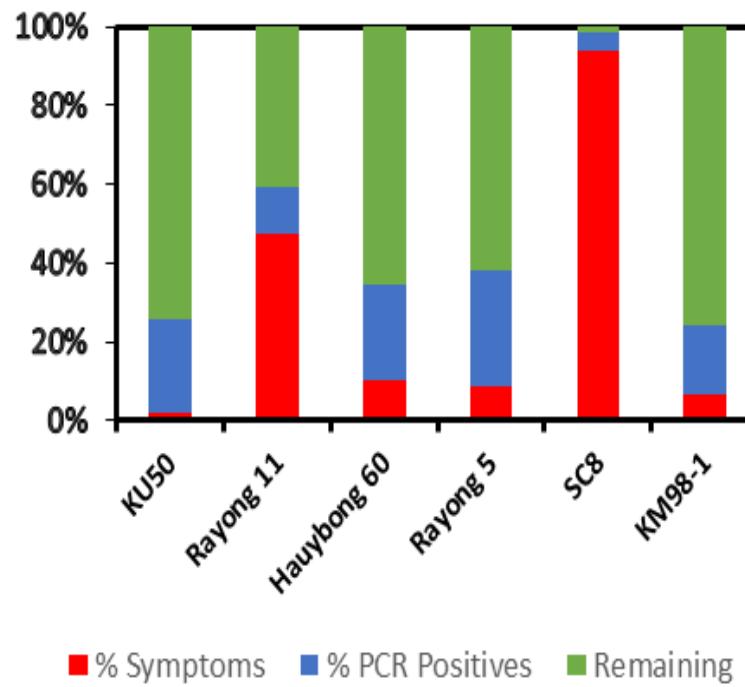


**Infected at 60 DAP produced on an average 1.5 to 2.2 kg/plant**

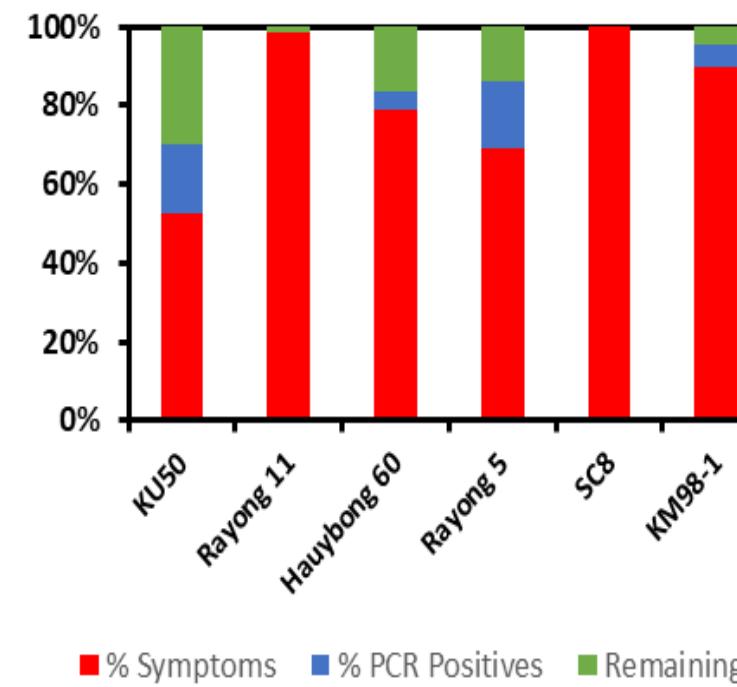
**Infected at 270 DAP and/or asymptomatic plants produced 2.5 to 3.8 kg/plant**

# Disease symptoms and PCR positive for CMD of asymptomatic plants

Total Site 1

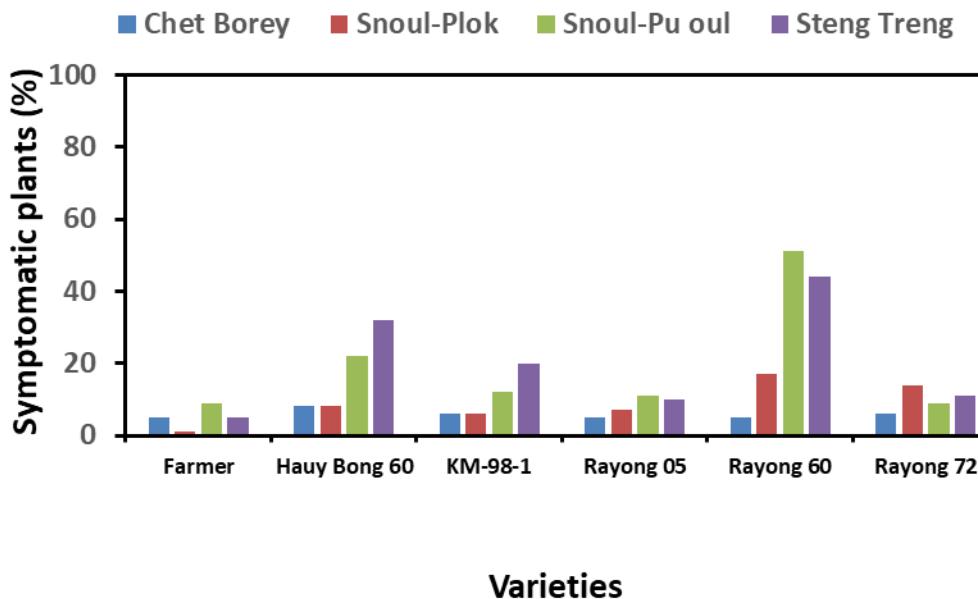
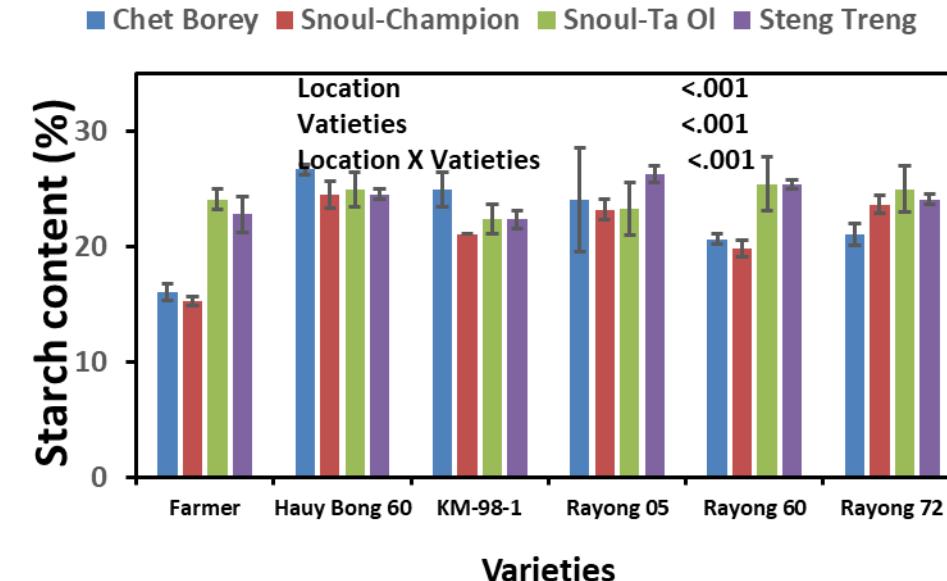
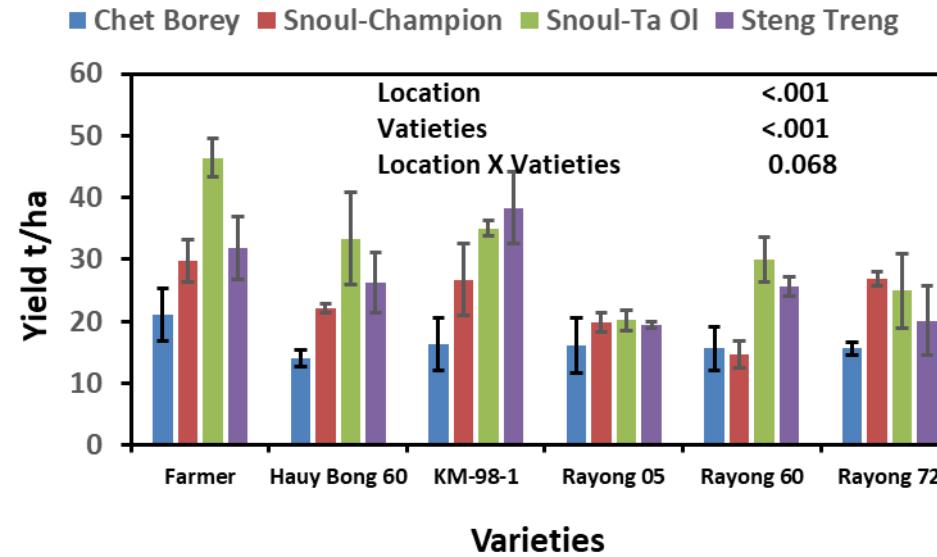


Total Site 2



**PCR detected presence of virus in asymptomatic plants**

# Farmers' field



Infected planting material from trader

Yield (t/ha)  $18.5 \pm 2.7$

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# Objective (Y2 experiment)

1. Test effectiveness of positive selection
2. Quantify yield loss due to plating diseased stakes
3. Test CMD resistant reputed variety (TME3)

Variety	Origin	Genetic background
KU50	Thailand	R 1 x R 90
Rayong 11	Thailand	R 5 x OMR 29-20-118
SC8	China	CMR38-120-10
HuayBong60	Thailand	R 5 x KU 50
KM98-1	Vietnam	R 1 x R 5
Rayong 5	Thailand	27-77-10x R3



Photo: Mr. Sok Sophearith

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## Number of infection after 60 DAP

White= clean stem

## Green=positive selection

Red= Infected stem from previous year

	White	Green	Red
KU50	0.0	0.0	2.1
R11	2.1	43.8	68.8
HB60	6.3	0.0	10.4
R5	0.0	14.6	70.8
SC8	4.2	22.9	97.9
KM 98-1	2.1	0.0	54.2

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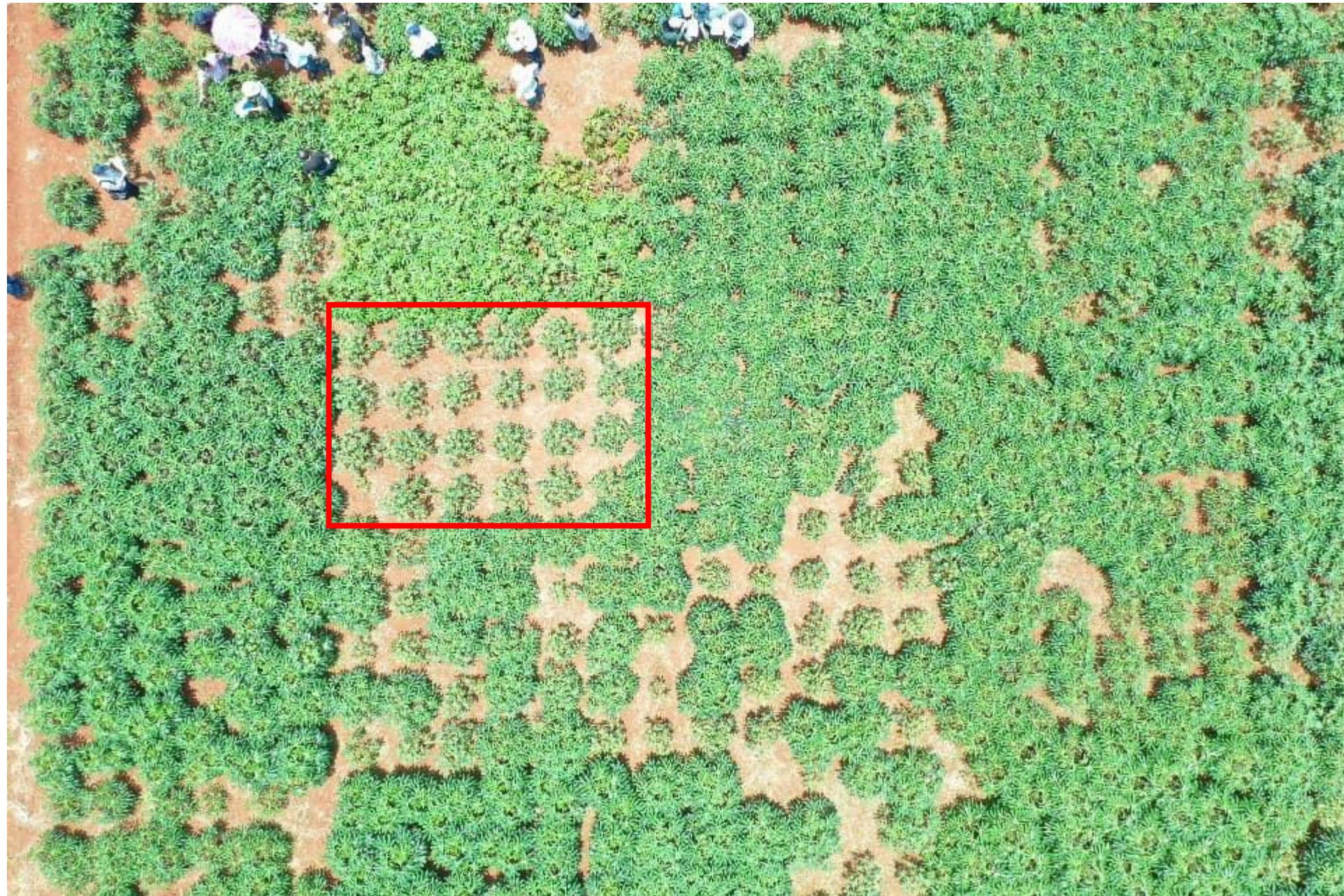


Photo Dr. Jonathan Newby

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# Conclusions

- Some variation in disease susceptibility was observed
- Early infection can lead to crop failure
- Clean plating material can produce profitable yield during first year of infection

# Acknowledgements

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- Dr. Jonathan Newby (CIAT-Laos)
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- All the farmers who participated and helped



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